# University of Southampton

Faculty of Environmental and Life Sciences

School of Health Sciences

**Exploring the Impact of Multilevel Environments Influencing the Adoption of Health Practices in Adults with Obesity in the United Kingdom**

by

**Nestor Serrano Fuentes RN, MSc, AFHEA**

ORCID ID 0000-0003-3085-7593. https://orcid.org/0000-0003-3085-7593

Thesis for the degree of Doctor of Philosophy

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## Abstract

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Obesity is a leading health challenge that causes millions of deaths and obesity-related long-term conditions. Reversing its upward trajectory requires understanding its multiple causes. One is the obesogenic environment, which refers to the set of influences that the opportunities, surroundings, or life conditions have on promoting obesity in individuals and populations. Some of these environments and how adults interact with them have not been explored enough in the past. This study aims to gain an in-depth understanding of how multilevel environments influence the adoption of health practices in adults with obesity in the United Kingdom. The study was divided into three phases that inform and complement each other.

The beginning of the research focused on social networks. A critical interpretative synthesis review was used to explore what and how social networks influence the adoption of obesity-related practices. This review showed cross-level influences between different types of ties, network processes, environmental and individual factors. It identified a pattern of health scenarios where networks were implicated and suggested the importance of developing multi-agent coalitions for tackling obesity. In the second phase, the review results informed a qualitative enquiry attempting to explain the impact of social networks on adults with obesity. This study highlighted the power of family and friends and the negative role of healthcare professionals. The third phase explored further aspects of interactions of individuals with the obesogenic environment utilising lay perspectives. Narrative accounts centred on living with normalcy and convenience through easy access to unhealthy food, people interacting with digital media for positive practice change, and the need to prioritise prevention in schools, the National Health Service and the food industry.

This thesis adds knowledge to the current social science understanding of the obesogenic environment. The results consider the importance of recognising healthy environments within it, a life span understanding of reciprocal interactions between the person-environment, the nature and processes of social networks, the National Health Service as a negative environment and the relevance of including mental health as part of health outcomes. The results could inform the design of more adequate and long-term sustainable interventions that consider, more than in the past, the everyday interactions between the environment and individuals. This allows moving away from the discourse of individual responsibility, reducing blaming and stigma from society and creating a more conducive context for political and societal change.

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# Research Thesis: Declaration of Authorship

Print name: Nestor Serrano Fuentes

Title of thesis: Exploring the Impact of Multilevel Environments Influencing the Adoption of Health Practices in Adults with Obesity in the United Kingdom

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as:

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Signature: ..... Date: .....

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*"…the ones who are mad to live, mad to talk, mad to be saved, desirous of everything at the same time, the ones who never yawn or say a commonplace thing, but burn, burn, burn, like fabulous yellow roman candles exploding like spiders across the stars…"* Jack Kerouac

It is time to close my eyes and remember all the people who have accompanied me on this incredible journey.

First, I would like to thank my supervisors, Prof Mari Carmen Portillo and Prof Anne Rogers. I feel lucky to have been directed by two world research leaders in their respective fields and wonderful human beings. The combination of knowledge, different styles and experiences has guided this restless mind and calmed 'its waters' in those moments when feeling lost, offering potential pathways and the responsibility to explore and choose those in line with my thoughts. In other words, you have given me freedom of thought. Also, you have taught me to do research of the highest quality under ethical and moral standards. Your contribution has gone much further, taking care of me, thinking about my well-being and contributing to my professional and personal development. Thank you from the bottom of my heart, it's impossible to receive more, and I hope you have enjoyed this journey as much as I.

I would never have come to the University of Southampton if I had not previously become passionate about 'social networks', something that started at the University of Leon (Spain) under the guidance of Dr Pilar Marques and the SALBIS Research Group. You showed me the beauty of networks, those supervisions in Ponferrada talking about networks and bicycles, Thomas Valente and his ideas on the diffusion of innovations, and boosted my professional career. I am very grateful.

I also want to remember my academic colleagues (also friends) for their incredible support and their time and interest in discussing research with me. Thank you, especially to Elenis (Dr Elena Andina), Roser (Dr Rosario Fernandez), maestro (Jesus Fernandez), super Glo and super Oscar (Dr Gloria Alvarez and Dr Oscar Zapata), Ivo and Nagore (Dr Ivaylo Vassilev and Dr Nagore Calvo), Sandra and Diego (Dr Sandra Gonzalez and Dr Diego Carbajo), Lindsay (Dr Lindsay Welch), Sandruki (Sandra Bartolomeu), Harm Van Noort, and Jonas Doerner. Some memories come to mind, such as the importance of self-management skills in academia, the word 'habitus' or that napkin with the hand drawing of a multilevel theoretical framework (I still have it).

I want to thank you for the support from the members of the Long-Term Conditions Research Group (Health Sciences, University of Southampton), the CLAHRC Theme 5: Engagement with self-

directed support (University of Southampton), my ex-work colleagues at Southampton General Hospital and Derriford Hospital in Plymouth, and the PhD students' colleagues from the University of Southampton (Jawahr, Abdullah, Talia, Toru, Shilpy, Dan and many more others) and the European Academy of Nursing Science.

What would I do without my best friends and the love and support of all my family and, above all, my sister, mum and dad? It is difficult to explain to you in simple words why I decided to get into an adventure of these dimensions; perhaps those of you who know me best do. Developing the capacity to push the limits of knowledge to seek social change and contribute to finding new ideas to improve people's health is a unique and infinite feeling. I fly and keep flying.

My dear Carmen Chamizo, wherever you are, I hope you feel proud because you were one of those responsible for lighting the flame, showing that a different Nursing existed and, above all, that there are no impossible dreams. You walk the path by my side.

Finally, I want to thank the participants of this research for opening yourselves and telling your experiences of living with obesity, a complex topic that, as you well know, carries much social stigma. Your voices will be part of a change that has already begun; let's keep fighting together.

Finally, I want to thank the NIHR ARC Wessex (formerly CLARHC Wessex) for their financial support.

I hope I haven't forgotten anyone, and if so, please forgive me.

Thank you,

Nestor

# Abbreviations

ANGELO: Analysis Grid for Environments Linked to Obesity

ARC: Applied Research Collaboration

BMI: Body Mass Index

CIS: Critical Interpretative Synthesis

CLAHRC: Collaborations for Leadership in Applied Health Research

COVID-19: Coronavirus Disease 2019

EnRG: Environmental Research framework for Weight Gain prevention

GP: General Practitioner

HFSS: High in Fat, Salt or Sugar

IOTF: International Obesity Task Force

LTCs: Long-Term Conditions

NHS: National Health Service

NICE: National Institute for Health and Care Excellence

NIHR: National Institute Health Research

OECD: Organisation for Economic Co-operation and Development

ORBs: Obesity-Related Behaviours

PhD: Doctorate of Philosophy

PT: Personal Trainer

SNA: Social Network Analysis

TA: Thematic Analysis

UK: United Kingdom

USA: United States of America

WHO: World Health Organization

# Chapter 1 Introduction to the thesis

## 1.1 Personal motivation

I feel the need to explain the motivation that led to carrying out this research from a personal point of view. In 2014, I arrived in the United Kingdom (UK) to start a new life. I perceived many differences with Spain (my native country), but, without a doubt, what mostly caught my attention was the number of people I saw on the street who had excess weight. A fact confirmed when I started working as a nurse in the hospital and discovered that excess weight was perceived as something 'normal' among my work colleagues and the patients I cared for; few people understood it as a health risk. After a short time, I became more interested in obesity in the UK and started to read news and health reports. According to those numbers, more than half of the adult population had excess weight. I said to myself: "This country has a big problem".

A year before leaving Spain, I discovered the impact of our social relationships on people's health in the research master's degree I had done. One of the examples I became aware of was of academics who showed how obesity spread in groups of people. If a person was surrounded by people who had obesity, that person had a relatively high chance of developing it in the future. For example, Christakis and Fowler did calculations to demonstrate this spread via social networks over 32 years (I will explain this later). At the same time, I thought about how my family influenced my lifestyle over time and the possible impact I could have had on friends daily. Indeed, I visualised and believed in the power of our social networks. At an academic level, I began to read much more about what had been done in research about social networks and obesity. It seemed like a field that could be exploited much more, especially on adults.

The actions and interventions that have been created to date have not been very effective in changing the upward trend of obesity. Thus, I set out to show how social relationships could significantly impact. However, for this, I needed to understand their origin, nature, and as components of the environment we are part of. Later, I explain in more detail why social networks could be very relevant in this health area, their necessity, the gaps in current research, and how throughout the research process, I decided to end this PhD thesis by broadening my perspective and not focusing exclusively on social networks, but the interactions which operate between social network members and the different levels of the environment (micro, meso, macro).

## 1.2 Personal development

I find it interesting and valuable to reflect on who I was before I started the PhD, how my knowledge, ideas and skills have developed, and the way in which undertaking this thesis has impacted me after six years. I also consider this part of the introduction an exercise in intellectual honesty.

How important is finding one small, defined and focused research problem that we, PhD students, can follow up on the time framework and the resources we have? I remember the first proposal I sent to the University to enrol in the doctoral program. At that point, I proposed a realistic evaluation study in which I would implement a new behavioural intervention to manage obesity and improve outcomes in adult patients with both obesity and obesity-related conditions. It would be based on social networks to address the implementation of improving engagement for change behaviours. That intervention would consist of using a web-based diagnostic tool (GENIE tool) together with an educational intervention delivered by voluntary organisations.

Over time and as I read more literature, I began to realise how big (practically impossible to carry out in a doctorate) that first proposal was. In parallel, I realised how little research had been done to study the nature of social networks in obesity. In other words, delving into the nature, content and properties to see what was happening in relationships to influence the adoption of negative and positive lifestyles. So I went from a multi-phase mixed-method study with an intervention at the heart of the study to a more critical, theoretical and exploratory approach in which qualitative research would be the key component in exploring the role of social networks and other environmental factors, which might have been overlooked in the past. This change and the nature of qualitative inquiry have shaped my way of looking at things, identifying specific components within open systems and being able to establish the connections between them. Hence, I have developed a capacity for deep critical thinking, reflections and argumentations on how individuals interact with the contexts they find themselves in.

Thanks to the different training and development opportunities I attended, there has been a massive development in knowledge and research skills. For example, introduction to qualitative data analysis, writing for publication, public policy engagement, engaging audiences from the stage, Greenwich Accelerated Development Programme in Social Networks (Social Networks in Health) at the University of Greenwich (London), the NIHR Infrastructure Doctoral Research Training Camp to learn how to write effective grant proposals, searching the literature for systematic reviews and introduction to NVivo, among others.

I do not consider myself, nor will I ever want to consider myself, an 'expert' on any given subject (e.g. obesity in adults); I have much respect for that word. However, I certainly now feel much more prepared to research topics that carry a social stigma in the future. I know this PhD process and how 'I walked the path' will provide a solid basis to conduct the best quality research and be mentally prepared to look for impact interventions in society and make a change in people's health and well-being.

## 1.3 Structure of the thesis

This thesis has the following structure:

- It starts with a discussion of the theoretical background (chapter 2) in which obesity is introduced as a critical health problem worldwide and, concretely, in the United Kingdom. Then, obesity is presented as a multifactorial condition, a preview to explain the evolution of knowledge and measurements to tackle obesity through social sciences. This starts from perspectives considering individuals' psychology, which have largely failed to bring and sustain practice change, to the importance of understanding environments more in-depth and the appearance and the first research around the notion of 'obesogenic environment' (a term that is clarified in this thesis). Next, theoretical models incorporating the need to understand obesity as a relationship between the individual's psychology and specific environments are introduced, and social networks are presented as part of those models. The introduction continues by understanding what social networks are and how they have been used to study public health problems and obesity, uncovering the gap to continue understanding how they operate by exploring the processes of networks involved when adopting obesity-related health practices.
- Chapter 3 presents the research methodology and reflects on the reasons for utilising a critical interpretative synthesis as a review method, the specific epistemological and ontological positions for the empirical studies, research design, data collection, analysis methods, and ethical considerations.
- The critical interpretative synthesis review is presented in chapter 4 in order to provide the first answers about how networks influence the adoption of health and unhealthy practices in adults with obesity.
- The review findings guided the development of chapter 5, which explores, 'in the real world', how different networks influence the adoption of obesity-related practices in adults with obesity. Thus, a qualitative network approach with semi-structured interviews, network mapping and sociodemographic questionnaires is used.

- Within the interviews, other questions explored the experience of living with obesity. When designing the interview, the need to use qualitative research to unpack other obesogenic environments overlooked by previous quantitative research (the predominant research in this field) was found. Therefore, chapter 6 is a qualitative study informed by reflexive thematic analysis that covers this gap. Thus, chapter 6 furthers the spectrum of the thesis (not focusing exclusively on social networks).
- Chapter 7 is the overall discussion. It summarises the three articles' main findings (chapters 4, 5 and 6). Also, it includes the original contributions to knowledge and integrates the results of the three articles to challenge the current concept of 'obesogenic environment', providing a new understanding. Finally, implications to practice, health policy and future research using social network approaches, qualitative research and the application of other social theories are presented.
- Chapter 8 shows the final conclusions.

# Chapter 2 Background

## 2.1 Introduction to obesity as a health challenge

Obesity is defined as excessive fat accumulation that presents a health risk (Moody, 2020). From a clinical perspective, for most adults having a body mass index (BMI) greater than or equal to 30 means they have obesity, and between 25 and 29.9 means having overweight. Over four million people die each year as a consequence of excess weight. It also represents a key risk factor for developing long-term conditions (LTCs) (Department of Health & Social Care (UK), 2020), including coronary heart disease, hypertension, stroke, some types of cancer (e.g. breast cancer and bowel cancer), type 2 diabetes, joint and muscular disorders, and respiratory problems among others (Stunkard and Walden, 1993; National Health Service [hereafter NHS], 2019c). Excess weight is not only characterised by physical health conditions but is linked to mental health problems such as anxiety, clinical depression, and low self-esteem (Kasen *et al.*, 2008; Morrison *et al.*, 2015), which are consequences of the stigma and discrimination associated with obesity (Emmer, Bosnjak and Mata, 2020). Thus, people experience 'fat stigma' and its consequent weight discrimination (e.g. being ignored, rejected or teased) (Pescosolido *et al.*, 2008) as part of the negative social meanings (e.g. laziness, weak will or lack of self-control) attached to having excess weight (Brewis, 2011).

Over the last three decades, obesity has risen dramatically. The worldwide prevalence of obesity nearly tripled between 1975 and 2016, and current numbers show that around 2 billion adults (39% of adults) have excess weight (overweight and obesity) (World Obesity Federation, 2019). In England, obesity has increased from 13% of men and 16% of women in 1993 to 27% of men and 29% of women in 2019. The latest statistics for the UK showed that 28% of adults had obesity, and a further 36% had overweight (Moody, 2020). This rate ranges from less than 6% in Japan and Korea, 10% in Romania (the lowest in Europe) and more than 30% in Mexico, New Zealand, Hungary, and the United States (Organisation for Economic Co-operation and Development [hereafter OECD], 2017, 2020). No one is 'immune' to developing obesity, but some people are more likely to have excess weight than others, for instance, low socioeconomic populations (Loring *et al.*, 2014). In England, adults in the most deprived regions have almost double the prevalence of obesity compared with the least deprived (36% compared with 20%) (Public Health England (UK), 2017). This difference is particularly pronounced for women, where 39% of women in the most deprived areas have obesity, compared with 22% in the least deprived areas (Moody, 2020). According to the UK Foresight Obesity report, by 2050 – if current trends continue – 50% of women and 60% of men could have obesity (Foresight, 2007). This rise in incidence has led to an

increase in health services expenditure. For example, in the NHS, the costs of treating overweight and obesity increased from £479.3 million in 1998 to £6.1 billion in 2015. The UK-wide NHS costs related to this are estimated to reach £9.7 billion by 2050, with wider costs to society predicted to reach £49.9 billion per year (Public Health England (UK), 2017).

Tackling the prevalence and incidence of excess weight is a challenge that, particularly, the UK has faced during the last decades, with little success (Department of Health (UK), 1992; Parliament. House of Commons, 2004; Department of Health & Social Care (UK), 2020). The failure of interventions might be related to the over-focus on a traditional understanding of the management of obesity as one relying on individualised health perspectives (e.g. motivations, preferences, beliefs, abilities or skills) to improve lifestyles (Greener, Douglas and van Teijlingen, 2010). Thus, changing obesity-related behaviours (ORBs) (lifestyles or obesity-related practices[1]) related to diet and physical activity became the main means of intervention and prevention of obesity. Nevertheless, the most important problem of tackling ORBs is that engagement within new actions mainly appears in the early stage of interventions and drops off over time. In terms of these behaviours, dietary behaviour involves the eating patterns individuals engage in, including the nature, variety, quality, and quantity of food, how food is prepared, and aspects related to choices or meal timing, among others (World Health Organization [hereafter WHO], 2003). Physical activity relates to all movement, including during leisure time, for transport, or as part of a person's work. It can be performed at varying intensities (WHO, 2022b).

Social sciences such as anthropology, psychology, behavioural economics, sociology, economics and politics have tried to look for new ways of understanding obesity. That is not considering it only from an individual prospect but also as a social health problem linked to the broader society (Maurer and Sobal, 1999). The latter necessitates identifying many potential causes and consequences and evaluating methods of prevention and treatment (Cawley, 2011) through different levels of analysis. Thus, new ways of understanding appeared, and obesity started to be considered a multifactorial condition, with co-occurring biological, psychosocial, lifestyle, and environmental factors contributing to it (Cawley, 2011; Gillison, 2019). For example, the Foresight Report (Foresight, 2007), which is well-known in the obesity research field, presents an innovative

[1] As a result of a process of reflection after the completion of my first article, I am not going to refer to health behaviours in this thesis (except in the first article), but to health practices. This change arose when reading the work by Cohn (2014, p. 160). Thus, when talking about behaviours, "the social, affective, material and interrelational features of human activity are effectively eliminated, as behaviour becomes viewed as outcomes of the individual and determined only by such things as motives, intentions and the subjective reception of norms and cues". Thus, issues of agency and responsibility are distributed in ways that assemble on the individual. However, health practices "are not a direct result or outcome of mental processes but emerge out of the actions and interactions of individuals in a specific context" (Cohn, 2014, p. 160).

obesity complex systems map on which over one hundred drivers (representing those five main topics) could cause excess weight.

The next sub-chapter of the introduction explores different ways social sciences have tried to address the obesity epidemic over the years.

## 2.2 Social science theories of obesity

This section reviews key social theories about obesity in adults and how approaches developed by the social and human sciences have been used to understand better and tackle obesity-related practices. It is beyond the remit of a PhD to review all of the social science literature applied in the obesity field; for example, a recent study identified 83 formal theories of behaviour and behaviour change (including more than 1,700 theoretical constructs) (Davis *et al.*, 2015). Instead, the section focuses on the most relevant perspectives informing the creation of obesogenic environment theoretical frameworks and models[2] and social networks as a basis for developing an understanding of interventions to tackle obesity-related practices, which is the focus of my PhD topic.

There is nothing more practical than a good theory. Rigorous theories can bridge the gap between research and practice by providing a crucial critique of the conventional wisdom of practice and improving it (Yorks, 2005). Theories influence our thinking about how the world works and determine the types of research questions and the research methods used to answer them (e.g. data collection choices, what questions we ask or how we ask them) (Valente, 2010). The section starts by explaining psychological models of behaviour and behaviour change. This is the backdrop against which I draw in theory that looks at more contextual factors and, specifically, obesogenic environment models which use behavioural/psychological theories. It is pervasive to read in the literature that psychological theories emphasise "individualistic, behaviour change strategies [which] negates the role of the social context in shaping behaviour, and thus implies a separation of people and their environment" (Travers, 1997, p. 58). After delving into the content of some of these theories, I would like to consider that previous statement with caution. Even throughout this introductory section, it is possible to see how there are theories of 'individual' behaviour change that consider the role of contextual factors. This is key to understanding the development of the ideas of the obesogenic environment and social networks.

[2] Frameworks are taxonomies and they identify components, mechanisms, or variables of phenomena of interest. Models are maps and they show how elements of phenomena of interest interact with and influence each other (May, 2020).

### 2.2.1 Psychological theories pertaining to obesity-related behaviours

Psychological theories are helpful in understanding, explaining, and predicting individual behaviour and behaviour change, as they define a set of interrelated constructs operating as predictors or mechanisms of action underlying behaviour change and can support the understanding of what works to change a specific behaviour (Teixeira and Marques, 2018). Behaviour change and maintenance interventions for obesity commonly target changes in physical activity and diet by modifying individual psychological characteristics; for example, changing beliefs and expectations, setting adequate goals and enhancing motivation, or guiding the use of self-regulation skills (e.g. self-monitoring) (Maes and Karoly, 2005; Sniehotta, Scholz and Schwarzer, 2005; Teixeira and Marques, 2018). Thus, social-psychological or expectancy-values theories of motivation have been applied in obesity research, such as the Health Belief Model, the Theory of Planned Behaviour and the Theory of Reasoned Action. Their central concept is that individuals are likely to implement a practice if they perceive it will lead to expected outcomes ('Chapter 2 Theoretical frameworks or models for nutrition education', 1995).

The Health Belief Model is a social cognitive model that assumes that specific constructs determine individual involvement in health-related behaviours: perceived severity (an individual's perception of the potential consequences of the disease), perceived susceptibility (a person's assessment of the possibility of getting the disease), perceived benefit (an individual's beliefs about whether the suggested behaviour will decrease the risk or severity of impact), perceived barrier (an individual's assessment of the cost and difficulties of adopting behaviours), self-efficacy (the belief about the capabilities to conduct a new health behaviour successfully), and cue to action (the external or internal motivations that promote the new behaviour). To give an example, some authors explored factors influencing behaviour intention of weight reduction among female middle-school students using this model, suggesting that perceived threat (a sum of susceptibility and severity) recognised self-efficacy and cues to action were significantly associated with the behavioural intention of weight reduction for all the students (Park, 2011).

The Theory of Planned Behaviour is an extension of the Theory of Reasoned Action. The latest suggests that a person's behaviour is characterised by the intention to perform the behaviour and that the intention is a function of the attitude toward the behaviour and subjective norms (Fishbein and Ajzen, 1975). The Theory of Planned Behaviour adds a third construct, perceived behavioural control. This theory suggests that behaviour is a function of a person's intention to conduct the health practice. Three constructs guide that intention: attitude, subjective norm, and perceived behavioural control. Attitude is the extent to which a person has a positive or adverse behaviour assessment. Subjective norm measures the importance others hold about conducting

or not a behaviour and one's readiness to comply with those referents. Perceived behavioural control outlines the perceived facility or difficulty an individual has in performing a behaviour and accounts for factors away from an individual's control. There is abundant empirical evidence supporting the Theory of Planned Behaviour's applicability to improve obesity-preventive lifestyles (Godin and Kok, 1996; Armitage and Conner, 2001; Chung and Fong, 2015; Didarloo *et al.*, 2017).

Individual behavioural interventions have generally resulted in only minor changes in target behaviours (Kinmonth *et al.*, 2008; Eriksson, Franks and Eliasson, 2009; Lakerveld *et al.*, 2013), and they have demonstrated limited success in promoting long-term maintenance of health behaviours (Spence and Lee, 2003). However, a systematic review of theoretical explanations for behaviour change maintenance (related to obesity management) identified the application of two types of theories to increase the effectiveness of health behaviour change interventions, which are Self-Determination Theory (Ng *et al.*, 2012; Teixeira, Carraça, *et al.*, 2012) and Self-Regulation Theories (Dombrowski *et al.*, 2012; Teixeira *et al.*, 2015). Self-Determination Theory is a theory of motivation with three essential psychological components: autonomy, competence, and relatedness. Thus, feeling autonomous and volitional in one's pursuits, effective and optimally challenged, and meaningfully connected to others[3] could have intrinsic value to the self and are crucial for well-being and behavioural change and maintenance (Teixeira, Silva, *et al.*, 2012). The social environment (e.g. family, co-workers) could influence these person's basic psychological needs; for example, in relatedness, 'feeling meaningful connected' could involve others showing emotional support in the person's activities. On the other hand, Self-Regulation Theories (stemming from Social Cognitive Theory) focus on how individuals direct the course of their development/disease management as they select and pursue goals and modify goals based on personal and environmental opportunities and constraints (Newman and Newman, 2020). Disease management strategies are learned using continuous and reciprocal self-regulatory processes, namely observation, judgment, and reaction (Clark, Gong and Kaciroti, 2001).

This section cannot end without identifying and explaining the importance of Social Cognitive Theory in obesity research, one of the most widely used behaviour change theories (McAlister, Perry and Parcel, 2008). It emerged from Social Learning Theory, which identified that people learn from their own experiences and by observing the experiences of others (Bandura, 1989). Social Cognitive Theory is used in behavioural treatment to guide an individual to correct

[3] Some of these psychological theories (e.g. Social Cognitive Theory and Self Determination Theory) are not purely psychological in nature since they overlap with micro sociological theories of interaction as well. For example, it is shown that interactions with social networks and other environments have been incorporated into these 'psychological' theories.

maladaptive thinking, so these thoughts do not lead to unhealthy practices (Wadden and Foster, 2000). It highlights reciprocal determinism in the interaction between individual and environmental factors, and the main concepts include self-efficacy, observational learning, outcome expectations, self-regulation, and facilitation (McAlister, Perry and Parcel, 2008). For example, engagement in regular physical activity can be determined by understanding the importance of the physical activity to health (knowledge); an individual's confidence in the capacity to perform physical activity or to overcome barriers to engaging in a specific behaviour (self-efficacy); a desire for positive physical health outcomes, positive self-evaluation and feedback from others (outcome expectations); establishing short and long-term action goals and strategies created to include physical activity into an existing plan (action goals and self-regulation); and environmental and interpersonal support systems (perceived facilitators) (Bandura, 1998). This theory has been applied in different obesity empirical studies (Mastin, Campo and Askelson, 2012; Adhikari *et al.*, 2018). For example, Neumark-Sztainer *et al.* (2003) explored the associations between different factors and physical activity performance using this theory in their observational study. Different personal factors (e.g. self-acceptance, athletic competence, self-worth, body image, perceived benefits, depressive mood, self-efficacy, enjoyment of physical activity, and BMI), behavioural factors (watching television and time constraints), and socio-environmental factors (social support and resources/costs) were assessed, being time constraints and support for physical activity from parents, peers, and teachers the two most regular factors associated with modification in physical activity.

This section has by no means covered the ground in terms of the range of psychological theories but has focused on the ones which connect to the main topic of the thesis of obesogenic environments and social networks where theories of interaction are relevant.

### 2.2.2 Socio-ecological approaches

Social sciences in obesity have explored the relationship between individuals and wider environments (Cawley, 2011). Health practices do not exclusively depend on personal motivations, beliefs, preferences, and skills. Environmental factors can facilitate or hinder healthy choices. Evidence shows that environmental shifts over the last three decades provide the main drivers needed to interact with individuals' biology to increase the prevalence of obesity (Cawley, 2011).

A relevant advance in obesity research is the use of socio-ecological or ecological approaches to explain obesity using different levels of analysis. The Social-Ecological Theory identifies individuals as embedded in larger social systems and illustrates the interactive characteristics of individuals

and environments that underlie health results (Sallis, Owen and Fisher, 2008). Many different multilevel ecological approaches have emerged and been applied to public health problems (Golden and Earp, 2012). Bronfenbrenner's multilevel framework (Bronfenbrenner, 1979) is one of the most accepted explanations regarding the impact of social environments on human development. Bronfenbrenner indicated that an environment (specifically, a child's environment) is a nested disposition of structures, each contained within the next. These structures are the microsystem, mesosystem, exosystem, macrosystem and chronosystem. The microsystem consists of the groups and institutions that have direct contact with the child and impact most directly and immediately his/her development, such as family, teachers, school peers, religious institutions and neighbourhood. The mesosystem encompasses the interactions between the microsystems, such as the interactions between the child's teachers and family. The exosystem involves other informal and formal social structures that do not influence the child directly but indirectly through its impact on microsystems. For example, parents' experiences at work can impact on child's experience at home. The macrosystem focuses on how the overarching culture affects a child's development, such as socioeconomic status, poverty, ethnicity and wealth, poverty. This chronosystem describes the environmental changes that occur over the life course (e.g. historical events, major life transitions) which influence the child's development (Bronfenbrenner, 1979).

Another ecological approach of relevance is Dahlgren and Whitehead's model of social determinants of health, which identifies personal characteristics (e.g. sex, age, ethnic group), individual lifestyle factors, social and community networks, living and working conditions (e.g. unemployment, housing or education), and general socioeconomic, cultural and environmental conditions (e.g. taxation or availability of work) (Dahlgren and Whitehead, 1991). These circumstances determine the quality of the health of the population. This model's theoretical underpinnings have been vital in further understanding the relationship between health inequities and obesity (Public Health England (UK), 2017). For example, the Marmot review 'Fair Society, Healthy Lives' (Marmot, 2010) shows a framework for action across social determinants of health to improve well-being and health for all and reduce health inequalities. This review highlights that social deprivation, income, and ethnicity impact the likelihood of developing obesity. These theoretical insights have been applied to National Measurement Programmes to continue developing knowledge on people living with disadvantages and health status (NHS Digital, 2021).

In the obesity literature, ecological approaches have synthesised findings which implicated economic, material/physical, social and political environmental factors with the physiological processes of excess fat (Egger and Swinburn, 1997; Lang and Rayner, 2005; Elder *et al.*, 2007;

Foresight, 2007; Moore, de Silva-Sanigorski and Moore, 2013). Ecological perspectives in obesity and health practices research have addressed environments in different ways, for example, researching food environments, built environments, or the obesogenic environment. The food environment refers to the settings in which a variety of food is accessible and available to individuals out-of-home in everyday life (Nutrition and Food Systems Division, 2016). The food environment influences how individuals buy and consume food according to aspects such as affordability, accessibility and availability of food, advertising, and media (Pitt *et al.*, 2017). People can access ready-made food for home and out-of-home consumption (e.g. takeaways, cafes or restaurants) and food for home consumption (e.g. from grocery shops and supermarkets) (Cummins, McKay and MacIntyre, 2005). For example, it has been studied that the location of fast-food outlets near secondary schools and the impact of fast-food availability on the food choices of school children could have essential effects on eating patterns (Davis and Carpenter, 2009; Smith *et al.*, 2013; Caraher, Lloyd and Madelin, 2014). The built environment[4] refers to buildings, spaces, and products created or modified by people, such as schools, homes, parks, workplaces, business areas, or roads (Srinivasan, O'Fallon and Dearry, 2003) and can influence population health (WHO and United Nations Human Settlements Programme, 2016). Most of the research on obesity that mentions the built environment has explored its impact on levels of physical activity, looking at urban planning and transportation practices. For example, different UK studies have found a positive association between living close to green spaces and increased physical activity levels (Giles-Corti and Donovan, 2002; Mytton *et al.*, 2012).

The obesogenic environment, which encompasses the food and built environments, refers to "the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations" (Swinburn, Egger and Raza, 1999, p. 564). The most relevant and cited obesogenic environmental approach is the 'Analysis Grid for Environments Linked to Obesity' (ANGELO) framework (Swinburn, Egger and Raza, 1999). This framework has been piloted at the population level for intervention utilisation by rating for relevance (to the local context), validity (evidence of impact), and potential magnitude of effect. The approach has also been applied in community approaches for planning actions (Simmons *et al.*, 2009) and policy analysis (Vine and Elliott, 2014; Mooney *et al.*, 2015). It divides the obesogenic environment into four broad categories of influence (economic, legislative, physical, and socio-cultural) and two levels of analysis, micro (local/institutional) and macro (regional/national)-levels:

[4] When referring to eating practices, the built environment is considered (on many occasions) as part of the food environment (Pitt *et al.*, 2017; Thayer *et al.*, 2021).

- *The physical environment* includes 'what is available' in an environment. For example, the physical environment concerning food refers to what is available in a variety of food outlets, including supermarkets, schools, vending machines, worksites or restaurants, among others. For physical activity, the physical environment considers those elements linked to active transport (e.g. footpaths, cycle paths or public transport) or those linked to active leisure (e.g. availability of sports grounds, community groups, or parks) (National Institute for Health and Care Excellence [hereafter NICE], 2018). Physical environmental factors include not only the visible world but also less appreciable factors such as exercise and nutrition advice or technological innovations (Swinburn, Egger and Raza, 1999).
- *The socio-cultural environment* refers to a society's or community's beliefs, attitudes and values related to eating and physical activity practices. These cultural and social norms can be influenced by age, gender, traditions, religion, or sub-group affiliations. In addition, attitudes, beliefs and values might be shaped at the micro-level, such as the home, work, school (e.g. through the relationships among staff and students or the role model of teachers (Centers for Disease Control and Prevention, 2021), in a group of friends (Marqués-Sánchez *et al.*, 2021) or at the macro-level (via media or advertisements).
- *The economic environment* refers to the costs related to food and physical activity. For example, economic influences on eating practices can be food production, manufacturing, distribution and retail costs (Swinburn, Egger and Raza, 1999). Also, some economic factors can influence the amount of physical activity people engage in, such as traffic safety, paid parking policies (Feeney, 1989) or national budgets allowing for health promotion (e.g. maintenance of footpaths) (Department for Levelling Up, Housing and Communities (UK), 2022).
- *The political environment* describes regulations, laws and policies (formal and informal) at a micro-level and macro-level that influence obesity. Family rules on television watching can be an example at a micro-level. In school settings, there might be school nutrition policies for food options (e.g. vending machines or school meals) (Swinburn, Egger and Raza, 1999). At a macro-level, there are laws, regulations, and town planning policies, such as restricting city centres to bicycle traffic (Department for Transport (UK), 2022) or zoning for the protection of open spaces (Housing, Communities and Local Government Committee (UK), 2021). Regarding eating practices, the use of nutrition labels on packaged foods (NHS, 2022), laws on marketing unhealthy foods (Department of Health and Social Care (UK), 2021), or the regulation of the amount of food advertising aimed at children and young people (Conway, 2022) are some examples of the political environment.

- *Micro-environment settings* (e.g. homes, schools or workplaces) can be dependent on the *macro-environment* (policy context, industrial production, social norms or technology), influencing as well the eating and physical activity practices within those more immediate micro-environments.

Since early literature reviews (McCormack *et al.*, 2004; Brug and van Lenthe, 2005) had shown a lack of consistent results concerning the impact of environmental factors on health practices over time, the theoretical ideas around the impact of environments continued to advance and improve. Thus, more recent research started to look more at the causal mechanisms that underlie the relationship between individual practices and the environment, and new models were created, such as the International Obesity Task Force (IOTF) model (Kumanyika *et al.*, 2002) and the Environmental Research framework for weight Gain prevention (EnRG) model (Kremers *et al.*, 2006).

The IOTF model (see Figure 1) presents a causal web linking broad distal factors at the international scale to factors at the national, community, and home/work levels and on to more proximal factors at the individual level. One specific difference between the IOTF conceptual model and the ANGELO framework is its linkage of factors at various geographical levels and the corresponding differentiation between 'upstream' and 'downstream' factors. In so doing, it shows the potentially more significant relevance of acting at more upstream levels to more effectively produce change at the individual level. For example, urbanization, economic growth, and globalization of food markets are all upstream environmental factors that might have contributed to the increased consumption of energy-dense food and declines in physical activity at the population level (Kumanyika *et al.*, 2002).

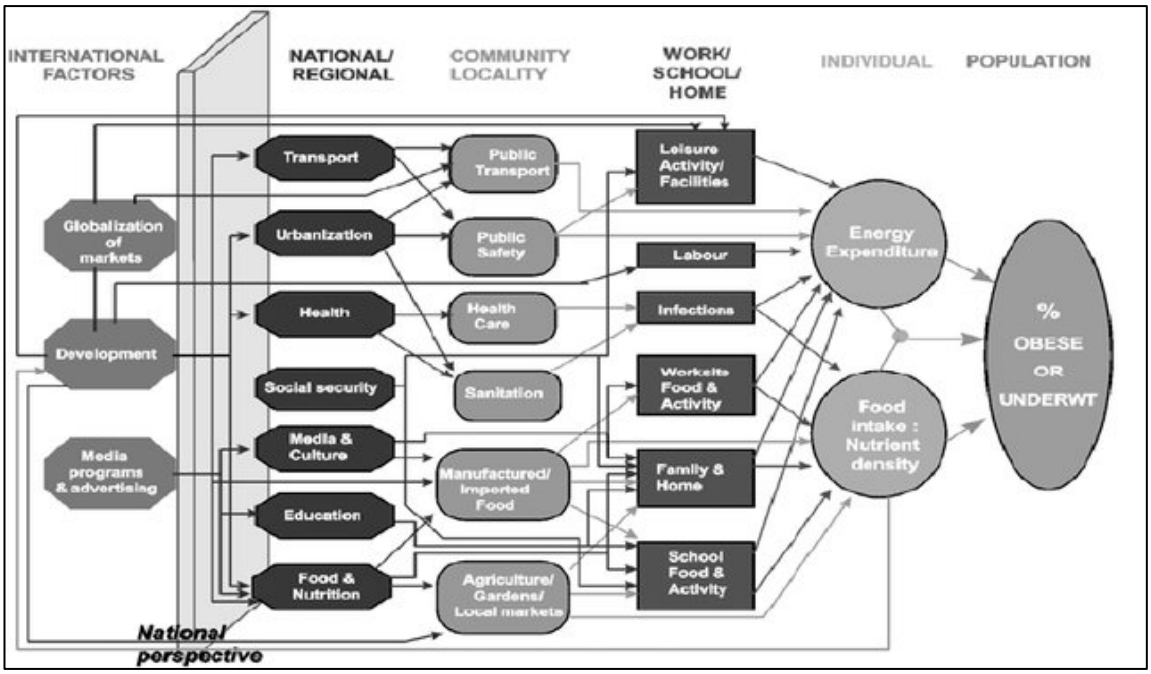


Figure 1. The International Obesity Task Force Obesity model (Kumanyika *et al.*, 2002).

The EnRG model (see Figure 2) merges behaviour change theories and the ANGELO framework. Micro and macro-level environmental factors (economic, political, physical, or socio-cultural) can influence practices. They can also influence practices via cognitive mediators, such as attitude, subjective norms or perceived behavioural control. For example, high prices of healthy foods might harm attitudes attributed to healthy eating practices, or poor accessibility of healthy foods might decrease self-efficacy expectations towards healthy eating. Also, some moderators can influence the level of cognitive mediation by either moderating the environment-cognition relationship (the range to which the environment induces behaviour-specific cognitions) or the cognition-behaviour connection (e.g. the extent to which the cognitions lead to actual engagement in the behaviour). Six types of moderators are specified: awareness, demographic factors, involvement, personality, habit strength and engagement in clustered behaviour (Kremers *et al.*, 2006).

The EnRG model was adapted and upgraded for a European project aimed to provide a comprehensive overview of determinants of obesity operating on multiple levels necessary to create sustainable and effective actions that were strong in terms of reach (the target population), efficacy (impact on important outcomes), adoption (by target institutions or settings), implementation (constancy of delivery of intervention) and maintenance (of intervention effects in settings and individuals over time) (Lakerveld *et al.*, 2012). This new version included social networks as part of the socio-cultural environment and highlighted network structural characteristics such as their size, density, proximity and intensity. After conducting the study, these authors investigated the link between social network characteristics and fresh food

intake, sedentary behaviour, and physical activity using the personal network approach (Bot *et al.*, 2016). Part of their conclusions was that a denser and more extensive network, more intense relationships and more friends living close were associated with healthier behaviours.

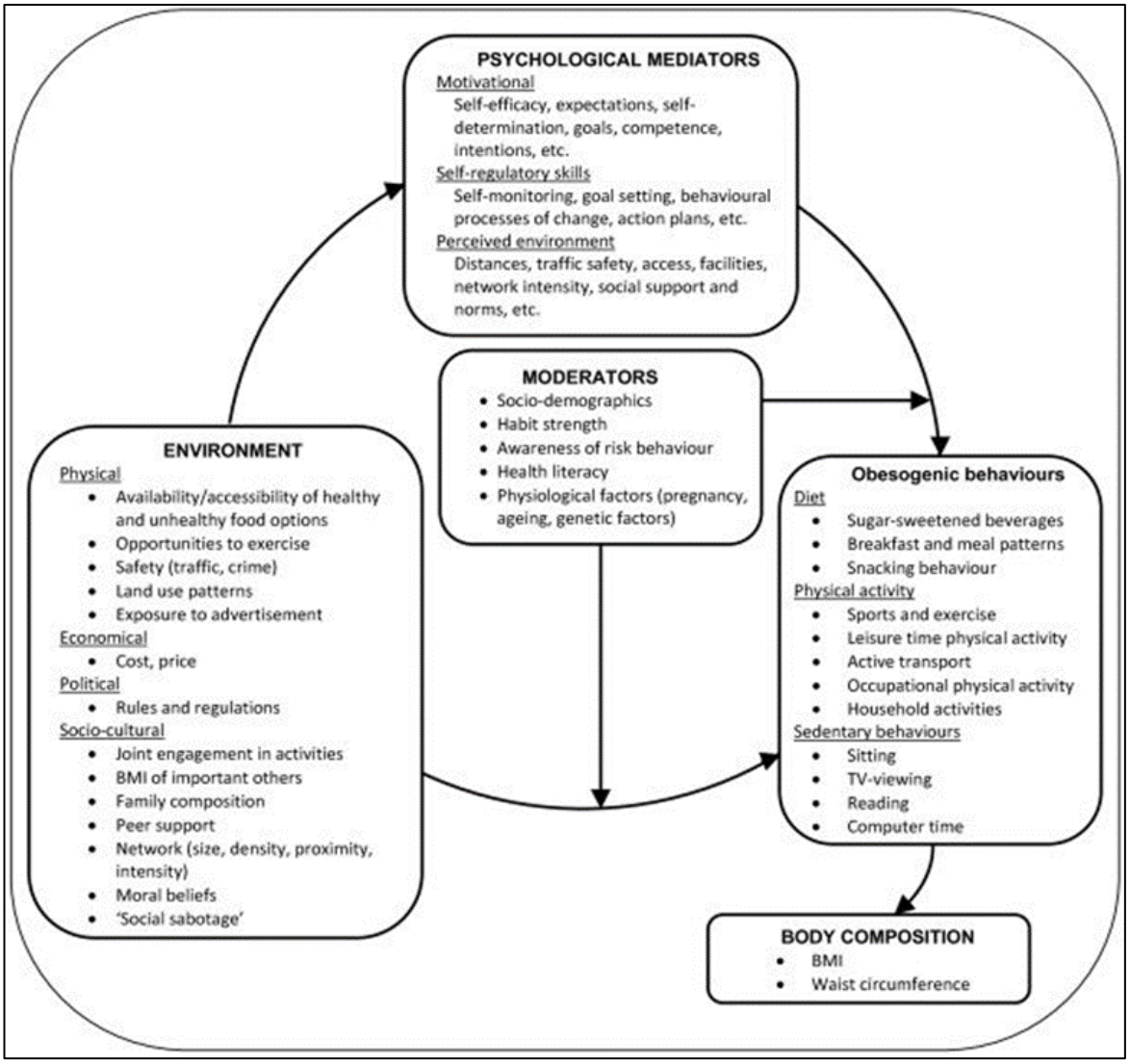


Figure 2. The EnRG model (Lakerveld et *al.*, 2012) .

The obesogenic environment frameworks and models shown in this introduction represent the advance of the application of social sciences to study obesity. However, two important weaknesses of these frameworks and models were identified throughout the research process. Firstly, at the beginning of the thesis, it was recognised that there was not enough understanding of how social networks influence obesity and obesity wider health-related problems as part of the obesogenic environment (the specific gaps are explained later in this thesis). The second weakness (this one was not identified at the beginning of the thesis) was that the pathways and mechanisms by which the obesogenic environment influences health practices have been explained using quantitative methods (Lake, Townshend and Alvanides, 2011). This means that, because of the nature of quantitative approaches, some environments might have been

overlooked in the development of previous theoretical ideas (Broers *et al.*, 2021) and that there might be a lack of understanding of the processes that underpin the interactions between individuals and the multiple environments in which obesity-related health practices occur (Blue, Shove and Kelly, 2021).

Following consideration of the first weakness identified (about social networks), it seemed relevant to pursue a more in-depth exportation of how social networks have been used in obesity research in order to develop new knowledge. The following section introduces the application of social networks research findings to explain some ideas and concepts that are used throughout this thesis and identify the gaps in social network research this thesis addresses.

### 2.2.3 Social networks and obesity

People live their day-to-day life as part of social networks[5] (a set of socially relevant network members connected by one or more relations) (Scott and Carrington, 2011), and their behaviours and practices are likely to be altered by the networks they are embedded in (Zhang *et al.*, 2018).

The primacy of relations and relatedness can be found in the work of influential thinkers such as Heraclitus, Einstein, Marx, Durkheim and Parsons, among others (Emirbayer, 1997). However, Georg Simmel was the one whose theoretical writings inspired and anticipated major empirical findings in network research, in this case, network analysis. For him, there was no 'society' without interactions, and he stated: "The significance of these interactions among individuals lies in the fact that it is because of them that the individuals, in whom these driving impulses and purposes are lodged, form a unity, that is, a society. For unity, in the empirical sense of the word, is nothing but the interaction of elements. An organic body is a unity because its organs maintain a more intimate exchange of their energies with each other than with any other organism; a state is a unity because its citizens show similar mutual effects" (Simmel, 1972, p. 23).

[5] There are some conceptual differences between social relations, social relationships and social networks. Social relations are continuous processes of iterative interactions that stabilise in durable and recognisible relationships (like kinship, friendship, working colleagues) and interactions discrete events that can be counted over a period of time (Borgatti *et al.*, 2009). Social relations derived from individual agency form the basis of social structure and the basic object for analysis by social scientists. Social relationships are a special case of social relations that can exist without any communication taking place between the actors involved. Social network is the theoretical construct in the social sciences to study social relations and relationships. During the manuscript, these concepts are used interchangeably when the conceptual differences do not alter the meaning of each word in its specific situation in the text.

Network science[6] starts from the observation that individuals are always entangled in meaningful relations in contextualised settings. The patterns of such entangled ties are produced by, and conversely shape, cultural and structural mechanisms that regulate social phenomena themselves (Bellotti, 2014). Network science can provide the epistemological, ontological and methodological perspective from which to understand social networks (Kadushin, 2012; Brandes *et al.*, 2013). Four dimensions of social networks are relevant here -structure, function, strength and content (Perry, Pescosolido and Borgatti, 2018). The structure of networks refers to the patterns of linkages between actors. Network function determines the type of exchanges, services, or supports accessible through relationships. Network strength describes the intensity and durability of ties between individuals within the network (Marsden and Campbell, 1984). Network content refers to attitudes, emotions and behaviours flowing between network members (Emirbayer and Goodwin, 1994).

Social network research studies three types of networks, - sociocentric, egocentric, and personal networks[7]. Sociocentric networks (or complete networks) are entire networks at the level of communities or workplaces (Borgatti, Everett and Johnson, 2013). Their analysis focuses on the properties of the entire network (the network level) or the structural positions of each individual within the network (the node level). Egocentric networks focus on a set of relationships surrounding a focal individual[8] (Hâncean, Molina and Lubbers, 2016). Personal networks (the networks of this PhD) can be considered a subset of the concept of egocentric networks, and their analysis refers to social relationships surrounding an individual, considering all social settings where this person is embedded (e.g. work, family or neighbourhood) (Hâncean, Molina and Lubbers, 2016).

The study of social networks has intensified during the last decades, with a persistent spread across some scientific disciplines, including business, anthropology, physics, computer science, education, economics, marketing, communication, political science, sociology, and medicine. The effects of social networks on health began to be studied in the 1970s through pioneer research that demonstrated empirically that social networks could impact mortality (Cassel, 1976; Cobb,

[6] Historically, there have been tensions to define and classify the notion of 'social networks' which could be a method, a paradigm, or a theory (the fundamental premise that interconnectedness represents the mechanism of action) (Perry, Pescosolido and Borgatti, 2018). Therefore, there is no single network theory.
[7] Traditionally, the literature has identified two types of networks: sociocentric and egocentric. Personal and egocentric networks have been used in an interchangeable way over time. I highly recommend the paper by Hâncean, Molina and Lubbers (2016) where they disentangle these concepts and uncover the differences between them.
[8] In the social network's language, a focal individual is usually referred as 'ego' and, the individuals to whom ego is connected are known as 'alters'. In this manuscript and the produced articles, the words 'ego', 'alters' and 'actors' are not used since the readers might not be familiarised with this specific network terminology.

1976; Berkman and Syme, 1979). In the 1990s, the appearance of the Acquired Immune Deficiency Syndrome epidemic, so dependent on spread through intimate connections with others, drew the attention of public health researchers to use social network analysis (SNA) tools for researching public health problems (Luke and Harris, 2007; Valente, 2010; Nam, Redeker and Whittemore, 2015). This included drug consumption (Bohnert, Bradshaw and Latkin, 2009), smoking (Seo and Huang, 2012), alcohol consumption (Rosenquist *et al.*, 2010), tracing syphilis epidemics and diffusion in communities of teenagers (Rothenberg *et al.*, 1998), or suicide (Bearman and Moody, 2004), among others. Thus, social networks became a useful and widely used approach to studying the impact of relationships on spreading health problems in society.

The spread of obesity also started to be studied through social networks. One of the most relevant network studies on obesity was based on data from the Framingham Heart Study, which reported that obesity spread through social ties (Christakis and Fowler, 2007). The authors followed up a network of 12,067 individuals from 1971 to 2003. They used longitudinal statistical models to explore if weight gain in one person was associated with weight gain in his or her friends, spouse, siblings, spouse, and neighbours. They looked into different characteristics of the spread of obesity, such as the existence of clusters of people with obesity within the network, the connection between one person's weight gain and weight gain among his or her social relationships, the dependence of this association on the type of relationships (e.g. ties between friends, spouses, siblings, and neighbours), and the influence of smoking behaviours, sex, and geographic distance between the individuals' homes. They found out that a person's chances of developing obesity increased by 57% if a friend developed excess weight, 40% if a sibling developed obesity and 37% if the spouse developed obesity. In addition, individuals of the same sex had a greater impact on each other than those of the opposite sex. Also, the researchers suggested that social distance (e.g. intensity and frequency of interactions between two parties) could be more relevant than the geographical distance to spreading norms and behaviours related to obesity. These findings attracted other researchers' attention, who attempted to find further explanations for the spread of obesity within this cohort of participants. For example, Cohen-Cole and Fletcher (2008) reproduced these analyses using a comparable data set. However, they found a statistically indiscernible social network effect on the potential development of an individual's weight once they had accounted for confounding effects of shared exposure to physical environments between connected individuals.

Since then, there have been studies looking at social networks' positive and negative influence on obesity and its related health practices in teenagers and adults. Thus, studies in the teenage population have shown, for example, that adolescents' weight can be associated with their friends' weight (Valente *et al.*, 2009). Also, groups of school friends can share similar negative

practices (e.g. sedentary screen-based activities or snacking) (de la Haye *et al.*, 2010), or adolescents tend to be friends of peers who perform similar amounts of physical activity and, consequently, they emulate their friends' behaviours (de la Haye *et al.*, 2011). Concerning adult samples, a study found that young adults with greater social norms who appreciated weight loss identified more social relationships with consonant values on weight loss and, therefore, greater ambition to lose weight (Leahey *et al.*, 2011). Also, snacking habits might be shared by socially connected individuals across adult friends, spouses and sibling peers, supporting evidence of collective behavioural processes impacting eating practices (Pachucki, Jacques and Christakis, 2011).

Most research on social networks and obesity has been exploratory, and few network-mediated interventions have been developed to address obesity specifically. Currently, the most relevant are targeting influential individuals to spread healthy information and behaviours through interpersonal ties (Kim *et al.*, 2015; de la Haye *et al.*, 2019) and creating opportunities for health-supportive relationships to be maintained (Centola, 2011; Gesell, Bess and Barkin, 2012; Vassilev *et al.*, 2019). In order to develop effective network-based obesity interventions, it is vital to continue developing an in-depth understanding of how social networks work, in other words, to unpack more of the mechanisms by which social relationships influence obesity (Valente, 2012).

Hedstrom (2005, p. 25) defines mechanisms as "entities (with their properties) and the activities that these entities engage in, either by themselves or in concert with other entities. These activities bring about change, and the type of change brought about depends upon the properties of the entities and the way in which they are linked to one other". In this regard, Berkman *et al.* (2000) developed a relevant conceptual model of social networks and health (see Figure 3), identifying a range of social network mechanisms and situating them within a cascading causal process from macro-social to psycho-biological processes. These authors embedded social networks in a larger social context in which upstream factors are seen to condition network structures. Those structures provided opportunities for different social network mechanisms (social support, social influence, social engagement and attachment and access to resources and material goods), which impacted health through different pathways, including stress responses, self-esteem, self-efficacy, security, and health practices. Social network mechanisms or processes are the main areas of network interest in this thesis because the literature concerning network mechanisms in health is still scarce (Berkman *et al.*, 2000; Smith and Christakis, 2008; Valente, 2012; Nam, Redeker and Whittemore, 2015). Specifically, how networks operate at multiple levels in the obesity field in adults seems an opportunity to explore and continue developing.

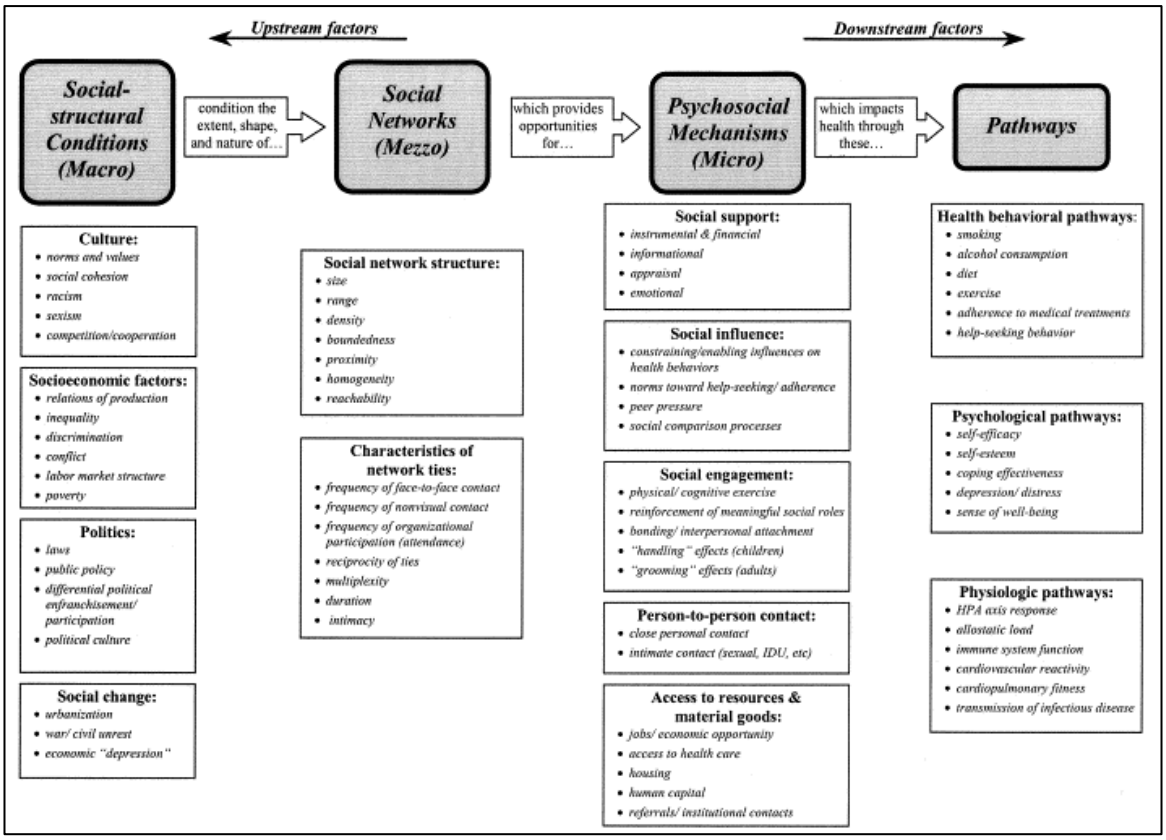


Figure 3. Conceptual model of how social networks impact health (Berkman *et al.*, 2000).

## 2.3 Research questions, aim and objectives

The main aim of this thesis is to gain an in-depth understanding of how different multilevel environments influence the adoption of health practices in adults with obesity in the UK.

It must be highlighted that the research question for the general aim (How different multilevel environments could influence the adoption of health practices in adults with obesity in the UK?) was not the first research question of this thesis. At the beginning of the thesis, the focus was to understand more about the mechanisms and processes by which social networks operate at multiple levels in adults' obesity. However, during the research process (when designing the interview questions for the second article), I realised the need to unpack other obesogenic environments (unrelated to social networks) in the UK that might have been overlooked in the past by previous quantitative research.

Therefore, this is the natural order of the research questions and objectives proposed based on the needs of the research process and, above all, the development of my thinking. The sum of the specific objectives below answers the main aim of this thesis:

The first specific research question focused on the influence of social networks:

1. How do social networks influence the adoption of health practices in adults with obesity?

It is linked to the following specific objectives:

a) To understand what and how social network properties and processes influence the adoption of healthy and unhealthy obesity-related health practices in adults.
b) To identify the types of relationships relevant to the adoption of practices in adults with obesity and to explore the type of activities these relationships engage with or promote to produce those practices and their potential health consequences.

This question is addressed mainly in the first and second articles (chapters 4 and 5). The first article identifies positive and negative health scenarios composed of different multilevel constructs where network processes are always present. The theoretical development from this first article (chapter 4) was considered for the next article (chapter 5), which aimed to explore types of network ties and activities within those networks in the 'real' world. In this empirical article, the design of the interview questions and the data analysis used the concepts and understanding from the first article. Furthermore, the background section of this thesis (chapter 2) addresses key social theories applied in the field of obesity as an introductory way to know what has been done before in terms of social theory and obesity and shows the relevance of introducing social networks as a way of understanding and developing interventions. Previous work on social networks and obesity, which studied the structure of networks rather than their nature, is also detailed in the background.

The second research question was:

2. How do adults with obesity interact with other environments for the adoption of health practices?

It connected to the following specific objective:

c) To explore how adults with obesity interact with other environments in which health practices occur and identify lay strategies for overcoming environmental barriers.

During the research process, it was identified the need to explore other components of the obesogenic environment (not only social networks) that had been overlooked in the past because of the use of quantitative research, the most predominant in this field. Thus, chapter 6 is the continuation of the qualitative empirical study and addresses this gap.

The overall research question is: How different multilevel environments could influence the adoption of health practices in adults with obesity in the UK?

This question covers all the previous specific objectives and the following:

d) To propose a new obesogenic environment model according to the life experience of adults with obesity in the UK.

Finally, the general aim can be answered by considering chapters 4, 5 and 6 separately and through the discussion section (chapter 7). The latter provides a wrap-up understanding of chapters 4, 5 and 6 together to develop knowledge on the impact of the obesogenic environment and propose a new model according to the experience of adults with obesity in the UK.

**Conclusion of chapter 2**

This chapter has presented a substantial body of knowledge, justifying the need for conducting this thesis. First, it introduced obesity as one of the leading health problems in the United Kingdom and worldwide, its complexity and multifactorial condition and how social sciences have been used to tackle it, evolving from psychological theories to socio-ecological approaches. The notion of the obesogenic environment was presented and disentangled, exploring different theoretical frameworks and models, and social networks were explained as part of it. Then, the main aim, specific research questions and objectives were introduced based on the identified gaps in the research area of obesogenic environments. The next chapter explains the methodology used in the thesis.

# Chapter 3 Methodology

This methodology section is divided into two main sections. One describes the reasons for using a critical interpretative synthesis (CIS) as a review method. The other section focuses on the qualitative study.

## 3.1 The review method

In this section, I explain the rationale of choosing and utilising a critical interpretative synthesis as a review method to answer the first specific objective, which is to understand what and how social network properties and processes influence the adoption of healthy and unhealthy obesity-related health practices in adults.

At the beginning of my PhD, I was interested in the role of social networks in influencing the adoption of health practices in adults with obesity, as already explained in the 'personal motivation' section. I was aware that answering the first developed question (how do social networks influence the adoption of health practices in adults with obesity?) would require the creation of theory. Only a few studies had highlighted the presence of network processes (how networks operate) in health, and most of these studies were not even empirical. If I wanted to develop new theory regarding social network mechanisms, I would not be able to use traditional review methods alone (e.g. a systematic review or scoping review), which are developed to assemble, pool and summarise data (Dixon-Woods, Cavers, *et al.*, 2006). Something else that I considered at that point is that if I wanted to study in-depth the influence of networks on obesity, I would require to search for studies that address not only social networks and obesity but health-related practices related to obesity (e.g. physical activity, eating practices and alcohol intake), and social relationships and obesity-related practices. The difference between social network and social relationships studies is that both study relations, but the latter do not always use network language or network concepts.

