World Health Organization
REGIONAL OFFICE FOR Europe

WHO EUROPEAN REGIONAL OBESITY REPORT 2022

ABSTRACT

Obesity is a complex multifactorial disease defined by excessive adiposity and is linked to an increased risk for many noncommunicable diseases (NCDs). Overweight and obesity affect almost 60% of adults and nearly one in three children (29% of boys and 27% of girls) in the WHO European Region. Recent estimates suggest that overweight and obesity is the fourth most common risk factor for NCDs in the Region, after high blood pressure, dietary risks and tobacco. It is also the leading risk factor for disability, causing 7% of total years lived with disability, and obesity is linked to greater morbidity and mortality from COVID-19. Early studies from a number of countries in the Region indicate that the prevalence of overweight and obesity and/or mean body mass index has increased in children and adolescents during the COVID-19 pandemic. This report examines the growing challenge and impact of obesity in the Region, building on past publications and aligning with initiatives to tackle cancer. The report focuses on managing obesity throughout the life course and tackling obesogenic environments; it also considers more recent challenges, including problematic digital marketing to children and the impact of the COVID-19 pandemic on obesity prevalence. Policy options to prevent obesity are outlined for consideration by Member States together with a suite of population-level approaches. The report highlights the importance of including prevention and control of obesity within measures to build back better in the wake of the COVID-19 pandemic. Addressing obesity is critical towards achieving the Sustainable Development Goals and is a priority in the European Programme of Work 2020–2025: United Action for Better Health.

KEYWORDS

OBESITY PREVENTION AND CONTROL
NONCOMMUNICABLE DISEASES
HEALTH POLICY
SUSTAINABLE DEVELOPMENT

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FOREWORD

In the WHO European Region, obesity poses an increasing challenge, with one in three school-aged children, one in four adolescents and almost 60% of the adult population now living with overweight or obesity. Raised body mass index is a major risk factor for noncommunicable diseases including cancers and cardiovascular diseases.

During the COVID-19 pandemic, we experienced the true impact of the obesity epidemic in our Region. People living with obesity were more likely to experience severe outcomes of the COVID-19 disease spectrum, including intensive care unit admissions and death. At the same time, preliminary evidence suggests that many of the restrictions related to containment of the pandemic, including school closures and periods of restricted population movements, have led to an increase in exposure to some of the risk factors that influence a person's likelihood to experience obesity or overweight, such as an unhealthy diet or sedentary lifestyle.

I convened the Pan-European Commission on Health and Sustainable Development, a group comprising global leaders with outstanding expertise and experience, to draw lessons from how the health systems in different countries have responded to the COVID-19 pandemic and to devise recommendations on how to improve and strengthen health and social care systems in the Region. This report on obesity shows us the need to build resilient health systems that enable multisectoral action to tackle obesity through a whole-of-government approach, with all stakeholders taking timely action.

The Global Monitoring Framework for the Prevention and Control of Noncommunicable Diseases 2013–2020 includes nine global voluntary targets for noncommunicable diseases. Of these, one particularly shows lack of progress and this is the target to halt the rise in diabetes and obesity by 2025.

The European Programme of Work accords obesity a priority within the gamut of noncommunicable diseases in the Region. The WHO Regional Office for Europe is committed to using available strategies and tools to support Member States and to bring about an impact at country level.

This report aims to accelerate the ongoing efforts to halt the rise in obesity in the WHO European Region. It brings together all of the relevant up-to-date statistics on the burden of obesity in the Region, and considers relevant policies and outlines the suggested health system's response.

This report will provide the appropriate platform to catalyse addressing obesity by bringing together the engaged stakeholders so that we can take action together. As recommended in the Monti Commission Report, through a concerted whole-of-government approach and by engaging all levels of society I am hopeful that we can change the trajectory of obesity in the Region by creating environments that are more enabling and promote investment in health, develop strong and resilient health systems and innovate for better health and improved health governance.

The WHO Regional Office for Europe stands ready to work with and support Member States in this endeavour.

Dr Hans Henri P. Kluge
WHO Regional Director for Europe

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ABBREVIATIONS

AAP	American Academy of Pediatrics
AVMSD	Audiovisual and Media Services Directive
BMI	body mass index (in kg/m^2)
CI	confidence interval
CIS	Commonwealth of Independent States
COPD	chronic obstructive pulmonary disease
COSI	Childhood Obesity Surveillance Initiative
COVID-19	coronavirus disease-2019
CPNP	WHO Collaborating Centre on Population Approaches for Non-Communicable Disease Prevention
CVD	cardiovascular disease
CWL	conventional weight loss
EASO	European Association for the Study of Obesity
ECPO	European Coalition of People Living with Obesity
EDC	endocrine-disrupting chemical
EMA	European Medicines Agency
EOSS	Edmonton Obesity Staging System
EU	European Union
FDA	United States Food and Drug Administration
FENSA	Framework of Engagement with Non-State Actors
GBD	Global Burden of Disease
GP	general practitioner
HBSC	Health Behaviour in School-aged Children
HFSS	high in fat, sugar and salt
HNWL	health, not weight loss
IARC	International Agency for Research on Cancer
ICU	intensive care unit
MBS	metabolic and bariatric surgery
MDA	meal delivery app
MetS	metabolic syndrome
MUST	Malnutrition Universal Screening Tool
NAFLD	nonalcoholic fatty liver disease
NCD	noncommunicable disease
NCD Office	WHO European Office for the Prevention and Control of Noncommunicable Diseases
NPM	nutrient profile model
OOH	out-of-home
OR	odds ratio
OSA	obstructive sleep apnoea
RCT	randomized controlled trial
RYGB	Roux-en-Y gastric bypass
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
SD	standard deviation
SDG	Sustainable Development Goal
SSB	sugar-sweetened beverage
T2DM	type 2 diabetes mellitus
WHA	World Health Assembly
YLD	years lived with disability

EXECUTIVE SUMMARY

Obesity is a complex multifactorial disease defined by excessive adiposity that presents a risk to health. It has been identified as a serious public health challenge globally and a major determinant of disability and death in the WHO European Region. Obesity increases the risk of noncommunicable diseases. Member States have been urged to halt the rise in obesity within and between population groups as a response to the individual and population burden it is causing across the Region.

This report, aimed at policy-makers and stakeholders, responds to the growing challenge and impact of obesity, providing the evidence to date, building on past publications that focus on overweight and obesity in the WHO European Region, and aligning it with initiatives to tackle cancer within Member States. The report concludes by recommending a suite of population-level interventions and policy options that Member States can consider in preventing and tackling obesity in the Region, with an emphasis on building back better after the COVID-19 pandemic.

Overweight and obesity have reached epidemic proportions in the WHO European Region, affecting almost 60% of adults. Children are also affected, with 7.9% of children younger than 5 years and one in three school-aged children living with overweight or obesity. Prevalence decreases temporarily in those aged 10–19 years, where one in four live with overweight or obesity. Alarmingly, there have been consistent increases in the prevalence of overweight and obesity in the WHO European Region and no Member State is on track to reach the target of halting the rise in obesity by 2025.

Obesity develops across the life course through two compounding mechanisms: (i) developmental programming based on preconception and gestational exposure to obesity; and (ii) unhealthy diet and physical inactivity driven by exposure to obesogenic environmental factors. This report presents the latest evidence that highlights how vulnerability to unhealthy body weight in early life can affect a person's tendency to develop obesity, and it shows that policy interventions that target environmental and commercial determinants of poor diet at the entire population level are likely to be most effective at reversing the obesity epidemic, addressing dietary inequalities and achieving environmentally sustainable food systems.

The term obesogenic environment is used to describe how modern environments drive the obesity epidemic. This report provides an update on the original framing of obesogenic environments by re-examining the relationships between food and physical activity and the sociocultural, physical, economic, and political factors impacting the obesogenic environments. In addition to the physical obesogenic environment, the obesogenicity of digital food environments is also described in this report. As digitalization continues to accelerate throughout the WHO European Region, a public health perspective must also be considered for these digital food environments. Digital marketing of unhealthy food products to children and the consequences are described. The proliferation of online gaming, with its negative consequences, are discussed as areas that also provide opportunities for the promotion and discussion of health and well-being. The extension of the physical food environment through online supermarkets and meal delivery apps

also provides opportunities to promote healthy behaviours. The role of health literacy and obesity is also discussed, including misconceptions among both the public and health professionals, which can lead to weight stigma, and the disparity in access to health information.

Obesity is associated with many diseases that affect multiple body systems. Adverse effects of obesity on health include those that result from the mechanical effects of increased body weight, such as some musculoskeletal complications, metabolic effects such as type 2 diabetes mellitus and cardiovascular risk, and the effects on mental health. Obesity is also considered a cause of at least 13 different types of cancer including cancers of the breast, colorectum, kidney, liver and ovary, multiple myeloma and meningioma. Across the WHO European Region, obesity is likely to be directly responsible for at least 200 000 new cancer cases annually, with this figure projected to rise in the coming decades. For some countries within the Region, it is predicted that obesity will overtake smoking as the main risk factor for preventable cancer in the coming decades. While strategies targeting those at higher risk of obesity-related cancers may be necessary, public health policies aimed at reducing obesity will likely have an important impact on the cancer burden. The worldwide spread of COVID-19 has had profound impacts on individuals, health systems, and the obesogenic environment. People living with overweight and obesity have been disproportionately affected by the consequences of the COVID-19 pandemic. Further, there have been unfavourable shifts in food consumption and physical activity patterns during the pandemic that will have effects on population health. The report explores the most recent data on the links between obesity and COVID-19.

Different treatment options for children, adolescents and adults and evidence for effectiveness and barriers to obesity management are also discussed. It is shown that people living with obesity may benefit from an approach aimed at improving patient-centred health outcomes, rather than weight loss or maintenance alone. It further shows that individualized care plans that address the causes of obesity and that provide support for behavioural change are advised. In addition, adjunctive therapies (psychological, pharmacological and surgical interventions) could be considered.

Obesity is complex, with multifaceted determinants (including social determinants) and health consequences, meaning that no single intervention alone can halt the rise of the growing obesity epidemic. In order to be successful, any policy must have high-level political commitment, strong political leadership and supportive government administrations. Policies must also be comprehensive, reaching individuals across the life course and targeting inequalities. Efforts to prevent obesity need to consider the wider determinants of the disease and policy options should move away from solely individualistic approaches and address the structural drivers of obesity. The report concludes by recommending a suite of population-level interventions and policy options that Member States should consider in preventing and tackling obesity in the WHO European Region, with an emphasis on building back better after the COVID-19 pandemic.

INTRODUCTION

The burden of noncommunicable diseases (NCDs) has increased continuously over recent years worldwide, and in 2021 they caused 90% of deaths and 85% of years lived with disability (YLDs) in the WHO European Region *(1)*. The WHO European Region is the WHO Region worst affected by NCD-related morbidity. The four main behavioural factors linked to mortality from NCDs are tobacco use, physical inactivity, alcohol consumption and an unhealthy diet *(2)*. Obesity is a complex multifactorial disease defined by excessive adiposity and is linked to an increased risk for many NCDs, including cardiovascular diseases (CVDs), 13 types of cancer, type 2 diabetes mellitus (T2DM) and chronic respiratory diseases including obstructive sleep apnoea (OSA) *(3–5)*. Overweight and obesity affects almost 60% of adults and one in three children (29% of boys and 27% of girls) are living with overweight or obesity *(6,7)*.

Recent estimates suggest that overweight and obesity cause more than 1.2 million deaths across the WHO European Region every year, the fourth highest cause after high blood pressure, dietary risks and tobacco and corresponding to more than 13% of total deaths. Overweight and obesity are also the leading behavioural factor increasing the risk for disability, causing 7% of total YLDs in the Region *(8)*. Furthermore, early studies from a number of European countries have indicated a rise in overweight and obesity prevalence, or mean body mass index (BMI), in children and adolescents during the COVID-19 pandemic *(9–12)*. Additionally, decreases in physical activity and increases in the consumption of foods high in fat, sugar and salt (HFSS) have been observed during the pandemic *(10,13,14)*. These observations emphasize the importance of building back better after the COVID-19 pandemic, which will include prevention and control of obesity.

Addressing obesity is key for achieving the Sustainable Development Goals (SDGs), particularly SDG 3: ensuring healthy lives and promoting well-being for all people at all ages *(15)*. This is a priority that is echoed in the European Programme of Work 2020–2025: United Action for Better Health *(16)*. Several policy frameworks and action plans to halt the rise in obesity have been set out, including the 2016 Report of the Commission on Ending Childhood Obesity, the European Charter on Counteracting Obesity and the Global Nutrition Targets 2025: Childhood Overweight Policy Brief *(17–19)*. Despite these action plans, there have been consistent increases in the prevalence of overweight and obesity in the WHO European Region and no Member State is on track to reach the target of halting the rise in obesity by 2025 *(20)*.

This report responds to the growing challenge and impact of obesity within the WHO European Region, building on past publications focusing on overweight and obesity in the Region and aligning with initiatives to tackle cancer within the European Union (EU) *(21)*. It begins with a compilation of the latest data on obesity across the life course in the Region. The following three chapters include a discussion of the problem of obesity across the life course and the role of environments, including the fast-evolving topic of digital environments and how these are contributing to the obesity epidemic. A chapter on public awareness of obesity describes the importance of public awareness. Further chapters discuss obesity and diseases including cancer and COVID-19, and the clinical management of obesity. The report concludes by suggesting policy options and population-level approaches that Member States can consider for implementation in order to prevent and manage obesity.

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1 All references were accessed on 28 January 2022.

1. BACKGROUND

Key highlights

- Obesity has been identified as a serious public health challenge globally and as a major determinant of disability and death in the WHO European Region.
- Excess body weight increases the risk of 13 types of cancer.
- People living with obesity are found to be at increased risk of severe COVID-19 outcomes.

In the WHO European Region:

- Overweight and obesity affect almost 60% of adults.
- Overweight (including obesity) is a common problem affecting 4.4 million children under 5 years of age, representing 7.9% of all children in this age group.
- The WHO European Childhood Obesity Surveillance Initiative shows that nearly one in three school-aged children are living with overweight or obesity.
- Prevalence decreases temporarily in adolescents, with one quarter living with overweight (including obesity).
- Alarmingly, there have been consistent increases in prevalence of overweight and obesity, and not a single Member State of the Region is on track to reach the target of halting the rise in obesity by 2025.
- This report speaks to the growing challenge and impact of obesity within Europe, building on past publications addressing overweight and obesity in the Region and aligning with parallel initiatives to tackle cancer across European countries.

1.1 Introduction

The burden of NCDs has increased continuously over recent years worldwide, and in 2021 they caused 90% of deaths and 85% of YLDs in the WHO European Region *(1)*. The WHO European Region is the WHO Region worst affected by NCD-related morbidity. The four main behavioural factors linked to mortality from NCDs are tobacco use, physical inactivity, alcohol consumption and an unhealthy diet *(2)*. Obesity is a complex multifactorial disease, defined as abnormal or excessive accumulation of fat that presents a risk to health. It has been identified as a serious public health challenge globally and a major determinant of disability and death in the WHO European Region *(3,4)*. Member States have been urged to halt the rise in obesity in response to the burden it causes at both individual and population level across the Region *(5)*.

1.2 Measuring obesity

1.2.1 Measuring obesity in adults

Excess adiposity is commonly measured through anthropometric methods and expressed as BMI, a value derived by dividing a person's weight by their height and expressed in units of kg/m^2. Although BMI does not provide a direct measure of adiposity, it is recognized as a practical approach in clinical or surveillance settings *(6–9)*, as height and weight measurements are non-invasive and do not require specialized skills or expensive equipment. Cut-offs used to determine overweight (including obesity) (⩾ 25 kg/m^2) and obesity (⩾ 30 kg/m^2) are age- and sex-independent for adults and have been found to be associated with health outcomes, including mortality *(10)*.

Although strong evidence has been found linking increasing BMI with ill health *(11)*, as BMI is simply a function of mass and height, it does not distinguish between adiposity and other tissue. The same BMI may not correspond to the same amount of fat mass in different individuals and may differ across populations, in particular by sex *(12)*, age *(13,14)* and ethnic group *(15)*. This has led to proposals to use different cut-offs for South Asian individuals, among whom a higher percentage of body fat and a greater risk of ill health have been found at lower BMI *(16)*.

Despite concerns over BMI, the index has been found to be a reasonable proxy when used for large numbers of people, with correlations found between BMI and total body fat *(17)* and total abdominal adipose tissue *(18)*, which is found to present a greater health risk than fat deposited in other parts of the body. This is particularly the case when abdominal fat is visceral or intra-abdominal – that is, found within the abdominal cavity surrounding the organs. Visceral fat has a greater impact on health than subcutaneous fat (fat found between the dermis and the underlying fascia), with BMI unable to distinguish between the two *(18)*.

Measurements of waist circumference, including waist-to-hip ratio, act as a proxy for abdominal fat mass *(19,20)* and show a similar association with future morbidity and mortality as BMI. Changes in waist circumference correlate with changes in the risk of obesity-related comorbidities, particularly CVD, with which it is associated independently of BMI *(21–25)*. Commonly used cut-offs for waist circumference are sex-specific and lower for women, who show increased risk of CVD and other comorbidities at lower waist circumference than men *(26,27)*. In addition, WHO suggests to combine BMI and waist circumference based on evidence that the combination of the two is a better predictor of future health risk *(6,27)*.

1.2.2 Measuring obesity in children and adolescents

As with adults, BMI is the most commonly used measure in children and adolescents. However, standard cut-offs cannot be used throughout childhood and adolescence because of changes in growth that occur over this time. Thresholds that vary by sex and age have been created to account for these changes, in such a way that weight status can be classified over the course of childhood and adolescence and between the sexes.

These thresholds are commonly referred to as child growth reference curves. By collecting height and weight from reference populations, curves depicting how BMI varies by age and sex are created, with weight status defined by deviance from the mean, either by standard deviation or by centile of reference population *(6)*.

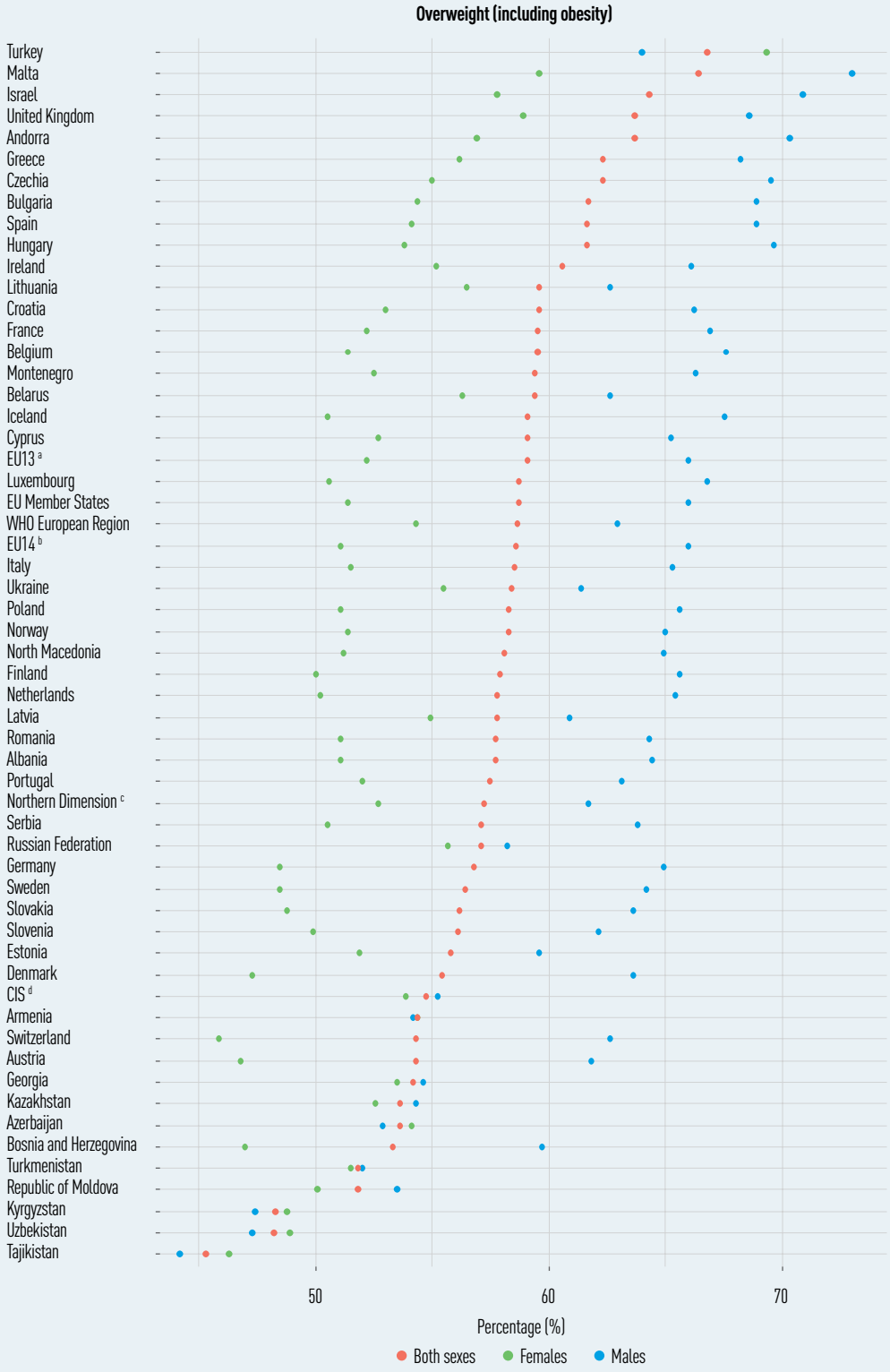
The WHO 2007 growth reference is recommended internationally for children and adolescents aged 5–19 years and was derived from a combination of the United States National Center for Health Statistics 1977 pooled growth data and the WHO Multicentre Growth Reference Study from Brazil, Ghana, Norway, India, Oman and the United States. The WHO 2007 reference aligns with the WHO Child Growth Standards at the age of 5 years and is available for height, weight and BMI for age. Thresholds for weight status are set on standard deviation spacing from the average *(28)*. For children aged 0 to 5 years, overweight is defined as the child's weight-for-height being greater than two standard deviations from the WHO Child Growth Standards median *(4)*. For children and adolescents aged 5–19 years, overweight and obesity are defined as BMI-for-age above one standard deviation and above two standard deviations, respectively, from the median of the WHO Growth Reference for School-aged Children and Adolescents.

1.3 Levels and trends of overweight and obesity in the WHO European Region

Globally, the prevalence of obesity tends to be higher in richer countries across Europe, North America and Oceania. Age-standardized estimates for 2016, from the WHO Global Health Observatory, indicate that obesity prevalence for adults in the WHO European Region is higher than in any other WHO region except the Region of the Americas *(29,30)*. Overweight and obesity in adults have reached epidemic proportions in the WHO European Region (Fig. 1.1; Table A2.1). WHO estimates that 59% of adults are living with overweight or obesity, with more than half of adults in 50 out of 53 Member States in the European Region living with overweight or obesity *(29,30)*. Levels are higher among males (63%) than among females (54%) across the WHO European Region and in most countries, with prevalence close to or exceeding 70% for males in a number of countries. Almost a quarter (23%) of adults in the European Region are living with obesity; more than one fifth of adults in 49 out of 53 Member States are living with obesity, with levels reaching one third in a number of countries. In contrast to overweight, obesity is more prevalent among females (24%) than among males (22%) at WHO European Region level and in about half of the countries. The highest levels of both overweight and obesity are found in Mediterranean and eastern European countries. Educational inequalities are widespread, with higher obesity prevalence in people with lower educational attainment (Fig. 1.2) *(31)*. In addition, gender analysis shows that in the WHO European Region inequalities in levels of overweight and obesity between men and women are widespread and heterogenous across socioeconomic determinants such as income, education, employment status and place of residence *(32)*.

Fig. 1.1

Prevalence of overweight and obesity among adults (age-standardized) in countries/country groups of the WHO European Region (2016)



a EU13: countries that became EU members after 2004 – Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

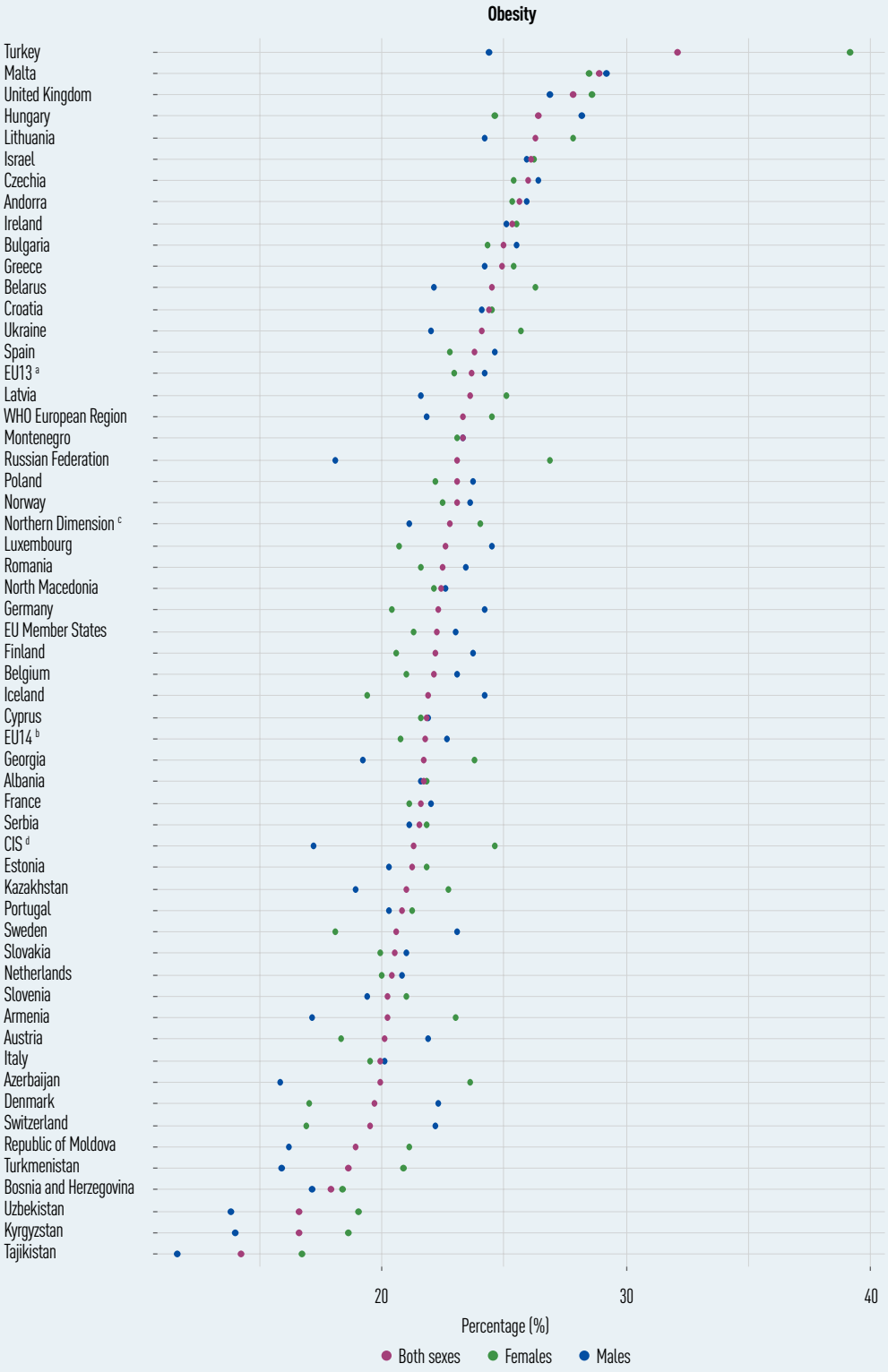
b EU14: countries that were part of the EU prior to 2004 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden.

c Northern Dimension: EU, Russian Federation, Norway, Iceland.

d CIS: members and associate members of the Commonwealth of Independent States – Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan.

Sources: WHO estimates, 2016 *(29)*; NCD-RisC, 2017 *(30)*.

Fig. 1.1 contd.



a EU13: countries that became EU members after 2004 – Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

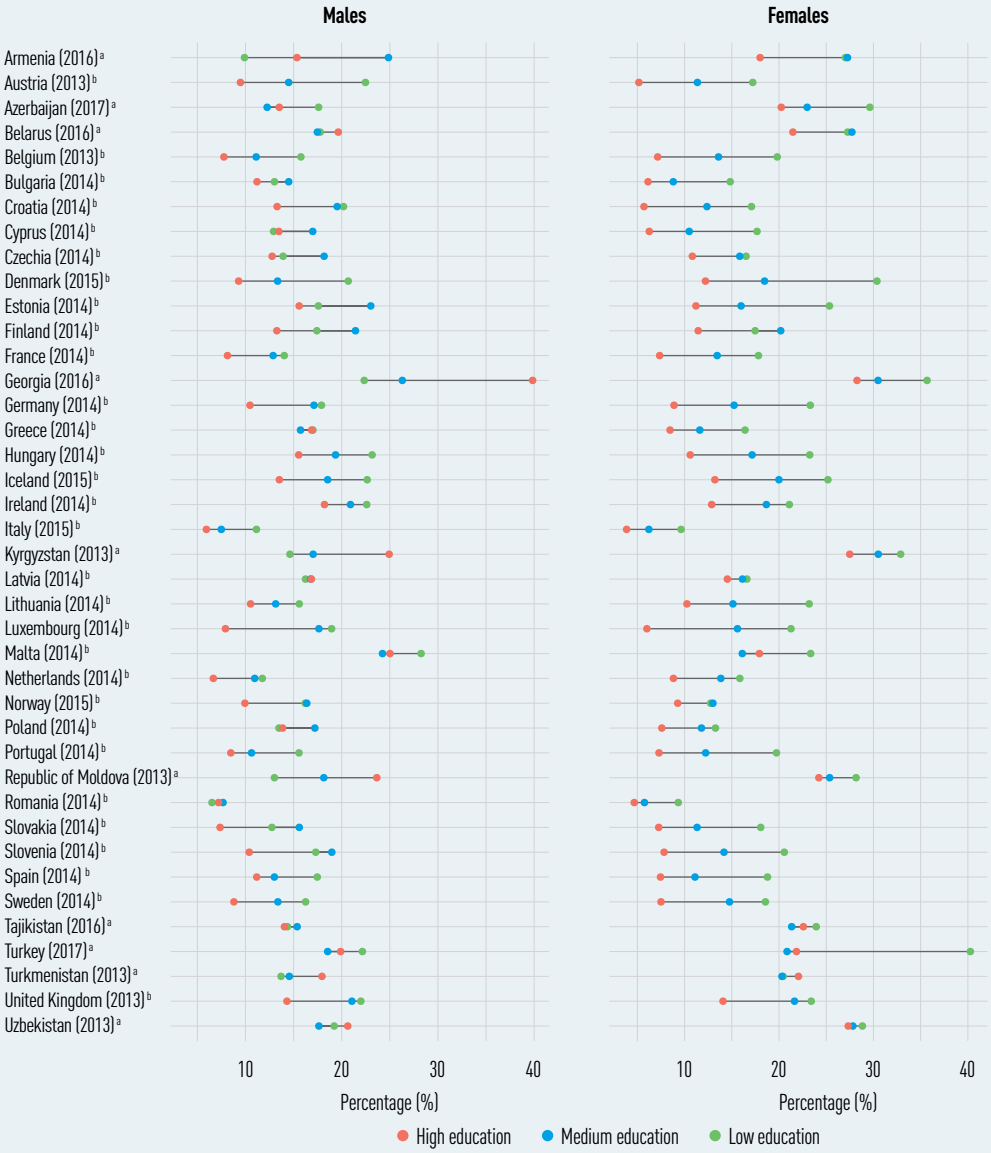
b EU14: countries that were part of the EU prior to 2004 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden.

c Northern Dimension: EU, Russian Federation, Norway, Iceland.

d CIS: members and associate members of the Commonwealth of Independent States – Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan.