I needed a review method that required interpretative and inductive (theory-building approach: themes derived from data) processes to create an in-depth understanding of social networks. Therefore, I decided between methods of qualitative evidence synthesis and mixed studies reviews (also called mixed-methods reviews). Based on my previous knowledge of social networks and a preliminary search, I thought most of the studies could be qualitative (thinking about what I wanted to aim for by answering the first research question created). With qualitative studies, I could identify network processes and functioning processes - that is, how networks are created (Perry, Pescosolido and Borgatti, 2018) and what resources are transferred between them within

a specific context (Kadushin, 2012). On the other hand, with quantitative studies, I could provide information to understand further the complexity surrounding how social networks influence, for example, by looking at their structure and whether their effects are statistically and theoretically significant (Perry, Pescosolido and Borgatti, 2018).

When deciding between the different types of mixed reviews, I preferred to use a method where the results of included studies were integrated and transformed into one type of data, in this case, qualitative data (Pluye and Hong, 2014). Therefore, considering that I had a 'how' question and I wanted to transform qualitative, quantitative and mixed-method data into qualitative findings, it would have to be a convergent qualitative synthesis (some examples of transforming quantitative results into qualitative codes can be seen in Appendix G, section 4, properties). Thus, there would be five potential options to choose from: thematic qualitative synthesis, realist synthesis, CIS, meta-narrative synthesis and multiple case synthesis. Why did I decide to opt for a CIS? One of the advantages of a CIS is that it has flexibility and is convenient in appraising quality, using relevance (e.g. likely contribution to theory development) rather than methodological characteristics to determine the 'quality' of individual papers (Flemming, 2010). Also, it is distinct in its 'explicit orientation' towards theory generation (Barnett-Page and Thomas, 2009), following an analysis process of different phases for the interpretation and integration of the data and, therefore, providing a more insightful way of understanding a phenomenon. Thus, following lines-of-argument (LOA) synthesis within the CIS, I would be able to develop different order constructs which could be linked to create a theoretical heuristic framework. More information about the CIS can be seen in chapter 4.

## 3.2 The qualitative study method

This section addresses the epistemological approach and qualitative methodology used to answer two specific research objectives: (i) to identify the types of relationships relevant to the adoption of practices in adults with obesity and to explore the type of activities these relationships engage with or promote to produce those practices and their potential health consequences; and (ii) to explore how adults with obesity interact with the wider obesogenic environment in which health practices occur and identify lay strategies for overcoming environmental barriers.

### 3.2.1 Epistemological approach to the qualitative study

Researchers are philosophers in that "universal sense in which all human beings are guided by highly abstract principles" (Bateson, 2000, p. 320). These principles integrate beliefs about epistemology (what is the relationship between the inquirer and the known? How the researcher

knows what he or she knows?), ontology (what kind of being is the human being? What is the nature of reality?), the role of values in the research (axiology), the language of research (rhetoric) and methodology (how do we gain knowledge of it?) (Denzin and Lincoln, 2005). These beliefs frame how researchers see and act in the world (Creswell and Poth, 2016). The net that contains the researcher's epistemological, ontological and methodological premises could be considered a paradigm, a "basic set of beliefs that guides action" (Guba, 1990, p. 17). Each paradigm demands the researcher, including the questions the researcher asks and the interpretations of the results.

I first considered critical realism for its potential application to study social mechanisms but opted for constructivism in the end, as explained below. In critical realism, 'reality' is divided into three domains: the actual domain represents events and patterns that link them; the empirical domain applies to people's observations and perceptions of events; and the real domain is structured by underlying mechanisms that generate events (Bhaskar, 2013). At the same time, critical realism distinguishes between the 'real' and the 'observable' world. The 'real' cannot be observed and exists independent of human perceptions, construction, and theories. The world is constructed from our experiences and perspectives through what is 'observable'. Thus, unobservable structures cause observable events, and the social world can be understood only if people understand the structures that generate events. My reflection was: "Ok, so if the 'real' is invisible and cannot be measured, how am I going to translate these ideas into practice? How can I frame the results of an empirical study using this paradigm if health sciences interventions are so pragmatic (e.g. nursing and public health research are dominated by positivist thinking)? How can I disseminate my results or convince someone when having to distinguish between the 'real' and the 'observable'? I decided to be more 'pragmatic' and focus on constructing ideas based on the experiences and realities of people living with obesity; thus, I decided to follow constructivism philosophical underpinnings.

In constructivism, individuals look for an understanding of the world they are part of. Individuals develop subjective meanings of their experiences, and the inquirer aims to interpret the meanings others have about the world about their experiences (Creswell, 2003). The constructivist paradigm considers a relativist ontology (there are multiple realities), a subjectivist o transactional epistemology (respondent and knower concrete understandings), and a naturalistic (in the natural world) set of methodological procedures. Someone at this point could ask, "if there are multiple realities, how 'truth' is achieved?" In this sense, constructivism follows an antifoundational explanation. Constructivism refuses to adopt any unvarying (or 'foundational'), permanent standards by which truth can be universally known (Schwandt, 2000). Truth and any agreement concerning what is valid knowledge appear from communication and negotiation processes between stakeholding community members and the processes of communication and negotiation

(Lincoln, 1995). This 'communicative and pragmatic concept' of validity (Rorty, 2009) is never fixed, but it is created through a community narrative shaped by historical and temporal conditions that gave rise to the community.

In addition to constructivism, part of this thesis is based on network abstraction; therefore, there is an ontological commitment where networks constitute realities, and network phenomena are seen as individual elements, pair-wise relationships between those elements, and a global patterning that could be considered a network structure (Brandes *et al.*, 2013). Social relations, networks and individuals are the bricks of social structure, whose ontological properties are irreducible to each other. Social networks cannot have ontological substance without considering cultural formations; the interactions that form the significance of networks always demand symbolic communication between individuals, and relations are purposively tied because they are meaningful (Bellotti, 2014).

### 3.2.2 Design of the qualitative study

Hermeneutical phenomenology, as part of a qualitative network approach, informed the research design. Phenomenology is the reflective study of lived experience about a phenomenon (Given, 2008). The researcher collects data from individuals who have experienced the phenomenon and creates a combined description of the experience's essence for all individuals. The description involves 'what' they experienced and 'how' they experienced it (Moustakas, 1994). In this manuscript, data provide a deeper understanding of individuals' perspectives and life experiences regarding the adoption of positive and negative obesity-related practices considering their environments. It is 'hermeneutical' because it is interpretive (rather than purely descriptive, as in transcendental phenomenology). The researcher's assumptions are not bracketed or set aside but are embedded and essential to the interpretive process (Laverty, 2003).

This hermeneutical phenomenology is considered part of a qualitative network approach[9]. What do I mean by 'qualitative social network approach'? There are two types of network approaches (methods) to study relationships: quantitative SNA and qualitative SNA (or qualitative social network approach). I need to remark at this point that SNA can refer to different aspects (Korom, 2015), such as an analysis method, a research method (within the sociology field), and even a

[9] Chapter 5 (the first empirical article) describes this type of design. However, chapter 6 (the second empirical article) mentions only hermeneutic phenomenology and not the qualitative network approach. Although data collection was done once using the qualitative network approach with hermeneutic phenomenology, it was decided not to include the 'network' aspect in that last article since there are no social relationships (between people) involved in the results and to avoid potential confusions by the readers.

paradigm (Scott and Carrington, 2011) (although I disagree with the latest)[10]. Quantitative SNA is based on graph theory with its roots in sociology and anthropology (Wasserman and Faust, 1994) and has been the dominant method of studying networks. It focuses on patterns of relations and studies structures of interconnected social actors, which are composed of nodes (e.g. individuals, groups, organisations) and their connecting ties or edges (e.g. relationships or interactions) (Knox, Savage and Harvey, 2006). However, quantitative SNA reduces relationships to numbers, bracketing out a potential empirical material from the lived histories of recurrent interaction, which continually evolves through continued interaction between parties (or significant absences of interaction) (Crossley, 2010).

A qualitative social network approach covers this gap. It focuses on the narratives and meanings of social ties and less on their structure, and it can add an awareness of the content, process, change, and context of social networks (Edwards, 2010). Qualitative methods employed for data collection and data analysis in network research are essentially the same as the methodology in typical qualitative social research (Scott and Carrington, 2011). Historically, it has been used to study six areas: the exploration of networks (issues that one knows little about because they are either entirely new or have yet to be studied); network practices (the concrete acts, practices, interactions, and communication patterns in light of the respective contexts in which they occur); network orientations and assessments (actors' perceptions and assessments of the relationships and networks of which they are a part), network effects (what mechanisms and conditions figure in when producing certain network outcomes), network dynamics (fluctuation or change in networks over time and in physical space), and the validation of network data (e.g. in-depth meanings of questionnaire questions and participants' answers) (Holstein, 2011). This thesis considers network practices, network orientations and assessments, network effects and network dynamics to study in-depth uncovered aspects of relationality between adults living with obesity and the obesogenic environment in the UK.

[10] Labelling 'social network analysis' (e.g. research method, paradigm, etc.) is an ongoing debate that does not have a unique answer. In this sense, I agree with Brandes *et al.* (2013) who state that SNA is used to label everything that is related to networks, even aspects not related to analysis such as different network concepts. If 'analysis' refers to everything, there will not be space for a 'network science'. If I had to opinate I would classify SNA as set of methods, measures and statistical approaches to analyse social networks, which in line with other authors' thinking (Wasserman and Faust, 1994; Borgatti, Everett and Johnson, 2013).

### 3.2.3 Participants and settings

A purposeful sampling strategy (non-probability sampling) was used to recruit participants based on the recruiter's judgments and the research's purpose (Greig, Taylor and MacKay, 2012). It involves identifying and selecting individuals or groups of individuals that are knowledgeable about or experienced a specific phenomenon (Kruger, 1988; Manen, 1997), in this case, those living with obesity in the UK. This purposeful sampling strategy involved snowballing and homogeneity (Palinkas *et al.*, 2015). The objective of snowballing is to identify cases of interest by sampling people who know others that generally have akin characteristics. The objective of homogeneity is to describe a particular subgroup in depth (individuals with experience of living with obesity) to reduce variation and simplify analysis. The inclusion criteria for the final sample were:

- To have a current BMI ≥30 kg/m2 or to have a current BMI <30 but used to have a BMI ≥30. Self-reported weight measurements were used to prevent anxiety in patients about being weighed.
- To live in the UK.
- To be able to communicate and understand English.
- To have a device with an Internet connection and microphone (e.g. mobile phone, tablet, computer). The availability of a camera/webcam in the device was strongly recommended but not essential to conduct the interviews.
- To have an email address.
- To show a willingness to participate in the project.

On the other hand, the exclusion criteria were:

- Not to meet any of the inclusion criteria above.
- To reject participating in the study.
- To have a mental impairment.

Participants were approached in community settings and via social media (Twitter, Facebook and LinkedIn). I utilised recruitments posters (see Appendix A.1) in the Hampshire area (outdoor boards in local villages, community boards in supermarkets, small food stores, University buildings and Southampton General Hospital), online advertisements (see Appendix A.2), sent letters of invitation (see Appendix A.3) to local weight management groups and LTCs related charities (asking for their gatekeepers approval when required) from different areas of England, Scotland, Wales and Northern Ireland and contacted with advocacy individuals dedicated to empowering people affected by obesity (via Twitter or email). Gatekeepers were managers of organisations;

they held leadership roles and could allow access to people who were part of the different organisations and community groups. A gatekeeper approval letter (see Appendix A.4) and a specific consent form for gatekeepers (see Appendix A.5) were created for this purpose. After gatekeeper approval, these leaders would distribute the participant information sheet (see Appendix A.6) via email, post and social media (if they belong to an online group) to the potential participants. Furthermore, they could post the social media advert on the researcher's behalf within the online groups (if required). Gatekeepers would not use coercion. Ten pounds were offered to the participants as a thank-you for their participation.

### 3.2.4 Data collection

Before I describe the tools, as mentioned above, it is important to highlight that data collection was done once and consisted of semi-structured individual interviews, a mapping technique tool and a sociodemographic questionnaire. No more data collection was necessitated since the information collected represented different aspects of the experience of living with obesity and the impact of different obesogenic environments. Thus, from this data collection, two completely different qualitative articles were developed (both together are considered the qualitative study of this thesis). One focused on social networks, and the other one on other components of the obesogenic environment:

- The second article of my PhD (chapter 5) uses questions related to social networks, network mapping tools and the sociodemographic questionnaire.
- The third article (chapter 6) uses questions related to other environmental factors and priorities to change and the sociodemographic questionnaire.

#### 3.2.4.1 Three data collection methods

Three tools were used for data collection:

- Individual semi-structured interviews with open-ended questions were conducted between May 2020 and March 2021. These types of interviews focus on a specific subject and allow flexibility to capture unpredictable findings (Pope and Mays, 2006). The participants were interviewed for between 30 and 120 minutes. The researchers considered the stigma that accompanied this topic and attempted to design an adequate interview schedule (see Appendix B) where language mattered (Albury *et al.*, 2020). The questions regarding social relationships were designed based on our previous literature review (Serrano Fuentes, Rogers and Portillo, 2019). Feedback regarding the type and

tone of the questions was provided by the qualitative research group members of the University of Southampton and the two first interviewees (participants 1 and 2).

- A personal network sociogram (see Appendix C) or hierarchical mapping technique (Antonucci, 1986) was incorporated to support the identification of social relationships to help generate rich data by producing reflections about how these relationships influenced participants' health. In the social network language, this is considered a 'name-generator' tool (a way to compile the names of others in the network and discuss their significance) (Tubaro, Ryan and D'angelo, 2016). Social networks are not 'out there' for all to see (Peay, 1980). Mapping social networks supports uncovering how interdependencies, associations, relationships and interactions shape society, overcoming standard sociological representations of independent actors as sets of individual attributes. This sociogram consisted of three concentric circles (Antonucci, 1986). The interviewer started the interview by asking, "who do you think is most important to you in influencing your health behaviours (eating, physical activity and alcohol intake), positively and negatively?" Thus, the interviewees could place proposed network members in either the central circle, considered essential; the middle circle, considered important but not as relevant as the central circle or the outer circle, considered necessary but not as important as the other two circles. Two diagrams were collected per person representing a moment in the past (when they started having obesity) and the present. Whilst filling in the diagrams out loud, participants were asked to explain why they chose the people they had placed within the circles and how they had influenced their health.
- A sociodemographic questionnaire (see Appendix D) was used to register different attributes and establish relationships with the individuals' conceptions of health experiences and opinions.

Due to the Coronavirus Disease 2019 (COVID-19) pandemic and its associated lockdowns, all data collection was conducted online. Considering that over three-quarters of adults in the UK use the Internet daily or almost daily (Lo Iacono, Symonds and Brown, 2016), this approach seemed adequate for that scenario and prevented face-to-face contact. VoIP (Voice over Internet Protocol) mediated technology was used to interview the participants. This system allows users to send video and voice across the internet via a synchronous (real-time) connection. Thus, videoconferencing was done via Microsoft Teams, the most reliable VoIP method in data security and privacy, according to the University of Southampton (Research Integrity and Governance Team, 2020). This method was chosen in comparison with others (e.g. telephone) since it provides a more personable approach (Irani, 2019), something that was found relevant when discussing this sensitive topic. Also, non-verbal communication can influence engagement in the discussion

for both interviewers and interviewees (Seitz, 2016; Irani, 2019). Phone calls were considered if there were any connection or technological problems or at the interviewee's request. Emails were used to send information about the study (no research data).

#### 3.2.4.2 Data collection procedures

Individuals expressing an interest in the research contacted me directly. After that, they received a participant information sheet via email. My contact details and the principal supervisor were included in the participant information sheet so that the individuals could ask doubts about the research. Once they decided to take part, two Microsoft Word documents with instructions via email were sent. One explained how to use Microsoft Teams for both Apple and Windows users (see Appendix E.1), and the other explained how to use SafeSend (see Appendix E.2). SafeSend is software hosted by the research institution and was the utilised method to transfer research and confidential data across the network securely encrypted. Also, a potential interview date was discussed and, one week before the interview, the researcher sent some documents to the interviewee via SafeSend:

- A consent form (see Appendix F). The participant had to send back the signed consent form to the researcher via SafeSend. If participants did not have a scan/printer to insert an original signature, they could fill it out electronically by typing their responses and full name. Once I received it, I signed and returned a copy to the study participant via SafeSend. This whole process was done before the interview date. That form of gaining informed consent was considered due to the COVID-19 pandemic and accepted by the University Ethics Committee.
- A sociodemographic questionnaire to be completed by the participant.
- A concentric circle diagram (network map or network diagram), which would be used on the day of the interview to visualise social relationships.

The day before the online meeting, the researcher reminded about the videoconference and recommended the participant undertake the interview in a quiet place while considering confidentiality (e.g. who is listening to the interview) and the best Internet connection possible. On the interview day, the participant received a link (URL) via email to join the meeting. Using a device with a camera/webcam was recommended to have a more personable approach during the meeting. However, if someone did not feel comfortable, videoconferencing could be done only with audio and without the use of the camera (one person preferred not to use the camera). If any discomfort arose regarding the nature of some questions, the question would have been reformulated (it did not happen). If the participant felt uncomfortable, there would have been the opportunity to skip questions in the questionnaire and the interviews. Participants could take a

break from any research activity or stop participating altogether. It is important to note that the upsetting questions cannot always be predicted because they will often depend on the participant's personal experiences, which will not be known to the researcher before conducting the interview (Richards and Schwartz, 2002). However, every effort was made to support participants during the interviews. Different contacts were provided in the participant information sheet in case of any issues, emotional support or complaints. These were The Samaritans group phone in case any participant needed to talk to someone after the interview, my contact, the email of the principal supervisor Prof Mari Carmen Portillo and the University of Southampton Research Integrity and Governance Manager. Due to the COVID-19 scenario, it was recommended to make contact by email.

Once the interviews were transcribed, and before starting to anonymise and analyse the results, the participants were contacted (via the agreed method) to remind them if they wanted to withdraw from the study and wanted their data to be withdrawn (that was the last opportunity). The participants had the right to ensure that all the data the researcher held were accurate and correct any errors should they wish to. Eighteen interviews were carried out via videoconference and one by telephone. All the interviews were recorded using a Dictaphone (Olympus WS-853). Researchers had no therapeutic relationship with participants.

#### 3.2.4.3 Access, storage and data protection

Participation and the information collected about the participants during the research were kept strictly confidential.

For secure storage and in compliance with the Data Protection Policy (2018) of the University of Southampton (UoS), hard data (concentric circle diagrams, other sheets such as printed transcriptions and the audio recorder) were kept in a locked filing cabinet in the doctoral student office at the University of Southampton. Only the PhD student had access to this locked cabinet. The transcription of the interviews, the questionnaires and the consent forms were kept on a UoS password-protected computer. The latter were stored in password-protected files. Personal data were kept separate from non-identifiable data. Due to the COVID-19 social scenario, most data was in electronic format.

Only the doctoral supervisors and the transcription service had access to the participant’s data before the doctoral researcher wrote up the data. All qualitative interviews were audio-recorded on an encrypted Dictaphone purchased for the study. Once the interviews were transcribed, data were anonymised, and the audio recordings were destroyed. Derived data were used on the questionnaire. This means that values/categories of a less granular nature were used to hide the

exact values (e.g. age or income). Concerning spatial information, only four characters of the postal code were used (this represents approximately 2,600 households). Also, all the real names were coded into fictitious names. Thus, research findings made available in the publications following the study do not include information that can be used to directly identify any participant.

The anonymised data will be retained for a period of ten years before being deleted. Participant contact details (name, email and telephone number) were deleted following the completion of the study.

### 3.2.5 Data analysis of the qualitative study

Two articles have been written presenting results from the same data collection and based on two different types of thematic analysis (TA). This section shows an overview of the different analyses.

In the second article (chapter 5), codebook template TA was utilised to identify, analyse and report repeated patterns across data (Brooks *et al.*, 2015). Template TA was chosen in comparison with other types of TA in order to use a-priori themes (informed by previous theory) to create an initial version of the coding template (McCluskey *et al.*, 2011). Thus, data analysis followed a deductive and inductive analysis process. Deductive in the sense that the results from the CIS review informed the inquiry process (interview questions) and the first domain summary themes and codes; therefore, topics were developed early on or even before the analysis (Braun and Clarke, 2021). Also, it was inductive in the sense that those initial domain summary topics (from the deductive analysis) were modified, and new themes and codes were created through the analytic process. The different phases involved in the analysis were (i) familiarisation with the data, (ii) creation of an a-priori template, (iii) coding, (iv) finalising the template and (v) writing up. The detailed analysis process can be seen in Appendix I.

In the third article (chapter 6), a reflexive TA (Braun and Clarke, 2006) was conducted using a six-stage framework (Braun and Clarke, 2021) to identify, analyse and report repeated patterns across data. Data analysis consisted of an inductive and iterative process since all the codes (developed first) and themes (created after the codes) were completely new and created through the research with movement back and forth between the different phases that consisted of (i) reading the transcripts to become aware of the content; (ii) identifying and coding essential features of the data related to environmental barriers and opportunities; (iii) examining the collating data and codes to build up broader patterns of meaning; (iv) candidate themes were reviewed against the dataset to determine a trustworthy story; (v) creating an elaborated analysis

of each theme and developing each theme's focus, and (vi) finalising the themes and producing the report. The detailed analysis process can be seen in Appendix K.

All the interviews were transcribed verbatim, ten of them by me and the rest by a professional transcriber. All the real names were coded into pseudonyms to ensure anonymity. Anonymised transcripts were uploaded to NVivo (version 1.2) to support the analysis.

#### 3.2.5.1 Quality and rigour of data

The criteria developed by Lincoln and Guba (1985) were introduced to establish the trustworthiness of this qualitative research. Thus, credibility, transferability, dependability and confirmability can be assessed through the research analysis process (Nowell *et al.*, 2017):

- Credibility focuses on the 'fit' between participants' views and the researcher's representation of them (Tobin and Begley, 2004). Lincoln and Guba (1985) proposed different techniques to address credibility. For example, prolonged engagement with data was used in this research throughout the entire analysis process. Also, peer debriefing with my supervisors was conducted to provide an external check on the research process and examine conceptual adequacy as a means to check preliminary findings (e.g. codes and themes) and interpretations against the raw data (Popay and Williams, 1998). The credibility of some of the network diagrams (those that had to be developed retrospectively by myself) was checked with the respective participants to ensure data rigour (this is explained further in the limitations section of this thesis). Also, participant 1 was contacted to verify the interpretation of the findings (no issues were raised).
- Transferability refers to the generalizability of the results. The generalization of the results was not obtained. This is addressed in the discussion sections of chapters 5 and 6.
- Dependability refers to ensuring the research process is traceable, logical and acutely documented (Tobin and Begley, 2004) (how dependability was met is explained below).
- Confirmability addresses that the researcher's findings and interpretations arise from the data. The researcher shows how interpretations and conclusions have been reached (Tobin and Begley, 2004) (how confirmability was met is explained below).

The COREQ checklist (Tong, Sainsbury and Craig, 2007), a specific tool for evaluating TA manuscripts (Braun and Clarke, 2021), and the detailed analysis processes of the qualitative study show the credibility, dependability and confirmability of the qualitative research. Thus, Appendix J presents the checklists used for the template TA article, Appendix L for the reflexive TA article, Appendix I shows the template TA process and Appendix K the reflexive TA process.

Data adequacy is also an indicator of quality (Glenton *et al.*, 2018). This is the richness or how thick the description of an event by participants is (Popay, Rogers and Williams, 1998). Thick descriptions provide the context of an experience, state the meanings and intentions that feed into those experiences and show the experiences as processes (Geertz, 1973). The data richness and its in-depth and detailed analysis, together with data saturation, determined the end of the analysis. After the seventeenth interview, no new codes and themes were generated from the narratives. Thus, it was concluded that the data analysis had reached a saturation point (data saturation) (Saunders *et al.*, 2018). However, two more interested participants were interviewed to ensure and confirm that there were no new emerging codes and themes[11].

### 3.2.6 Ethical considerations and reflection

This section explains the main difficulties during the ethics process, how they were addressed to get the final ethical approval and lessons learned for the future.

This PhD research was the first time I conducted empirical research, recruited participants, and applied for ethics approval. The main difficulty was the use of language, its tone, and changing from research language to translation for a lay population language. As a junior investigator, I made the mistake of thinking that the general public would understand the language I used daily in the academic context. Thus, the ethics reviewers identified words such as ‘interview schedule’, ‘sociodemographic’, ‘multifactorial condition’ as barriers for the participants. Thus, they were changed by the words ‘interview questions’, ‘individual characteristics’, and ‘complex and growing condition’, respectively. In this sense, the ethics reviewers suggested giving the participant information sheet to a non-academic person and asking them to provide feedback on the document.

Although the proposal had been approved, I initially found many difficulties in recruiting adults with obesity. After passing the participant information sheet to some academic colleagues, they found some issues related to language that had not been identified by the ethics reviewers (probably because these issues were related to obesity stigma, which reviewers might not be familiar with). For example, in the first version of the participant information sheet, in the section, 'what is this research about' I discussed the risks of obesity and the health problems that can occur from it. One of my work colleagues suggested that adults with obesity would be unlikely to

[11] Although there is not a definitive number to determine how many participants should be recruited in phenomenological research, there are recommendations that it should involve between 5 and 25 participants (Polkinghorne, 1989; Creswell and Poth, 2016). The whole premise of the phenomenological method is capturing as rich a narrative as possible; this negates the need for larger sample sizes.

want to talk to me with this section on the participant information sheet. This is because it could imply judgement and blame since it had a big component in individual health practices, which could be related to high numbers of deaths and LTCs. Also, I was still using a lot of research jargon (e.g. 'multiple factors', 'individual and environmental influences', 'behaviours'), which required high literacy and health literacy skills. This person suggested that I could also consider running the document through a reading age check online and try to get it down to reading age 11 at least (e.g. reading age is 8 in Portsmouth). All these aspects prevented me from succeeding in recruiting people; therefore, an amendment was required.

Other difficulties were related to the impact of the COVID-19 pandemic. The lockdown started when the proposal was sent to the ethics committee. Thus, the reviewers highlighted the need to amend the data collection procedure (it was supposed to be face-to-face in the first instance) unless I wanted to wait until the situation improved. At that point, the University of Southampton was in the process of developing guidelines for conducting online research and all researchers were asked to follow those guidelines recommendations (Research Integrity and Governance Team, 2020). Some reflections were done about the following:

- What remote means will I use to collect and record data?

For example, the guidelines recommended using Microsoft Teams to conduct videoconference interviews and criticised using other well-known digital platforms. In this regard, they highlighted that Zoom's data security and privacy measures are very poor. Furthermore, it has had security flaws in the past, including personal harvesting data for advertising and allowing the hijack of shared screens. This was the main reason for choosing Microsoft Teams compared with other digital platforms. Also, these guidelines reflected the security of individuals doing interviews at home; for example, by asking if interaction could alter the level of risk to participants, above all, those more vulnerable. For instance, it could be challenging to identify if participants need a break or are distressed/upset when undertaking interviews remotely. This was addressed in a debriefing statement, and some actions were highlighted in the participant information sheet. Also, they asked about considering if there could be risks related to where participants are located for the interview (e.g. being overheard by other household members or capturing voices from someone else in the background). In this sense, participants were advised to answer the questions in a quiet place (if possible) to ensure confidentiality.

- Obtaining informed consent?

Following the guidelines' recommendations, I sent the consent via SafeSend (explained before in the 'data collection procedures' section). Then, I asked the participants to fill it in (including

signing), scan it, and return it to me in an electronic format using SafeSend. If they did not have a scan/printer to insert their signature, they could complete the consent electronically (by typing in their responses and full name) and return it via SafeSend. Then, I inserted my signature and returned a copy to the participant. It is important to highlight that the exclusive use of electronic consent forms was allowed by the University of Southampton due to the coronavirus lockdown and, therefore, there are no hard copies of consent forms.

- How will I advertise my study and recruit study participants?; How will I distribute the study documents (e.g. participant information sheet)?

Everything was done online (explained in the 'data collection procedures' section). At this point, I learned the need to contact and ask for gatekeepers' permission (sending gatekeepers' letters and gatekeepers' consent forms) to access members of community groups and online groups (e.g. Facebook group administrators) and the need to ask for permission to put a research advertising poster in a public building.

If there was something that I would have changed, it was the fact that I did not involve Patient and Public Involvement (PPI) in the design of the participant information sheet and all the documents that participants would read. That would have facilitated things, saved time and potentially supported the recruitment process.

**Conclusion of chapter 3**

This chapter has covered the methodology used in this thesis. It started by exploring the reasons for utilising a critical interpretative synthesis as a review method. Next, the section continued by reflecting on the epistemological perspective and showing the qualitative study's design. Then, participants, settings and data collection procedures (including data access and protection) were detailed. After that, two different types of thematic analysis were explained as the data analysis methods of the qualitative study, followed by the notions used to assure the quality of data and the data analysis process. Finally, the chapter introduced the main difficulties faced during the ethical process and reflected on overcoming the barriers and learning for the future. The following three chapters represent the three articles created for this thesis and are presented in the order in which they were written.

# Chapter 4 Social network influences and the adoption of obesity-related behaviours in adults: a critical interpretative synthesis review

This chapter is the first article of this PhD. This is a critical interpretative synthesis review that shows the development of theory on different processes by which social networks impact the adoption of positive and negative lifestyles related to obesity. Therefore, this chapter is connected to the specific objective a).

## 4.1 Background

Obesity is a leading public health challenge in developed and developing countries. It has reached epidemic proportions globally, with at least 2.8 million people dying each year as a result of being affected by overweight or obesity (WHO, 2022a) and represents a key risk factor of developing long-term conditions (Wang *et al.*, 2011). The estimated prevalence of individuals with obesity has increased from 921 million in 1980 to 2.1 billion in 2013 (Ng *et al.*, 2014). In 2016, 39% of adults aged 18 years and over had overweight and 13% obesity (WHO, 2022a). There are variations in obesity incidence between countries with higher levels estimated in the UK and the United States of America (USA) (38.2% of adults in the USA (OECD, 2017) and 24.8% in the UK (Health and Social Care Information Centre, Lifestyle Statistics, 2013). The rise in incidence (three-fold over thirty years) has led to an increase in health services expenditure. For example, in the NHS the costs of treating overweight and obesity have increased from £479.3 million in 1998 to £4.2 billion in 2007 (Foresight, 2007). In relation to LTCs in the UK, 70% of total health costs account for this health issue (Nightingale, 2015).

A number of interventions have been designed to address obesity and overweight prevalence with the most common of these targeting ORBs, specifically, unhealthy food and drink choices (including alcohol), eating larger than average portions of food and a lack of physical activity (NHS, 2019b; NICE, 2019; Office for Health Improvement and Disparities (UK), 2022). However, a substantial number of individuals fail to adhere sustainably to these weight loss actions (Lemstra *et al.*, 2016) suggesting that new approaches need to be considered to assist individuals to engage in healthy behaviours and practices in support of long-term weight loss. These approaches might usefully incorporate an understanding of the complex social and contextual influences of obesity (Foresight, 2007; Millar *et al.*, 2011; Jebb, Aveyard and Hawkes, 2013). Possible influences include

food production, food consumption, societal influences, individual psychology and activities, activity environment and the linkages between them.

Social relationships are considered to be relevant mediators operating in open systems of a tangled and complex set of events, contexts, resources, practices, and priorities (Rogers *et al.*, 2011). The networks of people assist in the identification of the nuanced ways in which the management of health-related practices can be integrated into open systems. Thus, people in contemporary society are mutually dependent upon one another, and relationships and connections in personal communities have considerable potential positive and negative influences on individual's behaviours. For example, snacking habits might be shared by socially connected individuals across friends, spouses and sibling peers supporting evidence of collective behavioural process impacting on eating practices (Pachucki, Jacques and Christakis, 2011). Social relationships can also influence health positively, bringing into play 'protective' effects. For example, in terms of physical activity, adolescent girls who have more physically active friends report higher activity levels themselves (Voorhees *et al.*, 2005). Koetsenruijter *et al.* (2015) indicate that larger support relationships show a positive association with self-management skills in patients with diabetes, and therefore logically this applies to people with ORBs. An in-depth understanding of these relations might be useful from which to consider the design of interventions and approaches to improving ORBs, health outcomes and associated reducing in the costs of health service utilisation. Thus, to study these potentially meaningful relationships, a network approach (Brandes *et al.*, 2013) that provides the epistemological, ontological and methodological perspective from which to understand social networks (a set of people linked to one another by specific relationships) can be applied (Kadushin, 2012). Four dimensions of social networks are of relevance here -structure, function, strength and content (Perry, Pescosolido and Borgatti, 2018). The first of these considers the structural aspect of networks, including the patterns of linkages between actors (Perry, Pescosolido and Borgatti, 2018). Network function determines the type of exchanges, services, or supports accessible through relationships (Perry, Pescosolido and Borgatti, 2018) whilst network strength describes the intensity and durability of ties between individuals within the network (Marsden and Campbell, 1984). Network content refers to attitudes, emotions and behaviours flowing between network members (Emirbayer and Goodwin, 1994). Thus, network effects (e.g. health outcomes) are a function of interactions between these four dimensions (Perry, Pescosolido and Borgatti, 2018).

There has been conceptual and empirical attention paid to the impact of social networks on health (Smith and Christakis, 2008; Mackenbach *et al.*, 2016). Specifically, in terms of social networks and obesity, most of the research has focused on exploring spread, − differentiating relevant processes such as social selection, social influence and confounding effects (using mainly

quantitative approaches (Zhang *et al.*, 2018). Other authors have studied how social networks and social norms for unhealthy eating and inactivity might be associated with obesity treatments outcomes in adults (Leahey *et al.*, 2015). Nevertheless, few network-mediated interventions have been developed to address obesity specifically. Currently, the most relevant are targeting influential individuals to spread healthy information and behaviours through interpersonal ties (Kim *et al.*, 2015; de la Haye *et al.*, 2019) and creating opportunities for health-supportive relationships to be maintained (Gesell, Bess and Barkin, 2012; de la Haye *et al.*, 2019; Vassilev *et al.*, 2019). In building this nascent network focus in the field, it is necessary to unpack more of the mechanisms by which social networks influence obesity with a view to developing network-based obesity interventions that alter, nurture or harness these mechanisms (Valente, 2012). In order to understand how social networks affect ORBs, environmental-difference effects need to be considered (Kozlowski and Klein, 2000) and understood as operating at multiple levels (Bronfenbrenner, 1979; Brug *et al.*, 2008). A multilevel network perspective identifies principles that enable a more integrated understanding of phenomena that unfold within and across levels (Kozlowski and Klein, 2000; Lomi, Robins and Tranmer, 2016). Therefore, the identification, classification and integration of all these factors at different levels might develop pathways in which they are dynamically related in order to influence the adoption of positive and negative ORBs in adults and have the basis to create public health-policy relevant interventions.

The specific gap regarding what and how network properties and processes together with other factors produce positive and adverse health outcomes in adults with ORBs has been addressed to a limited extent previously (Latkin and Knowlton, 2015; Perkins, Subramanian and Christakis, 2015; Valente and Pitts, 2017). However, there is a specific need to focus on both positive and negative results (Labianca and Brass, 2006; Huitsing *et al.*, 2012) and for multilevel approaches to be bridged to create an integrated theory, specifying relationships between phenomena. Thus, this review aims to understand what and how social network properties and processes together with environmental-difference effects influence the adoption of healthy and unhealthy ORBs in adults.

## 4.2 Methods

The complexity that surrounds the understanding of how social networks influence the adoption of ORBs requires the synthesis and interpretation of many types of different research evidence. Thus, it was decided to use a CIS as a review method since it involves induction and interpretation of qualitative, quantitative and mixed-method data, and is primarily conceptual in process and outcome (Dixon-Woods, Cavers, *et al.*, 2006). Mathematical and quantitative research powerfully describes the structure of networks and documents whether their effects are significant or not, in

a statistical and theoretical sense (Perry, Pescosolido and Borgatti, 2018). The qualitative research presents the processes of network process and functioning, that is to say, how these networks are created (Perry, Pescosolido and Borgatti, 2018) and what resources are transferred between them within a specific context (Kadushin, 2012).

The induction and interpretation of these data is contrary to the conventional systematic reviews which are developed as a specific methodology for assembling, pooling and summarising data (Dixon-Woods, Cavers, *et al.*, 2006). Thus, this CIS aimed to generate concepts and theory where those concepts could be integrated and interpreted rather than summarising data per se. Another advantage for our research interests is that a CIS also has flexibility and is convenient in terms of appraising quality, using relevance (e.g. likely contribution to theory development) rather than methodological characteristics as a means of determining the 'quality' of individual papers (Flemming, 2010). In comparison with other methods of interpretative synthesis (e.g. meta-ethnography or grounded theory), a CIS does not only use qualitative research and, also, is distinct in its 'explicit orientation' towards theory generation (Barnett-Page and Thomas, 2009), following an analysis process of different phases for the interpretation and integration of the data and, therefore, providing a more insightful way of understanding a phenomenon. The generation of a more detailed and higher-order structured theoretical framework might be useful to identify potential healthy and unhealthy scenarios.

### 4.2.1 Search strategy

The search strategy was built around several bibliographic databases: CINAHL, Cochrane, EMBASE, Ovid, PsycINFO, Pubmed, Sociological Abstracts and Web of Science. To avoid the risk of missing relevant information, other strategies have been used to fit better with the exploratory nature of the aim (Dixon-Woods, Cavers, *et al.*, 2006). This includes hand searches (between 2000 and 2017) of some key journals (e.g. *Obesity, Obesity Reviews, The Annual Review of Public Health, The Annual Review of Sociology and Behavioural Medicine*). The publication of relevant articles regarding social networks and obesity and social networks and health in these journals motivated the undertaking of specific hand searching (Smith and Christakis, 2008; Valente, 2012; Latkin and Knowlton, 2015; Leahey *et al.*, 2015; Shakya, Christakis and Fowler, 2015; Zhang *et al.*, 2018). The time interval chosen was the year 2000 as there are relevant seminal papers from this date. The authors applied a citation snowballing technique to generate lists of related articles regarding the aim. Finally, specific websites were searched to identify epidemiological information related to obesity and overweight worldwide with a specific focus to the UK context, causes, prevention, obesity-related problems, relationship to prevention and management of LTCs, its economic impact on health systems and research institutions that are interested in social networks and

obesity. These websites are *Public Health England, The Global Obesity Prevention Center in Johns Hopkins Bloomberg School of Public Health, The National Institute for Health and Care Excellence, Yale Institute for Network Science* and *World Health Organization*.

### 4.2.2 Key terms

Four main terms were developed to cover the key elements of the aim of this review: obesity, long-term conditions, social networks and health behaviours (see Table 1). Diabetes-related terms were included in the list of terms connected with LTCs. The reason for this was that several articles regarding how social networks influence diabetes were found and that diabetes and obesity have several health behaviours in common, such as diet and physical activity. Also, other terms pertaining to obesity were considered but omitted finally in the search strategy, such as 'body fat', 'adiposity', 'body weight', 'energy intake', 'caloric intake' or 'nutrition'. This was because the focus was more on a sociological approach rather than a biomedical one. A combination of 'all field' search terms of each facet was undertaken to avoid missing relevant information. Truncations, acronyms and the booleans OR and AND were applied to combine terms within each column and between columns from Table 1.

Table 1. Search strategy: key terms.

| **Obesity** | **Long-term conditions** | **Social networks** | **Health behaviours** |
|---|---|---|---|
| Obese | Chronic illness* | Networks | Diet |
| Obesity | Chronic disease* | Network intervention* | Exercise |
| Overweight | Chronic condition* | Peer* | Food choice |
| | T2DM | Peer support | Health behav* |
| | DM | Social embeddedness | Health behav* change |
| | DM2 | Social influence* | Health behav* intervention |
| | Diabetes | Social network* | Physical activity |
| | Diabetic | Social relationship* | Weight loss |
| | Long-term condition* | Social support | |
| | LTC | | |
| | Type 2 diabet* | | |

### 4.2.3 Screening

Limits were used to search the online databases: articles published in English and Spanish languages, the year of publication (between 2000 and 2017) and age groups (all adults and 19

plus years). The inclusion criteria set initially were: (i) empirical studies (qualitative, quantitative and mixed-methods) exploring the influence of relationships on the adoption of ORBs; (ii) review studies and grey literature (policy/organizational documents, conferences, abstracts). The exclusion criteria were: (i) papers that did not mention terms related to 'relationships', 'social networks' and 'ties' in the title or abstract; (ii) articles focused on LTCs in which ORBs were not mentioned. Eligibility of the papers was performed analysing titles and abstracts. Full papers were retrieved for independent assessment when the title and abstract appeared to meet all inclusion criteria, or when suitability could not be judged by title and abstract.

#### 4.2.4 Quality assessment and data extraction

The integration of relevance and rigour was essential in the selection of articles. 'Rigour' proposes that literature needs methodological credibility to address the main aim (Lincoln and Guba, 2005). (Dixon-Woods, Cavers, *et al.* (2006) recommendations were followed to ensure quality assessment of the studies vis:

1. Are the aims and objectives of the research clearly stated?
2. Is the research design clearly specified and appropriate for the aims and objectives of the research?
3. Do the researchers provide a clear account of the process by which their findings were reproduced?
4. Do the researchers display enough data to support their interpretations and conclusions?
5. Is the method of analysis appropriate and adequately explicated?

Standardized data extraction templates were created to represent and make more visible data from the qualitative, mixed-methods and quantitative studies (see Table 2). They included information regarding paper reference and setting, Dixon-Woods, Cavers *et al.* (2006) appraisal prompts, methodological strengths, focus (aim) and main findings related to our research interests to illustrate the process followed.

Table 2. Extraction form.

| | | **Dixon-Woods, Cavers *et al.* (2006) appraisal prompts for informing judgments about quality** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of evidence** | **Paper reference and setting** | **1** | **2** | **3** | **4** | **5** | **Relevance/ Rigour** | **Study design** | **Methodological strengths** | **Focus** | **Effects networks** | **Processes** | **Factors** | **Types of links** | **Parameters** |
| Qualitative | (Alvarado, Murphy and Guell, 2015). Barbados (USA) | Y | Y | Y | Y | Y | Yes/yes | Descriptive study, semi-structured interviews | Well-described participants, provides quotes that reflect the results. | Women between 25-35 years, BMI equal or greater 25, not pregnant. | +/- | Social support, homophily, social modelling, diffusion, social comparison, social pressure, natural communication | Socio-cultural, psychosocial, technological, sociodemographic, environmental | Sport contacts, family, friends | |
| | (Kennedy *et al.*, 2015). Bulgaria, Greece, the Netherlands, Norway, Spain and UK | Y | Y | Y | Y | Y | Yes/Yes | Qualitative study, biographical interviews. | Well-described aims, sampling and recruitment and provides quotes that reflect the results | Individuals with T2DM in deprived or marginalized circumstances | +/- | Social support, social pressure, homophily | Socio-cultural, psychosocial, environmental | Healthcare professionals, community, family, friends | |
| | (Forthofer *et al.*, 2016). South Carolina (USA) | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, focus groups | Well-described sample and analysis | Population older than 18 years old. | + | Social support, social modelling, social pressure, diffusion | Environmental, socio-cultural, psychosocial | Family, community | Tie strength |

| | | **Dixon-Woods, Cavers *et al.* (2006) appraisal prompts for informing judgments about quality** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of evidence** | **Paper reference and setting** | **1** | **2** | **3** | **4** | **5** | **Relevance/ Rigour** | **Study design** | **Methodological strengths** | **Focus** | **Effects networks** | **Processes** | **Factors** | **Types of links** | **Parameters** |
| | (Knutsen *et al.*, 2017). Bulgaria, Greece, Norway, Spain and UK | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, semi-structured interviews | Well-described methods, provides quotes that reflect the results | Individuals with T2DM, areas high deprivation | +/- | Social support, social pressure, isolation | Socio-cultural, sociodemographic | Family, friends, community | |
| | (Ali, Baynouna and Bernsen, 2010). United Arab Emirates | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, focus groups | Well-described data collection, theoretical saturation, provides quotes that reflect the results | Women, 18 years old and older with no previous diabetes + abdominal obesity | +/- | Homophily | Psychosocial, socio-cultural, clinical, environmental | Healthcare professionals, Housekeeping | |
| | (Mama *et al.*, 2015). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, in - depth interviews | Theoretical saturation, provides quotes that reflect the results | Women middle-aged, obese, high socioeconomic status | - | Social pressure, social modelling, social support, homophily | Psychosocial, socio-cultural, environmental, sociodemographic | Neighbours, family | |
| | (Robertson, Mullan and Todd, 2014). Australia | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, semi-structured interviews and focus groups | Theoretical saturation, provides quotes that reflect the results | Overweight adults | +/- | Social pressure, social comparison, social support | Psychosocial, sociodemographic, socio-cultural | Friends, family | |

| | | **Dixon-Woods, Cavers *et al.* (2006) appraisal prompts for informing judgments about quality** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of evidence** | **Paper reference and setting** | **1** | **2** | **3** | **4** | **5** | **Relevance/ Rigour** | **Study design** | **Methodological strengths** | **Focus** | **Effects networks** | **Processes** | **Factors** | **Types of links** | **Parameters** |
| | (Sriram *et al.*, 2018). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, focus groups | Provides quotes that reflect the results | Midlife and older adults | +/- | Social support, comparison, isolation, social pressure, modelling, diffusion | Socio-cultural, environmental, sociodemographic, psychosocial | Family, friends, community, pets | |
| | (Daborn, Dibsall and Lambert, 2005). UK | Y | Y | Y | N | Y | Yes/Yes | Descriptive study, face to face in-depth interviews | Well-defined methods, provides quotes that reflect the results | Middle-aged low-income men | + | Social comparison, social support. | Psychosocial, socio-cultural, environmental, sociodemographic | Family | |
| | (Bell *et al.*, 2017). New Zealand | Y | Y | Y | N | Y | Yes/Yes | Descriptive study, semi-structured interviews | Provides quotes that reflect the results | Indigenous adults | + | Social support | Socio-cultural | Family | |
| Mixed-methods | (Procter *et al.*, 2014). UK | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, exploratory randomised controlled trial and semi-structured interviews | Well-defined methods, provides quotes that reflect the results | Adults employees | +/- | Social support, diffusion, natural communication, social pressure | Sociodemographic, psychosocial, socio-cultural | Healthcare professionals, community | |

| | | **Dixon-Woods, Cavers *et al.* (2006) appraisal prompts for informing judgments about quality** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of evidence** | **Paper reference and setting** | **1** | **2** | **3** | **4** | **5** | **Relevance/ Rigour** | **Study design** | **Methodological strengths** | **Focus** | **Effects networks** | **Processes** | **Factors** | **Types of links** | **Parameters** |
| | (Vassilev *et al.*, 2016). Greece, Spain, Bulgaria, Norway, UK and Netherlands | Y | Y | Y | N | Y | Yes/Yes | Cross-sectional observational study and interviews | Well-defined methods and analysis | Adult patients with T2DM | +/- | | Sociodemographic, psychosocial | Healthcare professionals | |
| | (Koetsenruijter *et al.*, 2015). Bulgaria, Greece, Netherlands, Norway, Spain and UK. | Y | Y | Y | Y | Y | Yes/Yes | Observational study interviews and questionnaires | Well-described methods and analysis | Patients with T2DM | + | Social support | Sociodemographic | Family, community organizations | |
| Quantitative | (O'Malley *et al.*, 2012). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, network survey | Well-defined methods | Adults | + | | | Friends | Tie strength, degree |
| | (Conklin *et al.*, 2014). UK | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, questionnaires | Well-described sample and analysis | Adults from the European Prospective Investigation of Cancer | +/- | Social support, isolation, | Sociodemographic | Family | Tie strength |

| | | **Dixon-Woods, Cavers *et al.* (2006) appraisal prompts for informing judgments about quality** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of evidence** | **Paper reference and setting** | **1** | **2** | **3** | **4** | **5** | **Relevance/ Rigour** | **Study design** | **Methodological strengths** | **Focus** | **Effects networks** | **Processes** | **Factors** | **Types of links** | **Parameters** |
| | (Mötteli, Siegrist and Keller, 2017). Switzerland | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, cross-sectional study (egocentric network approach) | Well-described aims and well-defined methods | Female adults | +/- | Homophily, social pressure. | Socio-cultural | Family | Tie strength |
| | (Barclay, Edling and Rydgren, 2013). Sweden | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, logistic regressions using egocentric network data | Well-defined methods and analysis, well-described aims | Adults | + | Homophily | | Friends | Tie strength |
| | (Winston *et al.*, 2015). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, cross-sectional examination of egocentric network data | Well-described analysis | Black Hispanic adults with BMI more or equal 25 | + | Social support | | Family, co-workers | Size of the network, tie strength |
| | (Becofsky *et al.*, 2015). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, questionnaires | Well-described methods | Adult patients | + | Social support | | Family, friends | Size of network |

| | | **Dixon-Woods, Cavers *et al.* (2006) appraisal prompts for informing judgments about quality** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of evidence** | **Paper reference and setting** | **1** | **2** | **3** | **4** | **5** | **Relevance/ Rigour** | **Study design** | **Methodological strengths** | **Focus** | **Effects networks** | **Processes** | **Factors** | **Types of links** | **Parameters** |
| | (Shakya, Christakis and Fowler, 2015). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, longitudinal survey | Well-described statistical analysis | Adults | +/- | Social comparison | Socio-cultural, psychosocial | | |
| | (Rancourt *et al.*, 2015). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, ecological assessment | Well-defined methods | Overweight young adult women | + | Social comparison | | Friends | |
| | (Leahey *et al.*, 2015). USA | Y | Y | Y | Y | Y | Yes/Yes | Randomized trial | Well-defined methods and procedures | Adults with overweight or obesity | +/- | Homophily | Socio-cultural | Family | Tie strength, size of network |
| | (Hempler, Joensen and Willaing, 2016). Denmark | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, cross-sectional surveys | Well-described analysis | Individuals T1DM, T2DM | | | Clinical | | |
| | (Christakis and Fowler, 2007). USA | Y | Y | Y | Y | Y | Yes/Yes | Descriptive study, longitudinal social network analysis | Well-described analysis | Adults | +/- | Homophily | Sociodemographic | Friends | Degree of separation, social distance |

### 4.2.5 Synthesis, analysis and data extraction

The lack of an existing holistic theoretical framework of how social networks influence the adoption of ORBs motivated the selection of lines-of-argument synthesis (LOA) as the analysis strategy. It implicates building a general interpretation grounded in the findings of separate studies identified by constant comparison between individual accounts and grouped in themes that are most powerful in representing the entire dataset (Dixon-Woods, Cavers, *et al.*, 2006). This consisted of coding inductively empirical data, specifically, sentences from the participants' quotes in the qualitative and mixed-methods papers and the text pertaining to the results, discussion and conclusions sections in the mixed-methods and quantitative studies (see Appendix G). A key aspect of the analysis consisted on the synthesis and integration of the qualitative, mixed-method and quantitative data. According to the type of integration, this review is a data-based convergent synthesis design (Hong *et al.*, 2017). This means that all the included studies are analysed using a specific method, in this case, a qualitative synthesis method (CIS review). Since only one synthesis method is used for all the empirical evidence, data transformation is involved (quantitative data are transformed into qualitative data using categories/themes). Thus, quantitative, mixed-methods and qualitative results are presented together to answer the same objectives (Roberts *et al.*, 2002; Hong *et al.*, 2017). These codes from the text and quotes from the qualitative, mixed-methods and quantitative articles (n = 277) represent the first-order constructs. The next step consisted of grouping these codes in wider categories, turning these into descriptive themes (Thomas and Harden, 2008). These data-driven themes or second-order constructs represent the original researcher's interpretations based on first-order constructs in order to describe the content of the empirical studies (Schütz, 1962). In this review, three data-driven themes were created.

As it is shown in the 'results' section, the varied combinations and integration between these drivers can explain and modify the different results in health. The information was integrated from the studies into a coherent theoretical framework comprising a group of constructs and the relationships between them (Dixon-Woods, Cavers, *et al.*, 2006) producing a synthesizing argument of how social networks and the context influence the adoption of ORBs in adults. Consequently, theory-driven or third-order constructs were created built on the explanations and interpretations of the studies (Dixon-Woods, Cavers, *et al.*, 2006) to determine new implications for the understanding more in-depth how social networks influence the adoption of obesity and the development of future social networks interventions applied to ORBs in adults. The authors involved in the review discussed and confirmed the themes between them and other members of

their research team as part of a process of reflexive dialogue against framing the analysis according to a single perspective.

## 4.3 Results

After all data searches were completed 28,289 citations were retrieved, of which 12,908 were duplicates. A further 15,198 records were excluded based on title and abstract. After applying the inclusion/exclusion criteria, 183 papers were identified for full screening. After 39 articles were excluded as irrelevant to the aim of the CIS, 144 papers were identified for eligibility (127 from database searching, 15 from manual searching and 2 from snowballing). Of the 144 studies screened, 106 were excluded after a full paper screening and 14 after theoretical saturation (Saunders *et al.*, 2018). Through the theoretical sampling, qualitative (n = 10), mixed-methods (n = 3) and quantitative studies (n = 11) were included and reviewed until theoretical saturation was achieved (Schreiber, Crooks and Stern, 1997; Dixon-Woods, Bonas, *et al.*, 2006; Portillo *et al.*, 2015; Lin and Melendez-Torres, 2017; McFerran *et al.*, 2017; Saunders *et al.*, 2018) (see Figure 4). Theoretical saturation is the point at which additional data does not lead to any emergent themes or concepts in the analysis (Birks and Mills, 2015; Given, 2015; Olshansky, 2015). It was relevant here as broad spectrum criteria for the inclusion and exclusion of identified relevant articles. In this review, theoretical saturation signalled the end of the identification of articles in which social relationships were related to the adoption of ORBs in adults. It needs to be highlighted that although grey literature was also reviewed, it was not included in the final analysis of review findings since it did not provide sufficient relevant information on the topic. Thus, 24 articles were theoretically rich enough and of central relevance to the aim.

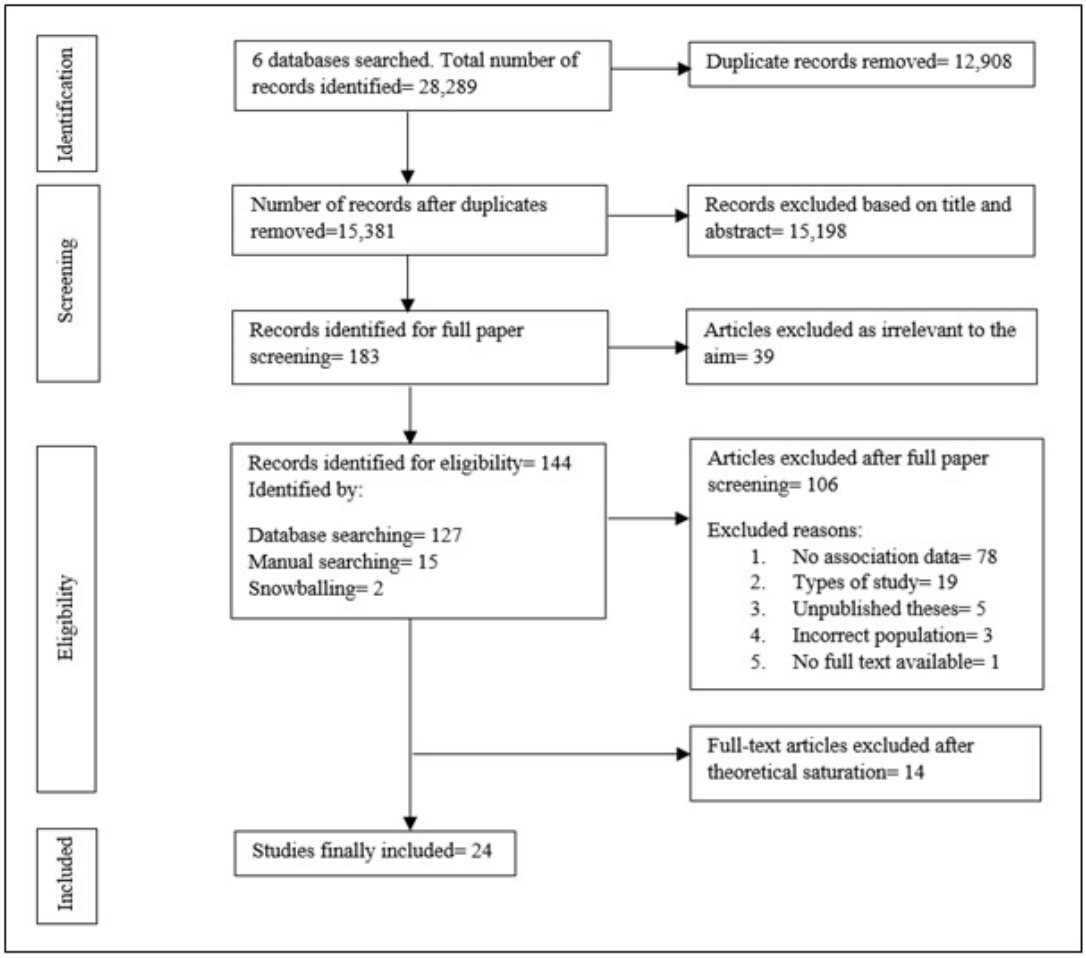


Figure 4. Diagram flow.

### 4.3.1 Data-driven themes

Three data-driven themes were developed from the reviewed literature: *meso-micro network processes for the adoption of ORBs, contextual and individual factors of ORBs, and types of ties and properties that influence the adoption of ORBs*.

The abstraction of the inductive concepts covered two levels of analysis. The following levels of analysis with their initial characteristics are adapted for this article based on relevant research of other authors (Bronfenbrenner, 1979; Taplin *et al.*, 2012; Portillo *et al.*, 2015, 2017; Rogers *et al.*, 2015; Bolíbar, 2016; Arias *et al.*, 2018):

- Meso-level: describing relationships with healthcare professionals and other individuals from the community or locality (neighbourhood, suburb, city).
- Micro-level: examining a person's closest social circle-peers (family, friends, co-workers, pets) and individual characteristics (biological, psychological and personal history factors).

#### 4.3.1.1 Meso-micro network processes for the adoption of obesity-related behaviours

Network processes are responsible for tie formation and outcomes (Bellotti, 2014) located within a social context that shapes practices, behaviours and the roles and functions that networked individuals achieve (Kennedy *et al.*, 2015). These network processes are classified into the different levels of analysis according to the nature of and involvement of ties participating in the relationships.

The reviewed papers identified network processes at the meso and micro-levels of analysis. Regarding the meso-level, the most relevant processes were *social support* (Procter *et al.*, 2014; Alvarado, Murphy and Guell, 2015; Kennedy *et al.*, 2015; Knutsen *et al.*, 2017; Sriram *et al.*, 2018) (Table 3, Q1 and Q2) and *social pressure* (Procter *et al.*, 2014; Alvarado, Murphy and Guell, 2015; Forthofer *et al.*, 2016; Knutsen *et al.*, 2017; Sriram *et al.*, 2018) found in 5 articles which have both positive (Table 3, Q3) and negative effects on health. For example, in terms of positive effects, a conversation in the streets with a friend from the gym might exert positive social pressure and increase the motivation to exercise (Alvarado, Murphy and Guell, 2015). With regard to negative effects, individuals with specific cultural norms might, for instance, influence the quality and amount of food intake (Table 3, Q4). Another relevant network process is *homophily* (Christakis and Fowler, 2007; Ali, Baynouna and Bernsen, 2010; Alvarado, Murphy and Guell, 2015; Kennedy *et al.*, 2015), the tendency of pairs of individuals to share the same characteristics (Kadushin, 2012), described as a positive network process to exercise -e.g. when individuals share the same gender (T1 in Table 3). The *diffusion* of new health information is also linked to positive effects on the adoption of ORBs (see Q6 in Table 3).