Sources: WHO estimates, 2016 *(29)*; NCD-RisC, 2017 *(30)*.

Fig. 1.2 **Percentage of adults living with obesity (age-standardized), by educational level (40 countries, latest available data)**



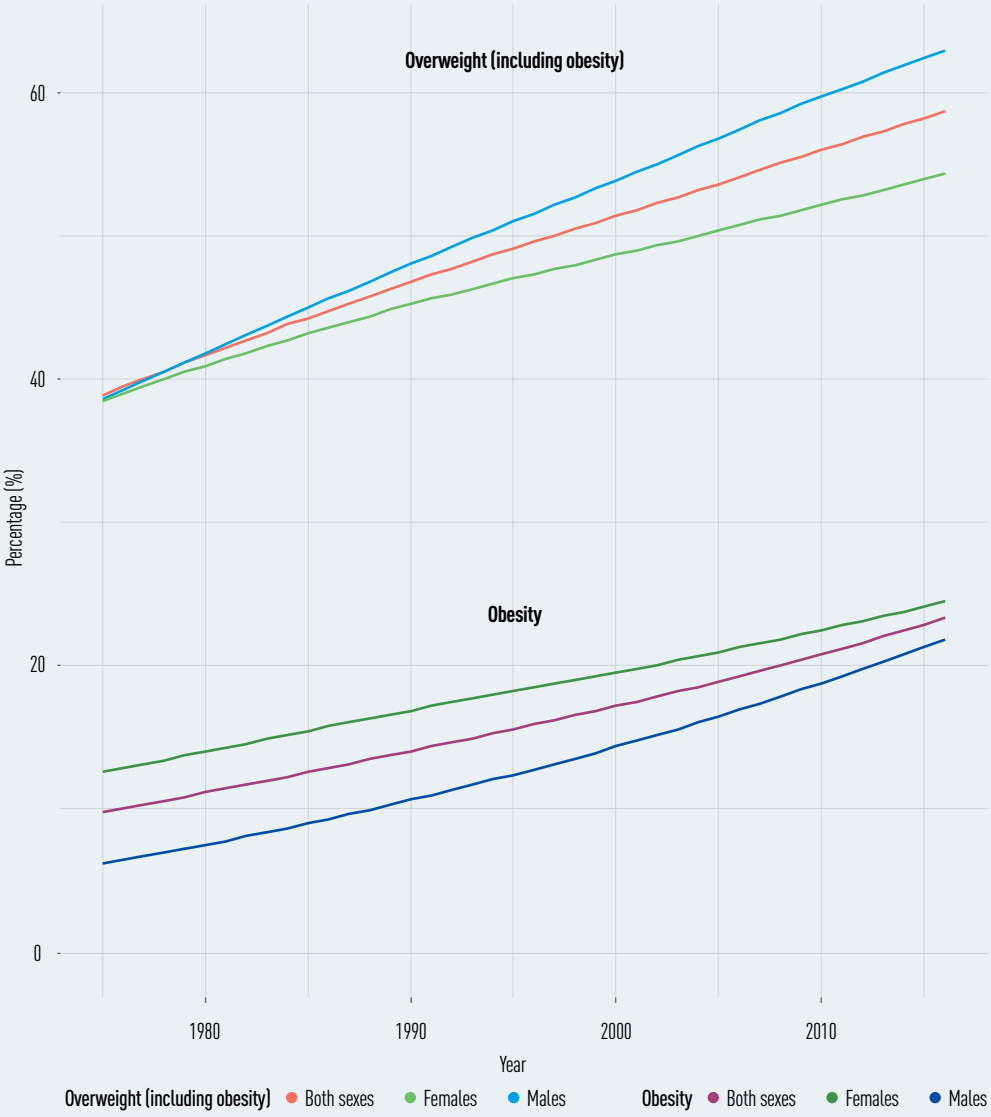
a STEPwise approach to surveillance (STEPS) survey.
b European Health Interview Survey

Source: HESRi Health Equity Dataset *(31)*.

Of great concern is the rapid increase in levels of overweight and obesity among adults. In the WHO European Region, recent prevalence estimates for obesity rose by 21% in the 10 years before 2016 and by 138% since 1975; and for overweight (including obesity), by 8% in the 10 years before 2016 and by 51% since 1975 (Fig. 1.3). Alarmingly, since adoption of the NCD voluntary global targets in 2013 there have been consistent increases in prevalence of overweight and obesity; not a single Member State in the WHO European Region is on track to reach the target of halting the rise in obesity and diabetes *(33)*.

Prevalence of overweight and obesity among adults in the WHO European Region, by sex (1975–2016)

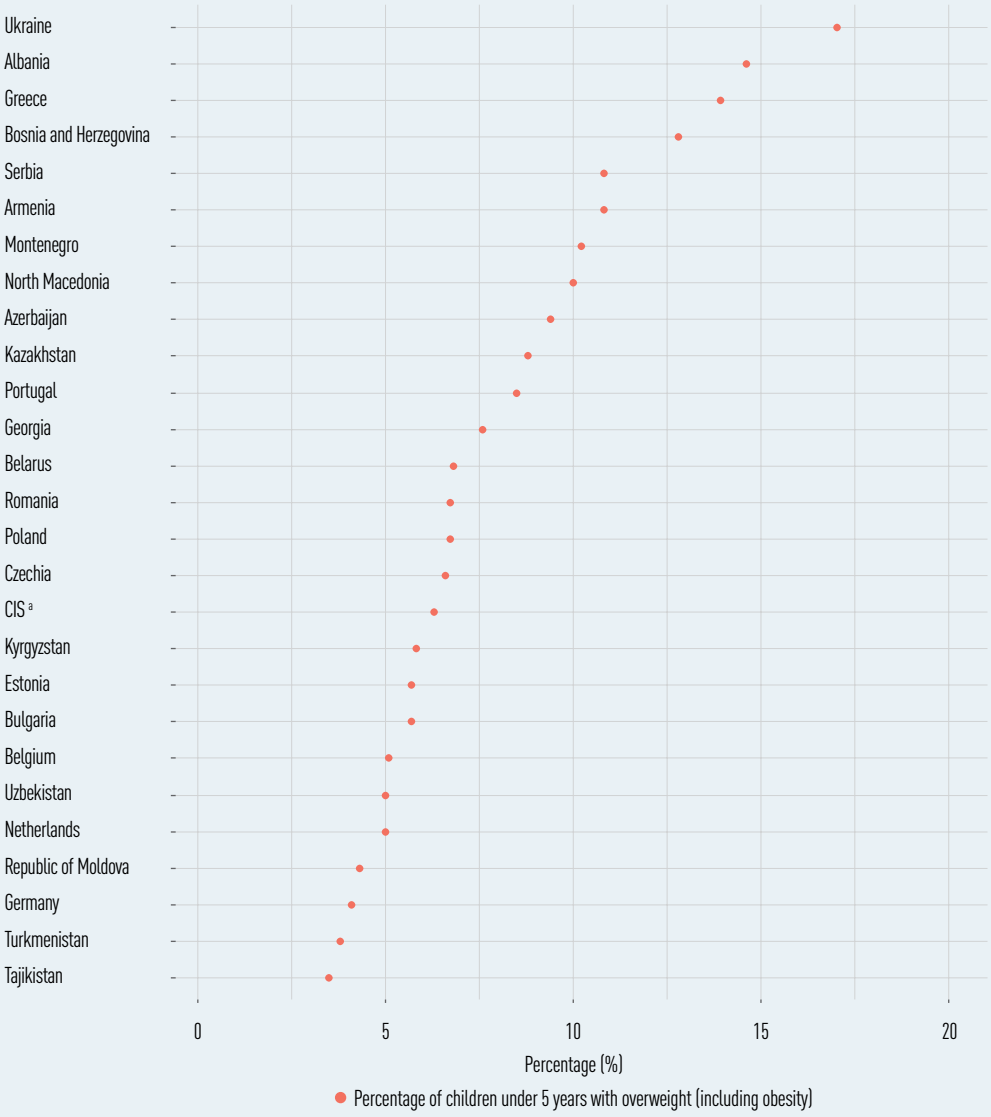
Fig. 1.3



Sources: WHO estimates, 2016 *(29)*; NCD-RisC, 2017 *(30)*.

Overweight and obesity are prevalent not only among adults but among children. Joint UNICEF/WHO/World Bank estimates reveal that in 2020 overweight (including obesity) was a common problem in the WHO European Region, affecting 4.4 million children under 5 years of age (representing 7.9% of children in this age group) *(34)*, with large variations between countries (Fig. 1.4; Table A2.2). However, data are scarce and only 26 countries, mostly in the eastern part of the Region, had sufficient data to allow estimates to be produced. Although not the focus of this report, it should be acknowledged that several countries in the European Region still experience the double burden of malnutrition,

Fig. 1.4 **Estimated prevalence of overweight (including obesity) among children under 5 years of age in selected countries of the WHO European Region (2020)**



a CIS: members and associate members of the Commonwealth of Independent States – Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Tajikistan, Turkmenistan, Uzbekistan (no data for Russian Federation).

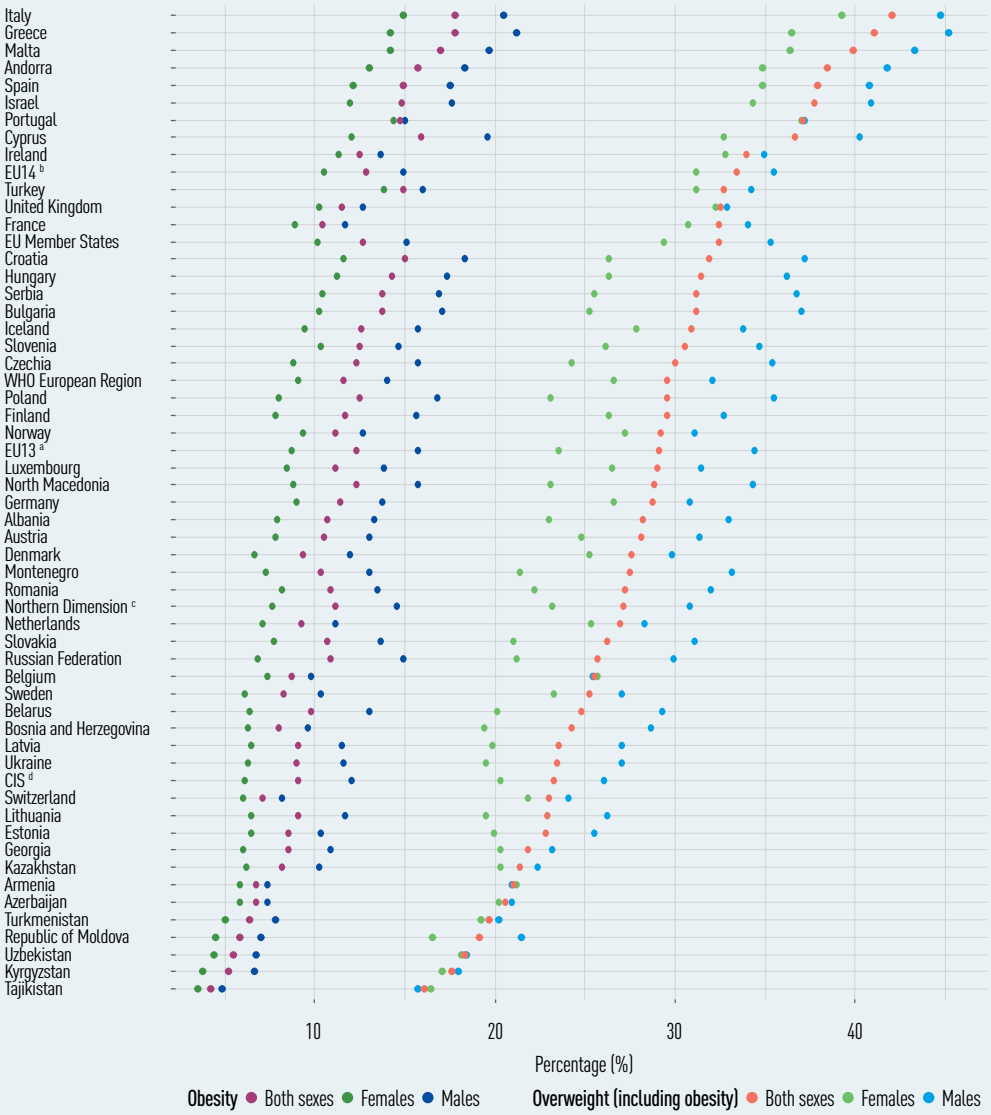
Source: UNICEF/WHO/World Bank joint child malnutrition estimates *(34)*.

with the coexistence of undernutrition along with overweight and obesity *(35)*. The causes of the double burden of malnutrition relate to a sequence of shifts in dietary patterns, disease burden and changes at the demographic level. These are also known as the nutrition, the epidemiological and the demographic transition.

The prevalence of overweight and obesity increases in the age group 5–9 years, with one in eight children (11.6%) living with obesity and nearly one in three (29.5%) with overweight (including obesity) (Fig. 1.5; Table A2.3). Prevalence decreases temporarily in the age group 10–19 years, when 7.1% live with obesity and 24.9% with overweight

Prevalence of overweight and obesity among children aged 5–9 years in the WHO European Region (2016)

Fig. 1.5



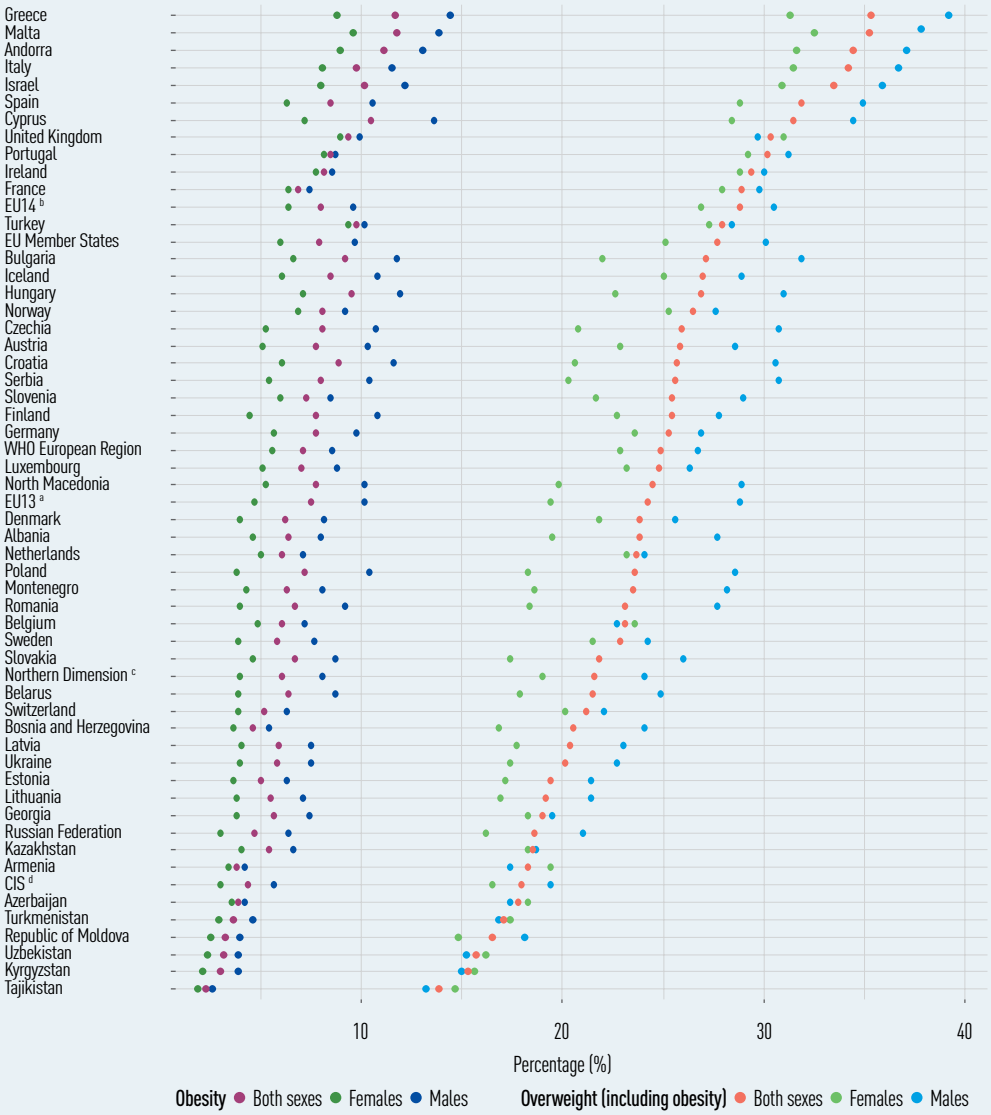
a EU13: countries that became EU members after 2004 – Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.
b EU14: countries that were part of the EU prior to 2004 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden.
c Northern Dimension: EU, Russian Federation, Norway, Iceland.
d CIS: members and associate members of the Commonwealth of Independent States – Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan.
Sources: WHO estimates, 2016 *(29)*; NCD-RisC, 2017 *(30)*.

(including obesity) (Fig. 1.6; Table A2.4). For both age groups, overweight and obesity are more prevalent in boys and in the countries in the Mediterranean basin.

The same data demonstrate that the prevalence of overweight and obesity among males aged 5–19 years increased nearly threefold between 1975 and 2016, and more than doubled in females of the same age (Fig. 1.7). Obesity levels rose at a faster rate and were around five times higher on average among children and adolescents aged 5–19 years in 2016 compared to 1975, with these large increases partly due to the very low levels of obesity in children in 1975. In the 10 years up to 2016, the prevalence of obesity increased by 40%; of overweight (including obesity) by 20%.

Fig. 1.6

Prevalence of overweight and obesity among children and adolescents aged 10–19 years in the WHO European Region (2016)

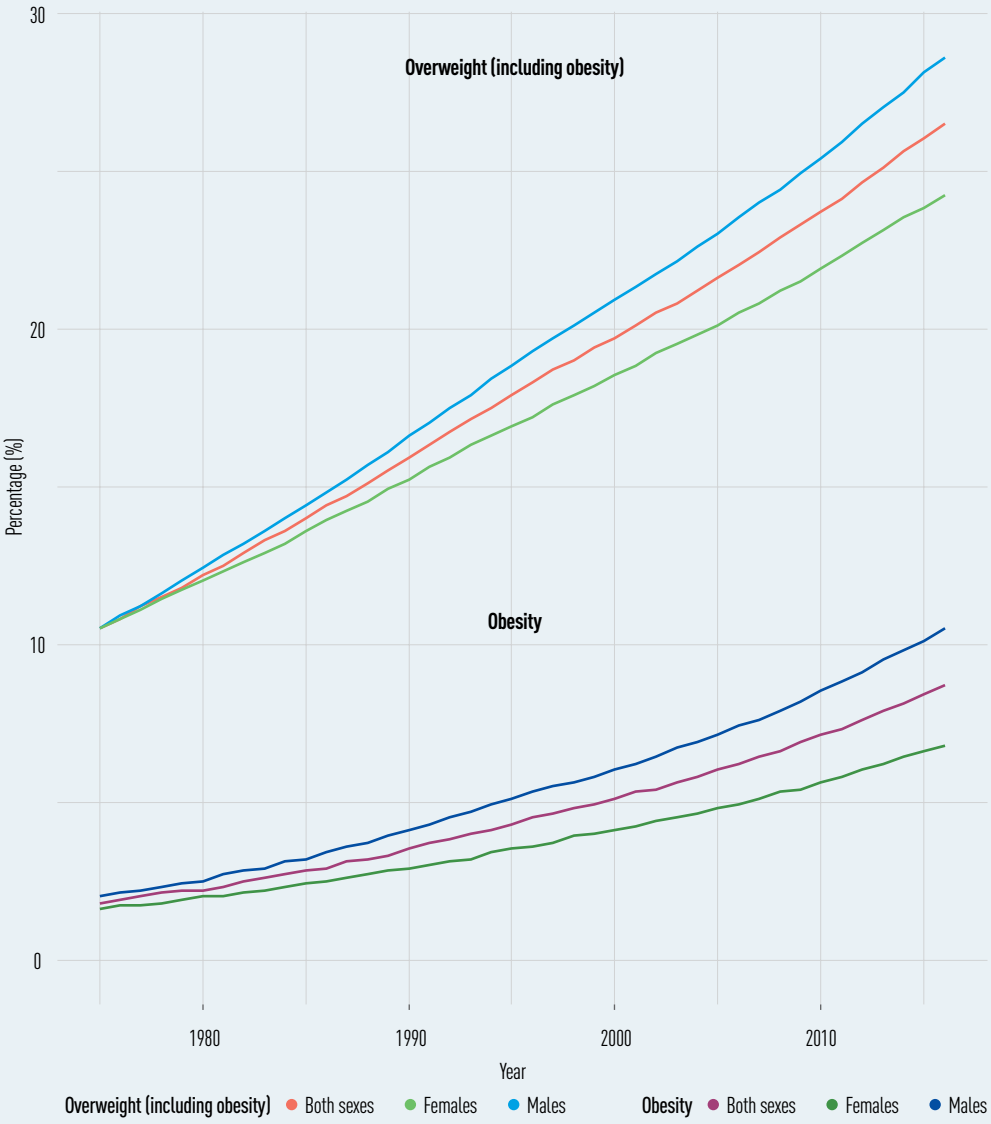


a EU13: countries that became EU members after 2004 – Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.
b EU14: countries that were part of the EU prior to 2004 – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden.
c Northern Dimension: EU, Russian Federation, Norway, Iceland.
d CIS: members and associate members of the Commonwealth of Independent States – Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan.
Sources: WHO estimates, 2016 *(29)*; NCD-RisC, 2017 *(30)*.

It should be noted that concerns have been raised over the use of modelled data for country-level estimates *(36)*; there are differences in the population estimates used by the Global Burden of Disease (GBD) to those used by United Nations agencies, suggesting that the complexity and computational intensity of imputation and modelling used make it challenging for others to explain how outputs relate to country data *(37)*. This supports calls for Member States to develop routine data collection programmes for obesity, such as the WHO European Childhood Obesity Surveillance Initiative (COSI) (Box 1.1), across the life course that would allow accurate tracking of trends and could be used to inform population-level approaches to prevention.

Prevalence of overweight and obesity among children and adolescents aged 5–19 years in the WHO European Region, by sex (1975–2016)

Fig. 1.7

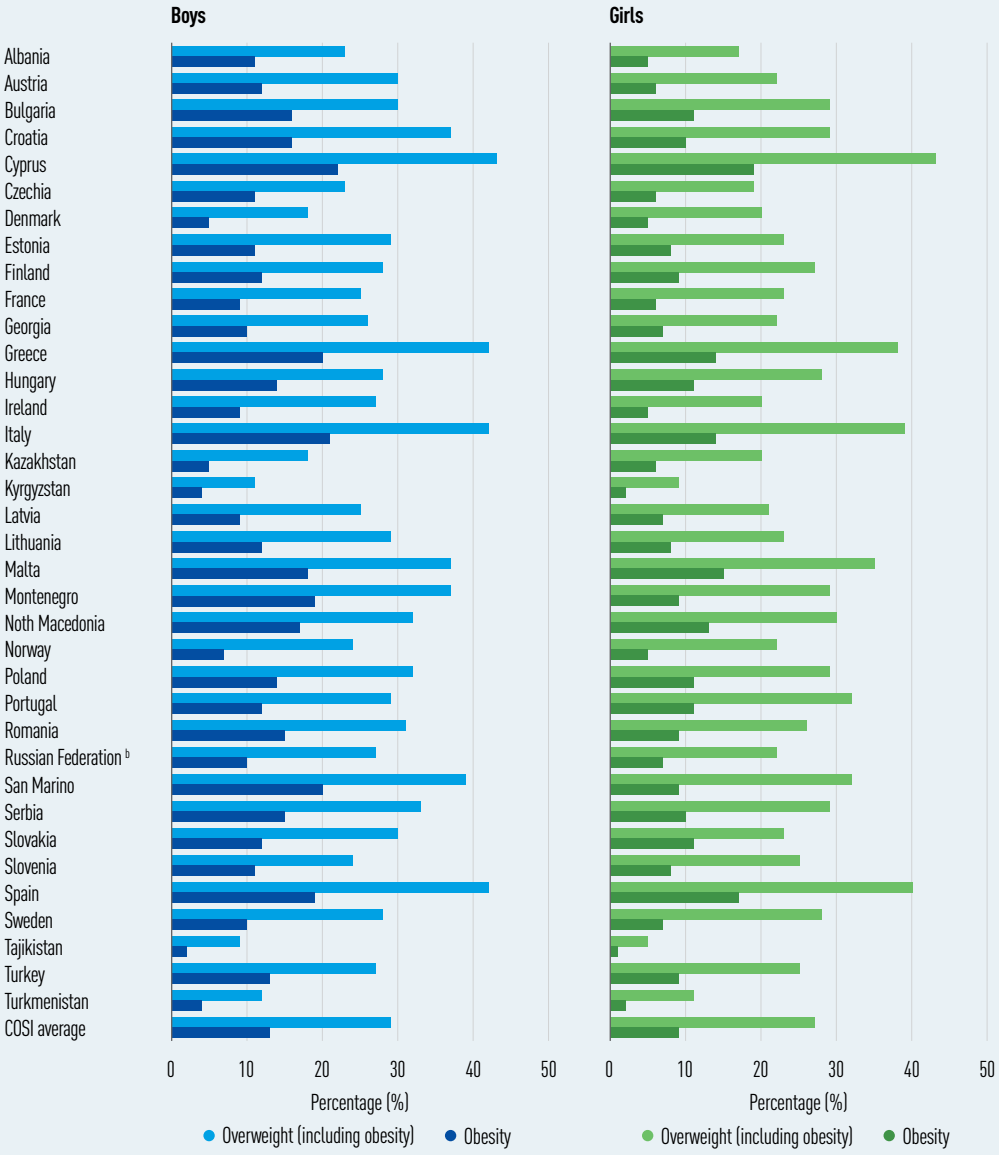


Sources: WHO estimates, 2016 *(29)*; NCD-RisC, 2017 *(30)*.

COSI, coordinated by the WHO Regional Office for Europe, is the largest surveillance initiative of its kind in the world, taking standardized weight and height measurements (Box 1.1). Data from the fourth round of COSI data collection, conducted between 2015 and 2017 in 36 countries of the WHO European Region, show that nearly one in three children (boys 29%, girls 27%) lived with overweight or obesity, and about one in 10 with obesity (boys 13%, girls 9%) (Fig. 1.8; Table A2.5) *(38)*.

Fig. 1.8

Prevalence of overweight and obesity among children aged 7–9 years in 36 countries of the WHO European Region, by sex (2015–2017) [a]



a See also Table A2.5 for age-standardized prevalence and Table A1.1 for COSI principal investigators. Data relate to round 4 data collection: (i) 7-year-old children in Bulgaria, Czechia, Denmark, Estonia, Finland, Georgia, Greece, Hungary, Ireland, Kyrgyzstan, Latvia, Lithuania, Malta, Montenegro, Portugal, North Macedonia, Russian Federation (Moscow only), Serbia, Slovakia, Slovenia, Spain, Tajikistan, Turkmenistan and Turkey; (ii) 8-year-old children in Albania, Austria, Croatia, France, Italy, Norway, Poland, Romania, San Marino and Sweden; and (iii) 9-year-old children in Cyprus and Kazakhstan.

b Moscow only

Source: adapted from WHO Regional Office for Europe (2021). Reproduced with permission of World Health Organization under Creative Commons Attribution CC BY-NC-SA 3.0 IGO Licence *(38)*.

Box 1.1

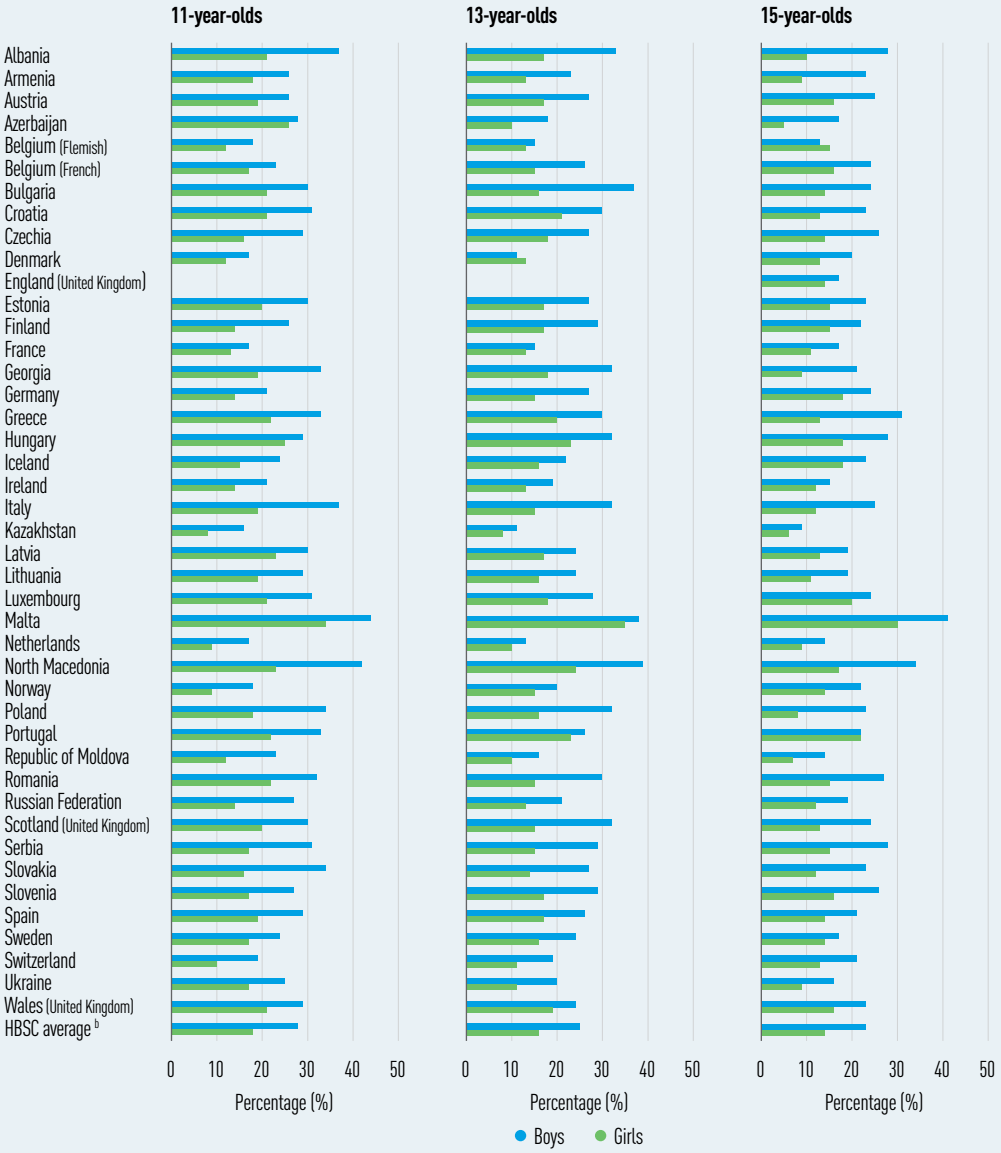
COSI

COSI is the largest surveillance initiative of its kind in the world and in 2021 COSI was established in over 40 Member States. Data are routinely taken every 3 years, using standardized weight and height measurements producing high-quality data.

Source: WHO Regional Office for Europe, 2016 *(39)*.

Prevalence of overweight (including obesity) and obesity among adolescents aged 11, 13 and 15 years in selected European countries, by sex (2017/2018) [a]

Fig. 1.9



a Data from 2017/2018 HBSC survey in Europe and Canada. See also Table A2.6 for age-standardized prevalence and Table A1.2 for HBSC principal investigators.
b HBSC values represent the average across the countries that provided relevant information; this includes all the countries listed in the table plus Canada and Greenland.
Source: adapted from Inchley et al (2020). Reproduced with permission of World Health Organization under Creative Commons Attribution CC BY-NC-SA 3.0 IGO Licence *(40)*.

Furthermore, in several Member States almost 40% of boys aged 6–9 years lived with overweight (including obesity), and almost 20% with obesity *(41)*. These data also show that the prevalence of overweight was higher among children whose parents had lower educational status; this association was particularly striking in a number of high-income countries, in which obesity prevalence among children with low parental education was roughly double that found among children with high parental education. In contrast, in a number of middle-income countries the direction of this relationship was reversed,

with children from families with high parental education demonstrating a greater prevalence of overweight (including obesity) than their peers from families with lower parental education *(41)*.

Self-reported data from older children, collected through the 2017/2018 Health Behaviour in School-aged Children (HBSC) survey in Europe, found that prevalence of overweight and obesity was higher among boys for all three age groups (11-, 13- and 15-year-olds) and decreased with age for both sexes (Fig. 1.9; Table A2.6) *(40)*. In the majority of European countries, a greater prevalence was found in individuals from lower-income families, a trend that was more prominent in high-income countries *(40)*.

Obesity in children is likely to endure into adulthood, and this will result in a population of individuals living with overweight or obesity who have been exposed to the impact of excess adiposity for a long period of time. This, in turn, is likely to lead to more serious health consequences at both individual and population levels *(42–45)*. Early studies from a number of European countries have indicated a rise in overweight and obesity prevalence, and/or mean BMI, in children and adolescents during the COVID-19 pandemic *(46–49)*, along with associated decreases in physical activity and increases in the consumption of HFSS foods *(47,50,51)*. This shows how important it is to "build back better" post COVID-19 in the prevention and control of obesity, in order to avoid future growth in the health consequences of high BMI across the WHO European Region.

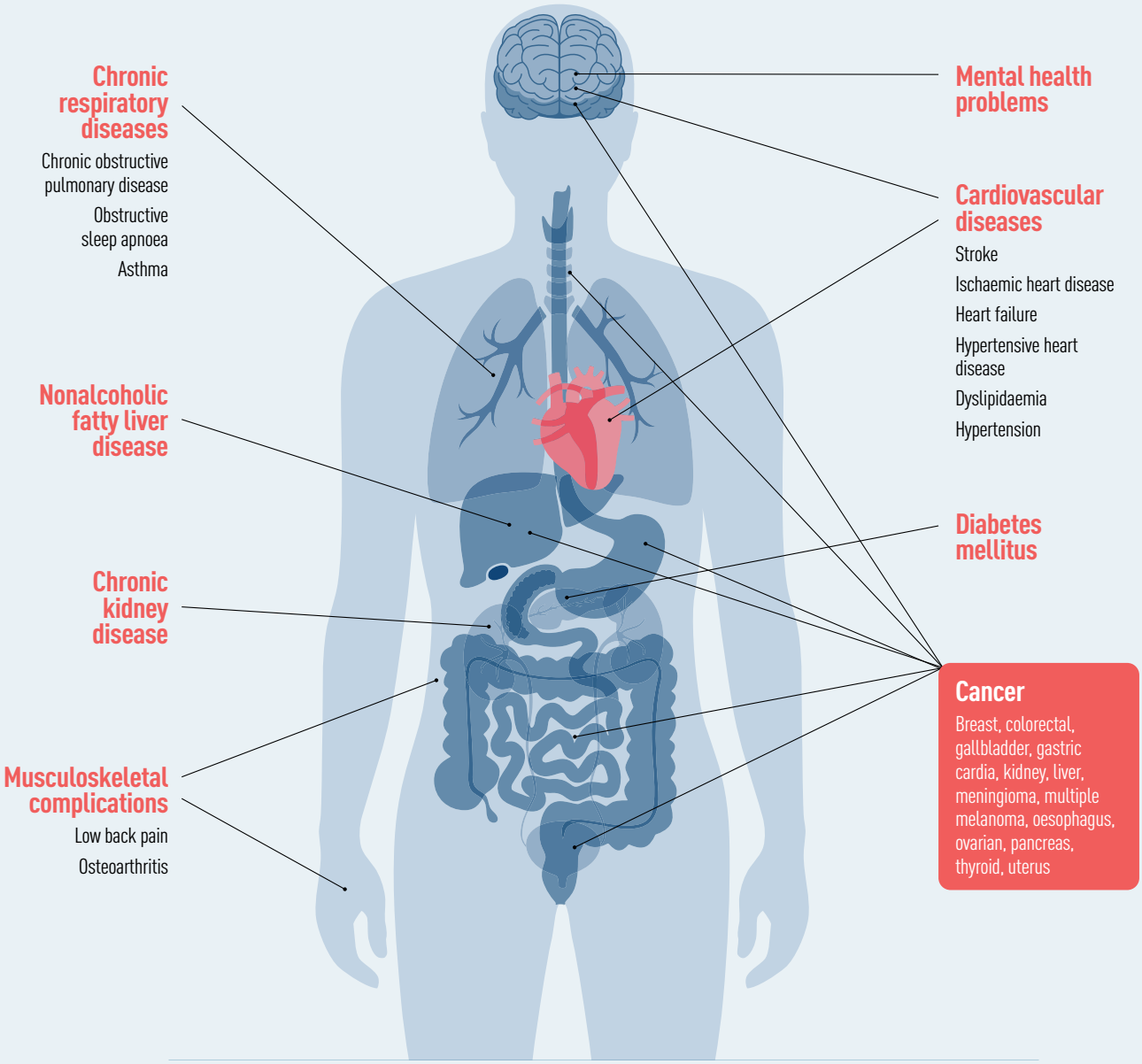
1.4 Health consequences of obesity

Living with overweight or obesity increases the risk of a range of diseases, many of which are found to occur more frequently with increasing BMI (Fig. 1.10) *(52–56)*. Excess adiposity is also linked to increased mortality, with those living with obesity found to have a life expectancy five years shorter than those with a "healthy" weight status (BMI 18.5–24.9 kg/m^{2}) *(57,58)*. Recent estimates suggest that overweight and obesity cause more than 1.2 million deaths across the WHO European Region every year; this represents more than 13% of total deaths, ranking fourth behind high blood pressure, dietary risks and tobacco use. Overweight and obesity are also the leading risk factor for disability, accounting for 7% of total YLDs in the Region *(59)*. However, a number of difficulties in evaluating the health consequences of obesity have been identified *(60)*, and it has been suggested that obesity-related deaths may be substantially underestimated *(61)*.

These health issues arise in people living with obesity in part because adipose tissue is a metabolically active endocrine organ, with fat cells (adipocytes) releasing and receiving hormones. Adipocytes release substances called adipocytokines; these are associated with a range of systemic or local actions including glucose and lipid metabolism, cell development, inflammation and oxidative stress, which can lead to a number of health problems *(6)*. Visceral fat, which surrounds the organs within the abdominal cavity, has a greater impact on health than subcutaneous fat, as it is more biologically active, has a higher density of cells, carries more blood flow and is located close to the portal vein, which results in an increased concentration of fatty acids reaching the liver *(62)*. Recent evidence from 2022, argues that the negative health effects of obesity stem not

Medical conditions associated with obesity

Fig. 1.10



Note: These do not include all health consequences associated with obesity.
Sources: Malnick & Knobler, 2006 *(52)*; GBD 2015 Obesity Collaborators et al., 2017 *(53)*; Lauby-Secretan et al., 2016 *(54)*; Brock et al., 2020 *(55)*; Luppino et al. (2010) *(56)*.

simply from an excess of fat but from the decline in its ability to respond to changes, or in other words, its plasticity *(63)*. The makeup and functioning of this tissue changes in response to weight fluctuations and aging. As fat declines in plasticity due to aging and obesity, it loses its ability to respond to bodily cues. In the current model of this phenomenon, the rapid growth of adipose tissue outpaces its blood supply, depriving the fat cells of oxygen and causing the accumulation of cells that no longer divide. This leads to the metabolic issues already mentioned earlier, such as insulin resistance, inflammation, and cell death.

The mass and metabolic activity of adipose tissue result in it affecting almost every body system, with excess adiposity carrying health implications throughout the life course. Evidence shows that a child of a mother with obesity may suffer from exposure to a suboptimal environment within the uterus and that early-life adversities may extend into adulthood *(64)*. At the same time, excessive gestational weight gain is associated with pregnancy-related complications and short- and long-term adverse effects in offspring, including an increased susceptibility to obesity and diet-related NCDs *(65)*.

Obesity is linked with clusters of diseases that greatly increase CVD risk, which is the most common cause of death in Europe *(66,67)*. These include atherosclerosis, hypertension, dyslipidaemia, insulin resistance, coagulability, endothelial dysfunction and inflammation *(68–74)*. As a consequence, those living with obesity are at substantially elevated risk of a range of CVDs *(68)*. In particular, obesity increases the risk for stroke *(75)* and coronary heart disease *(68)*, the two most common forms of CVD mortality. For both these diseases, abdominal obesity has been shown to be a greater predictor than total fat mass *(76)*, indicating the higher risk associated with abdominal and visceral fat accumulation.

Similarly, individuals who live with overweight or obesity are at increased risk of developing several types of cancer, with the risk of hormone-dependent (endocrine) cancers greater for those with abdominal obesity *(77)*. While CVD is the most common cause of death across the Region, cancer now causes more deaths than CVD in several higher-income countries *(66,67)*; this is a consequence of large decreases in CVD mortality, aligned with stable cancer mortality rates, over a number of decades *(78)*. Excess body weight increases the risk of many cancers, including endometrial, breast (particularly postmenopausal), colorectal, gallbladder, pancreatic, liver, kidney, gastric and oesophageal *(54,77)*, thyroid *(54,79)*, ovarian and blood cancers *(54,76,79–81)*. At the same time, obesity is linked with the development of more severe forms of cancer, such as metastatic, as well as an increased risk of dying from it *(77)*.

In addition to its link with these two prominent chronic diseases, obesity may lead to a greater risk of many others, including, but not limited to, metabolic diseases such as nonalcoholic fatty liver disease (NAFLD), T2DM, musculoskeletal, respiratory and reproductive issues, and various psychological and mental health problems. At the same time, individuals living with obesity often experience weight bias and social stigma *(6)*. These wide-reaching health impacts for individuals living with obesity lead to a large population health burden, which also carries financial implications due to the treatment of obesity-related ill health. People with obesity have been found to have 30% higher treatment costs than those without *(82)*, while there may also be indirect costs due to earnings lost as a result of premature mortality and obesity-related disability. Obesity alone was estimated to be responsible for as much as 8% of health costs in EU Member States in 2014 *(83)*. According to a 2019 report on the economic burden of obesity, between 2020 and 2050 Organisation for Economic Co-operation and Development countries will spend, on average, 8.4% of their entire annual health budget on treating the consequences of overweight (including obesity) *(84)*.

Recent concern has focused on the link between obesity and COVID-19, with people living with overweight and obesity found to be at increased risk of severe COVID-19

outcomes *(85)*. In addition, there are fears that many country-level responses to COVID-19, such as periods of restricted movement and subsequent impacts on food systems, may affect diet and physical activity behaviours, potentially leading to weight gain in individuals and a higher prevalence of overweight and obesity in the population *(86)*.

1.5 Determinants of obesity

Weight gain in individuals, understood in terms of an increase in adipose tissue, comes as a result of energy imbalance, in which the amount of energy taken in is greater than that used over a period of time *(3)*. However, this simple idea can obscure the complex nature of the ways in which the behaviours that lead to energy intake and expenditure may be determined, not to mention the large number of interactive influences on these *(6,87,88)*.

The high current population prevalence of overweight and obesity has arisen in part as a consequence of our suitability, in genetic and biological terms, to environments in which food was scarce and physical activity habitual. Genes that may have been advantageous in gorging food and storing fat in times of excess are now less suited to the current environment that was first described as "obesogenic" in the 1990s. This term comprehends the sum of influences that promote obesity *(89)*, recognized as the net result of biological, behavioural and environmental impacts that act through the mediators of energy intake and expenditure *(90)*. It is this combination of influences that produce effects over a number of years and throughout the life course of an individual *(87,91)*.

Environmental change has been stark, characterized by increased availability of cheaper, more energy-dense and less nutritionally beneficial foods *(92,93)*. These microenvironmental developments include increased urbanization, which is associated with more obesogenic environments that are less activity-promoting and provide greater access to unhealthy foods *(87,94)*. These influences are generally more prominent in more deprived urban areas in which limited food choices are available *(95–99)*, often referred to as food deserts *(100)*, and where individuals feel less able to use what available space there is for activity *(101,102)*.

The dietary patterns in most European countries are thought to have changed as a result of rising incomes and increasing food supply, a phenomenon often referred to as the nutrition transition *(103,104)*. At the same time, the development of technology has led to a decrease in habitual and occupational physical activity *(105–107)*, which has been further exacerbated by the rise of digital food environments – online settings that influence food and nutrition behaviour. These include social media, digital health promotion interventions, digital food marketing and online food retail *(108)* and are of growing concern as digital technologies become increasingly integrated into everyday life in all European Member States. Closely aligned with these technological developments is an increasing focus on the "commercial determinants" of obesity. Driven by the profit motive, these shape the food environment by determining the availability, promotion and pricing of the products we buy and consume *(109)*, to the extent that the food and beverage industries are thought to influence the highest levels of policy-making *(110)*.

1.6 Tackling obesity in individuals

There is a need to provide care for those living with obesity, with treatment recommended to follow a "chronic care" approach in which the choice of treatment is dependent on the severity of obesity, along with a number of other personal factors (Box 1.2) *(111)*. Multicomponent behavioural interventions are generally considered to be the best approach for treating obesity in both children and adults *(6)*, with intensive and long-term care strategies recommended *(112)*.

Box 1.2

People's experience of living with obesity: Federico [a]

Unlike a lot of people living with obesity, Federico did not have obesity as a child. In his youth, Federico was a competitive swimmer; it was after he retired from swimming competitively that his battle with obesity began. After quitting swimming, he continued to consume the same number of calories as if he was still a high-performance athlete, but now lacked any means of burning the calories. While he received very detailed guidance about his health and nutrition while he was training, no one had given him advice about how to manage his weight when he left the sport. Consequently, his weight continued to increase until he was about 25 years of age.

It was at this point that Federico's mother passed away. In order to cope with the loss, he ate 25 doughnuts and drank two litres of cola every night. One morning when leaving for work he had to wake his father up to tie up his shoes, as he could no longer do it himself. This became a wake-up call for Federico to do something about his weight. He initially approached his general practitioner (GP), who gave him a diet to follow without taking down any medical details, conducting any tests or providing any advice on how to follow the diet. After around 20 unsuccessful trials of the diet, Federico told his GP he needed another form of treatment. Federico was placed on the waiting list for bariatric surgery five months after meeting with a specialist; at that point Federico weighed 183 kg. During the waiting period before his surgery, Federico lost 25 kg by riding his exercise bike every night. He did this to avoid his shame of exercising in front of others. The period between his initial appointment and the surgery took two years, during which he saw different healthcare practitioners many times. This was a time full of uncertainty, with healthcare practitioners only giving him the advice to follow a diet for a long time which was not working and gave him a sense of failing. This shows the importance of increasing healthcare practitioners' knowledge on the various factors that can contribute to the development of obesity and that obesity needs proper diagnosis, management and better treatment.

He was given no guidance or support on how to manage his weight after the surgery, and had to find out for himself what worked and what did not. In the end, he lost just over 100 kg in that year. Federico insists on the importance of understanding that no matter what the BMI of someone that used to have obesity is, they will continue to live with obesity for the rest of their life. Relapse is probable and there must be support and guidance to assist people through this.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

Although clinical interventions, such as drug therapy and bariatric surgery, are available and have been found to be effective, they are not suitable for all people and robust criteria are required to determine those for whom such treatment would be appropriate *(6,60)*. Furthermore, clinical approaches should not be used in isolation; rather, they should be used in conjunction with interventions that target behaviour change *(113)* and are often preceded by and used alongside multicomponent behavioural interventions *(6,8)*.

1.7 Preventing obesity in populations

If obesity is to be combated on a national and European level, prevention efforts should not focus solely on individuals. Broader approaches that target whole population groups and the wider determinants of obesity need to be put in place *(60)*. Comprehensive long-term strategies must act to create environments that support and facilitate healthy behaviours, through evidence-informed intersectoral policy that tackles obesogenic environments and the commercial determinants of health. Equitable approaches to reduce overweight and obesity should tackle the upstream social, physical, cultural, economic and political factors that shape food and physical activity environments, and people's interactions with them, with a particular focus on income and socioeconomic inequalities *(60,114)*.

Such population prevention efforts must target all age groups throughout the life course *(115,116)*. A particular focus should be on children, in whom small changes can lead to larger impacts on morbidity and mortality *(106,107)* as overweight develops and becomes more pronounced with age. In addition, intervention early in the life course will enable the next generation to start life on a trajectory that is low-risk, not high-risk, with respect to later-life obesity and offers a better prospect of overall health.

1.8 Conclusion

Overweight and obesity affect almost 60% of adults in the WHO European Region, while nearly one in three children live with overweight or obesity. Alarmingly, there have been consistent increases in the prevalence of overweight and obesity, and not a single Member State of the Region is currently on track to reach the target of halting the rise in obesity by 2025. This report speaks to this growing challenge and impact of obesity within Europe, building on past publications that address overweight and obesity in the Region and aligning with parallel initiatives to tackle cancer across European countries *(117)*.

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2. OBESITY ACROSS THE LIFE COURSE

Key highlights

- Obesity develops and becomes more pronounced across the life course through two compounding mechanisms: (i) developmental programming based on preconception and gestational exposure to obesity and (ii) unhealthy diet and physical inactivity driven by exposure to obesogenic environmental factors.
- Prevention of obesity in critical life-course phases, such as early life and adolescence, is likely to have the greatest health and cost benefits, and holds the greatest promise for breaking the intergenerational cycle of obesity and dietary inequalities.
- Psychosocial factors and economic resources are socially patterned, can leave low-income families more vulnerable to unhealthy environmental exposures at all life stages and have a cumulative effect across the life course.
- Policy interventions that target the environmental and commercial determinants of poor diet at population level are likely to be most effective at reversing the obesity epidemic, addressing dietary inequalities and achieving environmentally sustainable food systems.
- Implementing targeted strategies for specific population groups at each of the key life-course stages alongside whole-of-population strategies will provide the comprehensive approach needed to achieve healthy weight goals.

2.1 Introduction

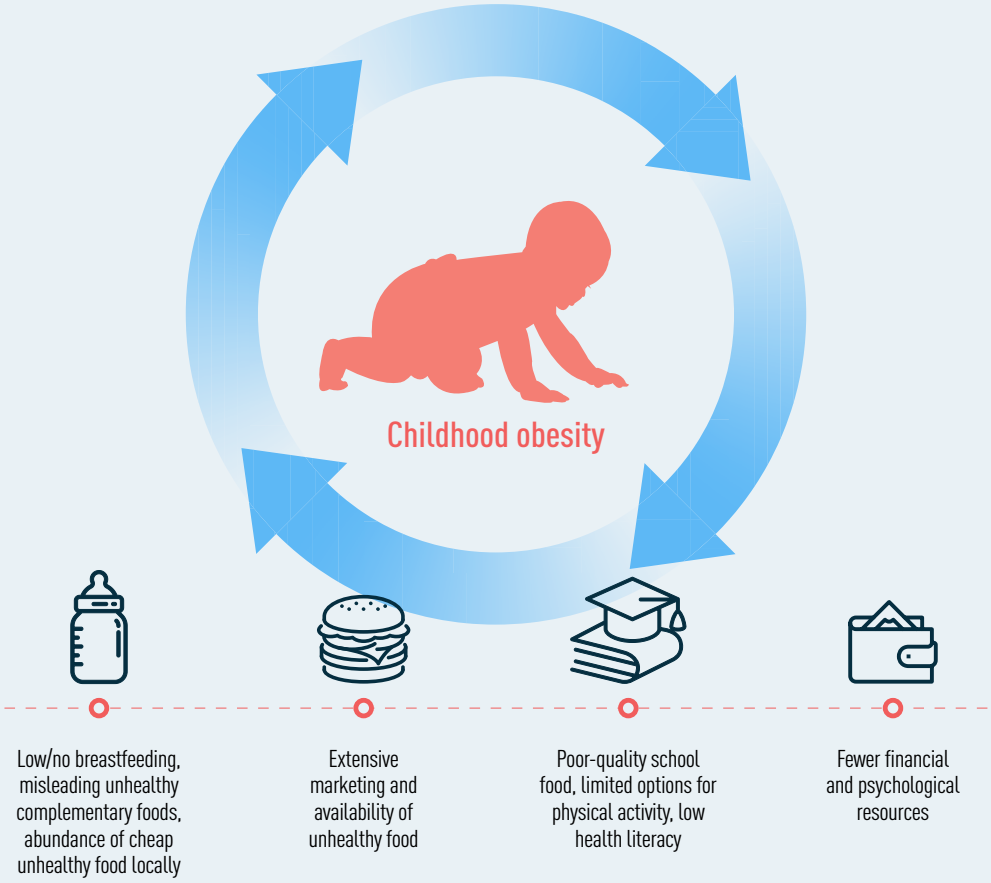
A person's weight trajectory starts early in life (before and during gestation) and develops through childhood and adulthood, and into older age. Since the late 1980s, a large body of literature has accumulated demonstrating how early life experiences influence weight and health status in later life *(1)*. This undeniable evidence illustrates the importance of adopting a life-course approach to disease prevention and that improving nutrition in the early years in particular, as well as nutrition and physical activity throughout life, is essential to enhance global health *(2–4)*. The 2030 SDGs highlight the global commitment to optimizing health throughout the life course in its third goal (SDG 3), which is to ensure healthy lives and promote well-being for all at all ages *(5)*. Aligned with the GBD Study 2019, which found that dietary risk factors have a substantial role in death and disease *(6)*, the significance of nutrition in achieving the SDGs is apparent in SDG 2, which is to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture. SDG 2 also places special emphasis on ending malnutrition, including overnutrition, at key stages of the life course, that is, adolescence, pregnancy and breastfeeding, and older age (SDG Target 2.2).

A life-course approach acknowledges the opportunity to prevent and control disease by targeting critical life stages, transitions and settings where significant differences can be achieved to optimize, improve or restore health *(7)*. This approach differs from more traditional disease-oriented initiatives that have focused on intervening on a single condition, usually at one particular point in the life course such as adulthood. A life-course approach is founded on evidence that adverse circumstances in early life and across the life course lead to an increased risk of chronic diseases in adulthood, such as CVD and T2DM.

The importance of adopting a life-course approach to prevent and manage obesity, poor diet and physical inactivity by intervening early and continuing with interventions throughout life is supported by several transnational strategies, including the Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020 *(8)*, the United Nations Decade of Action on Nutrition 2016–2025 *(9)* and the Global Action Plan on Physical Activity 2018–2030 *(10)*. Several European strategies also highlight the need to adopt a life-course approach, including the EU's Strategy on Nutrition, Overweight and Obesity related Health Issues *(11)*, the Physical Activity Strategy for the WHO European Region 2016–2025 *(12)* and the Report of the Commission on Ending Childhood Obesity *(13)*. Recommendations for nutrition intervention have been specifically highlighted for women of childbearing age and adolescent girls in a number of strategic initiatives, including the Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition and six Global Nutrition Targets 2025 *(14)* and the Global Strategy for Women's, Children's and Adolescent's Health (2016–2030) *(15)*. Collectively, the intervention strategies outlined in these initiatives describe the need to address the determinants of poor diet and physical inactivity at the individual, organizational and community levels. However, most strategies to date have focused on providing education to prompt individuals to adopt healthy dietary and physical activity behaviours (e.g. social marketing campaigns, clear labelling, and including nutrition and physical education in the curriculum) and creating healthier school environments. Stronger policy action to address the commercial causes of obesity could offer a greater opportunity to enhance progress, reduce existing inequalities in the burden of unhealthy body weight and poor diet *(16)*, and contribute to action on climate change, thereby improving health for all at all life stages.

This chapter describes the life-course approach to preventing obesity and poor diet. It summarizes the opportunities to reduce risk factors and heighten protective factors through evidence-based interventions at key life stages, from preconception to early years, childhood and adolescence, working age and into older age. It briefly outlines how vulnerability to unhealthy body weight in early life can affect a person's tendency to develop obesity through biological, behavioural, psychosocial, environmental and economic pathways (Fig. 2.1). The effects of early exposures can be exacerbated if these risk factors are also present throughout adolescence and adulthood, culminating in premature morbidity and mortality in later life. This chapter presents the findings of an umbrella review of interventions that are effective in preventing and managing obesity across the life course, focusing on a healthy start to life and progressing through the critical periods of transition over the life course. Policy action that targets the commercial, economic and societal determinants of poor diet and sedentary behaviour is needed to enable the reduction of inequalities affecting life-course trajectories, thereby benefiting the whole of society, future generations and the planet.

Fig. 2.1 **The early life origins of childhood obesity and their transgenerational impact**



2.2 Life-course strategy for obesity prevention

In many countries, alarming levels of unhealthy body weight exist across all segments of the life course. Obesity acquired during childhood frequently persists through adolescence and into adult life, indicating that it is a difficult condition to treat at any age (Box 2.1) *(17)*. Therefore, early prevention is crucial to reversing current trends.

Economic estimates show that investment in early childhood (including during preconception, adolescence, pregnancy and early childhood) can yield a 10:1 benefit–cost ratio in health, social and economic outcomes and reduce the NCD risk in later life *(18)*. While not specifically related to obesity, these estimates are consistent with evidence that susceptibility to obesity risk is particularly heightened during the pre- and perinatal periods, and leads to transgenerational amplification of the condition *(19)*. Epidemiological and clinical and basic science research clearly show that parental (maternal and paternal) nutritional and weight status before conception and maternal nutritional and weight status during pregnancy influence offspring body composition and health via the mechanism of developmental programming *(20)*. However, evidence is lacking of a role for physical activity in preconception health, particularly when independent of weight loss *(21,22)*.

Box 2.1

People's experience of living with obesity: Berglind [a]

It wasn't until she was an adolescent that Berglind began to face living with obesity. Berglind remembers her body developing very early, which she found difficult. When she was 11 years old, she spent the summer with a friend of her mother. This was the first time that Berglind had been put on a diet and was the first of many experiences that led to her feeling ashamed of her body and guilty about eating. As a result, she began to eat in secret.

A number of traumatic events took place in the following years; the death of one of her grandfathers was followed by the deaths of her grandmother, her very close aunt and her other grandfather. She was also raped by a family member at the age of 17. Berglind developed severe depression in response to the trauma and as a consequence exhibited behaviours such as partying and heavy drinking. Berglind recalls a number of times where she woke up after drinking heavily, having tried to take her own life. It was around this time that she found out she was pregnant. She says that her son became her lifeline. Berglind stopped drinking and began to get her life back on track; however, her weight continued to be an issue. Having always been self-guided in her approach to diet and exercise, Berglind eventually found an obesity clinic on a recommendation from a friend. However, her experience at the clinic was unsuccessful and she began to gain weight again. At age 35 years, Berglind entered a five-week programme at a weight specialist clinic. A year later she applied for bariatric surgery. Determined for the surgery to be a success, Berglind did everything she was advised to do and began to lose weight

Having experienced years of trauma, Berglind advocates for the importance of mental health when it comes to treating and managing obesity. Berglind believes that the hardest part is for a person to acknowledge the situation and accept that they are living with obesity. One of the most difficult realizations for Berglind after she had had surgery was the way people treated her once she had lost weight. She had never realized this until people began to acknowledge her in public, offer her service in stores and stop for her when she crossed the road. There is a lot of bullying and shaming among the general population that contributes to this problem.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

2.3 Epidemiological and clinical/basic science mechanisms

Early life plasticity is an adaptative response to the cellular environment that occurs at the very start of development and has profound implications for an individual's health throughout the life course. Adaptation occurs via epigenetic modifications that do not change the sequence of genetic DNA but instead produce changes in gene

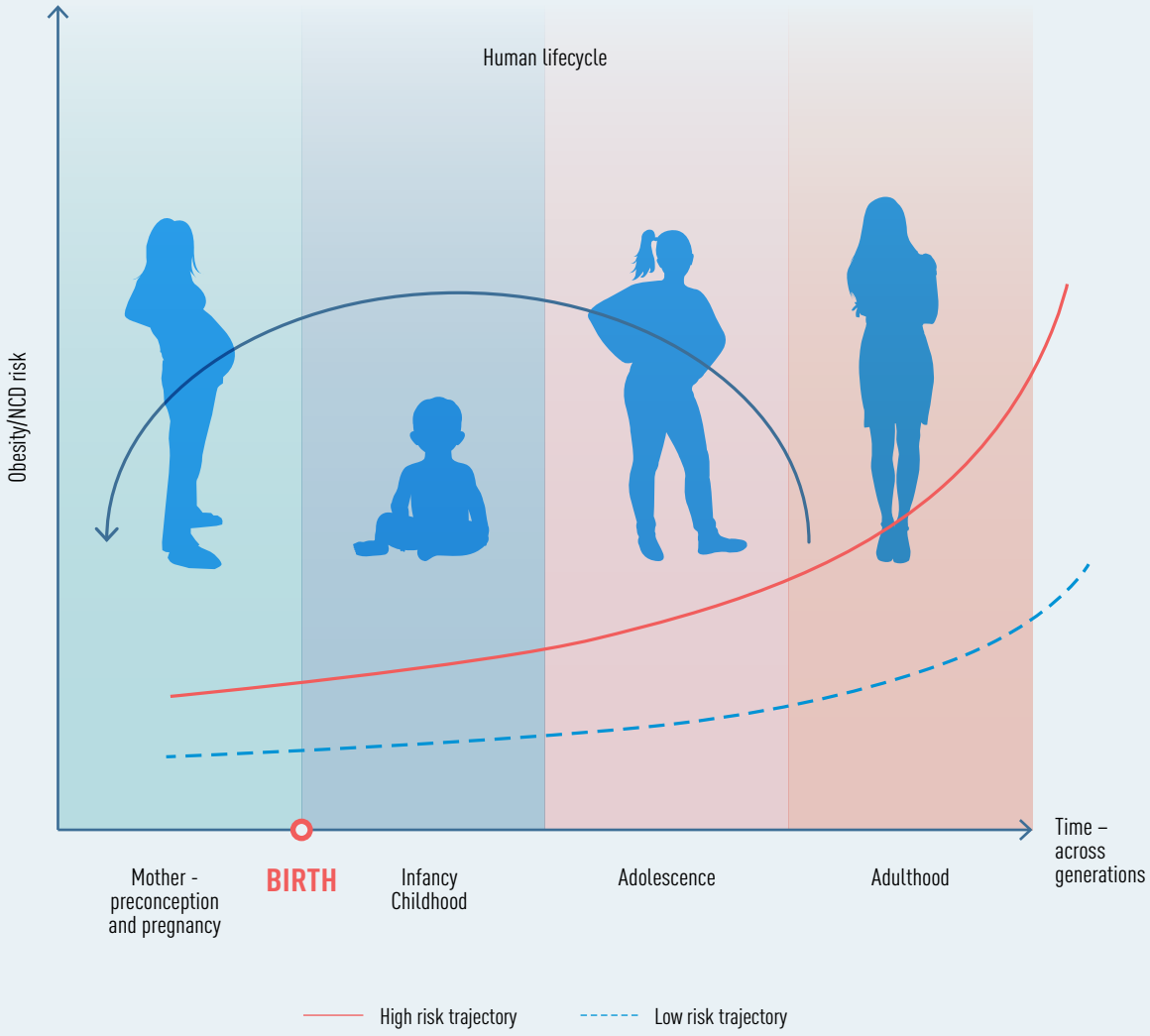
expression (due to DNA methylation) that then continue through subsequent cell divisions, driving the process of developmental programming *(23,24)*. Its purpose is to establish physiological growth and metabolic capabilities that match the nutritional and physiological environment in which they find themselves to optimize development for later life survival and fitness. In adulthood, NCDs can develop when environmental conditions change from those in early life and/or when exposure to risk factors (such as overnutrition) persist and accumulate throughout the life course *(19,25,26)*.