Table 3. Data-Driven Themes abstracted from quotes and text of the articles.

| **Data-Driven Themes** | **Quotes and Text From Findings** |
|---|---|
| Meso-micro network processes | Q1(+). "Several participants suggested external health promoters could provide additional encouragement: 'Somebody coming in from outside, say doing half an hour at lunchtime just doing a presentation about it or, you know, longer and getting people there and talking about that and saying 'and we have our in-house person who you know if you want to talk to him, d'you wanna get encouragement from him/her' that would be great but I think somebody coming in from outside actually would be a good idea." (Procter *et al.*, 2014)<br>Q2(+). "That's why I think the group would be kind of cool to get together with… to get together as a group and just share some ideas ..." (Sriram *et al.*, 2018)<br>T1(+). "During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups." (Alvarado, Murphy and Guell, 2015)<br>Q3(+). "I probably would pass somebody from my gym somewhere on the streets [… It's] motivational in the sense that if you don't go […to the gym] and pass a girl that I haven't seen in a while 'hey why I don't see you in the gym? What's going on with you?' and I guess guilt people into coming back. So yeah it's motivation." (Alvarado, Murphy and Guell, 2015)<br>Q4(-). "However, if I go back to the village where my husband comes from, they are country people and they love to bake, cook and it's lovely. It's gorgeous and because they know you're coming for afternoon tea, they'll have made you the apple pie and they'll have made you the cakes and if you went in there and tried to start explaining that you don't eat any of that… In that sort of culture, it just would not be understood, and also you're interfering with the social norms and you don't want to do that." (Knutsen *et al.*, 2017)<br>T2(+). "WhatsApp groups comprised of women in the same exercise class could make this social pressure and social support even stronger." (Alvarado, Murphy and Guell, 2015)<br>Q5(+). "We have people in my neighbourhood that you can be leaving out at five in the morning, and they're walking. You can come in at six in the afternoon and there's another group walking…We have a monthly HOA [homeowners association] meeting— and sometimes in those meetings people just go, "Hey, I saw you walking. Can I join your group?" (Mama *et al.*, 2015) |

| Data-Driven Themes | Quotes and Text From Findings |
|---|---|
| | Q6(+). "Overall the promoters found their booklet 'was well set out' and helped them approach participants: 'It was informative and useful and helped me set out what I needed to do, promote walking to work to the colleagues, and how to approach them and stuff, I thought it was quite good." (Procter *et al.*, 2014)<br>T3(+). "In contrast, having tight social networks was viewed as beneficial if friends were "health-conscious" and acted as positive role models." (Sriram *et al.*, 2018)<br>T4(+). "In the case of body size, a descriptive norms effect can work through direct comparison so that a person compares himself to others in his social reference group and makes decisions regarding his own status according to that metric." (Shakya, Christakis and Fowler, 2015)<br>Q7(+). "My husband insists that I shouldn't eat large quantities or any starchy food. My mum always scolds me, but this doesn't help; she just gets on my nerves. As soon as she sees me eating even the smallest amount of sweets, she'll start complaining. I can't say my daughters are indifferent. They'll remark when I overeat something. Everyone is focused on my diet." (Knutsen *et al.*, 2017)<br>T5(-). "Social events involving food were areas where maintaining normal social ties were often more important than attempting to force attention on dietary needs." (Kennedy *et al.*, 2015)<br>Q8(+). "I used to eat a lot of vegetables when I was at home, cause my wife was an extremely good cook, so we ate really well, I don't mean gluttony I mean just healthy food." (Daborn, Dibsall and Lambert, 2005)<br>Q9(+). "We are trying to exercise together, all of us… We aim to create a large group and include family and kids and socialize very often, so it becomes a big group and better habits." (Kennedy *et al.*, 2015)<br>T6(+). "More precisely, women and their most important eating companions tended to be similar in diet-related factors such as diet quality and eating styles as well as in BMI." (Mötteli, Siegrist and Keller, 2017)<br>Q10(+). "…found myself you know doing the walking home without having written it down and you know having told several people – I mean telling people that that's what you're doing actually makes you hold to it even more than if you, if I'd written it down." (Procter *et al.*, 2014)<br>T7(-). "Several elderly women also discussed the negative consequences of living alone on their diets. Without family members around, eating decisions were primarily based on convenience and several participants reported having no incentive to make dietary improvements at their advanced age." (Sriram *et al.*, 2018) |

| Data-Driven Themes | Quotes and Text From Findings |
|---|---|
| Contextual and individual factors | Q11(-). “Close to my house, there are no sidewalks. And I feel like I don’t want to get in the car and drive somewhere and get out and walk and get back in the car… I used to walk a lot, but I lived somewhere else so it made it very simple.” (Forthofer *et al.*, 2016)<br>Q12(+). “I’m looking for more, all the time… I’m getting ideas at the moment because when I go to the sports centre they’ve got loads of activities for older people like me and other illnesses, not just diabetes, they cover everything there.” (Kennedy *et al.*, 2015)<br>Q13(-). ‘‘When the weather is cold I walk, but it is difficult to walk in summer.’’ (Ali, Baynouna and Bernsen, 2010)<br>T8(+). “Participants described food-centric social events as a primary constraint to eating well. Limited entertainment options in these rural communities meant that most activities involved getting together for a snack or meal. Food provision was regarded as a sign of “hospitality” and people felt obligated to eat whatever was offered in social settings (e.g. church, senior centers).” (Sriram *et al.*, 2018)<br>Q14(-). “Walking is not culturally acceptable. My husband will not allow me to walk in the street but if it is a closed place [gym] he has no problem.” (Ali, Baynouna and Bernsen, 2010)<br>Q15(+). “Going to the gym the motivation is, well obviously it would be generally to lose weight, but going by the gym is relatively small so you know everybody that is there so it’s kind of a family type atmosphere.” (Alvarado, Murphy and Guell, 2015)<br>Q16(+). “My grandmother… when I was 13… I was the sole witness to her coronary occlusion which killed her on the spot and I never quite dealt with that so it has left me with a bit of a fear of heart disease and heart problems and seeing how violently they can end your life.” (Daborn, Dibsall and Lambert, 2005)<br>Q17(+). “There is some type of apprehension in the back of my mind, and I’m trying to figure out why, but I really need to say, “Go ahead, start doing it.” I guess I feel that if I start, I’m going to have to continue. It’s going to change my routine. [And that] Moves me out of my comfort zone.” (Mama *et al.*, 2015)<br>Q18(-). “I have the control to change things I just don’t change them, and I don’t know why. It’s ridiculous.” (Robertson, Mullan and Todd, 2014)<br>Q19(-). “The food we eat is not healthy because of the way we cook it and because we do not know enough about healthy food.” (Ali, Baynouna and Bernsen, 2010)<br>Q20(-). “I think people [study participants] have the intentions of walking … but, because their character is, just they don’t know how to live without the car.” (Procter *et al.*, 2014) |

| Data-Driven Themes | Quotes and Text From Findings |
|---|---|
| | T9(-). "During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p's<.023)." (Leahey *et al.*, 2015)<br>Q21(-). "I look after my husband, the house, everything. I don't look after myself as much as I used to. In the past, I would cook something for myself and something for the others to eat… I have to cook meals that my children and grandchildren like because my daughter works, and so I eat from these as well, so I don't miss out." (Knutsen *et al.*, 2017)<br>T10(-). "This man emphasizes the need to occasionally not adhere to the diet, especially at parties and when with friends." (Knutsen *et al.*, 2017)<br>Q22(-). "Without the help of my children, I wouldn't be able to cope. My pension is 140 leva—[not enough] for following a diet and buying drugs." (Knutsen *et al.*, 2017)<br>Q23(-). "I worked as […] a cashier at a supermarket until 2009 and you know a cashier sits down ain't much activity in that and then in 2009 to 2011 I did secretarial work – so that's even worse but then […] I got this new job that I totally love cause since I really can't get the exercise that I want to put in…" (Alvarado, Murphy and Guell, 2015)<br>T11(+). "Specifically, people who reported good self-management skills were more likely to have a diverse network, to be older, to be in relatively good health, to have high levels of income and education, and to live in the wealthier of the six countries (Norway, UK, Netherlands, Spain). High levels of self-monitoring were also associated with high education and relatively good health." (Vassilev *et al.*, 2016)<br>T12(+). "In these small rural towns, social interaction appeared to be an important facilitator of active lifestyles, particularly for women. Organized group activities, such as walking, were viewed as an opportunity to socialize with friends and connect with the community. Building these networks increased enjoyment and gave people more incentive to engage in activity." (Sriram *et al.*, 2018)<br>Q24(-). "Sometimes the walk is be good you know exercise but if I have my car I wouldn't walk at all only when I don't have do I walk cause everything closer in town [Bridgetown] that ya could walk to instead of wasting the gas but as for out here [St. Philip]… the closest shop there … nah… now that is daytime no way! Ain't walking. Too hot!" (Alvarado, Murphy and Guell, 2015)<br>T11(+). "Specifically, people who reported good self-management skills were more likely to have a diverse network, to be older, to be in relatively good health, to have high levels of income and education, and to live in the wealthier of the six countries (Norway, UK, Netherlands, Spain). High levels of self-monitoring were also associated with high education and relatively good health." (Hempler, Joensen and Willaing, 2016) |

| Data-Driven Themes | Quotes and Text From Findings |
|---|---|
| | T13(-). “People with type 2 diabetes were less physically active, less likely to follow recommended diet (men), had fewer contacts with family and friends and were less certain of counting on help in case of severe illness than people with type 1 diabetes.” (Hempler, Joensen and Willaing, 2016) |
| Types of ties | Q3(+). “I probably would pass somebody from my gym somewhere on the streets [… It’s] motivational in the sense that if you don’t go […to the gym] and pass a girl that I haven’t seen in a while ‘hey why I don’t see you in the gym? What’s going on with you?’ and I guess guilt people into coming back. So yeah it’s motivation.” (Alvarado, Murphy and Guell, 2015)<br>T14(+). “In Bulgaria compared to elsewhere, health professionals’ advice was taken more seriously and sought more frequently.” (Kennedy *et al.*, 2015)<br>Q4(+). “We have people in my neighbourhood that you can be leaving out at five in the morning, and they’re walking. You can come in at six in the afternoon and there’s another group walking… We have a monthly HOA [homeowners association] meeting— and sometimes in those meetings people just go, “Hey, I saw you walking. Can I join your group?” (Mama *et al.*, 2015)<br>T15(+). “Attending community organizations was positively related to physical activity, however only for patients with a low income (OR = 1.53).” (Koetsenruijter *et al.*, 2015)<br>Q25(+). “…my health…[is] my family…My children and husband, and our whanau whanui (tribal family) … our wellbeing is whanau (family)…[when] someone else is not well in our family, that has an impact…on our health…I’m connected to those people and our children…the heavier we are collectively, the better off we are individually…” (Bell *et al.*, 2017)<br>Q26(-). “No, my family doesn’t help me. I am responsible for health issues at home… I ask them to support me a bit more, taking the cakes out of my sight, but they’re all tomboy-like and take little care of me. They don’t see a disease in my diabetes.” (Kennedy *et al.*, 2015)<br>T16(+). “Whether the target was a friend moderated these effects. When engaging in an upward comparison to a friend, participants had more thoughts of exercising compared to when the target of the upward comparison was not a friend (Y=1.03, P=0.031). When engaging in a downward comparison to a friend, participants also reported more thoughts of dieting (Y=2.68, P=0.006) and exercising (Y=2.13, P=0.024) as compared to when targets were nonfriends.” (Rancourt *et al.*, 2015)<br>T9(-). “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p’s<.023).” (Leahey *et al.*, 2015)<br>Q27(-). “Our weights increase because we have housemaids and we depend on them a lot.” (Ali, Baynouna and Bernsen, 2010) |

| Data-Driven Themes | Quotes and Text From Findings |
|---|---|
| | T17(+). “In a multivariable regression model, greater weight loss was associated with help from a child with eating goals (p=.0002) and co-worker help with physical activity (p=.01).” (Winston *et al.*, 2015)<br>T18(+). “For several participants, pets provided much needed companionship and reason to be active. Pets appeared to be especially important motivators of physical activity for elderly individuals living alone.” (Sriram *et al.*, 2018) |
| Properties of social networks | T19. “Lower frequencies of family contact were associated with lower fruit variety scores and rare/no contact was similarly negative for both genders. By contrast, decreasing family contact seemed to have limited association with vegetable variety in men whereas weekly contact had a 0.56 unit difference (p ¼ 0.001) in score in women compared with daily family contact.” (Conklin *et al.*, 2014)<br>T20. “The degree to which this behaviour is shared is modulated by the strength of the relationship between the two individuals, with a greater probability of engaging in these behaviours observed when the relationship with the nominated peer is strong relative to when the relationship is weak.” (Barclay, Edling and Rydgren, 2013)<br>T21. “Moreover, having more friends is associated with an improvement in health, while being healthy and prosocial is associated with closer relationships. Specifically, a unit increase in health is associated with an expected 0.45 percentage-point increase in average closeness, while adding a prosocial activity is associated with a 0.46 percentage-point increase in the closeness of one’s relationships.” (O’Malley *et al.*, 2012)<br>T22. “Participants reporting social contact with 6 or 7 friends on a weekly basis had a 24% lower mortality risk than those in contact with ≤ 1 friend (HR 0.76, 95% CI 0.58–0.98).” (Becofsky *et al.*, 2015)<br>T9. “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p’s<.023).” (Leahey *et al.*, 2015)<br>T23. “Whereas increasing social distance appeared to decrease the effect of an alter on an ego, increasing geographic distance did not. The obesity of the most geographically distant alters correlated as strongly with an ego’s obesity as did the obesity of the geographically closest alters. These results suggest that social distance plays a stronger role than geographic distance in the spread of behaviours or norms associated with obesity.” (Christakis and Fowler, 2007) |

The micro-level is represented more than the meso-level-mentioned in 20 articles (Daborn, Dibsall and Lambert, 2005; Christakis and Fowler, 2007; Ali, Baynouna and Bernsen, 2010; Conklin *et al.*, 2014; Procter *et al.*, 2014; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Becofsky *et al.*, 2015; Kennedy *et al.*, 2015; Koetsenruijter *et al.*, 2015; Leahey *et al.*, 2015; Mama *et al.*, 2015; Rancourt *et al.*, 2015; Shakya, Christakis and Fowler, 2015; Winston *et al.*, 2015; Forthofer *et al.*, 2016; Bell *et al.*, 2017; Knutsen *et al.*, 2017; Mötteli, Siegrist and Keller, 2017; Sriram *et al.*, 2018) with 12 articles identifying *social support* as an essential network process for the adoption of healthy practices (Daborn, Dibsall and Lambert, 2005; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Becofsky *et al.*, 2015; Kennedy *et al.*, 2015; Koetsenruijter *et al.*, 2015; Mama *et al.*, 2015; Winston *et al.*, 2015; Forthofer *et al.*, 2016; Bell *et al.*, 2017; Knutsen *et al.*, 2017; Sriram *et al.*, 2018). As *social support* is a broad concept, it was sub-divided. *Peer support* by family members was key to acquiring good dietary habits (Daborn, Dibsall and Lambert, 2005) (Table 3, Q8) and *group support* to performing physical activity (Kennedy *et al.*, 2015), as of Q9 in Table 3. *Homophily* (Mötteli, Siegrist and Keller, 2017) (Table 3, T6) and *social comparison* (Shakya, Christakis and Fowler, 2015) with families and friends also representing positive processes for the adoption of healthy ORBs in adults. For instance, as shown in T4 in Table 3, individuals might make decisions about their own health whilst they are comparing their body size with others. The presence of negative effects on health included *isolation*, described as a high-risk factor of developing unhealthy behaviours (Conklin *et al.*, 2014; Knutsen *et al.*, 2017; Sriram *et al.*, 2018) and a variety of diet (Table 3, T7). The network facet of *social pressure* showed dual effects (Robertson, Mullan and Todd, 2014; Kennedy *et al.*, 2015; Mama *et al.*, 2015; Knutsen *et al.*, 2017; Mötteli, Siegrist and Keller, 2017). For example, a negative effect is when friends push the individual not to follow the diet in the context of a social event (Table 3, Q7 and T5). A positive effect is the pressure that the family exerts on the individual's diet (Table 3, Q7) or when a friend encourages the individual to exercise (Mama *et al.*, 2015). Finally, *natural communication* (Procter *et al.*, 2014; Alvarado, Murphy and Guell, 2015) and *social modelling* (Mama *et al.*, 2015; Forthofer *et al.*, 2016; Sriram *et al.*, 2018) were described in the reviewed literature in both levels of analysis as processes for the adoption of positive ORBs, as illustrated in T2, Q5, T3 and Q10 in Table 3.

#### 4.3.1.2 Contextual and individual factors for the adoption of obesity-related behaviours

In addition to *meso-micro network processes*, there is evidence that shows how other contextual and individual factors influence the adoption of ORBs in adults.

With regard to the meso-level, *environmental factors* described in 7 articles (Daborn, Dibsall and Lambert, 2005; Ali, Baynouna and Bernsen, 2010; Alvarado, Murphy and Guell, 2015; Kennedy *et*

*al.*, 2015; Mama *et al.*, 2015; Forthofer *et al.*, 2016; Sriram *et al.*, 2018) the lack of conducive built environments were considered to be the main barriers to exercise (Table 3, Q11), whilst community resources such as group activities stimulate the adoption of healthy activities in older people (Table 3, Q12). Additionally, *socio-cultural factors* (Ali, Baynouna and Bernsen, 2010; Alvarado, Murphy and Guell, 2015; Kennedy *et al.*, 2015; Bell *et al.*, 2017; Knutsen *et al.*, 2017; Sriram *et al.*, 2018) were considered a positive and negative influence on normative social responses to individuals' behaviours. For example, regarding negative effects, gendered norms are included in some communities which may impact through presenting a barrier to be overcome in order to perform physical activity (Table 3, Q14).

18 articles described *contextual and individual factors* at the micro-level (Daborn, Dibsall and Lambert, 2005; Christakis and Fowler, 2007; Ali, Baynouna and Bernsen, 2010; Barclay, Edling and Rydgren, 2013; Procter *et al.*, 2014; Robertson, Mullan and Todd, 2014; Rogers *et al.*, 2014; Alvarado, Murphy and Guell, 2015; Kennedy *et al.*, 2015; Koetsenruijter *et al.*, 2015; Leahey *et al.*, 2015; Mama *et al.*, 2015; Shakya, Christakis and Fowler, 2015; Forthofer *et al.*, 2016; Hempler, Joensen and Willaing, 2016; Vassilev *et al.*, 2016; Mötteli, Siegrist and Keller, 2017; Sriram *et al.*, 2018) and 11 articles showed that *psychosocial factors* (Daborn, Dibsall and Lambert, 2005; Ali, Baynouna and Bernsen, 2010; Procter *et al.*, 2014; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Kennedy *et al.*, 2015; Mama *et al.*, 2015; Shakya, Christakis and Fowler, 2015; Forthofer *et al.*, 2016; Vassilev *et al.*, 2016; Sriram *et al.*, 2018) play an essential role in the adoption of ORBs. For example, regarding positive effects, living through *critical moments* like the loss of a relative (Daborn, Dibsall and Lambert, 2005), possessing high internal *motivation* (Mama *et al.*, 2015), *self-efficacy* (Robertson, Mullan and Todd, 2014) and a specific *knowledge* about healthy food (Ali, Baynouna and Bernsen, 2010) are facilitators to change health behaviours, as stated in Q16, Q17, Q18 and Q19 in Table 3. Nevertheless, *personal attitude* is sometimes a barrier; this is the case when a person decides between the use of the car or walking to commute (Table 3, Q20). Moreover, *socio-cultural factors* were described in 13 articles (Daborn, Dibsall and Lambert, 2005; Ali, Baynouna and Bernsen, 2010; Procter *et al.*, 2014; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Kennedy *et al.*, 2015; Leahey *et al.*, 2015; Mama *et al.*, 2015; Shakya, Christakis and Fowler, 2015; Forthofer *et al.*, 2016; Knutsen *et al.*, 2017; Mötteli, Siegrist and Keller, 2017; Sriram *et al.*, 2018), showing negative effects on health in most of the examples. This is the case concerning *social norms* (Leahey *et al.*, 2015), *social events* (Knutsen *et al.*, 2017) and *competing demands* (Sriram *et al.*, 2018) such as family responsibilities (caring, children hobbies). *Sociodemographic factors* were identified in 11 articles (Daborn, Dibsall and Lambert, 2005; Christakis and Fowler, 2007; Conklin *et al.*, 2014; Procter *et al.*, 2014; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Koetsenruijter *et al.*, 2015;

Mama *et al.*, 2015; Vassilev *et al.*, 2016; Knutsen *et al.*, 2017; Sriram *et al.*, 2018) with *socioeconomic status* (Daborn, Dibsall and Lambert, 2005; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Koetsenruijter *et al.*, 2015; Vassilev *et al.*, 2016; Knutsen *et al.*, 2017) and *gender* (Daborn, Dibsall and Lambert, 2005; Christakis and Fowler, 2007; Conklin *et al.*, 2014; Robertson, Mullan and Todd, 2014; Vassilev *et al.*, 2016; Sriram *et al.*, 2018) having positive and negative effects. A poor socioeconomic status with a lack of social support might be a barrier to accessing healthier food in following a healthy diet (Table 3, Q22). On the other hand, having high levels of income is associated with better education and the self-report of good self-management skills (Table 3, T11). In terms of *gender*, women are seemingly more willing to participate in community groups and work with a shared aim collectively than men (Table 3, T12). Certain types of *jobs*, *age*, *transport* and *education* were also mentioned (Table 3, Q23, T11 and Q24). *Clinical factors* such as underlying medical conditions are barriers to performing physical activity (Hempler, Joensen and Willaing, 2016). For example, individuals with type 2 diabetes are more willing to exercise than individuals with type 1 diabetes (Table 3, T13). This may be because overweight and obesity, which in many cases, accompanies type 2 diabetes, might be the precipitating factor.

#### 4.3.1.3 Types of ties and properties of social networks for the adoption of obesity-related behaviours

In this review, *ties* are understood as the links between individuals (Kadushin, 2012). They are meaningful as different types of contacts offering potential ways to change behaviours.

Ten articles described *weak ties* at the meso-level. The strength of 'weak ties' hypothesizes that things flow from people with whom one has limited tenuous contact and relationality (Rogers *et al.*, 2014). Here, *community organizations and community groups* (Procter *et al.*, 2014; Kennedy *et al.*, 2015; Koetsenruijter *et al.*, 2015; Forthofer *et al.*, 2016; Knutsen *et al.*, 2017; Sriram *et al.*, 2018) were identified as relevant ties for the adoption of a good diet and physical behaviours. Also, networking with *healthcare professionals* and *neighbours* were identified as a means of getting involved with behaviour change, as illustrated in T14 and Q4 in Table 3. Twenty articles described contacts at the micro-level as key players for the adoption of ORBs. These included in the main strong ties, that is to say, relations between contacts that have strong bonding connections between them. In this regard, 15 articles related *family* contacts with positive and negative effects on health (Daborn, Dibsall and Lambert, 2005; Ali, Baynouna and Bernsen, 2010; Conklin *et al.*, 2014; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Becofsky *et al.*, 2015; Kennedy *et al.*, 2015; Koetsenruijter *et al.*, 2015; Mama *et al.*, 2015; Winston *et al.*, 2015; Forthofer *et al.*, 2016; Bell *et al.*, 2017; Knutsen *et al.*, 2017; Mötteli, Siegrist

and Keller, 2017; Sriram *et al.*, 2018). For example, there may be cases where family members might be supportive or not with diet (Table 3, Q25 and Q26). *Friends* were also mentioned in 11 articles as key players (Christakis and Fowler, 2007; O'Malley *et al.*, 2012; Barclay, Edling and Rydgren, 2013; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Becofsky *et al.*, 2015; Kennedy *et al.*, 2015; Leahey *et al.*, 2015; Rancourt *et al.*, 2015; Knutsen *et al.*, 2017; Sriram *et al.*, 2018). It is seemingly easier to engage in exercising if individuals compare themselves with friends (Rancourt *et al.*, 2015) (Table 3, T16). On the other hand, there is a high risk of adopting bad dietary habits if a person belongs to a group of friends with overweight and with a strong set of social norms for unhealthy eating, as stated in T9 in Table 3. Finally, according to the literature *sports contacts* (Alvarado, Murphy and Guell, 2015), *housekeeping* (Ali, Baynouna and Bernsen, 2010), *co-workers* (Winston *et al.*, 2015) or *pets* (Sriram *et al.*, 2018) are identified as types of ties at the meso-micro levels of analysis (Table 3, Q3, Q27, T17 and T18).

Networks are formed by individuals and the ties among them and thus, it is relevant to continue the description of networks by examining simple properties or measurements of these social structures (Bellotti, 2014). Some key features of the social networks were essential to define the structure of the network and patterns of the adoption of ORBs in adults. More concretely, in 7 articles (O'Malley *et al.*, 2012; Barclay, Edling and Rydgren, 2013; Conklin *et al.*, 2014; Leahey *et al.*, 2015; Winston *et al.*, 2015; Forthofer *et al.*, 2016; Mötteli, Siegrist and Keller, 2017) the *tie strength* (frequency of contact and feeling of closeness) with members of the family or healthy companions consistently describes higher diet quality as it can be seen in T19 and T20 in Table 3. Another property to consider is the *degree* or number of contacts that each individual possesses. Having more friends is related to healthier habits (Table 3, T21). Moreover, the *size* of the network is relevant for positive and negative effects (Becofsky *et al.*, 2015; Leahey *et al.*, 2015; Winston *et al.*, 2015). The bigger the network an individual is part of with poor health habits, the harder it might be to lose weight (Table 3, T22). By contrast, individuals reporting social contact with six or seven friends have more opportunities to engage in healthy behaviours than those in contact with only one friend (T9 in Table 3). Finally, distances between members of the network were considered in terms of *social distance* (degree of separation) and geographic distance. The social distance is the distance that an individual is from others (Hanneman and Riddle, 2005) (e.g. the distance between two adjacent individuals is one). A study of the spread of obesity in a large social network over 32 years demonstrated that increasing social distances appeared to decrease the influence of contacts to enhance weight gain in the individual, but increasing *geographic distance* did not (Christakis and Fowler, 2007), that is to say, the geographical distance did not modify the effect of those contacts. Thus, social distance could play a stronger role than geographic distance in the spread of behaviours or norms associated with obesity.

### 4.3.2 Theory-driven themes

The aim of the review required an in-depth exploration of how data-driven themes influence the adoption of positive and negative ORB's in adults. Two theory-driven themes have been developed from the synthesizing argument to complete this theoretical framework, and the understanding of the events studied (see Figure 5). These themes are *developing multi-agent coalitions* and *cross-level influence*.

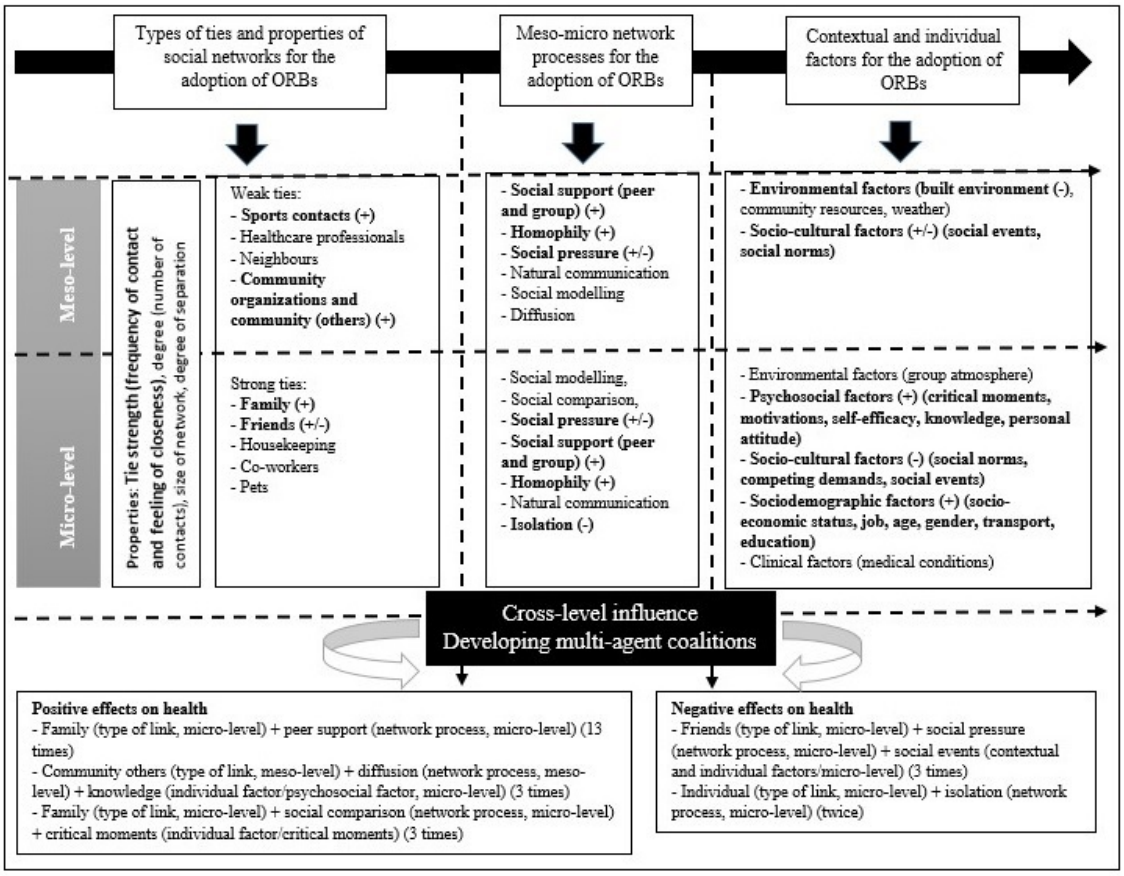


Figure 5. Complex system approach with inductive constructs. (Legend) The most relevant constructs are highlighted in bold. (+) and (−) symbols explain if the constructs have positive or negative effects on health. The two theory-driven themes point to different coalitions with positive and negative effects on health.

In the process of the review, different health scenarios where social networks are present in the adoption of ORBs have been broken down to different levels of analysis. In each scenario (text or quote), various components have been identified and coded individually, showing their positive and negative effects on health. They were then grouped in wider categories or data-driven themes. These themes were *meso-micro network processes, contextual and individual factors and types of ties and properties of social networks*. Nevertheless, during the process of analysis, it has been shown how the majority of the components cannot act on their own but were mediated in

some way to affect health. Thus, *developing multi-agent coalitions* is a driver that highlights the necessity of the combination and influence between these different concepts, developing power of cumulative effects. These different *multi-agents coalitions* produce and, therefore, acknowledge both positive and negative health outcomes in the individuals. For example, social pressure by close contacts (*friends* or *family*) at micro-level has shown typically positive results in this review (Robertson, Mullan and Todd, 2014; Mama *et al.*, 2015; Knutsen *et al.*, 2017; Mötteli, Siegrist and Keller, 2017). Nevertheless, if a *socio-cultural factor* (e.g. social events) is considered, this effect might be more harmful. In this latest case, it is shown how a positive effect is reversed into a negative one by adding an extra component (contextual factor). The following two examples represent this fact.

> "My husband insists that I shouldn't eat large quantities or any starchy food. My mum always scolds me, but this doesn't help; she just gets on my nerves. As soon as she sees me eating even the smallest amount of sweets, she'll start complaining. I can't say my daughters are indifferent. They'll remark when I overeat something. Everyone is focused on my diet." (Knutsen *et al.*, 2017)

This example represents, a multi-agent coalition culminating in a positive effect on health: *Family (type of tie, micro-level)* + *social pressure (process, micro-level)*.

> "This man emphasizes the need to occasionally not adhere to the diet, especially at parties and when with friends." (Knutsen *et al.*, 2017)

This last example, which was extracted from the same article as the previous one, shows how adding an extra data-driven theme (party, *social event*) changes the effect into one, which is more negative. This coalition would be *friends (type of tie, micro-level)* + *social pressure (process, micro-level)* + *social events (contextual and individual factors/socio-cultural factors, micro-level)*.

The identified relevant combinations implicating positive and negative effects on health are available in Appendix H. The most relevant *multi-agent coalitions* are presented below, based on the number of times that appeared in the chosen articles and classified into positive and negative health effects.

Positive effects:

- *Family (type of link, micro-level)* + *peer support (network process, micro-level)* (13 times).
- *Community others (type of link, meso-level)* + *diffusion (network process, meso-level)* + *knowledge (individual factor/psychosocial factor, micro-level)* (3 times).

- *Family (type of link, micro-level) + social comparison (network process, micro-level) + critical moments (individual factor/critical moments)* (3 times).

Negative effects:

- *Friends (type of link, micro-level) + social pressure (network process, micro-level) + social events (contextual and individual factors/micro-level)* (3 times).
- *Individual (type of link, micro-level) + isolation (network process, micro-level)* (twice).

*Cross-level influence* refers to the dynamic relationship between the individuals that are embedded in social relationships and the context at multiple levels of analysis, in this case, micro and meso levels. This concept cannot be understood without the influence of *developing multi-agent coalitions*. Two examples with the involvement of different levels of analysis are illuminating:

> "I probably would pass somebody from my gym somewhere on the streets [… It's] motivational in the sense that if you don't go […to the gym] and pass a girl that I haven't seen in a while 'hey why I don't see you in the gym? What's going on with you?' and I guess guilt people into coming back. So yeah it's motivation." (Alvarado, Murphy and Guell, 2015)

This event is formed by a *type of link (sports contacts, meso-level)*, a *network process (social pressure, meso-level)* and an *individual factor (psychosocial factor/motivation, micro-level)*.

> "Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub." (Knutsen *et al.*, 2017)

This coalition can be interpreted as the combination of *friends (type of tie, micro-level) + peer support or group support (process, meso-level) + social norms and social events (contextual factor/socio-cultural factor, meso-level)*.

Thus, as per Figure 5, it can be seen that *developing multi-agent coalitions* and the *presence of cross-level influence* between the different data-driven themes produce positive and negative ORBs.

## 4.4 Discussion

This CIS offers an opportunity to gain novel insights regarding how social networks influence the adoption (or abandonment) of positive and negative ORBs in adults with obesity, overweight or

risk of obesity. The qualitative, quantitative and mixed-method empirical evidence from the reviewed papers were included in the process of the development of new themes and a synthesizing argument with the aim of addressing a gap found in the literature namely what and how network properties and processes together with other environmental factors produce positive and negative health outcomes in adults with ORBs.

The consideration of all dimensions of network analysis and exploration, that is to say, structure, function, strength and content required the contribution of both qualitative and quantitative approaches. Traditionally, theories have identified a variety of processes in social networks and obesity research, generating discussions between researchers about aspects of social selection, social contagion, confounding, social influence (Christakis and Fowler, 2007; Cohen-Cole and Fletcher, 2008; Aral, Muchnik and Sundararajan, 2009; Valente, 2012). Here our focus is mainly on social influences, which have been classified under the umbrella term of social processes in order to open up new ways of discussion about the underlying processes of social networks.

A strength of this article was the application of social network theory which in previous studies identified the importance of relationships in the adoption of ORBs but without considering this network approach (Daborn, Dibsall and Lambert, 2005; Ali, Baynouna and Bernsen, 2010; Conklin *et al.*, 2014; Robertson, Mullan and Todd, 2014; Alvarado, Murphy and Guell, 2015; Mama *et al.*, 2015; Bell *et al.*, 2017; Mötteli, Siegrist and Keller, 2017; Sriram *et al.*, 2018) in a manner which illuminates the depth, meaning and structure of these relationships and associations with contextual and environmental factors. This affirms that structural and functional characteristics of social networks together with environmental and personal factors may contribute to health behaviours (Berkman *et al.*, 2000; Kawachi and Berkman, 2001; Nam, Redeker and Whittemore, 2015). Several authors have recognized some of these ideas before, but individually and in the absence of considering the sum of other factors in the adoption of health behaviours (Kristal *et al.*, 1995; Sarkar, Fisher and Schillinger, 2006; Latkin and Knowlton, 2015; Perkins, Subramanian and Christakis, 2015; Valente and Pitts, 2017). This review presents an integrated developed contribution in comparison with the previous studies, in particular flagging up how the combination and the relationship between these concepts at different levels of analysis produce positive, negative and contingent health behavioural outcomes in adults with ORBs. Thus, different agents were identified at two levels of analysis (meso and micro levels). This research resonates with Bronfenbrenner's ecological theory (Bronfenbrenner, 1979) since it was concerned with tackling numerous environmental factors and numerous persons in different interaction relationships, roles, actions and processes. Nevertheless, the formula of using the six different levels of analysis (individual, microsystem, mesosystem, exosystem, macrosystem and chronosystem) do not equate with our idea about open system thinking, which is more related

with the multilevel approach of social network theory. Thus, the levels of analysis are simplified into, micro, meso and macro levels (Lazega and Snijders, 2015; Bolíbar, 2016). In this regard, networks are understood as a dynamic response to individual interactions (Degenne and Forsé, 1999). It implies that social interaction is actually the most elementary unit of social belonging and dynamics, and thus that it is what generates social spaces and positions (Lozares, Martín and López, 1998; Bottero and Crossley, 2011). Following this, for example, the role of family and health services cannot consider in the same level of analysis (e.g. micro-level), since the interaction of the individual with them might be potentially different. Similarly, the potential contacts that have a stronger and closer relationship with the individual were identified in the micro-level. In the meso-level, community contacts and less-frequent contacts are situated. This way of thinking is in line with other authors' research (Barclay, Edling and Rydgren, 2013; Mötteli, Siegrist and Keller, 2017). Also, the meso-level was proposed as the limit of the analysis because of the relevant amount of literature available.

The main focus of this CIS is to show how networks, together with the environment, influence the adoption of ORBs. During the process of analysis of data, different health scenarios were broken down into different themes at different stages. This process allows the creation of a 'story' (synthesizing argument) that explores 'what' and 'how' these new themes influence the adoption of ORBs. As a consequence, two new synthetic constructs *developing multi-agent coalitions* and *cross-level influence* point to a dynamic multilevel set of influences between multiple constructs (data-driven themes) that produce different positive and negative health results. With regard to positive effects, the combination *of family (type of link, micro-level)* with *peer support (network process, micro-level)* is the most important because it was the most mentioned in the literature (thirteen times), showing the engagement of individuals in health behaviours. By contrast, with regard to negative effects, the combination of *friends (type of link, micro-level)*, with *social pressure (network process, micro-level)* and *social events (contextual and individual factors, micro-level)* is the most relevant (appearing three times). In relation to this, a relevant aspect that has been uncovered during the review is the potential power that the data-driven themes possess to address or reverse unwanted effects in which context plays a significant role. For example, *social pressure by family* at micro-level has typically positive effects on health. This is the case when the *family control* what an individual is eating at home. Nevertheless, *social pressure* exerted by close contacts in concrete *social events* (e.g. parties, pubs) enhances the adoption of negative ORBs, such as the intake of unhealthy food.

These results could have utility for health policy, considering the design of innovative interventions based on the integration of social networks and other contextual factors at multiple levels of analysis. The *development of multi-agents coalitions* between the different individual

components of the data-driven themes created, using *cross-level influences* might be suitable to apply in the complex environment where individuals live. Thus, per example, this review has shown that the coalition *family (type of link, micro-level)* with *peer support (network process, micro-level*) has potential positive influences on health. In this sense, it would be interesting to explore the design of interventions where different members of the family could be embedded. For example, delivering educational programmes to the family rather than the individual or the collective participation of the family in different community assets and activities. This might enhance the influence of other members in the community and the exertion of group support (e.g. running group). In these examples, different aspects of networks together with contextual factors are present. The use of social network online tools based on social prescription and acknowledgement of new resources instead of the typical and well-known resources of the community to support this engagement with self-directed support might be relevant. Social network online tools might be used to identify other members of an individual network (apart from the family) that might be interested in sharing these activities with other people, even to connect 'isolated' individuals to others and these community assets or activities. This would potentially increase the size of the social network to avoid isolation and loneliness in adults, both risk factors for mortality associated with obesity. Isolation has been identified in this review as one of the main issues in ORBs. The most relevant scenario of negative health effects in this CIS was the combination of *friends (type of link, micro-level)*, with *social pressure (network process, micro-level)* and *social events (contextual and individual factors, micro-level)*. In this sense, it has been demonstrated in the results section how different constructs such as the *contextual factor 'social event'* has the power to reverse positive health effects. From a health policy perspective, it might be relevant to modify *contextual and individual factors* such as paying greater attention to how we can create or modify infrastructures and environments to practise physical activity or enhance the self-efficacy of avoiding unhealthy practices (e.g. alcohol intake, high-sugar food) in social events. The consideration of attending specific social events (e.g. regular meetings in pubs), in which the relationships influence negatively, might be relevant for predicting potential negative results. The regulation and limitation of alcohol intake or an increase in its price in local and macro festivals and pubs (places where social relationships enhance their consumption) can be other actions. Additionally, the identification and visibility of influential individuals (e.g. friends that go to the gym regularly or celebrities that promote healthy cooking in the media) might be considered as a prominent mediator in engaging people who wish to make changes to their health behaviours and their social norms.

Consideration needs to be given to the nature of qualitative research and the understanding of the open social systems analysed in this review, suggesting typicality rather than the

generalization of the data abstracted (Sayer, 1992). These results might not be reproducible and predictive against the different criteria used in quantitative research. The creation of the synthesizing argument with the results obtained in this review provides a novel and more conceptually deep starting point for future interventions, considering conceptualizations at multiple levels for theoretical and application-relevant interventions which quantitative studies alone are unable to provide. In order to explore the veracity content and nature of the ties and the specific contexts where these relationships occur, it is necessary to translate and use these finding in the design of interventions.

This CIS has limitations. Firstly, the findings contained in the included studies were interpreted according to our research interests. The lack of studies regarding how mechanisms and properties of social networks influence the adoption of health behaviours, in general, opens an easily questionable route of interpretation. In this sense, the transformation of quantitative data into a qualitative form followed a 'coding' process. The use of this analysis strategy to deal with quantitative data could be questionable due to the lack of reviews that integrate qualitative and quantitative data with which to compare. Another limitation is the restriction on searching only in the English and Spanish languages. It may have excluded relevant articles. However, the requirement of translation could result in the misinterpretation of specific information. The final number of articles that explicitly identified the specific focus of social networks and ORBs could be considered limited in number. Nevertheless, these were sufficient to attain theoretical saturation (Schreiber, Crooks and Stern, 1997; Dixon-Woods, Bonas, *et al.*, 2006; Portillo *et al.*, 2015; Lin and Melendez-Torres, 2017; McFerran *et al.*, 2017; Saunders *et al.*, 2018). In this sense, concepts and linkages between them were well-developed, and no additional data were needed. Finally, the authors are aware of how broad and complex the topic is. Although the aim is to provide a whole and innovative vision of an event, certain factors might require more in-depth analysis using other strategies and more empirical work.

## 4.5 Conclusions

This CIS offers a new way to understand the use of social networks in the 'obesity' field in open settings. Breaking down different health scenarios in an analytical process allows the creation of a synthesizing argument that explores 'what' and 'how' social networks together with environmental-difference effects influence the adoption of positive and negative ORBs in adults using a multilevel approach. The data-driven themes *meso-micro network processes, contextual and individual factors, and types of ties and properties* were identified individually as components and causes of different health scenarios. Nevertheless, these drivers do not act on their own. As a consequence, *developing multi-agent coalitions* considering *cross-level influences between* the

data-driven themes are two mechanisms that were created to understand more in-depth how social networks and the environment influence the adoption of ORBs. These two new constructs point to a dynamic multilevel set of influences between multiple constructs (data-driven themes), developing scenarios where positive and negative health results are identified. This synthesizing argument could be considered by those designing future interventions and policy in this area, who might need to consider the wider open system of socially connected individuals and harness these forces to design new interventions where social networks and other contextual and individual factors operate together in a complex multilevel environment.

**Conclusion of chapter 4**

The developed understanding of multi-level influences and the identification of specific positive and negative health scenarios where a list of network processes is present were translated to the next phase of the research. This is shown in the next chapter of this thesis.

# Chapter 5 The influence of social relationships and activities on the health of adults with obesity: a qualitative study

This chapter represents the second article of this PhD. This is an empirical qualitative network approach that explores the role of different social networks in influencing the adoption of positive and negative obesity-related practices in adults with obesity or a history of obesity. The results of the critical interpretative synthesis review (previous chapter) were considered to develop the inquiry process and the results of this article. This chapter is connected to the specific objective b).

## 5.1 Introduction

Obesity is defined as excessive fat accumulation that presents a health risk. From a clinical perspective, for most adults having a BMI greater than or equal to 30 means they have obesity (WHO, 2022a). It is the fifth leading risk factor for global deaths and represents a significant risk factor of developing a range of LTCs, including coronary heart disease, hypertension, type 2 diabetes and joint and muscular disorders, among others (WHO, 2022a). Currently, 63% of adults in England are above a healthy weight, and of these, 28% live with obesity (Department of Health & Social Care (UK), 2020). Tackling obesity rates is a health challenge that the UK has faced during the last decades, with little success (Department of Health (UK), 1992; Parliament. House of Commons, 2004; OECD, 2017). Evidence points to its multiple causes, complexity (Foresight, 2007) and the need to extend understanding beyond individual to including how physical and social obesogenic environments promote obesity risk factors, such as overeating, physical inactivity, and energy imbalance. The relevance of physical, economic, policy, and socio-cultural conditions (Swinburn, Egger and Raza, 1999; Smith and Cummins, 2009) extends to that of networks relationships relevant to the spread and reduction of obesity through social ties, particularly close ties of friends and spouses (Christakis and Fowler, 2007). Social networks refer to the structure and function of a person's social relationships and the nature of the ties that connect them. Exploring further the value social networks might play in shaping different health practices has been suggested by Lakerveld *et al.* (2012), particularly in understanding the role and meaning of relationships.

Traditionally, social relationships in health have been studied using SNA. This method analyses structures reducing relationships to numbers and bracketing off part of inter-agency and

contextual richness of network interaction (Knox, Savage and Harvey, 2006; Crossley, 2010). In obesity, the study of the role of relationships has focused on analysing the phenomenon of spread quantitatively, looking at the attributes of people and the risk of developing excess weight through smaller clusters (Christakis and Fowler, 2007; Cohen-Cole and Fletcher, 2008; Bahr *et al.*, 2009; Hruschka *et al.*, 2011; Zhang *et al.*, 2018). Powell *et al.* (2015) attempt to identify different processes through which social ties affect weight influencing behaviours, body size ideals and norms, potentially describing why and how excess weight clusters within networks. In a critical interpretative synthesis review, the content of the relationships and how these interact with environmental and individual determinants to influence the adoption of ORBs (Serrano Fuentes, Rogers and Portillo, 2019) suggests an absence of understanding the processes by which relationships positively and negatively influence the health of adults with obesity. This research introduces an empirical qualitative inquiry insight to know more about what and how social relationships might influence the adoption of positive and negative obesity health practices related to eating, physical activity and alcohol intake in terms of what respondents narrate about their involvement. Thus, the aims are first to identify the types of relationships relevant to the adoption of practices in adults with obesity and, second, to explore the type of activities these relationships engage with or promote to produce those practices and their potential health consequences.

## 5.2 Materials and methods

### 5.2.1 Design

A constructivist epistemology hermeneutic phenomenology was used to inform this study of the lived experience (Given, 2008) of how social relationships influence the health of adults with obesity. The researchers' assumptions were not bracketed or set aside but were embedded and essential to the interpretive process (Laverty, 2003). This methodology was used as part of a qualitative social network approach (Bellotti, 2014), in which the focus was on the meaning and narratives of social ties and less on their structure.

Ethical approval to conduct the research was obtained from the Faculty Ethics Committee under the reference ERGO 55638.

### 5.2.2 Participants

A purposeful sample was recruited since it identifies and selects individuals or groups knowledgeable about or experienced a specific phenomenon (Manen, 1997), in this case, those

living with obesity in the UK. This purposeful sampling strategy involved snowballing. Participants were considered eligible for inclusion in the study if they had a current or a history of BMI ≥30 kg/m2, lived in the UK, were able to communicate and understand English, had a device with Internet connection and microphone (e.g. mobile phone, tablet, and computer) and an email address. They were approached in community settings and via social media (Twitter, Facebook and LinkedIn). Researchers utilised recruitments posters in the Hampshire area (including the Isle of Wight), online advertisements, sent letters of invitation to local weight management groups and LTCs related charities (asking for their managers' approval when required) from different areas of England, Scotland, Wales and Northern Ireland and contacted with advocacy individuals dedicated to empowering people affected by obesity (via Twitter or email). Managers of organisations in this research were considered those individuals that held leadership roles and could allow access to people who were part of the different organisations and community groups.

### 5.2.3 Data collection

Individual semi-structured interviews with open-ended questions were conducted between May 2020 and March 2021. These types of interviews focus on the specific subject and allow flexibility to capture unpredictable findings (Pope and Mays, 2006). The participants were interviewed for between 30 and 120 minutes. The researchers considered the stigma that accompanied this topic and attempted to design an adequate interview schedule where language mattered (Albury *et al.*, 2020). The questions regarding social relationships were designed based on our previous literature review (Serrano Fuentes, Rogers and Portillo, 2019). Feedback regarding the type and tone of the questions was provided by the qualitative research group members of the authors' affiliation and the two first interviewees (participants 1 and 2).

A personal network sociogram was incorporated to support the identification of social relationships to help generate rich data (Tubaro, Ryan and D'angelo, 2016) by producing reflections about how these relationships influenced participants' health. This sociogram consisted of three concentric circles (Antonucci, 1986). The interviewer started the interview by asking, 'Who do you think is most important to you in influencing your health behaviours (eating, physical activity and alcohol intake), positively and negatively? Thus, the interviewees could place proposed network members in either the central circle considered essential, the middle circle considered important but not as relevant as the central circle or the outer circle, considered necessary but not as important as the other two circles. Two diagrams were collected per person representing a moment in the past (when they started having obesity) and the present. Whilst filling in the diagrams out loud, participants were asked to explain why they chose the people they had placed within the circles and how they had influenced their health. An example diagram

can be seen in Figure 6. Additionally, a sociodemographic questionnaire was used to register different attributes and establish relationships with the individuals' conception of health experiences and opinions.

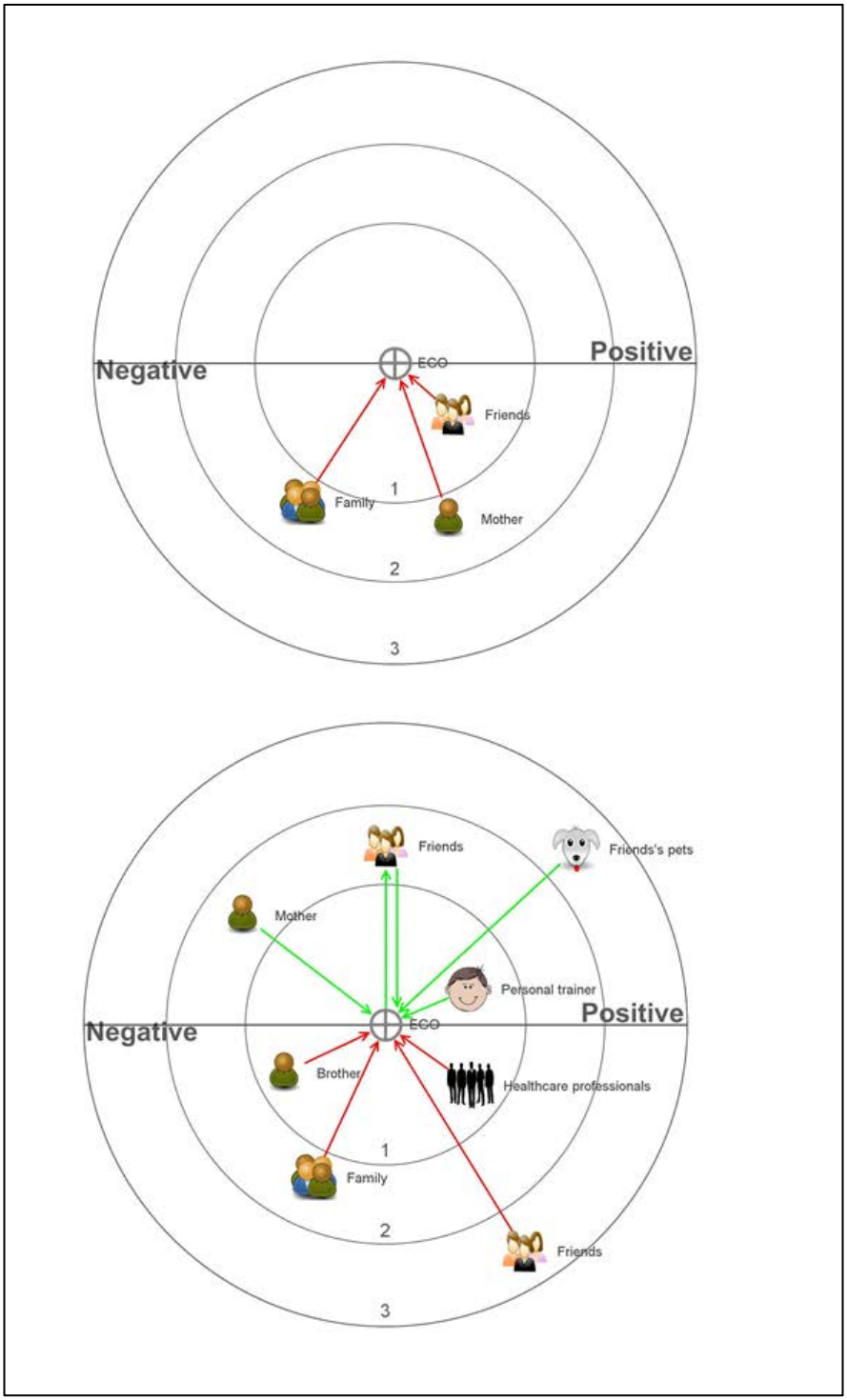


Figure 6. Participant's 1 networks in two different periods (past, top diagram and present, bottom diagram). Red arrows are negative relationships, and green arrows are positive. Those relationships closest to the central circle are the most important.

Due to the COVID-19 pandemic, all data collection was conducted online, specifically via email and videoconferencing. Emails were used to contact the participants and send information about the study (e.g. participant information sheet). SafeSend service (software hosted by the research institution) was utilised to transfer research and confidential data across the network securely encrypted. Consent was gained from all participants before initial interviews, which were conducted by videoconferencing. This method was chosen in comparison with others (e.g. telephone) since it provides a more personable approach (Irani, 2019), something that was found relevant when discussing this sensitive topic. Phone calls were considered if there were any connection or technological problems or at the interviewee's request. Thus, eighteen interviews were carried out via videoconference and one by telephone. NSF conducted all the interviews and recorded using a Dictaphone (Olympus WS-853). Researchers had no therapeutic relationship with participants.

### 5.2.4 Data analysis

The interviews were transcribed verbatim, ten of them by the first author (NSF) and the rest by a professional transcriber. Template TA was utilised to identify, analyse and report repeated patterns across data (Braun and Clarke, 2006). Data analysis followed a deductive and inductive analysis process. Deductive in the sense that themes can be developed early on or even before the analysis (Braun and Clarke, 2021). Inductive in the sense that new themes and codes are created through the analytic process. Template TA was chosen in comparison with other types of TA since it allows a-priori themes to be utilised to create an initial version of the coding template (McCluskey *et al.*, 2011). The different phases involved in the analysis can be seen in detail in Appendix I.

To increase the validity of the analysis, the primary author conducted a debriefing with the rest of the authors (AR and MCP). Two tools were used to ensure the quality of the results: the COREQ checklist (Tong, Sainsbury and Craig, 2007) and the tool for evaluating TA manuscripts developed by Braun and Clark (Braun and Clarke, 2021). The different domains with our answers can be seen in Appendix J. Also, participant 1 was contacted to verify the interpretation of the findings (no issues were raised). After the seventeenth interview, no new codes and themes were generated from the narratives. Thus, the authors concluded that the data analysis had reached a saturation point (data saturation) (Saunders *et al.*, 2018). However, two more interested participants were interviewed to ensure and confirm that there were no new emerging codes and themes. All the real names were coded into pseudonyms to ensure anonymity. Regarding software, NVivo (version 1.2) supported the labelling and organisation of themes.

## 5.3 Results

Nineteen adults (thirteen women and six men) who have or used to have obesity (BMI≥30) were interviewed. Table 4 summarises the main attributes of each participant and Table 5 shows a list with all themes, sub-themes, codes and their frequencies.

Table 4. Participants' sociodemographic characteristics.

| Participants | Age | Current BMI | Long-term conditions | Civil status |
|---|---|---|---|---|
| 1. Female | 25-29 | 36 | Underactive thyroid | Single |
| 2. Female | 40-44 | 36 | IBS, arthritis, fibromyalgia | Married-live-in partner |
| 3. Female | 40-44 | 34 | Mild asthma, back pain | Divorced |
| 4. Female | 25-29 | 35 | Asthma, polycystic ovarian syndrome | Married/live-in partner |
| 5. Female | 45-49 | 34 | Nil | Separated |
| 6. Male | 30-34 | 33 | Nil | Single |
| 7. Female | 25-29 | 25 | Nil | Single |
| 8. Female | 25-29 | 33 | Nil | Single |
| 9. Female | 55-59 | 30 | Barrett's Oesophagus | Separated |
| 10. Female | 30-34 | 29 | Nil | Single |
| 11. Male | 40-44 | 28 | Nil | Single |
| 12. Male | 65-69 | 35 | Nil | Married/live-in partner |
| 13. Male | 45-49 | 29 | Depression, reactive arthritis | Married/live-in partner |
| 14. Male | 35-39 | 49 | Psoriasis | Married/live-in partner |
| 15. Female | 50-54 | 27 | Asthma | Married/live-in partner |
| 16. Female | 55-59 | 39 | Nil | Married/live-in partner |
| 17. Male | 35-39 | 24 | Nil | Single |
| 18. Female | 25-29 | 33 | Underactive thyroid | Married/live-in partner |
| 19. Female | 18-24 | 40 | Nil | Single |

Table 5. Themes, sub-themes and codes. Two numbers have been added per data item. The first number represents the number of interviews where the item appears. The second one represents the number of times the item has been identified in all the interviews.

**1.Everyday familial routines matter (18/124)**
1.1 Activities with positive effects on health (18/72)
1.1.1 Family (in general) (3/5)
1.1.1.1 Being a role model (2/2)
1.1.1.2 Conducting activities together (1/1)
1.1.1.3 Counselling (1/2)
1.1.2 Parents (13/20)
1.1.2.1 Being a role model (1/1)
1.1.2.2 Physical loss (2/3)
1.1.2.3 Peer pressure (3/4)
1.1.2.4 Conducting activities together (1/1)
1.1.2.5 Counselling (3/3)
1.1.2.6 Emotional support (3/3)
1.1.2.7 Education in cooking and eating healthy (4/5)
1.1.3 Pets (5/7)
1.1.3.1 Providing physical exercise (5/7)
1.1.4 Partners (12/23)
1.1.4.1 Cooking and shopping healthy food (2/7)
1.1.4.2 Counselling (3/3)
1.1.4.3 Emotional support (4/4)
1.1.4.4 Sharing lifestyle goals and making joint efforts (3/3)
1.1.4.5 Comparing (4/4)
1.1.4.6 Being a role model (2/2)
1.1.5 Children (6/12)
1.1.5.1 Having similar characteristics (1/1)
1.1.5.2 Emotional support (2/2)
1.1.5.3 Cooking and shopping healthy food (1/1)
1.1.5.4 Education in eating healthy (1/3)
1.1.5.5 Peer pressure (4/5)
1.1.6 Grandparents (2/2)
1.1.6.1 Comparing (1/1)
1.1.6.2 Emotional support (1/1)
1.1.7 Siblings (2/2)
1.1.7.1 Counselling (2/2)
1.1.8 Aunts and uncles (1/1)
1.1.8.1 Emotional support (1/1)
1.2 Activities with negative effects on health (16/52)
1.2.1 Family (in general) (5/9)
1.2.1.1 Having similar characteristics (2/3)
1.2.1.2 Peer pressure (1/2)
1.2.1.3 Growing up seeing and modelling bad practices (1/1)
1.2.1.4 Judging, labelling and commenting (1/1)
1.2.1.5 Conducting activities together (1/2)
1.2.2 Parents (12/25)
1.2.2.1 Providing an excess of control (5/7)
1.2.2.2 Conducting activities together (1/1)
1.2.2.3 Cooking and shopping (7/13)
1.2.2.4 Growing up seeing bad practices (4/4)
1.2.3 Pets (1/1)
1.2.3.1 Encouraging physical activity (1/1)
1.2.4 Partners (4/8)
1.2.4.1 Having similar characteristics (1/1)
1.2.4.2 Peer pressure (2/2)
1.2.4.3 Comparing (1/1)
1.2.4.4 Conducting activities together (3/3)
1.2.4.5 Eating and shopping (1/1)
1.2.5 Children (1/1)
1.2.5.1 Education in cooking healthy (1/1)
1.2.6 Grandparents (3/4)
1.2.7.1 Peer pressure (1/1)
1.2.7.2 Cooking and providing excess amount of food (2/3)
1.2.7 Siblings (4/4)
1.2.8.1 Peer pressure (1/1)
1.2.8.2 Physical loss (1/1)
1.2.8.3 Judging, labelling and commenting (2/2)
**2. Chasing healthier lifestyles and modelling and connecting emotionally with friends (18/87)**
2.1 Activities with positive effects on health (18/68)
2.1.1 Close friends (15/41)
2.1.1.1 Having similar characteristics (3/5)
2.1.1.2 Modelling (1/2)
2.1.1.3 Comparing (3/3)
2.1.1.4 Cooking and shopping healthy food (1/1)
2.1.1.5 Conducting activities together (6/9)
2.1.1.6 Counselling (5/6)
2.1.1.7 Emotional support (11/15)
2.1.2 Community friends (gym and weight management groups) (9/23)
2.1.2.1 Leadership and counselling (3/5)
2.1.2.2 Sharing agendas and aims (3/3)
2.1.2.3 Conducting activities together (1/1)
2.1.2.4 Emotional support (5/9)
2.1.2.5 Comparing (1/1)
2.1.2.6 Modelling (1/2)
2.1.2.7 Peer pressure (2/2)
2.1.3 Colleagues at work (2/4)
2.1.3.1 Emotional support (1/1)
2.1.3.2 Conducting activities together (1/1)
2.1.3.3 Comparing (1/2)
2.2 Activities with negative effects on health (12/19)
2.2.1 Close friends (10/14)
2.2.1.1 Comparing (1/1)
2.2.1.2 Cooking and shopping healthy food (1/1)
2.2.1.3 Conducting activities together (5/5)
2.2.1.4 Counselling and mentoring (1/1)
2.2.1.5 Peer pressure (5/6)
2.2.2 Community friends (gym and weight management groups) (3/5)
2.2.2.1 Comparing (2/3)
2.2.2.2 Counselling (2/2)
**3. Healthcare professionals as negative influencers (11/20)**
3.1 Activities with positive effects on health (2/3)
3.1.1 Emotional support (1/1)
3.1.2 Counselling (2/2)
3.2 Activities with negative effects on health (10/17)
3.2.1 Counselling, patronising and not providing person-centred plans (7/12)
3.2.2 Communication, lack of a sensitive approach (4/5)

In the main, three types of social relationships were identified through the narratives and network diagrams: family members, friends and healthcare professionals. The activities by which these relationships could influence participants' health are explained in detail below. The interviewees reported potential health consequences related to mental health and the adoption of different health practices regarding eating, physical activity, and alcohol intake. Also, broader social and economic contexts within which these interactions were situated could be identified as part of the narratives.