The Developmental Origins of Health and Disease concept is based on observational research in Hertfordshire (United Kingdom) that assessed historical birth-weight records against chronic disease incidence in adulthood *(27)*. Results from the study of 15 726 men and women born between 1911 and 1930 showed that lower birth weight was associated with approximately twice the likelihood of death from coronary heart disease compared with higher birth weight *(28)*. Subsequent cohort studies across Europe have shown that poor nutrition prior to and during pregnancy have negative, lifelong consequences for the development of numerous NCDs (i.e. coronary heart disease, stroke, hypertension, T2DM, osteoporosis and sarcopenia) independent of adulthood risk factors, including low socioeconomic status, obesity, smoking and alcohol intake *(7)*. Furthermore, individuals who were briefly exposed prenatally to severe starvation during the Dutch famine of the Second World War, followed by plentiful food, not only experienced a higher risk of coronary heart disease and lower glucose intolerance during adulthood but also had infants who were shorter and heavier *(29)*. These findings indicate that nutritional exposures in early life have transgenerational effects that are likely to be caused by the transmission of epigenetic changes across generations *(30)*.

Human and animal studies from 2018 found that overnutrition in early life can induce persistent changes in gene expression and metabolism that increases susceptibility to an unhealthy body composition and cardiometabolic diseases in the offspring and subsequent generations *(20,31)*. Mothers who have an unhealthy body weight before pregnancy are more likely to have infants with an increased risk of being large for gestational age or of macrosomia (birth weight > 4000 g) *(19)*. Women with obesity have poorer quality eggs or oocytes and, consequently, embryos because of the high levels of inflammatory cytokines, hormones and metabolites circulating in their blood. Animal studies have further demonstrated that when embryos from mothers with obesity are transferred to mothers with a healthy body weight increased adiposity and physiological dysregulation continues after birth *(32,33)*. However, clinical research shows that reducing maternal body weight prior to pregnancy through bariatric surgery leads to a lower risk of the infants being large for gestational age *(34)*, with a lower risk of obesity and insulin resistance in childhood and adolescence *(35)*. Paternal obesity and unhealthy dietary patterns have also been linked to increased obesity risk in future generations via reducing sperm quality and quantity *(36)*. Animal experiments suggest that paternal diet and physical activity interventions can reverse these negative developmental effects *(37)*. Collectively, evidence from epidemiological, animal and clinical research indicates the importance for both men and women of having a healthy body weight prior to conceiving their children *(20,31)*. Intervention at an early life stage will enable the next generation to start life on a low-risk, rather than high-risk, trajectory for later life obesity and NCDs (Fig. 2.2).

Life-course model of obesity and NCD prevention illustrating the importance of early life intervention

Fig. 2.2



Source: adapted from Davies (2015). Reproduced with permission of the Government of the United Kingdom. Contains public sector information licensed under the Open Government Licence v3.0. *(38)*.

2.4 Maternal weight status

Worrying levels of overweight and obesity among men and women of childbearing age are seen across many European countries and continue to increase. In Hungary, Ireland, Portugal, Spain and the United Kingdom more than 20% of women are estimated to have obesity when they become pregnant. This percentage is similar across other European countries and is socioeconomically patterned, with the greatest burden experienced by those from lower socioeconomic backgrounds *(39,40)*. Women with obesity enter pregnancy with poorer quality diets and low levels of physical activity; they have an

increased risk of miscarriage, excessive gestational weight gain, gestational diabetes, hypertensive disorders of pregnancy, stillbirth and postpartum haemorrhage *(41,42)*. Cohort studies have shown that excessive weight gain during pregnancy is associated with higher birth weight, a 46% increased risk of overweight or obesity among children by age 2–5 years *(43)*, and greater likelihood of unhealthy body weight, larger waist circumference and more visceral adipose tissue at age 10 years *(44)*. Interestingly, these associations were not observed among adolescents whose mothers gained adequate (not excessive) weight while pregnant. Women who gain excessive weight during pregnancy are more likely to have greater postpartum weight retention and, therefore, to enter a subsequent pregnancy at even greater risk to their own and their child's health *(45)*. Observational research also shows that women frequently reduce their physical activity levels during pregnancy and that the levels remain low in the year following childbirth *(46,47)*. This reduction in physical activity is commonly combined with decreased intakes of fruit and vegetables and increased intakes of snack foods that are high in saturated fat, salt and sugar during the transition from pregnancy to post-pregnancy, particularly among women from a lower socioeconomic background *(48)*.

The prevalence of severe obesity (defined as BMI ⩾35 kg/m^2) among women increased between 1975 and 2014 *(49)*; in the United Kingdom there was a threefold increase in just three years (from 1.5% to 4.5% in 2017 to 2019) *(50)*. Mothers who fall within the highest classifications of obesity are more likely to have their infants early (preterm) and/or with a low or very low birth weight *(51)*. These somewhat surprising trends could be explained by mothers with severe obesity being undernourished despite their high energy intake, likely motivated by the abundant availability of low-cost, energy-dense, nutrient-poor foods *(52,53)*. Micronutrient deficiencies in pregnant mothers can influence their children's health and weight status. For example, low folate concentration in pregnancy has been associated with greater risk of unhealthy body weight at age 5–6 years *(41)*. Additionally, the amount of vitamin D transferred through the umbilical cord was shown to be lower in mothers with obesity compared with those of a healthy weight, despite similar maternal blood levels. Low vitamin D levels combined with adiposity in infants can be detrimental for bone development and body composition in childhood *(54)*.

2.5 Early life exposures

High-birth-weight infants (> 4000 g) are more likely to have overweight or obesity in childhood compared with infants with a healthy birth weight (2500–4000 g) *(55,56)*. Typically, their excess body weight persists or worsens through adolescence and into adulthood *(41)*. After birth, preterm and low-birth-weight infants are more likely to gain weight rapidly *(57)*. Evidence from Bulgaria, Croatia, France, Italy, Poland and Romania indicates that preterm infants have a higher odds of developing obesity in childhood compared with full-term infants *(58)*. Meta-analyses show that infants who gain weight faster than average during their first 24 months are more likely to have excess body weight in later life *(59,60)*. A longitudinal study of length/height and weight measurements for more than 120 000 children from birth to 24 months found that rapid weight gain in the first six months had the greatest impact on obesity in later childhood (ages 5 and

10 years), particularly if more than two weight-for-length percentiles are crossed *(61)*. Research from Europe and North America has shown that infants from low-income families gain weight faster than those from higher-income households *(62–64)*, probably because unhealthy environmental exposures (including easy access to and marketing of energy-dense, nutrient-poor cheap foods in lower socioeconomic areas) unintentionally leads to overfeeding. When combined with altered developmental programming, this leads to rapid postnatal weight gain.

2.6 Breastfeeding

Clear evidence indicates a socioeconomic gradient in early infant growth. Infants from lower-income families are heavier at age 3 months, experience a greater increase in weight from birth to 3 months and meet the criteria for rapid growth more frequently than infants from higher-income families *(63,64)*. Further exploration of these relationships indicates that the approach used to feed infants is a key driver, with breastfeeding being protective against excess weight gain. Out of all six WHO regions, the European Region has the lowest rate of exclusive breastfeeding *(65)*. A randomized controlled trial (RCT) promoting positive infant feeding practices revealed that formula feeding and feeding on a schedule were the only two modifiable factors associated with rapid weight gain from birth to age 7 months. The most likely mechanisms for this effect are the higher protein content of formula or overly frequent feeding, which can override the infant's developing capability to self-regulate their energy intake *(66)*. A link between obesity in childhood and not being breastfed, or only a short duration of breastfeeding, was indicated in a multicountry analysis of data from 22 Member States in the WHO European Region's COSI study *(58)*, and in a meta-analysis of international data *(67)*. However, the association between breastfeeding and later life obesity does not consistently hold after correcting for parental weight or socioeconomic status *(68)*. Therefore, the protection afforded from breastfeeding against excess weight gain in childhood is likely to be modest but to form part of a broader, complex system of interacting psychological, social, environmental and economic factors that can protect people against or increase their risk of overweight or obesity.

2.7 Early life inequalities

Obesity is socially patterned, with inequalities rising among children in Europe *(69)*, particularly during the COVID-19 pandemic (see Chapter 8). A 2021 cross-sectional assessment of the association between socioeconomic position and overweight/obesity prevalence among more than 120 000 children aged 6–9 years from 24 Member States in the WHO European Region found lower parental education to be a strong driver of unhealthy body weight in children, particularly in high-income countries *(70)*. Among low- and middle-income countries, parental employment had the strongest association with childhood overweight and obesity, possibly resulting from time limitations for meal preparation and, therefore, a greater reliance on highly processed convenience foods

and meals *(70–72)*. In the United Kingdom data from the National Child Measurement Programme show that children from the lowest-income neighbourhoods are more than twice as likely to be living with obesity than those from the highest-income neighbourhoods *(73)*. This pattern was similar among both younger (age 4–5 years) and older (age 10–11 years) children, and driven by an increase in obesity prevalence among vulnerable children and a reduction among children from high-income families between 2010 and 2020. Such inequalities are preventable and unfair, and represent systematic differences in the broader determinants of excess weight between high-income families and more vulnerable families.

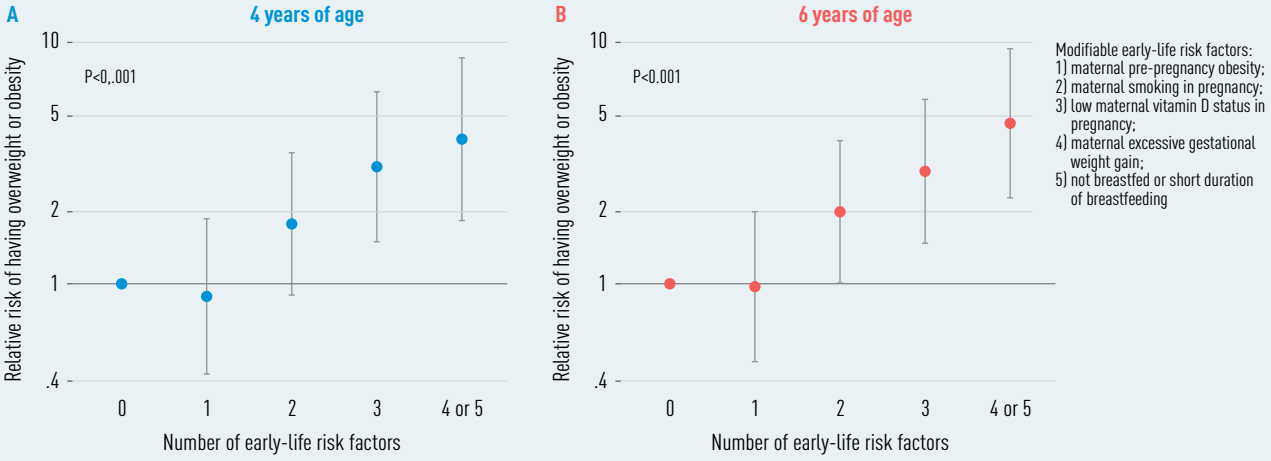
Children living in environments with many more risk factors than protective factors will have a tendency towards continued excess weight gain, while those growing up in environments with more protective and health-enhancing factors will develop better and sustain a healthier weight *(74)*. Several studies have shown that those young children from a lower socioeconomic background are more vulnerable to overweight and obesity in later childhood, even if their family's economic circumstances improve *(74)*. For example, research among a large, representative sample of children from Quebec province (Canada) generated poverty trajectories from birth to age 12 years found higher body weights in children from low-income families (particularly in later childhood) than in those who come from high-income families *(75)*. The study also found that children whose socioeconomic status increased over time retained a higher risk of having excessive body weight in later childhood but that those whose socioeconomic status decreased had no increase in risk.

The influence of low socioeconomic status in early life on later childhood obesity probably results from the clustering of obesogenic exposures. Evidence from the Southampton Women's Survey (United Kingdom) suggests that exposure to several early life risk factors has a cumulative effect on overweight or obesity in later childhood. Five early life risk factors for excess body weight in childhood, all of which have greater prevalence among mothers from a lower socioeconomic background, were examined: maternal obesity, excess weight gain during pregnancy, low maternal vitamin D status, short breastfeeding duration (< 1 month) and smoking *(76)*. The findings showed a fourfold increase in risk of overweight or obesity for children exposed to four or more risk factors compared with those exposed to none at ages 4 and 6 years, with differences in fat mass between these groups of 19% and 47%, respectively (Fig. 2.3).

Data from 19 Member States that participated in the fourth round of the WHO European Region's COSI study further support the combined influence of dietary and physical activity behaviours on weight status *(72)*. In particular, the synergistic effect of engaging in high levels of physical activity and having high fruit and vegetable intakes, alongside limited screen time and low consumption of sugar-sweetened beverages (SSBs), was necessary for children to have a healthy body weight. Having only a high fruit and vegetable intake or only high physical activity levels was not sufficient to avoid having overweight or obesity. These studies form part of a wider body of evidence indicating that the effects of obesogenic exposures become more pronounced in later childhood. Two compounding mechanisms are likely to be at play: developmental programming resulting from prenatal exposure to maternal obesity, and greater postnatal exposure to obesogenic environmental factors *(76)*.

Modifiable early life risk factors for childhood overweight or obesity

Fig. 2.3



Source: adapted from Robinson et al. (2015). Reproduced with permission of Oxford University Press under Creative Commons CC BY license *(76)*.

Research in the United States and Europe demonstrates how early life obesogenic exposures can be socially patterned. At age 7 years, ethnic disparities in obesity could be explained by black children having greater exposure than white children to factors such as excess weight gain during infancy, early introduction of solids, higher intakes of SSBs and fast food, and having a television in their bedrooms *(77)*. Across Europe, pooled data from 24 countries show disparities in screen time, sport club participation and active travel to school among 6–9-year-old children *(78)*. Use of electronic devices and television watching was higher and involvement in sports clubs lower among children with a lower socioeconomic background, but these children were also more likely to walk or cycle to school; however, no socioeconomic disparities in active play were observed. Evidence of inequalities in dietary behaviour among primary school-aged children is also apparent across the WHO European Region *(79)*. For example, low fruit and vegetable intake and high sugary drink consumption was observed in children whose parents have low educational attainment across high- and middle-income countries in Europe.

Children's eating behaviours develop from their early social interactions, most notably with their parents at mealtimes *(80)*. The strongest influence on a children's dietary quality is their mother's dietary quality. This accounts for almost a third of the variance in young children's diets, with the effects persisting from the introduction of solids until late childhood *(81,82)*. Mothers with a lower socioeconomic background have poorer diets than mothers with a higher socioeconomic background *(38,83)*. This is largely driven by their lifelong exposure to obesogenic environments, combined with fewer financial and psychosocial resources to buffer these unhealthy exposures (Box 2.2) *(16,84)*. Mothers with a low socioeconomic status are also less likely to follow complementary feeding guidelines: they are more likely to commence solid foods early (before 6 months of age) and offer energy-dense, nutrient-poor foods consistent with their own diets, such as bread, savoury snacks, biscuits and chips *(82,85)*. Evidence indicates that food preferences and satiety set-points become established (and difficult to reverse) in early

childhood. Therefore, shared patterning among family members can propagate dietary habits and weight status across generations, highlighting a need for structural policies and interventions to provide low-income families with support they need to break the cycle of obesity *(19)*.

Box 2.2

Challenges in feeding children healthily

Mothers with a low socioeconomic status made the following comments.

"It's easy to take the kids down to McDonalds or something."

"Fruit and veg is expensive. It's a shame they can't make it cheaper."

"There's always buy-one-get-one-free isn't there on a packet of chicken nuggets or something."

"I'd rather it not be right at the checkout. I'd rather get them chocolates if they have been good or something, so I don't like them seeing it there or while we are waiting, they might get irritated if I said no."

"The special offers as you walk through the doors, it's the first thing that you come in contact with..... yeah (I buy it), I feel like a child. I am afraid."

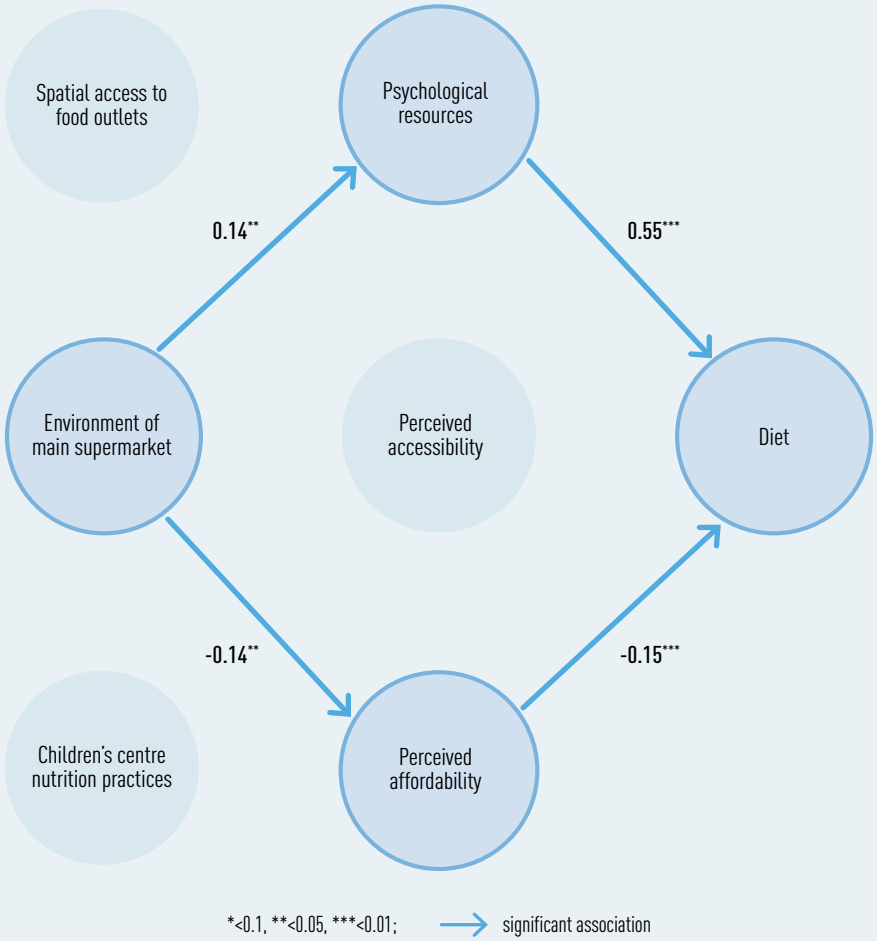
Sources: Barker et al., 2008 *(86)*; Dhuria et al., 2021 *(87)*.

2.8 Life-course exposure to obesogenic risk factors

Although parents exert the primary influence on their children's dietary and physical activity behaviours during the early years, a study of weight trajectory modelling from age 2 to 7 years clearly showed that risk factors for unhealthy body weight and poor diet extend beyond the family *(62)*. The study showed that at age 2 years children from low-income families had higher BMIs than children from higher-income families. However, after this age, living in a low- or very low-income neighbourhood had greater impact on unhealthy childhood body weight than the family's socioeconomic status. These findings are consistent with a larger body of evidence suggesting that unhealthy community and food retail environments are exacerbating dietary inequalities *(84,88–91)*.The differential effects of unhealthy environments on life-course dietary and obesity trajectories are likely to occur through two mechanisms: (i) low-income families experience a greater exposure to obesogenic environments, and (ii) individuals from higher-income families have the educational, economic and psychological resources to protect them from obesogenic environmental exposures. Furthermore, pathway analysis of synergies between the psychological, economic and environmental determinants of diet revealed that the relationship between a mother's supermarket environment and dietary quality is influenced by her psychological and economic resources (Fig. 2.4) *(92)*. These individual-level factors are socially patterned and can leave low-income families more vulnerable to obesogenic environmental exposures at all stages of the life course. (See Chapter 3 for a further discussion of obesogenic environments.)

Pathway analysis showing significant interactions between the environmental and psychosocial determinants of diet

Fig. 2.4



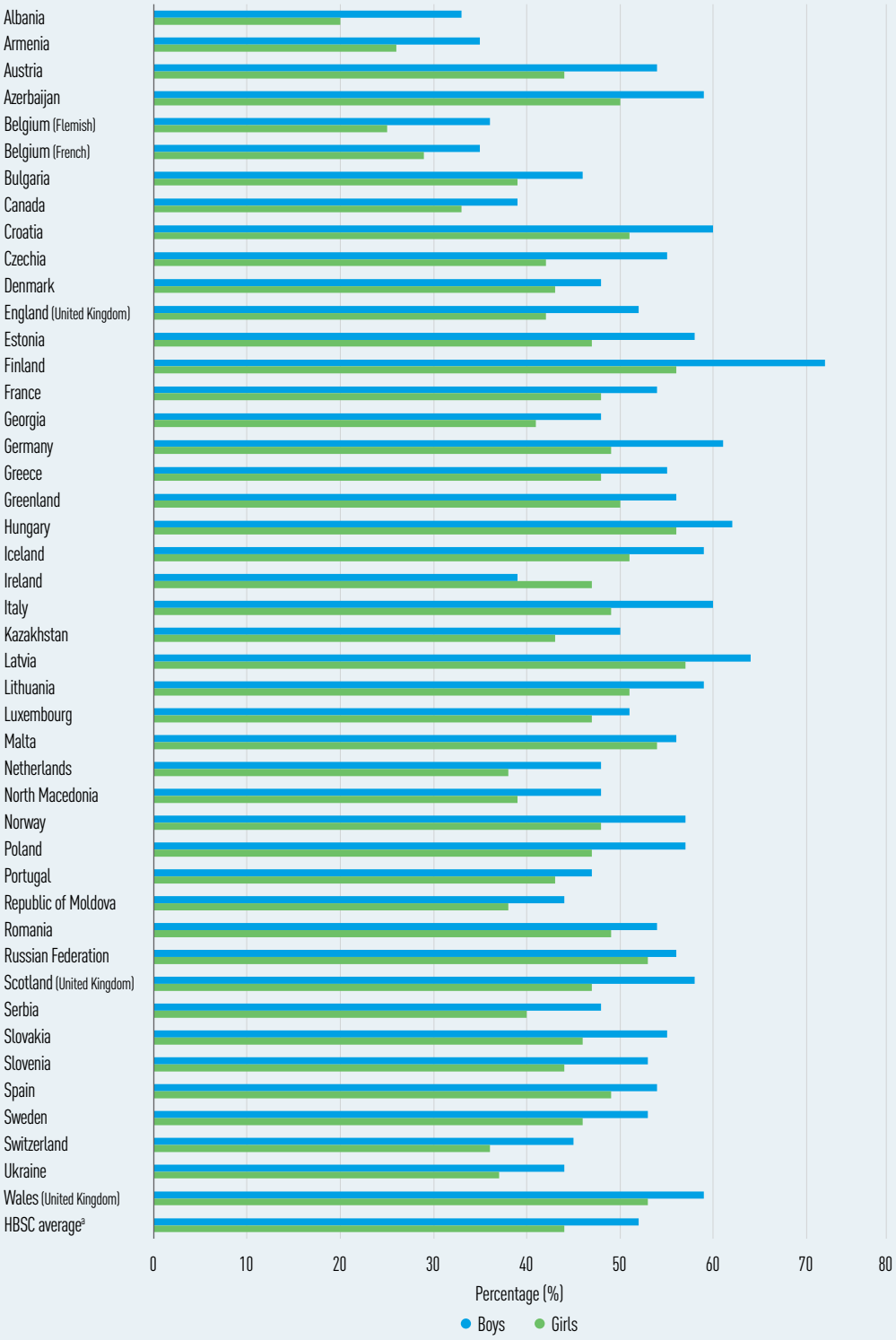
Source: adapted from Vogel et al. (2019). Reproduced with permission of Springer Nature under Creative Commons Attribution 4.0 International license *(92)*.

Other determinants that can take the form of cumulative risk factors or protective factors on children's food choices include child-care and school environments, school curricula, and sport and recreation settings *(19,93)*.

2.9 Youth and adult life exposures

Adolescence is a critical stage of physical and psychological development when the adoption of new behaviours can have lasting consequences on the health of an individual and of their future children *(94)*. A review of adolescents' dietary and physical activity patterns across high-income countries showed that they are far from compliant with national nutritional recommendations *(95)*. International data from 45 countries show that physical activity recommendations are followed by just 19% of adolescents *(96)*, almost half of adolescents eat neither fruit nor vegetables daily (Fig. 2.5), and one in six consume sugary drinks at least once a day *(96)*. Poor dietary trends are also more extreme among older adolescents and those from lower socioeconomic backgrounds *(97)*.

Fig. 2.5 **Proportion of adolescents who eat neither fruit nor vegetables every day**



[a] Including all countries from table.

Source: adapted from Inchley et al (2020). Reproduced with permission of World Health Organization under Creative Commons Attribution CC BY-NC-SA 3.0 IGO Licence *(96)*.

The need for autonomy from parental guidance and importance of peer groups during adolescence can prompt the development of poorer health behaviours *(98)*. Young people often find it difficult to engage with the concept of long-term health consequences and frequently prioritize the present over the future *(99)*. New neurological research has discovered the physiological reasons why adolescents are drawn to immediately gratifying behaviours *(100)*. The prefrontal cortex (the brain region responsible for behavioural control) does not fully develop until the second decade of life whereas, the brain's reward system is fully developed much earlier. This discrepancy means that young people find it difficult to make reasoned decisions, such as to resist environmental prompts of cheap fast food or to undertake an hour of physical activity each day. Furthermore, research shows that adolescents living with obesity have more extreme neurological responses to unhealthy food cues than those with a healthy body weight *(101)*. These physiological drivers are compounded by adolescents' preference to use unhealthy food outlets and eating occasions as a basis for socializing with their peers *(102,103)*. This may be particularly challenging for those living in lower-income areas with many takeaway outlets and lack of parks, green spaces and safe footpaths *(104–107)*.

Longitudinal studies have shown that continuous lifetime exposure to low socioeconomic status has a cumulative effect on the risk of obesity and is a significant predictor of ill health in later life *(108,109)*. Trajectory modelling of weight status across the life course also identified a sensitive period in late adolescence/early adulthood, in which increased body weight was associated with the greatest increase in T2DM risk three decades later *(110)*. Unfavourable psychosocial circumstances at this life stage, such as low school engagement, low parental support for education, and parental separation or divorce, can be particularly influential in initiating an unhealthy body weight trajectory that continues via low educational attainment and restricted financial resources in later adulthood. Further research is needed to identify interventions that can buffer young people against the persistent drivers of inequalities that ultimately influence their health in later life.

Accumulated dietary and physical activity behaviours across an individual's lifetime predict their risk of NCDs and other conditions such as frailty and impaired mobility in later life. Older adults have specific needs because they are undergoing a complex process of physical, psychological and social changes. Many older adults are extremely vulnerable to becoming physically inactive and malnourished while living with obesity *(111,112)*. Improving physical activity levels in older adults is the most effective strategy to improve health outcomes in this population and reduce the heavy burden on health-care systems *(12)*. Yet nearly two thirds of older adults do not meet the current recommendations on physical activity. Older adults are also at an increased risk of nutritional deficiencies because of impaired appetite and repetitive dietary choices. Evidence suggests that food intake can decline by as much as 25% in adults aged over 70 years *(113)*. In addition, socioeconomic inequalities in older age further exacerbate those accumulated over the life course, resulting in a loss of four to seven years of good physical function among adults aged 60 years with a low socioeconomic status compared with those with a higher socioeconomic status *(114)*. Strategies to support healthy dietary and physical activity practices in older adults are an additional component of a life-course approach to addressing obesity.

2.10 Evidence from intervention studies

This section synthesizes evidence from an umbrella review of effective and promising interventions to prevent obesity across the whole population, as well as specific interventions for population groups at each key life stage: pre- and periconception, pregnancy, infancy, childhood, adolescence, working life, and retirement/older age. A comprehensive approach is needed to support people to meet the dietary recommendations. This would also generate a shift towards more environmentally sustainable diets, along with approximately 20–50% lower greenhouse gas emissions and lower land use *(91)*. Furthermore, healthier built environments can promote substantial improvements in physical activity (active transport in particular) at population level and bring climate benefits, for example, by reducing air pollution and traffic congestion *(115,116)*. Interventions that are most likely to be effective in addressing inequalities in poor diet and obesity risk and in encouraging the adoption of healthy, sustainable choices are highlighted.

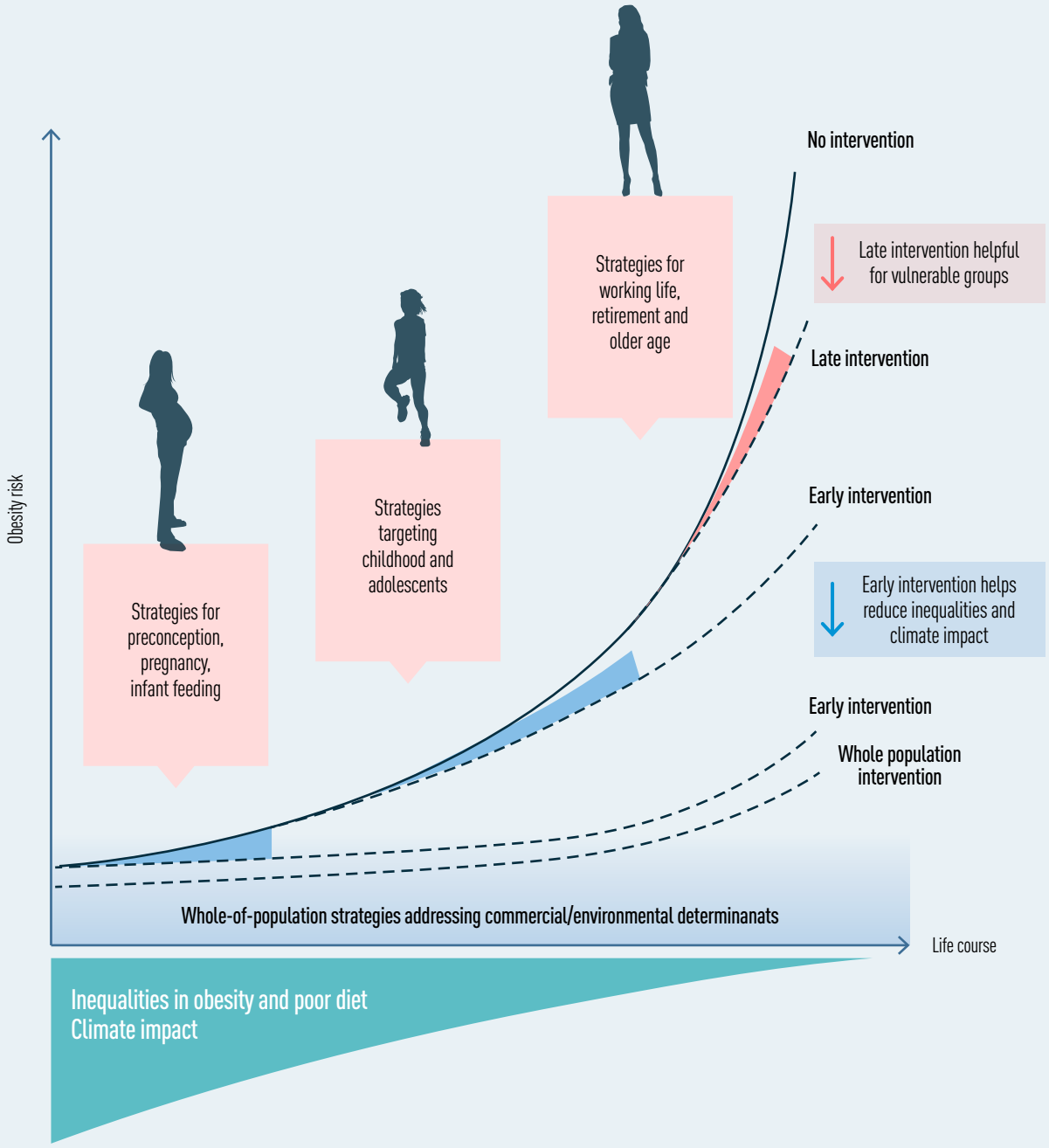
2.10.1 Whole population: interventions affecting all life stages

Obesity is a complex condition driven by numerous social, environmental and economic exposures that interact with individual behavioural and biological factors to accumulate across the life course *(117)*. A key risk factor for unhealthy body weight in each life stage is environmental exposure to unhealthy food and excess calorie intake *(118)*. Policy interventions that target the environmental and commercial determinants of poor diet at population level are likely to be most effective at reversing the obesity epidemic and at addressing rising inequalities and climate change *(16)*, particularly if supported by more targeted strategies for specific population groups and subgroups (Fig. 2.6). Whole-of-population strategies currently being considered or implemented by governments include taxing SSBs, restricting the promotion and prominent positioning of unhealthy foods, banning online advertising of unhealthy foods to children, and limiting the proliferation of takeaway outlets in lower-income neighbourhoods.

Taxation of SSBs offers a solid basis for using fiscal policy to encourage industry to reformulate unhealthy products and promote healthier food choices. SSB taxes have become increasingly adopted by governments because of their relative ease of implementation compared with other nutrition policies *(120)*. A meta-analysis of data from eight high- and middle-income countries found that the purchase of SSBs is typically reduced by a similar rate to the price rise; however, consumption patterns vary according to consumer age, income and baseline intake *(121)*. Countries planning to implement a SSB tax to reduce obesity levels should base the tax on sugar density and set it at a higher rate than has been implemented to date *(120)*. They should also consider expanding the policy to incorporate unhealthy energy-dense, nutrient-poor food and drinks or taxing sugar and salt for use in processed foods, as recommended in the 2021 National Food Strategy commissioned by the United Kingdom government *(122)*.

Whole-of-population policy interventions to address obesity, supported by targeted strategies across the life course

Fig. 2.6



Source: adapted from Godfrey et al. (2010). Reproduced with permission of Elsevier under Creative Commons CC-BY-NC-ND license *(119)*.

Supermarkets are the primary source of food for millions of families and are now recognized as an important setting to implement strategies to improve population diet. Price promotions and prominent product positioning are two strategies frequently used by supermarkets to encourage customers to purchase products *(123,124)*. Systematic reviews have shown that these strategies are frequently used on unhealthy food items and prompt customers to buy more of these products *(125,126)*. Restricting the use of these promotional strategies on unhealthy foods in supermarkets and other retailers offers the potential to improve food choices. A 2021 study showed that removing unhealthy foods from checkouts and nearby aisle-ends led to approximately 1500 fewer portions of confectionery being sold in a supermarket each week *(127)*. The Government of the United Kingdom is to introduce world-leading legislation in October 2022 to restrict prominent positioning and multibuy promotions of HFSS products. This provides an example for other governments to watch and follow *(128)*. Advertising unhealthy foods on television and online can also influence food choice, particularly among children *(129)*. Research shows that unhealthy food advertising can increase the amount of food that children consume and also influence their food preferences from an early age *(130)*. The effect is particularly strong among more vulnerable children *(90)*. Governments are advised to implement WHO recommendations on the marketing of food and drinks to children *(131)*, and food companies are being urged to voluntarily commit to the EU Code of Conduct on Responsible Food Business and Marketing Practices as part of the European Commission's Farm to Fork Strategy *(132)*. The Code sets out seven aspirational objectives, each with specific targets and measurable actions, to support the promotion of healthy, climate-friendly food choices for all European customers and the adoption of an environmentally and economically sustainable and efficient food system in Europe *(133)*.

At neighbourhood level across high-income countries, there is strong evidence for the proliferation of takeaway and fast-food outlets and for disparities in their distribution, with greater clustering in lower-income areas than in high-income areas *(105)*. Local authorities can use their planning powers to prevent clustering and the proliferation of takeaway outlets to protect communities, particularly those most vulnerable to unhealthy local food environments *(88,89)*. In England (United Kingdom) this strategy is achieved using the National Planning Policy Framework and associated Planning Practice Guidance *(134)*. There is some evidence of similar measures being implemented in places of historical beauty (such as Venice), but there the motive appears to relate to preserving architectural heritage rather than promoting health *(135)*. Local authorities in other European countries are likely to have opportunities to enact similar powers.

Meeting physical activity recommendations is becoming increasingly difficult for families as community environments have become more urbanized and distances between home and school, work, shops and locations for leisure activities have increased *(136)*. However, many municipalities across Europe are taking action to improve neighbourhood walkability and the quality of parks and playgrounds, as well as providing adequate infrastructure for active transport. These actions by policy-makers should continue as evidence shows that such interventions are making a positive impact on physical activity levels in children and adults *(106,137)*. Systematic reviews have shown that the evidence of beneficial impacts on physical activity levels is strongest for streetscape

features that support walking and cycling (foot/bike paths, traffic calming features and road crossings), public fitness equipment, temporary street closures and play equipment, and availability of public transport *(106,107,138)*. Limited evidence suggests that infrastructure improvements to the built environment may predominantly benefit families with a high socioeconomic status *(106)*. Therefore, a thorough evaluation of such policy interventions is warranted to assess the potential for inequitable benefits. Increasing the availability and affordability of community sports facilities offers the potential to reduce socioeconomic inequalities in sports participation *(139,140)*.

Population-wide policy initiatives focused on individual behaviour change include developing and promoting dietary guidelines and front-of-pack nutrition labelling. Both strategies aim to support individuals in making better and informed food choices. However, they could achieve greater public engagement and influence by combining indicators of health with environmental sustainability *(141)*. Front-of-pack labelling can also prompt the reformulation of products towards healthier profiles, leading to a greater population impact. Currently, multiple food labelling formats are employed across Europe, but a uniform, user-friendly front-of-pack-labelling system is being developed as part of the Farm to Fork Strategy *(132,142)*. Action is also under way to harmonize sustainability claims on food products and develop a labelling framework that encompasses the nutritional, climatic, environmental and social aspects of food products. To be most effective, labelling and dietary guidelines should be implemented alongside other nutrition-promoting regulations (such as those described above).

2.10.2 Pre- and periconception

Implementing strategies to optimize women's and men's weight and nutritional status before planning and conceiving a pregnancy is important to reduce health risks and provide important lifelong benefits for their child *(31)*. However, changing dietary and physical activity behaviours before conception is challenging because prospective parents rarely engage with health services until they are already pregnant *(143)*. Although evidence of effective preconception nutrition interventions is scarce, recommendations published in 2018 shifted from solely targeting prospective parents promoting preconception nutrition at all stages of the life course *(41)*. This dual strategy firstly involves proactively engaging with women and couples who are planning or contemplating pregnancy when they interact with health-care services (including primary, community, reproductive and weight-management care) to provide them with timely, culturally sensitive support for behaviour change. The second complementary strategy involves promoting the health of all young people through creating supportive food environments and public messaging to improve preconception nutrition and physical activity to build strong, healthy mothers and children *(143,144)*. By adopting this approach, all individuals can benefit from preconception health whether or not they intend on becoming parents, and the whole of society is likely to benefit from breaking the intergenerational chain of inequalities.

This dual strategy would also support improvements in women's periconception nutrition and weight status. The transition from antenatal care into postnatal care and then into early years services provides health professionals with regular opportunities to engage with parents about their nutrition, physical activity and weight status prior

to a subsequent pregnancy. A synthesis of six systematic reviews of post-pregnancy interventions showed that those targeting both diet and physical activity and combining individualized support with self-monitoring are most likely to lead to postpartum weight loss in women across weight categories *(42)*. Skills training for health professionals to support behaviour change in parents is available through the Healthy Conversation Skills training programme *(145)*. The programme is designed to help health professionals engage and motivate their patients via brief consultations to identify self-directed solutions to achieve dietary and physical activity behaviour change. This training programme has been implemented at national level in the United Kingdom within the National Health Service Making Every Contact Count approach and could be incorporated into postnatal services to offer postpartum support to families living with obesity to help them prepare for the next pregnancy *(41,146,147)*.

2.10.3 Pregnancy

Pregnancy is a life stage in which women are likely to be receptive to changing their dietary, physical activity and other health behaviours *(148,149)*. In fact, a 2016 study found that pregnancy is not only a sensitive period for a child's neurological development: greater plasticity also occurs in the pregnant mother's brain, which may result in a greater willingness to change existing habits *(150)*. Meta-analyses of RCTs on the effects of dietary interventions during pregnancy on maternal weight gain showed small but significant reductions in gestational weight gain but with no effect on birth weight *(151,152)*. An overview of 12 systematic reviews in 2018 indicated that pregnancy interventions addressing both diet and physical activity are effective in reducing the risk of having infants with a high birth weight for women with an unhealthy body weight. However, for these women a higher dose of physical activity is necessary to influence gestational weight gain compared with women of a healthy body weight and weight loss prior to pregnancy is necessary to achieve optimal pregnancy outcomes *(42)*. A meta-analysis of 2019 showed that mothers with lower educational attainment are at greater risk of excessive or inadequate gestational weight gain. However, dietary interventions reduced this risk in mothers of all education levels *(153)*. These encouraging results indicate that dietary interventions with an empowerment-based approach can support dietary change in pregnant women with poorer diets, who often have lower levels of self-efficacy or confidence in their ability to make healthier food choices *(154,155)*.

Pregnant women from lower socioeconomic backgrounds are more susceptible to food insecurity. Experiencing food insecurity during pregnancy and childhood is of particular concern because it is associated with poorer physical and mental health in women and children *(156,157)*. Food voucher policies, such as the United Kingdom's Healthy Start scheme, support low-income pregnant women and young families to make healthy food choices by providing vouchers for fruit, vegetables, pulses, plain milk and baby formula milk. A review of the scientific literature on food voucher use found that some, but not all, women use the vouchers to consume more fruit and vegetables *(158)*. Combining food voucher schemes with behavioural interventions during pregnancy may be the most effective way to optimize the diets of vulnerable mothers during pregnancy.

2.10.4 Infancy

Mothers are recommended to initiate breastfeeding within one hour of birth and to breastfeed exclusively for their first 6 months of life to achieve optimal growth, development and health in their infants *(159)*. Rates of exclusive breastfeeding are generally low across Europe *(160)*. Particularly low breastfeeding prevalence among younger mothers from low socioeconomic backgrounds contributes to existing inequalities in obesity and health *(161)*. Reasons given by mothers for not following the breastfeeding recommendations include inadequate practical support to establish breastfeeding and overcome physical and practical challenges, parental concerns that their infant is not receiving sufficient milk, and mothers feeling uncomfortable breastfeeding around others *(161,162)*.

WHO and Cochrane suggest implementing the Baby-Friendly Hospital Initiative and Ten Steps to Successful Breastfeeding to encourage breastfeeding initiation and ensure adequate support for mothers and their newborns *(163–166)*. Approximately a third of Member States in the WHO European Region had no certified breastfeeding facilities as reported in 2017 *(167)*, indicating a need for further action. Other initiatives recommended for implementation at national level include (i) longer maternity leave and measures to support breastfeeding in the workplace; (ii) laws that protect the right to breastfeed in public; and (iii) inclusion of lactation support training into undergraduate and postgraduate curricula for health professionals *(14,160)*. Systematic reviews of interventions by health professionals to support mothers to initiate and sustain breastfeeding have found that specialized, non-judgmental breastfeeding counselling sessions delivered in-person in the postnatal period can increase breastfeeding duration and exclusivity *(168,169)*. This strategy was particularly effective among vulnerable mothers *(162)*. Furthermore, action is needed to ensure full implementation of the International Code of Marketing of Breast Milk Substitutes *(170)*, which spells out key legal safeguards against industry practices that undermine breastfeeding *(65)*. Most Member States in the WHO European Region have adopted exclusions to the Code, which has impeded efforts to prohibit baby formula milk promotion and to promote exclusive breastfeeding. Therefore, firmer efforts are needed to regulate the marketing of baby formula milk and follow-on formula *(65,160)*. Although baby formula milk is important as a breast milk substitute for mothers who are unable to breastfeed, the nutritional profile could be improved. Trials have shown that infants fed baby formula milk with a lower protein content have growth patterns that more closely resemble those of breastfed infants *(169,171)*. The findings support recommendations to review policies for baby formula milk composition to protect formula-fed babies against obesity in later life.

The introduction of solid foods is another important component of early life nutrition. With young families having increasingly busy lives and pressure on both parents to work, the feasibility of providing infants with home-prepared foods has reduced. Consequently, the availability of commercial complementary foods has grown substantially *(172)*. Reviews of the nutritional profile of commercial complementary and toddler foods found that sugar and salt levels were unnecessarily high and did not align with complementary feeding recommendations *(172,173)*. Misleading product labelling and marketing, such as ingredients not matching product names, also makes it difficult for parents to determine the true nutritional value of products. Governments can take action to ensure

that commercial infant foods are marketed and labelled accurately and appropriately *(173)*. Targets encouraging reformulation to improve the nutritional profile of infant and toddler foods could also be considered. However, the threat of legislation is likely to be needed to ensure that all voluntary marketing and reformulation targets are met. Whole-of-population strategies targeting environmental exposures to unhealthy food are likely to further support a reduction in the consumption of energy-dense, nutrient-poor snacks foods by young children. Behavioural interventions targeting the introduction of complementary foods are most likely to be effective at encouraging adherence to dietary guidelines if they include clear recommendations for solid foods to be introduced around 6 months of age, target a reduction in SSBs for the infant and family members, and promote continual, repeated exposure to a variety of fruit and vegetables from age 6 months to increase acceptance of new healthy foods throughout childhood *(169)*. Socioeconomically vulnerable families, in particular, are likely to benefit from targeted support from health professionals that is culturally appropriate, practical and empowering, and promotes positive parenting *(174,175)*.

2.10.5 Childhood

Evidence suggests that settings frequently used by children, particularly schools, child-care settings and children's recreational facilities, play an important role in supporting healthy food choices and limiting exposure to unhealthy foods and beverages *(13)*. A survey of national school food policies in Europe found that all 30 countries assessed had a national school food policy; however, only 18 policies contained mandatory food-based standards and age-appropriate portion sizes *(176)*. Food prepared in school is frequently healthier than food brought from home: research from the United Kingdom showed that only 1% of packed lunches met school food standards between 2006 and 2016 *(177)*. Government provision of free school meals has been shown to improve children's intake of healthy foods and lead to small reductions in unhealthy body weight *(178,179)*. Child-care settings and recreational facilities are not routinely subject to mandatory food standards, and research has shown that these settings do not typically adhere to voluntary government standards or dietary guidelines *(180–182)*. However, interventions to increase the healthiness and sustainability of foods offered in these settings can help to improve dietary behaviours *(183,184)*. Incorporating healthy eating into school and child-care curricula can improve health literacy among children and their families; therefore, opportunities exist for governments to make good nutrition and obesity risks statutory components of health education materials *(180)*. Extending these educational requirements to include food sustainability could provide an additional way to engage children in health and climate issues *(185)*. Extending mandatory food standards to child-care settings and recreational facilities, making nutritional education a statutory requirement in educational curricula and ensuring the provision of free school meals for more vulnerable children could further encourage children to adopt healthier, more environmentally sustainable dietary habits and may help to reduce inequalities.

International evidence shows that only about one third of physical education lesson time contributes moderate–vigorous physical activity levels in children *(186)*. This falls short of advice from the United States Centre for Disease Control and Prevention for 50% of lesson time to be spent doing moderate–vigorous activity *(187)*. Walking school

bus programmes offer further opportunities to increase children's physical activity. An evaluation of 184 programmes across the world found that programme activities are more likely to be sustained in low-income, rather than high-income, communities *(188)*. Student participation was higher in programmes that had multiple route leaders, were coordinated by school staff (rather than parents) and had no external funding. Further efforts are needed across countries, particularly in lower-income areas, to develop school policies that extend active time in physical education lessons and coordinate walking school bus programmes.

Cochrane and other reviews indicate that the success of weight-management programmes for children is largely limited to younger children and relies on behaviour change strategies lasting for more than two years *(189)*. Weight-management programmes were found to be rarely effective among older children and adolescents *(19,190)*: however, the most promising were those that address poor diet and physical inactivity and focus on family routines, including eating meals as a family, having adequate sleep and limiting screen time *(191)*. (See Chapter 9 for a more detailed discussion of the clinical management of obesity.)

2.10.6 Adolescence

Given consistent evidence of the difficulty in treating obesity among adolescents using traditional weight-management programmes *(190,192)*, alternative strategies and motivators are likely to be needed for this target population. Poor dietary patterns among adolescents are not related to lack of knowledge. A 2021 qualitative study found that adolescents are aware of dietary recommendations and the implications of poor diet for their health, but that this is not sufficient to motivate or sustain healthier behaviours *(193)*. Healthy eating interventions for adolescents may be more effective if they align with adolescent values such as autonomy, social justice and peer group identification *(193,194)*. In 2019 an RCT found that framing healthy eating as a good way to take a stand against manipulative and unfair food marketing practices of the food industry reduced adolescents' ingrained positive associations with unhealthy food marketing and improved their dietary choices from the school cafeteria for at least three months *(195)*. These findings suggest that reframing unhealthy dietary choices as being incompatible with important adolescent values could be a low-cost, scalable solution to changing adolescents' food preferences. Extending this approach to framing healthy eating as a strategy for achieving collective action against climate crisis may yield similar benefits for adolescent dietary choices.

Digital technologies also have the potential to engage adolescents in changing their behaviour. Virtually all 16-to 24-year-olds in high-income countries own smartphones *(196)*, making this an obvious mode of delivery for low-cost, population-level dietary interventions to young people. A review of the effectiveness of digital interventions found that specific features of interventions (that is, goal setting, self-monitoring and targeting to specific populations) can lead to improved diet and physical activity behaviours among adolescents *(197)*. Furthermore, incorporating digital interventions into multicomponent school-based strategies (alongside changes to the school environment and curricula, parental involvement and health education delivered by teachers) has the potential

to lower excess body weight towards a healthier range in adolescents *(198)*. However, evidence is lacking on interventions that are effective at improving the diet and weight status of young people from lower socioeconomic backgrounds.

2.10.7 Working life

Employment and occupational health services are important for adult health, and workplace wellness programmes can help to maintain a healthy, productive workforce *(199)*. However, systematic reviews and meta-analyses have shown that workplace wellness programmes for healthy eating lead to only modest improvements in fruit and vegetable intake, waist circumference, body weight and BMI *(200–203)*. The long-term effectiveness of workplace wellness programmes is unknown because few studies have assessed whether the beneficial changes were sustained beyond the end of the programme. Common strategies include providing education and information, improving the food environment (increased availability or reduced cost of healthy foods) and making sociocultural changes (active involvement of management). A meta-analysis showed that improving the food environment had a larger effect on some outcomes *(200)*. Although work wellness interventions have only modest effect sizes, they could provide meaningful risk reduction if employee reach and participation are high *(203)*. The shifting nature of work (especially remote working) following the COVID-19 pandemic may require the future development of novel, virtual workplace wellness programmes.

Targeted weight loss strategies are needed to support adults experiencing obesity. A 2019 overview of systematic reviews found that dietary behaviour change interventions for at-risk groups can effectively reduce dietary fat intake and increase fruit and vegetable intake *(204)*. However, evidence was less clear for other dietary changes such as increasing fibre or reducing free sugars and salt. Dietary change was particularly effective among individuals who had experienced cancer but was less consistent among individuals with risk factors for CVD or T2DM. Interventions with more frequent contact were effective, but the setting and mode of delivery did not influence outcome: both digital and in-person delivery were beneficial. More-effective interventions had components to support problem solving, goal setting and self-monitoring, and relapse prevention *(204)*. The few studies assessing weight maintenance found that sustaining healthier behaviours beyond the intervention period was difficult. Weight regain following weight loss is common, with additional weight gain often seen after short-term weight loss *(205)*. A 2021 review of successful strategies for sustained weight loss showed the importance of personalized and evolving goals, continuous monitoring, encouraging experiences, strong networks of peers and professionals, and the ability to resist ever-present challenges *(206)*. These findings illustrate the great difficulty of achieving sustained weight loss in adulthood, particularly in current obesogenic environments. (See Chapter 9 for a more detailed discussion of the clinical management of obesity.)

2.10.8 Retirement and older age

The transition to retirement provides an opportunity to promote healthier dietary and physical activity behaviours as older people begin to restructure their daily routines

(207). Offering lifestyle interventions at this age is particularly important because many older adults already have an unhealthy BMI. The risk of gaining further weight, alongside the risk of losing muscle mass, can accelerate physical frailty, along with reduced capacity to perform daily activities *(208)*. Global estimates show that one in 10 older adults currently are affected by sarcopenic obesity (defined as high fat mass combined with low muscle mass and function *(209)*), which can have a detrimental impact on daily living activities and clinical outcomes *(210,211)*. Interventions to prevent the onset or worsening of sarcopenic obesity in older adults require a careful consideration of their nutritional deficiencies, frailty and pre-existing comorbidities *(212)*. Therefore, intervention strategies should be individualized and include gradual weight reduction, regular and appropriate physical activity, adequate protein intake and sufficient fluid intake to ensure hydration. Systematic reviews have shown that dietary interventions targeting adults in the retirement transition age range are effective at improving diet (particularly by increasing fruit, vegetable and fish intake) *(207,208)*. Levels of effectiveness were similar among those with obesity and those without additional health risks and for direct (face-to-face) versus indirect (telephone) intervention delivery. These results suggest that interventions should use a blended format (digital and in-person contacts) to deliver tailored content based on an individual's motivations and previous occupation and for empowering conversations to personalize the activities and goals *(213)*. Interventions combining dietary and physical activity components produced the greatest improvements in physical performance and quality of life by mitigating the loss of muscle and bone mass observed in diet-only interventions *(214)*. Interventions targeting older adults who have experienced lifelong low socioeconomic status may need to provide extra support, such as help in accessing supermarkets or meal providers, offering protein-enriched beverages, or providing nutritional supplements (particularly vitamin D and calcium) *(111,215)*. However, further evidence is needed to identify the most effective interventions.

2.11 Conclusion

Sufficient evidence indicates that nutritional and unhealthy body weight exposures prior to conception and during pregnancy play an important role in programming body composition in early life and susceptibility to obesity and NCDs in later life. Therefore, prevention of overweight and obesity in critical life-course phases (preconception, early life, childhood and adolescence) is likely to achieve the greatest health, economic and societal benefits and holds the greatest promise for breaking the intergenerational cycle of obesity and dietary inequalities. The introduction of policies to alter obesogenic environments could benefit the whole population and reduce inequalities affecting the life-course obesity trajectory. Targeted interventions for specific population groups across the lifespan could provide necessary additional support for individuals and families at the greatest risk of experiencing poor health due to unhealthy diets, physical inactivity and obesity.

Policy considerations

- Whole-of-population policies and interventions that address the environmental and commercial determinants (see also Chapter 10) of poor diet are likely to be most effective at reversing the obesity epidemic.
- The most promising whole-of-population policies are to:
  - tax SSBs and the use of sugar in processed foods
  - restrict the prominent positioning and promotion of unhealthy foods
  - ban online advertising of unhealthy foods to children
  - limit the proliferation of takeaway outlets in low-income neighbourhoods.
- These are likely to be most effective if supported by targeted strategies for specific life-course phases, including:
  - engaging proactively with women and couples contemplating pregnancy and their close family members when they interact with health-care services to support them with timely, culturally sensitive support for behaviour change, alongside public messaging to promote better preconception nutrition and physical activity;
  - combining food voucher schemes with behavioural interventions during pregnancy to optimize the diet of vulnerable mothers during pregnancy;
  - implementing the Baby-Friendly Hospital Initiative and the Ten Steps to Successful Breastfeeding, alongside full implementation of the International Code of Marketing of Breast Milk Substitutes;
  - adopting policies to ensure that commercial infant foods are labelled accurately and marketed in accordance with regulations, and setting targets to encourage reformulation to improve the nutritional value of infant/toddler foods;
  - providing socioeconomically vulnerable families with targeted support from health professionals that is culturally appropriate, practical and empowering, and promotes positive parenting;
  - extending mandatory food standards to child-care settings and recreational facilities, making nutrition education statutory in educational curricula and ensuring the provision of free school meals for more vulnerable children;
  - delivering targeted messaging for young people that reframes unhealthy dietary choices as incompatible with adolescent values of autonomy and social justice or framing healthy eating as a strategy to achieve collective action against climate change;
  - offering workplace wellness programmes focused on improving dietary and physical activity behaviours, alongside targeted weight loss strategies for adults with obesity; and
  - offering older adults of low socioeconomic status or in retirement transition dietary and physical activity interventions that highlight the importance of adequate protein and fluid intake and appropriate regular physical activity.

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3. OBESOGENIC ENVIRONMENTS

Key highlights

- Actions on upstream social, cultural, economic and political factors that shape food and physical activity environments (including childhood poverty), and people's interactions with these, should be at the forefront of efforts to equitably reduce overweight and obesity.
- Urban design, in particular enhancing active transport infrastructure and access to green and blue spaces, can have positive influences on health through increasing physical activity.
- Retail food environments are key determinants of diet quality and population health. Efforts to improve the healthiness of retail food environments require multilevel actions, including government-led policies and retail initiatives related to nutrition and obesity prevention.

3.1 Introduction, origins and history of the concept of obesogenic environments

It is a quarter of a century since the term "obesogenic environment" was coined to describe how modern environments drive the obesity epidemic *(1)*. In this framework, obesity is understood within a context of unhealthy sociocultural, physical, economic and political environments that impact upon the key drivers, physical activity and food intake. Since then, this concept has stimulated an enormous amount of prevention research exploring these environmental determinants. It has also contributed to a much needed cultural shift in research and, more recently, policy, in which individual behaviours are no longer the central focus and individuals with overweight or obesity are less likely to be blamed. This research is timely, as it has prepared us for the seismic shifts that have occurred in digital economies and globalization of trade, travel and communications. In this chapter, we describe these advances and provide an update on the original framing of obesogenic environments by re-examining the relationship between food and physical activity, and sociocultural, physical, economic and political environments. For coverage of obesogenic digital food environments, see Chapter 4.

3.2 Sociocultural environments

Equity for all in actions to support health and well-being is a core public health principle. The WHO reports Closing the gap in a generation: health equity through action on the social determinants of health *(2)* and Healthy, prosperous lives for

all: the European health equity status report *(3)* demonstrated that equitable prevention of overweight and obesity requires: (i) improving daily living conditions; (ii) addressing the inequitable distribution of power, money and resources; and (iii) ongoing monitoring of health inequities and the effectiveness of actions *(3–7)*. These reports identify multiple economic, political, commercial and cultural determinants of health and health inequalities, commonly referred to as "social" or "upstream" determinants *(8–10)*. To prevent obesity across an entire population and reduce inequities in obesity prevalence, it is essential to understand how these upstream determinants shape (i) food environments; (ii) physical activity such as active transport and mobility environments; (iii) people's interactions with these food and physical activity environments; and (iv) the scope in which effective and equitable nutrition and physical activity actions are proposed, adopted and implemented.

The daily living conditions in which we are born, live, work, play and age – that is, the conditions that determine our opportunities to be healthy and well across our life course – represent the intersection between determinants and people. These conditions also capture the circumstances in which we live, such as family structures and traditions, resources, employment and/or distance from services *(11,12)*. Living conditions are uniquely experienced by different groups (as defined, for example, by ethnicity, socioeconomic position, disability and gender), and inequities in living conditions translate into inequities in individual opportunities to consume healthy diets and participate in sufficient physical activity. For example, inequities in education are associated with inequities in job and income opportunities *(13)*, which determine how much money a person or family can afford to spend on foods and beverages; and the lower cost of unhealthy foods and beverages compared to healthy ones is perceived to be a leading driver of unhealthy diets, particularly among people receiving low incomes *(14)*. These conditions interact to increase inequities in obesity *(15)*. Obesity prevention essentially requires not only action on an individual's food and physical activity environment, but also consideration of their broader living conditions and context and how these are influenced by upstream determinants.