Three main relational themes were identified: (1) *everyday familial routines matter*, (2) *chasing healthier lifestyles: comparing, modelling and connecting emotionally with friends*, and (3) *healthcare professionals as negative influencers*.

### 5.3.1 Everyday familial routines matter

Participants reported histories of influences stemming from interactions in domestic settings over time, starting from childhood to the present. Family members were the most mentioned people in terms of influence on participants' health. Eighteen participants addressed the importance of their families in everyday routines which could induce different health related responses from participants.

#### 5.3.1.1 Activities with positive effects on health

Past interactions with family members during childhood have salient current meaning and positive effects on some participants' lives. For example, mothers providing education on cooking and eating healthier was reported as having effects on participants' current relationship with food, knowing what they should eat to prevent gaining weight.

> "I think a positive influence of my family background is that I was taught cooking. So from a boy I was able to cook and that makes all the difference" (participant 13).

> "For me my relationship with food is probably completely different and I think also again for my upbringing my mum was very much she was really good with making sure we ate well" (participant 18).

Sharing contemporary lifestyle goals and making joint efforts with partners to achieve those goals was reported several times during the interviews. For instance, participant 10 explained the interaction with her boyfriend to motivate themselves, exercising and preparing healthier food together:

> "My boyfriend influences me a lot: we go to the gym together, we cook together, this week we talk about cooking healthier food, we go running 3 or 4 times a week. We are always saying to each other, come on, now we are going to run because we are relaxing" (participant 10).

Children were identified as ties which influenced. For example, some parents pointed out their honesty to comment on things, exerting pressure as reminders to be aware of what they needed to improve. These positive interactions could work in both directions. Thus, participant 5 highlighted how her children increased her awareness of what she was doing wrong, and, consequently, this could enhance her to improve her shopping, cooking and teaching practices towards them.

> "They are both teenagers, they started giving back so they would tell me we really need to have more vegetables mummy or why are we having chips again…, it's started working both ways because when you are a parent and they are little you take decisions for them and you teach them, etc." (participant 5).

Pets were found to have a role in providing opportunities for physical exercise for their owners. For some, dogs encouraged daily physical activity and, also, walking the dog with friends who also owned pets provided a supportive context to connect with others and conduct exercise together.

> "The last 18 months I've done my main exercise had been walking the dog, but not great distances. The Labrador I used to love going 4-5 miles" (participant 12).

> "I'm not close to the forest but it's only a car journey away so I've got friends that have animals and stuff as well so we've been on dog walks together" (participant 4).

#### 5.3.1.2 Activities with negative effects on health

Several participants reported growing up seeing and modelling bad eating habits from members of their families. For example, participant 10 highlighted that gaining weight and developing a 'strange' relationship with food could have its origin during childhood since her father had already bad habits around food:

> "My father's way of eating is brutal. He eats fat, sugar, he eats very badly; eat everything that should not be eaten; vegetables, once a month. Well, I imagine that during my childhood; all that has affected me a lot, developing a relationship with food that is a bit strange" (participant 10).

Also, parents could provide an excess of control rather than adequate emotional support. Some participants described their parents as monitoring and using normative judgemental attitudes, questioning interviewees' efforts and provoking tensions within the relationship. Participant 13 mentioned these issues over the years:

> "My parents, 'cause they are negative. There's not so much they do anything now, but there's been an historical perspective on it, which is that my parents were very when I was growing up, were very invasive in terms of my body shape" (participant 13).

Conducting everyday life with family members in tandem could be a potential risk of gaining weight. For example, participant 13 explained the relevance of sharing drinking and sedentary practices with his partner over the years and recognised the importance of conducting together other activities to work towards opposite effects on health:

> "Most important person to me unquestionably has to be my husband. So basically we've been together for 24 years now, and on our health and well-being lifestyles are very pretty much together, always hard, isn't it? With diet because when you have somebody who is there to share a bottle of wine or you know or to watch a film instead of doing some exercise either you sort of bad for each other, and so we tend to put on weight together at the same time, and the health deteriorates over time" (participant 13).

Social relationships occur within specific social contexts, and broader social and economic factors could shape some activities within these interactions. For example, family economic conditions and food prices could have modified the type of food that some parents bought and cooked for their children. Participant 1 commented on the difficulties when there was insufficient income at home during her childhood, which could influence the type of food they were having at home:

> "My mum tried her best but that was, obviously quick easy food was a bit cheaper as well and obviously being a single parent she got what she could afford" (participant 1).

Another broad factor was the restriction and changes to everyday practices in response to COVID-19 isolation policies which could have modified how families bought and cooked food for the worse:

> "With this pandemic, there were a few occasions when I actually served to my children a ready-made lasagne, heavily reduced. When I did it the second time, they said oh my gosh mummy are we going to eat ready meals from now on" (participant 5).

> "The pandemic was difficult, shopping was horrible, between queues, the first days the fact that there was nothing on the shelves. We believed in comfort eating" (participant 14).

### 5.3.2 Chasing healthier lifestyles: comparing, modelling and connecting emotionally with friends

The influence of friends was the second most mentioned type of relationship among the participants, and several activities, most of them with a potential positive impact on health. Comparing with friends that had already healthy lifestyles and modelling their practices was identified. For example, participant 8 started hanging out with a healthy friend to move from inactive to exercise. Also, participant 12 was suggested for trying a new diet that caused his friends to lose weight:

> "A very close friend of mine promoted healthy food a lot, we go to the gym and for walks together" (participant 8).

> "A friend of mine, last September and his wife. He sent a picture of him and his wife. And he said, what do you think? We've lost about three stone and we're going to a wedding and I've to go and get a new suit because this one don't fit anymore and he was like holding these trouser waist out a massive gap. Have you done that? They just followed a diet called Asansi, and he said you wanna give it a go? So I gave it a go for two" (participant 12).

Engaging with different community resources such as gyms and weight management groups provided opportunities to build relevant friendships which could influence in different ways. For example, exercising with other gym members was relevant to establishing a supportive psychological network and maintaining habits. This was explained by participant 6, who used to have obesity and started a gym journey to lose weight and keep fit:

> "Then because you go to the gym, because you do exercise, because you know how it feels to be overweight in the past, then you start hanging out with friends or making new friends that help you in the support not just psychological support but also when it comes to going to the gym or doing any sport or any other activity but that you like, that you consider important for you in your life" (participant 6).

Leadership and support provided by personal trainers enhanced behaviour change and the maintenance of habitus during a fitness journey. Participant 1 highlighted a person-centred

education and the emotional support provided by her personal trainer, whom she already considered a friend.

> "So I started with my PT about a year ago, over a year ago, on my fitness journey, whatever you want to call it, and he has taught me a lot, he's taught me about myself, he's taught me about food, he's taught me about my relationship with food and he's also taught me about my exercise. So actually at the moment in terms of actual aspects of health he has probably been one of my biggest positive motivators at the moment. He's just helped me with my health behaviours and the fact that food and exercise can be enjoyable. He's become a friend probably at the end of all of this as well which is really good" (participant 1).

Friends from weight management groups shared agendas and aims, such as chasing specific lifestyle goals. Living similar experiences allowed them to connect emotionally with other participants. Also, they could compare with each other and be a source of motivation to change practices. This was explained by participant 15:

> "My running clubs and my bootcamp class, they influenced me the most, more than my family, because they are encouraging and they are friendly and competitive. So in terms of my weight loss journey and my weight now, I think the people that are most important and influences me the most are certainly my friends that I've met through the clubs, running and bootcamp club…But I think that other magic of slimming world apart from the good food, is it's a group thing, this incredible community spirit of people who are going through the same stuff, meet up once a week for an hour and have a chat about what's difficult for them and how to change their lives" (participant 15).

Friends who did not experience similar life circumstances were found to be crucial in providing emotional support. Thus, trust and the degree of intimacy between close friends, respect and understanding were reported. For example, participant 9 stated being able to talk to any of his closest friends about weight concerns.

> "A few of my friends I think I would put there. And could have quite frank conversations about how I'm feeling, how they are, if you've got any weight problems, yes to be able to talk to them more" (participant 9).

On a few occasions, friends were found to influence negatively. Thus, most adverse health practices from their influence happened when modelling them in social gatherings and meetings. These involved eating worse and drinking above the recommended amounts of alcohol in

company. Participants 7 and 11 identified conducting certain activities and modelling what others did to facilitate social interactions.

> "You go out with your friends, you have drinks, you go out for food, it's all just, if your friends smoke you are more likely to smoke, it's hard to avoid things that are not necessarily good for you if your peer social group do it as well" (participant 7).

> "Where before you end up just getting flush and drunk because it's available, it's free, it's being sociable if you know what I mean" (participant 11).

### 5.3.3 Healthcare professionals as negative influencers

Different types of healthcare professionals, mainly General Practitioners (GPs) were identified to have a negative impact. Although the interviewees had less contact with them, they were considered in the main to be unhelpful. Ten participants recognised them as negative influencers to manage obesity by increasing the stigma, not exploring each case in-depth or not providing the right tools to improve physical activity levels or diet. For example, participant 1 pointed out that healthcare workers were patronising and did not provide person-centred individualised plans over time:

> "I've found them to be quite patronising over the years because I've gone to them a few times and obviously being like I've got these issues and they're like well you need to do this, this and this, you need to change this and it's like OK how are you going to help me do that. And they're like oh, that's not an excuse my daughter does this, and it's like well but your daughter is very different to me, you are not being individualised of me" (participant 1).

Additionally, other participants mentioned the lack of a sensitive approach in the language. For example, participants 2 and 7 highlighted the repetitive use of certain words such as 'obese' or 'fat', words they do not find very supportive and make them feel upset.

> "So every time I go and see my GP he tells me I'm too fat, he tells me I'm morbidly obese, which is not very helpful" (participant 2).

> "And I know when I was obese and I went to the doctors it just made me more defiant, they were like you are obese and I was like no I'm not. It's just not a very kind way of dealing with it" (participant 7).

Participant 14 even stated that his GP obviated that he was taking some medication (for another condition) whose side effects were weight gain. However, the clinician was justifying his obesity with a bad diet:

> "I went to the GP and he told me you have fitting yourself into obesity. That after having been taking, and he knew it, I was taking Mirtazapine for months that make you gain weight. Going to a GP because you are taking depression pills and then he is telling you that you have become obese because of what you have eaten…it does not help your mental health either" (participant 14).

## 5.4 Discussion

This research moves away from the traditional understanding of networks and obesity, which has focused on studying structures and its spread in clusters of people. Instead, this qualitative inquiry sought to gain an understanding of how and why some social relationships influence the everyday health of adults with obesity. Specifically, our results illuminate the contingent and multifaceted ways in which networks can influence obesity-related practices in adults related to eating, physical activity and alcohol intake.

The visualisation of network diagrams and the narratives show that immediate family members were the most important relationships for participants. The potential impact of the family is not new, and it has been explored before, for instance, in relation to people living with type 2 diabetes (Kennedy *et al.*, 2015; Knutsen *et al.*, 2017). This study adds to existing evidence by identifying and describing positive and negative interactions over time, starting during childhood and continuing today through everyday routines at these domestic settings. From a positive perspective, parents' provided education on how to cook and eat healthy during the early stages of some participants' life, which contributed to their current and healthy relationship with food. In addition, elements of mutual influence were found, such as sharing lifestyle goals and making joint efforts with partners to eat healthier and increase physical activity levels and the pressure exerted by children to eat healthier. Consequently, some parents (participants) changed their shopping and cooking practices. Similar to our findings on the positive impact of children, other authors point to the role of children in supporting participants in making healthy shopping choices (Shand *et al.*, 2021). Pets (considering them as part of the family) provided daily exercise to their owners. This supports existing evidence on pets' positive role in supporting people with other long-term health problems (Brooks *et al.*, 2016). From a negative perspective, growing up seeing and modelling bad eating practices from parents, exerting excessive control and pressure by parents, again sharing and conducting, in this case, non-healthy lifestyles with partners and

buying and cooking unhealthy food depending on economic capabilities were reported. In line with the latest, Thayer *et al.* (2021) pointed out in a recent study in teenagers how a family's financial position influenced what foods their families purchased in stores.

Friends were the second most mentioned type of influential relationship, and their impact was usually positive. The participants identified the role of intimate or closest friends and friends from other meaningful social systems (weak ties (Ibarra, 1993)). The latest was friendship relationships built in community settings as part of the participants' lifestyle journey, providing opportunities to access diverse resources (MØnsted, 1995). These results echo more recent evidence, which suggests the relevance of weak ties for the self-management of other LTCs (Rogers *et al.*, 2014; Vassilev *et al.*, 2016). Considering the activities within these friendship interactions, comparing with intimate friends that had already healthy lifestyles and modelling their practices were drivers to increasing exercise levels and trying new diets. Also, engaging in gyms and weight management groups (community settings) offered the space to interact with personal trainers, gym and group members (weak ties friends) to whom share similar lifestyle norms, compare, model and find a source of motivation, information and emotional support to change and keep practices over time. This is the only relevant difference between the participants who had lost weight and do not have obesity currently and those with obesity. Thus, most of those who have been successful in their weight loss journey had more varied networks with the inclusion of community interactions. Other studies show how finding people with similar characteristics and lifestyle norms improve people's capacity to improve their mindset and motivate changes (Jepson *et al.*, 2012). As with previous research the interviewees reported emotional support to understand and respect new choices by intimate friends (Øen *et al.*, 2018). The only negative influence of friends was noted when eating and drinking were involved in meetings, potentially due to sharing norms (e.g. drinking alcohol when socialising) or modelling others to facilitate social interactions. This supports existing evidence about the impact of friends in social events and gatherings in other countries (Yoon, Yoo and Kwon, 2018), and that individuals eat more when their friends eat more, and eat less when their companion eats less (Baker, Strickland and Fox, 2019).

In addition to the influence of informal networks (family and friends), the participants identified the impact of healthcare professionals, although they were more peripheral in the network diagrams on most occasions. Although this is not a new issue in the literature, the negative influence of healthcare professionals (Young and Powell, 1985; Thomas *et al.*, 2008; Owen-Smith, Donovan and Coast, 2014) (we could name them formal networks) was reported. The interviewees detailed the lack of effective counselling and individualised care plans to change health practices, and the lack of a sensitive approach and harmful language during the communication, such as reiterating the use of 'obese' and 'fat'. Current research by other authors

in the UK explores how healthcare professionals consult with people living with obesity regarding weight loss and identify similar issues (Albury *et al.*, 2020; Talbot *et al.*, 2021; Warr *et al.*, 2021). For example, the use of a biased, generalised and non-person-centred language, conversations of causes of obesity focusing on individuals' management and the lack of a collaborative approach between the professional and the person to identify individual, meaningful goals were highlighted by others and confirmed by us.

Contemporary intervention guidelines (NICE, 2020) and prevention lifestyle measures mention the benefit of receiving support from different individuals to lose weight and prevent weight regain. Most of this information seems very superficial and does not delve into how our daily and closest relationships can cause positive and negative health changes and the opportunities and the mechanisms by which different people from the community can impact the weight journey. Our results and the way data was collected could be implemented in practice change and reproducing habitus of meaningful practices. Clinicians could use the described inquiry process (interviews and network mappings) to reflect on the impact of individuals' relationships and plan specific person-centred and long-term sustainable network interventions to improve individuals' physical and mental well-being in people with obesity and its associated conditions. Within the planning of actions, patients could tailor individual preferences, deciding what could work about managing their health and well-being. For example, behavioural treatments for people with obesity could include family as part of changing daily routines involving eating or physical activity. The role of friends as key to designing interventions seems to be warranted given their salience and input obesity-related practices. Interventions incorporating close personal contacts, in particular learning skills, have been found to be effective (Mills *et al.*, 2017). Also, it could be useful to increase awareness of local community health resources and how the people who participate in them could influence change practice. Different innovative interventions (Valaitis *et al.*, 2021; University of Southampton, no date) are being tested, facilitating health services addressing these issues through social prescription. The use of network mapping could be used as a reflective process by the general population. Who is important, whom they should keep, whom they should avoid, or whom they should include in their network and how they influence are some prompts that the network mapping could help reflect on.

Furthermore, this research adds evidence to the necessity of changing how obesity is approached in clinical settings. Therefore, it might be necessary to provide further education on weight management, including managing delicate discussions and stressing the multiple and complex underlying causes of obesity. This could avoid scenarios where people with obesity could self-blame as a result of negative interactions with healthcare professionals. For example, this awareness and actions in clinical practice could be implemented by introducing guidelines created

by healthcare professionals, obesity researchers, people living with obesity, carers, and other stakeholders who have worked collaboratively to address these issues.

The visualisation and the narratives of our participants' network diagrams in different moments in life presented the involvement of varied types of relationships, showing the importance of considering historical life perspectives to understand the process of gaining and losing weight and the role of networks, understanding them as dynamic entities rather than static (Morris, Kennedy and Sanders, 2016). For future research, it would be relevant the use of biographic narratives (to understand more in-depth the content of meaningful relationships over time) with the exploration of the structure of social relationships using network metrics could provide an upgraded tool to explore their impact on health over time.

Also, more qualitative research needs to be conducted to explore in-depth private accounts about living with obesity to continue gaining a necessary and still sparse understanding of its multiple causes and the meaning of living with it. This could be used as part of participatory action research in which researchers and the affected populations work together as agents of change to generate strategies to tackle obesity and its related health and social issues. Involving their voices to develop new policies must be a priority to address the current psychology and aetiology of obesity and ensure that they receive adequate quality care with effective and person-centred interventions. Also, their empowerment and taking roles in patient and public advocacy could contribute to ending still some crucial barriers such as weight stigma and discrimination.

### 5.4.1 Study strengths and limitations

One of the strengths of this research was the use of network mapping to identify members of participants' social networks and reflect on how these influenced their health behaviours. Furthermore, the narratives not only showed the enmeshed and collective nature of the negative influences to adopt unhealthy practices but also how relationships could be a solution to conduct healthier lifestyles and reverse the effects of obesogenic environments from a micro perspective.

On the other hand, this research and its development context show challenges and limitations. The COVID-19 pandemic, the lockdowns, and the fact that this topic encompasses significant social stigma challenged the recruitment process and the possibility to attract more interested potential participants. Forty-four local and national weight management groups and obesity and LTCs charities were contacted with no success. The majority did not reply to the requests (a follow-up email or message was sent to each potential participant and group if there was no initial response). A few just declined the potential participation without providing reasons. Others stated that the lockdown period was not the moment to conduct this type of research. Also, a

varied sample of participants (e.g. different sociodemographic characteristics) could not be obtained and the relationship between the individuals' attributes and their attached health opinions was not explored. Therefore, the new understanding of relationships' influences must be considered cautiously and not establish generalisations since they might not apply to people with other sociodemographic characteristics. Another potential limitation might be the accuracy of the network diagrams. The original idea was to collect the network data in person with the participant. However, the pandemic changed the way data was collected. Although the concentric circles with some instructions were sent to think about and draw their networks several days before the interview, some people did not conduct the exercise. This could lead to exaggerating some relationships and omitting others that may be important to their health (Ahrens, 2018) when interviewing online due to the limited availability in time.

## 5.5 Conclusions

This qualitative approach offers a new way to explore what and how social relationships influence the health of adults with obesity and thus point to the content of intervention that foregrounds relational resources in changing obesity-related practices. Specifically, it identifies different types of relationships, activities within these interactions, and specific contexts that could induce positive and negative health outcomes. As part of our results, we raise awareness of and reflection on the relevance of informal relationships (family and friends) and the negative impact of healthcare professionals (as formal relationships) to manage obesity and its wider-related health issues. These relationships can shape the risk of gaining and losing weight and impact mental health through the different activities we have unravelled. Our exploration could make the general population and stakeholders aware of the power of social relationships in health and well-being, suggesting their relevance to creating individual person-centred and long-term sustain.

**Conclusion of chapter 5**

This chapter has focused on studying social networks as part of the obesogenic environment to understand the adoption of obesity-related practices by utilising network diagrams and network-specific interview questions. The next chapter explores further aspects of interactions of the individuals with other obesogenic environments using lay perspectives.

# Chapter 6 Beyond individual responsibility: exploring lay understandings of the contribution of environments on personal trajectories of obesity

This chapter shows the third and last article of this thesis. As part of the qualitative network approach, it explores and identifies other components of the obesogenic environment unrelated to social networks and how people with obesity interact with them. The chapter is connected to the specific objective c).

## 6.1 Introduction

The worldwide prevalence of obesity almost tripled between 1975 and 2016 (The Lancet Gastroenterology & Hepatology, 2021), with an associated rise in other long-term conditions (WHO, 2022a), including hypertension, coronary heart disease, type 2 diabetes and joint and muscular disorders. This rise is projected to continue estimating that by 2050, half of the adults in different countries (e.g. England) might have obesity (Agha and Agha, 2017). It has been suggested that prevention efforts should focus on a multiplicity of factors, including biological, sociological, psychological, and economic influences and the dynamic interactions between them (Foresight, 2007). However, research on obesity has tended to focus on individual behaviours, overlooking the environmental determinants of health outcomes in which individuals spend their lives and shape lifestyles and choices (Kickbusch, Allen and Franz, 2016). This tendency has shifted with the introduction of the need to study obesogenic environments, the sum of influences that the opportunities, surroundings, or conditions of life have on promoting obesity in populations and individuals (Swinburn, Egger and Raza, 1999). These environments are complex and require multidisciplinary approaches to disentangle them (Stokols *et al.*, 2003).

Most studies looking at pathways and mechanisms by which the environment influences behavioural physical activity, eating practices, and weight gain, have used cross-sectional study designs to answer whether and to what extent environmental characteristics are associated with these outcomes (Lake, Townshend and Alvanides, 2011). Research that has been done on environmental causes of obesity to date from a qualitative approach originates mainly from countries outside the United Kingdom (UK) and has focused exclusively on the food environment or the physical environment (Pitt *et al.*, 2017; Brown *et al.*, 2019; Ozodiegwu *et al.*, 2019; Neve and Isaacs, 2022). Research in the UK has explored perceptions of children, teenagers and parents

of food and physical environments (Pearce *et al.*, 2009), low-income populations about the food environment (Thompson *et al.*, 2013, 2018), or adults and the availability of urban parks and physical activity (McCormack *et al.*, 2010). In addition, previous research shows the relevance of exploring lay views of the causes and management of obesity and identifying the environment's potential impact. For example, one study showed that while most healthcare professionals identify structural and social factors as causes and solutions to obesity, the lay population seem to lean towards greater endorsement of biological and behavioural factors for causes and solutions (Ogden and Flanagan, 2008).

In line with this, the present study aims to cover a research gap that asks to explore lay beliefs used by individuals (Popay and Williams, 1996; Helman, 2007) to explain the wider notion of the obesogenic environment as a reason for ill-health in their everyday lives and enhance understanding of the interactions between these environments and individuals in the adoption and enactment of eating and physical activity practices. This will extend the focus to a more in-depth analysis of obesity-related practices in obesogenic environments independently of engagement with professional perspectives of specific causes and management strategies. Also, to our knowledge, exploring the wider notion of the obesogenic environment in adults in the UK by exploring individual experiences has not been done before. Therefore, the aim of this research is to understand the influence of environments on the adoption of health practices in adults with obesity and to identify lay strategies with which to address environmental barriers to behaviour change.

## 6.2 Materials and methods

### 6.2.1 Design

This study used a constructivist epistemology hermeneutic phenomenology (Given, 2008). The researchers' assumptions were not bracketed or set aside but were embedded and essential to the interpretive process (Laverty, 2003). Qualitative research was used to identify environmental factors that may have been overlooked in the construction of previous theoretical ideas (Broers *et al.*, 2021) and offer an in-depth understanding of the processes that underpin the interactions between individuals and the multiple environments in which obesity-related health practices occur (Blue, Shove and Kelly, 2021).

Ethical approval to conduct the research was obtained from the Faculty Ethics Committee under the reference ERGO 55638.

### 6.2.2 Participants

A purposeful sampling (Manen, 1997) that involved snowballing was used to select participants, who met the inclusion criteria. Participants were considered eligible for inclusion in the study if they had a current or a history of body mass index (BMI) ≥30 kg/m2, lived in the United Kingdom, were able to communicate and understand English, had a device with Internet connection and microphone and an email address. They were approached in community settings and via social media (Twitter, Facebook and LinkedIn). Researchers utilised recruitments posters in community settings, online advertisements, sent letters of invitation to local weight management groups and long-term conditions related charities (asking for their managers' approval when required) from different areas of England, Wales, Scotland, and Northern Ireland and contacted advocacy individuals dedicated to empowering people living with obesity (via Twitter or email).

### 6.2.3 Data collection

Individual semi-structured interviews (Pope and Mays, 2006) were conducted by NSF between May 2020 and March 2021. An interview schedule guided the interviews with open-ended questions where language mattered (Albury *et al.*, 2020). Thus, the tone and the type of questions were reviewed by the qualitative research group members of the authors' affiliation and the two first interviewees (participants 1 and 2). The interviews lasted between 30 and 120 minutes and were digitally recorded using a Dictaphone (Olympus WS-853). Furthermore, a socio-demographic questionnaire was used to register different participants' attributes and build relationships with the individuals' conception of health opinions and experiences.

Data was collected online due to the COVID-19 pandemic. Emails were used to provide information about the study to the participants. They gave consent with the option to withdraw at any point and completed the socio-demographic questionnaire prior to the interviews. The interviewees sent this confidential information using software (SafeSend) hosted by the research institution to transfer data across the network securely encrypted. NSF used video conferencing to conduct the interviews since this method provides a more personable approach than others (Irani, 2019), which was pertinent to addressing this sensitive topic. Phone calls were considered at the participants' request or any technological problem. All interviews were held individually; eighteen were conducted by videoconference and one by phone call. Researchers had no therapeutic relationship with the participants.

### 6.2.4 Data analysis

The interviews were transcribed verbatim, ten of them by NSF and the rest by a professional transcriber. Anonymised transcripts were uploaded to NVivo (version 1.2) to support the analysis. Reflexive TA (Braun and Clarke, 2006) was taken using and adapting to this research a six-stage framework (Braun and Clarke, 2021) to identify, analyse and report shared patterns of meaning across data. Data analysis followed an iterative and inductive process since the new themes and codes were created through the research, with movement back and forth between the different phases. The different phases consisted of (i) reading the transcripts to become aware of the content; (ii) identifying and coding essential features of the data related to environmental barriers and opportunities; (iii) examining the collating data and codes to build up broader patterns of meaning; (iv) candidate themes were reviewed against the dataset to determine a trustworthy story; (v) creating an elaborated analysis of each theme and developing each theme's focus, and (vi) finalising the themes and producing the report. The detailed analysis process, which aims to show a thoughtful and reflective engagement with data, can be seen in Appendix K.

Co-authors (AR and MCP) were contacted to peer review the analysis process to ensure meaningful interpretation and the trustworthiness of codes and themes. Two tools were used to ensure the quality of the results: the COREQ checklist (Tong, Sainsbury and Craig, 2007) and the tool for evaluating TA manuscripts developed by Braun and Clark (Braun and Clarke, 2021). The different domains with our answers can be seen in Appendix L. Also, participant 1 agreed to verify the interpretation of the results and no concerns were raised. After the seventeenth interview, no new codes and themes were created from the narratives. At that point, the authors decided that there was data saturation (Saunders *et al.*, 2018). However, two more interested participants were interviewed to ensure and confirm that there were no new emerging codes and themes.

## 6.3 Results

Nineteen adults (thirteen women and six men) who have or used to have obesity were interviewed. Table 6 summarises the main attributes of each participant.

Table 6. Participants' attributes.

| Participants | Age | Current BMI | Long-term conditions | Place of residence | Occupation | Work situation |
|---|---|---|---|---|---|---|
| 1. Female | 25-29 | 36 | Underactive thyroid | Affluent urban | Nurse | Full time |
| 2. Female | 40-44 | 36 | IBS, arthritis, fibromyalgia | Affluent urban | Cafe manager | Part-time |
| 3. Female | 40-44 | 34 | Mild asthma, back pain | Affluent rural | Nurse | Part-time |
| 4. Female | 25-29 | 35 | Asthma, polycystic ovarian syndrome | Deprived urban | Healthcare assistant | Full time |
| 5. Female | 45-49 | 34 | Nil | Affluent rural | Clinical trials assistant | Full time |
| 6. Male | 30-34 | 33 | Nil | Affluent urban | Military services | Part-time |
| 7. Female | 25-29 | 25 | Nil | Affluent urban | Trainee mental health nurse | Full time |
| 8. Female | 25-29 | 33 | Nil | Affluent urban | Physiotherapist | Part-time |
| 9. Female | 55-59 | 30 | Barrett's Oesophagus | Deprived urban | Nursery supervisor | Full time |
| 10. Female | 30-34 | 29 | Nil | Affluent urban | Nurse | Full time |
| 11. Male | 40-44 | 28 | Nil | Deprived urban | Nurse | Full time |
| 12. Male | 65-69 | 35 | Nil | Affluent rural | Procurement and supplies manager | Pensioner |
| 13. Male | 45-49 | 29 | Depression, reactive arthritis | Affluent rural | Health researcher | Full time |
| 14. Male | 35-39 | 49 | Psoriasis | Deprived urban | Video editor | Unemployed |
| 15. Female | 50-54 | 27 | Asthma | Affluent urban | Nurse | Full time |
| 16. Female | 55-59 | 39 | Nil | Affluent urban | Social worker | Part-time |
| 17. Male | 35-39 | 24 | Nil | Affluent urban | Goods operator | Unemployed |
| 18. Female | 25-29 | 33 | Underactive thyroid | Affluent urban | Manager business | Full time |
| 19. Female | 18-24 | 40 | Nil | Affluent urban | Student | n/a |

Three main themes were created: *Living with convenience and normalcy: the increased accessibility of unhealthy food*, *people interacting with digital media for positive practice change*, and *the need to prioritise prevention in schools, the National Health Service and the food industry*.

### 6.3.1 Living with convenience and normalcy: the increased accessibility of unhealthy food

Participants identified the food environment as the main barrier to adopting healthier lifestyles, above all, through increased access and exposure to convenient food, triggering participants to eat unhealthier. For example, participant 14 explained the disproportionate amount and reduced price of processed products compared to healthy and fresh food. Participant 2 also pointed out the small number of healthy restaurants available compared to fast-food restaurants:

> "Accessibility in supermarkets. There are two whole aisles with chips in a supermarket, another one only with cookies and chocolate. It's like oh my god, and ridiculous prices. It is cheaper to buy four doughnuts than buying lettuce". (Participant 14)

> "There is far too much, far too much fast food and convenience food around. It's heart breaking that when you are going along the shops all you are seeing is things made of pastry and sugar and burgers and things like that. It's not very often you find a salad bar for instance. It's much easier for our society to jump into quick food and it's unhealthy food". (Participant 2)

A discrepancy was found in the narratives when justifying shopping practices using a limited budget. Some of the participants preferred the purchase of unhealthy food since it is normally cheaper, full of high calories, and lasts longer than fresh and healthier food. For example, participant 4 described why she preferred to buy a big bag of processed chicken nuggets rather than vegetables and fruits. In contrast, participant 11, who is currently in healthy weight status, assured that eating healthy food is not more expensive. However, it is about adjusting personal practices and overcoming the structural incentives to buy less good food based on triggers from the environment:

> "For example each month I will buy a big bag of chicken nuggets which has got 50/60 chicken nuggets in there because I know that's going to last me the month and it's going to do my kids a meal at least once a week. That's like £3 a bag. I can't get loads of fruit and veg for £3, or I can't make another meal for £3. It's weighing them up". (Participant 4)

> "It’s not expensive. It’s about appropriating and being more knowledgeable what are your options really… so if I buy for instance beef one good example probably going to

> cost me £5 per kilogram and then if you buy chicken wings it's probably £2 for a kilogram. I would rather have the £5 per kilo beef that I know because it's a kilogram that will leave me with probably between 6 to 8 portions and that's going to sustain me for what four days for a fiver. And then you go to KFC (Kentucky Fried Chicken) or value meal of £6. It doesn't make sense. So I buy quality food and I only buy what I need to eat and anything I don't need to eat I don't buy them anymore". (Participant 11)

The demands of working life and employment inequalities were identified as causes of undermining lifestyles, involving greater burden and more effort on top of demands to earn enough to eat healthier. For example, participant 4 stated the difficulty of integrating healthy eating within her family (shift workers) due to the lack of time to cook; they just warmed pre-cooked food. Also, participant 5 recognised accessing unhealthy food after stressed and long days working at the hospital and a lack of resources of time and energy.

> "Being a working family, I do my shift work and my husband works really weird shifts so he does 2pm until 11pm at night so he's not here when the kids get home, he's not here for teatime. Living with my parents they do a lot of childcare so it's a kind of anyone and everyone does everything. My mum and dad both work so it's chuck something in the oven and forget about it, leave it in for half an hour and then you've got dinner rather than prepare something". (Participant 4)

> "Even if I have a day when I spend just collecting data we have got loads of data collection for those studies, loads, so I can spend the day just going through the hospital system trying to find information for the database. So I come back home and I'm drained again, tired. This is where I look for shortcuts when it comes to food. I have my nap, it's 6pm in the evening I'm not going to make a fancy meal, it needs to be something quick". (Participant 5)

Another relevant aspect related to work-life was the availability of unhealthy food in hospital settings. Most of the participants that worked in this context reported a normalised custom by patients, families and work colleagues to deliver high-content sugar and calorie food such as snacks, chocolates and cakes as a token of appreciation for their care and as a mean of 'fuel' their busy days. The constant availability of this type of food in staff rooms and kitchens increased the exposure to unhealthy eating; for example, participant 1 explained this situation:

> "Then obviously all the free food we've been getting which has not been helping or the free chocolate – we got a massive order the other day of just chocolate upon chocolate

upon chocolate. Sweets. Which is lovely and we're all incredibly grateful but it does make it a little bit harder". (Participant 1)

### 6.3.2 People interacting with digital media for positive practice change

The interviewees deepened their relationships with new technologies in their day-to-day life and uncovered different characteristics and ways in which they positively influenced. The participants identified the role of digital media in shaping healthy lifestyle knowledge, which could lead to positive changes in dietary and exercise practices. For example, participant 17, who used to have obesity as a young adult, highlighted a transformation due to his fitness journey. Constant physical training, the motivation to become a personal trainer and getting helpful content on YouTube on physical exercise and different types of diets supported a positive, healthy lifestyle change. Also, participant 2 mentioned how the use of different technological platforms allowed her access to free, inspirational, reliable and scientific information, also with the thought that this information could be transferred and applicable to her circumstances. Consequently, she felt more confident in attempting to modify her cooking practices and perform physical exercises:

"I was very aware of obesity due to my past, and I decided to become a personal trainer. And apart from that, I spend much time on YouTube, getting informed. You start looking at workouts, then you start looking at diets, then you start looking at supplements, and then you end up looking at what a lifestyle is. So maybe my point of view is very different from how the rest of the population, who may not invest their free time in knowing about these things. I like it; I enjoy it". (Participant 17)

"I think one of the main things that started me changing the way I was thinking about things was I found TED talks. I didn't know what that was, my goodness just when you are washing up or you are in the kitchen cooking you've just got a TED talk playing in the background just on random things about what you'd like to learn about, giving you proper scientific evaluation of things and it gives you more confidence to think I am right. The computers and the TV have come in brilliant because the amount of things that you can access for free like indoor exercise, exercise for older people which is useful for me even though I'm not old with yoga and things like that it's been really good for me and it's given me a lot of chance". (Participant 2)

Some participants did not explain the positive influence of digital media exclusively but the importance of specific digital celebrities and influencers in diffusing relevant information and, above all, how that information was transmitted. For example, participant 5 explained a YouTuber's positive influence since this person was very relaxed in his approach to preparing new

cooking recipes. This way of communication motivated her to try to incorporate a change in her cooking practices:

> "She pointed me in the direction of this guy on YouTube and I hate watching YouTube videos, there is too much choice, there is just too many people doing those things. I liked this bloke because he was very relaxed in his approach, he wouldn't preach me on the type of flour I had to have, he was like do you know it doesn't really matter. A lot of it was very relaxed so I thought actually watching him saying oh I can do that it's possible". (Participant 5)

### 6.3.3 The need to prioritise prevention in schools, the National Health Service and the food industry

The interviewees were also asked about their strategic priorities if they were the Prime Minister of the United Kingdom to reverse the harmful effects of the environment on their health practices. All of them were clear about the need to focus much more on a preventive approach to three particular environmental influences: schools, the NHS and the food industry. Thus, the prioritisation of education in children was identified as the most important action. For example, participant 15 highlighted a need to change children's knowledge at schools, specifically, by providing education on cooking healthy and increasing the awareness of the content of food in terms of calories and types of nutrients. Participant 1 extended this thinking and added the importance of involving working parents in cooking lessons, specifically, to develop knowledge about cooking healthy with a limited budget. For this participant, the loss of cooking skills is a current nationwide issue:

> "Start with the kids, with children and teach them how to cook properly, teach them how to cook at school, bring back sort of very basic home economics, but not just teach them how to cook, but teach them what is in food. So the calorie content of food to understand, you know, you shouldn't be going over a thousand eight hundred calories a day if you weigh this amount of weight". (Participant 15)

> "I would invest the money into schools, into education in food into schools – not schools so much but I think cooking lessons. Yes, I think if you can have a good relationship with food when you are younger and you can learn how to experiment with food, I don't know if I want to say for like working families. I think food is fun and I think people need to know that there is fun from food, but I think people just don't know how to cook. So I think that they go for the easy option, they don't learn. Parents aren't available to be able to teach them how to cook. I learnt how to cook as I got older, but I

never learnt with my parents whereas my friends' dad is a fantastic cook and she learnt how to cook from him. I think if that was something that you gave people those opportunities to learn and taught them how to do it really basic like on very limited money, I think if it's like a mandatory thing you do with your parents at school as you grow up, like the parents come in, the kids come in and they learn to cook". (Participant 1)

According to participants' opinions, despite obesity being a significant health issue, the NHS seems far from tackling it effectively. Thus, the second most important priority was investing more money in the NHS to create more primary prevention services and work towards a change in the obesity management plans. For example, participant 11, who had a leadership role in the NHS, explained that the current strategies focus more on developing treatments and interventions for those affected and experiencing long-term conditions related to obesity (e.g. cardiovascular diseases) instead of developing measures for preventing excess weight and conducting healthier lifestyles. Participant 14 also highlighted the importance of prevention and added the need to contract more multidisciplinary specialists to deal with health practices and other causes and the wider consequences (e.g. biological and psychological) related to weight loss.

"Not much investment on preventative medicines or primary prevention. You'd probably have more money to help people and put ICDs (Implantable Cardioverter Defibrillator) and very expensive heart surgery but no investment for people to live healthily, give them support to lose their weight, no investment to give them healthier options or fitness training or have the ability to actually have a very good work/life balance". (Participant 11)

"Above all, strengthen the health system in terms of prevention and forms and give real money in terms of weight reduction, more dietitians, more nutritionists. Prevention based on tests when children start to gain weight. The entire NHS's vital part has to be forced to implement all this, including mental health, endocrines, tests, and primary care because primary care is totally forgotten". (Participant 14)

Changing the food industry by penalising junk food companies and investing more money in British agriculture to reduce basic products' prices were highlighted as potential measurements to influence peoples' decisions and encourage them to choose healthy products. For example, participant 13 established comparisons and reflected on the positive impact of corrective taxes on alcohol and tobacco, which could have similar effects on unhealthy food. Participant 6 insisted on

the importance of investing more in farmer's markets and British agriculture to reduce the importing of food from other countries, which could reduce the price for the consumers.

> "I think stronger curtailing of, and you know, high taxation and all those sorts of things of that food industry. Like cigarette and smoking, the same has to be applied I think to fast food, so it's actually not spending money, but actually it is making harder for food companies to profit from poor quality food and high fat high sugar". (Participant 13)

> "I will try to get the companies subsidise the company who are for the key ingredients like your milk, like your bread, like your vegetables rather than constantly bringing, a lot of the vegetables don't come from the United Kingdom so invest in agriculture. We can grow our own potatoes 30 years ago to feed why can we not do so, continue to do so and produce rather than to constantly buy because it's cheaper to buy from abroad and bring in. But it's cheaper for the company not for the consumer. So bring things more locally, invest a lot more in agriculture". (Participant 6)

## 6.4 Discussion

This qualitative study covers a current gap that asked for research on lay perspectives to understand the wider notion and the potential impact of the obesogenic environment on adults with personal trajectories of living with obesity in the UK to adopt health practices related to eating and physical activity. The generated themes represent information about barriers, opportunities, and priorities to change within the environment.

The first theme describes the food environment as the most important barrier to conducting healthy practices and presents different ways people interact with it. For example, the increased availability and permanent exposure to unhealthy and cheap food in local stores, supermarkets and restaurants might encourage unhealthy food choices. This scenario is not new. Other studies showed a substantial rise in exposure to food outlets and foods for consumption away from home in the United Kingdom (Burgoine *et al.*, 2009; Poltawski *et al.*, 2020). Further research identified how retail food environments facilitate the promotion of less healthy food. For example, in Scotland, price promotions on unhealthy products present a more significant reduction in price for a set cost than promotions on healthy drinks and food (Food Standards Scotland, 2016). A particular study showed that people who buy more of their food on promotion tend to purchase more High in Fat, Salt or Sugar (HFSS) products and are more likely to be people with excess weight (Coker *et al.*, 2019). Something new was the identification of contradictions in the participants' narratives when justifying shopping and eating practices using a limited budget. Some people with obesity identified that eating healthier was more expensive than eating junk

food using a limited budget, an idea that was rejected by people who had already lost weight. I will expand on this and its implications later.

The demands of working life were facilitators to increasing access to convenient food. Thus, some current work practices make it challenging to find time and energy to eat and cook healthier. The results might uncover the presence of employment inequalities, suggesting that people with specific jobs might have less flexibility over working hours and can spend less time on self-care, mirroring the findings of other authors on other health conditions (Ettner *et al.*, 2009; Forbes *et al.*, 2016). Also, participants identified hospitals as snacking environments, considering them as negative environmental influences. This differs from the current public perspectives that consider the NHS part of a separate management system with no negative influence on individuals' health practices. Other research points out barriers to eating healthy in the workplace (without specification), such as eating more unplanned junk food in response to stress, co-worker influence and time constraints (Leung *et al.*, 2018).

The second theme describes inter-relationships of people with new technologies (e.g. social media platforms such as YouTube or TED Talks, apps, or documentaries on Netflix) and digital celebrities to improve their health practices related to eating and physical activity. Previous research outlines that higher exposure and greater attention to health in the media could lead to more excellent knowledge about healthier behaviours (Ritland and Rodriguez, 2014). In recent years, some research evaluated the effectiveness of community-cooking skills education programs designed by celebrity chefs (e.g. Jamie Oliver), which are being used to promote cooking confidence and skills as a vehicle for healthy eating with positive results (Flego *et al.*, 2014; Hutchinson *et al.*, 2016). In addition, a recent scoping review studied the relationship between social media and physical activity and identified that one-third of the studies revealed positive effects regarding the promotion of physical activity and other health outcomes such as weight loss and blood pressure reduction (Günther, Schleberger and Pischke, 2021). Compared to this previous literature, our results extend this positive influence by showing how technology and digital celebrities can induce positive changes in obesity-related health practices (e.g. through the availability of innovative and inspirational information and the manner in which information was transmitted). The last theme identifies preventive priorities in three particular environments to change the current obesity trend in the UK: schools, the NHS and the food industry. I reflect on these priorities later when discussing future implications by comparing them with previous policy interventions and potential future directions.

These themes and what has been done before to tackle obesogenic environments ask for an in-depth reflection on future implications. The information from the first theme (e.g. the

contradictions about eating healthy and price) suggests that there might be gaps in people's capacity to interact with obesogenic environments designed to promote unhealthy choices. Providing further knowledge and psychological skills for self-control (Cohen and Lesser, 2016) to protect their vulnerability against the constant exposure to what the obesogenic environments offer (e.g. HFSS promotions in supermarkets or how food stores work to encourage impulsive decisions) seems pertinent. Thus, people could make better decisions within these environments and adjust their practices to avoid their negative impact (e.g. increasing knowledge of types of nutrients or planning and preparing healthy meals for the week). Part of that knowledge could be accessed through the infinite possibilities that new technologies, social media, and influencers offer. Social media and digital tools could promote and facilitate access to healthy lifestyles, especially in populations with health inequalities that suffer from geographical, financial or educational barriers. Knowledge and cognitive skills can be changed. However, it needs to be considered that these adjustments for practice change might not always be possible or would require extra effort from people due to inequitable social structures. Some examples could be employment inequalities (e.g. time to dedicate to improving health and well-being), a severe lack of household economic capabilities that allow only the choice of the necessary (people at high risk of food insecurity, which is a current hot topic in the United Kingdom) and therefore, a potential lack of varied nutrients or close access to more expensive and small food retailers rather than supermarkets which offer more variety of food products and prices. Therefore, working parallel to eliminate social inequities seems necessary to improve health practices.

Bringing to light stories like those of the health workers who talked about the demands of working life and the hospital snacking environments could have implications. For example, they could raise awareness of the constant exposure to HFSS food at workplaces and open the door to change the social norms of providing this type of food as a sign of gratitude by patients, family and co-workers. Also, these stories could make more visible the nature of specific employments (e.g. nurses and their long day and night shifts and stress) and how they might be linked with health inequalities (e.g. more risk of developing excess weight). Despite the potential and unmodifiable nature of the everyday stress and pace of working life, measurements could be put in place to protect employees' health and well-being. For example, providing protected time to conduct healthier lifestyles during workdays and implementing employee health screenings could help identify health risk factors and promote healthy living. These messages could raise politicians' and media awareness of why a relevant percentage of NHS staff in England have obesity and avoid unfair critiques (*Anger as NHS staff accused of being 'fat'*, 2020) that focus on individual responsibility without considering the role of environmental influences.

The identified priorities by the participants to change aspects of the current obesogenic environment should be considered to understand what measures currently exist and what people know about them, what measures are working or not, and propose future actions. First, there has been significant progress in British schools in terms of education on healthy eating in children and families based on a limited budget. For example, The National Curriculum in England (introduced in 2014) implemented the subject 'Cooking and nutrition' in schools so that students could be taught about food provenance and origins, cooking and food preparation, and applying healthy nutrition and eating (Ballam, 2020). However, it is necessary to allocate more time and resources to food education knowledge, which is still inconsistent across primary and secondary schools (Jamie Oliver Food Foundation, 2017), something that can affect future practices (Serrano-Fuentes, Rogers and Portillo, 2022).

Another priority asked for a change in the way the NHS approaches obesity, with a need to focus more on prevention than treatment options and provide support to people living with obesity by incorporating more multidisciplinary specialists. Lately, recent NHS reports have developed strategies to improve obesity management (Department of Health and Social Care, 2021; NHS, 2019a). The plan is that the NHS will focus more on prevention, including obesity-related ill health and improving services for supporting behaviour change via information provision, service design and clinical interventions (e.g. targeted weight management services or social prescribing). A current example is the NHS digital weight management programme, a 12-week online programme designed to offer a personalised level of support to help manage weight and improve longer-term health outcomes (NHS, no date). Therefore, the NHS seems to be at a transition point, and changes seem to be beginning to be implemented. Ensuring that people with obesity and front-line professionals (e.g. GPs) are aware of all the new and future services available will be essential. We suggest that providing continuous and up-to-date education for patients and even professionals about the role of positive and negative environments could be considered since it seems that most weight management interventions focus exclusively on the individual and ignore those complex environments that are constantly changing and adapting to business needs.

The last priority asked for the control of the food industry and food prices. In this line, the British government has designed and implemented some strategies to tackle obesity (Cabinet Office and Department of Health and Social Care (UK), 2019; Department for Environment, Food and Rural Affairs (UK), 2020; Department of Health & Social Care (UK), 2020; Public Health England (UK), 2020; Theis and White, 2021), which seem insufficient. Thus, some authors state that there has not been enough progress since the strength of industry opposition and government hesitation to implement interventionist policies to force restraints on the free market and influence individual choice presents a significant barrier (Swinburn *et al.*, 2015; Pell *et al.*, 2019; Brookes, 2021;

Brookes and Baker, 2021). Other authors identified the inability of policymakers to regulate processes and environments relevant to chronic illness management (Rogers *et al.*, 2015). Therefore, we suggest that working on how the individuals relate to the environments and giving them the tools to make healthier choices seems more pertinent than waiting for a significant and effective response from the government and the industry.

In terms of future research and considering that the environment is constantly changing, qualitative research needs to be a continuous priority to uncover the different environmental influences that operate across multiple levels of society. Qualitative research applied to understand interactions between individuals and environments should prioritise people living in disadvantaged circumstances (e.g. low income, less education, limited access to space or more exposure to the sale of unhealthy foods) since these factors impact whether people can eat healthily or be active and increase the risk of developing excess weight. This would deepen some important aspects, such as how socioeconomic status might impact the adoption of specific health practices. In this line, understanding and compiling lay perspectives and other members of the public (e.g. healthcare professionals) perspectives about the impact of obesogenic environments could play a crucial role in developing equitable interventions and policies where health inequalities are addressed. The role of social media and social media influencers seems to be an area that needs further exploration. For example, researching the processes of interaction between people looking for health changes in social media, how and why people engage or do not with them, how information is diffused, and the identification of role models through opinion leaders theory might be relevant.

One of the strengths of this research is the use of personal accounts to uncover current processes of interaction between individuals and multiple environments and identify overlooked environmental factors that could influence the adoption of different lifestyles in adults with obesity, an aspect that quantitative studies cannot do. On the other hand, this research and its development context show challenges and limitations. The coronavirus pandemic, the lockdowns, and the fact that this topic encompasses significant social stigma challenged the recruitment process and the possibility of attracting more interested potential participants. Forty-four local and national weight management groups and obesity and long-term conditions charities were contacted with no success. The majority did not reply to the requests, a few just declined the potential participation without providing reasons, and others stated that the lockdown period was not the moment to conduct this type of research. Also, we could not obtain a varied sample of participants (e.g. different socio-demographic characteristics), so we did not explore the relationship between the individuals' attributes and their attached health opinions. Therefore,

our results must be considered cautiously and not establish generalisations since they might not apply to people with other socio-demographic characteristics.

## 6.5 Conclusions

This qualitative study explores how adults with obesity interact with multiple environments, which could shape the adoption of different individual eating and physical activity practices. The food environment seems to be the major problem due to the disproportionate amount and low price of unhealthy products and the demands and inequalities of working life as a facilitator to access them. Specific workplaces, such as hospital settings, can become snacking environments due to established social norms. On the other hand, social media and digital celebrities and how they interact with individuals and vice-versa could promote positive health changes. Schools, the NHS and food companies were targeted as negative environmental influences and the main settings to prioritise preventive measures against obesity. The results uncover new environmental factors that were not identified in previous research and potential gaps in people's capacity to interact with current obesogenic environments to make healthier choices. These perceptions from individuals living with obesity could inform the design of more adequate and effective interventions that consider, more than in the past, the interactions between the environment and individuals. Finally, this research could raise awareness amongst lay populations about the socio-ecological nature of obesity, reducing blaming and stigma from society and creating a more conducive context for political and societal change.

**Conclusion of chapter 6**

This chapter has explored lay understandings of other components of the obesogenic environment (unrelated to social networks) as a cause of adopting obesity-related practices and how adults interact with these environments. At this point, chapters 4, 5 and 6 have studied in-depth relational resources between adults-multilevel obesogenic environments. The next chapter provides an overall discussion of this thesis.

# Chapter 7 Discussion

## 7.1 Introduction

This thesis contributes to a growing research field (obesity) by understanding and developing theory about the interactions between adults with obesity and the obesogenic environment in the UK and its implications for individuals' health.

The thesis began by outlining the impact of obesity on individuals' health and well-being and on society as a major public health problem. Obesity was presented as a multifactorial condition, in which social science provided explanations regarding the evolution of knowledge and measurements to tackle obesity. This started from interventions in individuals' psychology, which have largely failed to bring sustained practice and behavioural change, to the introduction of the concept and research on the obesogenic environment. Social networks were presented as part of the obesogenic environment, and the need to further explore their impact on obesity was introduced as a priority for this thesis to understand in-depth how social networks influence the adoption of obesity-related practices in adults with obesity.

A critical interpretative synthesis (chapter 4) was introduced as a review method to develop a further understanding of the processes by which social networks influenced the adoption of positive and negative lifestyles regarding physical activity, eating and alcohol intake. The next step consisted of translating the review's results into empirical research collecting primary data. The developed theoretical ideas were used in a qualitative study to explore networks in terms of what adults with obesity or a history of obesity narrated about their involvement (chapter 5). A qualitative network approach informed by a constructivist epistemology hermeneutic phenomenology was used using semi-structured interviews (questions were developed using the knowledge from the review), sociodemographic questionnaires and personal network sociograms. When studying the influence of social networks through personal accounts of adults living with obesity, it was decided to broaden the spectrum and explore other environmental influences that could have been overlooked in the past due to the use of quantitative research. The latter was presented in chapter 6.

This discussion section starts by summarising the key findings of the three articles (chapters 4, 5 and 6). Then, contributions to knowledge are presented, bringing the results of the three articles together to provide a new understanding of the notion of the obesogenic environment while comparing it with previous relevant literature. This is connected to the specific objective d).

Finally, in this order, implications to practice and public and social policy, future research and strengths and limitations are detailed.

## 7.2 Summary of key findings

In Table 7 (see next page), the main findings of chapters 4, 5 and 6 are presented, linking them to the appropriate research questions and the methods used.

Table 7. Summary of key findings related to the corresponding research questions and methods.

| Research questions | Methods | Summary of key findings |
|---|---|---|
| How do social networks influence the adoption of health practices in adults with obesity? | Critical interpretative synthesis review | 1. The review study developed a new way of looking at social network phenomena by separating the different components of a health (obesity) scenario into 'types of ties', 'network processes' and 'contextual and individual factors'. Thus, relevant health scenarios were the effect of 'developing multi-agent coalitions' and 'cross-level influence'. This means that there is a dynamic multilevel (micro, meso and macro) set of influences between multiple constructs (networks, other contextual factors, and individual factors) that produce different positive and negative health results related to food, physical activity and alcohol intake practices. The health scenarios were:<br>• Family members providing peer support was considered the most important (the most mentioned in the literature) health scenario to adopt healthy practices.<br>• Friends exerting social pressure in social events was the most relevant health scenario to adopting unhealthy practices. |
| | Hermeneutic phenomenology, as part of a qualitative network approach | 2. The familial members type of network was the most relevant. Here the types of ties had a mixed impact on the health practices of individuals. It was identified how vital family food practices are (e.g. shopping, modelling family eating practices and early education on healthy cooking). Also, elements of mutual influence were found, such as making joint efforts or sharing lifestyles with other members of the family (e.g. partners) to conduct |

| Research questions | Methods | Summary of key findings |
|---|---|---|
| | | healthy or unhealthy practices related to food, physical activity or alcohol practices. Children exerting pressure to eat healthier was crucial; consequently, some parents (participants) changed their food practices.<br>3. Friends were the second most important type of tie with mainly positive effects. Engaging in weight management groups and gyms offered the space to interact with personal trainers, gym members and other people to whom share similar lifestyle norms, compare, model and find a source of motivation, information and emotional support to change and keep practices over time. Comparing with intimate friends with already healthy lifestyles and modelling their practices were drivers to increasing exercise levels and trying new diets. Receiving emotional support to understand and respect new choices from intimate friends was also highlighted.<br>4. Healthcare professionals were the third most relevant type of tie - identified as negative influences on the adoption of healthy practices due to a lack of understanding of multiple causes of obesity, a lack of individualised plans still a harmful and stigmatised interaction with adults with obesity, and, in general, a lack of a sensitive approach. |

| Research questions | Methods | Summary of key findings |
|---|---|---|
| How do adults with obesity interact with other environments for the adoption of health practices? | Hermeneutic phenomenology, as part of a qualitative network approach | 5. The food environment was recognised as the most important environmental barrier to conducting healthy practices. Some aspects facilitated access to the unhealthy food environment:<br>• The increased availability and permanent exposure to unhealthy and cheap food in local stores, supermarkets and restaurants.<br>• The demands and inequalities of working life make finding time and energy challenging to eat and cook healthier.<br>• Specific workplaces, such as hospital settings, can become snacking environments due to established social norms.<br>6. There were contradictions in the participants' narratives when justifying shopping and eating using a limited budget. Some people with obesity identified that eating healthier was more expensive than eating junk food using a limited budget, an idea rejected by people who had already lost weight.<br>7. New technologies (YouTube, TED talks, and documentaries on Netflix) and digital celebrities were highlighted to improve their health practices related to eating and physical activity. Technology and digital celebrities could induce positive changes in obesity-related health practices (e.g. through the availability of innovative and inspirational information and the manner in which information was transmitted). |

| Research questions | Methods | Summary of key findings |
|---|---|---|
| | | 8. Preventive priorities were identified in three environments in the UK.<br>• Schools should incorporate more education on the content of food and cooking classes involving children and other family members.<br>• The NHS needs to change its approach to obesity, focusing on prevention rather than treatment. It should incorporate more specialists to tackle the multiple consequences of obesity (e.g. mental health, endocrinology or dietitians).<br>• The Government and the food industry should contribute by reducing exposure to unhealthy products and the price of basic products. |

## 7.3 Original contributions to knowledge

This part of the thesis integrates the results of the three articles (chapters 4, 5 and 6), making an original contribution to current knowledge. Also, it covers the last specific objective, proposing a new obesogenic environment model according to the life experience of adults with obesity in the UK.

### 7.3.1 A new definition for the obesogenic environment

The concept of 'obesogenic environment' was detailed in chapter 2, exploring its origin and development. In the introduction, I described the concept's content and the respective theoretical frameworks and models. The process and results of this thesis allow identifying some weaknesses in previous ideas and provide new theoretical insights.

Traditionally, research on the obesogenic environment has focused on identifying its components (environmental determinism) rather than how the environment is used or the interaction population-environment (Smith and Cummins, 2009). Also, the context in which the definition and different models were created is unclear. Considering that "concepts must be related to contexts" (Risjord, 2009, p. 685) and having recognised some gaps in the current content of those ideas, the use of a qualitative approach to study the impact of the obesogenic environment on adults is justified. This is a useful and innovative (in the obesogenic environment research area) way to explore the non-static obesogenic environment to focus on the relational and emergent qualities of matter between the population and the different environments at the level of everyday events. This allows the re-theorisation of the relationship individuals-environments considering spatiotemporal ideas.

Taking into account this thesis's results, the obesogenic environment is presented in this discussion section (see Figure 7) as the sum of everyday interactions between multiple external forces and the population that modify, positively and negatively, individuals' health practices and mental health over the years. Next, I am going to disentangle this statement while comparing it with previous literature.

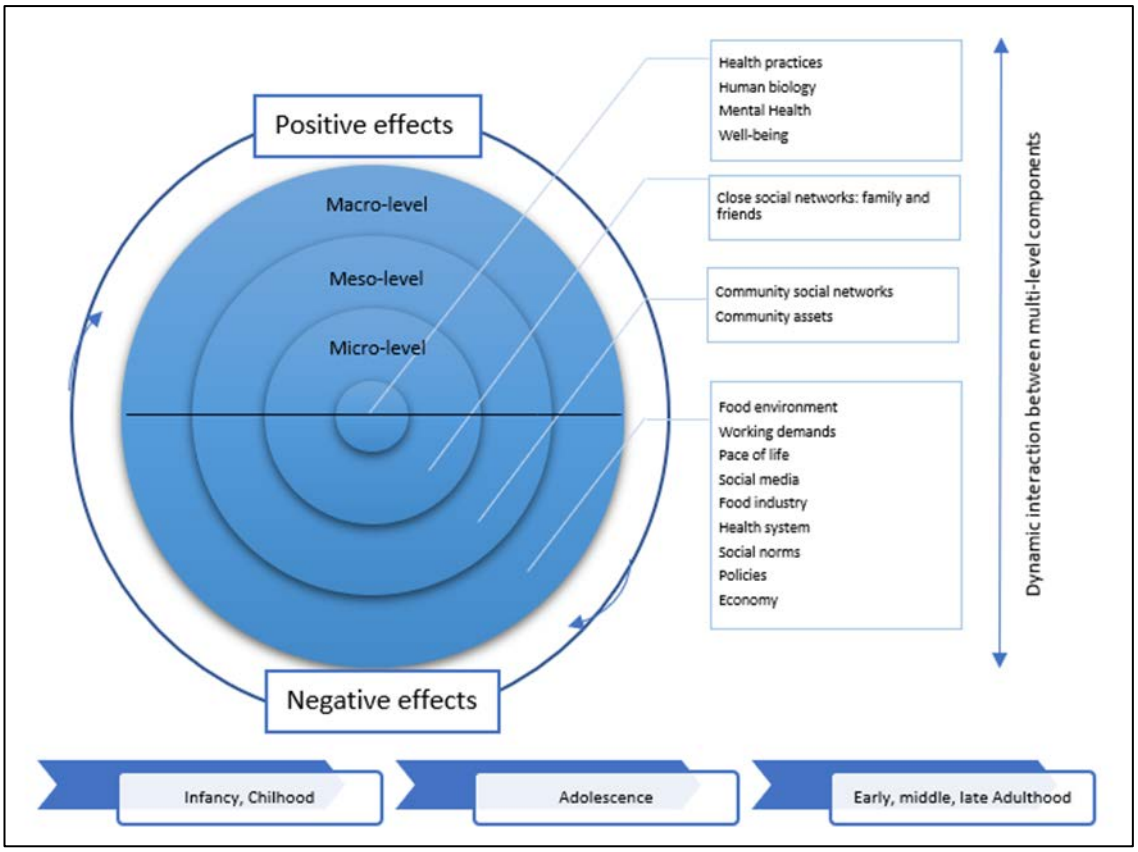


Figure 7. Obesogenic environment model based on the experience of adults living with obesity in the UK.

### 7.3.2 People live in an obesogenic environment that can promote mainly unhealthy practices but also provide opportunities to conduct healthier practices

Traditionally, the term 'obesogenic environment' has had a negative connotation. For example, the media refers to the obesogenic environment as harmful and directs us towards junk food (Lawrence, 2018). In addition, research has focused on adverse environments to refer to the notion of an obesogenic environment. One of the reasons could refer to the etymology of 'obesogenic'. It comprises 'obese' or having a BMI of 30 or above, and 'genic', meaning generating or producing. Therefore, 'obesogenic' means "tending to cause obesity" ('obesogenic, adj.', 2022). Nevertheless, within the obesogenic environment, there are also opportunities to conduct healthy practices. Below, I uncover positive and negative environments not specified in previous obesogenic environment theoretical frameworks and models. Also, and most importantly, I explain in-depth how individuals relate to them (an aspect almost ignored in the literature), showing an innovative developed relationality understanding based on the lay perspectives and, where appropriate, linking that with social network theory to develop new knowledge about social network processes.

It is relevant to highlight that this thesis has explored network processes under the umbrella term of 'social influence' to delve deeper into the work of other authors who have theorized this network mechanism and its impact on health and, therefore, propose new contributions to knowledge. The background section shows the theoretical model of Berkman *et al.* (2000), where they identified four mechanisms: social influence, social support, social engagement and access to resources and material goods. These authors defined 'social influence' or 'personal influence' as the recipient seeking the influencer's advice; the influencer actively attempts to convince the recipient to make the decision or conduct the action or simply informs the recipient, and the influencer serves as a role model. This could be summarised in searching for advice, persuasion to take action and modelling. However, Marsden (1993) considers 'social influence' as social relations that provide a basis for modifying a behaviour or attitude by one actor in response to another. I think the second definition opens the spectrum more to identify multiple possibilities about how social networks influence and the different activities that relationships engage with or promote to produce health effects. The new knowledge on networks developed in this thesis adds to Berkman's model a more in-depth understanding of the network process 'social influence' by explaining different ways individuals influence each other and differentiating them according to their positive or negative effects on health. The information related to this in this section will also be innovative in the area of social networks and obesity.

#### 7.3.2.1 Environments promoting unhealthy practices

Social gatherings with close networks (e.g. meetings with friends in a pub or big family meetings) are environments presenting barriers to conducting healthy practices in adults with obesity since they are spaces with shared social and cultural norms that impact food and drinking consumption. For example, people around could eat poorly (e.g. type and amount of food). A negative and conscious behavioural imitation might occur as a consequence of feeling and being sociable (morality), having a sense of belonging to the group, potentially being accepted and even feeling social pressure from others. These social gatherings seem to have the power to modify the positive effects that these close networks would have by exerting peer pressure in other contexts (e.g. this thesis showed that peer pressure by friends had positive effects in gyms). These examples show the importance of considering where social relationships occur and the interaction between different elements of the multilevel environment (e.g. friends (micro-level), a pub in the community (meso-level) and social norms (macro-level)). Referring to the relevance of social gatherings, Knutsen *et al.* (2017) found the impact of close friendship networks in these settings with food in adults' (with type 2 diabetes) practices. For example, in that study, participants outlined the need to occasionally not adhere to the diet, especially at parties and when with friends, as part of a 'normal' social life.

Food costs seem to be an ongoing concern within the food environment (full of fast-food outlets and supermarket chains enhancing highly profitable ultra-processed food). The results add to evidence of the existence of tensions in the discourse about whether eating healthier is more expensive than eating junk food based on a limited budget, which can impact food practices. However, the results are innovative in finding this difference by comparing the perceptions of those living with obesity and those who managed to lose weight and have a healthy weight currently. The general feeling (by those living with obesity) that healthy food is more expensive than junk food has been found in other qualitative studies looking at food practices (Paes, Ong and Lakshman, 2015). In one study, the participants reported that most of their food choices were prompted by multi-buy, and introductory offers (Dhuria *et al.*, 2021), which are often in unhealthy products, as already discussed in chapter 6. Also, these participants purchased their food products in bulk if they were reduced in price to get better value for their money. The fact of seeking value for money has consistently been described as a driver for food practices in people with lower socioeconomic status (Pitt *et al.*, 2017). However, the results of this thesis also show how some people have adapted their practices to eat healthily and spend less money than when they used to have obesity. In this line, only one study has been found that remarks on this possibility. In that research, a facilitator of a weight management group highlighted that some people tend to be obsessed that fruit and vegetables are just too expensive, and it is more about education, changing the way they think, and planning in advance, although there could be other barriers to do this such as a complex and busy life (Coupe, Cotterill and Peters, 2018). This could suggest the presence of false and normalised perceptions around the possibility of conducting healthier food practices using a limited budget and, therefore, a lack of capacity (knowledge and skills) to interact better with the obesogenic environment (this is further explained in the following sections of this discussion).

#### 7.3.2.2 Environments promoting healthy practices

Domestic (partners and parents) and friendship (close friends) environments were ideal for making joint efforts or sharing a lifestyle to meet a shared goal, in this case, conducting healthier practices related to eating and physical activity. This is aligned with the concept 'collective efficacy'. This is the shared perception and capacity for successful management through shared objectives and efforts, which has been explored in networks to support the self-management of people living with type 2 diabetes (Kennedy *et al.*, 2015; Knutsen *et al.*, 2017). For example, Knutsen *et al.* (2017) identified that familial members were fundamental in shaping practices, for example, by changing their diet together and abandoning habits that family members enjoyed and were used to.

Weak ties are recognised to be relevant. They are characterised by the briefness of interactions with strangers and acquaintances based on lower levels of commitment, trust and connectedness than more bonding stronger ties (Rogers *et al.*, 2014). New relationships developed in the community (weak ties) are essential for adopting and maintaining healthy practices. They are vital since they tend towards 'homophily', that is, the phenomenon of associating with individuals who are similar to the self (Kadushin, 2012). However, in which ways can individuals be similar? For example, people can associate with others that share similar lifestyle goals (reducing weight by conducting more physical activity), as well as social norms or values (people know how important it is to conduct a physical activity such as walking to stay healthy). Also, other weak ties (e.g. relationships with personal trainers, gym members) are crucial to providing new opportunities to access diverse resources, adopting and sustaining in time new and healthy practices, information and support, which in turn, could provide a sense of value, belonging ("the gym is like my family", "my boots camps are like my family") and prevent other aspects such as negative mental health and isolation. The importance of weak ties is not new in the health literature. For example, a realist review suggested that more distanced and less intimate contacts may offer varied facets of support in patients with chronic illness (Vassilev *et al.*, 2011). Other empirical studies illuminate the power of more marginal individuals to support long-term condition management (Rogers *et al.*, 2014; Vassilev *et al.*, 2016). Kennedy *et al.* (2015) identified weak ties connections to obtain more health-related resources, particularly by having organisations in people with type 2 diabetes social networks (this could be the use of weight management groups).

Online environments (e.g. YouTube, TED talks, and documentaries on Netflix) and digital celebrities interact with individuals and can induce positive changes in obesity-related health practices. Social media platforms can help access new, inspirational, and reliable information about healthy diet and physical activity practices that can be applied to individuals' everyday lives. Also, digital celebrities and influencers are relevant in regards not only to the information they transmit but also to how they do it (e.g. relaxed attitude demonstrating the importance of developing a healthy relationship with food). This is relevant because online environments have traditionally been considered to have a negative role through constant exposure to junk food advertisements. For example, some authors explained that advertising on television and other marketing strategies primarily promotes unhealthy food (Cairns *et al.*, 2013; Whalen *et al.*, 2019).

Incorporating online environments (e.g. social media) as part of understanding the obesogenic environment is something new (Granheim, 2019; WHO, 2021; Granheim *et al.*, 2022). Current obesogenic environment frameworks and models do not recognise the role of digitalisation in shaping, for example, food purchase and consumption. In this respect, Granheim (2019) has recognised the importance of including digital food environments as part of the food

environment. She has contributed to knowledge development in this area by conceptualising three factors influencing diet-related outcomes: digital actors (e.g. the food industry, governments or the media), digital settings where these actors act, and digital activities conducted by such actors within the digital context. The digitalisation of food environments is becoming a key topic in public health (even more after the COVID-19 pandemic), given the increased use of food delivery applications, technologies to improve food production and distribution, and much health information (and misinformation) on social media platforms (Pilgrim and Bohnet-Joschko, 2019; Wang *et al.*, 2019; Keeble *et al.*, 2020).

### 7.3.3 The obesogenic environment also influences mental health

The results of this thesis acknowledge the importance of exploring the impact of the environment on the adoption of obesity health-related practices and mental health. Different examples were found, such as the negative impact of healthcare professionals on patients' mental health when dealing with obesity-sensitive conversations due to a patronising attitude and a lack of a sensitive approach potentially related to an existing weight stigma. This can induce opposite effects to the desired ones when looking for health support, such as depression, anxiety, social isolation, loss of identity, poor medication adherence, lower self-efficacy, decreased motivation to conduct physical activity, binge eating disorders or bulimia nervosa (Ashmore *et al.*, 2008; Vartanian and Smyth, 2013; Papadopoulos and Brennan, 2015; Puhl and Suh, 2015; Wu and Berry, 2018). Another example from this thesis is when a person follows a healthy diet requirement (a positive lifestyle change) and feels the emotional support from friends to not join the collective action and follow the norm in social meetings with friends and family (e.g. eating what others are eating, potentially unhealthy food). This support in adverse situations thrives individuals by promoting engagement and attachment in new healthier lifestyles, enhancing positive well-being and finding meaning and purpose in practice change and life (Feeney and Collins, 2015).

Previous multilevel conceptual and analytical obesogenic environmental frameworks and models that assess the relationships between people and environments (e.g. ANGELO, IOTF and EnRG) do not recognise the effects of the environment on mental health and are conceptualised concerning the 'energy balance model'. This energy balance is focused on the disruption of the body's 'natural' energy balance; in other words, obesity arises from an imbalance between the quantity of energy consumed and the amount expended (Witten and Pearce, 2016), which underpins many medical accounts of obesity. Including the impact on mental and physical health allows a more holistic approach to health promotion and disease prevention.

### 7.3.4 The obesogenic environment needs to be understood as a reciprocal interaction between individuals and environments

Changes in individuals' health are direct expressions of a broader social context (environment influences individuals' health). At the same time, an individual could have the power to modify her/his environment. This thesis has shown different examples of this bidirectional influence. For example, parents highlighted their children's honesty in complaining about family diet practices. As a reaction, parents improved their shopping and cooking in order to eat healthier. Also, there were elements of mutual influence when sharing lifestyle goals and making joint efforts with family and friends to achieve healthy lifestyle goals (e.g. cooking together or running together). Those interactions generated feelings of mutual motivation to induce practice change. Environmental changes were not identified exclusively between different individuals (social networks). Those adults that live with a 'healthy' weight currently (they used to have obesity before) have developed skills to avoid some of the obesogenic environments that affected them before and select and engage with new ones. For example, some people adjusted personal practices (e.g. by abandoning food consumption in fast-food restaurants) when they became aware of their obesity and the potential health consequences of living with it. Thus, they overcame structural incentives to buy less good food based on environmental triggers and started to eat healthier by cooking from scratch and planning their meals for the week (dividing the food into rations). To complement those changes in the food environment, some adults decided to engage in new environments, such as gyms, to conduct more physical activity.

In this line, Bronfenbrenner (1979, p. 21) stated, in his book 'The ecology of human development' compendium (where he develops the multilevel approach, which has been applied in public health research), that "human development involves the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by relations between these settings, and by the larger contexts in which the settings are embedded". However, this reciprocal interaction understanding has not been specified in the most relevant obesogenic environment theoretical models and frameworks since then. The multiple influences of the ANGELO framework impact fat mass by acting through the mediators of energy intake (energy-dense food) and/or energy expenditure (physical activity) (Swinburn, Egger and Raza, 1999). In the IOTF Working Group conceptual model, environments influence individuals, but not the other way around (Kumanyika *et al.*, 2002). The EnRG model shows the mediating role of behaviour-specific cognitions (causal mechanisms) in the influence of the environment on health behaviours. Again, there is only a unique direction of influence (environment influences health practices) (Kremers *et al.*, 2006). This thesis has demonstrated the importance of including a

reciprocal relationality explanation to understand how obesity and related conditions are developed in the population from a public health lens.

### 7.3.5 Obesity and related LTCs are not static but need to be understood through interactions with the obesogenic environment over the life course of individuals

The impact of the obesogenic environment on the development of excess weight, the mental health attached to it, and the processes of looking for healthier options need to be understood through the life span. In this thesis, the impact of the time dimension was phenomenological in character, identified and perceived by the participants to be of relevance to their obesity trajectory. Different activities not only took place in the immediate present but as part of a larger temporal trajectory, reaching back into the past where different environments had impacted individuals' health. For example, some participants recognised that some current health practices originated during childhood due to interactions within their domestic environments. The potential presence of unconscious modelling as part of practices based on familial social norms was relevant, for example, those who grow up seeing and imitating their parents' health practices and, specifically, poor food practices. Another example is how vital early parent education is on how to cook and eat healthy since this could contribute to current relationships with food.

Different social theorists highlight the importance of time to understand practices (Bourdieu, 1977; Schatzki, 1997) and consider that adults are the product of their own past, materially and socially reproduced (not simply in the abstract) but through recursive, ongoing relations between practices. Also, Bronfenbrenner's socio-ecological model uncovered the issue of time (chronosystem) and its influence on human development by examining the influence and changes in the environment over time. He stated, "To demonstrate that human development has occurred, it is necessary to establish that a change produced in the person's conceptions and/or activities carries over to other settings and other times" (Bronfenbrenner, 1979, p. 35). None of the obesogenic environmental frameworks and models introduced in the background of this thesis (chapter 2) considers a time perspective. This component would benefit them to better describe the appearance and trajectory of the obesity epidemic.

### 7.3.6 Does the NHS constitute part of the negative obesogenic environment?

The health system, and more concretely, the NHS (understanding it as a workplace and system management) has been included in this thesis as part of the negative obesogenic environment that promotes unhealthy lifestyles and poor mental health, an idea that nobody else has considered before.

Firstly, participants with obesity highlighted negative interactions (having negative effects on mental health) with healthcare professionals when looking for support, understanding support as the material and psychological resources provided through social interactions (Berkman *et al.*, 2000). In general, there seems to be a lack of understanding of multiple causes of obesity, a lack of individualised plans, still a harmful, patronising and stigmatised interaction with adults with obesity, and, in general, a lack of a sensitive approach. Other qualitative studies have identified how individuals affected with obesity encounter weight bias and stigma when interacting with the healthcare system (Alberga *et al.*, 2019; O'Donoghue *et al.*, 2021; Puhl *et al.*, 2021). Even some authors criticise that one of the reasons could be that healthcare professionals' thinking on weight management might be pre-contemplative regarding their own or their family's body weight or eating histories (something found in the interviews although not specified in the results of this manuscript) (Rich, Monaghan and Aphramor, 2010). This is not surprising considering that, in a recent report in the UK, only 26% of people living with obesity expressed being treated with respect and dignity by healthcare professionals when seeking advice or treatment for their obesity (All-Party Parliamentary Group on Obesity, 2018).

Also, hospitals have been identified as snacking environments full of unhealthy food, considering them as negative environmental influences. In this line, only one previous study has been found to explore similar ideas. The authors highlighted potential barriers and facilitators to eating healthily in a hospital setting in the north of England. They found, from the perceptions of parents whose children were inpatients, that there was a lack of affordable healthy options in hospital outlets for sale, and a variety of healthy food types was lacking (McSweeney *et al.*, 2018). In addition, the results of this thesis uncover the presence of employment inequalities, suggesting that people working in the NHS might have less flexibility over working hours and can spend less time on self-care. Shift jobs in the NHS could make finding time and energy challenging to eat and cook healthier.

## 7.4 Implications to practice and public and social policy

The methods and results of this thesis can be applied to improve the services provided by health and social services to prevent and manage obesity and its related health conditions and develop public and social policies that consider the voices of those living with obesity.

### 7.4.1 The use of network mapping in healthcare and social services

Healthcare and social services could be beneficiaries of the results that consider social networks and the role of environmental influences in different manners.

Network mapping could be implemented in practice change and reproducing the habitus of meaningful practices. Community clinicians could use the interview inquiry process and network diagrams to reflect on the impact of individuals' relationships and plan specific person-centred and long-term sustainable network interventions to improve individuals' physical and mental well-being in people with obesity and its associated conditions. Within the planning of actions, patients could tailor individual preferences, deciding what could work for managing their health and well-being. The results showed the importance of strong and more intimate relationships, which could be used, for example, to develop interventions to deliver educational programmes to the family rather than the individual. Also, they highlight the importance of weaker connections that are vital to adopting new practices and generally in community settings. Those health services unfamiliar with the relevance of these types of relationships could use these results to increase awareness of local community health resources and how the people participating in them could influence change practice. This could have some benefits, such as engaging in new meaningful relationships, which could provide the motivation and support for practice change and sustainability or increase the size of the social network to avoid potential isolation and loneliness in adults (Leavell *et al.*, 2019), both risk factors for mortality associated with obesity. Some new interventions apply some of these ideas and are being tested, facilitating health services addressing these issues through social prescription (Valaitis *et al.*, 2021; University of Southampton, no date). In addition to increasing awareness of the relevance of community services, these interventions could use social network online tools to identify new and unknown community resources and other members of an individual network that might be interested in sharing these community activities with the individual (e.g. the collective participation of the family in various community activities and assets).

### 7.4.2 Towards improving the management of obesity in health and social care services

Health and social care services could consider these results to add more evidence about how their workers address obesity and navigate the potential reasons to explain the unsuccessful interaction between adults living with obesity and clinicians. The results of this thesis and other research (already mentioned in chapters 5, 6 and 7) suggest that changing how obesity is approached in these health and social services is necessary. Therefore, it might be fundamental to provide further education on weight management, including managing delicate discussions and stressing the multiple and complex underlying causes of obesity, and create more time in consultations for people with obesity so that there is time to explore personal experiences in order to choose what kind of intervention could be useful for each person. This could avoid scenarios where people with obesity could self-blame due to negative interactions with health

and social care professionals. People living with obesity should be invited into a dialogue to reflect on their experiences, challenges and how they handle them or how they make sense of their body changes. Deep reflections and personal narratives on possibilities and barriers can provide insights into what matters for a person living with obesity, establish a strong and confident person-health professional relationship, and boost a person-centred approach. For example, this awareness and actions could be implemented by introducing guidelines created by health and social care professionals, obesity researchers, people living with obesity, carers, and other stakeholders who have worked collaboratively to address these issues.

The experiences of people with obesity suggest not only the presence of negative interactions with healthcare professionals but a need to focus on how obesity is approached in the NHS. Thus, more services on prevention than treatment options and supporting people living with obesity by incorporating more multidisciplinary specialists could be pertinent. Lately, recent NHS reports have developed strategies to improve obesity management (NHS, 2019a). The plan is that the NHS will focus more on prevention, including obesity-related ill health and improving services for supporting behaviour change via information provision, service design and clinical interventions (e.g. targeted weight management services or social prescribing). The UK Government is already aware of some of these issues, and the pressure primary care has on managing obesity (as normally the first consultation option). It aims to bring a programme with incentives for GPs and referral pathways into weight management services in every local healthcare system. Also, the Government is currently working with the NICE and the British Medical Association to implement incentives for doctors through the Quality Outcomes Framework to guarantee that everyone living with obesity is offered support for weight loss (Department of Health & Social Care (UK), 2020).

Ensuring that people with obesity and front-line professionals (e.g. GPs) are aware of all the new and future services available will be essential. In addition, providing a continuous and up-to-date education for patients and even professionals about the role of positive and negative environments could be considered since most weight management interventions focus exclusively on the individual and ignore those complex environments constantly changing and adapting to business needs.

### 7.4.3 Increasing awareness of the impact of obesogenic environments

The results of this thesis show that there might be gaps in people's capacity (e.g. knowledge or cognitive skills) to interact with obesogenic environments designed to promote unhealthy choices. Therefore, providing knowledge and psychological skills for self-control (Cohen and

Lesser, 2016) to protect their vulnerability against the constant exposure to what the obesogenic environments offer (e.g. HFSS promotions in supermarkets or how food stores work to encourage impulsive decisions) seems pertinent. People could make better decisions within these environments and adjust their practices to avoid their negative impact (e.g. increasing knowledge of types of nutrients or planning and preparing healthy meals for the week). A consideration of the wider social context would be required to reflect on what types of changes can be made based on each individual's social determinants of health, which in some cases lead to health inequalities (this has been explained in the discussion section of chapter 6). Part of that knowledge and skills could be accessed through new technologies' infinite possibilities. The NHS could focus on this particular interaction between individual-negative obesogenic environments and create a digital platform for the general population (since everyone is at risk of being unhealthy due to the obesogenic environment) to explain the different components of the obesogenic environment, how they influence behaviours and practices and provide some tips to reduce their negative impact. Technology-mediated initiatives can help to develop new ideas, access new information, have the potential to deliver content efficiently, and strive for equity (Murray *et al.*, 2016).

Another important implication could be the need to consider the NHS not only as a separate obesity management system but as part of the negative obesogenic environment, which could be relevant to understanding why so many healthcare professionals develop excess weight in the United Kingdom. The results of this thesis could raise awareness of the constant exposure to HFSS food in hospital settings and open the door to changing the social norms of providing this type of food as a sign of gratitude by patients, family and co-workers. Also, these stories could make more visible the nature of specific employments (e.g. nurses and their long day and night shifts and stress) and how they might be linked with health inequalities (e.g. more risk of developing excess weight). Despite the potential and non-modifiable nature of the everyday stress and pace of working life, measurements could be put in place to protect NHS employees' health and well-being. For example, providing protected time to conduct healthier lifestyles during workdays and implementing employee health screenings could help identify health risk factors and promote healthy living.

These results could make social relationships 'hidden' power more visible in people's everyday health practices. Thus, the general public could be aware of the importance of domestic relationships (family), friends and the capacity that new relationships in the community could have in adopting innovative practices (e.g. new and easy-to-prepare healthy diets or the adoption of new physical activity practices, such as Nordic Walking). The general population could use network mapping to identify potential relevant relationships in their health and reflect on why

they are important; in other words, who is important, whom they should keep, whom they should avoid, or whom they should include in their network and how they influence. These tools might be useful to improve the self-management of health and well-being in general.

### 7.4.4 Public and social policy

Contemporary intervention guidelines and prevention lifestyle measures mention the benefit of receiving support from different individuals to lose weight and prevent weight regain. These guidelines can serve as an orientation to visualise to which degree social networks are prevalent in policies. However, most of this information seems, in general, very superficial and does not delve into how our daily and closest relationships can cause positive and negative health changes and the opportunities and the mechanisms by which different people from the community can impact the weight journey. Therefore, the key findings from chapters 4 and 5 and future research on networks and health practices by others could be incorporated to update health and social policies.

The following are some examples of current policies where the importance of relationships is mentioned. For example, the 'Weight management: lifestyle services for overweight or obese adults' (NICE, 2020) explains the benefit of receiving long-term support from local support and community groups, the practice nurse, pharmacist, weight management programme, online groups or networks, family and friends. This resonates with the findings of this thesis, which has highlighted the relevance of intimate relationships (domestic and friendship environments) and the importance of weak ties in the community. Also, the Scottish document Policy Interventions to Tackle the Obesogenic Environment (Mooney, Haw and Frank, 2011) highlights, in its section 'Interventions in the socio-cultural environment', an ecological model developed by Maibach, Abroms and Marosits (2007), which describes the relevant attributes of people as operating different levels of analysis, such as individual, community or population levels (the micro, meso and macro-levels of this thesis). That section highlights the importance of the connectedness and size of a person's social network, the diversity of ties, community cohesion or the degree to which the different relations in a social network provide positive modelling and social support (these two network processes have been identified in the results). Other guidelines specify one concrete health activity (e.g. physical activity) and the role that networks have at different ages, for example, highlighting that parents and carers can encourage the performance of physical activity in their children by interacting with them as often as possible and serving as role models (social modelling process in this thesis) (Department of Health, Physical Activity, Health Improvement and Protection, 2011). However, networks are not mentioned to be applicable to adults' health.

Other UK Government guidelines that explain the influence of the environment do not mention social networks at all (Public Health England (UK), 2017).

In general, there is no doubt that the British Government is aware of the importance of the role of the environment in obesity. For example, the Department of Health & Social Care (2020) describes that obesity is also about the environment people live in, the information received to make choices, healthy and unhealthy options offered and the influences that modify those choices. Some government interventions on the environment have been developed and implemented already (Cabinet Office and Department of Health and Social Care (UK), 2019; Department for Environment, Food and Rural Affairs (UK), 2020; Department of Health & Social Care (UK), 2020; Public Health England (UK), 2020; Theis and White, 2021). The actions have focused on introducing a soft drinks industry levy (Her Majesty's Revenue and Customs (UK), no date), sugar reduction (e.g. 20%) in food (Public Health England (UK), 2020), food labelling to present clear information about the content of the food, implementing traffic lights in two-thirds of products sold in the UK (Government UK, no date), introducing mandatory calorie labelling in large restaurants, cafes and takeaways (Department of Health and Social Care (UK), 2022), restricting advertising of unhealthy foods being shown on television before 9 pm and in paid-for advertising online (Department of Health and Social Care (UK), 2021), working with schools to promote healthy eating (e.g. Breakfast clubs where children can have a healthy breakfast in the school) (Department for Education (UK), 2022), and reducing access to food outlets (Public Health England (UK), 2014), among others. Also, Public Health Campaigns have been created. One is Change4Life, an integrated marketing approach that uses different marketing channels to help families make small and sustainable improvements to their diet and activity levels. Some of its content concerns increasing awareness of types of fat, a sugar calculator, useful tips to swap snacks for healthy food through a food scanner App, easy and healthy recipes, and activities to be taken in family (e.g. getting the family involved to cook healthy recipes from scratch and linking them to recipes and shopping lists) (NHS, 2021).

In the last years, efforts have been made to improve the negative obesogenic environment. However, they still seem insufficient since people are still 'bombarded' by unhealthy food options (Gregory, 2021), and some results of the interventions explained in the last paragraph are not very promising (Theis and White, 2021). Also, the results of this thesis show that more efforts should be focused on school policies and back up the need to further intervene in junk food industries and reduce the price of 'basic' products, such as milk, meat and vegetables. Some authors state that there has not been enough progress since the strength of industry opposition and government hesitation to implement interventionist policies to force restraints on the free market and influence individual choice presents a significant barrier (Swinburn *et al.*, 2015; Pell *et*

*al.*, 2019; Brookes, 2021; Brookes and Baker, 2021). In the meantime, I suggest that working on how the individuals relate to obesogenic environments and giving them the tools to make healthier choices (as explained in section 7.4.3) seems more pertinent than waiting for a major and significant effective response from the Government and the food industry.

Finally, involving the voices of those living with obesity to develop new interventions and policies must be a priority to address the current psychology and aetiology of obesity and ensure that they receive adequate quality care with effective and person-centred interventions. This must be prioritised to create ambitious national plans for tackling adulthood obesity, which still seems to have less attention than childhood obesity, with many more strategies developed (All-Party Parliamentary Group on Obesity, 2018). Also, their empowerment and role in patient and public advocacy could contribute to ending some crucial barriers, such as weight stigma and discrimination.

## 7.5 Future research

The exploratory work conducted to explore the nature of the relationship between the person-obesogenic environment uncovers future research lines connected to this thesis's results.

It would be relevant to explore trajectories of obesity where networks are present by using biographic narratives (to understand more in-depth the content of meaningful relationships over time) with the exploration of the structure of social relationships using network metrics, which could provide an upgraded tool to explore their impact on health. In other words, combining quantitative and qualitative approaches can contribute to a better understanding of how networks matter and what conditions and mechanisms are present when producing certain network outcomes. Studying the structure could be very useful, but only when the network size could allow for obtaining relevant data (e.g. in a network of six people, it does not make sense to study the structure). Thus, other network characteristics could be analysed, such as the structure of patterns of ties with an ego network (alter-alter ties) and the density, which is a measure of the prevalence of dyadic linkage (number of links) within a social network (Frey, 2018). Density can be used to explore the component of bonding social capital, the capacity of alters (other relationships) to collectively influence ego (Bott, 2001), cooperation or shared social norms (Putnam, 2000; Kawachi, Subramanian and Kim, 2007).

It would be beneficial to understand how social capital is transferred between members of specific groups and relationships (e.g. those identified in this thesis) utilising mixed-methods sociocentric (entire networks) network analysis. This would focus on the group rather than a specific individual, for example, exploring the diffusion of innovations (new knowledge, new

practices) within a weight management group and supported by the Diffusion of Innovation Theory (Rogers, 2003). Thus, it could be possible to identify who adopted the innovation earlier and what characteristics this person possesses. This would allow the detection of specific network mechanisms and observe their emergence across the context, contributing to the literature on network processes through weak ties. These 'early adopters' or 'opinion leaders' (Valente and Pumpuang, 2007) who embrace change opportunities earlier could be role models and influence those more sceptical about change.

Another example could be exploring groups using mixed-methods social network analysis by exploring motivation networks within other community activities, such as gyms. This would allow the identification of successful healthy relationships and the chance to understand the content of those relationships, why that person is so important, how he/she influences the individual or, for example, if there is a collective positive effect as a group and how it works to produce positive effects. In open systems, these aspects produce the semi-predictable patterns that account for the social aspects of cultural and structural configurations (Bellotti, 2014). A wide understanding of demi—regularities within networks and health practices might be useful for creating and applying network interventions for lifestyle changes and habit forming.

The role of social media and social media influencers seems to be an area that needs further exploration. For example, researching the processes of interaction between people looking for health changes in social media, how and why people engage or do not with them and how information is diffused (e.g. using the Diffusion of Innovations Theory, mentioned earlier in this section) might be relevant.

In order to succeed in the social battle toward reducing obesity in the population, it is crucial to conduct much more qualitative research. For example, more research is needed on the meaning of living with obesity, how people handle their life when struggling with it and which aspects of well-being might manifest in such situations, the fluctuation of weight and its impact on mental health or the individual efforts of people with obesity to regain well-being and balance in their lives, among others. There are other aspects, such as identity, and other mental health consequences, for example, those related to weight bias (negative beliefs and attitudes towards others because of their weight) and social stigma (label attached to a person who is the victim of prejudice) (O'Donoghue *et al.*, 2021) during a lifetime, which are causes of worsened mental health, and lack of engagement with, and success of currently available treatments, isolation or unhealthy lifestyles (Puhl and Suh, 2015; Phelan, 2018; Wu and Berry, 2018). This is of vital importance since 88% of people reported having been stigmatised or criticised as a consequence of having obesity (All-Party Parliamentary Group on Obesity, 2018). Illuminating the sum of

individuals' attributes may lead to modifying social norms (e.g. the sum of personal stories about the aetiology of obesity could change the blame discourse around obesity). Traditions, norms, and moral codes strongly influence our behaviour, but they gradually and iteratively change when we start to ignore them, replace them, or reproduce them differently. This could provide the basis to build a non-judgemental and respectful context where obesity could be considered, more seriously by the general public, as a complex individual and social health problem. In order to track how obesity is perceived by society, machine learning approaches, qualitative sociolinguistic analysis, and other big data procedures could be used to explore social media and the general public discourses.

Also, considering the obesogenic environment as an entity that is not static, continuous research using qualitative approaches is required to re-theorise individual-environments relations. This will allow contextualising evidence base to support action and policies for tackling the obesity crisis. Although everyone is at risk of developing excess weight, research should prioritise the identification and involvement of those affected with obesity and living in disadvantaged circumstances (e.g. low income, less education, limited access to space or more exposure to the sale of unhealthy foods) since these factors impact whether people can eat healthily or be active and increase the risk of developing excess weight. In this respect, understanding and compiling lay perspectives and other members of the public (e.g. healthcare professionals, individuals with no health problems and policymakers) perspectives about the impact of obesogenic environments could play a role in developing equitable interventions and policies where health inequalities are addressed. Participatory action research, in which researchers and the affected populations (e.g. adults living with obesity in deprived areas) work together as agents of change, could generate strategies to tackle obesity and its related health and social issues. Regardless of the interventions created, it is essential to understand obesity as a complex problem or a complex system where outcomes of health are the consequence of a multitude of interdependent elements within a connected whole (Rutter *et al.*, 2017).

Considering that behaviours and practices are shaped within social contexts in everyday life and thinking about obesity as a social health problem, it would be relevant to understand and research lifestyle causes not as individual practices but as social practices. Social practices are situated behaviours embedded in and reproduce broader social structures (Delormier, Frohlich and Potvin, 2009). Theories that study social practices (practice theories) try to better understand the dynamics between agency (individuals' capabilities to act independently and to make their own choices) and structure (the recurrent patterned arrangements that limit or influence the choices and opportunities available) (Barker and Jane, 2016) in the daily life of experiences of health and ill-health (Maller, 2015). Thus, researchers move beyond psychological or behavioural

approaches to look to social explanations for health outcomes across particular groups and locations, for example, adults with obesity in the United Kingdom (as a group). Some of these ideas can be seen in Bourdieu's account of social practices under the notion of 'habitus'. (Bourdieu (1990, p. 52) declared, "The theory of practice as practice insists … that the objects of knowledge are constructed, not passively recorded, and, contrary to intellectualist idealism, that the principle of this construction is the system of structured, structuring dispositions, the habitus, which is constituted in practice and is always oriented towards practical functions". There are other practice theories; for example, obesity could be studied by exploring food and eating as social practices through the Structuration Theory (Giddens, 1984).

Structuration Theory suggests that the 'micro' of human agency and the 'macro' of social structure are in an iterative relationship (they influence each other) such that the repetition of the acts of individual agents reproduces the structure (Giddens, 1984). Norms and traditions influence our behaviour, but they gradually and iteratively change when we ignore them, replace them, or reproduce them differently; in simple words, as practices change, so does structure, and vice-versa. To show some examples, Delormier, Frohlich and Potvin (2009) examined social structural conditions and their relationship to the practice of family feeding and created a theoretical framework to understand population eating patterns and to guide health promotion actions aiming to shape social structures, improving population-level eating and food patterns.

Chan, Deave and Greenhalgh (2010) used a modified version of Giddens' Structuration Theory (Stones, 2005). This modified version considers four analytically distinct components of the structure-agency relationship: (i) external structures (conditions of action, which may be either enabling or constraining); (ii) internal structures within the agent (what individuals 'know'); (iii) active agency (in which agents draw, routinely or strategically, on their internal structures); and (iv) outcomes (in which both external and internal structures are either reproduced or changed). External structures are mainly mediated through position practices. A position-practice is a social position and associated identity and practice, together with the network of social relations which recognise and support it. Position practices are perpetuated (and changed) through their enactment by active agents within the network of relationships. Internal structures could be divided into general dispositions (e.g. skills, attitudes, ambitions, and personal morals), which shape an act in particular situations. Action is a situated accomplishment in which individuals adjust to the actions of others because they can interpret their symbolic meaning. Outcomes may be intended or unintended, feeding back on internal and external structures and preserving them faithfully or changing them as they are enacted. Thus, Chan, Deave and Greenhalgh (2010) studied childhood obesity in Hong Kong using this theory, suggesting that the primary caregiver (father or mother) appeared confused by mixed messages about what is normal, expected and

legitimate behaviour and, specifically, external social structures created pressure to shift childcare routines from the logic of nurturing to the logic of consumption. Something similar could be done in the future while applying this theory, understanding social networks and other parts of the environment as structures and considering notions of agency and structures together in a transition society (food environments change constantly). Thus, obesity could be studied based on the change in social health practices (as a society, not the individual) over time, considering the influence of historical environmental influences (changes in the environment). An essential point of using social practice theories is that they could contribute to avoiding blaming victims and brings, again and as I discussed during this thesis, socio-technical constructions of health to light.

## 7.6 Strengths and limitations

This section describes the strengths and limitations of this thesis.

The strengths are:

1. The CIS was an innovative tool and review method to apply social network concepts and develop theory from previous studies that considered the importance of relationships in the adoption of ORBs in a manner which illuminated the depth, meaning and structure of these relationships and associations with contextual and environmental factors. It flagged up a new understanding of relationality in which positive and negative social network effects result from a multilevel interaction between individuals and the broader social and cultural context. The application of social networks to understand both healthy and unhealthy obesity-related practices (when using social networks to research obesity) is new in the literature.
2. The creation of the synthesising argument with the results obtained in the review provides a novel and more conceptually deep starting point for future interventions, considering conceptualisations at multiple levels for theoretical and application-relevant interventions, which quantitative studies alone are unable to provide.
3. In terms of the empirical study, the use of network mapping was useful and relevant to identify members of participants' social networks and reflect more in-depth on how these influenced their health practices.
4. The participants' narratives not only showed the enmeshed and collective nature of the negative influences to adopt unhealthy practices but also how relationships could be a solution to conduct healthier lifestyles.
5. The use of personal accounts uncovered current processes of interaction between individuals and multiple environments and identified previously overlooked

environmental factors that could influence the adoption of different lifestyles in adults with obesity, an aspect that quantitative studies cannot do.

6. To my knowledge, this is the first research that conducts a qualitative network approach to study the role of relationships in adults living with obesity. Therefore, phenomena were explored through a different lens than quantitative SNA in the field, providing information about the content, function and nature of networks and their effects.
7. To my knowledge, this is the first study that explores lay understandings of the wider notion of the obesogenic environment as a cause of obesity, obesity-related practices (diet and physical activity) and its wider related health problems, such as mental health and the presence of obesity-related long-term conditions. This was done by exploring barriers and opportunities in the obesogenic environment.
8. The concept of 'obesogenic environment' has been challenged, proposing new insights based on the relational and emergent qualities of matter between the population and different environments at the level of everyday events. This version is based on the context of adults living with obesity in the UK.
9. The discussion section shows the potential of the results of this thesis to apply to health and social care interventions and health policies where the voices of those more affected by obesogenic environments should be considered.
10. This research contributes to the current understanding of obesity by talking to people living with obesity, which is always challenging due to social stigma barriers. It does not 'close the circle' of exploratory pathways of obesity aetiology. However, it opens the door to different types of research and theories that can be applied in the future to continue with this line of research.
11. The thesis shows the development of knowledge, critical thinking, and a transparent language, which aims to show each step of the research process, what I was thinking at each moment, barriers and how I overcame them and why I decided to do things in certain manners.

The limitations are:

1. Concerning the CIS, the findings contained in the included studies were interpreted according to the research interests. The lack of studies regarding how mechanisms and properties of social networks influence the adoption of health behaviours, in general, opens an easily questionable route of interpretation. In this sense, the transformation of quantitative data into a qualitative form followed a 'coding' process. The use of this analysis strategy to deal with quantitative data could be questionable due to the lack of reviews that integrate qualitative and quantitative data with which to compare.

2. Another limitation of the CIS is the restriction on searching only in the English and Spanish languages. It may have excluded relevant articles. However, the requirement of translation could result in the misinterpretation of specific information. I am conscious that the final number of articles that explicitly identified the specific focus of social networks and obesity-related behaviours could be limited in number. Nevertheless, these were sufficient to attain theoretical saturation. In this sense, concepts and linkages between them were well-developed, and no additional data were needed.
3. The coronavirus pandemic, the lockdowns, and the fact that this topic encompasses significant social stigma challenged the recruitment process and the possibility of attracting more interested potential participants. Forty-four local and national weight management groups and obesity and long-term conditions charities were contacted with no success. The majority did not reply to the requests (a follow-up email or message was sent to each potential participant and group if there was no initial response). A few just declined the potential participation without providing reasons. Others stated that the lockdown period was not the time to conduct this research. Also, a varied sample of participants (e.g. different sociodemographic characteristics) could not be obtained; therefore, the relationship between the individuals' attributes and their attached health opinions was not explored. The new understanding of relationships' influences must be considered cautiously and not establish generalisations since they might not apply to people with other sociodemographic characteristics. In the future, using Patient and Public Involvement (PPI) could facilitate participants' engagement and recruitment process.
4. Another potential limitation might be the accuracy of the network diagrams. The original idea was to collect the network data in person with the participant. However, the pandemic changed the way data was collected. Although the concentric circles with some instructions were sent to think about and draw their networks several days before the interview, some people did not conduct the exercise. This could lead to exaggerating some relationships and omitting others that may be important to their health when interviewing online due to the limited availability of time. This required an extra effort on my part, insisting and trying that the interviewees tease out further details during the rest of the interview. In this regard, on the day of the interview, and as they went along, the participants mentioned out loud where they would place their relationships. Others just told a whole narrative of their own story. Therefore, some networks had to be done retrospectively, taking into account the type of language they used and the subjective assessment of the researcher. Thus, it was undoubtedly subjective to represent the positions according to tie strength (it describes values such as frequency, intensity or

durability) in the diagram. Those networks that had to be created retrospectively were sent back to the participants to check their accuracy.

**Conclusion of chapter 7**

This chapter has presented the key findings of the three articles (chapters 4, 5 and 6), original contributions to knowledge compared to previous relevant literature, implications to practice and health policy, future research and strengths and limitations are detailed. The next chapter is the last one, which shows the final conclusions of this thesis.

# Chapter 8 Conclusions

This thesis covers a gap in the literature that asked for a deeper understanding of how multilevel environments could influence the adoption of health practices in adults with obesity in the UK. Different processes of the interaction between adults-obesogenic environments about their involvement in the adoption of health practices were unpacked using social network ontological abstraction and qualitative inquiry methods.

Considering social networks as part of the environment, the results raise awareness of and reflection on the relevance of informal relationships (family and friends) and the negative impact of healthcare professionals (as formal relationships) on shaping the risk of gaining and losing weight and impact mental health through the different processes proposed. Also, other environmental influences were uncovered, which were not identified before in other research as part of the obesogenic environment. The food environment still seems to be the main problem, being the demands and inequalities of working life facilitators to conduct unhealthy food practices. Specific workplaces, such as hospital settings, can become snacking environments due to established social norms. On the other hand, social media and digital celebrities and how they interact with individuals and vice-versa could promote positive health changes. Schools, the NHS and food companies were targeted as negative environmental influences and the main settings to prioritise preventive measures against obesity.

These results consider the wider open system of socially connected individuals and harness these forces to design new interventions where social networks and other contextual and individual factors operate together in a complex multilevel environment. Also, they suggest the need to re-considerate the current understanding of the obesogenic environment, suggesting a focus on the reciprocal interactions between individuals and these environments through a life span and including the existing positive influences within this obesogenic environment to reduce harmful exposure.

These perceptions from adults living with obesity could inform the design of more adequate, long-term sustainable and effective interventions that consider, more than in the past, the interactions between the environment and individuals and make the general population and stakeholders aware of environments that have been overlooked in the past, such as social networks. Finally, this research could raise awareness amongst lay populations about the socio-ecological nature of obesity, reducing blaming and stigma from society and creating a more conducive context for political and societal change.

# Appendix A Documents for recruitment

## A.1 Research poster

University of Southampton

PUBLIC HEALTH

- Are you 18 years old or over and have a current BMI (body mass index) 30 or over, or have a current BMI less than 30, but used to have 30 or over in the past? (To calculate your BMI, you can search online for "NHS BMI calculator" or scan the QR code below)
- Are you able to take part in a short interview through video call at a time that is convenient for you?

I am recruiting participants to take part in this research project. With your experience and opinions, we hope to better understand the complex condition of obesity in the United Kingdom to develop public health policies according to the current social scenario.

For more information, you can contact Nestor Serrano-Fuentes, PhD doctoral researcher, email: nsf1e16@soton.ac.uk

Ethics reference number: 55638
Date: 09/08/2020
Takedown date: 20 December 2020

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk | nsf1e16@soton.ac.uk |

[Poster version 5(A1)]

## A.2 Social media posts

**LinkedIn and Facebook**

Are you an adult that would be considered to have obesity or did you used to have it? I want to listen to your personal story of living with obesity.

With your experience and opinions, we hope to better understand and raise awareness of its complexity.

This study will involve taking part in one videoconference or telephone interview at a time convenient to you!

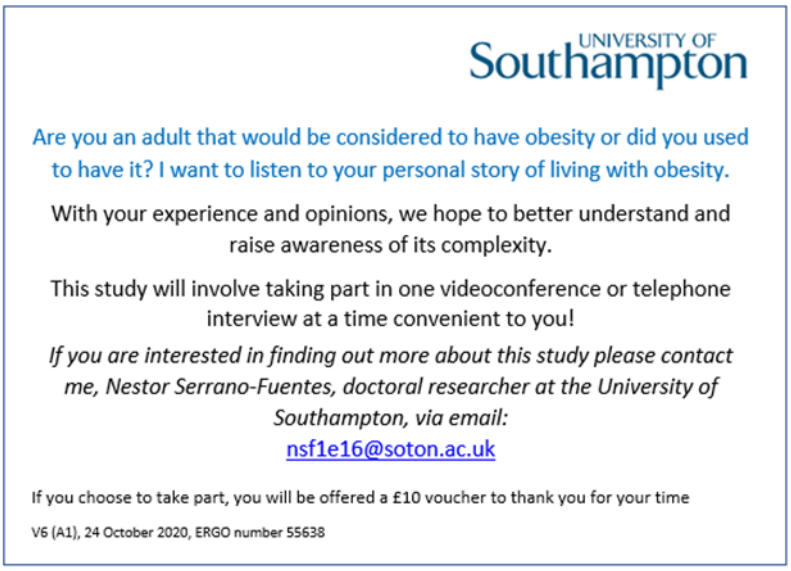
If you are interested in finding out more about this study please contact me, Nestor Serrano-Fuentes, PhD doctoral researcher at the University of Southampton, via email: nsf1e16@soton.ac.uk

If you chose to take part, you will also be offered a £10 voucher to thank you for your time!

*V6 (A1), 24 October 2020, ERGO number 55638*

**Twitter**

Are you an adult that would be considered to have obesity or did you used to have obesity? If so, we want to hear your experiences and opinions. More details below ↓



## A.3 Letter of invitation


Dear citizen,

I would like your help with a research study. As a doctoral researcher and cardiac nurse, I am very interested in exploring and understanding a complex condition, which is obesity.

I want to interview adults (18 years old or over) with a body mass index (BMI)* of 30 or greater than 30 to understand your experience and discuss multiple factors that influence health choices and behaviours. The interview will take around 45 minutes and at a convenient place for you.

With your collaboration and thinking, we will create knowledge together and help to understand this growing health condition in the United Kingdom. Your responses may therefore benefit others and could inform future research and interventions.

Results will be anonymised, and data will be confidential.

**How can I take part?**

If you are interested in taking part, or want more information, you can establish contact directly with me, writing to the following email.

Researcher: Nestor Serrano (nsf1e16@soton.ac.uk)

Supervisor: Prof Mari Carmen Portillo (mcpv1r14@soton.ac.uk)

Thank you for your help,

Yours sincerely

Nestor Serrano

*To can calculate your BMI search online for 'NHS BMI calculator'.

[Letter on invitation_version3]

## A.4 Gatekeepers' approval letter

Building 67. School of Health Sciences

University of Southampton

University Road

Southampton

SO17 1BJ

24 October 2020

Dear Sir / Madam

My name is Nestor Serrano-Fuentes and I am a PhD student in Health Sciences at the University of Southampton. I am writing to ask your permission to recruit participants from your organisation for my PhD research entitled Exploring environments and individual factors that influence the lifestyles of adults with obesity: a phenomenological study with social network analysis, which has been given ethical clearance by the University of Southampton Research Ethics Committee under reference 55638. As part of that approval process, I am required to obtain gatekeeper permission from sites where I recruit participants.

The main aim of this study is to understand the complexity of obesity as a health condition and identify its multiple causes. I am looking for adults with a current body mass index (BMI) of 30 or greater than 30 or a current BMI of less than 30, but used to have 30 or more in the past that want to discuss their views regarding obesity in the United Kingdom and their experience of living with it. The study will consist of 25 individual interviews using videoconference or phone calls (together with filling out individual questionnaires). Each interview would take around 45 minutes. Thus, due to the current COVID-19 scenario, all the research will be conducted online.

I have prepared a description of the study and what is involved in it for potential participants. Thus, I have attached a participant information sheet (full description of the project) for participants. Your assistance would consist of distributing (as appropriate) this document to the members of your organisation via email, social media (if you are a member of an online group), post, etc. I would anticipate that interested participants would contact me directly to complete

the study in their own time and, therefore, there should be no disruption to you and your organisation.

I hope that you find the attached project of interest. Please feel free to contact me if you have any queries (nsf1e16@soton.ac.uk). Alternatively, you may wish to contact my supervisor, Prof Mari Carmen Portillo (mcpv1r14@soton.ac.uk) if you would like a reference or other information.

Many thanks for taking the time to read this and I hope to hear from you soon.

Yours sincerely

Nestor Serrano-Fuentes

[24/10/2020] [Version 4(A2)] [55638]

## A.5 Gatekeepers' consent form

UNIVERSITY OF Southampton

### CONSENT FORM (gatekeeper approval)

**Study title: Exploring environments and individual factors that influence the lifestyles of adults with obesity: a phenomenological study with qualitative social network analysis**

**Researcher name: Nestor Serrano-Fuentes**
**Supervisor: Prof. Mari Carmen Portillo**
**ERGO number: 55638**

***Please initial the box(es) if you agree with the statement(s):***

| | |
|---|---|
| **I have read and understood the gatekeeper letter and the participant information sheet for participants (27 October 2020, version 8(A2)) and have had the opportunity to ask questions about the study.** | |
| **I understand that even if I agree to help now, I can withdraw at any time without any consequences of any kind.** | |
| **I understand that I will assist to distribute the participant information sheet between the members of my organisation.** | |
| **I understand that all data collected in this study is confidential and anonymous.** | |
| **I understand that I am free to contact any of the people involved in the research to seek further clarification and information.** | |

Name of gatekeeper (print name)……

Role title and/or organisation that you represent

……

Signature of gatekeeper……

Date…… ……

Name of researcher (print name)……

Signature of researcher ……

Date……

[27/10/2020] [Version 6(A2)]

## A.6 Participant information sheet

UNIVERSITY OF Southampton

**Study Title: Exploring environments and individual factors that influence the lifestyles of adults with obesity: a phenomenological study with qualitative social network analysis**

Researcher: Nestor Serrano-Fuentes

ERGO number: 55638

You are being invited to take part in the above research study. To help you decide whether you would like to take part or not, it is important that you understand why the research is being done and what it will involve. Please read the information below carefully and ask questions if anything is not clear or you would like more information before you decide to take part in this research. You may like to discuss it with others, but it is up to you to decide whether or not to take part. If you are happy to participate, you will be asked to sign a consent form.

**What is the research about?**

Dear participant,

My name is Nestor Serrano-Fuentes. I am a nurse and a doctoral researcher in Health Sciences at the University of Southampton.

As part of my doctoral thesis, I am exploring in-depth the complex and growing condition of obesity in adults in the United Kingdom (UK), which remains largely misunderstood by society. My aim is to listen and understand different experiences of adults that live or used to live with obesity. More details are explained below, in the section 'What data will be collected?'

The development of answers could provide new information to re-think the definition of obesity, raise awareness of its causes, find ways to reduce the levels of stigma associated with it and create knowledge to develop public health interventions according to the current social scenario.

**Why have I been asked to participate?**

I am looking for 25 adults (18 years old or over) with a current body mass index (BMI) 30 or over, or a current BMI less than 30, but used to have 30 or more in the past. If you don't know your BMI, you can calculate it here:

https://www.nhs.uk/live-well/healthy-weight/bmi-calculator/

I am looking for people that want to feel free to open up to discuss their individual experience of living with obesity and their opinions about obesity in the United Kingdom.

Participants will need to have a device with Internet connection and microphone (mobile phone, computer, tablet, etc.) and an email address. Camera/webcam availability within the device will be strongly recommended (not mandatory) since interviews will be conducted, preferably, via videoconference.

**What will happen to me if I take part?**

If you decide that you would like to take part, you will be given the opportunity to ask the researcher any questions you have (contact details are under 'Where can I get more information?' later on in this document). Once you have decided to take part, you can contact me directly and we will discuss a potential interview date and/or further questions. One week before the interview, I will send you some documents. They will consist of:

1. A consent form. Once you sign the form, you will need to send it back to me. Then, I will sign it and send a copy to you with both responses/signatures. If you don't have a printer/scanner to insert your signature, you can fill the form electronically by typing your answers and full name. This process needs to be done before our videoconference.
2. A small questionnaire. It will take 5 minutes to complete, and it is not mandatory to send it back to me before our meeting.
3. A concentric circle diagram with some instructions (see figure below). We will use it the day of the interview.

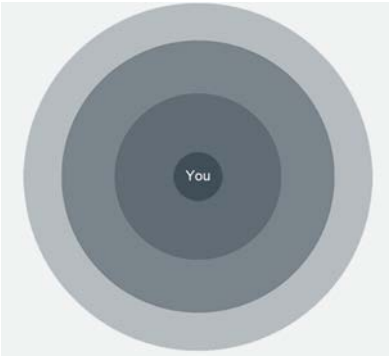



Figure: concentric circle diagram

I will send these documents via SafeSend (a service of the University of Southampton) to ensure the maximum safety of data protection. You will use the same service. I will explain to you how it works at the appropriate time; it is straightforward.

The day before the interview, I will send a reminder about our videoconference. You will be interviewed by myself at a time convenient to you. I will use Microsoft Teams instead of other programmes such as Skype. Microsoft Teams is the most secure method in terms of data security and privacy following the recommendations of the Research Integrity and Governance of the University of Southampton. You won't need to download any program. The day of the interview, you will receive a link (URL) in your email with which you can join our session. It is recommended to use a device with a camera/webcam so that we can have a more personable approach during our meeting. However, if you do not feel comfortable, videoconferencing can be done only with audio and without the use of the camera. Only as a last option, the possibility of interviewing by telephone (phone call) could be considered. This option will be contemplated if there are connection or technological problems or at the interviewee's request. I will recommend you undertake the interview in a quiet place while considering confidentiality (e.g. who is listening to the interview) and the best Internet connection possible. Also, you might consider the use of a Wi-Fi network instead of mobile data to avoid extra costs. The research team is not expected to reimburse those costs.

The interview will begin with a verbal explanation of the study. It is expected to last between 45 and 60 minutes approximately. However, this time may vary depending on your responses or time available. It will be done only once and will be audio-recorded to fully capture your answers and enhance the accuracy of reporting your experiences. These recordings are required for participation.

Once all the audio recordings are transcribed, I will remind you about the possibility to withdraw from the study (this will be the last opportunity). This is explained below in this document. Once I write the results, one or two participants (from the total) will be selected to read and give their opinion about how the data are written and potential suggestions to improve the report. During all the research process, you have the right to ensure that all the data we hold about you are accurate and to correct any errors should you wish to. The final report will be ready at the end of 2021, and you can receive a copy of this (explained below). After that, no more contact will be needed.

Are there any benefits in my taking part?

With your collaboration and thinking, we will create knowledge together and help to understand a complex and growing condition in the United Kingdom. Your responses may, therefore, benefit others and could inform future research, interventions and social and health policies.

We understand that we are benefitting greatly from your participation and will reimburse you for your time with a 10 pounds voucher.

**Are there any risks involved?**

Thinking and talking about obesity might not always be comfortable and might be upsetting. In this sense, I have attempted to design adequate interview questions based on previous research and the feedback of different academic and health professionals working on this topic. Should you feel upset, there is the opportunity to move onto a different question, take a break in the interview, or terminate the meeting altogether.

Additionally, if feel you need to talk to someone after the interview, you can phone the Samaritans group on 116 123.

**What data will be collected?**

One week before the interview, I will send you a short questionnaire to collect personal information. Thus, different characteristics such as age, marital status (e.g. married, single, divorced, etc.), education, occupation or income level will be collected. The answers of some of these characteristics will be grouped in categories to hide the exact values and, therefore, protect your anonymity (e.g. age: 18-24, 25-29, etc.). Regarding your location, I will ask only for the first 5 digits of your postcode (this represents approximately 2,600 homes). Therefore, your actual address will not be disclosed. Also, there will be some questions which collect some sensitive personal data. These will include information on ethnicity, biological sex and health data (e.g. weight, height, or if you have a chronic disease). These data could play an important role in your conception regarding your health experiences and opinions. This questionnaire will be linked with your interview using a fictitious name, so your real name will never appear.

The day of the interview, we will start talking about the potential influence of different social relationships (e.g. family, friends, neighbours, etc.) in your health (with positive and maybe not so positive effects). Who and how these people influence your health? All the real names that you mention (including yours) will be coded into fictitious names. At this point, we will use the concentric circle diagram. I will send it with some instructions one week before the interview. It will help to imagine those people that influence your health.

In the second part of the interview, you will have the opportunity to talk about everything you want about your individual experience of living with obesity. Also, there will be some specific questions regarding lifestyles (e.g. diet or physical activity). We could talk about those you are proud of and those you are not so proud of (if that is the case). What makes you choose those lifestyles (again, regarding diet, physical activity or alcohol intake)? For example, food prices, personal motivation, knowledge, peer support, type of work, what your city/town is offering you, social media and advertisements, availability of time, etc. Are there more barriers or opportunities in your city/village to try to manage your health positively?

Finally, we will think and reflect on the condition of obesity in the UK.

As you can see, the scope of the interview is extensive since I want to understand these experiences from different angles.

**Will my participation be confidential?**

Your participation and the information I collect about you during the research will be kept strictly confidential.

For secure storage and in compliance with the Data Protection policy (2018) of the University of Southampton, hard data (e.g. printed transcriptions of the interviews, the concentric circle diagrams that I will complete and the audio recorder) will be kept in a locked filing cabinet in one of the researchers' office (I or my main supervisor) at the University of Southampton in Highfield Campus. Only I and my main supervisor will have access to this locked cabinet. The transcription of the interviews, the questionnaires and the signed consent forms will be kept on a University of Southampton password-protected computer. The latter will be stored in password-protected files. Personal data will be kept separate from non-identifiable data.

Only my doctoral supervisors and the transcription service of the University of Southampton will have access to data about you during the research process. Thus, my supervisors could help me to interpret some information, and the transcription service will transcribe the audio recordings. Once the interviews are transcribed, data will be anonymised, so you can not be identified. Audio recordings will be immediately destroyed once the interviews are transcribed. Individuals from regulatory authorities (people who check that we are carrying out the study correctly) may require access to your data. All these people have a duty to keep your information, as a research participant, strictly confidential.

When confidential data has to be sent (e.g. the audio recordings to the transcription service or the completed questionnaire, SafeSend (service hosted by the University of Southampton) will be used to ensure the utmost safety.

**Do I have to take part?**

No, it is entirely up to you to decide whether or not to take part. If you decide you want to take part, you will need to sign a consent form to show you have agreed to take part.

If you are interested, you can contact me directly (I give my contact details below).

**What happens if I change my mind?**

You have the right to change your mind and withdraw without giving a reason, and without your participant rights being affected. After that, no longer contact will be needed.

If you regret having participated in the study and want to withdraw after being interviewed, please let me know if you want your information (answers from the questionnaire and interview) to be analysed and incorporated in the final results or you want your data to be destroyed. Please, bear in mind that data can be withdrawn until it is unlinked from your identifiable data. This moment will coincide with the beginning of the analysis. You will be notified of this moment at the time via email and/or by phone call/text message (via agree method). A week of margin will be given to receive a response from you. Also, I will remind you of this information on the day of the interview.

**What will happen to the results of the research?**

Once the data collection has been completed, the information obtained will be written up, anonymised and analysed. The findings will be written up into a report. A summary of the study and its results will be made available to those who have participated. To request this information, you are asked to contact the researcher (contact details below) to request a summary, which will be emailed or posted to you (as per your preference) upon completion and write up. It is anticipated that the findings will be published in a relevant scientific journal.

As I said, all the data that you provide will be anonymised. Thus, all the real names (including yours) will be coded into fictitious names. The reports/publications created from this research will not include information that can directly identify you.

In addition to presenting the data in scientific publications, I have the intention to communicate the results in national and international conferences, present this information to non-expert audiences and to local and national politics that can plan and create future innovative interventions while considering your answers.

All data collected will be retained for the next ten years (after completion of the doctoral thesis), as per University of Southampton policy. Hard copies of anything related with the research data will be kept in a locked filing cabinet in one of the researchers' office (I or my main supervisor) at the University of Southampton in Highfield Campus. The electronic data (transcriptions of the anonymised interviews, questionnaires and signed consent forms) will be kept on a University of Southampton password-protected computer. Only I and my principal supervisor will have access to all these data.