Policy recommendations to prevent obesity across socioeconomic groups include reducing childhood poverty through schemes that create fairer income, employment and education opportunities across the life course *(16,17)*. Across 34 European Member States, it has been estimated that 20 of every 100 children, on average, live in relative poverty *(3)*. Moreover, differences in exposure to adequate social protection have been found to contribute to 35% of the inequity in self-reported health between the most and least affluent adults in Europe, which suggests that lack or inadequacy of social protection is the largest driver of health inequities *(3)*. While there is some evidence to suggest that social protection policies (such as universal basic income, minimum income assistance, cash transfer programmes and increasing minimum income) can improve employment, education, socioemotional and well-being levels in high-income countries *(18,19)*, few countries (only Finland, Iceland and Norway, to date) have enacted such policies *(20)* and national spending on social protection has decreased on average across the WHO European Region *(3)*. Nonetheless, the recent piloting of the European Child Guarantee initiative in Bulgaria, Croatia, Germany, Greece, Italy, Lithuania and Spain is likely to increase political pressure to ensure that children

who experience disadvantage have adequate access to health care, education, early education and care, housing and healthy nutrition *(21)*. The effects of these types of policy on equitably improving population diets, physical activity levels and weight will require further attention and investigation on the part of all stakeholders into the future.

3.2.1 Economic determinants

The economic determinants of overweight and obesity include the high costs of healthy foods and organized sport, economic crises, unaffordable housing, precarious work and area-level deprivation. Economic determinants influence the affordability and desirability of actions that promote a healthy weight. Indeed, these determinants have influenced the relative affordability of unhealthy diets for those living on low or no incomes *(22,23)*, the widespread perception that unhealthy foods and beverages are cheaper than healthier options *(14)*, and the pervasive marketing of unhealthy foods and beverages, especially to vulnerable populations such as children *(14,24,25)*. Recent research that compares the cost of a "healthy diet" with the cost of the "current unhealthy diet" shows that consumption of a healthy diet can be cheaper than the current unhealthy diet, but for those on low incomes the marketing and subsequent perception of unhealthy foods as cheaper drive much food-related behaviour *(26)*.

Fiscal measures, such as SSB taxes and food subsidies, and restructuring of social protection policies are recognized as effective actions to address the economic determinants of obesity, but further measures are required. Currently, food systems are structured according to traditional economic theories that prioritize commercial interests and practices across the food supply chain to generate profits *(27)*. The liberalization of trade policies since the late 1900s has increased the global supply of unhealthy unhealthy foods and SSBs, reduced their prices, and consequently been linked to the increased incidence of overweight and obesity and CVD *(28–30)*. Government subsidies are also used to lower the costs associated with producing and consuming foods and beverages that are damaging to the health of our populations and planet *(31)*. This has led to the consolidation of wealth and political power among transnational food and beverage companies, presenting a major barrier to government-led policies to improve the food system *(32)*.

To address the health impacts of trade policies, evidence indicates that coherent policy will be required to comprehend the interests, ideas and institutional processes maintained by all sectors; this suggests that new trade regulatory frameworks will be required that uphold international commitments to improve diet-related health for everyone, globally *(32)*. This should include: removing market barriers in the agricultural sectors in low- and middle-income countries to support cheaper and easier ways of moving core healthy products across borders; protecting regulatory space for the implementation of policies that support populations to eat in a healthy and sustainable way in the face of competing trade and commercial interests; and revising subsidies to exclude harmful products (such as biofuels) and to provide better support for plant-based agricultural practices *(32)*. There is a need to rebalance public–private interests in trade relationships both locally and globally to improve population diets around the world.

3.2.2 Political determinants

Policy and overarching governance structures and ideologies shape our daily living conditions and opportunities to be physically active and to consume healthy diets *(2)*. Internationally, policy progress to address physical activity and healthy eating has been slow, and most countries are not on course to achieve the nutrition-related SDGs (even in spite of the fact that WHO has revised its targets for physical activity globally) *(33)*. In 2020 only eight countries were on track to meet four of 10 global nutrition targets, with inequalities in food systems and nutrition persisting *(34)*. Even though 164 countries had developed national nutrition plans by 2018, the allocation of necessary funding and implementation of comprehensive policy actions to address obesity and diet-related NCDs have been suboptimal *(35)*. With respect to the policy cycle *(36)*, this means that even if nutrition and physical activity policies are placed on political agendas and formulated, their adoption and implementation will not necessarily proceed. The implementation of nutrition and physical activity policies needs to be recognized as nonlinear, influenced by political commitment, prioritization, financing, irrationality, advocacy and lobbying *(37,38)*.

The 2019 Lancet Commission report The global syndemic of obesity, undernutrition, and climate change *(32)* articulated how policy inertia (collectively defined as insufficient political leadership and governance, often stemming from opposing commercial interests and insufficient public demand) constitutes a key barrier to progress on policy actions addressing undernutrition and obesity (collectively, malnutrition) prevention. Generating political commitment to obesity prevention will require a range of actions across Member States, including strong political leadership, supportive government administrations, effective actor networks, civil society mobilization, societal change and focusing events, cohesive and resonant framing, robust data systems, and evidence to support policy changes *(10)*.

Emerging approaches to strengthen political commitment to obesity prevention focus on rights-based and citizen-centred framing of nutrition issues, aligning with the United Nations Convention on the Rights of the Child, which recognizes that children have the right to nutritious foods and healthy environments *(39)*. In the United Kingdom the Greater London Authority has implemented an excellent example of a rights-based, citizen-centred approach to equitable nutrition policy, with the ambition that every child in London should achieve a healthy weight; in its formulation, children's voices and lived experiences have been amplified and translated into 10 shared priority policy actions *(17)*. The highest priority is to put an end to childhood poverty, clearly demonstrating that obesity needs to be politically recognized as a social, rather than an individual, issue.

Countries in Latin America offer excellent examples of strong political commitment and civil society support for upstream population obesity prevention *(40)*. In the WHO European Region, the city of Amsterdam has received widespread recognition for its long-term policy investments in using a systems approach to mobilize society and equitably reduce childhood overweight and obesity *(41)*, winning the City European Health Award in 2019. At country level within the Region, the United Kingdom has seen a shift in its attempts to reduce overweight and obesity towards comprehensive policies that will create healthier food and physical activity environments *(42)*; it is to be hoped that this promising development will be followed by actions.

3.3 Physical determinants of overweight and obesity

The physical determinants of overweight and obesity comprise what is physically available to individuals and populations that contributes to overweight and obesity, such as unhealthy food and devices such as televisions, computers and cars that replace opportunities for physical activity. Physical determinants are described below under the headings of food environments (section 3.4) and physical activity environments (section 3.5).

3.4 Food environments

3.4.1 Policies and regulations

Policies and regulations are critical influences on the healthiness of food environments. They include: (i) standards that determine the way food is produced, labelled and marketed to consumers; (ii) regulations that prescribe the types of foods available in food retail outlets and specific settings (such as neighbourhoods, schools and hospitals); and (iii) trade and investment policy *(43)*. More broadly, market operating conditions that affect food companies and retailers (such as imbalances in production and trade subsidies) may heavily influence the way in which they operate *(44)*.

While health ministries have a key role to play in developing policies and regulations that create healthier food environments, a wide range of government sectors have responsibility for policies that also influence food environments *(45)*. These sectors include education, trade, agriculture, business and finance, urban planning, and government finance, which operate across multiple levels of government (including local, national and international) and have an influence on the healthiness of food environments *(43,45)*.

Over several decades, policies and regulations in most high- and middle-income countries have led to food environments that are overwhelmed by highly accessible, relatively cheap and heavily promoted unhealthy foods that typically contain high levels of sodium, saturated fat and/or added sugar *(46)*. These unhealthy food environments result from changes in the global food supply (for instance, in the European context, heavy subsidies, both national and EU-funded, on the production of meat, dairy and sugar make them relatively cheaper and more available population-wide); they are now the major drivers of unhealthy diets, obesity and related NCDs *(46)*.

When considering why this has occurred, it quickly becomes clear that it is a consequence of narrow-minded economic growth *(44)* leading to more liberalized, less regulated global markets *(46)*. While the focus on economic growth and liberalized markets has had many benefits, such as improved food security, this strong drive for economic growth has also led to overconsumption of energy-dense, nutrient-poor food *(46)*. In essence, it is this overconsumption that has led to high levels of obesity, as well as other societal problems, such as rising greenhouse gases and environmental degradation *(32)*.

The proliferation of unhealthy food environments has considerable implications for health equity. Evidence from the Netherlands indicates that children are more likely to be exposed to fast-food outlets in the close vicinity of their home if their mother has a lower level of education *(47)*. Migrants to European nations are also populations of particular concern, as research suggests that they acculturate to the (typically unhealthy) environments and dietary practices of their host nation *(48)*.

Improving the healthiness of food environments requires a comprehensive societal response, including implementation of a broad range of government policies and a substantial response from food companies (Box 3.1) *(49)*. There is global consensus on the areas for action, and agreement that transitions to healthy food environments will need to be predominantly government-led *(32)*.

Box 3.1

People's experience of living with obesity: Ken [a]

Ken has been living with obesity since he was a child. His mother also lived with obesity for as long as he can remember. Throughout his childhood, doctors constantly tried to ascertain why he was so heavy, as his weight continued to increase well into his adolescence. In retrospect, Ken recognizes the unhealthy behaviours and environments of his life: he was working long hours, eating takeaway food and frequently drinking alcohol. As he approached the year 2000 and his 40th birthday, Ken decided to make changes. A diabetes nurse who was working with Ken at the time expressed her concerns about his health and encouraged him to seek a referral to a new obesity clinic. His visit to the clinic was the first time he had taken his obesity seriously.

From his observations from being a health-care worker as well as someone living with obesity, Ken discusses how obesity is a complex health issue that is oversimplified by people, with a lot of blame and shame involved. While public awareness and understanding of obesity has come a long way, Ken believes that key stakeholders, including health-care professionals, the food industry and the advertising industry, need to engage in obesity prevention measures. Ken stresses the need to focus resources on both prevention and management of obesity. He accessed the obesity clinic through a referral from a GP and believes that this referral process is one of the main barriers for people accessing obesity treatment; either they do not have a GP, or their GP does not have knowledge of the clinic. Ken believes that many people are, therefore, unable to access a specialist weight management clinic.

Ken also discusses that he thinks there is a need for tailored approaches to obesity management for various minority groups. He believes that there is a difference between how men and women talk about overweight as well as in their inclination to discuss their experiences and challenges. This is a difference that Ken believes is often overlooked in treatment. Ken believes we need to look to the members of least heard communities and ensure their needs around obesity prevention and management are fully met.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

Globally recommended policy actions include comprehensive regulations to restrict the exposure of children to marketing of unhealthy foods and brands, improved health-related food labelling, and fiscal policies that more effectively incentivize consumption of healthier foods and disincentivize consumption of unhealthy foods *(32)*. Evidence of the effectiveness and cost-effectiveness of such policies to improve the healthiness of food environments is growing, including evidence that policies that are targeted at creating healthy food environments are likely to have a more equitable impact than interventions focused on individual behaviour change *(32,50,51)*.

While there is strong evidence of the burden of diet-related disease and potential solutions that are both effective and cost-effective exist – and in spite of consistent and urgent calls from health experts and public health organizations for multisectoral, multicomponent actions to improve diets – government efforts have generally fallen short of recommendations *(32,49,52)*. Most governments have high-level strategic plans drawn up to improve nutrition, prevent obesity and reduce NCDs *(52)*. However, globally, there has been a notable lack of action when it comes to implementing a comprehensive set of recommended policies to create healthier food environments *(49)*. Faced with extensive movement of goods, marketing, etc. across borders, governments across Europe need to work together. For governments, important reasons frequently given for the lack of policy implementation include limited locally specific evidence of the economic impact of the recommended interventions, strong pressure from the food industry to limit or delay regulations that may reduce their profitability, and a lack of political leadership in the area *(32,44,53)*.

Efforts by the food industry to respond to population nutrition concerns have been similarly weak *(44,54)*. While several prominent food companies have made some commitment to address obesity-related issues, voluntary company policies and commitments are often nonspecific and limited in scope, with poor monitoring and compliance mechanisms in place *(44,54)*. Moreover, large firms are known to deploy a wide range of strategies to protect their business models and products from adverse regulation, while simultaneously building and preserving their market dominance and profits *(55)*. As such, effective nutrition-related actions are unlikely without government intervention and/or sustained public and investor pressure for change *(44)*.

The big challenge for governments is to design public policy to maximize public benefit. This will require broadening the definition of prosperity beyond the current narrow focus on economic growth to include health, well-being, and social and environmental outcomes for current and future generations *(32)*. As part of such refocusing, governments will need to create market operating conditions that favour companies seeking to work for the healthiness of people and the planet, as well as to make profits *(32)*.

Some examples of inspirational and effective initiatives to promote healthy food environments that have been implemented around the world are shown in Box 3.2.

Box 3.2

Policy in action: encouraging healthy eating choices

- In Greece the DIATROFI programme found that combining food aid distributed by means of daily healthy meals at school with an educational programme on healthy nutrition was the most effective way to reduce food insecurity and childhood obesity and to improve students' dietary habits, educational activity and health-related quality of life *(56)*.
- In Flanders, Belgium, the Flemish Institute for Healthy Living has developed new nutrition and physical activity guides designed to make every citizen aware of what constitutes a healthy lifestyle and to motivate them to make healthy choices *(57)*.
- In Austria the "Healthy eating from the start!" programme, established in 2008 and focusing on the prenatal period to the age of 10 years, applies a holistic approach which involves addressing families and individuals, environments, and societal and legal structures. Meanwhile, the "Children eat healthy" programme, developed in 2019 for children between 4 and 10 years, sets out to create and provide new resources to stimulate better diets and to test new communication styles for children, their carers and educators *(58)*.
- In Spain a school programme, co-financed by the EU and the Ministry of Agriculture and Autonomous Communities of Spain, promotes the consumption of fruit, vegetables and milk in schools. The aims of this programme are to promote healthy habits and to reduce the levels of obesity and associated diseases.
- Spain has increased VAT on SSBs and on drinks with added sweeteners (included in Law 11/2020, of December 30, on General State Budgets for the year 2021).

3.4.2 Retail environments

Retail food environments, where food is sold for personal consumption, either immediately or later, include a range of formal and informal markets. Formal markets are those that are regulated through formal governance structures and include food outlets such as supermarkets, convenience stores, dine-in restaurants and fast-food outlets, including online interfaces *(59,60)*. People get an increasing proportion of their food from restaurants, catering establishments, cafés and fast-food outlets. Informal markets are typically regulated through less formal governance structures and include wet markets, street vendors, kiosks and mobile vendors. The retail food environment can be conceptualized as the community food environment (the type, availability and accessibility of food retail outlets in a particular area) and the consumer food environment (the availability and nutritional quality of products available within food retail outlets and the way they are marketed in-store) *(60)*.

Transformations in both consumer and community food environments have shaped the global obesity pandemic *(60)*. In terms of the consumer food environment, unhealthy foods have become more available, more affordable, more acceptable and more heavily

promoted through retail food environments such as supermarkets, convenience stores and fast-food outlets *(60)*. Overconsumption of these energy-dense foods – which are often more palatable and less satiating *(61)* – has been linked to increasing rates of overweight and obesity worldwide *(59,60)*. This has occurred at the same time as a decline in traditional food markets and small specialized stores and an increase in the dominance of supermarket outlets *(60)*. This has already occurred in high-income countries and is underway in low- and middle-income countries *(59,60)*. "Food deserts", where individuals have limited access to affordable and healthy food *(60)*, and "food swamps", where there is a high density of establishments selling unhealthy food relative to healthier options, reflect the impact of the local food environment on dietary behaviours and risk of obesity *(46,59,60,62)*.

A growing number of interventions and programmes designed to improve the healthiness of retail food environments have been implemented and evaluated; for the most part, these involve manipulation of availability, price or product position *(63-66)*. Most such measures report positive impacts on the healthiness of purchasing or consumption, but they have not been taken to scale. Also, few of them focus on reducing the marketing and promotion of unhealthy foods and drinks by retailers and manufacturers. Government-led regulations designed to promote healthier retail environments and improve population diets have also been implemented effectively in several countries in recent years. Most of these are targeted at front-of-pack labelling *(67,68)*, restricting advertising, promotion and sale of unhealthy foods and beverages, mostly to children *(67-78)*, or impose taxes on unhealthy foods and SSBs *(79)*. A notable example is the United Kingdom legislative ban on unhealthy food and beverage multibuy offers (buy one, get one free), sale of unhealthy foods at checkouts and at shop entrances, and sale of unlimited refills of unhealthy foods and beverages in places where they are sold to the public *(78)*.

Investors are increasingly being leveraged by governments to encourage retailers to shift to healthier food environments. For example, in Denmark the retail group Salling Group is refurbishing its supermarkets towards a healthier store layout, and about half of its stores have been renovated to have a larger fresh section *(80)*. Tools for assessing retail policies and actions relating to nutrition and obesity prevention have been developed *(81)*, which are an important way of holding retailers to account, advocating for change and monitoring progress over time. A relative lack of action persists in relation to cafés, catering and dine-in restaurants. This is a fast-growing sector that is not typically held to account to the same extent as other food retailers and manufacturers. The use of food delivery services and apps has become an increasingly important area of focus during the COVID-19 pandemic (see also Chapter 4 on obesogenic digital environments) *(82)*.

3.4.3 Food marketing

Globally, the food and soft drink industries spent more than US$ 33 billion advertising their products in 2020 *(83,84)*. Exposure to marketing of unhealthy foods and brands normalizes consumption of unhealthy foods and influences attitudes, expectations, and purchasing and consumption behaviour across the life course, particularly in children *(85,86)*. In Europe children are exposed to high levels of unhealthy food marketing in

their daily lives in a variety of settings (schools, sports, supermarkets) and through a variety of media (television, digital devices, the Internet) *(87-89)*. International evidence reveals that children from a lower socioeconomic background are disproportionately exposed to such marketing, with some indication that the negative impacts on dietary intake may also be worse for children from such backgrounds *(90)*. Exposure to unhealthy food marketing leads to weight gain and an increased risk of overweight and obesity, cognitive impairments, reduced quality of life and NCDs *(91–93)*.

Strong and consistent evidence demonstrates that government-led statutory action will be required to protect children from the harmful impacts of food marketing, as industry-led codes of practice are found to be largely ineffective *(94-105)*. Despite this, there is relatively little action internationally, and what exists generally still follows out-of-date and ineffective schemes involving self-regulation or codes of practice. For example, the industry-led EU Code of Conduct on Responsible Food Business and Marketing Practices *(106)* has consistently been shown to be largely ineffective.

Chile became the first country, in 2016, to implement comprehensive food marketing controls. Under the Food Labelling and Advertising Law, all advertising of HFSS foods and beverages that is directed at children (under 14 years of age) is prohibited. This includes all marketing on the packaging of foods using child-directed techniques and incentives, such as cartoons, animations, toys and any other content that could attract the attention of children. A ban on all unhealthy food advertising on television programmes aired between 06:00 and 22:00 is also included in the law. Analysis of the impact of this law revealed a significant reduction in children's exposure to food advertising; television advertising with child-targeted appeals, such as cartoon characters, fell by 35% for preschoolers and by 52% for adolescents *(107)*. The percentage of all cereal packages using child-directed strategies was also found to be significantly lower, falling from 36% to 21% after implementation *(108)*. Industry labour market outcomes (aggregate employment and average real wages) have not been affected *(109)*.

In 2021 government of the United Kingdom announced the Health and Care Bill, which, if passed into law, will be the first of its kind globally to include a ban on all paid-for advertising of less healthy food and beverage products on online platforms. Proposed exemptions include brand advertising (as long as there are no HFSS foods advertised); advertisements on digital-only audio media (such as podcasts and music streaming); media supporting point of sale (as when buying a product online from a retailer); small and medium-sized enterprises (fewer than 250 employees); non-paid-for marketing (such as own-brand websites and organic social content); and business-to-business marketing. The bill also includes a ban on all unhealthy food advertising on television between the hours of 05:30 and 21:00.

While many other jurisdictions around the world have some statutory regulations in place to restrict unhealthy food marketing, such regulations are often limited to single media or settings and/or are underpinned by terms and conditions that leave large numbers of children exposed to unhealthy food marketing.

3.4.4 Fiscal environment

The price of foods and beverages is a key driver of population diets. Foods and beverages are generally considered to be price-elastic – as price goes up, consumption goes down, and vice versa. Incentivizing the purchase and consumption of healthier foods and beverages may therefore be leveraged through fiscal policies. This includes subsidies for healthier foods and taxes on unhealthy foods and beverages, as mentioned in section 3.2.1 above. The cost of the health burden caused by unhealthy foods and beverages is not covered by the companies that produce and sell them; instead, this cost is borne by taxpayers. Fiscal policies provide a tool to correct this market failure and recoup some of the costs associated with overweight and obesity.

WHO has called for the adoption of fiscal policies to increase accessibility and desirability of healthier foods and to discourage consumption of less healthy options *(33)*. The intention of food and beverage taxes is fourfold: (i) to increase the retail price and reduce purchase and consumption; (ii) to shift societal norms by sending a powerful message that regular consumption of unhealthy foods and beverages is not considered part of a healthy nutritious diet; (iii) to incentivize manufacturers to reformulate to lower-taxed products when the tax is tied to nutrient thresholds (for example, amount of sugar per 100 ml in SSBs); and (iv) to generate significant government revenue, which may be important in times of economic downturn or may be reinvested in societal health and well-being.

Although taxes on unhealthy foods and beverages continue to be underutilized, there has been considerable momentum in this direction in recent years *(110)*. Most notably, taxes on SSBs have now been implemented in more than 40 jurisdictions around the world, covering more than 2 billion people *(111)*. International evidence, including from Chile, Mexico, Saudi Arabia, the United Kingdom and several states within the United States, demonstrates that SSB taxes are effective in reducing SSB purchases and consumption, generally with greater impact on low-income households *(79)*. Emerging evidence also demonstrates positive impacts on beverage reformulation. Recent evaluation of the United Kingdom Soft Drinks Industry Levy demonstrated a large reduction in the sugar content of soft drinks, with six of the top 10 SSB manufacturers found to have reformulated more than half the products in their portfolio *(112)*. The evidence to support food taxes is less consistent; however, it is recognized that broad-based taxes are important in minimizing substitution of healthy foods with unhealthy alternatives that are not covered by the tax *(79)*.

Subsidies on healthy foods are most commonly embedded in social welfare programmes or achieved through indirect action by removing import tariffs on fruits and vegetables that would otherwise raise the prices for consumers *(113)*. For example, free trade across the EU has resulted in the elimination of import tariffs, while modelling studies suggest that the price of fruits and vegetables in England may rise between 14.3% and 16.6% as a result of higher import tariffs due to a no-deal Brexit *(114)*. Subsidies have been shown to increase consumption of targeted foods; however, several studies also reveal an associated increase in total energy intake and possible stigma for low-income consumers *(16,113)*. A combination of fiscal tools, including broad-based taxes on unhealthy foods and beverages and subsidies on healthy foods, is likely to be the most effective way of shifting population consumption towards healthier diets and reducing obesity.

3.5 Physical activity environments

The obesogenic physical activity environment promotes sedentary behaviour and reduces opportunities for physical activity. Important co-benefits of active living go beyond health and have broad social, environmental and economic benefits, such as reduced carbon emissions, cleaner air, improved social connections among the elderly, longer independent living and more productive societies *(115)*.

3.5.1 Physical environment

The physical environment, both built and natural, can influence opportunities for participation in physical activity *(116)*. The built environment refers to all objects, spaces and buildings that have been created for and modified by people, including schools, workplaces, transport systems, neighbourhoods, houses and sports grounds; and natural environments are those that provide opportunities for people to be physically active outdoors, including greenspace, lakes, oceans and mountains *(116)*.

3.5.1.1 Built environments

Health-promoting urban design and planning principles have been shown to increase active transport and active recreation. The influence of the urban environment on health is highlighted by the WHO European Health Cities Network *(117)*. One aspect of the most recent phase of the network (2019–2025) is a focus on whole-of-community approaches that strengthen capacity at local government level to provide health-promoting environments and act to reduce health inequalities within and between countries *(20)*.

Specific elements of the built environment have been found to enhance physical activity levels. These include greater land-use mix (colocation and integration of multiple destinations), greater intersection density (enhancing connectivity), residential density, and access to public transport and recreation facilities *(20,118)*. In particular, the physical environment shapes opportunities to engage in active transport, which has benefits beyond physical activity, including traffic reduction and associated decline in carbon emissions and noise pollution *(119)*. Research involving adults across 10 countries, including four European cities, found residents of the most activity-friendly neighbourhoods accumulated 68–89 more minutes of physical activity per week compared to people in the least activity-friendly neighbourhoods *(120)*. There is growing evidence of similar associations in adolescents and children *(121,122)*. In addition, the school physical activity-built environment is also important (Box 3.3).

The Lancet series on urban design, transport and health identified successful environmental interventions that have resulted in increased walking, cycling and use of public transport *(118)*. These interventions include improving accessibility of destinations, equitable employment distribution across urban areas, car parking disincentives, pedestrian- and cycle-friendly transport networks, increasing access to public transport, and making active travel more desirable. European cities that have implemented traffic plans restricting car access and improving cycling infrastructure have been successful in increasing cycling levels *(125,126)*. While the equity impacts of these initiatives were not reported, evidence indicates that creating urban environments

that are more conducive to active transport can play a role in reducing health inequalities *(127,128)*. Modelling of the health impacts of implementing policies to make six diverse cities more compact predicted increases in population-level physical activity, primarily attributable to active travel, and a subsequent decline in NCD incidence *(129)*. Such approaches are reflected in the WHO Global Action Plan on Physical Activity 2018–2030 *(33)* and the WHO European Health Cities Network *(130)*.

Box 3.3

Polygon For Physical Activity of School-Aged Children

In Croatia approximately 14% of the main elementary schools and 83% of peripheral schools do not have sports facilities. To support teachers in providing physical education that meets students' needs for physical activity, kinesiological equipment "Polygon For Physical Activity of School-Aged Children" was designed within the National Health Promotion Programme, "Healthy living" *(123,124)*. This set of moveable equipment consists of 25 elements that are safe for children and easy to assemble and disassemble and is aimed to serve as an alternative solution for implementing Physical Education class as well as to enable children to be regularly physically active in schools lacking school sports gyms both during and outside school hours. The Croatian Institute of Public Health has, with the help of the Ministry of Health and the European Social Fund, secured the procurement of "Polygon" sets for 120 main and 1000 peripheral elementary schools in the Republic of Croatia that did not have a school sports gym. An educational manual was prepared to help teachers to use the equipment, and the three-member teams, a school kinesiologist and two class-teachers, from each school were trained in the practical use of the equipment. The main impact of this intervention is that students who attend schools without school gyms now can engage in physical activity in schools creatively and innovatively and participate in Physical Education classes in school regardless of weather conditions. Teachers can implement a full curriculum of Physical Education course and accomplish goals and tasks set by the Croatian national curriculum, and teach children about the health benefits of regular physical activity. The entire intervention had an impact on raising awareness on the importance of physical activity in school-aged children, especially in schools with no spatial conditions for regular physical activity in children.

3.5.1.2 Natural environments

Natural environments comprise greenspace (publicly available open space with a high proportion of green cover) *(131)* and blue space (spaces that include coastal areas, lakes, rivers and canals) *(132)*. Distance and access to greenspace and blue space consistently show a positive association with physical activity levels in several systematic reviews *(133–135)*, although associations with obesity vary according to location and demographics *(136–138)*.

Interventions to enhance existing greenspaces, construct new greenspaces and add walking/cycling trails, in combination with physical activity-focused programmes, have resulted in increased physical activity levels within these spaces *(139)*. In the United

Kingdom a national programme that involved extending walking and cycling trails to improve connectivity, including riverside walking trails, resulted in increased walking and cycling over a two-year period *(140)*. In 2020 Public Health England encouraged local councils to invest in greenspace infrastructure for healthier communities *(141)*. Other examples of current practice include the following:

- In Paris, France an increase in the number of cycle lanes and separation of cyclists from motorized traffic resulted in a 54% increase in bicycle use between 2018 and 2019 *(125)*.
- In Slovenia recent initiatives aimed at increasing active transport include co-finance for municipalities to enhance pedestrian and cycling infrastructure and development of guidelines and rules to assist cities in developing safe and effective cycling and pedestrian networks *(142)*.
- In Slovenia as part of the programme entitled Expert Basis for Spatial Planning of Green Areas, guidelines were developed for green space planning to support municipalities in devising relevant approaches and promote physical activity of the population *(143)*.
- In Serbia the city of Novi Sad is the flagship "Healthy City" in Serbia, where more than 90 km of bicycle paths are available, as well as public rental schemes and mountain bike routes on the nearby Fruska Gora mountain.
- In the United States construction of an urban greenway/trail to provide connectivity between residential and nonresidential destinations in Knoxville, Tennessee, resulted in increased total physical activity, walking and cycling *(144)*.
- In Western Australia the Liveable Neighbourhoods Community Design Guidelines planning policy was introduced to ensure that newly built environments support active transport, reduce reliance on car travel, and enhance social cohesion and safety. The Residential Environments project (RESIDE) has evaluated the health and well-being outcomes for residents of a new housing development built under this policy *(145)*.

To strengthen a multifactorial approach to health-promoting environments, providing access to high-quality natural environments needs to be included as part of wider systems change to increase opportunities for physical activity and to reduce obesity across the life course *(146)*.

3.5.2 Policy and regulation

Policy levers to encourage regular physical activity and reduce sedentary time can operate at multiple levels (for example, setting, local government, national, state) and have low implementation costs *(147,148)*. Key policy areas include: (i) transport; (ii) infrastructure and planning (discussed in the previous section); (iii) education; (iv) employment; (v) health care; and (vi) sport and active recreation.

Policy interventions in education settings (for example, early learning, school, higher education, trade) have been shown to increase physical activity. Key initiatives are WHO's framework for health-promoting schools *(149)* and the Centers for Disease

Control and Prevention's Whole School, Whole Community, Whole Child framework *(150)*. These represent standards of practice that can improve the health of children, adolescents and staff in education settings worldwide. Whole-of-school approaches are multifaceted interventions targeting multiple behaviours (for example, physical activity, sedentary behaviour, diet quality, sun protection), require cross-setting engagement and investment (government, schools, local council, health services) and can improve the health, well-being and education of children.

Various work-related well-being and/or specific physical activity policies have been shown to be effective in increasing employee physical activity and/or reducing sedentary time *(151)*. Examples include policies requiring staff to take frequent short breaks from sitting (1–2 minutes every 30 minutes) *(152)*, flexible work times and breaks for employees to participate in physical activity, and policies that promote active transport (such as cheaper or free public transport passes or bicycles and disincentives to use motor vehicles) *(153)*.

Health services are another important setting for promoting physical activity. Policies promoting physical activity screening, prescription, counselling, referral and monitoring should be a routine part of a patient's treatment *(154)*. Interventions in primary care have been found to increase physical activity among patients *(155)*. Policies embedding physical activity assessment and prescription should also be embedded in university training for health-care professionals.

At local government level, policies and funding to maintain, improve and expand local recreation and sporting facilities and protect public open spaces (including greenspace) are key action areas for physical activity promotion *(156)*. State and national governments are introducing policies to provide, promote and protect state and national parks for health and well-being *(157)*.

Some examples of inspirational and effective initiatives to promote physical activity that have been implemented around the world are shown in Box 3.4.