I think that the anonymised interviews could contain rich information that could be used for other research (secondary analysis) and learning after the completion of this doctoral thesis. You will have the option to give or not give permission to use your anonymised research data for these purposes. Within the consent form, in the 'optional' section, you will find a statement referring to this fact, and you will decide what you want to do. This choice will not affect the point of conducting the interview. If you permit to use your data, the transcripts of your anonymised interview will be uploaded at the University of Southampton Institutional Repository for the next ten years. If not, your data will just be retained as it has been explained in the previous paragraph and will not be used for further research and learning.

**Where can I get more information?**

As I am the main researcher, if you have further questions, want more information, or want to participate in the study, please feel free to contact me via the following email.

nsf1e16@soton.ac.uk

**What happens if there is a problem?**

If you have a concern about any aspect of this study, you may contact me, and I will do my best to answer your questions.

Following this, if you have any issues or complaints, you might contact my doctoral supervisor Prof Mari Carmen Portillo by email (m.c.portillo-vega@soton.ac.uk). She is a Professor in Long-Term Conditions at the University of Southampton.

If you remain unhappy, you can contact the University of Southampton Research Integrity and Governance Manager, which will provide further information and support, on the following detail:

Research Governance Office

George Thomas Building 37

Room 4079

University of Southampton

Highfield

Southampton

SO17 1BJ

023 8059 5058

rgoinfo@soton.ac.uk

Due to the current COVID-19 scenario, it is recommended to make contact by email.

**Data Protection Privacy Notice**

The University of Southampton conducts research to the highest standards of research integrity. As a publicly-funded organisation, the University has to ensure that it is in the public interest when we use personally-identifiable information about people who have agreed to take part in research. This means that when you agree to take part in a research study, we will use information about you in the ways needed, and for the purposes specified, to conduct and complete the research project. Under data protection law, 'Personal data' means any information that relates to and is capable of identifying a living individual. The University's data protection policy governing the use of personal data by the University can be found on its website (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page).

This Participant Information Sheet tells you what data will be collected for this project and whether this includes any personal data. Please ask the research team if you have any questions or are unclear what data is being collected about you.

Our privacy notice for research participants provides more information on how the University of Southampton collects and uses your personal data when you take part in one of our research projects and can be found at http://www.southampton.ac.uk/assets/sharepoint/intranet/ls/Public/Research%20and%20Integrity%20Privacy%20Notice/Privacy%20Notice%20for%20Research%20Participants.pdf

Any personal data we collect in this study will be used only for the purposes of carrying out our research and will be handled according to the University's policies in line with data protection law. If any personal data is used from which you can be identified directly, it will not be disclosed to anyone else without your consent unless the University of Southampton is required by law to disclose it.

Data protection law requires us to have a valid legal reason ('lawful basis') to process and use your Personal data. The lawful basis for processing personal information in this research study is for the performance of a task carried out in the public interest. Personal data collected for research will not be used for any other purpose.

For the purposes of data protection law, the University of Southampton is the 'Data Controller' for this study, which means that we are responsible for looking after your information and using it properly. The University of Southampton will keep identifiable information about you for 10 years after the study has finished after which time any link between you and your information will be removed.

To safeguard your rights, we will use the minimum personal data necessary to achieve our research study objectives. Your data protection rights – such as to access, change, or transfer such information - may be limited, however, in order for the research output to be reliable and accurate. The University will not do anything with your personal data that you would not reasonably expect.

If you have any questions about how your personal data is used, or wish to exercise any of your rights, please consult the University's data protection webpage (https://www.southampton.ac.uk/legalservices/what-we-do/data-protection-and-foi.page) where you can make a request using our online form. If you need further assistance, please contact the University's Data Protection Officer (data.protection@soton.ac.uk).

As stated above, data will be anonymised.

Thank you.

I just want to say thank you for taking a few minutes to read this information sheet and considering taking part in the research. I am looking forward to hearing from you and working together to provide new answers to one of the main health conditions in the world.

[27/10/2020] [Version 8(A2)]

# Appendix B Interview schedule

I appreciate that you have accepted our appointment today.

My name is Nestor. I am a PhD student in Health Sciences at the University of Southampton and I am also a cardiac nurse at Southampton General Hospital.

As you could read in the information sheet, within my research, I am very interested in understanding and exploring the condition of obesity in adults and, at the same time, different factors that influence choices, behaviours and lifestyles (in terms of physical activity, diet and alcohol intake). In particular, I am very interested in the potential influence of the environment.

I consider this situation as an opportunity to talk about a 'sensitive' topic in society. I think, as a society, we really need to explore it more in-depth and one of the ways is to sit with people and talk about it. I want you to feel comfortable and open up to me as far as possible. So, please, feel free to discuss your views openly during the interview. From time to time, I might ask you for further clarification to assist me to understanding your responses.

I would like to reassure you that this interview is confidential. We will ensure that any information included in our report does not identify you as the respondent, codifying all the names that you will provide during the interview, including your own name. Also, the answers will be shared only with my PhD supervisors and the transcription service.

I would like to request your permission to audio-record this interview so that your responses can be transcribed later. Recording will facilitate my analysis of the data during the course of this project.

Any questions before we start?

1. According to the scientific literature, when it comes to handling our own health, one of the main factors that influence our behaviours is our social relationships. What do you think about that? Have you ever thought about the influence of your relationships on your own health?

Shall we reflect a little bit more in-depth about this? Here, we have a diagram (Show the interviewee the concentric circle diagram). This circle diagram is made to visualise what persons you think are key in helping and hinder the handling of your health. Therefore, these people can influence you adopt healthy and maybe not so healthy lifestyles. You can see in the diagram that you are in the middle of the circle and then we are going to think about people who are the most influential to you (show the list of types of ties); they will be written right in that centre circle. Anyone who is still relevant (positively and negatively) but a bit less so will go in the next circle

along, and then anyone who is a bit less important (in comparison with the other two groups) then that would go in the next circle along. To make the difference between negative and positive relationships clear, we are going to place positive relationships from the middle up, and the negatives ones from the middle down. Any doubts?

Let us start with whoever is most influential for you (I show table with list of relationships). This is a potential list of people, in case it can help. Obviously, you can think in other people as well. While you are filling the diagram (name of the person and type of relationship), I would like you to think why that person is in that circle and how that person helps/hinders the handling of your lifestyles.

2. Out of curiosity, do these people know each other? You can use lines in the diagram to link them and you can write on the line what kind of relationship they have (family, friendship).

3. I can see there is/are/isn't/aren't healthcare professionals/voluntary organizations in the diagram. What is your experience with them?

4. Do you think this diagram has changed over the years?

- If it has changed, do you think you could draw that diagram in this other sheet and explain it a little bit? (How and why has this changed over time?)/ I can see that you maintain /do not maintain some/many relationships, why is that?

5. How would you like the diagram to look like in the future (in terms of management of your health)? Same? Any changes? Just imagine it.

6. Have you found useful to do this little exercise of reflection? Why?

7. OK. Now, let's move away from the topic of social relationships and let's talk about your individual experience. In general terms, how do you perceive yourself in terms of health? (If participants mention the topic of having overweight/obesity, I will ask them if they want to talk a bit more about it. For example, I would ask if there is something that they find challenging in terms of living with overweight).

8. Now, we are going to talk about health behaviours (specifically regarding diet, physical activity and alcohol intake).

- How do you think your health behaviours are? Is there something in particular that you are proud of? In the same line, is there something that you are not proud of, in other words, or something that you would like to change?

- For example, in terms of diet, what does a typical week look like?

- What does a typical week look like in terms of physical activity?

- What about alcohol intake?

9. Have these behaviours changed over the years? How was that?

10. We have lived a strange situation, which is the COVID-19 pandemic, a lockdown, etc. Did this situation change any of your behaviours? In which sense?

11. I would like you to think very in-depth now about what factors influence your choices, behaviours and lifestyles (regarding diet, physical activity and alcohol intake). Firstly, let's think about healthy or positive ones and, after that, maybe… those that might be not so healthy, if that is the case... (If the participant does not understand this statement, I will mention different examples such as motivation, access to supermarkets, income, etc., and I can give an example about myself).

- Do you think that the environment (social context) out there influences your choices? How is that?

-From all of these factors, which is the most important for you? Or maybe all the factors that you are mentioning have the same impact…

12. You mentioned before… that you are not very proud of/you would like to change… Could there be something that helps you to improve that? (Community activities, walking more, online support, etc.). In this regard, do you think there are enough opportunities out there to make changes?

13. Now, we are going to think in the society, from a broad perspective, and specifically in the United Kingdom.

- How do you perceive people in the UK in terms of health (in general) currently?

- Do you think people (in general) have worse health in comparison with a few years ago?

- What do you think are the main health problems?

- What is your opinion about obesity as a health condition in the UK?

- According to statistics, having overweight is three folded than thirty years ago. Why do you think this has happened? Let's think in potential causes (e.g. socioeconomic status to have access to healthy food, lack of support, social pressure, food industry, etc.).

14. Imagine that you have the power to make important decisions in society and you have a big lump of money to invest in health, for example, you are the Prime Minister of the United Kingdom now. What would you do to try to prevent these problems? What would be the priorities for you? Do you think there are enough solutions in the environment out there?

15. So, my last question of the interview refers to a 'new word' in the media, which is 'obesogenic environment'. Have you heard this word before? Even if you haven't heard of those words, would you dare to try to define this concept and give me some examples? Do you like it? Do you think it is inappropriate to use?

We have covered a great deal of ground. Thank you for being so patient with me. Well, I don't have more questions.

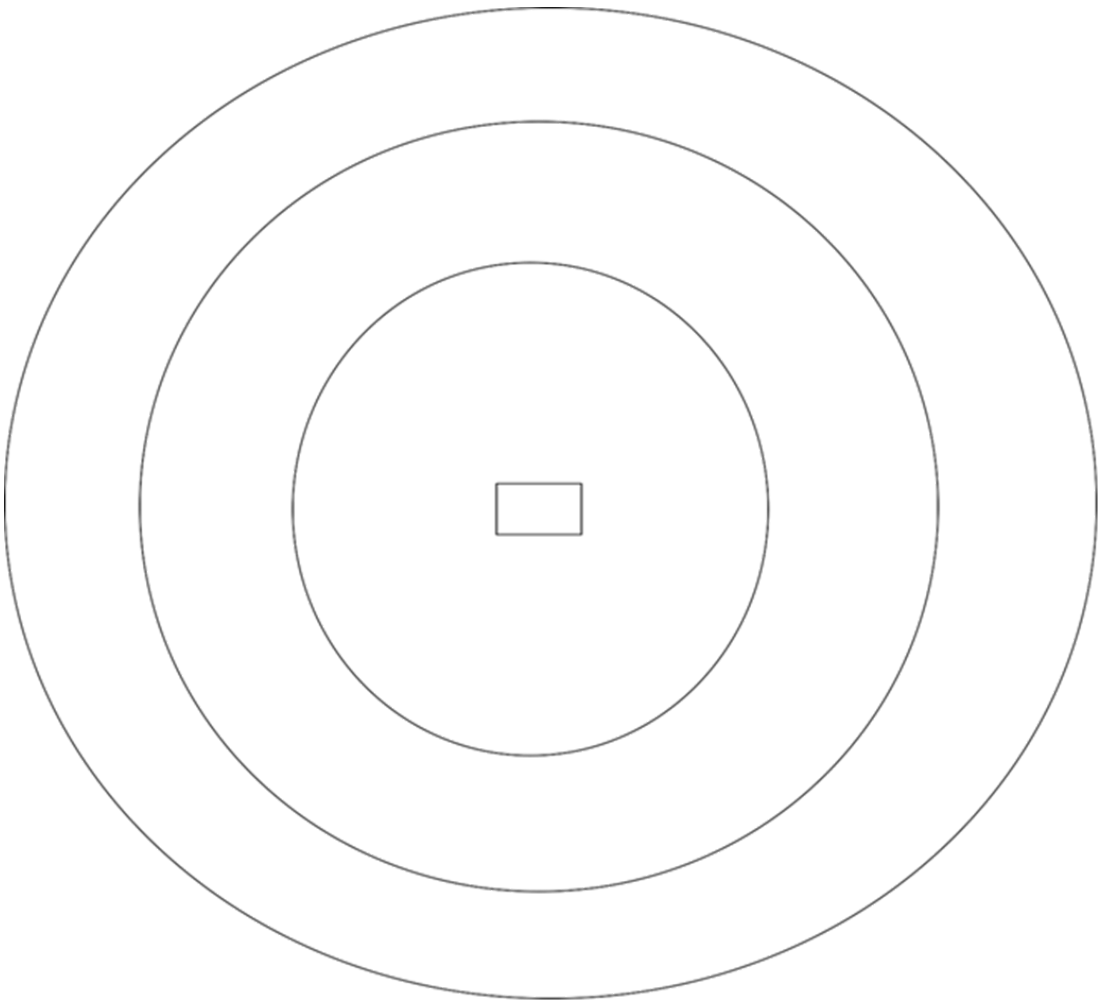
Do you think there is anything we have missed out? Do you have any other comments about what we have discussed or about the research as a whole?

During all the research process, you have the right to ensure that all the data we hold about you are accurate and to correct any errors should you wish to. If you regret having participated in the study and want to withdraw after being interviewed, please let me know if you want your information (answers from the questionnaire and interview) to be analysed and incorporated in the final results or you want your data to be destroyed. Please, bear in mind that data can be withdrawn until it is unlinked from your identifiable data. This moment will coincide with the beginning of the analysis. You will be notified of this moment at the time via email and/or by phone call/text message (via agree method). A week of margin will be given to receive a response from you (it's your choice) (Participant to provide details at this moment). A week of margin will be given to receive the response from you.

You are welcome to have a full copy of the final report too after I finished my study (PhD thesis manuscript/research article).

Thank you very much.

# Appendix C Personal networks diagram and instructions



The day of the interview, we will start talking about the potential influence of different social relationships in your health (with positive and maybe not so positive effects). Who and how these people influence your health? All the real names that you mention (including yours) will be coded into fictitious names. We will use the concentric circle diagram (see diagram below).

This circle diagram is made to visualise what persons you think are key in helping and hinder the handling of your health. Therefore, these people can influence you adopt healthy and maybe not so healthy lifestyles. In the diagram, you are in the middle (the small square). Then, we are going to think about people who are the most influential to you (see the list of relationships below); they will be written right in that centre circle. Anyone who is still relevant (positively and

negatively) but a bit less so will go in the next circle along, and then anyone who is a bit less important (in comparison with the other two groups) then that would go in the next circle along. To make the difference between negative and positive relationships clear, we are going to place positive relationships from the middle up, and the negatives ones from the middle down.

At this point, you might think ahead about some of this information.

**Relationships**

-Family (spouse/partner, son/daughter, grandchildren, mother/father, brothers/sisters, other relatives)

-Friends (female/male) [types of friends, be specific]

-Co-workers

-Pets

-Sports contacts

-Healthcare professionals (GP, nurse, pharmacist, psychiatrists, physiotherapists, etc.)

-Non-healthcare professionals (social workers, legal agents, religious or spiritual leaders, supervisors, etc.)

-Neighbours

-Community organizations and community (others) (support group, lunch/tea club, Internet-based discussion group, religious group, ethnic group, other social groups)

-Others

# Appendix D Sociodemographic questionnaire

## Socio-demographic questionnaire

**Fill in and tick off:**

**1. Biological sex: (tick off)**
**Female ☐ Male ☐**

**2. Age:**
**18-24☐ 55-59☐**
**25-29☐ 65-69☐**
**30-34☐ 70-74☐**
**35-39☐ 75-79☐**
**40-44☐ 80-84☐**
**45-49☐ 85 or over☐**
**50-54☐**

**3. Weight and Height:**

**4. Do you have any chronic illness? Could you name it?**

**5. Do you live alone?**
**Yes ☐ No ☐**

**6. Civil status: (tick off)**

**Married/live-in partner ☐ Divorced ☐ Single ☐ Widow/-er ☐**

**7. Ethnicity, cultural group (choose from the following list):**

**White**

**English / Welsh / Scottish / Northern Irish / British**
**Irish ☐**
**Gypsy or Irish Traveller ☐**
**Any other White background (please write _____ in)**

**Mixed / Multiple ethnic groups**

**White and Black Caribbean ☐**
**White and Black African ☐**
**White and Asian ☐**
**Any other Mixed / Multiple ethnic background (please write _____ in)**

**Asian / Asian British**

**Indian ☐**
**Pakistani ☐**
**Bangladeshi ☐**
**Chinese ☐**
**Any other Asian background (please write _____ in)**

**Black / African / Caribbean / Black British**

**African ☐**
**Caribbean ☐**

Any other Black / African / Caribbean background (please write in) ☐

Other ethnic group

Arab ☐

Any other ethnic group (please write ☐ in)

8. Do you have a pet?

Yes ☐ No ☐

9. Place of residence: (tick off)

Deprived urban ☐ Affluent urban ☐ Deprived rural ☐ Affluent rural ☐

10. Postal code: (only the first 5 characters; e.g. SO15 5)

11. Educational level: (tick off)

Primary school☐ Secondary school (up to 16) ☐ College ☐ University ☐

12. Occupation most recent: (For example "Plumber")

13. Work situation: (tick off)

Working full time ☐ Working part- time ☐ Pensioner ☐ Unemployed ☐ Disabled ☐

14. How do you perceive your health status on a scale from 1 to 10. '1' would be 'extremely good' and '10' would be 'extremely bad'. Write a number here:

15. How do you perceive your health practices (regarding diet) on a scale from 1 to 10. '1' would be 'extremely good' and '10' would be 'extremely bad'. Write a number here:

16. How do you perceive your health practices (regarding physical activity) on a scale from 1 to 10. '1' would be 'extremely good' and '10' would be 'extremely bad'. Write a number here:

17. How do you perceive your health practices (regarding alcohol intake) on a scale from 1 to 10. '1' would be 'extremely good' and '10' would be 'extremely bad'. Write a number here:

18. What is your household's total income from all sources, e.g. employment, benefits, pensions, investments, savings, maintenance payments, grants?
*Please do not deduct: taxes, national insurance contributions, Health insurance payments*

| Per week | | OR | Per year (approximately) |
|---|---|---|---|
| Nil | ☐ | | ☐ Nil |
| Up to £99 | ☐ | | ☐ Up to £5,199 |
| £100 to £199 | ☐ | | ☐ £5,200 to £10,399 |
| £200 to £299 | ☐ | | ☐ £10,400 to £15,599 |
| £300 to £399 | ☐ | | ☐ £15,600 to £20,799 |
| £400 to £499 | ☐ | | ☐ £20,800 to £25,999 |
| £500 to £599 | ☐ | | ☐ £26,000 to £31,999 |
| £600 to £999 | ☐ | | ☐ £32,000 to £51,999 |
| £1000 or more | ☐ | | ☐ £52,000 or more |

[Questionnaire version 3]

# Appendix E Instructions to use Microsoft Teams and SafeSend

## E.1 Microsoft Teams

We are going to use Microsoft Teams to undertake the interview.

Before the interview, you will receive an invitation in your email. You do not have to do anything in that email (e.g. accepting the invitation). Only the day of the interview you will have to click the option 'Join Microsoft Teams meeting' in this email.

If you have Microsoft in your device, you will have the option to join the meeting using the web browser, without downloading the App or the icon desktop. However, to prevent surprises and to make sure that we don't have problems to join our meeting, I'm going to ask you to download the App (if you are using a mobile phone or a tablet for our interview) or the icon for your computer desktop (if you are using a laptop/computer) before our interview day.

To download it. If you are using a laptop/computer:

Go to the web page

https://www.microsoft.com/en-gb/microsoft-365/microsoft-teams/download-app

Click 'Download for desktop' and then, click 'Download Teams'.

To download it. If you are using a mobile phone/tablet:

Download Microsoft Teams using Play Store or the way you usually use to download any other App. It will be approx. 41 MB

Create an account:

Once it is installed, you will have to sign up for free. If you are using a laptop/computer, when you open the icon, you might not find the option 'sign up for free'. If this is the case, just click 'learn more' and you will find the option.

Also, you can find the option 'sign up for free' in the link below

https://www.microsoft.com/en-gb/microsoft-365/microsoft-teams/group-chat-software

If you are using the App, you will find the option 'sign up for free' when you open it.

Appendix E

At some point, you might be asked about ‘How do you want to use Teams?’ Click ‘For work’. Also, you might be asked for your company name; you can invent this information.

The day of the interview

Click the option ‘Join Microsoft Teams meeting’ in the email that you received with the invitation. It will take you to a window where you will have to write your name and where you can connect/disconnect your camera and microphone. Then, join the meeting.

## E.2 SafeSend

UoS Safesend is the service we are going to use to send confidential information (it is hosted by the University of Southampton).

How it works

1.Receiving files from me (Nestor):

You will receive an email from UoS SafeSend (check the junk email folder as well). Click the link of that email. Then, download all the files from the web page.

2.Sending files to me (Nestor):

1. Go to the following web page: https://safesend.soton.ac.uk/

2. Click 'Drop-off' on the Home page.

3. The following information will appear:

Have you been given a 'Request Code'? The answer is 'No'

Your name (required). Write your name and surname

Your organisation (you do not have to complete it)

Your email address (required)

Click in the box 'I'm not a robot'

Click 'Send confirmation'

4. Go to your email address and open the email that you have just received from UoS SafeSend (it might be in the junk email folder-check all the folders). Please open the email and click the link that is within it.

5. A new window from UoS SafeSend will appear. In Add Recipients, write my name and my email address and then click 'Add and Close' (if you have closed this window accidentally, you will have the option to add my details as well by clicking the green and white little icon in the next screen). You can write a short note to me if you want. On the right side of this window, some options will appear to tick or untick; don't do anything there, it is set automatically. Then, you can click 'Click to add files or just drug them here' or just drag the files there. Use the one you feel more comfortable with; both options are easy to use. Once the files are uploaded, click 'drop-off files'.

# Appendix F Participants' consent form

UNIVERSITY OF Southampton

## CONSENT FORM

**Study title: Exploring environments and individual factors that influence the lifestyles of adults with obesity: a phenomenological study with qualitative social network analysis**

**Researcher name: Nestor Serrano-Fuentes**
**Supervisor: Prof. Mari Carmen Portillo**
**ERGO number: 55638**
**Participant Identification Number:**

***Please initial the box(es) if you agree with the statement(s):***

| | |
|---|---|
| **I have read and understood the participant information sheet (27 October 2020, version 8(A2)) and have had the opportunity to ask questions about the study.** | |
| **I agree to take part in this research project and agree for my data to be used for the purpose of this study.** | |
| **I understand that I will not be directly identified in any reports of the research.** | |
| **I understand that special category information will be collected about me to achieve the objectives of the study (biological sex, ethnicity and health data)** | |
| **I understand that my personal information collected about me (for contact purposes) such as my name, email address or telephone number (if provided) will not be shared beyond the study team.** | |
| **I understand my participation is voluntary and I may withdraw until the analysis of the results begins and my personal information is no longer linked to the data. My participation rights will not be affected.** | |
| **I understand that taking part in the study involves audio recording which will be transcribed and then destroyed for the purposes set out in the participation information sheet.** | |

**Name of participant (print name)**.....

**Signature of participant**.....

**Date**.....

**Name of researcher (print name)**.....

[27/10/2020] [Version 8(A2)] [55638]

UNIVERSITY OF Southampton

Signature of researcher .....

Date.....

---

*Optional - please only initial the box(es) you wish to agree to:*

| | |
|---|---|
| I give permission for my anonymised interview transcript to be held by The University of Southampton as described in the participant information sheet so it can be used for future research projects and learning for the next ten years. | |

Agreement to give permission to use your anonymised interview transcripts for other research purposes is optional and participation in the current study is not dependent on agreeing to this fact.

[27/10/2020] [Version 8(A2)] [55638]

Consent form [27/10/2020] [Version 8(A2)]

# Appendix G All data-driven

This appendix shows the inductive codes developed in the CIS to represent patterns across data (from sentences from the participants' quotes in the qualitative and mixed-methods papers and the text pertaining to the results, discussion and conclusions sections in the mixed-methods and quantitative studies).

Data-driven Themes

1. Meso-micro network processes

Meso-level

1.1 Social support

1.1.1 Peer support

Q1(+). "My doctors said before that I need to, to walk more … I mean it's the kind of thing that you sort of – you kind of know anyway really within yourself that you know you're not doing enough of any kind of exercise. This [study invitation] is what gave me the stimulus if you like to actually get on and do something about it … and even the doctor didn't even manage to persuade me of that." (Procter *et al.*, 2014)

Q2(+). "Several participants suggested external health promoters could provide additional encouragement: 'Somebody coming in from outside, say doing half an hour at lunchtime just doing a presentation about it or, you know, longer and getting people there and talking about that and saying 'and we have our in-house person who you know if you want to talk to him, d'you wanna get encouragement from him/her' that would be great but I think somebody coming in from outside actually would be a good idea." (Procter *et al.*, 2014)

1.1.2 Group support

T1(+). "During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups." (Alvarado, Murphy and Guell, 2015)

Q3(+). "When I had to reduce weight, I went to a weight loss group at 'X'… When they realized that I was a cook I was engaged to take part in cooking courses and things like that for overweight people with diabetes who have challenges with their intake…" (Kennedy *et al.*, 2015)

T2(-). “Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub.” (Knutsen *et al.*, 2017)

Q4(+). “That’s why I think the group would be kind of cool to get together with… to get together as a group and just share some ideas ...” (Sriram *et al.*, 2018)

1.2 Homophily

T3(+). “During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups.” (Alvarado, Murphy and Guell, 2015)

Q5(+). “When I had to reduce weight, I went to a weight loss group at ‘X’… When they realized that I was a cook I was engaged to take part in cooking courses and things like that for overweight people with diabetes who have challenges with their intake…” (Kennedy *et al.*, 2015)

T4(+). “Most of the women agreed that they prefer walking with other women; they feel safer and more comfortable.” (Ali, Baynouna and Bernsen, 2010)

T5(+). “Persons of the same sex had relatively greater influence on each other than those of the opposite sex.” (Christakis and Fowler, 2007)

1.3 Social pressure

Q6(+). “I probably would pass somebody from my gym somewhere on the streets [… It’s] motivational in the sense that if you don’t go […to the gym] and pass a girl that I haven’t seen in a while ‘hey why I don’t see you in the gym? What’s going on with you?’ and I guess guilt people into coming back. So yeah it’s motivation.” (Alvarado, Murphy and Guell, 2015)

Q7(+). “Cause for instance I sit home and I wouldn’t walk, but if somebody called me and I know I’m in a group and we walkin’ today, I’ll try to walk…cause you don’t wanna let anybody down.” (Forthofer *et al.*, 2016)

Q8(+). “What happened to you the other day? Why didn’t you come walking? And it’s kind of – its sort of an accountability where if you’ve got that moral support from saying ‘What’s up? You missed two days.” (Forthofer *et al.*, 2016)

T6(-). “Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub.” (Knutsen *et al.*, 2017)

Q9(-). “However, if I go back to the village where my husband comes from, they are country people and they love to bake, cook and it’s lovely. It’s gorgeous and because they know you’re coming for afternoon tea, they’ll have made you the apple pie and they’ll have made you the cakes and if you went in there and tried to start explaining that you don’t eat any of that… In that sort of culture, it just would not be understood, and also you’re interfering with the social norms and you don’t want to do that.” (Knutsen *et al.*, 2017)

T7(-). “Participants described food-centric social events as a primary constraint to eating well. Limited entertainment options in these rural communities meant that most activities involved getting together for a snack or meal. Food provision was regarded as a sign of “hospitality” and people felt obligated to eat whatever was offered in social settings (e.g. church, senior centers).” (Sriram *et al.*, 2018)

Q10(+). “An element of competition may help… if the progress was recorded and shared between all the people on the scheme, it could possibly have a positive effect…” (Procter *et al.*, 2014)

1.4 Natural communication

T8(+). “WhatsApp groups comprised of women in the same exercise class could make this social pressure and social support even stronger.” (Alvarado, Murphy and Guell, 2015)

1.5 Social modelling

Q11(+). “Participants described a program leader who would help in these areas. One expressed a desire for such a person “to motivate us or have the knowledge, but both would be good.” Another described this role as “It’s somebody that will enhance the group to walk.” (Forthofer *et al.*, 2016)

Q12(+). “We have people in my neighbourhood that you can be leaving out at five in the morning, and they’re walking. You can come in at six in the afternoon and there’s another group walking…We have a monthly HOA [homeowners association] meeting— and sometimes in those meetings people just go, “Hey, I saw you walking. Can I join your group?” (Mama *et al.*, 2015)

1.6 Diffusion

T9(+). “All participants received a Walk Member Handbook with community trail maps and other information sheets about issues of interest.” (Forthofer *et al.*, 2016)

Q13(+). “That’s why I think the group would be kind of cool to get together with… to get together as a group and just share some ideas…” (Sriram *et al.*, 2018)

T10(+). “Much of this health information was viewed with a degree of scepticism, particularly claims made about food. In contrast to the scepticism levelled at scientific, medical and government information sources, health messages that derived from within participants’ own social network were given more credence.” (Sriram *et al.*, 2018)

Q14(+). “Overall the promoters found their booklet ‘was well set out’ and helped them approach participants: ‘It was informative and useful and helped me set out what I needed to do, promote walking to work to the colleagues, and how to approach them and stuff, I thought it was quite good.” (Procter *et al.*, 2014)

Micro-level

1.7 Social modelling

T11(+). “When asked about recommended strategies for encouraging a friend to walk, participants emphasized social support in the form of direct encouragement (e.g. “you can make it”), serving as a role model, and offering to walk with the friend.” (Forthofer *et al.*, 2016)

T12(+). “In contrast, having tight social networks was viewed as beneficial if friends were “health-conscious” and acted as positive role models.” (Sriram *et al.*, 2018)

1.8 Social comparison

T13(+). “While describing their motivations for pursuing physical activity, some women explained that witnessing friends and family with long term chronic conditions motivated them to take control of their own health as much as possible.” (Alvarado, Murphy and Guell, 2015)

Q15(-). “I think it’s also about what I know I’m missing out on if I do exercise more. I mean, my friends and family are often going out of an evening, seeing films or going out to dinner or for drinks. I’d have to miss out on all of that if I was prioritising exercise a couple of nights a week, or even just eating really healthily would inhibit my ability to just do things like that. I don’t want to miss out.” (Robertson, Mullan and Todd, 2014)

T14(+). “Watching a family member’s health deteriorate came as a wake-up call to change their own behaviour.” (Sriram *et al.*, 2018)

Q16(+). “My grandmother… when I was 13… I was the sole witness to her coronary occlusion which killed her on the spot and I never quite dealt with that so it has left me with a bit of a fear of heart disease and heart problems and seeing how violently they can end your life.” (Daborn, Dibsall and Lambert, 2005)

T15(+/-). “In the case of body size, a descriptive norms effect can work through direct comparison so that a person compares himself to others in his social reference group and makes decisions regarding his own status according to that metric.” (Shakya, Christakis and Fowler, 2015)

T16(+). “Relative to social comparisons to targets of the same weight, weight-focused comparisons to both thinner and heavier individuals led to increased thoughts of dieting and exercising. Moreover, comparisons to thinner targets also increased the likelihood of engaging in actual dieting and exercising behaviours. Weight comparisons to friends amplified these effects.” (Rancourt *et al.*, 2015)

1.9 Social pressure

T17(-). “Social events involving food were areas where maintaining normal social ties were often more important than attempting to force attention on dietary needs.” (Kennedy *et al.*, 2015)

Q17(+). “My husband insists that I shouldn’t eat large quantities or any starchy food. My mum always scolds me, but this doesn’t help; she just gets on my nerves. As soon as she sees me eating even the smallest amount of sweets, she’ll start complaining. I can’t say my daughters are indifferent. They’ll remark when I overeat something. Everyone is focused on my diet.” (Knutsen *et al.*, 2017)

T18(-). “This man emphasizes the need to occasionally not adhere to the diet, especially at parties and when with friends.” (Knutsen *et al.*, 2017)

Q18(-). “Often, when [you are] offered a piece of chocolate, you don’t say that you have diabetes, you take it and eat it just because you don’t want to offend the person and you feel uncomfortable admitting you have diabetes and you shouldn’t eat sweets.” (Knutsen *et al.*, 2017)

Q19(+). “If you have someone that’s going to encourage you, say, “Come on, let’s go, let’s go do this,” or “Come on, it’s only going to take 10 minutes,” or something like that, then you go,“Okay, I’ll do it.” (Mama *et al.*, 2015)

T19(+). “One motivator for weight-loss which was raised specifically by young adults was to feel more confident when approaching people they find attractive, and forming intimate relationships.” (Robertson, Mullan and Todd, 2014)

Q20(-). “When I go to parties or I meet up with friends, I don’t go with my diet, I just eat whatever.” (Robertson, Mullan and Todd, 2014)

T20(+/-). “Depending on these factors, regularly shared meals, such as family meals, might more or less conform to dietary guidelines although they are often generally perceived as healthy meals.” (Mötteli, Siegrist and Keller, 2017)

1.10 Social support

1.10.1 Peer support

T21(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

T22(+). “Collective efficacy was most frequently obtained through a respondent’s partner changing their lifestyle, especially in cooking and eating, to make life easier for the partner with diabetes.” (Kennedy *et al.*, 2015)

Q21(+). “In the last 2 years things have worsened, because my wife got ill; she was the one who took care of me – she cooked and pleased me with delicious meals, but now she can’t anymore and I have to take care of her and of me (alone). Now, my son started helping me – he buys drugs and provides me with insulin.” (Kennedy *et al.*, 2015)

Q22(+). “Another participant highlighted the instrumental role played by family members, such as a granddaughter who might say, “Come on Grandma, let’s walk. You know you’re supposed to walk. Now come on, let’s go.” (Forthofer *et al.*, 2016)

Q23(+). “My wife makes cakes, but not lately as she doesn’t want to tempt me. But I know they are in the fridge… If we have a barbecue, my family serves me a Diet Coke.” (Knutsen *et al.*, 2017)

T23(+). “Meals often involve family gatherings, and negotiations take place related to norms and culture of gender and family life. It appears in the interviews that female partners often play a supportive and active role monitoring their male partner’s diabetes diet underlining gender differences in diabetes.” (Knutsen *et al.*, 2017)

T24(+). “However, many men attributed their healthier eating habits to their wives’ food preparation and procurement efforts (eg, home canning and gardening). Some women also discussed successful compromises during family meal times including serving smaller portions, making healthy recipe modifications, and preparing separate meals.” (Sriram *et al.*, 2018)

T25(+). “Several women cited peer support as a primary motivator for maintaining healthy eating habits.” (Sriram *et al.*, 2018)

Q24(+). It's healthy [referring to diet] because I was brought up by my mother who was a very good cook." (Daborn, Dibsall and Lambert, 2005)

Q25(+). "I used to eat a lot of vegetables when I was at home, cause my wife was an extremely good cook, so we ate really well, I don't mean gluttony I mean just healthy food." (Daborn, Dibsall and Lambert, 2005)

T26(+). "Receiving spousal/partner support also reduced mortality risk 19% (HR 0.81, 95% CI 0.66-.99)." (Mötteli, Siegrist and Keller, 2017)

T27(+). "Having a spouse was associated with a better physical health status (B = 1.01), especially for patients with a high income." (Koetsenruijter *et al.*, 2015)

T28(+). "In a multivariable regression model, greater weight loss was associated with help from a child with eating goals (p=.0002) and co-worker help with physical activity (p=.01)." (Winston *et al.*, 2015)

Q26(+). "My son would say let's walk instead of taking the train or bus." (Winston *et al.*, 2015)

1.10.2 Group support

Q27(+). "He has performed some navigation work in terms of making judgements of who he might contact in case of emergency, but does not need to do much negotiation as the support that his family provides him with in terms of diet and help in contexts where he does not feel as autonomous, supplements these needs." (Kennedy *et al.*, 2015)

Q28(+). "We are trying to exercise together, all of us… We aim to create a large group and include family and kids and socialize very often, so it becomes a big group and better habits." (Kennedy *et al.*, 2015)

Q29(+). "What works for me is walking. That's the only thing that really works. It makes my daughter, who also is headed toward weight problems-it gives her something completely different. She's trying to do half marathons now. So, we're both-we see ourselves working into way more activity, even at this age. Even my husband's getting into it… So, it's really become a family affair kind of thing… Because that's the only way I think we're going to keep it going." (Mama *et al.*, 2015)

T29(+/-). "Family was a social influence for many, but the effect seemed highly varied. While some found criticisms from their family about being overweight helpful and motivating, others found it discouraging and hurtful." (Robertson, Mullan and Todd, 2014)

T30(+). “In addition to reinforcing family bonds, these participants felt that exercising with their spouse or close family member provided the accountability needed to maintain good habits. For several participants, pets provided much needed companionship and reason to be active. Pets appeared to be especially important motivators of physical activity for elderly individuals living alone.” (Sriram *et al.*, 2018)

Q30(+). “[If] you wanna eat healthy… you pretty much have to change your friends at that point in time. And like in [this town], who you gonna change your friends to? Ya know, it’s not like you have nine hundred thousand other people that you can go out with and visit with.” (Sriram *et al.*, 2018)

Q31(+). “…my health…[is] my family…My children and husband, and our whanau whanui (tribal family) … our wellbeing is whanau (family)…[when] someone else is not well in our family, that has an impact…on our health…I’m connected to those people and our children…the heavier we are collectively, the better off we are individually…” (Bell *et al.*, 2017)

T31(+). “By contrast, decreasing family contact was associated with lower scores among over-50s with infrequent friend contact such that rare/no contact showed a -1.01 unit difference ($p < 0.05$) compared to daily contact. Differences in friend contact of one vegetable item/day were significant (p ¼ 0.056) for adults with rare/no family contact.” (Conklin *et al.*, 2014)

T32(+). “Participants reporting family support had a 19% lower risk of mortality as compared to participants reporting no family support (P=.01).” (Becofsky *et al.*, 2015)

1.11 Homophily

T33(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

T34(+). “Most of the women agreed that they prefer walking with other women; they feel safer and more comfortable.” (Ali, Baynouna and Bernsen, 2010)

T35(+). “More precisely, women and their most important eating companions tended to be similar in diet-related factors such as diet quality and eating styles as well as in BMI.” (Mötteli, Siegrist and Keller, 2017)

T36(-). “These results indicated that an unhealthy social eating environment might be a risk factor for the development of unhealthy eating patterns and obesity.” (Mötteli, Siegrist and Keller, 2017)

T37(+). “The results of this study show that the probability of engaging in regular exercise or eating a healthy diet is higher when individuals have friends who also engage in these behaviours.” (Barclay, Edling and Rydgren, 2013)

Q32(+). “What works for me is walking. That’s the only thing that really works. It makes my daughter, who also is headed toward weight problems-it gives her something completely different. She’s trying to do half marathons now. So, we’re both-we see ourselves working into way more activity, even at this age. Even my husband’s getting into it… So, it’s really become a family affair kind of thing… Because that’s the only way I think we’re going to keep it going.” (Mama *et al.*, 2015)

T38(+). “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p’s<.023).” (Leahey *et al.*, 2015)

T39(+). “Persons of the same sex had relatively greater influence on each other than those of the opposite sex.” (Christakis and Fowler, 2007)

T40(+). “The sex of the ego and alter also appeared to be important. When the sample was restricted to same-sex friendships (87% of the total), the probability of obesity in an ego increased by 71% (95% CI, 13 to 145) if the alter became obese.” (Christakis and Fowler, 2007)

1.12 Natural communication

Q33(+). “…found myself you know doing the walking home without having written it down and you know having told several people – I mean telling people that that’s what you’re doing actually makes you hold to it even more than if you, if I’d written it down.” (Procter *et al.*, 2014)

1.13 Isolation

Q34(+). “However, you get fed up and tired; so, when I have the opportunity to be alone and take it easy, I relax and do things I like to do. I also feel that I have better control of the diabetes. No outside negative influence.” (Knutsen *et al.*, 2017)

T41(-). “Several elderly women also discussed the negative consequences of living alone on their diets. Without family members around, eating decisions were primarily based on convenience and several participants reported having no incentive to make dietary improvements at their advanced age.” (Sriram *et al.*, 2018)

T42(-). “We found that being single or widowed was associated with a lower variety score, particularly vegetable variety, and associations were enhanced when combined with male gender, living alone or infrequent friend contact.” (Conklin *et al.*, 2014)

2. Contextual and individual factors

Meso-level

2.1 Environmental factors

2.1.1 Built environment

T43(+). “While opportunities for active commuting seemed limited, interviews and participant observation revealed that most women could walk in their neighbourhoods or easily access spaces to walk.” (Alvarado, Murphy and Guell, 2015)

Q35(-). “Close to my house, there are no sidewalks. And I feel like I don’t want to get in the car and drive somewhere and get out and walk and get back in the car… I used to walk a lot, but I lived somewhere else so it made it very simple.” (Forthofer *et al.*, 2016)

Q36(-). ‘‘Changing diet alone without exercise will not help lose weight and there are no places to do Exercise.’’ (Ali, Baynouna and Bernsen, 2010)

Q37(-). Women who did not have access to a nearby physical activity resource at work or home described this as a barrier to doing physical activity. One 45-year-old African American woman states, “… If I could just walk outside, I think that’d be more easier… Ain’t got to worry about having enough gas to drive.” (Mama *et al.*, 2015)

Q38(-). “It’s a fast food society – you don’t get many vegetables in a Big Mac.” (Daborn, Dibsall and Lambert, 2005)

2.1.2 Community resources

Q39(+). “I’m looking for more, all the time… I’m getting ideas at the moment because when I go to the sports centre they’ve got loads of activities for older people like me and other illnesses, not just diabetes, they cover everything there.” (Kennedy *et al.*, 2015)

Q40(+). “When I had to reduce weight, I went to a weight loss group at ‘X’… When they realized that I was a cook I was engaged to take part in cooking courses and things like that for overweight people with diabetes who have challenges with their intake…” (Kennedy *et al.*, 2015)

T44(+). “Similar to Bulgaria, in Greece (G), financial austerity led to stronger dependence on family support, but unlike Bulgaria, most people are co-located within a domestic environment. For those without family networks, the health centres played a strong supporting role.” (Kennedy *et al.*, 2015)

T45(+). “In Greece, due to the financial crisis, charitable organizations are providing more of such care to the homeless.” (Kennedy *et al.*, 2015)

Q41(+). ‘‘We want encouragement from the club, they should organise programmes and different sport competitions.” (Ali, Baynouna and Bernsen, 2010)

T46(+). “In these small rural towns, social interaction appeared to be an important facilitator of active lifestyles, particularly for women. Organized group activities, such as walking, were viewed as an opportunity to socialize with friends and connect with the community. Building these networks increased enjoyment and gave people more incentive to engage in activity.” (Sriram *et al.*, 2018)

2.1.3 Weather

Q42(-). “Sometimes the walk is be good you know exercise but if I have my car I wouldn’t walk at all only when I don’t have do I walk cause everything closer in town [Bridgetown] that ya could walk to instead of wasting the gas but as for out here [St. Philip]… the closest shop there … nah… now that is daytime no way! Ain’t walking. Too hot!” (Alvarado, Murphy and Guell, 2015)

Q43(-). ‘‘When the weather is cold I walk, but it is difficult to walk in summer.’’ (Ali, Baynouna and Bernsen, 2010)

2.2 Socio-cultural factors

2.2.1 Social events

T47(-). “Participants described food-centric social events as a primary constraint to eating well. Limited entertainment options in these rural communities meant that most activities involved getting together for a snack or meal. Food provision was regarded as a sign of “hospitality” and people felt obligated to eat whatever was offered in social settings (e.g. church, senior centers).” (Sriram *et al.*, 2018)

2.2.2 Social norms

T48(+). “During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups.” (Alvarado, Murphy and Guell, 2015)

Q44(+/-). “You know with diabetics especially with Africans to be frank Africans they don’t like saying what they are suffering from, everybody’s just hiding what is. A lot of my friends don’t know I’m diabetic, and I’ve been with them for 10 years they don’t know.” (Kennedy *et al.*, 2015)

T49(-). “Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub.” (Knutsen *et al.*, 2017)

Q45(-). “However, if I go back to the village where my husband comes from, they are country people and they love to bake, cook and it’s lovely. It’s gorgeous and because they know you’re coming for afternoon tea, they’ll have made you the apple pie and they’ll have made you the cakes and if you went in there and tried to start explaining that you don’t eat any of that… In that sort of culture, it just would not be understood, and also you’re interfering with the social norms and you don’t want to do that.” (Knutsen *et al.*, 2017)

Q46(+). “Religious celebration and fasting have an impact and produce challenges for patients with diabetes. Religious factors were apparent in negotiations of food choice, especially among respondents from Greece: I’m fasting these days. I find it’s good for me. I avoid milk, meat, eggs and cheese.” (Knutsen *et al.*, 2017)

Q47(-). “Walking is not culturally acceptable. My husband will not allow me to walk in the street but if it is a closed place [gym] he has no problem.” (Ali, Baynouna and Bernsen, 2010)

T50(+). “Most of the women agreed that they prefer walking with other women; they feel safer and more comfortable.” (Ali, Baynouna and Bernsen, 2010)

Q48(+). “… You can throw all the medicines and all the gym memberships [at me]… but if they don’t understand their wairautanga (spirituality)… you’ll never be that full person that our tupuna (ancestors) use to be…” (Bell *et al.*, 2017)

Micro-level

2.3 Environmental factor

2.3.1 Group atmosphere

Q49(+). “Going to the gym the motivation is, well obviously it would be generally to lose weight, but going by the gym is relatively small so you know everybody that is there so it’s kind of a family type atmosphere.” (Alvarado, Murphy and Guell, 2015)

2.4 Psychosocial factors

2.4.1 Critical moments

T51(+). “While describing their motivations for pursuing physical activity, some women explained that witnessing friends and family with long term chronic conditions motivated them to take control of their own health as much as possible.” (Alvarado, Murphy and Guell, 2015)

Q50(+). “In the last 2 years things have worsened, because my wife got ill; she was the one who took care of me – she cooked and pleased me with delicious meals, but now she can’t anymore and I have to take care of her and of me (alone). Now, my son started helping me – he buys drugs and provides me with insulin.” (Kennedy *et al.*, 2015)

T52(+). “Family health concerns were another driver of participant’s eating behaviours. Having a spouse or child diagnosed with a chronic condition motivated many people to make supportive dietary changes.” (Sriram *et al.*, 2018)

T53(+). “Watching a family member’s health deteriorate came as a wake-up call to change their own behaviour.” (Sriram *et al.*, 2018)

Q51(+). “My grandmother… when I was 13… I was the sole witness to her coronary occlusion which killed her on the spot and I never quite dealt with that so it has left me with a bit of a fear of heart disease and heart problems and seeing how violently they can end your life.” (Daborn, Dibsall and Lambert, 2005)

Q52(-). “There was a period going back 9 or 10 years after my mother died. . . when I was going through a very very difficult period I was living for a period off bread and porridge which was very unhealthy.” (Daborn, Dibsall and Lambert, 2005)

2.4.2 Motivation

T54(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

Q53(+). “I probably would pass somebody from my gym somewhere on the streets [… It’s] motivational in the sense that if you don’t go […to the gym] and pass a girl that I haven’t seen in a

while 'hey why I don't see you in the gym? What's going on with you?' and I guess guilt people into coming back. So yeah it's motivation." (Alvarado, Murphy and Guell, 2015)

Q54(+). "I'm looking for more, all the time… I'm getting ideas at the moment because when I go to the sports centre they've got loads of activities for older people like me and other illnesses, not just diabetes, they cover everything there." (Kennedy *et al.*, 2015)

Q55(-). "Sometimes I feel bored and depressed, when I try to reduce weight by eating less and exercise I see that there is no change in my weight so I feel depressed and I will stop everything and spend most of my time using the computer and internet especially after I finished university I noticed my weight increased more." (Ali, Baynouna and Bernsen, 2010)

Q56(+). "There is some type of apprehension in the back of my mind, and I'm trying to figure out why, but I really need to say, "Go ahead, start doing it." I guess I feel that if I start, I'm going to have to continue. It's going to change my routine. [And that] Moves me out of my comfort zone." (Mama *et al.*, 2015)

T55(+). "One motivator for weight-loss which was raised specifically by young adults was to feel more confident when approaching people they find attractive, and forming intimate relationships." (Robertson, Mullan and Todd, 2014)

Q57(+). "Offering a cash incentive for people to walk rather than drive." (Procter *et al.*, 2014)

2.4.3 Self-efficacy

T56(+). "Health promotion methods: guided practice, enactment, verbal persuasion, goal setting, planned coping responses." (Forthofer *et al.*, 2016)

Q58(-). "I have the control to change things I just don't change them, and I don't know why. It's ridiculous." (Robertson, Mullan and Todd, 2014)

Q59(+). "I was never wanting to do more than walk halfway to work … that was my ultimate, and that for me would be success and he [promoter] kept giving me routes and to get here and I kept saying but I'm not doing that am I because that isn't my goal and you need to support me with my goal rather than yours … if I set my goal on what he wanted, I wouldn't have achieved it and then I would've failed so I wanted to be able to succeed in what I wanted to do." (Procter *et al.*, 2014)

Q60(+). "I thought the apps and all the stuff that you do on the computer to be able to track and log everything and find the easier routes to walk and things like that was really, really good … I think they should be publicised a bit more because I definitely think that would help people and convince more people to walk." (Procter *et al.*, 2014)

T57(+). “Specifically, people who reported good self-management skills were more likely to have a diverse network, to be older, to be in relatively good health, to have high levels of income and education, and to live in the wealthier of the six countries (Norway, UK, Netherlands, Spain). High levels of self-monitoring were also associated with high education and relatively good health.” (Vassilev *et al.*, 2016)

2.4.4 Knowledge

T58(+). “All participants received a Walk Member Handbook with community trail maps and other information sheets about issues of interest.” (Forthofer *et al.*, 2016)

Q61(-). “The food we eat is not healthy because of the way we cook it and because we do not know enough about healthy food.” (Ali, Baynouna and Bernsen, 2010)

Q62(+/-). “[Health messages] shouldn’t be too clever or too scientific because you soon get bored with that. People understand that they should be interested, just simple messages, large clear simple messages.” (Daborn, Dibsall and Lambert, 2005)

Q63(+). “Overall the promoters found their booklet ‘was well set out’ and helped them approach participants: ‘It was informative and useful and helped me set out what I needed to do, promote walking to work to the colleagues, and how to approach them and stuff, I thought it was quite good.” (Procter *et al.*, 2014)

2.4.5 Personal attitude

Q64(-). “I do a lot of things that jeopardize the health but to me, regardless if you do or don’t do, things still happen […] Sometimes you will see a person don’t smoke don’t drink is still see them develop well everybody got diabetes so yeah but to me it don’t matter what you do or don’t to bring it on. Things just happen…” (Alvarado, Murphy and Guell, 2015)

T59(+). “Whatsapp groups comprised of women in the same exercise class could make this social pressure and social support even stronger.” (Alvarado, Murphy and Guell, 2015)

T60(+). “Some women described being active at home and doing a range of activities from Zumba® DVDs to light weight lifting and floor exercises to walking on a treadmill.” (Alvarado, Murphy and Guell, 2015)

Q65(-). “I feel heavy [fat] but I do not want to reduce my weight.” (Ali, Baynouna and Bernsen, 2010)

Q66(-). ‘‘For me, computer and Internet; I spend a lot of time using it and so there is no time for exercise.” (Ali, Baynouna and Bernsen, 2010)

T61(+/-). “Individuals agreed that there was a general social pressure to lose weight and be thin, particularly from the media.” (Robertson, Mullan and Todd, 2014)

Q67(-). “I think people [study participants] have the intentions of walking … but, because their character is, just they don’t know how to live without the car.” (Procter *et al.*, 2014)

Q68(+). “I thought the apps and all the stuff that you do on the computer to be able to track and log everything and find the easier routes to walk and things like that was really, really good … I think they should be publicised a bit more because I definitely think that would help people and convince more people to walk.” (Procter *et al.*, 2014)

T62(+/-). “Normative comparison, therefore, involves self-judgment, and, within that context, people may judge themselves to be either superior or inferior to others.” (Mötteli, Siegrist and Keller, 2017)

2.5 Socio-cultural factors

2.5.1 Social norms

T63(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

T64(-). “In some cases, the family did not provide support when it might have been expected, there may be a gender factor here – older women often did not get the support they expected from their family whereas men did (especially when widowed or divorced).” (Kennedy *et al.*, 2015)

T65(+/-). “Depending on these factors, regularly shared meals, such as family meals, might more or less conform to dietary guidelines although they are often generally perceived as healthy meals.” (Mötteli, Siegrist and Keller, 2017)

T66(+/-). “… body size, a descriptive norms effect can work through direct comparison so that a person compares himself to others in his social reference group and makes decisions regarding his own status according to that metric.” (Mötteli, Siegrist and Keller, 2017)

T67(-). “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual

friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p's<.023)." (Mötteli, Siegrist and Keller, 2017)

2.5.2 Competing demands

T68(-). "Several women described child rearing responsibilities as one of the primary reasons why they were not active." (Alvarado, Murphy and Guell, 2015)

Q69(-). "I have three children, a husband who works three shifts… it's just too easy to say 'now, you have to start exercising; exercise every day!' So you commute 20-miles each day, and you have three kids, school, day care, a man…" (Kennedy *et al.*, 2015)

Q70(-). "My son has football practice so after work it's like I don't have no time, just runnin' to go get him. But I should drop him off and go walk, but once I get home he's hungry. Everything takes over." (Forthofer *et al.*, 2016)

Q71(-). "I look after my husband, the house, everything. I don't look after myself as much as I used to. In the past, I would cook something for myself and something for the others to eat… I have to cook meals that my children and grandchildren like because my daughter works, and so I eat from these as well, so I don't miss out." (Knutsen *et al.*, 2017)

Q72(-). "There is no time because there is a lot of housework''. ''Sometimes appetite, we can't prevent ourselves from eating; sometimes children are at home so no time to exercise." (Ali, Baynouna and Bernsen, 2010)

T69(-). "In general, most women cited a lack of time for doing physical activity and lacked motivation and confidence if or when time became available." (Mama *et al.*, 2015)

Q73(-). "I really do believe that for me, and for a lot of people who are Hispanic and Black, it's education. The parents and the grandparents not teaching us as a young child… They were either cleaning, cooking, or working. And [physical activity] that wasn't the priority…" (Mama *et al.*, 2015)

Q74(-). "My work and my kids take up time, which technically means that I have less time to exercise because of them, but that's certainly not their fault… but every parent accepts that's just part of the deal I think, so I'm okay with that." (Robertson, Mullan and Todd, 2014)

T70(-). "Family obligations emerged as a common barrier to being physically active. Women in these rural households frequently assumed traditional caregiving roles and prioritized time with

their kids and husbands over exercise. Some articulated concerns over abandoning family responsibilities to fulfill their own needs." (Sriram *et al.*, 2018)

Q75(-). "Um at the moment [my diet is] wickedly poor, very poor cause I'm busy at the moment, I don't really have time to cook." (Daborn, Dibsall and Lambert, 2005)

Q76(-). "They've got to pick up children from schools or clubs or some people have elderly relatives that they look after… some people will be rushing home to go off to yoga, pilates, dance so it depends if it's going to take a lot longer." (Procter *et al.*, 2014)

2.5.3 Social events

T71(-). "Social events involving food were areas where maintaining normal social ties were often more important than attempting to force attention on dietary needs." (Kennedy *et al.*, 2015)

Q77(-). "When I go to parties or I meet up with friends, I don't go with my diet, I just eat whatever." (Robertson, Mullan and Todd, 2014)

T72(-). "This man emphasizes the need to occasionally not adhere to the diet, especially at parties and when with friends." (Knutsen *et al.*, 2017)

Q78(-). "I've got cakes in the house and everything else and I've got them all in for Christmas, I mean it's for everybody else. So, it's neither here nor there. I think they just all accept that I won't eat them and that's it, and they keep telling me I'm too strong willed." (Knutsen *et al.*, 2017)

2.6 Sociodemographic factors

2.6.1 Socioeconomic status

Q79(-). "I would like to find a gym that is cheap that I could get a personal trainer. Ain't cheap! Man, tell me is 60 dollars a session! That is 60 dollars for one session one 45 minute session! Not even an hour." (Alvarado, Murphy and Guell, 2015)

Q80(-). "Without the help of my children, I wouldn't be able to cope. My pension is 140 leva—[not enough] for following a diet and buying drugs." (Knutsen *et al.*, 2017)

Q81(-). "Budget. Like not everyone can afford a gym membership. I mean they're pretty absurd." (Robertson, Mullan and Todd, 2014)

T73(-). "Both "male" and "low-income status" are significant risk factors for eating an inappropriate diet." (Daborn, Dibsall and Lambert, 2005)

T74(+/-). “People in Family supported networks were more likely to be women, and were characterised by lower education and income levels amongst ‘egos’, but had high levels of network member involvement and reported high levels of well-being.” (Vassilev *et al.*, 2016)

T75(+). “Specifically, people who reported good self-management skills were more likely to have a diverse network, to be older, to be in relatively good health, to have high levels of income and education, and to live in the wealthier of the six countries (Norway, UK, Netherlands, Spain). High levels of self-monitoring were also associated with high education and relatively good health.” (Vassilev *et al.*, 2016)

T76(+). “Having a spouse was associated with a better physical health status (B = 1.01), especially for patients with a high income.” (Koetsenruijter *et al.*, 2015)

T77(+). “Attending community organizations was positively related to physical activity, however only for patients with a low income (OR = 1.53).” (Koetsenruijter *et al.*, 2015)

2.6.2 Job

Q82(-). “I worked as […] a cashier at a supermarket until 2009 and you know a cashier sits down ain’t much activity in that and then in 2009 to 2011 I did secretarial work – so that’s even worse! Cause […] when you’re sitting down and working all day sitting down Facebook – you know after you ya know finish your work – but then […] I got this new job that I totally love cause since I really can’t get the exercise that I want to put in, I think it give me a little moderate […] up and down.” (Alvarado, Murphy and Guell, 2015)

2.6.3 Age

T78(-). “Some young adults reported that the media provided motivation to lose weight. In contrast, older adults described actively attempting to resist it through the way they engage with and respond to such pressure.” (Robertson, Mullan and Todd, 2014)

T79(+). “Specifically, people who reported good self-management skills were more likely to have a diverse network, to be older, to be in relatively good health, to have high levels of income and education, and to live in the wealthier of the six countries (Norway, UK, Netherlands, Spain). High levels of self-monitoring were also associated with high education and relatively good health.” (Vassilev *et al.*, 2016)

2.6.4 Gender

T80(+/-). “Young females spoke about wanting to lose weight and reduce body fat, while males described intentions to build muscle mass and ‘bulk up.” (Robertson, Mullan and Todd, 2014)

T81(+). “In these small rural towns, social interaction appeared to be an important facilitator of active lifestyles, particularly for women. Organized group activities, such as walking, were viewed as an opportunity to socialize with friends and connect with the community. Building these networks increased enjoyment and gave people more incentive to engage in activity.” (Sriram *et al.*, 2018)

T82(-). “In contrast, men were less likely to view structured group exercise as a social activity.” (Sriram *et al.*, 2018)

T83(-). “Both “male” and “low-income status” are significant risk factors for eating an inappropriate diet.” (Daborn, Dibsall and Lambert, 2005)

T84(+). “People in Family supported networks were more likely to be women, and were characterised by lower education and income levels amongst ‘egos’, but had high levels of network member involvement and reported high levels of well-being.” (Vassilev *et al.*, 2016)

T85(-). “We found that being single or widowed was associated with a lower variety score, particularly vegetable variety, and associations were enhanced when combined with male gender, living alone or infrequent friend contact.” (Conklin *et al.*, 2014)

T86(-). “Negative associations between loneliving and variety scores were also stronger in men: lone-living men had a -1.46 unit difference ($p < 0.001$) in vegetable variety score which was significantly different ($p ¼ 0.001$) from the -0.66 unit difference ($p < 0.001$) in score for lone-living women, compared to co-living counterparts.” (Conklin *et al.*, 2014)

T87(+). “The sex of the ego and alter also appeared to be important. When the sample was restricted to same-sex friendships (87% of the total), the probability of obesity in an ego increased by 71% (95% CI, 13 to 145) if the alter became obese.” (Christakis and Fowler, 2007)

T88(+). “Persons of the same sex had relatively greater influence on each other than those of the opposite sex.” (Christakis and Fowler, 2007)

2.6.5 Transport

Q83(-). “Sometimes the walk is be good you know exercise but if I have my car I wouldn’t walk at all only when I don’t have do I walk cause everything closer in town [Bridgetown] that ya could walk to instead of wasting the gas but as for out here [St. Philip]… the closest shop there … nah… now that is daytime no way! Ain’t walking. Too hot!” (Alvarado, Murphy and Guell, 2015)

Q84(-). “I think people [study participants] have the intentions of walking … but, because their character is, just they don’t know how to live without the car.” (Procter *et al.*, 2014)

2.6.6 Education

Q85(-). “I really do believe that for me, and for a lot of people who are Hispanic and Black, it’s education. The parents and the grandparents not teaching us as a young child… They were either cleaning, cooking, or working. And [physical activity] that wasn’t the priority…” (Mama *et al.*, 2015)

T89(-). “People in Family supported networks were more likely to be women, and were characterised by lower education and income levels amongst ‘egos’, but had high levels of network member involvement and reported high levels of well-being.” (Vassilev *et al.*, 2016)