Box 3.4

Policy in action: getting people active

- In 2020 Luxembourg became the first country in the world to make all public transport (trams, buses, trains) free for all residents and visitors *(158)*.
- In Serbia "The National School Sport Association (Savez za školski sport Srbije) established the "Sports to schools" scheme in 2012, with the main goal of increasing the number of elementary schoolchildren (grades 1–4) participating in school sports and exercise. In 89 cities, children can join the programme that provides 2 hours of structured physical activity for free. "Let's get our children active" (Pokrenimo našu decu) is a programme launched in 2016 that offers different 15-minute physical activity modules to be delivered on a daily basis in the classroom, gym or outside.
- In local communities across Serbia free access to public pools and other sports facilities (ice rink, gyms, etc.) is provided during school breaks. The offer usually

Box 3.4 contd.

includes free swimming or skating lessons, fitness/games instruction or even summer/winter camps, etc. Some additional opportunities are provided throughout the year for children and youth with disabilities (e.g. free access to exercise facilities on allotted hours, subsidized fees, weekend programmes, etc.).

- In 2021 North Macedonia amended its law that mandated the provision of physical activity opportunities in primary schools throughout the country. This law also ensured the integration of physical education teachers into the classes of other teachers from the first to the fifth grade, referred to as the Tandem Model *(159)*.
- In the city of Reykjavik in Iceland a digital platform "Leisure Card" has been introduced as part of the so-called "Icelandic prevention model" to support structural leisure activities and other measures that contribute to positive behavioral changes among Icelandic adolescents. The purpose of the Leisure Card (a grant worth about €350 per year per child) is that all children and adolescents in Reykjavik aged 6-18 years can participate in the structured leisure activities (sports, culture, music, dancing, etc.) regardless of their economic and social circumstances *(160)*.
- In Victoria, Australia the Get Active Kids Voucher programme offers eligible families up to 200 Australian dollars per child to get their children involved in organized sport and active recreation by reimbursing out-of-pocket expenses such as membership fees, equipment and uniforms *(161)*.
- Parkrun is a volunteer-run community running and walking event (5 km for adults, 2 km for juniors) that originated in Teddington, London, United Kingdom in 2004. Now operating in over 23 countries, including Australia, Austria, Canada, Denmark and Sweden, parkrun offers free events every weekend that allow families, individuals and communities to engage in physical activity *(162)*.
- CATCH (Coordinated Approach To Child Health) is a multicomponent and multilevel intervention that originated in the United States to create healthy school environments through five modules (physical education/physical activity; health and nutrition; vaping prevention; family and community; and sun safety) *(163–165)*.
- Originating in Bogotá, Colombia Ciclovía is a free community programme in which streets are closed on Sundays for seven hours and during holidays, allowing various forms of active recreational activities (such as walking, cycling, running and rollerblading) to take place *(166)*. Ciclovía now exist in 50% of countries in the Americas *(167)*.
- In the United Kingdom Sport England's This Girl Can mass-media campaign, launched in 2015, was designed to encourage women and girls of all shapes, sizes, abilities and backgrounds to become active in sport. The evocative campaign counteracted the stereotypical commercial representation of sport as the domain of attractive and elite individuals, replacing it with a vision that empowered women regardless of size, shape or ability *(168)*; the number of women participating in sport in England reportedly rose by a quarter of a million with 12 months of the campaign's launch *(169)*.
- Daughters and Dads Active and Empowered (DADAE) is a community-based programme in Australia that targets fathers as the agents of change to improve their daughters' physical activity levels, skills and well-being *(170,171)*.

3.5.3 Fiscal environment

WHO's Global Action Plan on Physical Activity 2018–2030 *(33)* calls for the adoption of fiscal policies to promote physical activity and reduce inequity experienced by populations. Economic levers are likely to be especially important for vulnerable groups (such as people with disabilities, people with low income, women and girls, and culturally and linguistically diverse populations), who face unique barriers to participation in physical activity, and can help to reduce health disparities and inequities *(147)*. International examples of fiscal strategies include incentivizing physical activity participation either by providing targeted financial payments (such as cash rewards for meeting activity targets) or by reducing financial barriers (for example, by offering free or subsidized vouchers, equipment or memberships) *(172)*. These fiscal strategies increase physical activity and offset the costs incurred by both physical inactivity *(173)* and overweight and obesity *(174)*.

However, evidence of the effectiveness of economic and/or fiscal interventions to increase physical activity is inconclusive. This uncertainty is partly because the studies are heterogeneous in terms of the target of the fiscal interventions and the target outcomes. Macroenvironmental incentives (for example, through government) and microenvironmental incentives (such as in workplaces) have been shown to increase physical activity *(172)*. Examples of successful fiscal interventions to increase active transport include providing free bicycles *(172)*, subsidizing public transport passes *(174)* and dynamic road prices (such as congestion taxes) *(175)*. Financial payments (cash rewards, vouchers, etc.) have also been shown to increase leisure-time physical activity among adults *(176)*, although no effect was observed for total physical activity. Incentivizing other ways of active transport could be explored further, such as the use of e-bikes, which have been shown to reduce the use of motorized vehicles with a positive effect on health *(177)*.

3.5.4 Other obesogens: endocrine-disrupting chemicals

Apart from the aspects already discussed about the obesogenic food environment and the physical activity environment, there is also evidence that other factors or obesogens in the environment exist that have an effect on obesity. One of these are industrially produced endocrine-disrupting chemicals (EDCs). Emerging evidence indicates that EDCs can influence appetite and weight regulation, and quantities found in common food packaging and household products can have obesogenic effects *(178)*. An EDC has been defined as "an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny, or (sub)populations" *(178)*. EDCs are widespread and found in agriculture, food packaging, road traffic pollution, water supply, household furnishings and cosmetics; being so widespread, these pollutants are hard for individuals to avoid and therefore appear to justify government intervention to reduce exposure.

3.6 Conclusion: tackling the complexity of obesogenic environments

Since the concept of obesogenic environments was first introduced, intervention efforts have increasingly engaged with the upstream drivers of obesity and their complex interplay. Methods to help stakeholders engage with and address this complexity – particularly the systems science approach that underpins the WHO call to strengthen health systems – are now being applied to explicitly capture the complex relationships of cause and effect, to understand the potential and unintended consequences of actions within a system, and to apply this knowledge to obesity prevention. Systems science is contributing to the design of national obesity prevention interventions in the United Kingdom *(141)*, at EU level *(179)*, and in communities in a number of other countries including Australia *(180–182)*. The 2019 Lancet Commission report recognizes the potential of whole-of-system approaches to address malnutrition in all its forms (not just obesity) as well as climate change *(32)*.

One outcome of whole-of-system approaches is to locate the original components of the obesogenic environment within the broader social determinants of health and well-being and to connect them with economic prosperity and ecological health and well-being. The Lancet Commission report identifies policy inertia, caused by competing priorities pulling governments in multiple directions, as a key challenge for obesity prevention *(32)*. A further challenge is the long-term commitments required of governments to address these problems. WHO's European Healthy Cities Network aims to tackle this challenge by catalysing a movement towards high-level commitment to health across government sectors and levels *(117)*. This movement is underpinned by a vision to prioritize actions that promote people's livelihoods, enable community participation in decision-making, and broaden our understanding of prosperity to include values-based governance, while promoting planetary health and peace globally. Capturing multiple perspectives on how systems work and where leverage points will be most effective will be a key next step to overcoming this challenge and achieving daily living conditions that are more healthful. The environments described in this chapter remain critical to our efforts to prevent obesity by ensuring access to health-promoting spaces for all.

Systems science allows us to see the complexity within systems and to move seamlessly from microsystems through meso- and macrosystems, opening the potential to prevent malnutrition and protect planetary health simultaneously. Strengthening community action *(183)* is the starting point for initiating this. Improvements in the healthfulness of food and physical activity environments, achieved by working with stakeholders to co-create sustainable change *(184,185)*, provide a contemporary approach to this. Additional efforts are required to codesign actions that reflect the voices and values of those who are underrepresented in, but often severely impacted by, high-level decision-making due to social and/or economic exclusion.

WHO has identified the necessary infrastructure to support such change; this comprises *(186)*:

- leadership (e.g. ministerial-level commitment to obesity and NCD prevention);
- intelligence and monitoring systems (e.g. population-wide dietary surveys, anthropometric measurements and food environment monitoring);
- policy evaluations;
- financial commitment (e.g. sufficient recurrent funding for health promotion activities);
- networks, including partnerships (e.g. across various sectors of government and with nongovernmental organizations for coordinated preventive action; and
- workforce development (e.g. development of obesity and NCD prevention skills within, and outside, government).

Governments also need to invest in the basic infrastructure, or building blocks, for obesity prevention in order to sustain preventive action and underpin more direct prevention actions *(187)*. These building blocks (leadership/governance, service delivery, human resources, information, finance, and products, treatments and technologies) are often neglected because they are less visible and immediate than health promotion programmes, events and social marketing campaigns *(187)*.

To equitably prevent population overweight and obesity, we need to recognize that food and physical activity environments and cultures are not simply relevant to health and nutrition. They reflect a much more complex and diverse set of beliefs, attitudes and practices concerning why, when, where and how we eat, live, work, move and play *(188,189)*. This recognition will help us address not only obesogenic environments but other modifiable risk factors for NCDs *(190)* and the confluence of the crises of undernutrition, obesity and climate.

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4. OBESOGENIC DIGITAL FOOD ENVIRONMENTS

Key highlights

- Digital food environments are a significant and worthwhile area to study and monitor, especially when it comes to understanding the determinants of obesity.
- Digital marketing of unhealthy food products has an impact on children's food choices and eating behaviour and can increase the risk of overweight and obesity.
- Studies using the CLICK monitoring framework have shown not only the high exposure of children to products high in fat, sugar and salt while using their online devices but also the extent to which existing nutrient profile models are disregarded.
- Detailed, accurate and accessible data on the nutritional content of foods and beverages are needed to inform robust policy development.
- Digital techniques and machine learning can be used to generate large datasets from online retail data.
- For online retail environments, databases such as foodDB provide in-depth weekly snapshots of product data and can track trends and inform monitoring and evaluation.
- Emerging evidence highlights the role of meal delivery apps in extending the physical food environment and providing convenient access to unhealthy food and beverage options with the swipe of a finger.
- The digital ecosystem is evolving rapidly, so effective regulatory and monitoring systems adapted to national and regional contexts are needed.

4.1 Introduction

Digital food environments are the online settings through which flows of services and information that influence people's food and nutrition choices and behaviour are directed. They encompass a range of elements, including social media, digital health promotion interventions, digital food marketing and online food retail *(1)*.

Digital technologies are becoming integrated, to varying degrees, into everyday life across the 53 countries of the WHO European Region. In many parts of the Region, computer and smartphone use is widespread and internet connectivity is stable and fast *(2)*. Many people living in the Region are also avid users of social media platforms *(3)*. This means that decisions about acquiring, preparing and consuming food are no longer made solely in our "offline", or analogue, lives. Digitalization is currently taking place in all dimensions of the food environment, allowing new forms of buying and selling food to emerge *(4)*.

This evolution makes digital food environments a significant and worthwhile area to study and monitor, especially when it comes to understanding the determinants of obesity.

Fig. 4.1 shows a conceptual framework of digital food environments in which numerous digital actors, activities and settings play a role in influencing consumers' dietary patterns and behaviour with respect to health and nutrition in the digital food environment *(5)*. At the same time, the digital food environment interacts with physical food environments in multiple ways. For example, meals that are ordered online are prepared in physical restaurants, and groceries that are ordered via a website are packed in warehouses and transported to private homes. Food marketing has taken on new forms in the digital space and many online platforms have introduced marketing of food and drink products in their content *(1)*. This, in turn, can lead to broader social, cultural, environmental, economic and technological impacts *(5)*.Thus, in light of this report, the obesogenicity of digital food environments can be defined as the sum of influences that the digital surroundings, opportunities or conditions have on promoting obesity in individuals or populations.

Digital food environments are largely absent from the public health agenda. While an increasing number of people are accessing online services and spending more time online *(6)*, regulators often lag behind in developing regulatory frameworks that govern rapidly evolving digital platforms. For example, it is difficult to regulate the marketing of unhealthy products, as advertising has become more targeted and personal and, consequently, more difficult to monitor *(1)*. Undoubtedly, digital food environments are influencing the accessibility, desirability, affordability and convenience of food in the WHO European Region. However, this is a relatively understudied and multifaceted subcomponent of food environments. As such, a solid evidence base has yet to be developed. (For more on obesogenic environments, see Chapter 3.)

This chapter will investigate the connection between digital food environments and obesity. The examples of digital marketing, gaming, online supermarkets and meal delivery apps will be discussed. These examples, together with case studies from Member States, will be used to demonstrate current interventions in the WHO European Region.

4.2 Digital marketing

While the evidence is not consistent whether exposure to unhealthy food advertising actually increases the consumption of unhealthy food in adults, an increased unhealthy food intake in children can be observed immediately after being exposed to unhealthy food advertisements. This effect is even stronger for children who already live with overweight or obesity *(7)*. Digital marketing is reaching children through a variety of entertainment media that influence their choice of food and eating behaviour *(8)*. Projects funded by the EU, such as STOP (Science and Technology in childhood Obesity Policy) and Best-ReMaP, aim to promote joint action on the part of EU Member States to reduce childhood obesity by including several focus points. The huge challenge posed by digital marketing of unhealthy products to children is also acknowledged. Best-ReMaP has four main aims or outcomes *(9)*:

- to devise a harmonized EU nutrient profile model (NPM), built on the basis of the WHO Regional Office for Europe NPM *(10)*;

A conceptual framework of digital food environments

Fig. 4.1

Source: adapted from Granheim (2019). Reproduced with permission of United Nations System Standing Committee on Nutrition (UNSCN) *(5)*.

- to develop guidance on a code of practice, which will provide a toolkit with checklists;
- to build a harmonized EU monitoring protocol, which will be based on a comprehensive review of already existing monitoring protocols, such as the Nordic monitoring protocol, the INFORMAS approach and the WHO CLICK monitoring framework *(11–13)*; and
- to propose a unified EU framework for action.

One emerging part of online marketing technique is the use of advergames, which are online games that are often developed for children to advertise certain brands of products in a positive entertaining environment. Evidence shows that these games have a significant effect on the consumption of unhealthy foods *(4)*. Lifelong exposure to digital marketing of unhealthy foods, which has already started in childhood, is a major concern, especially because of the effects that are caused by short and immediate exposure to unhealthy food advertisements. Food and beverage companies can target advertisements to specific children or adolescents based on their online profiles, personal characteristics and previous browsing history *(13)*.

While television marketing was heavily used in the past and is still used (Box 4.1), online and digital marketing techniques have taken over. As a result of this history, there is a more robust evidence base related to television marketing than online and digital marketing. Several studies exploring the effect of television marketing on children's eating behaviour have found that there is an effect on a child's eating behaviour *(14–16)*. Studies show that television food advertisements promote especially unhealthy foods and create a positive atmosphere that influences their attitude towards these foods; healthy foods are advertised less *(17,18)*. While voluntary television marketing restrictions have been implemented in some countries, studies show that television restrictions are generally not respected and monitoring is difficult.

Box 4.1

Learning from the monitoring and evaluation of television marketing in the Russian Federation, Kyrgyzstan and Kazakhstan

Learning from studies on television marketing of food and beverages can help us to understand how similar tactics might be carried over to digital food environments.

Monitoring and evaluation of the scale and nature of food marketing to children via television were carried out in the Russian Federation, Kyrgyzstan and Kazakhstan in 2017–2018 *(19–21)*. In Kazakhstan and the Russian Federation the most common type of advertising on television was advertising of food and beverages (32.8% and 19.2%, respectively) among all advertised goods (products). In Kyrgyzstan the share of food and beverage advertising was 7.2%, the fifth most common form of advertising to children. In Kazakhstan and Kyrgyzstan the most common forms of food advertising were SSBs such as cola and lemonade. In these three countries, an average of 73% of television-advertised food and beverages would be prohibited for advertising if restrictive measures covering HFSS products were in place, as per WHO recommendations.

Advertising HFSS food and beverages to children has a long history and has gradually improved its effectiveness and the influence it has on children. Marketing techniques and strategies have also changed over time. Modern approaches and complex algorithms enable marketing companies to buy and use large amounts of data points to reach and acquire customers. Though marketing techniques have changed over time, children have always been influenced by HFSS food marketing *(22)*.

Digital marketing is currently one of the most widely used forms of marketing. Use of complex algorithms and new strategies such as social media influencer marketing means that online marketing has become very powerful and influential, especially for children and young people *(13)*.

Especially during the global COVID-19 pandemic, the food and drink industry has increased the impact of its marketing by using different approaches to promote their unhealthy products. While some companies changed their brand logos and packaging into COVID-19-related illustrations (such as lungs), others addressed health-care workers directly by providing food and drinks, donated money to aid organizations or supported COVID-19-related health interventions. Digital marketing also increased significantly during the pandemic, and use of increased virtual interaction and digital marketing was observed. Social media also became an influential platform that was increasingly used during the pandemic *(23)*.

4.2.1 Developing policy approaches to digital marketing to children

The high numbers of children living with obesity, heavy marketing towards children, lack of regulation and the need to act put marketing of food and nonalcoholic beverages to children on the agenda during the Sixty-third World Health Assembly (WHA) in May 2010. The WHA recognized the extensive level of food marketing, especially the large number of HFSS products marketed to children globally. The importance of monitoring and the attempts made by some Member States to regulate marketing was also recognized. Recommendations were formulated to guide the efforts made by Member States to design new policies, or strengthen existing policies, on food marketing communications to children in order to reduce the impact of HFSS food and beverage marketing *(14,24)*.

Resolution WHA63.14 requested that the WHO Director-General provides technical support to Member States in implementing, as well as monitoring and evaluating, the recommendations. This framework document has been developed in response to the mandate of resolution WHA63.14 and is aimed at policy-makers wanting to apply the recommendations in their individual territories *(14,24)*.

The recommendations define the concept of "marketing to children", provide examples of marketing techniques, and explain how marketing works and who is involved. Policy development is then described in a step-by-step process, starting with what is required for a situation analysis and moving on to the pros and cons of adopting a comprehensive or stepwise policy approach; which children need protection; what communication channels and marketing techniques to target; and what foods should be included or excluded. Building consensus across government and other stakeholders is the key to successful policy implementation (Box 4.2) *(14,24)*.

Box 4.2

Portuguese law that restricts unhealthy food marketing

Since 2019 Portugal has had a law that restricts the advertising of energy-dense HFSS food and beverages. Food products may only be advertised if they comply with the Portuguese NPM, which is based on the WHO Regional Office for Europe NPM.

Law No. 30/2019 of 23 April 2019 protects children and adolescents under 16 years of age and covers traditional broadcast channels and various venues (such as schools). The law also applies to non-broadcast and online media, such as websites, social media platforms and mobile applications where the content is intended for children under 16 years.

After implementation of the law, monitoring children's exposure to unhealthy food marketing became a high priority so that compliance with the law could be evaluated. Portugal piloted the WHO CLICK monitoring framework (see section 4.2.3 below) and is preparing to implement it using a larger and more representative sample. Other methods have been implemented as well – specifically, the WHO monitoring protocols for websites and social media brand pages, as well as for YouTube videos from social media influencers. From these monitoring initiatives, it was found that Portuguese children had been exposed to unhealthy food marketing when online. Some violations of the law have been reported and referred to the judicial system by the competent authority in Portugal. However, these processes have proved to be complex and challenging to corroborate.

It is essential that all lessons are learned if a thorough monitoring system is to be implemented in the country. Especially with the new technologies and techniques now being used, monitoring digital marketing poses considerable challenges. An accurate and regular monitoring system is crucial to evaluate compliance with the law, thereby ensuring that children are indeed protected from harmful marketing practices.

Even though data protection laws such as the General Data Protection Regulation (GDPR) have broadly been adopted in the EU, children's data are still used in targeted and personalized marketing techniques. Instead of sharing the same advertisements with everyone, algorithms target messages based on a child's interests. Children are generally more vulnerable to advertising messages and techniques as they are less able to recognize marketing manipulation and marketing techniques *(22)*. Another intervention, introduced by the European Commission in March 2010, is the Audiovisual and Media Services Directive (AVMSD), whose purpose is to coordinate legislation on audiovisual media within the EU. The AVMSD was created in response to the quickly developing audiovisual media sector, in order to maintain an environment that allows competition in the European audiovisual industry and provides a controlled environment for people to freely express themselves, while at the same time combating racial and religious hatred and protecting minors using media from harmful content. The most recent revisions of the AVMSD were conducted in 2016 and 2018. After the revision, EU countries had 21 months to enshrine the guidelines in their national law *(25–27)*.

4.2.2 Social media platforms and influencers

Marketing to children is often located at places that are connected with emotions – for example, video games or social media platforms that encourage children to engage with the marketing content and share it with friends *(18,22)*. When data are collected from children regarding their online presence, the marketing can be even more powerful and influential. Existing regulations are not working effectively enough to protect children. Often voluntary approaches are used, which are not properly enforced and implemented by the industry. Studies show that voluntary approaches are lacking effectiveness worldwide *(28)*.

Social media platforms, such as Facebook, Instagram, Snapchat, YouTube and TikTok among others, are popular platforms for children and young people as well as for marketing and advertising companies. While there are existing age restrictions in place, age verification is weak and often bypassed by children. Access to these platforms allows children to see and interact with content shared by celebrities, which can lead children to believe that these celebrities are sharing insights about their lives as friends would do. This can have a great impact on how children perceive advertisements presented by their favourite celebrities. Advertisements are often not marked, or not clearly marked, as such, which makes it hard to identify marketing. The extensive use of HFSS advertisements by social media influencers can be explained by the social cognitive theory. Children see their favourite influencers as role models and change their behaviour accordingly. It is also likely that children see influencers presenting and endorsing HFSS food products as a highly credible and trusted source of information *(29)*. In view of the negative health impacts that marketing of HFSS foods can have on children, the food marketing defence model was developed by Jennifer Harris and colleagues to explain how marketing affects children and to show what is needed for them to see an advertisement as such and understand the purpose behind it *(30)*. The model lists four conditions that are needed for children to resist food marketing: awareness of advertising, understanding of its persuasive intent, the ability to resist it and the motivation to do so.

Studies have shown that HFSS food marketing through social media influencer channels has an immediate effect on children's eating behaviour. Use of social media as a marketing platform has become more popular in recent years and the number of children using social media has increased, resulting in a higher exposure of children to marketing. Especially when advertisements are well integrated into social media influencers' content, it is hard for children to recognize marketing as such and endorsements from such figures have a powerful effect *(31)*. Children are generally less able than adults to recognize advertisements and more likely to be influenced by marketing *(7,15,16)*. Evidence suggests that children with a low socioeconomic background are more likely to be exposed to outdoor as well as television marketing *(32)*. Mandatory marketing restrictions can protect children irrespective of their socioeconomic background.

However, even when children see and understand that content includes advertisements, they still seem to trust their favourite influencers. Studies have concluded that many children believe that they are resistant to advertisements, but the existing evidence suggests that this is unlikely to be the case *(29)*.

4.2.3 Establishing monitoring systems

In the WHO set of recommendations on the marketing of foods and nonalcoholic beverages to children, 12 recommendations are formulated for Member States to implement in their national contexts *(14)*. Along with recommendations on the rationale underlying policy and on policy development, implementation and research, recommendations 10 and 11 address the need for objective policy monitoring and evaluation.

In order to restrict marketing, NPMs have been developed to set thresholds that either permit or prohibit the marketing of certain food products. According to a WHO definition, nutrient profiling is "the science of classifying or ranking foods according to their nutritional composition for reasons related to preventing disease and promoting health" *(33)*. NPMs are used for different purposes to classify foods and drinks based on their nutritional composition, which – in the case of marketing restrictions – allows products to be categorized as permitted or not permitted to be marketed to children; the nutrient content of the food or beverage has to be within the limits set by the NPM, otherwise the product cannot be marketed to children *(33)*. The WHO Regional Office for Europe developed an NPM to restrict marketing to children in 2015, which will be updated in 2022 *(10)*. Countries are encouraged to adapt the NPM to their national context and implement it.

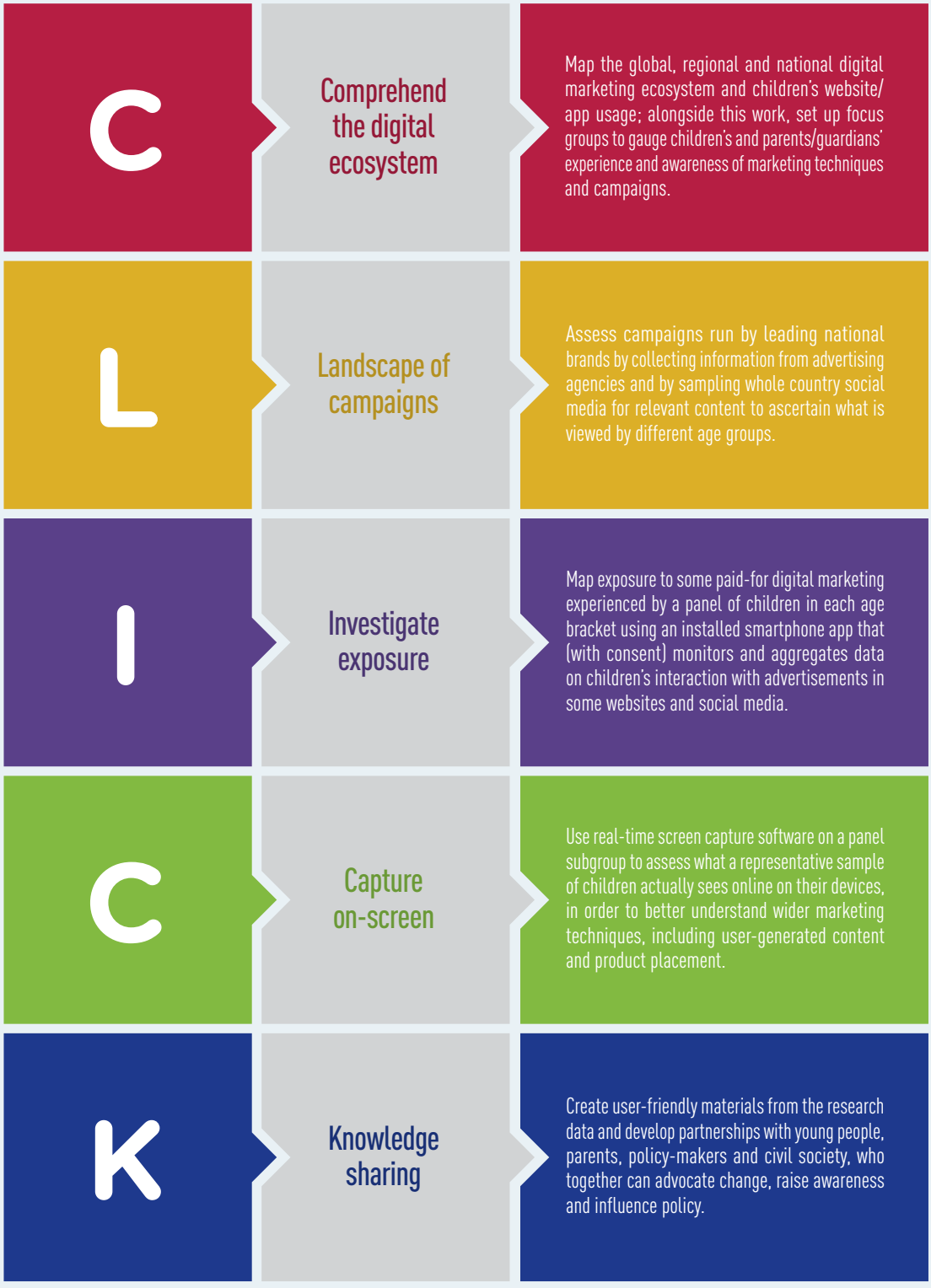
One serious limitation in implementing NPMs is the lack of complete information on nutritional composition for some products, especially in countries without clear labelling regulations. This information is needed to properly classify foods *(34)*. Another difficulty is the lack of monitoring systems that show the actual marketing exposure of children and whether the industry respects the limitations set by NPMs. Many false assumptions and misconceptions exist, even at government level, which can jeopardize strong marketing restrictions. For example, a recent study concluded that the United Kingdom government underestimated the impact and scale of digital marketing; it pointed out the importance of solid monitoring and analytical approaches to present the actual extent of children's exposure to digital marketing, rather than relying on assumptions *(35)*.

Given the individualized nature of digital food marketing, it is essential to capture children's actual exposure to this form of marketing. There are some commercial tools available to capture the unique details (media ID) of digital advertisements seen on a device. However, only paid-for advertisements shown to children using social media can be tracked by means of their media ID. Issues such as product placement and promotion of products by influencers are hard to monitor using existing tools. The challenges presented by monitoring are both ethical and practical in nature. Clear protocols that have been approved by ethics boards are essential. Children are a vulnerable subpopulation, which makes the screen capture of their devices a sensitive issue, and it can also be a security issue if the risks associated with recording personal data or location data are not addressed. On the practical side, various issues have to be considered, including the resource-heavy data analysis required after collecting thousands of data points, the problem of collecting relevant data for analysis from large platforms, and the difficulty in using a single monitoring system that should be adaptable to different national contexts *(13)*.

To further support Member States, the WHO European Office for the Prevention and Control of Noncommunicable Diseases (NCD Office) developed the CLICK monitoring framework (Fig. 4.2) *(13)*. This is designed to assist Member States in monitoring all kinds of digital marketing, including paid-for advertisements, product placements and influencer marketing, and to support them in implementing regulations and policies to control marketing.

The CLICK monitoring framework

Fig. 4.2



Source: adapted from WHO Regional Office for Europe (2018). Reproduced with permission of World Health Organization under Creative Commons Attribution CC BY-NC-SA 3.0 IGO Licence *(13)*.

Studies using the CLICK monitoring framework have shown not only the high exposure of children to HFSS products while using their online devices but also the extent to which existing NPMs are disregarded. Often marketing restrictions are voluntary in nature and do not have a mandatory component with which the food industry is obliged to comply. Enforcement and monitoring of compliance with marketing restrictions are lacking in many countries. Stricter policies are needed to reduce marketing pressure on children and to protect them from constant exposure to unhealthy products. The CLICK monitoring framework has been successfully adopted in Norway, where it was found that eight out of 10 food and drink advertisements for children contravened the WHO Regional Office for Europe NPM *(36)*.

Digital marketing of HFSS products has a direct effect on children's eating habits which can lead to childhood overweight and obesity *(7,32,37)*. Most national marketing restrictions are too weak and do not properly protect children. WHO has provided a set of recommendations regarding marketing of foods and nonalcoholic beverages to children *(14)*, and it is committed to supporting countries to implement objective monitoring systems and strict marketing regulations that protect children regardless of their socioeconomic background.

4.3 Active video games and internet-based interventions

In 2020 the gaming industry experienced impressive growth in the number of players and saw an increase in gross sales and revenues. Currently, there are close to 3 billion players across the world. Most players (2.8 billion) play on mobile phones, and there are 1.4 billion PC players and nearly 0.9 billion console players. While the video gaming boom was accelerated by COVID-19, its growth is predicted to continue beyond the pandemic *(31)*. The video game industry is continuously evolving and progressively versatile, offering a range of platforms, modes and genres. For example, active video game consoles allow users to interact with the game physically, and playing online has advanced the multiplayer nature of gaming *(38)*. Furthermore, video games are socially interactive in a way that has never been seen before. Increasingly, players are gaming online, not only with friends and family but with complete strangers, crossing vast geographical distances and thus blurring cultural boundaries, age and generation gaps, socioeconomic differences, and even language barriers *(39)*.