T90(+). “Specifically, people who reported good self-management skills were more likely to have a diverse network, to be older, to be in relatively good health, to have high levels of income and education, and to live in the wealthier of the six countries (Norway, UK, Netherlands, Spain). High levels of self-monitoring were also associated with high education and relatively good health.” (Vassilev *et al.*, 2016)

2.7 Clinical factors

2.7.1 Medical condition

Q86(-). “I cannot move a lot because I had a stroke and so I cannot walk or do any exercise and this is why I gained weight.’’ (Ali, Baynouna and Bernsen, 2010)

T91(+/-). “People with type 2 diabetes were less physically active, less likely to follow recommended diet (men), had fewer contacts with family and friends and were less certain of counting on help in case of severe illness than people with type 1 diabetes.” (Hempler, Joensen and Willaing, 2016)

3. Types of ties and properties of social networks

Meso-level (weak ties)

3.1 Sport contacts

T92(+). “During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups.” (Alvarado, Murphy and Guell, 2015)

T93(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

Q87(+). “I probably would pass somebody from my gym somewhere on the streets [… It’s] motivational in the sense that if you don’t go […to the gym] and pass a girl that I haven’t seen in a while ‘hey why I don’t see you in the gym? What’s going on with you?’ and I guess guilt people into coming back. So yeah it’s motivation.” (Alvarado, Murphy and Guell, 2015)

T94(+). “WhatsApp groups comprised of women in the same exercise class could make this social pressure and social support even stronger.” (Alvarado, Murphy and Guell, 2015)

3.2 Healthcare professionals

T95(+). “In Bulgaria compared to elsewhere, health professionals’ advice was taken more seriously and sought more frequently.” (Kennedy *et al.*, 2015)

Q88(+). “We want a dietitian in each club to help us lose weight.” (Ali, Baynouna and Bernsen, 2010)

Q89(+). “My doctors said before that I need to, to walk more … I mean it’s the kind of thing that you sort of – you kind of know anyway really within yourself that you know you’re not doing enough of any kind of exercise. This [study invitation] is what gave me the stimulus if you like to actually get on and do something about it … and even the doctor didn’t even manage to persuade me of that.” (Procter *et al.*, 2014)

Q90(-). “…They [doctors] all say I’m too heavy…they give you medication but it obviously hasn’t worked…I’m just not used to these medications…” (Vassilev *et al.*, 2016)

3.3 Neighbours

Q91(+). “We have people in my neighbourhood that you can be leaving out at five in the morning, and they’re walking. You can come in at six in the afternoon and there’s another group walking… We have a monthly HOA [homeowners association] meeting— and sometimes in those meetings people just go, “Hey, I saw you walking. Can I join your group?” (Mama *et al.*, 2015)

3.4 Community organizations and community (others)

T96(+). “In Greece, due to the financial crisis, charitable organizations are providing more of such care to the homeless.” (Kennedy *et al.*, 2015)

Q92(+). “When I had to reduce weight, I went to a weight loss group at ‘X’… When they realized that I was a cook I was engaged to take part in cooking courses and things like that for overweight people with diabetes who have challenges with their intake…” (Kennedy *et al.*, 2015)

Q93(+). “Cause for instance I sit home and I wouldn’t walk, but if somebody called me and I know I’m in a group and we walkin’ today, I’ll try to walk…cause you don’t wanna let anybody down.” (Forthofer *et al.*, 2016)

Q94(+). “What happened to you the other day? Why didn’t you come walking? And it’s kind of – its sort of an accountability where if you’ve got that moral support from saying ‘What’s up? You missed two days.” (Forthofer *et al.*, 2016)

Q95(-). “However, if I go back to the village where my husband comes from, they are country people and they love to bake, cook and it’s lovely. It’s gorgeous and because they know you’re coming for afternoon tea, they’ll have made you the apple pie and they’ll have made you the cakes and if you went in there and tried to start explaining that you don’t eat any of that… In that sort of culture, it just would not be understood, and also you’re interfering with the social norms and you don’t want to do that.” (Knutsen *et al.*, 2017)

T97(+). “In these small rural towns, social interaction appeared to be an important facilitator of active lifestyles, particularly for women. Organized group activities, such as walking, were viewed as an opportunity to socialize with friends and connect with the community. Building these networks increased enjoyment and gave people more incentive to engage in activity.” (Sriram *et al.*, 2018)

T98(-). “Participants described food-centric social events as a primary constraint to eating well. Limited entertainment options in these rural communities meant that most activities involved getting together for a snack or meal. Food provision was regarded as a sign of “hospitality” and people felt obligated to eat whatever was offered in social settings (eg, church, senior centers).” (Sriram *et al.*, 2018)

Q96(+). “That’s why I think the group would be kind of cool to get together with… to get together as a group and just share some ideas ...” (Sriram *et al.*, 2018)

Q97(-). “I was never wanting to do more than walk halfway to work … that was my ultimate, and that for me would be success and he [promoter] kept giving me routes and to get here and I kept saying but I’m not doing that am I because that isn’t my goal and you need to support me with my goal rather than yours … if I set my goal on what he wanted, I wouldn’t have achieved it and then I would’ve failed so I wanted to be able to succeed in what I wanted to do.” (Procter *et al.*, 2014)

Q98(+). “Several participants suggested external health promoters could provide additional encouragement: ‘Somebody coming in from outside, say doing half an hour at lunchtime just doing a presentation about it or, you know, longer and getting people there and talking about

that and saying 'and we have our in-house person who you know if you want to talk to him, d'you wanna get encouragement from him/her' that would be great but I think somebody coming in from outside actually would be a good idea." (Procter *et al.*, 2014)

T99(+). "Attending community organizations was positively related to physical activity, however only for patients with a low income (OR = 1.53)." (Koetsenruijter *et al.*, 2015)

Micro-level (close bond connections)

3.5 Family

Q99(-). "Some women don't have help - the children have dads that don't help or other family members so that's why too." (Alvarado, Murphy and Guell, 2015)

T100(+). "While describing their motivations for pursuing physical activity, some women explained that witnessing friends and family with long term chronic conditions motivated them to take control of their own health as much as possible." (Alvarado, Murphy and Guell, 2015)

T101(-). "In some cases, the family did not provide support when it might have been expected, there may be a gender factor here – older women often did not get the support they expected from their family whereas men did (especially when widowed or divorced)." (Kennedy *et al.*, 2015)

Q100(+). "We are trying to exercise together, all of us… We aim to create a large group and include family and kids and socialize very often, so it becomes a big group and better habits." (Kennedy *et al.*, 2015)

Q101(+). "My children have booked me a private doctor. I don't know how much it costs – they won't tell me. And if I haven't gone to the private clinic for a long time, they call me… My family takes my illness into consideration, they even monitor me. When I go to visit them my children make efforts to cook diet food." (Kennedy *et al.*, 2015)

Q102(-). "No, my family doesn't help me. I am responsible for health issues at home… I ask them to support me a bit more, taking the cakes out of my sight, but they're all tomboy-like and take little care of me. They don't see a disease in my diabetes, I'm telling you, they don't see it at all… So in that sense I don't have anybody, anybody that tells me: 'hey, you're exceeding yourself, don't eat that'." (Kennedy *et al.*, 2015)

T102(+). "Collective efficacy was most frequently obtained through a respondent's partner changing their lifestyle, especially in cooking and eating, to make life easier for the partner with diabetes." (Kennedy *et al.*, 2015)

Q103(+). “In the last 2 years things have worsened, because my wife got ill; she was the one who took care of me – she cooked and pleased me with delicious meals, but now she can’t anymore and I have to take care of her and of me (alone). Now, my son started helping me – he buys drugs and provides me with insulin.” (Kennedy *et al.*, 2015)

Q104(+). “He has performed some navigation work in terms of making judgements of who he might contact in case of emergency, but does not need to do much negotiation as the support that his family provides him with in terms of diet and help in contexts where he does not feel as autonomous, supplements these needs.” (Kennedy *et al.*, 2015)

Q105(+). “Another participant highlighted the instrumental role played by family members, such as a granddaughter who might say, “Come on Grandma, let’s walk. You know you’re supposed to walk. Now come on, let’s go.” (Forthofer *et al.*, 2016)

T103(+). “When asked about recommended strategies for encouraging a friend to walk, participants emphasized social support in the form of direct encouragement (e.g. “you can make it”), serving as a role model, and offering to walk with the friend.” (Forthofer *et al.*, 2016)

T104(+/-). “This perspective relates to how diet affects close family relations and accordingly how the individual with diabetes necessarily involves family members in customary food practices. The changes obviously involve abandoning habits that family members were used to and enjoyed.” (Knutsen *et al.*, 2017)

Q106(+). “My wife makes cakes, but not lately as she doesn’t want to tempt me. But I know they are in the fridge… If we have a barbecue, my family serves me a Diet Coke.” (Knutsen *et al.*, 2017)

Q107(-). “To my regret, my husband doesn’t have pity on me, or understand my illness and he even takes my diabetes quite light-heartedly. He doesn’t give me money for medicines or for buying better quality foods, so that I can stick to a healthy lifestyle and keep up a proper diet for this type 2 diabetes.” (Knutsen *et al.*, 2017)

Q108(+). “Without the help of my children, I wouldn’t be able to cope. My pension is 140 leva—[not enough] for following a diet and buying drugs.” (Knutsen *et al.*, 2017)

T105(+). “Meals often involve family gatherings, and negotiations take place related to norms and culture of gender and family life. It appears in the interviews that female partners often play a supportive and active role monitoring their male partner’s diabetes diet underlining gender differences in diabetes.” (Knutsen *et al.*, 2017)

Q109(+). “My husband insists that I shouldn’t eat large quantities or any starchy food. My mum always scolds me, but this doesn’t help; she just gets on my nerves. As soon as she sees me eating even the smallest amount of sweets, she’ll start complaining. I can’t say my daughters are indifferent. They’ll remark when I overeat something. Everyone is focused on my diet.” (Knutsen *et al.*, 2017)

Q110(-). “Walking is not culturally acceptable. My husband will not allow me to walk in the street but if it is a closed place [gym] he has no problem.” (Ali, Baynouna and Bernsen, 2010)

Q111(-). “My family won’t encourage me; for example if I want to bring a walking machine they say there is no place to keep it.” (Ali, Baynouna and Bernsen, 2010)

Q112(-). “I really do believe that for me, and for a lot of people who are Hispanic and Black, it’s education. The parents and the grandparents not teaching us as a young child… They were either cleaning, cooking, or working. And [physical activity] that wasn’t the priority…” (Mama *et al.*, 2015)

Q113(+). “What works for me is walking. That’s the only thing that really works. It makes my daughter, who also is headed toward weight problems-it gives her something completely different. She’s trying to do half marathons now. So, we’re both-we see ourselves working into way more activity, even at this age. Even my husband’s getting into it… So, it’s really become a family affair kind of thing… Because that’s the only way I think we’re going to keep it going.” (Mama *et al.*, 2015)

Q114(-). “I think it’s also about what I know I’m missing out on if I do exercise more. I mean, my friends and family are often going out of an evening, seeing films or going out to dinner or for drinks. I’d have to miss out on all of that if I was prioritising exercise a couple of nights a week, or even just eating really healthily would inhibit my ability to just do things like that. I don’t want to miss out.” (Robertson, Mullan and Todd, 2014)

T106(+/-). “Family was a social influence for many, but the effect seemed highly varied. While some found criticisms from their family about being overweight helpful and motivating, others found it discouraging and hurtful.” (Robertson, Mullan and Todd, 2014)

Q115(+/-). “I eat what my mum gives me. Usually my mum makes all of my dinners and gives me a packed lunch, so my diet is pretty much all that I need.” (Robertson, Mullan and Todd, 2014)

T107(+). “Food choice negotiations within the family emerged as a key determinant of eating behaviour. As the primary food preparers, women frequently reported difficulties in reconciling their spouses’ food preferences with their own desires to eat healthfully.” (Sriram *et al.*, 2018)

T108(+). “However, many men attributed their healthier eating habits to their wives’ food preparation and procurement efforts (e.g. home canning and gardening). Some women also discussed successful compromises during family meal times including serving smaller portions, making healthy recipe modifications, and preparing separate meals.” (Sriram *et al.*, 2018)

T109(+). “Family health concerns were another driver of participant’s eating behaviours. Having a spouse or child diagnosed with a chronic condition motivated many people to make supportive dietary changes.” (Sriram *et al.*, 2018)

T110(+). “Watching a family member’s health deteriorate came as a wake-up call to change their own behaviour.” (Sriram *et al.*, 2018)

T111(+). “In addition to reinforcing family bonds, these participants felt that exercising with their spouse or close family member provided the accountability needed to maintain good habits. For several participants, pets provided much needed companionship and reason to be active. Pets appeared to be especially important motivators of physical activity for elderly individuals living alone.” (Sriram *et al.*, 2018)

Q116(+). “My grandmother… when I was 13… I was the sole witness to her coronary occlusion which killed her on the spot and I never quite dealt with that so it has left me with a bit of a fear of heart disease and heart problems and seeing how violently they can end your life.” (Daborn, Dibsall and Lambert, 2005)

Q117(+). “I used to eat a lot of vegetables when I was at home, cause my wife was an extremely good cook, so we ate really well, I don’t mean gluttony I mean just healthy food.” (Daborn, Dibsall and Lambert, 2005)

Q118(+). “It’s healthy [referring to diet] because I was brought up by my mother who was a very good cook.” (Daborn, Dibsall and Lambert, 2005)

Q119(+). “…my health…[is] my family…My children and husband, and our whanau whanui (tribal family) … our wellbeing is whanau (family)…[when] someone else is not well in our family, that has an impact…on our health…I’m connected to those people and our children…the heavier we are collectively, the better off we are individually…” (Bell *et al.*, 2017)

T112(+/-). “Depending on these factors, regularly shared meals, such as family meals, might more or less conform to dietary guidelines although they are often generally perceived as healthy meals.” (Rancourt *et al.*, 2015)

T113(+). “By contrast, decreasing family contact was associated with lower scores among over-50s with infrequent friend contact such that rare/no contact showed a -1.01 unit difference ($p < 0.05$) compared to daily contact. Differences in friend contact of one vegetable item/day were significant (p ¼ 0.056) for adults with rare/no family contact.” (Conklin *et al.*, 2014)

T114(+). “In a multivariable regression model, greater weight loss was associated with help from a child with eating goals (p=.0002) and co-worker help with physical activity (p=.01).” (Winston *et al.*, 2015)

T115(-). “Weight gain was associated with having network members with obesity living in the home (p=.048) and increased network size (p=.002).” (Winston *et al.*, 2015)

Q120(+). “My son would say let's walk instead of taking the train or bus.” (Winston *et al.*, 2015)

Q121(-). “My husband and sister criticized me. If they saw me serve less food or eat vegetables they said I wanted to be sexy. They made fun of me because I was eating healthier than before. They said I just wanted to be skinny.” (Winston *et al.*, 2015)

T116(+). “Participants reporting family support had a 19% lower risk of mortality as compared to participants reporting no family support (P=.01).” (Becofsky *et al.*, 2015)

T117(+). “Receiving spousal/partner support also reduced mortality risk 19% (HR 0.81, 95% CI 0.66-.99).” (Sriram *et al.*, 2018)

T118(+). “Having a spouse was associated with a better physical health status (B = 1.01), especially for patients with a high income.” (Koetsenruijter *et al.*, 2015)

3.6 Friends

T119(+). “While describing their motivations for pursuing physical activity, some women explained that witnessing friends and family with long term chronic conditions motivated them to take control of their own health as much as possible.” (Alvarado, Murphy and Guell, 2015)

T120(-). “Social events involving food were areas where maintaining normal social ties were often more important than attempting to force attention on dietary needs.” (Kennedy *et al.*, 2015)

Q122(+/-). “You know with diabetics especially with Africans to be frank Africans they don’t like saying what they are suffering from, everybody’s just hiding what is. A lot of my friends don’t know I’m diabetic, and I’ve been with them for 10 years they don’t know.” (Kennedy *et al.*, 2015)

T121(-). “This man emphasizes the need to occasionally not adhere to the diet, especially at parties and when with friends.” (Knutsen *et al.*, 2017)

T122(-). “Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub.” (Knutsen *et al.*, 2017)

T123(+). “One motivator for weight-loss which was raised specifically by young adults was to feel more confident when approaching people they find attractive, and forming intimate relationships.” (Robertson, Mullan and Todd, 2014)

Q122(-). “I think it’s also about what I know I’m missing out on if I do exercise more. I mean, my friends and family are often going out of an evening, seeing films or going out to dinner or for drinks. I’d have to miss out on all of that if I was prioritising exercise a couple of nights a week, or even just eating really healthily would inhibit my ability to just do things like that. I don’t want to miss out.” (Robertson, Mullan and Todd, 2014)

Q123(-). “When I go to parties or I meet up with friends, I don’t go with my diet, I just eat whatever.” (Robertson, Mullan and Todd, 2014)

T124(+). “In contrast, having tight social networks was viewed as beneficial if friends were “health-conscious” and acted as positive role models.” (Sriram *et al.*, 2018)

T125(+). “In these small rural towns, social interaction appeared to be an important facilitator of active lifestyles, particularly for women. Organized group activities, such as walking, were viewed as an opportunity to socialize with friends and connect with the community. Building these networks increased enjoyment and gave people more incentive to engage in activity.” (Sriram *et al.*, 2018)

Q124(-). “[If] you wanna eat healthy… you pretty much have to change your friends at that point in time. And like in [this town], who you gonna change your friends to? Ya know, it’s not like you have nine hundred thousand other people that you can go out with and visit with.” (Sriram *et al.*, 2018)

T126(+). “Moreover, having more friends is associated with an improvement in health, while being healthy and prosocial is associated with closer relationships. Specifically, a unit increase in health is associated with an expected 0.45 percentage-point increase in average closeness, while adding a prosocial activity is associated with a 0.46 percentage-point increase in the closeness of one’s relationships.” (O’Malley *et al.*, 2012)

T127(+). “In response to the name generators (‘‘Who do you spend free time with’’ and ‘‘Who do you discuss important issues with’’), we found that Americans identify an average of 4.4+-1.8

close social contacts (the average respondent lists 2.2 friends, 0.76 spouses, 0.28 siblings, 0.44 co-workers, and 0.30 neighbours).” (O’Malley *et al.*, 2012)

T128(+). “The results of this study show that the probability of engaging in regular exercise or eating a healthy diet is higher when individuals have friends who also engage in these behaviours.” (Barclay, Edling and Rydgren, 2013)

T129(+). “Participants reporting social contact with 6 or 7 friends on a weekly basis had a 24% lower mortality risk than those in contact with ≤ 1 friend (HR 0.76, 95% CI 0.58–0.98).” (Becofsky *et al.*, 2015)

T130(+/-). “Relative to social comparisons to targets of the same weight, weight-focused comparisons to both thinner and heavier individuals led to increased thoughts of dieting and exercising. Moreover, comparisons to thinner targets also increased the likelihood of engaging in actual dieting and exercising behaviours. Weight comparisons to friends amplified these effects.” (Rancourt *et al.*, 2015)

T131(+). “Whether the target was a friend moderated these effects. When engaging in an upward comparison to a friend, participants had more thoughts of exercising compared to when the target of the upward comparison was not a friend (Y=1.03, P=0.031). When engaging in a downward comparison to a friend, participants also reported more thoughts of dieting (Y=2.68, P=0.006) and exercising (Y=2.13, P=0.024) as compared to when targets were nonfriends.” (Rancourt *et al.*, 2015)

T132(-). “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p’s<.023).” (Mötteli, Siegrist and Keller, 2017)

T133(+). “A person’s chances of becoming obese increased by 57% (95% confidence interval [CI], 6 to 123) if he or she had a friend who became obese in a given interval. Among pairs of adult siblings, if one sibling became obese, the chance that the other would become obese increased by 40% (95% CI, 21 to 60). If one spouse became obese, the likelihood that the other spouse would become obese increased by 37% (95% CI, 7 to 73).” (Christakis and Fowler, 2007)

T134(+). “The sex of the ego and alter also appeared to be important. When the sample was restricted to same-sex friendships (87% of the total), the probability of obesity in an ego increased by 71% (95% CI, 13 to 145) if the alter became obese.” (Christakis and Fowler, 2007)

3.7 Housekeeping

Q125(-). “Our weights increase because we have housemaids and we depend on them a lot.” (Ali, Baynouna and Bernsen, 2010)

3.8 Co-workers

T135(+): “In a multivariable regression model, greater weight loss was associated with help from a child with eating goals (p=.0002) and co-worker help with physical activity (p=.01).” (Winston *et al.*, 2015)

3.9 Pets

T136(+). “In addition to reinforcing family bonds, these participants felt that exercising with their spouse or close family member provided the accountability needed to maintain good habits. For several participants, pets provided much needed companionship and reason to be active. Pets appeared to be especially important motivators of physical activity for elderly individuals living alone.” (Sriram *et al.*, 2018)

4. Properties

4.1 Tie strength (frequency of contact and feeling of closeness)

T137. “In order to allow for variable schedules, teams were not necessarily expected to walk as a group, but they were expected to have regular contact in order to serve as motivational resources and walking partners for group members as their schedules permitted.” (Forthofer *et al.*, 2016)

T138. “Moreover, having more friends is associated with an improvement in health, while being healthy and prosocial is associated with closer relationships. Specifically, a unit increase in health is associated with an expected 0.45 percentage-point increase in average closeness, while adding a prosocial activity is associated with a 0.46 percentage-point increase in the closeness of one’s relationships.” (O’Malley *et al.*, 2012)

T139. “Lower frequencies of family contact were associated with lower fruit variety scores and rare/no contact was similarly negative for both genders. By contrast, decreasing family contact seemed to have limited association with vegetable variety in men whereas weekly contact had a 0.56 unit difference (p ¼ 0.001) in score in women compared with daily family contact.” (Conklin *et al.*, 2014)

T140. “Similarly, unit differences in vegetable variety scores were significantly lower (p ¼ 0.026) for widowed over-50s with infrequent friend contact than for those with frequent contact (-2.02

versus -0.87; both $p < 0.001$) compared to partnered counterparts-a difference of 1.15 items/day." (Conklin *et al.*, 2014)

T141. "Results for family contact and vegetable variety were most surprising: weekly contact (versus daily) was significantly positively associated in women, but men showed limited associations." (Conklin *et al.*, 2014)

T142. "Women who dined more often with healthy eaters reported on average a higher diet quality and a lower body mass index (BMI)." (Mötteli, Siegrist and Keller, 2017)

T143. "The degree to which this behaviour is shared is modulated by the strength of the relationship between the two individuals, with a greater probability of engaging in these behaviours observed when the relationship with the nominated peer is strong relative to when the relationship is weak." (Barclay, Edling and Rydgren, 2013)

T144. "Participants in contact with a child helpful with eating goals ≤ once a week (but at least once a month) had borderline greater weight loss compared to those with more frequent contact [-13.9 (±10.7), n=8 vs. -5.6 (±11.2) lbs., n=93, P =.05]." (Winston *et al.*, 2015)

T145. "Our data suggest that emotionally close social ties (partners, best friends, children, relatives) have a greater association with obesity status at baseline than social contacts with presumably less emotional valence (e.g. casual friends, colleagues)." (Mötteli, Siegrist and Keller, 2017)

4.2 Degree (number of contacts)

T146. "Moreover, having more friends is associated with an improvement in health, while being healthy and prosocial is associated with closer relationships. Specifically, a unit increase in health is associated with an expected 0.45 percentage-point increase in average closeness, while adding a prosocial activity is associated with a 0.46 percentage-point increase in the closeness of one's relationships." (Hanneman and Riddle, 2005)

T147. "Furthermore, increased degree is associated with reduced transitivity, while closeness and transitivity are positively correlated. Thus, as an individual accumulates more alters, the average closeness of their own relationships and of the relationships between the alters in their egocentric network decline." (Hanneman and Riddle, 2005)

4.3 Size of network

T148. "Weight gain was associated with having network members with obesity living in the home (p=.048) and increased network size (p=.002)." (Winston *et al.*, 2015)

T149. “participants reporting social contact with 6 or 7 friends on a weekly basis had a 24% lower mortality risk than those in contact with ≤ 1 friend (HR 0.76, 95% CI 0.58–0.98).” (Becofsky *et al.*, 2015)

T150. “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p’s<.023).” (Mötteli, Siegrist and Keller, 2017)

4.4 Degree of separation

T151. “Whereas increasing social distance appeared to decrease the effect of an alter on an ego, increasing geographic distance did not. The obesity of the most geographically distant alters correlated as strongly with an ego’s obesity as did the obesity of the geographically closest alters. These results suggest that social distance plays a stronger role than geographic distance in the spread of behaviours or norms associated with obesity.” (Christakis and Fowler, 2007)

4.5 Social distance

T152. “Whereas increasing social distance appeared to decrease the effect of an alter on an ego, increasing geographic distance did not. The obesity of the most geographically distant alters correlated as strongly with an ego’s obesity as did the obesity of the geographically closest alters. These results suggest that social distance plays a stronger role than geographic distance in the spread of behaviours or norms associated with obesity.” (Christakis and Fowler, 2007)

# Appendix H Coalitions

This appendix shows relevant combinations of data-driven themes implicating positive and negative health scenarios developed in the CIS review.

1. Meso-level

1.1 Social support

1.1.1 Peer support

Q1(+). “My doctors said before that I need to, to walk more … I mean it’s the kind of thing that you sort of – you kind of know anyway really within yourself that you know you’re not doing enough of any kind of exercise. This [study invitation] is what gave me the stimulus if you like to actually get on and do something about it … and even the doctor didn’t even manage to persuade me of that.” (Procter *et al.*, 2014)

Coalition: Healthcare professionals (type of tie, meso-level) + peer support (process, meso-level).

Q2(+). “Several participants suggested external health promoters could provide additional encouragement: ‘Somebody coming in from outside, say doing half an hour at lunchtime just doing a presentation about it or, you know, longer and getting people there and talking about that and saying ‘and we have our in-house person who you know if you want to talk to him, d’you wanna get encouragement from him/her’ that would be great but I think somebody coming in from outside actually would be a good idea.” (Procter *et al.*, 2014)

Coalition: Healthcare professionals (type of tie, meso-level) + peer support (process, meso-level).

1.1.2 Group support

T1(+). “During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups.” (Alvarado, Murphy and Guell, 2015)

Coalition: Sport contacts (type of tie, meso-level) + group support (process, meso-level).

Q3(+). “When I had to reduce weight, I went to a weight loss group at ‘X’… When they realized that I was a cook I was engaged to take part in cooking courses and things like that for overweight people with diabetes who have challenges with their intake…” (Alvarado, Murphy and Guell, 2015)

Coalition: Community organizations (type of tie, meso-level) + group support (process, meso-level) + community resources (contextual factor/environmental factor, meso-level).

T2(-). “Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub.” (Knutsen *et al.*, 2017)

Coalition: Community others (type of tie, meso-level) + peer support (process, meso-level) + social norms (contextual factor/socio-cultural factor, meso-level).

Q4(+). “That’s why I think the group would be kind of cool to get together with… to get together as a group and just share some ideas ...” (Sriram *et al.*, 2018)

Coalition: Community other (type of tie, meso-level) + group support (process, meso-level).

1.2 Homophily

T3(+). “During follow-up visits all but one woman in the study agreed that men and women were not active together. In contrast, women reported discussing exercise with other women and joining all-female exercise groups.” (Alvarado, Murphy and Guell, 2015)

Coalition: Sport contacts (type of tie, meso-level) + homophily (process, meso-level).

Q5(+). “When I had to reduce weight, I went to a weight loss group at ‘X’… When they realized that I was a cook I was engaged to take part in cooking courses and things like that for overweight people with diabetes who have challenges with their intake…” (Kennedy *et al.*, 2015)

Coalition: Community organizations (type of tie, meso-level) + homophily (process, meso-level) + community resources (contextual factor/environmental factor, meso-level).

T4(+). “Most of the women agreed that they prefer walking with other women; they feel safer and more comfortable.” (Ali, Baynouna and Bernsen, 2010)

Coalition: Community (others)(type of tie, meso-level) + homophily (process, meso-level) + social norms (contextual factor/socio-cultural factors, meso-level).

T5(+). “Persons of the same sex had relatively greater influence on each other than those of the opposite sex.” (Christakis and Fowler, 2007)

Coalition: Others (type of tie, meso-level) + homophily (process, meso-level) + social norms (contextual factor/socio-cultural factors, meso-level).

1.3 Social pressure

Q6(+). “I probably would pass somebody from my gym somewhere on the streets [… It’s] motivational in the sense that if you don’t go […to the gym] and pass a girl that I haven’t seen in a while ‘hey why I don’t see you in the gym? What’s going on with you?’ and I guess guilt people into coming back. So yeah it’s motivation.” (Alvarado, Murphy and Guell, 2015)

Coalition: Sport contacts (type of tie, meso-level) + social pressure (process, meso-level) + motivation (contextual and individual factor/psychosocial factor, micro-level).

Q7(+). “Cause for instance I sit home and I wouldn’t walk, but if somebody called me and I know I’m in a group and we walkin’ today, I’ll try to walk…cause you don’t wanna let anybody down.” (Forthofer *et al.*, 2016)

Coalition: Community (others) (type of tie, meso-level) + social pressure (process, meso-level).

Q8(+). “What happened to you the other day? Why didn’t you come walking? And it’s kind of – its sort of an accountability where if you’ve got that moral support from saying ‘What’s up? You missed two days.” (Forthofer *et al.*, 2016)

Coalition: Community (others) (type of tie, meso-level) + social pressure (process, meso-level).

T6(-). “Participation and attendance at the pub involve negotiations and a counterbalance of the intake of beer and the health promoting effects of positive social relationships taking place at the pub.” (Knutsen *et al.*, 2017)

Coalition: Community others (type of tie, meso-level) + social pressure (process, meso-level) + social norms (contextual factor/socio-cultural factor, meso-level).

Q9(-). “However, if I go back to the village where my husband comes from, they are country people and they love to bake, cook and it’s lovely. It’s gorgeous and because they know you’re coming for afternoon tea, they’ll have made you the apple pie and they’ll have made you the cakes and if you went in there and tried to start explaining that you don’t eat any of that… In that sort of culture, it just would not be understood, and also you’re interfering with the social norms and you don’t want to do that.” (Knutsen *et al.*, 2017)

Coalition: Community others (type of tie, meso-level) + social pressure (process, meso-level) + social norms (contextual factor/socio-cultural factor, meso-level).

T7(-). “Participants described food-centric social events as a primary constraint to eating well. Limited entertainment options in these rural communities meant that most activities involved getting together for a snack or meal. Food provision was regarded as a sign of “hospitality” and

people felt obligated to eat whatever was offered in social settings (e.g. church, senior centers)." (Sriram *et al.*, 2018)

Coalition: Community organizations (type of tie, meso-level) + social pressure (process, meso-level) + social norms (contextual factor/socio-cultural factor, meso-level).

Q10(+). "An element of competition may help… if the progress was recorded and shared between all the people on the scheme, it could possibly have a positive effect…" (Procter *et al.*, 2014)

Coalition: Community (others) (type of tie, meso-level) + social pressure (process, meso-level) + motivation (contextual and individual factor/psychosocial factor, micro-level).

1.4 Natural communication

T8(+). "WhatsApp groups comprised of women in the same exercise class could make this social pressure and social support even stronger." (Alvarado, Murphy and Guell, 2015)

Coalition: Sport contacts (type of tie, meso-level) + natural communication (process, meso-level) + personal attitude (contextual and individual factor/psychosocial factor, micro-level).

1.5 Social modelling

Q11(+). "Participants described a program leader who would help in these areas. One expressed a desire for such a person "to motivate us or have the knowledge, but both would be good." Another described this role as "It's somebody that will enhance the group to walk." (Forthofer *et al.*, 2016)

Coalition: Community (others) (type of tie, meso-level) + social modelling (process, meso-level).

Q12(+). "We have people in my neighbourhood that you can be leaving out at five in the morning, and they're walking. You can come in at six in the afternoon and there's another group walking…We have a monthly HOA [homeowners association] meeting— and sometimes in those meetings people just go, "Hey, I saw you walking. Can I join your group?" (Mama *et al.*, 2015)

Coalition: Neighbours (type of tie, meso-level) + social modelling (process, meso-level).

1.6 Diffusion

T9(+). "All participants received a Walk Member Handbook with community trail maps and other information sheets about issues of interest." (Forthofer *et al.*, 2016)

Coalition: Community (others) (type of tie, meso-level) + diffusion (process, meso-level) + knowledge (contextual and individual factor/psychosocial factor, micro-level).

Q13(+). “That’s why I think the group would be kind of cool to get together with… to get together as a group and just share some ideas…” (Sriram *et al.*, 2018)

Coalition: Community other (type of tie, meso-level) + group support (process, meso-level).

T10(+). “Much of this health information was viewed with a degree of scepticism, particularly claims made about food. In contrast to the scepticism levelled at scientific, medical and government information sources, health messages that derived from within participants’ own social network were given more credence.” (Sriram *et al.*, 2018)

Coalition: Community (others) (type of tie, meso-level) + diffusion (process, meso-level) + knowledge (contextual and individual factor/psychosocial factor, micro-level).

Q14(+). “Overall the promoters found their booklet ‘was well set out’ and helped them approach participants: ‘It was informative and useful and helped me set out what I needed to do, promote walking to work to the colleagues, and how to approach them and stuff, I thought it was quite good.” (Procter *et al.*, 2014)

Coalition: Community (others) (type of tie, meso-level) + diffusion (process, meso-level) + knowledge (contextual and individual factor/psychosocial factor, micro-level).

2. Micro-level

2.1 Social modelling

T11(+). “When asked about recommended strategies for encouraging a friend to walk, participants emphasized social support in the form of direct encouragement (e.g. “you can make it”), serving as a role model, and offering to walk with the friend.” (Forthofer *et al.*, 2016)

Coalition: Friends (type of tie, micro-level) + social modelling (process, micro-level).

T12(+). “In contrast, having tight social networks was viewed as beneficial if friends were “health-conscious” and acted as positive role models.” (Sriram *et al.*, 2018)

Coalition: Friends (type of tie, micro-level) + social modelling (process, micro-level).

2.2 Social comparison

T13(+). “While describing their motivations for pursuing physical activity, some women explained that witnessing friends and family with long term chronic conditions motivated them to take control of their own health as much as possible.” (Alvarado, Murphy and Guell, 2015)

Coalition: Friends or family (type of tie, micro-level) + social comparison (process, micro-level) + critical moments (contextual and individual factors/psychosocial factors, micro-level).

Q15(-). “I think it’s also about what I know I’m missing out on if I do exercise more. I mean, my friends and family are often going out of an evening, seeing films or going out to dinner or for drinks. I’d have to miss out on all of that if I was prioritising exercise a couple of nights a week, or even just eating really healthily would inhibit my ability to just do things like that. I don’t want to miss out.” (Robertson, Mullan and Todd, 2014)

Coalition: Family (type of tie, micro-level) + social comparison (process, micro-level).

T14(+). “Watching a family member’s health deteriorate came as a wake-up call to change their own behaviour.” (Sriram *et al.*, 2018)

Coalition: Family (type of tie, micro-level) + social comparison (process, micro-level) + critical moments (contextual and individual factors/psychosocial factors, micro-level).

Q16(+). “My grandmother… when I was 13… I was the sole witness to her coronary occlusion which killed her on the spot and I never quite dealt with that so it has left me with a bit of a fear of heart disease and heart problems and seeing how violently they can end your life.” (Daborn, Dibsall and Lambert, 2005)

Coalition: Family (type of tie, micro-level) + social comparison (process, micro-level) + critical moments (contextual and individual factors/psychosocial factors, micro-level).

T15(+/-). “In the case of body size, a descriptive norms effect can work through direct comparison so that a person compares himself to others in his social reference group and makes decisions regarding his own status according to that metric.” (Mötteli, Siegrist and Keller, 2017)

Coalition: Friends or family (type of tie, micro-level) + social comparison (process, micro-level).

T16(+). “Relative to social comparisons to targets of the same weight, weight-focused comparisons to both thinner and heavier individuals led to increased thoughts of dieting and exercising. Moreover, comparisons to thinner targets also increased the likelihood of engaging in actual dieting and exercising behaviours. Weight comparisons to friends amplified these effects.” (Rancourt *et al.*, 2015)

Coalition: Friends (type of tie, micro-level) + social comparison (process, micro-level).

2.3 Social pressure

T17(-). “Social events involving food were areas where maintaining normal social ties were often more important than attempting to force attention on dietary needs.” (Kennedy *et al.*, 2015)

Coalition: Friends (type of tie, micro-level) + social pressure (process, micro-level) + social events (contextual and individual factors/socio-cultural factors, micro-level).

Q17(+). “My husband insists that I shouldn’t eat large quantities or any starchy food. My mum always scolds me, but this doesn’t help; she just gets on my nerves. As soon as she sees me eating even the smallest amount of sweets, she’ll start complaining. I can’t say my daughters are indifferent. They’ll remark when I overeat something. Everyone is focused on my diet.” (Knutsen *et al.*, 2017)

Coalition: Family (type of tie, micro-level) + social pressure (process, micro-level).

T18(-). “This man emphasizes the need to occasionally not adhere to the diet, especially at parties and when with friends.” (Knutsen *et al.*, 2017)

Coalition: Friends (type of tie, micro-level) + social pressure (process, micro-level) + social events (contextual and individual factors/socio-cultural factors, micro-level).

Q18(-). “Often, when [you are] offered a piece of chocolate, you don’t say that you have diabetes, you take it and eat it just because you don’t want to offend the person and you feel uncomfortable admitting you have diabetes and you shouldn’t eat sweets.” (Knutsen *et al.*, 2017)

Coalition: Family or friends (type of tie, micro-level) + social pressure (process, micro-level).

Q19(+). “If you have someone that’s going to encourage you, say, “Come on, let’s go, let’s go do this,” or “Come on, it’s only going to take 10 minutes,” or something like that, then you go,“Okay, I’ll do it.” (Mama *et al.*, 2015)

Coalition: Family or friends (type of tie, micro-level) + social pressure (process, micro-level).

T19(+). “One motivator for weight-loss which was raised specifically by young adults was to feel more confident when approaching people they find attractive, and forming intimate relationships.” (Robertson, Mullan and Todd, 2014)

Coalition: Friends (type of tie, micro-level) + social pressure (process, micro-level) + motivation (contextual and individual factors/psychosocial factor, micro-level)

Q20(-). “When I go to parties or I meet up with friends, I don’t go with my diet, I just eat whatever.” (Robertson, Mullan and Todd, 2014)

Coalition: Friends (type of tie, micro-level) + social pressure (process, micro-level) + social events (contextual and individual factors/socio-cultural factors, micro-level).

T20(+/-). “Depending on these factors, regularly shared meals, such as family meals, might more or less conform to dietary guidelines although they are often generally perceived as healthy meals.” (Mötteli, Siegrist and Keller, 2017)

Coalition: Family (type of tie, micro-level) + social pressure (process, micro-level) + social norms (contextual and individual factors/socio-cultural factors, micro-level).

2.4 Social support

2.4.1 Peer support

T21(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

Coalition: Friends (type of tie, micro-level) + peer support (process, micro-level) + motivation (contextual and individual factors/psychosocial factors, micro-level) + social norms (contextual and individual factors/socio-cultural factors, micro-level).

T22(+). “Collective efficacy was most frequently obtained through a respondent’s partner changing their lifestyle, especially in cooking and eating, to make life easier for the partner with diabetes.” (Kennedy *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

Q21(+). “In the last 2 years things have worsened, because my wife got ill; she was the one who took care of me – she cooked and pleased me with delicious meals, but now she can’t anymore and I have to take care of her and of me (alone). Now, my son started helping me – he buys drugs and provides me with insulin.” (Kennedy *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level) + critical moments (contextual and eventual factor/psychosocial factor, micro-level).

Q22(+). “Another participant highlighted the instrumental role played by family members, such as a granddaughter who might say, “Come on Grandma, let’s walk. You know you’re supposed to walk. Now come on, let’s go.” (Forthofer *et al.*, 2016)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

Q23(+): “My wife makes cakes, but not lately as she doesn’t want to tempt me. But I know they are in the fridge… If we have a barbecue, my family serves me a Diet Coke.” (Knutsen *et al.*, 2017)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

T23(+). “Meals often involve family gatherings, and negotiations take place related to norms and culture of gender and family life. It appears in the interviews that female partners often play a supportive and active role monitoring their male partner’s diabetes diet underlining gender differences in diabetes.” (Knutsen *et al.*, 2017)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

T24(+). “However, many men attributed their healthier eating habits to their wives’ food preparation and procurement efforts (e.g. home canning and gardening). Some women also discussed successful compromises during family meal times including serving smaller portions, making healthy recipe modifications, and preparing separate meals.” (Sriram *et al.*, 2018)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

T25(+). “Several women cited peer support as a primary motivator for maintaining healthy eating habits.” (Sriram *et al.*, 2018)

Coalition: Friends or family (type of tie, micro-level) + peer support (process, micro-level) + motivation (contextual and individual factors/psychosocial factors, micro-level).

Q24(+). “It’s healthy [referring to diet] because I was brought up by my mother who was a very good cook.” (Portillo *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

Q25(+). “I used to eat a lot of vegetables when I was at home, cause my wife was an extremely good cook, so we ate really well, I don’t mean gluttony I mean just healthy food.” (Portillo *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

T26(+). “Receiving spousal/partner support also reduced mortality risk 19% (HR 0.81, 95% CI 0.66-.99).” (Becofsky *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

T27(+). “Having a spouse was associated with a better physical health status (B = 1.01), especially for patients with a high income.” (Koetsenruijter *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level) + socioeconomic status (contextual and individual factors/sociodemographic factor, micro-level).

T28(+). “In a multivariable regression model, greater weight loss was associated with help from a child with eating goals (p=.0002) and co-worker help with physical activity (p=.01).” (Winston *et al.*, 2015)

Coalition: Family and co-workers (type of tie, micro-level) + peer support (process, micro-level).

Q26(+). “My son would say let's walk instead of taking the train or bus.” (Winston *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + peer support (process, micro-level).

2.4.2 Group support

Q27(+). “He has performed some navigation work in terms of making judgements of who he might contact in case of emergency, but does not need to do much negotiation as the support that his family provides him with in terms of diet and help in contexts where he does not feel as autonomous, supplements these needs.” (Kennedy *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

Q28(+). “We are trying to exercise together, all of us… We aim to create a large group and include family and kids and socialize very often, so it becomes a big group and better habits.” (Kennedy *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

Q29(+). “What works for me is walking. That’s the only thing that really works. It makes my daughter, who also is headed toward weight problems-it gives her something completely different. She’s trying to do half marathons now. So, we’re both-we see ourselves working into way more activity, even at this age. Even my husband’s getting into it… So, it’s really become a family affair kind of thing… Because that’s the only way I think we’re going to keep it going.” (Mama *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

T29(+/-). “Family was a social influence for many, but the effect seemed highly varied. While some found criticisms from their family about being overweight helpful and motivating, others found it discouraging and hurtful.” (Robertson, Mullan and Todd, 2014)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

T30(+). “In addition to reinforcing family bonds, these participants felt that exercising with their spouse or close family member provided the accountability needed to maintain good habits. For several participants, pets provided much needed companionship and reason to be active. Pets appeared to be especially important motivators of physical activity for elderly individuals living alone.” (Sriram *et al.*, 2018)

Coalition: Family and pets (type of tie, micro-level) + group support (process, micro-level).

Q30(+). “[If] you wanna eat healthy… you pretty much have to change your friends at that point in time. And like in [this town], who you gonna change your friends to? Ya know, it’s not like you have nine hundred thousand other people that you can go out with and visit with.” (Sriram *et al.*, 2018)

Coalition: Friends (type of tie, micro-level) + group support (process, micro-level).

Q31(+). “…my health…[is] my family…My children and husband, and our whanau whanui (tribal family) … our wellbeing is whanau (family)…[when] someone else is not well in our family, that has an impact…on our health…I’m connected to those people and our children…the heavier we are collectively, the better off we are individually…” (Bell *et al.*, 2017)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

T31(+). “By contrast, decreasing family contact was associated with lower scores among over-50s with infrequent friend contact such that rare/no contact showed a -1.01 unit difference ($p < 0.05$) compared to daily contact. Differences in friend contact of one vegetable item/day were significant (p ¼ 0.056) for adults with rare/no family contact.” (Conklin *et al.*, 2014)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

T32(+). “Participants reporting family support had a 19% lower risk of mortality as compared to participants reporting no family support (P=.01).” (Becofsky *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + group support (process, micro-level).

2.5 Homophily

T33(+). “Asked about who they last heard talking about physical activity, some women explained that they talked with female friends about being active regularly. For these women, peer encouragement was reported to be a strong motivator.” (Alvarado, Murphy and Guell, 2015)

Coalition: Friends (type of tie, micro-level) + homophily (process, micro-level) + motivation (contextual and individual factors/psychosocial factors, micro-level) + social norms (contextual and individual factors/socio-cultural factors, micro-level).

T34(+). “Most of the women agreed that they prefer walking with other women; they feel safer and more comfortable.” (Ali, Baynouna and Bernsen, 2010)

Coalition: Friends and family (type of tie, micro-level) + homophily (process, micro-level) + social norms (contextual and individual factors/socio-cultural factors, micro-level).

T35(+). “More precisely, women and their most important eating companions tended to be similar in diet-related factors such as diet quality and eating styles as well as in BMI.” (Mötteli, Siegrist and Keller, 2017)

Coalition: Friends and family (type of tie, micro-level) + homophily (process, micro-level).

T36(-). “These results indicated that an unhealthy social eating environment might be a risk factor for the development of unhealthy eating patterns and obesity.” (Mötteli, Siegrist and Keller, 2017)

Coalition: Friends and family (type of tie, micro-level) + homophily (process, micro-level).

T37(+). “The results of this study show that the probability of engaging in regular exercise or eating a healthy diet is higher when individuals have friends who also engage in these behaviours.” (Barclay, Edling and Rydgren, 2013)

Coalition: Friends (type of tie, micro-level) + homophily (process, micro-level).

Q32(+). “What works for me is walking. That’s the only thing that really works. It makes my daughter, who also is headed toward weight problems-it gives her something completely different. She’s trying to do half marathons now. So, we’re both-we see ourselves working into way more activity, even at this age. Even my husband’s getting into it… So, it’s really become a family affair kind of thing… Because that’s the only way I think we’re going to keep it going.” (Mama *et al.*, 2015)

Coalition: Family (type of tie, micro-level) + homophily (process, micro-level).

T38(+). “During treatment, participants lost an average of 4.4% of initial body weight, and social influence factors were adversely associated with weight loss outcomes. Having more casual friends who were overweight at baseline and being part of a social network with stronger social norms for unhealthy eating predicted poorer weight losses (p’s<.023).” (Mötteli, Siegrist and Keller, 2017)

Coalition: Friends (type of tie, micro-level) + homophily (process, micro-level) + social norms (contextual and individual factors/socio-cultural factors, micro-level).

T39(+). “Persons of the same sex had relatively greater influence on each other than those of the opposite sex”. (Christakis and Fowler, 2007)

Coalition: Friends and family (type of tie, micro-level) + homophily (process, micro-level) + gender (contextual and individual factors/sociodemographic factor, micro-level).

T40(+). “The sex of the ego and alter also appeared to be important. When the sample was restricted to same-sex friendships (87% of the total), the probability of obesity in an ego increased by 71% (95% CI, 13 to 145) if the alter became obese.” (Christakis and Fowler, 2007)

Coalition: Friends (type of tie, micro-level) + homophily (process, micro-level) + gender (contextual and individual factors/sociodemographic factor, micro-level).

2.6 Natural communication

Q33(+). “…found myself you know doing the walking home without having written it down and you know having told several people – I mean telling people that that’s what you’re doing actually makes you hold to it even more than if you, if I’d written it down.” (Procter *et al.*, 2014)

Coalition: Friends and family (type of tie, micro-level) + natural communication (process, micro-level).

2.7 Isolation

Q34(+). “However, you get fed up and tired; so, when I have the opportunity to be alone and take it easy, I relax and do things I like to do. I also feel that I have better control of the diabetes. No outside negative influence.” (Knutsen *et al.*, 2017)

Coalition: Individual (type of tie, micro-level) + isolation (process, micro-level).

T41(-). “Several elderly women also discussed the negative consequences of living alone on their diets. Without family members around, eating decisions were primarily based on convenience and several participants reported having no incentive to make dietary improvements at their advanced age.” (Sriram *et al.*, 2018)

Coalition: Individual (type of tie, micro-level) + isolation (process, micro-level).

T42(-). “We found that being single or widowed was associated with a lower variety score, particularly vegetable variety, and associations were enhanced when combined with male gender, living alone or infrequent friend contact.” (Conklin *et al.*, 2014)

Coalition: Individual (type of tie, micro-level) + isolation (process, micro-level) + gender (contextual and individual factors/sociodemographic factor, micro-level).

# Appendix I Data analysis in detail using template thematic analysis

This appendix shows a detailed data analysis of the second article of this thesis (chapter 5).

**Before the analysis: transcription**

The interviews were transcribed verbatim, ten of them by the first author (NSF) and the rest by a professional transcriber. The support from the latest was needed since the sound quality was not ideal in some of the interviews conducted online. All the transcripts were checked for errors by listening back to the audio recordings and reading the transcripts at the same time. Small notes were specified in the transcripts to identify nonverbal communication, long pauses, or some change in the tone of voice. This could support the coding process.

For this study, template analysis was chosen. Thus, a list (template) of hierarchical codes (themes and codes) representing areas of knowledge identified in their textual data was produced. Five phases were involved in this research:

**Stage 1. Familiarisation**

Familiarisation with the data, becoming immersed with the content. The main author of the research listened back to the audios and read a couple of times each interview transcript to have a 'whole picture' of the entire data set.

**Stage 2. Creation of an a-priori template**

An *a-priori* hierarchical template with themes (broader patterns of meanings) and codes (lower-order codes) was created. These were modified through inductive data engagement. The *a-priori* template was identified through previous relevant research. Thus, themes and codes were developed from the critical interpretative synthesis review:

*Serrano Fuentes N, Rogers A, Portillo MC. Social network influences and the adoption of obesity-related behaviours in adults: A critical interpretative synthesis review. BMC Public Health. 2019 Dec;19(1):1-20.*

Appendix I

A-priori template

- **Types of ties of social networks for the adoption of obesity-related behaviours**
  - Meso-level ties
    - Sport contacts
    - Healthcare professionals
    - Neighbours
    - Community organizations and community (others)
  - Micro-level ties
    - Family
    - Friends
    - Housekeeping
    - Co-workers
    - Pets
- **Types of properties of social networks for the adoption of obesity-related behaviours**
  - Tie strength
  - Degree
  - Size of network
  - Degree of separation
- **Meso-micro network processes for the adoption of obesity-related behaviours**
  - Meso-level processes
    - Social support (peer and group)
    - Homophily
    - Social pressure
    - Natural communication
    - Social modelling
    - Diffusion
  - Micro-level processes
    - Social modelling
    - Social comparison
    - Social pressure
    - Social support (peer and group)
    - Homophily
    - Natural communication
    - Isolation
- **Contextual and individual factors for the adoption of obesity-related behaviours**
  - Micro-level factors
    - Environmental factors
      - Built environment
      - Community resources
      - Weather
    - Socio-cultural factors
      - Social events
      - Social norms
  - Micro-level factors
    - Environmental factors
      - Group atmosphere
    - Psychosocial factors
      - Critical moments
      - Motivations
      - Self-efficacy
      - Knowledge
      - Personal attitude
    - Socio-cultural factors
      - Social norms

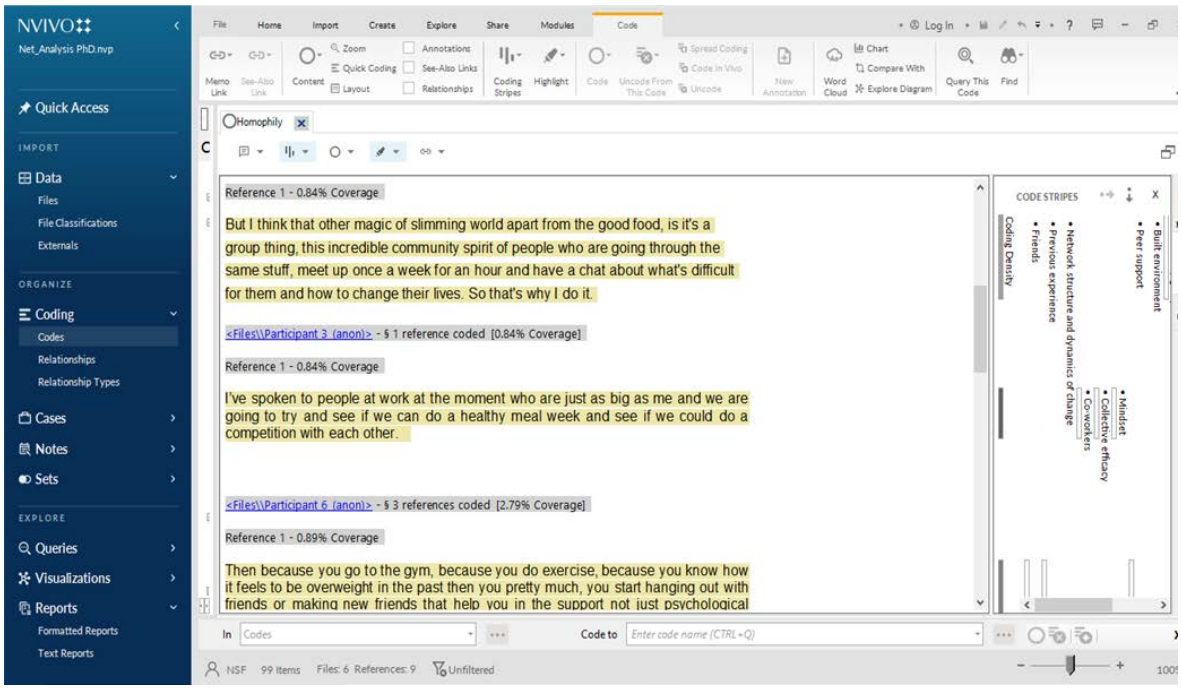
| | |
|---|---|
| | Competing demands |
| | Social events |
| Sociodemographic factors | |
| | Socioeconomic status |
| | Job |
| | Age |
| | Gender |
| | Transport |
| | Education |
| Clinical factors | |
| | Medical conditions |

**Stage 3. Coding**

The initial template was applied to start coding (generating labels) the data set, highlighting parts of the text that contributed towards the research aim.

The first author (NSF) underlined interesting text segments (parts of sentences, whole sentences or even paragraphs) and used the right-hand margin to specify codes or labels. Notes and ideas were written in a printed version of the transcripts. Below, an excerpt of open coding from the first attempt of coding is presented. In this example, Participant 3 mentioned that some work colleagues were living the same situation as her. Thus, they were working out together how they could lose some weight and enhance motivation by creating a competitive atmosphere. On the right part of the screen, some codes were highlighted. In that case, the codes *mindset*, *co-workers* and *collective efficacy* were created for that text fragment.

Screenshot from NVivo when doing the analysis



The initial template was continuously modified during the analysis process. Below, different versions are presented, and changes are explained.

**Template version 1**

After the first five interviews, a first review of the data took place, and the first suggestions were made by the rest of the team. Thus, the initial template started to change. New codes were created, and existing ones were redefined or even deleted from the template. The themes *importance of networks* and *network structure and dynamics of change* were created. At this stage of the research, the main author was willing to include all the characteristics related to the structure of social networks (although they were omitted later, as explained below). Also, the levels of analysis (meso and micro) were removed. The different *types of processes* and the *contextual and individual factors* were divided into positive and negative effects.

Template version 1

- **Type of ties**
  - Online networks
  - ex-husband
  - Personal trainer
  - Pet
  - Neighbours
  - Sport contacts
  - Co-workers
  - Community group
  - Boyfriend and girlfriend
  - Housemates
  - Friends
  - Family
  - Healthcare professionals
- **Contextual and individual factors**
  - Contextual
    - Negative
      - Prices
      - Social norms
      - Family socioeconomic status
      - School activities
      - Bars and pubs
      - Working environment
      - Social events
      - War times
      - Change country
      - Coronavirus
    - Positive
      - Networks with conditions
      - New country
      - Social norms
      - Built environment
- **Processes, ties and outcomes**
  - Negative
    - Social support
    - Competing
    - Diffusion of practices
    - Isolation
    - Death
    - Social modelling
    - Homophily
    - Bullying
    - Socialising
    - Social comparison
    - Peer pressure
    - Peer support
    - Patronising
    - Judging
    - Exercising
    - Mentoring
    - Labelling
    - Advising
    - Shopping
    - Collective efficacy
    - Cooking
  - Positive
    - Competing
    - Social awareness
    - Homophily
    - Community support
    - Social modelling
    - Peer support
    - Companion
    - Social prescription

| | | |
|---|---|---|
| | Social media | Caring |
| | Community services | Walking |
| | Incorporation to work | Advice |
| | School starting September | Emotional |
| Individual | | Trust |
| Positive | | Mentoring |
| | Knowledge | Collective efficacy |
| | Mindset | Cooking |
| | Age | Social comparison |
| | Motivation | Peer pressure |
| | Awareness | **Importance of networks** |
| | Critical moment | **Network structure and dynamics of change** |
| | Previous experience | |
| | Happiness | |
| Negative | | |
| | Marital status | |
| | Socioeconomic status | |
| | Work | |
| | Genre | |
| | Self-management | |
| | Mindset | |
| | physical appearance | |
| | Mental health | |

**Template version 2**

Although some changes were produced, the template from version 1 to version 2 kept a similar structure.

Type of ties

*Online networks* were removed. At this point, *social media* (contextual factors) was considered to be an intermediary between the different participants. *Influencers, YouTubers (online networks)* were not considered for this study.

The code *family* was divided into more minor codes (members of the family). Thus, *aunts and uncles*, *children*, *siblings*, *grandparents*, *partners*, and *parents* were added.

*Classmates* were added as a code.

Contextual and individual factors

Contextual negative

*Prices* and *family socioeconomic status* were included in the category *Individual-socioeconomic status*. *School activities, war times* and *change country* were deleted as irrelevant. *Bars and pubs* were included in *social events*. *Built environment* was added.

Appendix I

Contextual positive

*Green spaces* was added to *built environment*. *Network conditions* was added into *individual-previous experience* and deleted from *contextual factors*. *New country*, *community services* and *incorporation to work* were deleted as irrelevant.

Individual positive

*Critical moment* was added to *previous experience*. *Happiness* was deleted as irrelevant. *Motivation* and *awareness* were deleted as these quotes served as examples to justify the importance in mental health (network effects), and therefore, the examples had other codes where network processes were identified. *Sociodemographic factors* and *availability of free time* were added.

Individual negative

*Genre*, *work*, *marital status*, *socioeconomic status* were merged into the new code *sociodemographic factors*. *Self-management* was deleted as irrelevant. *Mindset* and *mental health* were deleted since they were going to be included as part of the narrative (explanation of the story). Therefore, they were not relevant as codes. *Previous experience* was added as a new code.

<u>Processes, ties and outcomes</u>

Negative processes

*Competing*, *diffusion of practices*, *exercising* and *socialising* were deleted as irrelevant. *Social support* was included in *peer support*. The codes *patronising*, *judging*, and *labelling* were merged into the code *judging, bullying and labelling*. *Advising* was included in *counselling and mentoring. Cooking and shopping* were put together, the same as *counselling and mentoring*. *Judging, bullying and labelling*, *cooking and shopping*, *collective efficacy* and *counselling and mentoring* were added as minor codes within the code *peer support*.

Positive processes

*Competing*, *social awareness*, *companion*, *social prescription*, *caring*, *walking* and *trust* were deleted as irrelevant. *Advice* was included in the code *counselling and mentoring*. *Counselling and mentoring* and *cooking and shopping* were created. *Emotional*, *counselling and mentoring*, *collective efficacy* and *cooking and shopping* were included as more minor codes in the code *peer support*.

Template version 2

**Type of ties**
- ~~Online networks~~
- ex-husband
- Sport contacts and personal trainers
- Pet
- Neighbours
- Sport contacts
- Co-workers
- Community group
- Housemates
- Friends
- Family
  - Aunts and uncles
  - Children
  - Siblings
  - Grandparents
  - Partner
  - Parents
- Healthcare professionals
- Classmates

**Contextual and individual factors**
- Contextual
  - Negative
    - ~~Prices~~
    - ~~Family socioeconomic status~~
    - ~~School activities~~
    - ~~Bars and pubs~~
    - ~~War times~~
    - ~~Change country~~
    - Coronavirus
    - Working environment
    - Built environment
    - Social norms
    - Social events
  - Positive
    - Social norms
    - Built environment and green spaces
    - Social media
    - School
    - ~~Networks with conditions~~
    - ~~New country~~
    - ~~Community services~~
    - ~~Incorporation to work~~
- Individual
  - Positive
    - Knowledge
    - Availability of free time
    - Mindset
    - Sociodemographic factors
    - Previous experience
    - Age
    - ~~Motivation~~
    - ~~Awareness~~
    - ~~Critical moment~~
    - ~~Happiness~~
  - Negative
    - ~~Marital status~~
    - ~~Socioeconomic status~~
    - ~~Work~~
    - ~~Genre~~
    - ~~Self-management~~
    - ~~Mindset~~

**Processes, ties and outcomes**
- Negative
  - ~~Social support~~
  - ~~Competing~~
  - ~~Diffusion of practices~~
  - Isolation
  - Death
  - Social modelling
  - Homophily
  - ~~Socialising~~
  - Social comparison
  - Peer pressure
  - Peer support
    - Judging, bullying & labelling
    - Cooking and shopping
    - Collective efficacy
    - Counselling and mentoring
  - ~~Patronising~~
  - ~~Judging~~
  - ~~Exercising~~
  - ~~Labelling~~
  - ~~Advising~~
- Positive
  - ~~Competing~~
  - ~~Social awareness~~
  - Homophily
  - Community support
  - Social modelling
  - ~~Companion~~
  - ~~Social prescription~~
  - ~~Caring~~
  - ~~Walking~~
  - ~~Advice~~
  - ~~Trust~~
  - Peer support
    - Emotional
    - Counselling and mentoring
    - Collective efficacy
    - Cooking and shopping
  - Social comparison
  - Peer pressure

**Importance of networks**

**Network structure and dynamics of change**

~~Mental health~~
physical appearance
Previous experience
Sociodemographic factors

**Template version 3**

From version 2 to 3, there were significant changes. Firstly, *types of ties* and *processes* were merged. Thus, it was decided to establish two themes according to a multilevel analysis based on our previous critical interpretative synthesis review (*Micro-relationships* and *its processes and meso-relationships and its processes*). The *importance of networks* was deleted as a theme. The theme *contextual and individual factors* was modified. Thus, some relevant individual attributes (e.g. *mindset*, *previous experience* or *knowledge*) were added into the different *network processes*. The part regarding *contextual factors* was tagged with the theme *Macro-conditions influence network outcomes* and the *coronavirus* and *socio-cultural conditions* were the broader codes within this category.

Template version 3

**Macro-conditions influence network outcomes**
- Coronavirus
  - Negative effects
  - Positive effects
- Socio-cultural conditions
  - Negative effects
    - Working environment
    - Built environment
    - Social norms
    - Social events
    - War
    - Economic
  - Positive effects
    - Time
    - Built environment and green spaces
    - Social norms
    - Schools
    - Social media

**Visualisation of networks**
- Structure
- Dynamics

**Micro-relationships and its processes**
- Family networks
  - Family (in general)
    - Negative effects
      - Homophily
      - Peer pressure
      - Social modelling
      - Peer support
        - Judging, bullying and labelling
        - Collective efficacy
    - Positive effects

- Social modelling
- Peer pressure
- Peer support
  - Collective efficacy
  - Counselling and mentoring

Pets
- Negative effects
  - Peer support
  - Collective efficacy
- Positive effects
  - Peer support
  - Collective efficacy

Partners
- Negative effects
  - Homophily
  - Peer pressure
  - Social comparison
  - Peer support
    - Collective efficacy
- Positive effects
  - Peer pressure
  - Peer support
    - Cooking and shopping
      - individual factor previous experience
    - Counselling and mentoring
    - Emotional
    - Collective efficacy
  - Social comparison
  - Social modelling

Children
- Negative effects
  - Peer support
    - Cooking and shopping
- Positive effects
  - Homophily
  - Peer support
    - Emotional
    - Cooking and shopping
    - Counselling and mentoring
      - Individual factor_knowledge
  - Peer pressure

Aunts and uncles
- Negative effects
  - Peer pressure

Grandparents
- Negative effects
  - Peer pressure
  - Peer support
    - Judging, bullying and labelling
    - Cooking and shopping
- Positive effects
  - Social comparison
    - Individual factor previous experience
  - Peer support
    - Emotional

- Siblings
  - Negative effects
    - Peer pressure
    - Death
    - Peer support
      - Judging, bullying and labelling
  - Positive effects
    - Peer support
      - Emotional
      - Counselling and mentoring
- Parents
  - Negative effects
    - Peer pressure
    - Peer support
      - Collective efficacy
      - Judging and labelling
      - Cooking and shopping
    - Social modelling
  - Positive effects
    - Social modelling
      - Social comparison
        - Individual factor mindset
        - Individual factor previous experience
      - Peer pressure
      - Peer support
        - Collective efficacy
        - Counselling and mentoring
        - Emotional
        - Cooking and shopping

Friends networks

- Negative effects
  - Homophily
  - Social comparison
  - Peer support
    - Judging, bullying and labelling
    - Cooking and shopping
    - Collective efficacy
    - Counselling and mentoring
  - Peer pressure
- Positive effects
  - Homophily
    - individual factor mindset
  - Peer pressure
  - Social modelling
  - Social comparison
    - individual factor previous experience
  - Peer support
    - Cooking and shopping
    - Collective efficacy
    - Counselling and mentoring
    - Emotional

**Meso-relationships and its processes**

Community relationships

- Classmates
  - Negative effects

- Social comparison
- Peer support
  - Judging, bullying and labelling
- Positive effects
  - Social comparison

Sport contacts and personal trainers

- Negative effects
  - Social comparison
  - Peer support
    - Counselling and mentoring
- Positive effects
  - Social comparison
  - Homophily
  - Peer pressure
  - Peer support
    - Counselling and mentoring

Neighbours

- Negative effects
  - Peer pressure
- Positive effects
  - Social comparison

Co-workers

- Negative effects
  - Peer pressure
  - Peer support
    - Collective efficacy
- Positive effects
  - Social modelling
  - Social comparison
  - Homophily
    - Individual factor mindset
  - Peer support
    - Emotional
    - Collective efficacy

Community group

- Negative effects
  - Social comparison
- Positive effects
  - Social modelling
  - individual factor previous experience
  - Peer pressure
  - Homophily
  - Collective efficacy
  - Community support

Healthcare professionals

- Negative effects
  - Peer support
    - Counselling and mentoring
    - Judging, bullying and labelling
- Positive effects
  - Peer support
    - Emotional
    - Counselling and mentoring
      - individual factor mindset

Appendix I

**Template version 4**

In this version, the theme *visualisation of networks* and data related to networks' structure and dynamics were removed. After meeting with the rest of the authors, we suggested that there was too much information in the paper and that the part related to the structure should be added elsewhere. Also, the different levels of analysis (meso-micro) to differentiate different types of networks were ignored since this could avoid theoretical confusion. Instead, four new main themes were created to identify the types of networks and encompass the different network processes: *become part of the community*, *healthcare professionals are another brick in the wall*, *types of influence processes of family networks*, and *friends and the activities by which they affect health*. These themes represent four types of relationships: community groups and other members from the community, healthcare professionals, family and friends.

Template version 4

**1.Macro-determinants influence network outcomes**

- Coronavirus
  - Negative effects
  - Positive effects
- Socio-cultural conditions
  - Negative effects
    - Working environment
    - Built environment
    - Social norms
    - Social events
    - War
    - Economic
  - Positive effects
    - Time
    - Built environment and green spaces
    - Social norms
    - Schools
    - Social media

**2.Become part of the community**

- Classmates
  - Negative effects
    - Social comparison
    - Peer support
      - Judging, bullying and labelling
  - Positive effects
    - Social comparison
- Sport contacts and personal trainers
  - Negative effects
    - Social comparison
    - Peer support
      - Counselling and mentoring
  - Positive effects
    - Social comparison
    - Homophily

- Peer pressure
- Peer support
  - Counselling and mentoring

Neighbours
- Negative effects
  - Peer pressure
- Positive effects
  - Social comparison

Co-workers
- Negative effects
  - Peer pressure
  - Peer support
    - Collective efficacy
- Positive effects
  - Social modelling
  - Social comparison
  - Homophily
    - Individual factor mindset
  - Peer support
    - Emotional
    - Collective efficacy

Community groups and weight management groups
- Negative effects
  - Social comparison
- Positive effects
  - Social modelling
    - individual factor previous experiences
  - Peer pressure
  - Homophily
  - Community support
    - Collective efficacy

**3.Healthcare professionals are another brick in the wall**

Negative effects
- Peer support
  - Counselling and mentoring
  - Judging, bullying and labelling

Positive effects
- Peer support
  - Emotional
  - Counselling and mentoring
    - individual factor mindset

**4.Types of influence processes of family networks**

Family (in general)
- Negative effects
  - Homophily
  - Peer pressure
  - Social modelling
  - Peer support
    - Judging, bullying and labelling
    - Collective efficacy
- Positive effects
  - Social modelling
  - Peer pressure
  - Peer support
    - Collective efficacy

- Counselling and mentoring
- Pets
  - Negative effects
    - Peer support
      - Collective efficacy
  - Positive effects
    - Peer support
      - Collective efficacy
- Partners
  - Negative effects
    - Homophily
    - Peer pressure
    - Social comparison
    - Peer support
      - Collective efficacy
  - Positive effects
    - Peer pressure
    - Peer support
      - Cooking and shopping
        - individual factor previous experience
      - Counselling and mentoring
      - Emotional
      - Collective efficacy
    - Social comparison
    - Social modelling
- Children
  - Negative effects
    - Peer support
      - Cooking and shopping
  - Positive effects
    - Homophily
    - Peer support
      - Emotional
      - Cooking and shopping
      - Counselling and mentoring
        - Individual factor_knowledge
    - Peer pressure
- Aunts and uncles
  - Negative effects
    - Peer pressure
- Grandparents
  - Negative effects
    - Peer pressure
    - Peer support
      - Judging, bullying and labelling
      - Cooking and shopping
  - Positive effects
    - Social comparison
      - Individual factor previous experience
    - Peer support
      - Emotional
- Siblings
  - Negative effects
    - Peer pressure
    - Death

- Peer support
  - Judging, bullying and labelling
- Positive effects
  - Peer support
    - Emotional
    - Counselling and mentoring

Parents

- Negative effects
  - Peer pressure
  - Peer support
    - Collective efficacy
    - Judging, bullying and labelling
    - Cooking and shopping
  - Social modelling
- Positive effects
  - Social modelling
    - Social comparison
      - Individual factor mindset
      - Individual factor previous experience
    - Peer pressure
    - Peer support
      - Collective efficacy
      - Counselling and mentoring
      - Emotional
      - Cooking and shopping

**5. Friends and the activities by which they affect health**

Negative effects

- Homophily
- Social comparison
- Peer support
  - Judging, bullying and labelling
  - Cooking and shopping
  - Collective efficacy
  - Counselling and mentoring
- Peer pressure

Positive effects

- Homophily
  - individual factor mindset
- Peer pressure
- Social modelling
- Social comparison
  - individual factor previous experience
- Peer support
  - Cooking and shopping
  - Collective efficacy
  - Counselling and mentoring
  - Emotional

**Template version 5**

The codes related to network processes were created in a critical review (chapter 4) based on a creative and interpretative process. Since peoples' narratives are studied, it was decided to

change these more theoretical codes into simple words referring to the activities that induce the adoption of different health practices. For example, *collective efficacy* was changed into *conducting activities together* or *social modelling* during the childhood, which was changed into *growing up seeing and modelling bad practices*.

All the community relationships (weak ties) that had a friendship component were included in the second theme to create a distinction in the main manuscript between the influence of close friendship relationships and weak ties friendship relationships. Also, the names of the themes were modified to specify a pattern of meaning rather than a topic summary (the latter is more common in codebook TA). This further analysis adds meaning to the results. The theme *macro-determinants influence network outcomes* was removed to simplify the template and focus on relationships and their processes. Some broader social and economic factors were reported when writing up some results, but they were not considered a priority for this manuscript.

Template version 5

**1.Everyday familial routines matter**
- Activities with positive effects on health
  - Family (in general)
    - Being a role model
    - Conducting activities together
    - Counselling
  - Parents
    - Being a role model
    - Physical loss
    - Peer pressure
    - Conducting activities together
    - Counselling
    - Emotional support
    - Education in cooking and eating healthy
  - Pets
    - Providing physical exercise
  - Partners
    - Cooking and shopping healthy food
    - Counselling
    - Emotional support
    - Sharing lifestyle goals and making joint efforts
    - Comparing
    - Being a role model
  - Children
    - Having similar characteristics
    - Emotional support
    - Cooking and shopping healthy food
    - Education in eating healthy
    - Peer pressure
  - Grandparents
    - Comparing
    - Emotional support
  - Siblings
    - Counselling

- Aunts and uncles
  - Emotional support
- Activities with negative effects on health
  - Family (in general)
    - Having similar characteristics
    - Peer pressure
    - Growing up seeing and modelling bad practices
    - Judging, labelling and commenting
    - Conducting activities together
  - Parents
    - Providing an excess of control
    - Conducting activities together
    - Cooking and shopping
    - Growing up seeing bad practices
  - Pets
    - Encouraging physical activity
  - Partners
    - Having similar characteristics
    - Peer pressure
    - Comparing
    - Conducting activities together
    - Eating and shopping
  - Children
    - Education in cooking healthy
  - Grandparents
    - Peer pressure
    - Cooking and providing excess amount of food
  - Siblings
    - Peer pressure
    - Physical loss
    - Judging, labelling and commenting

**2. Chasing healthier lifestyles and modelling and connecting emotionally with friends**

- Activities with positive effects on health
  - Close friends
    - Having similar characteristics
    - Modelling
    - Comparing
    - Cooking and shopping healthy food
    - Conducting activities together
    - Counselling
    - Emotional support
  - Community friends (gym and weight management groups)
    - Leadership and counselling
    - Sharing agendas and aims
    - Conducting activities together
    - Emotional support
    - Comparing
    - Modelling
    - Peer pressure
  - Colleagues at work
    - Emotional support
    - Conducting activities together
    - Comparing
- Activities with negative effects on health
  - Close friends

| |
|---|
| Comparing |
| Cooking and shopping healthy food |
| Conducting activities together |
| Counselling and mentoring |
| Peer pressure |
| Community friends (gym and weight management groups) |
| Comparing |
| Counselling |
| **3. Healthcare professionals as negative influencers** |
| Activities with positive effects on health |
| Emotional support |
| Counselling |
| Activities with negative effects on health |
| Counselling, patronising and not providing person-centred plans |
| Communication, lack of a sensitive approach |

**Stage 4. Finalising the template**

The template was finalised and applied to all the interview transcripts. A final version of the template was considered when it covered all the aspects of the research aim.

**Stage 5. Writing up**

The final phase was writing up, weaving together the analytic narrative and data extracts and contextualising the analysis regarding current literature.

The final template consisted of three themes, two sub-themes for each theme and 95 codes. The first theme was divided into two sub-themes in the main manuscript since the sections were relatively balanced in terms of length. The part of the text representing the second theme was not divided since the two sub-sections would not be equal in terms of length (although both positive and negative activities were specified in the text). The third theme in the text represents only negative processes since they were the most relevant.

# Appendix J Checklists with answers to evaluate template thematic analysis research process

## J.1 Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| **Domain 1: Research team and reflexivity** | | | |
| Personal characteristics | | | |
| 1 | Interview/facilitator | Which author/s conducted the interview or focus group? | The first author (NSF) conducted all the interviews. |
| 2 | Credentials | What were the researcher's credentials? E.g. PhD, MD | First author: PhD student (NSF)<br>The rest of the authors are Emeritus professor and professor. |
| 3 | Occupation | What was their occupation at the time of the study? | First author: PhD student and research assistant.<br>The rest of the authors, as mentioned in question 2. |
| 4 | Gender | Was the researcher male or female? | First author, male. Not specified in the manuscript. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| 5 | Experience and training | What experience or training did the researcher have? | The researcher had previous training at the faculty (qualitative courses). Not specified in the manuscript. |
| Relationships with participants | | | |
| 6 | Relationship established | Was a relationship established prior to study commencement? | Only a first contact was established to describe the study and look for potential participants. There is no therapeutic relationship between researchers and participants (specified in the main manuscript). |
| 7 | Participant knowledge of the interviewer | What did the participants know about the researcher? e.g. personal goals, reasons for doing the research | A participant information sheet that explained the research in detail was provided before conducting the interviews. |
| 8 | Interviewer characteristics | What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic | The interest in the research topic was explained in the introduction of the participant information sheet. Part of that explanation is specified in the introduction section of this article. |
| **Domain 2: study design** | | | |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| Theoretical framework | | | |
| 9 | Methodological orientation and Theory | What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis | A constructivist epistemology hermeneutic phenomenology. It is explained in the manuscript. |
| Participant selection | | | |
| 10 | Sampling | How were participants selected? e.g. purposive, convenience, consecutive, snowball | Purposive. It is explained in the text. |
| 11 | Method of approach | How were participants approached? e.g. face-to-face, telephone, mail, email | Email, social media and community context. It is explained in the text. |
| 12 | Sample size | How many participants were in the study? | 19. Specified in the text. |
| 13 | Non-participation | How many people refused to participate or dropped out? Reasons? | None of the participants dropped out. However, 44 community groups (long-term conditions and weight management groups at a local and national level-UK) and 17 individuals declined or did not respond to participating in the study. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| Setting | | | |
| 14 | Setting of data collection | Where was the data collected? e.g. home, clinic, workplace | Data was collected via videoconference and telephone (specified in the manuscript). Most of the participants were at their homes at the time of the interview. |
| 15 | Presence of non-participants | Was anyone else present besides the participants and researchers? | Before the interview, it was recommended to stay in a quiet place to ensure confidentiality. No more people were visualised at the time of the interview. |
| 16 | Description of sample | What are the important characteristics of the sample? e.g. demographic data, date | A sociodemographic questionnaire was used to collect data, and a table was created in the main manuscript specifying the most relevant characteristics for this study (see Table 4). |
| Data collection | | | |
| 17 | Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot tested? | The questions were created by the principal author and delivered by him. Some insights and a brief description of what he was going to ask |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| | | | were provided in advance. The interview was pilot tested with friends and family members of the first author.<br>The questions regarding social networks were designed based on our previous literature review. The qualitative research group members of the authors' affiliation and the two first interviewees provided feedback regarding the type and tone of the questions. |
| 18 | Repeat interviews | Were repeat interviews carried out? If yes, how many? | No. All the interviews were carried out once. |
| 19 | Audio/visual recording | Did the research use audio or visual recording to collect the data? | The interviews were audio-recorded. It is explained in the manuscript. |
| 20 | Field notes | Were field notes made during and/or after the interview or focus group? | Field notes were made when the first author re-read and listened again the interviews. |
| 21 | Duration | What was the duration of the interviews or focus group? | Between 30 and 120 minutes. Explained in the text. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| 22 | Data saturation | Was data saturation discussed? | Data saturation was used. It is specified in the manuscript. |
| 23 | Transcripts returned | Were transcripts returned to participants for comment and/or correction? | We gave the option to return the individual transcripts to the correspondent interviewee as per request. None of the participants requested the transcript. |
| **Domain 3: analysis and findings** | | | |
| Data analysis | | | |
| 24 | Number of data coders | How many data coders coded the data? | The main researcher coded all the data. The rest of the authors checked the name of the domain summary themes and codes, and suggestions were provided to make changes. |
| 25 | Description of the coding tree | Did authors provide a description of the coding tree? | A coding tree is detailed in Appendix I, and Table 5 in the main manuscript. |
| 26 | Derivation of themes | Were themes identified in advance or derived from the data? | Both. This is explained in methods. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| 27 | Software | What software, if applicable, was used to manage the data? | NVivo version 1.2. |
| 28 | Participant checking | Did participants provide feedback on the findings? | Participant 1 provided feedback about the results (specified in the manuscript). |
| Reporting | | | |
| 29 | Quotations presented | Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number | Quotations were presented, and participants were anonymised using numbers, e.g. Participant 1. |
| 30 | Data and findings consistent | Was there consistency between the data presented and the findings? | There is consistency between the data presented and the findings. |
| 31 | Clarity of major themes | Were major themes clearly presented in the findings? | Three themes were presented as subheadings of the results section. |
| 32 | Clarity of minor themes | Is there a description of diverse cases or discussion of minor themes? | Themes were divided in subthemes. Codes were not specified in a special format since we wanted to focus on the story itself. A table with all themes, sub-themes and codes is in the main manuscript (Table 5). |

## J.2 A tool for evaluating thematic analysis manuscripts for publication: Twenty questions to guide assessment of thematic analysis research quality

| Questions | Answers |
|---|---|
| *Adequate choice and explanation of methods and methodology* | |
| 1. Do the authors explain why they are using TA, even if only briefly? | It is described in the data analysis section. |
| 2. Do the authors clearly specify and justify which type of TA they are using? | Codebook (template) TA. It is described in the data analysis section. |
| 3. Is the use and justification of the specific type of TA consistent with the research questions or aims? | The aim has a naturalistic insight to identify and explore in-depth aspects of social relationships. Also, TA is consistent with a phenomenology approach. |
| 4. Is there a good 'fit' between the theoretical and conceptual underpinnings of the research and the specific type of TA (i.e. is there conceptual coherence)? | The theoretical and conceptual underpinnings are based on social network theory, specifically our critical interpretative synthesis review. Codebook TA starts from an a-priori template which was created from the results of the CIS review. This is explained in the manuscript and, in more detail, in Appendix I. |

| Questions | Answers |
|---|---|
| 5. Is there a good 'fit' between the methods of data collection and the specific type of TA? | Individual semi-structured interviews were used, which fit well with the use of TA. |
| 6. Is the specified type of TA consistently enacted throughout the paper? | Appendix I shows all the phases of the specific analysis, which are explained step by step. |
| 7. Is there evidence of problematic assumptions about, and practices around, TA? These commonly include:<br>● Treating TA as one, homogenous, entity, with one set of – widely agreed on – procedures.<br>● Combining philosophically and procedurally incompatible approaches to TA without any acknowledgement or explanation.<br>● Confusing summaries of data topics with thematic patterns of shared meaning, underpinned by a core concept.<br>● Assuming grounded theory concepts and procedures (e.g. saturation, constant comparative analysis, line-by-line coding) apply to TA without any explanation or justification.<br>● Assuming TA is essentialist or realist, or atheoretical. | All these points were taken into account.<br>-TA was not treated as one since there are different types of TA.<br>- A constructivist epistemology hermeneutic phenomenology methodology was used to study lived experience. It is consistent with TA.<br>-Three thematic patterns of shared meaning were created.<br>Grounded theory (as an analytical method) is completely different from TA.<br>-TA is not atheoretical. TA is suited to both experiential (e.g. critical realist, contextualist) and critical (e.g. relativist, constructionist) framings of language, data and meaning.<br>-TA is not only a data reduction or descriptive approach. There is an interpretative activity conducted by the researchers through the lenses of |

| Questions | Answers |
|---|---|
| ● Assuming TA is only a data reduction or descriptive approach and therefore must be supplemented with other methods and procedures to achieve other ends. | their particular social context. Also, opinions during the analytical process were added. |
| 8. Are any supplementary procedures or methods justified, and necessary, or could the same results have been achieved simply by using TA more effectively? | Not applicable. |
| 9. Are the theoretical underpinnings of the use of TA clearly specified (e.g. ontological, epistemological assumptions, guiding theoretical framework(s)), even when using TA inductively (inductive TA does not equate to analysis in a theoretical vacuum)? | They are explained in the introduction and methodology sections. |
| 10. Do the researchers strive to 'own their perspectives' (even if only very briefly), their personal and social standpoint and positioning? (This is especially important when the researchers are engaged in social justice oriented research and when representing the 'voices' of marginal and vulnerable groups, and groups to which the researcher does not belong.) | As part of a hermeneutical phenomenology, the opinions were crucial for the analysis and created the codes and themes. On the other hand, there was an adjustment to the participants' narratives for not losing the essence of the lived experience. |

| Questions | Answers |
|---|---|
| 11. Are the analytic procedures used clearly outlined, and described in terms of what the authors actually did, rather than generic procedures? | The different steps were specified in Appendix I. |
| 12. Is there evidence of conceptual and procedural confusion? For example, reflexive TA (e.g. Braun and Clarke 2006) is the claimed approach but different procedures are outlined such as the use of a codebook or coding frame, multiple independent coders and consensus coding, inter-rater reliability measures, and/or themes are conceptualised as analytic inputs rather than outputs and therefore the analysis progresses from theme identification to coding (rather than coding to theme development). | The procedure of codebook TA was followed, although it is true that there are elements of reflexive TA; for example, main themes are not domain summary themes, but they specify a pattern of meaning. TA is flexible enough to conduct this practice, and the article benefits from it. |
| 13. Do the authors demonstrate full and coherent understanding of their claimed approach to TA? | The use of TA is justified in regard to the aims, philosophy and methodology. |
| *A well-developed and justified analysis* | |

| Questions | Answers |
| --- | --- |
| 14. Is it clear what and where the themes are in the report? Would the manuscript benefit from some kind of overview of the analysis: listing of themes, narrative overview, table of themes, thematic map? | The themes are subheadings in the results section. A table with a list of final themes and codes is in the main manuscript (see Table 5), and more information is provided in Appendix I. |
| 15. Are the reported themes topic summaries, rather than 'fully realised themes' – patterns of shared meaning underpinned by a central organising concept?<br>● If so, are topic summaries appropriate to the purpose of the research?<br>○ If the authors are using reflexive TA, is this modification in the conceptualisation of themes explained and justified?<br>● Have the data collection questions been used as themes?<br>● Would the manuscript benefit from further analysis being undertaken, with the reporting of fully realised themes?<br>● Or, if the authors are claiming to use reflexive TA, would the manuscript benefit from claiming to use a different type of TA (e.g. coding reliability or codebook)? | Although the process of codebook TA was used, fully realised themes were developed since the manuscript benefits from it. This modification in the conceptualisation of the manuscript's themes is not explained in the main article since there was no space for it. More details are explained in Appendix I. |

| Questions | Answers |
| --- | --- |
| 16. Is non-thematic contextualising information presented as a theme? (e.g. the first 'theme' is a topic summary providing contextualising information, but the rest of the themes reported are fully realised themes). If so, would the manuscript benefit from this being presented as non-thematic contextualising information? | All of them are fully themes. |
| 17. In applied research, do the reported themes have the potential to give rise to actionable outcomes? | In the discussion section, it is explained how some of the results could be useful for future interventions. |
| 18. Are there conceptual clashes and confusion in the paper? (e.g. claiming a social constructionist approach while also expressing concern for positivist notions of coding reliability, or claiming a constructionist approach while treating participants' language as a transparent reflection of their experiences and behaviours) | A constructivist epistemology was followed. There are no conceptual clashes in the paper. |
| 19. Is there evidence of weak or unconvincing analysis, such as:<br>● Too many or two few themes? | Three themes were created for the main manuscript. |

| Questions | Answers |
|---|---|
| ● Too many theme levels?<br>● Confusion between codes and themes?<br>● Mismatch between data extracts and analytic claims?<br>● Too few or too many data extracts?<br>● Overlap between themes? | Codes were differentiated from the wider categories. Also, there are two sub-themes in the first theme. Appendix I reports the full list of codes, sub-themes and themes. Although each theme has two-sub themes, it was decided to represent only sub-themes in the first theme as they were the most relevant and keep a balance in the main manuscript regarding the length of the sections.<br>The data extracts relate to the created codes.<br>There was an attempt to balance the most representative results, a variety of positive and negative effects on health and the number of examples provided to describe each code.<br>Themes represent different types of networks, so overlapping should have been avoided. |
| 20. Do authors make problematic statements about the lack of generalisability of their results, and or implicitly conceptualise generalisability as statistical probabilistic generalisability | The results cannot be generalised. This information belongs to individuals who have different stories and similar socio-demographic characteristics. However, the results might provide an idea of the importance of social networks in the obesity and long-term conditions research fields and a way to explore in-depth and raise awareness of relationships. |

# Appendix K Data analysis in detail using reflexive thematic analysis

This appendix shows a detailed data analysis of the third article of this thesis (chapter 6).

**Before the analysis: transcription**

The interviews were transcribed verbatim, ten of them by the first author (NSF) and the rest by a professional transcriber. Support from the latest was needed since the sound quality was not ideal in some of the interviews conducted online. All the transcripts were checked for errors by listening back to the audio recordings and reading the transcripts at the same time. Small notes were specified in the transcripts to identify nonverbal communication, long pauses, or some change in the tone of voice. This could support the coding process.

**Some essential notions for understanding the analysis process**

- Reflexive TA was chosen (Braun and Clarke, 2022). Data analysis followed an inductive and iterative process since the new themes and codes were created through the research, with movement back and forth between the different phases. The analysis moves beyond the superficial and simple data description or reduction (Morse, 2020).
- Coding frameworks were created through the research process only to facilitate a relatively quick analysis process and offer some structure (Braun *et al.*, 2019). The final template with codes and themes is not specified in the final manuscript since the structured framework does not share the nature and characteristics of reflexive TA [12]. In reflexive TA, coding is an open, iterative process. It is not 'fixed' at the beginning of the process (e.g. by using a coding frame –they might delimit the depth of flexibility and engagement central to qualitative research practice) (Braun and Clarke, 2019; Braun *et al.*, 2019). Codes can evolve throughout the coding process—such changes during coding aim to capture better the researcher's developing conceptualisation of the data.
- Six phases (Braun and Clarke, 2006) were followed to guide the analysis, although adapted to the needs of the research process. The description of the different phases and the content of the main manuscript might demonstrate the immersion, thoughtfulness, creativity, and insight to ensure quality in this TA research.

[12] Structured frameworks are used in other types of thematic analysis, such as codebook thematic analysis or coding reliability.

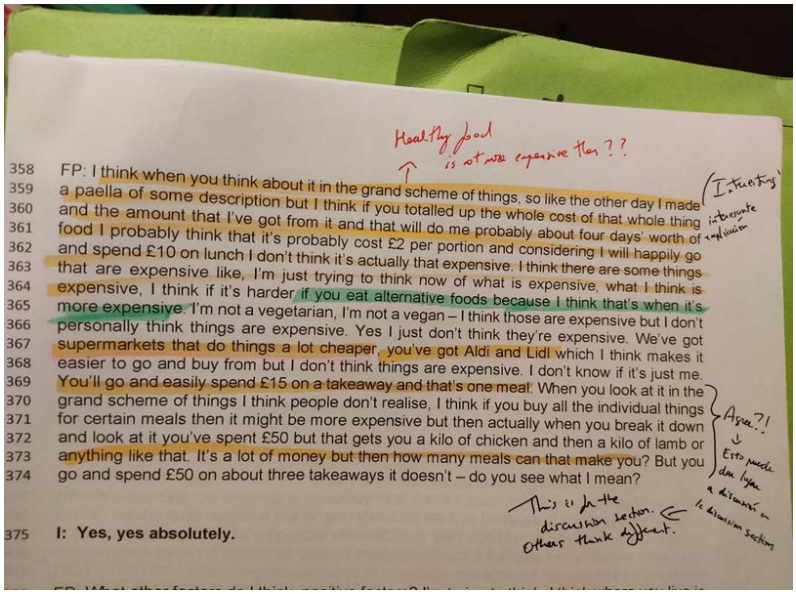
**Phase 1. Reading the transcripts to become aware of the content**

Familiarisation with the data, becoming immersed with the content. The main author of the research (NSF) listened back to the audios and read a couple of times each interview transcript to have a 'whole picture' of the entire data set and allowed to start thinking about the first potential ideas and patterns of data (Braun and Clarke, 2006). In this phase, researchers are encouraged to be vigilant with their pre-existing thoughts, perspectives and developing theories (Starks and Trinidad, 2007). This is because reflexive TA (inductive in nature), in part, is a process of coding without trying to fit it into the researcher's analytic preconceptions (Nowell *et al.*, 2017).

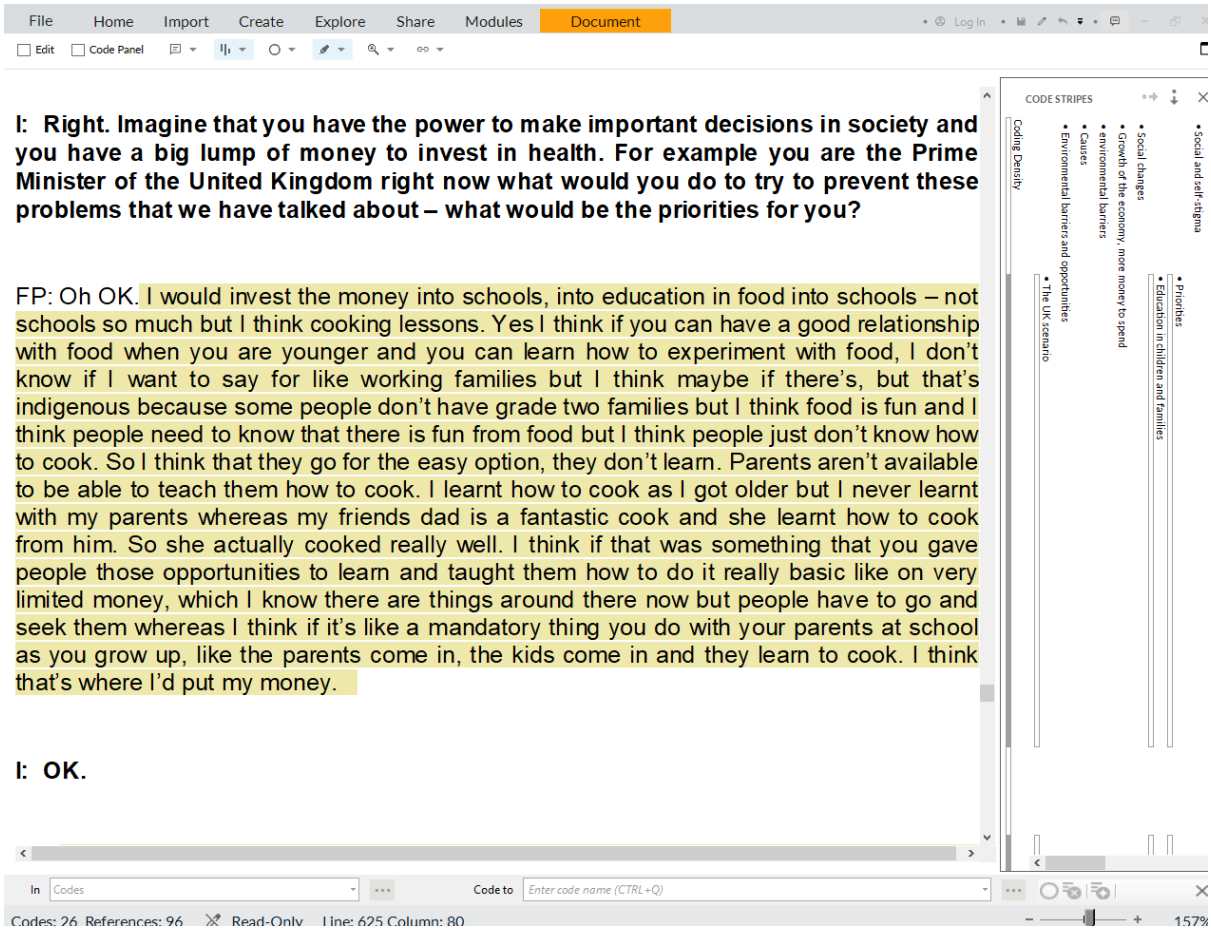
**Phase 2. Identifying and coding essential features of the data related to environmental barriers, opportunities and priorities to change**

Interesting text segments (parts of sentences, whole sentences or even paragraphs) were underlined, and the right-hand margin was used to specify codes or labels. Coding allows to simplify and focuses on distinguishing characteristics of the data which could relate to a theme or a particular issue in the data (King, 2004). Codes should have explicit boundaries to avoid redundancy or interchangeability (Attride-Stirling, 2001). Furthermore, notes and ideas were written in a printed version of the transcripts (see image below). The screenshot below is an excerpt of open coding of Participant's 1 transcript using NVivo. The interviewee was asked about her priorities for change if she were the British Prime Minister. The paragraph highlighted in yellow colour (her answer) was coded initially with the code 'education in children and families' (codes are on the right-hand side of the picture).

Printed version with notes



Screenshot of NVivo during the analysis




**Phase 3. Examining the collating data and codes to build up shared topics.**

Returning to the previous example (the NVivo screenshot), that paragraph, its meaning, and the 'education in children and families' code were incorporated into two new items developed to represent shared topics: *priorities* and the *UK scenario*. A preliminary idea of the potential topics in these initial phases was developed. I am still not talking about 'themes' (patterns of shared meaning, cohering around a central organising concept) but 'topics' or 'domain summaries'. The difference is that a theme identifies an area of the data and tells the reader something about the shared meaning in it. In contrast, a domain summary summarises participants' responses relating to a particular topic (so shared topic but not shared meaning) (Sandelowski and Leeman, 2012; Braun *et al.*, 2019). For example, the previous broader code *priorities* could be considered a domain summary. The word *priorities* does not communicate the essence of this theme. Also, it doesn't tell the reader something specific about these *priorities* and what underlying concept underpinned what the participants had to say about the *priorities*. In addition, it is difficult to develop themes as conceptually founded patterns at the start because it requires a depth of engagement to move beyond the data's apparent content and identify unexpected unifying patterns of meaning (Braun *et al.*, 2019).

**Phase 4. Topics were reviewed against the dataset to determine a trustworthy story.**

In this phase, the developed codes suffered modifications, information was simplified to meet the requirements of the aims and the story I wanted to shed light on, and domain summaries were still kept and not transformed into themes.

The following table represents the first template (coding framework) created with codes, broader codes and topics (the last two in light green and darker green colour). In the table, 'files' represent the number of interviews in which the item appeared. 'References' represent the number of times the item was identified throughout all the interviews. These numbers should not be considered for the validity of the results. In this sense, I remember that using a coding framework (which includes the list of codes and numbers of appearances) is not appropriate for reflexive TA (again, it was used here as a support tool for the analysis). Also, the results are not written based on the number of data items when qualitative research is done, which can be debatable since "counting responses misses the point of qualitative research" (Pyett, 2003, p. 1174), as frequency does not determine value. For example, there could be some information relevant to answering the research questions/aims, which is not necessarily determined by whether a large number of people said it.

**Template version 1**

| Name | Files | References |
|---|---|---|
| Environmental barriers and opportunities | 19 | 171 |
| Environmental barriers | 17 | 109 |
| Food environment | 12 | 42 |
| Convenient food | 7 | 11 |
| Food prices, marketing | 11 | 19 |
| Knowledge to spend in healthy food | 8 | 13 |
| Pubs | 2 | 2 |
| Takeaways | 5 | 10 |
| Gym prices | 3 | 3 |
| Lack of time | 4 | 11 |
| New technologies, TV, advertisements and social media | 7 | 13 |
| postal code | 5 | 9 |
| Types of work and conditions | 12 | 21 |
| Weather | 6 | 10 |
| Environmental opportunities | 19 | 62 |
| Gym | 8 | 11 |
| Nature | 3 | 4 |
| New technologies, TV programmes, social media, celebrities, apps | 12 | 22 |
| Postal code | 1 | 2 |
| Social norms | 5 | 5 |
| Weight management groups | 5 | 9 |
| Work | 7 | 9 |
| Obesity and mental health as a process | 17 | 63 |

| | | |
|---|---|---|
| Social and self-stigma | 17 | 63 |
| The UK scenario | 19 | 200 |
| Causes | 18 | 107 |
| Education | 7 | 8 |
| Gym prices | 1 | 1 |
| Health inequalities | 7 | 13 |
| Postal code | 3 | 4 |
| Schools | 3 | 4 |
| Social changes | 16 | 77 |
| Capitalism | 1 | 4 |
| Food environment | 2 | 2 |
| Amount of convenient food | 11 | 19 |
| Confusing and too much information | 5 | 8 |
| Delivery facilities | 2 | 3 |
| Food prices | 10 | 18 |
| Industry | 10 | 16 |
| Social norms | 9 | 16 |
| Takeaways | 5 | 5 |
| Growth of the economy, more money to spend | 6 | 8 |
| Less cooking | 7 | 16 |
| Less networks, isolation | 1 | 1 |
| Less time, pace of life | 10 | 23 |
| Technology | 6 | 13 |
| Types of work | 1 | 1 |
| Women working | 2 | 4 |
| Work and life balance | 2 | 5 |
| Priorities | 19 | 93 |
| Awareness campaigns | 2 | 2 |
| Education in children and families | 14 | 34 |
| Industries | 3 | 4 |
| More farming, change nature of supermarkets | 5 | 5 |
| More healthcare support, more investment | 10 | 15 |
| Prevention and approach from the beginning | 3 | 7 |
| Reduce number of hours at work | 1 | 1 |
| Reduce prices and economic support | 12 | 18 |
| Cheaper gyms and personal trainers | 4 | 5 |
| Free things | 2 | 2 |
| Free activities community | 1 | 1 |
| Free meal plans | 1 | 1 |
| Reduce food prices | 6 | 7 |
| Support to people with lower income | 4 | 4 |
| Social prescription | 4 | 4 |
| Sugar and fat taxes | 3 | 3 |

The category *environmental barriers* and its respective codes were moved as part of *causes* in the *UK scenario* main category since the codes were repeated or very similar in both categories, for example, *convenient food* (individual's own experience environmental barrier) and *amount of convenient food* (UK causes). The idea was to differentiate between barriers and opportunities of

the participants' everyday experiences and their opinion of barriers and opportunities in the UK (whole country vision). When reading the information after the development of the first version of the codebook, I realised that many codes were repeated in both categories and some codes and their respective quotes (e.g. weather) were not clear enough in order to classify them into the *UK scenario* or the participants' own experiences *environmental barriers* categories. I decided that establishing the difference between both categories could be extremely challenging and even could not be relevant as the analysis progressed.

Apart from this, the codes *types of work*, *women working* and *work and life* were merged into the code *work*. *Work* was added as part of the broader code *less time, pace of life*. The codes *technology*, *less time and pace of life*, and *less cooking* were added as part of the wider code *food environment*. At this point, I thought that these were enablers to access the negative food environment. The code *less networks, isolation* was removed since I was already talking about social networks in the second article. Furthermore, the codes *industries* and *sugar and fat taxes* were added as part of the wider code *more farming, change nature of supermarkets* and *social prescription* was moved as part of *more healthcare support and more investment*.

**Template version 2**

| Name | Files | References |
|---|---|---|
| Environmental opportunities | 19 | 62 |
| Gym | 8 | 11 |
| Nature | 3 | 4 |
| New technologies, TV programmes, social media, celebrities, apps | 12 | 22 |
| Postal code | 1 | 2 |
| Social norms | 5 | 5 |
| Weight management groups | 5 | 9 |
| Work | 7 | 9 |
| Obesity and mental health as a process | 17 | 63 |
| Social and self-stigma | 17 | 63 |
| The UK scenario | 19 | 346 |
| Causes | 19 | 252 |
| Education | 7 | 8 |
| Gym prices | 3 | 4 |
| Health inequalities | 7 | 13 |
| Postal code | 3 | 4 |
| Schools | 3 | 4 |
| Social changes | 19 | 259 |
| Capitalism | 1 | 4 |
| Food environment | 19 | 247 |
| Amount of convenient food | 10 | 20 |
| Confusing and too much information | 5 | 8 |
| Convenient | 7 | 11 |
| Delivery facilities | 2 | 3 |
| Food prices, marketing | 15 | 35 |

| | | |
|---|---|---|
| Knowledge to spend money | 8 | 13 |
| Industry | 10 | 19 |
| Less cooking | 7 | 16 |
| Less time, pace of life | 18 | 65 |
| Work | 16 | 31 |
| Social norms | 9 | 16 |
| Takeaways | 8 | 15 |
| Technology | 10 | 27 |
| Growth of the economy, more money to spend | 6 | 8 |
| Weather | 6 | 8 |
| Priorities | 19 | 94 |
| Education in children and families | 14 | 34 |
| More farming, change nature of supermarkets | 11 | 12 |
| More healthcare support, more investment | 13 | 29 |
| Prevention and approach from the beginning | 4 | 10 |
| Social prescription | 4 | 4 |
| Reduce prices and economic support | 13 | 19 |
| Cheaper gyms and personal trainers | 4 | 5 |
| Free things | 3 | 3 |
| Free activities community | 2 | 2 |
| Free meal plans | 1 | 1 |
| Reduce food prices | 6 | 7 |
| Support to people with lower income | 4 | 4 |
| Sugar and fat taxes | 3 | 3 |

**Phase 5. Creating an elaborated analysis of each theme and developing each theme's focus**

This phase was the point to tell an innovative story by looking again at the data available. Hence, the most relevant information for the manuscript was selected. Domain summary themes were transformed into themes (shared pattern of meaning) while considering how they could fit into the story about the entire data set concerning the research questions (Braun and Clarke, 2006). For example, the category *causes* in the *UK scenario* was transformed into the theme *living with convenience: the increased accessibility of unhealthy food*. Thus, this theme focused on the food environment and how easy it was to access this type of food through different drivers (codes), such as *less time, pace of life*.

The category *environmental opportunities* was transformed into the theme *new technologies as inducers of health practices* and focused on digital celebrities and different mass media. Previous codes, such as *postal code* or *weather* were removed since they were less innovative, and others, such as *gym* and *weight management groups* had been mentioned already in the other qualitative article created for this thesis. The category *obesity and mental health as a process* and the information linked to *social and self-stigma* was removed as it became irrelevant or, again, less innovative for this article. Furthermore, it was decided to give more relevance to the *priorities* to

change in the UK identified by the participants, and the theme *more education, resources to the health system and control food industry* was developed. This was divided into three wider codes: *education in children and families*, *the NHS* and *food industry*.

**Template version 3**

| Name | Files | References |
|---|---|---|
| Living with convenience: the increased accessibility of unhealthy food | 19 | 247 |
| Food environment | 19 | 247 |
| Amount of convenient food | 13 | 21 |
| Confusing and too much information | 5 | 8 |
| Delivery facilities | 2 | 3 |
| Food prices, marketing | 15 | 35 |
| Knowledge to spend money | 8 | 13 |
| Industry | 10 | 19 |
| Less cooking | 7 | 16 |
| Less time, pace of life | 18 | 65 |
| Working life | 16 | 31 |
| Social norms | 9 | 16 |
| Takeaways | 8 | 15 |
| Technology | 10 | 27 |
| Postal code | 7 | 10 |
| New technologies as inducers of healthier practices | 12 | 22 |
| Digital celebrities | 7 | 9 |
| New technologies | 8 | 13 |
| More education, resources to the health system and control food industry | 18 | 99 |
| Education in children and families | 14 | 34 |
| Food industry | 13 | 23 |
| More farming, change nature of supermarkets, industries | 11 | 12 |
| Reduce food prices | 6 | 7 |
| Support to people with lower income | 4 | 4 |
| The NHS | 13 | 42 |
| More specialists | 8 | 12 |
| Prevention and approach from the beginning | 5 | 11 |
| Social prescription | 4 | 4 |

**Phase 6. Finalising the themes and producing the report**

A first draft of the full manuscript was created, and themes and codes were adjusted after a peer debriefing with my supervisors. The themes were modified until consensus was reached, and we were satisfied that data were represented and displayed in a useful and meaningful way. The peer debriefing process helped expose research details that could otherwise remain unspoken (Lincoln and Guba, 1985). For example, according to my supervisors, the themes concerning new technologies and the priorities were quite abstract and vague, and they needed to be more concise. Thus, the new themes after their modification were *people interacting with digital media for positive practice change* and *the need to prioritise prevention in schools, the National Health*

*Service and the food industry*. Furthermore, some other codes were improved, moving from descriptive codes to interpretive codes with more meaning and significance. For example, *working life* was changed to *the demands of working life and employment inequalities*. This allowed describing the latter in-depth by explaining how shift workers have less time to cook healthy or are much more tired after a long day, which encourages fast-food consumption. The discussion between us also uncovered the relevance of highlighting contradictions when referring to food prices, an aspect that I had not mentioned at that point in the manuscript. However, related quotes had already been incorporated into the code *food prices, marketing*. This discrepancy between the interviewees added richness and further interpretation to the information highlighted in that code and was relevant for the discussion section.

The second theme was modified so that it was more implicit about the importance of the relationship between technology-individuals and vice-versa to look for a change towards healthier practices. The third theme highlighted the importance of prevention and explained further different aspects, such as the type of resources or support that is currently required or missing in the NHS. Prevention was highlighted in three specific settings. The first one was education at schools and the importance of involving families. The second one was the NHS and the need for more specialists dealing with obesity and related-long term conditions, a change of obesity management with more investment in public health and less in treatments for obesity consequences, and the relevance of social prescription. The third code is related to the food industry and the need to change food marketing strategies and impact on unhealthy food industry or reduce the price of basic food products.

Therefore, the results progressed from description, where the data was organised to show patterns, to interpretation, where it was attempted to theorize the significance of the patterns and their broader meanings and implications, often in relation to literature (Braun and Clarke, 2006). In the discussion section, the findings were contrasted with the broader and previous literature, and it was identified that some results supported the literature and others challenged and added to it (Tuckett, 2005). For example, technology has traditionally been presented as a barrier as part of the obesogenic environment, but this research presents it as an opportunity to change harmful lifestyles. Another example is the role of the NHS. This article introduces the British health service as part of the negative obesogenic environment. This is innovative and challenges the belief that it is a separate management system to tackle obesity with no consequences in the development of excess weight.

# Appendix L Checklists with answers to evaluate reflexive thematic analysis research process

## L.1 Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| **Domain 1: Research team and reflexivity** | | | |
| Personal characteristics | | | |
| 1 | Interview/facilitator | Which author/s conducted the interview or focus group? | The first author (NSF) conducted all the interviews. |
| 2 | Credentials | What were the researcher's credentials? E.g. PhD, MD | First author: PhD student<br>The rest of the authors are Emeritus professor and professor. |
| 3 | Occupation | What was their occupation at the time of the study? | First author: PhD student and research assistant.<br>The rest of the authors, as mentioned in question 2. |
| 4 | Gender | Was the researcher male or female? | First author, male. Not specified in the manuscript. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| 5 | Experience and training | What experience or training did the researcher have? | The researcher had previous training at the faculty (qualitative courses). Not specified in the manuscript. |
| Relationships with participants | | | |
| 6 | Relationship established | Was a relationship established prior to study commencement? | Only a first contact was established to describe the study and look for potential participants. There is no therapeutic relationship between researchers and participants (specified in the main manuscript). |
| 7 | Participant knowledge of the interviewer | What did the participants know about the researcher? e.g. personal goals, reasons for doing the research | A participant information sheet that explained the research in detail was provided before conducting the interviews. |
| 8 | Interviewer characteristics | What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic | The interest in the research topic was explained in the introduction of the participant information sheet. Part of that explanation is specified in the introduction section of this article. |
| **Domain 2: study design** | | | |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| Theoretical framework | | | |
| 9 | Methodological orientation and Theory | What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis | A constructivist epistemology hermeneutic phenomenology. It is explained in the manuscript. |
| Participant selection | | | |
| 10 | Sampling | How were participants selected? e.g. purposive, convenience, consecutive, snowball | Purposive. It is explained in the text. |
| 11 | Method of approach | How were participants approached? e.g. face-to-face, telephone, mail, email | Email, social media and community context. It is explained in the text. |
| 12 | Sample size | How many participants were in the study? | 19. Specified in the text. |
| 13 | Non-participation | How many people refused to participate or dropped out? Reasons? | None of the participants dropped out. However, 44 community groups (long-term conditions and weight management groups at a local and national level-UK) and 17 individuals declined or did not respond to participating in the study. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| Setting | | | |
| 14 | Setting of data collection | Where was the data collected? e.g. home, clinic, workplace | Data was collected via videoconference and telephone (specified in the manuscript). Most of the participants were at their homes at the time of the interview. |
| 15 | Presence of non-participants | Was anyone else present besides the participants and researchers? | Before the interview, it was recommended to stay in a quiet place to ensure confidentiality. No more people were visualised at the time of the interview. |
| 16 | Description of sample | What are the important characteristics of the sample? e.g. demographic data, date | A sociodemographic questionnaire was used to collect data, and a table was created in the main manuscript specifying the most relevant characteristics for this study (see Table 6). |
| Data collection | | | |
| 17 | Interview guide | Were questions, prompts, guides provided by the authors? Was it pilot tested? | The questions were created by the principal author and delivered by him. Some insights and a brief description of what he was going to ask |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| | | | were provided in advance. The interview was pilot tested with friends and family members of the first author.<br>The qualitative research group members of the authors' affiliation and the two first interviewees provided feedback regarding the type and tone of the questions. |
| 18 | Repeat interviews | Were repeat interviews carried out? If yes, how many? | No. All the interviews were carried out once. |
| 19 | Audio/visual recording | Did the research use audio or visual recording to collect the data? | The interviews were audio-recorded. It is explained in the manuscript. |
| 20 | Field notes | Were field notes made during and/or after the interview or focus group? | Field notes were made when the first author re-read and listened again the interviews. |
| 21 | Duration | What was the duration of the interviews or focus group? | Between 30 and 120 minutes. Explained in the text. |
| 22 | Data saturation | Was data saturation discussed? | Data saturation was used. It is specified in the manuscript. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| 23 | Transcripts returned | Were transcripts returned to participants for comment and/or correction? | The option to return the individual transcripts to the corresponding interviewee (as per request) was given. None of the participants requested the transcript. |
| **Domain 3: analysis and findings** | | | |
| Data analysis | | | |
| 24 | Number of data coders | How many data coders coded the data? | The PhD student coded all the data. The rest of the authors checked the name of the themes and codes, and suggestions were provided to make changes. |
| 25 | Description of the coding tree | Did authors provide a description of the coding tree? | A coding tree is detailed in Appendix K of the article. |
| 26 | Derivation of themes | Were themes identified in advance or derived from the data? | Themes are derived from data; this was an inductive process. It is explained in the main manuscript |
| 27 | Software | What software, if applicable, was used to manage the data? | NVivo version 1.2. |

| No | Item | Guide questions/description | Answer |
|---|---|---|---|
| 28 | Participant checking | Did participants provide feedback on the findings? | Participant 1 provided feedback about the results (specified in the manuscript). |
| Reporting | | | |
| 29 | Quotations presented | Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number | Quotations were presented, and participants were anonymised using numbers, e.g. Participant 1. |
| 30 | Data and findings consistent | Was there consistency between the data presented and the findings? | There is consistency between the data presented and the findings. |
| 31 | Clarity of major themes | Were major themes clearly presented in the findings? | Three themes were presented as subheadings of the results section. |
| 32 | Clarity of minor themes | Is there a description of diverse cases or discussion of minor themes? | Codes were not specified in a special format in the main manuscript since the researcher wanted to focus on the story itself. A table with themes and codes can be seen in Appendix K. |

## L.2 A tool for evaluating thematic analysis manuscripts for publication: Twenty questions to guide assessment of thematic analysis research quality

| Questions | Answers |
|---|---|
| *Adequate choice and explanation of methods and methodology* | |
| 1. Do the authors explain why they are using TA, even if only briefly? | It is described in the data analysis section. |
| 2. Do the authors clearly specify and justify which type of TA they are using? | Reflexive TA. It is described in the data analysis section. |
| 3. Is the use and justification of the specific type of TA consistent with the research questions or aims? | The aim has a naturalistic insight to identify and explore in-depth aspects of how individuals interact with obesogenic environments. Also, TA is consistent with a phenomenology approach. |
| 4. Is there a good 'fit' between the theoretical and conceptual underpinnings of the research and the specific type of TA (i.e. is there conceptual coherence)? | The theoretical underpinnings are those around the understanding of obesity as a complex multi-factorial condition, the notion of the obesogenic environment and their previous theoretical considerations, and the usefulness and importance of lay understandings. |

| Questions | Answers |
|---|---|
| 5. Is there a good 'fit' between the methods of data collection and the specific type of TA? | Individual semi-structured interviews were used, which fit well with the use of TA. |
| 6. Is the specified type of TA consistently enacted throughout the paper? | Appendix K has been developed in which the different phases of the research process are explained step by step, with the aim of providing transparency about how data was analysed and utilised to write the final manuscript. |
| 7. Is there evidence of problematic assumptions about, and practices around, TA? These commonly include:<br>● Treating TA as one, homogenous, entity, with one set of – widely agreed on – procedures.<br>● Combining philosophically and procedurally incompatible approaches to TA without any acknowledgement or explanation.<br>● Confusing summaries of data topics with thematic patterns of shared meaning, underpinned by a core concept.<br>● Assuming grounded theory concepts and procedures (e.g. saturation, constant comparative analysis, line-by-line coding) apply to TA without any explanation or justification. | All these points were taken into account.<br>-TA was not treated as one since we are aware that there are different types of TA.<br>- A constructivist epistemology hermeneutic phenomenology methodology was used to study lived experience. It is consistent with TA.<br>-Three themes (patterns of shared meaning underpinned by a core concept) were created.<br>-Grounded theory (as an analytical method) is completely different from TA. In this case, saturation was used, and data analysis and collection stopped when the information began to repeat itself. |

| Questions | Answers |
|---|---|
| ● Assuming TA is essentialist or realist, or atheoretical.<br>● Assuming TA is only a data reduction or descriptive approach and therefore must be supplemented with other methods and procedures to achieve other ends. | -TA is not atheoretical. TA is suited to both experiential (e.g. critical realist, contextualist) and critical (e.g. relativist, constructionist) framings of language, data and meaning.<br>-TA is not only a data reduction or descriptive approach. There is an interpretative activity conducted by the researchers through the lenses of their particular social context. Also, opinions during the analytical process were added. |
| 8. Are any supplementary procedures or methods justified, and necessary, or could the same results have been achieved simply by using TA more effectively? | Not applicable. |
| 9. Are the theoretical underpinnings of the use of TA clearly specified (e.g. ontological, epistemological assumptions, guiding theoretical framework(s)), even when using TA inductively (inductive TA does not equate to analysis in a theoretical vacuum)? | They are explained in the introduction and methodology sections. |
| 10. Do the researchers strive to 'own their perspectives' (even if only very briefly), their personal and social standpoint and positioning? (This is | As part of a hermeneutical phenomenology, the opinions were crucial for the analysis and the creation of the codes and themes. On the other hand, I |

| Questions | Answers |
|---|---|
| especially important when the researchers are engaged in social justice oriented research and when representing the 'voices' of marginal and vulnerable groups, and groups to which the researcher does not belong.) | adjusted as much as possible to the participants' narratives to avoid losing the essence of the lived experience. Also, a dose of interpretation was needed to write the results since this was a reflexive TA. |
| 11. Are the analytic procedures used clearly outlined, and described in terms of what the authors actually did, rather than generic procedures? | The different steps are specified in Appendix K. |
| 12. Is there evidence of conceptual and procedural confusion? For example, reflexive TA (e.g. Braun and Clarke 2006) is the claimed approach but different procedures are outlined such as the use of a codebook or coding frame, multiple independent coders and consensus coding, inter-rater reliability measures, and/or themes are conceptualised as analytic inputs rather than outputs and therefore the analysis progresses from theme identification to coding (rather than coding to theme development). | Reflexive TA was used, so all its characteristics as a method of analysis were considered. |
| 13. Do the authors demonstrate full and coherent understanding of their claimed approach to TA? | The use of reflexive TA in regard to our aims, philosophy and methodology were justified. |

| Questions | Answers |
|---|---|
| A well-developed and justified analysis | |
| 14. Is it clear what and where the themes are in the report? Would the manuscript benefit from some kind of overview of the analysis: listing of themes, narrative overview, table of themes, thematic map? | The themes are subheadings in the results section. |
| 15. Are the reported themes topic summaries, rather than 'fully realised themes' – patterns of shared meaning underpinned by a central organising concept?<br>● If so, are topic summaries appropriate to the purpose of the research?<br>○ If the authors are using reflexive TA, is this modification in the conceptualisation of themes explained and justified?<br>● Have the data collection questions been used as themes?<br>● Would the manuscript benefit from further analysis being undertaken, with the reporting of fully realised themes? | The themes are 'fully realised themes'. The justification for using reflexive TA and these types of themes is in line with the nature of the research gap. |

| Questions | Answers |
|---|---|
| ● Or, if the authors are claiming to use reflexive TA, would the manuscript benefit from claiming to use a different type of TA (e.g. coding reliability or codebook)? | |
| 16. Is non-thematic contextualising information presented as a theme? (e.g. the first 'theme' is a topic summary providing contextualising information, but the rest of the themes reported are fully realised themes). If so, would the manuscript benefit from this being presented as non-thematic contextualising information? | All of them are fully themes. |
| 17. In applied research, do the reported themes have the potential to give rise to actionable outcomes? | In the discussion section, it is explained how some of the results could be useful for future interventions. |
| 18. Are there conceptual clashes and confusion in the paper? (e.g. claiming a social constructionist approach while also expressing concern for positivist notions of coding reliability, or claiming a constructionist approach while treating participants' language as a transparent reflection of their experiences and behaviours) | A constructivist epistemology was followed, and I think there are no conceptual clashes in the paper. |

| Questions | Answers |
|---|---|
| 19. Is there evidence of weak or unconvincing analysis, such as:<br>● Too many or two few themes?<br>● Too many theme levels?<br>● Confusion between codes and themes?<br>● Mismatch between data extracts and analytic claims?<br>● Too few or too many data extracts?<br>● Overlap between themes? | Three themes were created for the main manuscript.<br>Codes were differentiated from the themes (this can be seen in Appendix K).<br>The template in Appendix K does not represent a final version that reports the full list of codes, sub-themes and themes since this type of analysis does not follow a template procedure. This time it was used just as a guide.<br>I think that data extracts relate to the created codes.<br>Themes do not overlap between them since they represent three different messages (barriers, enablers and priorities to change). |
| 20. Do authors make problematic statements about the lack of generalisability of their results, and or implicitly conceptualise generalisability as statistical probabilistic generalisability | The results cannot be generalised. This information belongs to individuals who have different stories and similar socio-demographic characteristics. |

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