At the same time, video games are of major concern for public health because of their association with negatives effects on physical and mental health. However, there is no clear consensus on the link between video gaming and physical and health behaviours or on their impact on public health issues *(40)*. Current evidence suggests that the impact of video games on physical and mental health depends on the type of gamer involved. Individuals who play more than five hours per week were found to have negative outcomes, including higher BMI, musculoskeletal injuries and sleeping problems *(41)*. Excessive gaming also has social consequences, and the evidence suggests that it plays

a negative role, especially in the case of young males, in an individual's interpersonal relationships. On the other hand, individuals whose game playing is positively motivated may have outcomes that are positive for their health *(40,42)*.

There is an association between the time spent playing video games and the amount of SSBs consumed – an association that is partly due to the SSB industry's high investment in advertising directed at video gamers. Alcohol and tobacco advertisements are also very common in video games, and it has been shown that adolescents exposed to such content are twice as likely to use tobacco and alcohol. It is unfortunate that Pan European Game Information systems are often unreliable and unable to identify whether alcohol or tobacco content is present in video games and that SSB industries are active sponsors of video game titles and leagues *(43,44)*.

The eSport (electronic sport) industry is also growing fast. In 2020 its revenues reached $1.1 billion and it engaged about 495 million people across the world. eSports are often professional competitions that use video games as platforms where two or more individuals engage in competitive play within gaming communities *(31)*. Among young people, eSport has been linked to poorer diet, unhealthy lifestyle behaviours, and other physical impacts such as eye fatigue or strain, hand, neck or wrist pain, and increased periods of sedentary behaviour. However, the significant prevalence of young people as participants and the streaming of eSports provide an opportunity to present strategies to encourage healthy lifestyle behaviours that could offset the negative outcomes resulting from growing engagement with eSports. For instance, gamers should be aware of the impacts that eSports may have on their physical and dietary behaviours *(45)*.

According to the evidence, active video games and internet-based interventions had some statistically significant effects on weight-related outcomes, compared to control groups. This suggests that technology-based interventions could have a positive impact on physical health. The most effective of such interventions would have the potential to help children and adolescents living with overweight and obesity, by lessening their weight gain and increasing their light to moderate physical activity *(45–47)*.

In 2016 the game Pokémon Go combined a virtual game with involvement in the real world by making players move around to locate and catch virtual creatures called Pokémon. In a very short period, the game had been adopted by about 40 million people. Some researchers, seeing the game as a potential intervention that could get people moving on a large scale, began to study how these types of game could be used to help reduce obesity and promote physical activity and other public health goals. The evidence from these analyses subsequently indicated that Pokémon Go increased physical activity levels across men and women of all ages, irrespective of their prior activity level, age, weight status and gender *(48)*. Similarly, video games that incorporate complex behavioural procedures seem to be effective in increasing and maintaining fruit and vegetable consumption among children *(49)*.

Some researchers have suggested that, rather than designing new video games to deliver health interventions, there is more potential in adapting existing commercial

games that millions of people already play to incorporate elements that promote health. For example, the Twitch entertainment portal is a website and video streaming service for video game play that reached 45 million viewers during its first two years. This kind of established community already has a platform that can be used to promote health and healthy behaviours. However, such efforts will require innovative public–private collaborations between researchers, policy-makers, gaming communities and private-sector developers *(50)*.

Evidence suggesting an association between video game playing time and decline in (and promotion of) physical health status is relatively scarce, with most studies published in recent years *(41)*. More studies are needed to increase our understanding of the effects of video games – their relationship with individuals' adherence to healthier behaviours and their role in preventing and managing obesity and increasing physical activity levels *(39)*. Although video games are associated with some increase in physical activity, they are not a substitute for physical activities. Nevertheless, their popularity and the way they combine gaming and physical activity offer an opportunity to deliver interventions that promote well-being in children and adolescents, helping to prevent and treat obesity and weight-management and mental health problems.

4.4 Online supermarkets

The physical food environment consists of a wide array of foods and beverages that form part of our diet. The rise of the digital food environment has accelerated in recent years, providing a new dimension to food availability. This is true of both the retail and out-of-home (OOH) sectors, with both becoming increasingly available on digital platforms.

4.4.1 Collecting data from online supermarkets

Digital food environments provide new opportunities to improve the availability of data on the foods that we buy and consume. This is highly desirable, both from a consumer knowledge perspective and from a policy-making perspective. Third-party food sales and composition data can be used to monitor nutrition-related policies. These data can give more granular and useful information on price, brand, ingredient and nutrition composition than can be found in the results of national dietary surveys and food composition tables. Such data can be used to incorporate monitoring and evaluation into nutrition policy implementation, allowing policy-makers to assess the efficacy of policies and target where improvements may be necessary *(34)*. In this way, the most effective obesity prevention and management initiatives can be highlighted, and the areas that most need attention can be identified. There are limitations that need to be navigated. For instance, it should be recognized that many consumers, particularly those on lower incomes, still shop in-store because of minimum spends for orders and the lack of discount retailer presence online. However, this is changing as ever more retailers create and expand their online presence.

Focusing on the retail sector, obtaining information about foods and beverages in the physical environment is traditionally time-consuming and labour-intensive, requiring researchers to visit outlets and collect information manually. This also increases the potential for human error and bias in selecting and recording product data. For these reasons, detailed, accurate and accessible data on the characteristics and nutritional content of foods are not easily available. Most datasets that exist are expensive and often have limitations such as infrequent collection points, insufficient granularity or incomplete information on the latest products on the market.

There are three main types of data on product sales and purchases:

- **value of sales and purchases** – the monetary value of sales and purchases at national, store or household level and within specified time periods;
- **volume of sales and purchases** – the volume of sales and purchases measured in kilograms, litres or number of units at national, store or household level and within specified time periods;
- **market share** – the proportion of sales and purchases given as a percentage or in absolute terms, by product name, brand or company.

Data can be accessed either through the retailer directly or from third-party providers *(34)*. Collecting data from retailers may be difficult, as fierce competition within the industry may make them reluctant to disclose potentially sensitive information. Access may require lengthy legal agreements or labour-intensive physical visits to stores, resulting in relatively little, potentially nonrepresentative data. Third-party data are generally collected systematically across multiple stores, retailers and regions, making them more detailed and objective, with potential for time-series analysis. However, this can be expensive, and not all companies in all countries are willing to provide data. In addition, data users have little control over the data collection process, including recruitment incentives, recruitment bias and dropout rates for household panels *(34)*. This means that, while the potential data opportunities are rich, the reality is that it can be hard to get a realistic and complete picture of those population groups who may most benefit from targeted obesity-related interventions.

4.4.2 Identifying the ingredient and nutrient composition of products sold in online supermarkets

Ingredient and nutrient composition data provide information on the ingredients, energy and nutrient content per 100 g/ml, and sometimes also per serving, of products. In the EU, foods in the retail environment must display energy, carbohydrate, total fat, saturated fat, total sugars, protein and salt content in g/100 g. Other nutrients such as fibre may also be labelled, particularly if the product includes a nutrition or health claim. Linking this information with sales and purchase data allows researchers and policy-makers to assess the impact of policies, measures such as reformulation and consumption patterns *(34)*. Front-of-pack nutrition labelling simplifies nutrition information provided on food labels and aims to help consumers with their food choices (Box 4.3).

Box 4.3

Front-of-pack labelling in France

The Nutri-Score is a graded colour-coded front-of-pack label adopted by France in 2017. Its implementation is voluntary according to EU regulation, and since its adoption, more than 600 companies, representing more than 50% of market share, have taken up the scheme *(51)*. Awareness of the system in the population has followed a similar growth, with more than 80% of the population having heard about or seen the Nutri-Score in 2020 *(52)*. In addition, a number of other European countries, including Belgium, the Netherlands, Germany, Luxembourg and Switzerland, have since adopted the Nutri-Score on a voluntary basis *(53)*, though others such as Italy and Greece oppose it.

Though the system is designed to appear on the front of prepackaged foodstuffs in store, most companies also integrate the label on their own website to complete the information about their product portfolio. More importantly, retailers adopting the system have incorporated the Nutri-Score on their digital platforms for food delivery. Though representing less than 10% of market share in 2020 this sector of the retail industry demonstrated a high growth (+46.5% in 2020), driven in particular by the COVID-19 pandemic and the measures taken to contain it *(54)*.

Initially limited to products from their own retail brand, retailers progressively affixed the Nutri-Score to products from other brands, even those that had not directly adopted the scheme (the Nutri-Score's conditions of use allow retailers to apply it to products they distribute provided the rightsholder has lodged no objection during a three-month prior notice period). The image of the label is therefore displayed on the picture of the product or on the webpage giving information about the product, and in some cases it is visible in listings of products, allowing consumers to compare their nutritional quality at a glance. Some retailers have even incorporated selection fields so that consumers can select specific classes of the Nutri-Score.

Following online grocery stores, some OOH outlets, either fast-food or food delivery websites, have adopted the Nutri-Score, including McDonald's, which announced that it had adopted it in the summer of 2021.

In order to obtain insights into the potential impact of the Nutri-Score implementation in the OOH environment, in 2019 and 2020 the French health ministry issued a call for its formal testing in catering, including digital delivery platforms. Results of the winners of this call are expected in 2022. Working groups with the winners of the call will develop a harmonized methodology for the use of Nutri-Score in catering. The French health ministry plans to extent the use of Nutri-Score to unpacked foods.

Food and nutrient composition databases are fundamental to nutritional epidemiology, providing vital information on the nutrient content of foods consumed. This information can be used in many ways, including to inform nutrition and obesity-related policies to improve population health and reduce the burden of NCDs. However, food composition databases can be costly and time-consuming to develop and maintain; outdated and

incomplete data are therefore a real challenge across the WHO European Region. In some cases, neighbouring countries share their national databases, as in the Balkan region. However, although this can extend data provision, it also leaves questions about accuracy and applicability of data to each country. Thus knowledge gaps remain, with the result that policies may not be based on robust evidence or may allow only limited monitoring and evaluation. Either scenario increases the potential for weak policy and interventions that are mistargeted, ineffective or even counterproductive in reducing obesity risk.

Nutrient composition databases can come from public or commercial sources. National nutrient composition databases are often free and publicly available, but not all countries have them or regularly update them, and they may only include information on generic, non-branded foods. The foods that are not covered may disproportionately include energy-dense foods that are likely to contribute more to obesity, potentially making the resulting data less useful in informing obesity-related policies. Commercial nutrient composition databases typically include branded foods but are often very expensive and not publicly available. Other noncommercial nutrient composition databases may be developed by research groups and are generally accessible for noncommercial research purposes. However, these often focus on selected product groups or nutrients relevant to the research team in question. One of the most comprehensive databases of this kind is foodDB, developed in the United Kingdom.

4.4.3 The foodDB platform and database

The foodDB dataset has been developed by the WHO Collaborating Centre on Population Approaches for Non-Communicable Disease Prevention (CPNP) since 2015. It can provide detailed, accurate and up-to-date nutrition information that is included on the packaging of a large range of products sold in major United Kingdom retail outlets with an online presence. This removes the need to manually collect data, which is time-consuming and comparatively ineffective. The foodDB database collects data on over 300 000 food and drink products *(55)*; this level of detail allows the evaluation of nutrition-related policy interventions. For example, foodDB has been used for an evaluation of the impact of the United Kingdom Soft Drinks Industry Levy on reformulation of sugar, price, product size and market diversity *(56)*, and an analysis of the nutrition profile of products alongside a multicomponent environmental impact index *(57)*.

Data available on a daily basis from the foodDB platform include all category hierarchies, product availability, price and promotions. More in-depth weekly snapshots include nutrient composition, labelling, ingredients, image and country of origin. Other functionalities include calculation of relevant nutrient profiling scores. The foodDB software is object-oriented and is able both to cope with changes in retailer websites and to add new online food retailers. All this makes foodDB an important epidemiological tool, providing an innovative big-data approach to food composition databases and a rich dataset that can better inform obesity-related initiatives. However, foodDB does not capture sales data, while further limitations of the academic setting of the foodDB project suite include the large resource requirements to produce data extracts and

the lack of secure funding arrangements to ensure the ongoing data collection that underlies this important work.

Following the successful development and implementation of foodDB in the United Kingdom, the NCD Office is working with the CPNP to pilot the platform in selected Member States (Hungary, Ireland, Israel and Portugal) and to extend its utility in the WHO European Region. This collaborative work will assess the value of using foodDB as a platform to provide enhanced capacity to evaluate food system policy interventions and to produce datasets for international comparison. To date, the CPNP has collected over 4 TB (terabytes) of data with over 15 million data lines of full data collection, representing over 300 000 food and drink products from 15 retailers in five countries.

Databases like foodDB can also be used to track and investigate trends that are evident in and facilitated by the digital food environment, such as the growing popularity of plant-based eating. The countries of WHO European Region, like other developed countries around the world, are seeing a shift towards plant-based diets. Public health and environmental experts and, increasingly, governments are encouraging this move, primarily as a response to concerns over population health and environmental sustainability *(58)*. However, this move towards plant-based foods is characterized by convenience foods that are often unhealthy and energy-dense. These foods contribute to weight gain and obesity, unlike minimally processed foods such as fruits and vegetables, wholegrains, pulses and nuts. The food industry has moved with this trend, and there has been rapid growth in the number of plant-based substitute products on the market. These products include "analogue" processed meats, such as burgers, sausages and nuggets, and dairy substitutes, such as plant-based imitation milk, yoghurt and cheese.

Although plant-based foods often have a "health halo", contrasting them with the high environmental footprint of some animal-source foods, unhealthy plant-based substitutes may be nutritionally poor, being energy-dense and high in saturated fat, free sugars and salt *(59,60)*. There is also a lack of research into their nutritional content, particularly compared to their animal-source equivalents. The WHO NCD Office is using the foodDB dataset to investigate and characterize the nutritional content of commercially available plant-based products sold in retail settings as substitutes for conventional animal-source foods. The aim of work of this kind, facilitated by tools such as foodDB, is to assist policy-makers by generating evidence-based recommendations in light of dietary transitions. These recommendations can feed into policy development and implementation. Other examples include exploring fiscal measures to promote fruit, vegetable and wholegrain intake, and labelling legislation to ensure that the nutritional content of foods sold in both retail and OOH digital environments is available to consumers, enabling them to make informed, healthier choices.

4.5 Meal delivery apps

The OOH food sector has increased rapidly in recent years, with more people accessing meals from an OOH source. The sector includes all food and beverage outlets where food and drinks can be purchased and consumed outside the home, either on or off the outlet premises. Meal delivery apps (MDAs) – online platforms that allow customers to order food or drinks for immediate consumption upon delivery – are a fast-growing part of the OOH food sector. The COVID-19 pandemic accelerated the use of digital channels to access meals as households throughout the WHO European Region were advised to stay at home *(61)*.

MDAs have existed in Europe since 2000, yet they have only become popular in some parts of the WHO European Region very recently *(1)*. Meals are delivered from food service outlets to private residences and offices by riders using bicycles, motorbikes and cars. In some countries, such as the United Kingdom, meal delivery companies are not classified as food businesses and are therefore not subject to the same rules and regulations.

There are two main types of online delivery platform: aggregator apps and aggregator websites. Aggregator apps offer access to multiple restaurants on one app. These apps are downloaded onto smartphones, and credit card details are entered and stored on the app to facilitate a quick (repeat) ordering process. Aggregator websites provide essentially the same services as aggregator apps but are accessed via the internet rather than being downloaded. Some restaurants (mainly chains) have also developed their own apps and websites where orders can be placed. Many chains and franchises that are present on aggregator apps and websites have also developed their own apps *(62)*.

4.5.1 MDAs and obesity

Little is known about MDAs and their relationship to obesity. They are a part of the OOH food sector that is constantly evolving and growing, making it difficult to track *(62)*. However, it is possible to draw from the pool of evidence specific to the OOH food sector, as MDAs are the online extension of that sector. Evidence suggests that food and beverages purchased from the OOH sector are more energy-dense and higher in fat, sugar and salt than their retail counterparts (Box 4.4). Portion sizes are often larger, which encourages overeating, particularly if there is little price differential between portion sizes *(63–66)*. Furthermore, package deals or loyalty discount rewards can encourage overordering and hence overconsumption of foods *(67)*. The United Kingdom government suggests that regular overconsumption of a relatively small number of calories can lead to individuals becoming overweight or having obesity and that this can be exacerbated by eating out *(68)*. Research in the United Kingdom suggests that eating out accounts for 20–25% of adult energy intake and that when someone dines out or eats a takeaway meal they consume, on average, 200 more calories per day than if they eat food prepared at home *(69,70)*. Further studies suggest that portions of food or drink that people eat out or eat as takeaway meals contain, on average, twice as many calories as equivalent retailer own-brand or manufacturer-branded products *(71)*.

Box 4.4

People's experience of living with obesity: Bjargey[a]

Bjargey was a teenager when she began to gain weight. She did not know or understand what was happening to her body; it seemed out of her control at the time. Between the ages of 22 and 25, Bjargey had three children, gaining weight after each pregnancy. By the time she reached 30 years of age, she realized that something was wrong and decided that she needed to seek help from a doctor to find out if she was unwittingly contributing to her weight gain. The doctor's advice was simple: eat less and move more.

Her experience was common to many who live with obesity; the doctor spent no time getting to know Bjargey's situation or medical history and simply handed her a meal plan. Determined to lose weight, Bjargey started to eat less and less. She would eat only half of the recommended meals initially, hoping that this would lead to weight loss. Soon, she was skipping meals and barely eating at all. However, in the following year, Bjargey gained 20 kg. It was after this that Bjargey realized there was a cause for her gain weight that needed an explanation. Bjargey was fortunate enough to find a doctor who ran an obesity programme, where she regularly saw a nutritionist and a nurse who took regular measurements of blood pressure and blood tests. These tests revealed that there were aspects of Bjargey's hormonal system that were causing her to gain weight.

Bjargey stresses the detrimental impact that the increase in technology has had on people living with obesity. While digital environments have added ease to the way we are able to communicate with others, they also encourage people to stay indoors and miss out on forms of face-to-face social contact. Bjargey also discusses how digital environments have made it easier for people to order food for home delivery. People who are stressed and under pressure resort to ordering delivery food, which further reduces reasons for them to leave their homes. When tired and strained, people are also likely to order unhealthy food options as they crave food that will give them energy quickly and be readily available. This easy access to digital environments, however, could be utilized to create platforms for sharing information to help people living with obesity. Bjargey stresses the importance of allowing people living with obesity to have easy access to the right information and programmes that will assist them to manage their weight effectively.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

Furthermore, as obesity was reported as a risk factor for COVID-19, research found that people living with obesity were more likely to take stay-at-home orders seriously and leave home only for necessities. Research into the response to stay-at-home orders from people living with obesity found that anxiety, boredom and stress made it more challenging for them to eat healthily *(72,73)*.

Scholars and practitioners describe environments where outlets selling unhealthy food and beverages predominate over outlets selling healthy goods as "food swamps": environments with a high density of establishments selling high-calorie fast food and beverages with a low nutrition value, relative to healthier food and beverage options *(74)*. Research from the United States has found that a presence of a food swamp is a strong predictor of the proportion of adults living with obesity *(75)*. The same study found that the food swamp effect was stronger in areas with greater income inequality and where residents are less mobile. Similar findings have emerged in the United Kingdom, where a positive correlation between density of fast-food outlets and area-level deprivation was found *(76)*.

Although the phenomenon has not been investigated in detail, MDAs may encourage sedentary behaviour. This is because food is delivered directly to the household or office. Some meal delivery platforms explicitly promote staying at home by advertising, for example, that the meal would pair well with "binge-watching" Netflix or equivalent streaming services. Other platforms advertise that going out to pick up lunch or dinner does not make sense when the cost of delivery is so low. MDAs have also been embedded within gaming platforms so that users do not need to stop in the middle of their gaming session to prepare food.

Research into MDAs and marketing is limited at this time. Anecdotal evidence suggests that promotions offering free delivery and membership are sometimes linked to other services such as paid subscription programmes on e-commerce platforms. In other cases, SSBs and alcoholic drinks in "combo" (combination) deals are promoted in conjunction with special events such as football and other sporting championships. Television advertisements promoting MDAs are common during peak viewing periods, and some meal delivery companies sponsor television shows. Billboards and poster advertisements featuring MDAs are commonly found around busy transit hubs such as bus and train stations.

Not all meals on MDAs share the same level of popularity. In a three-city study (including one European city, Amsterdam), burgers, pizza and Italian were in the top 10 of most advertised meals *(77)*. Up until recently, the options on MDAs were mainly main meals *(78)*. However, many now include breakfast, lunch and snack options *(79)*. Aggregator apps also have the capacity to target advertising at particular times of day and to choose which types of meal are incentivized during popular dining times. This means that larger chains of restaurants, often offering more unhealthy options or package deals, are highly visible on MDAs at popular mealtimes. Anecdotal evidence suggests that unhealthy meal options are also prevalent in targeted promotional campaigns sent via email and social media platforms. Similarly, restaurants are able to pay to promote their products by having them appear at the top of search results, further exacerbating the issue *(80)*.

MDAs may increase the possibility of broader exposure to unhealthy food and beverages with high energy density, HFSS and a lack of dietary fibre and vitamins and minerals.

In Brazil unhealthy beverages and unhealthy ready-to-eat meals make up the vast majority of what is offered on MDAs *(81)*. Another study in New Zealand and Australia found that 85.9% of all popular menu items provided by online food delivery platforms were energy-dense, nutrient-poor discretionary foods *(82)*. A Canadian study of 759 menu items on MDAs found that the meals offered did not meet recommendations for healthy eating *(83)*. According to another study of 4323 delivery options in three cities – Amsterdam, Chicago and Melbourne – most food types available for delivery were not considered healthy *(77)*. Further research is required to assess the extent to which MDA users are less likely to have a balanced diet and more likely to consume unhealthy levels of saturated fat, free sugars, trans fats and salt, all of which contribute to elevated NCD risk. However, there have not been any studies to date investigating the nutritional content of the most frequently ordered meals in the WHO European Region.

MDAs may increase the accessibility of a broad range of unhealthy meals and beverages, including alcohol and SSBs, by enabling people to have meals delivered to them directly, promoting sedentary behaviour *(84)*. They do this in part by extending the reach of food service outlets in the built environment. For example, preliminary research in Denmark found that McDonald's fast-foods outlet could significantly increase their geographical coverage when meals were sold through MDAs, covering the entire country *(85)*. A study from Canada also found that online food delivery services can substantially extend geographical access to foods prepared away from home by up to 9 km *(83)*.

Ongoing research at the WHO NCD Office, in conjunction with partners at various research institutions, is looking into the types of meal sold on MDAs and their nutritional quality. This research is also investigating the geographical reach of MDAs, with the overall objective of contributing to the currently limited pool of evidence specific to MDAs. This, in turn, may help Member States to make more informed decisions about whether and how to regulate MDA platforms.

A lack of information on the nutritional quality of meals offered on MDAs has sparked the interest of public health authorities. However, through conversations with Member States and experts, the WHO NCD Office has found that there are other entry points and policy levers that may influence regulation of MDAs as well as the information displayed on them. These include food safety, alcohol sales, road safety, labour rights, urban planning, physical activity and municipal waste collection *(84)*. Going forward, it would seem prudent to ensure that MDAs are classified as food businesses, like cafés and restaurants, and hence subject to similar rules and regulations on labelling and other measures (Box 4.5).

As a part of the food system, MDAs can contribute to perpetuating unhealthy food choices with potential negative health implications. There is a minimal pool of peer-reviewed studies on MDAs to draw from at this time, yet on their current trajectory it appears that MDAs attach too little importance to the nutrition and potential health outcomes of the products they sell.

Box 4.5

United Kingdom strategy on calorie labelling on menus in cafés, restaurants and takeaways

In May 2021 the United Kingdom government announced that calories will be labelled on menus and food labels in OOH food businesses in England from April 2022 *(86)*. In the United Kingdom, MDAs are not classified as food businesses and therefore are not subject to the same rules and regulations.

The regulations will apply to large businesses with 250 or more employees in England, including cafés, restaurants and takeaways. Calorie information must be displayed for non-prepacked food and soft drink items that are prepared for customers. This includes displaying the information at the point of choice for the customer, such as physical menus, online menus, food delivery platforms and food labels.

Requiring large businesses to label calories on menus will not affect small, independent businesses who might find the requirement more difficult. The government plans to work with the food and drink sector and local authorities to ensure that the regulations are implemented smoothly.

This is the first Member State of the WHO European Region to implement such a policy that covers both online and offline settings. These measures are a part of the United Kingdom government's wider strategy to tackle obesity. Calorie labelling will contribute to more informed, healthier choices when it comes to eating food out or ordering takeaways.

A Cochrane Review of 28 studies suggests that calorie labelling in OOH settings may help reduce calorie intake and make a useful impact as part of a wider set of measures aimed at tackling obesity *(87)*. However, the authors of this study suggest that additional high-quality research in real-world settings is needed to allow more certain conclusions.

4.5.2 Moving forward

Despite the lack of an evidence base, innovators, policy-makers and public health experts alike will need to join forces to devise new strategies and incentives that lead to healthier meal options *(62)*. A systems approach to addressing the impact of MDAs on health and nutrition outcomes will be required. Left unaddressed, MDAs may play a significant role in increasing the accessibility of energy-dense, nutrient-poor HFSS food and beverages. This, in turn, could lead to increased NCD risk and health burden. As such, there is a clear need for further evidence as well as strong, effective policies in this area. If these are pursued, MDAs and other online food and meal delivery systems could become a driving force to improve diets and reduce the NCD risk across the WHO European Region.

It is also important to note that the channels through which consumers purchase food in the digital environment are evolving and diversifying *(62)*. For example, meal delivery boxes are becoming more popular, some of which can bring healthy ingredients to households.

These boxes provide meal kits where fresh ingredients are pre-prepared and require only minimal processing at home. As in the case of improving access to fresh fruit and vegetables, one of the main barriers to the widespread use of healthy meal delivery boxes is their cost. Other examples of how the digital food environment is expanding include apps that provide households with access to fresh fish, fruits or vegetables *(1)*.

4.6 Conclusion

Digital technologies are not necessarily a threat to public health; rather, the issue is how technology is used – what is advertised and how the content of advertisements is understood, and what is available on digital platforms that can contribute to obesogenic digital food environments. This chapter has demonstrated the importance of monitoring and regulating digital food environments in areas such as digital food and beverage marketing and online food delivery platforms. It has also shown the need for further applied research that can inform interventions and public health policy.

In summary, obesity is a complex issue that requires action across multiple sectors. This chapter has made the case for the inclusion of digital food environments as one of the many complex determinants of obesity. As digitalization continues to accelerate throughout the WHO European Region, a public health perspective must also be applied to digital food environments.

Policy considerations

- Monitor children's exposure to digital food and beverage marketing.
- Develop and implement mandatory government-led measures to restrict children's exposure to unhealthy food marketing. Such statutory measures should comprise clearly defined criteria for identifying foods not permitted to be marketed to children (nutrient profile model); they should also address the problem of brand marketing and include a robust monitoring and enforcement system.
- Conduct comprehensive analyses of policy measures that address the digitalization of food environments (including but not limited to labelling and healthy food label symbols when buying groceries online; labelling requirements for online food retail; other online food sale regulations; health and nutrition claims; digital food marketing).
- Monitor policy implementation related to digital marketing, online food retail and online meal delivery in the WHO European Region.
- Ensure that restaurants that are required to display nutrition information also include this information on meal delivery apps.
- Where applicable, classify meal delivery companies as food businesses and hold them accountable in the same way.
- Invest in food literacy actions that help people to distinguish between healthy and unhealthy food and beverages sold in the digital food environment.

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5. PUBLIC AWARENESS OF OBESITY AS A RISK FACTOR

Key highlights

- Both the public and the medical community have been slow to recognize obesity as a complex, multifactorial disorder.
- Health literacy is a potentially unrecognized obesity determinant.
- False perceptions of obesity may cause weight stigma, which is prevalent in the media, schools and workplaces, and even in health-care settings.
- Applying a life-course approach to public health strategies can help increase public awareness of obesity and overweight.
- The failure of traditional obesity control measures highlights the importance of developing a new non-stigmatizing and multifaceted public policy.

5.1 Introduction

This chapter highlights the role of public awareness that obesity influences the risk of life-threatening disease and chronic conditions. It describes the importance of public awareness, perceptions and misperceptions on obesity development and the detrimental impact of misconceptions and weight stigma at the individual and societal levels. Transforming public awareness requires a future focus on advocacy and calls to action on, for example, child obesity and the life-course perspective, combined with a new approach to public campaigning sustained by structural interventions. Importantly, it should build on behavioural insights and coproduction principles of equality, diversity, accessibility and reciprocity – through which the importance of personal individual experiences is acknowledged and considered – to enhance obesity-related health literacy at population level. Despite political will to counteract it, the obesity epidemic continues to be one of the most important public health challenges facing Europe and the world today *(1)*. While being affected by overweight or obesity increases the risk of developing life-threatening disease and chronic conditions, the costs extend far beyond public health through effects on individuals, families, communities, the economy and society as a whole *(1)*. Although obesity is acknowledged as a disease, the public and the medical community have been slow to recognize it as a complex, multifactorial disorder. Many people still believe that obesity is under personal control. However, at least 50% of NCD-related deaths are preventable through prevention strategies focused on modifiable factors such as obesity, physical activity and nutrition *(2)*.

5.1.1 Misconceptions and false perceptions about obesity

The obesity epidemic cannot simply be tackled by focusing on food and diet. Research shows that the risks associated with obesity are perceived differently in various circumstances. Individual patients with obesity seeking help are very much aware that obesity is a disease and of the associated health risks. Although they do not always recognize its strong link with cancer, people with obesity who seek help do perceive obesity as a social burden through its influence on risk of developing chronic conditions such as CVD and T2DM *(3)*. Nevertheless, most people with obesity do not seek help. Furthermore, misperceptions among health professionals and upstream determinants (industry, policy and society) continue to undermine the recognition that obesity influences the risk of disease. Obesity rates will continue to increase if individuals, society and professionals at different levels of policy, health care, social work, schools and prevention have false perceptions about the severe consequences of obesity. However, a slow shift is evident towards greater access to care, reduced weight bias and stigma, and better support for the prevention and treatment of obesity *(4)*.

5.1.2 Lack of public awareness relates to inequity

Despite many efforts, there is a general lack of awareness on the relation between obesity and NCDs. For example, a 2018 study by Hooper et al. revealed that only a quarter of adults in the United Kingdom are aware that cancer is a health condition associated with overweight or obesity *(5)*. Moreover, differences in awareness exist between different socioeconomic groups: in general, people of a higher socioeconomic status have greater awareness and a lower BMI than people of a lower socioeconomic status. Furthermore, people in low-income groups are less able to act on new information, and cost is often the deciding factor when purchasing food. Indeed, surveys have shown that low-income groups in Europe know what constitutes a healthy diet but that barriers are created by the lack of affordability, accessibility and availability of foods, along with other practical considerations. Therefore, obesity strategies based on guidance to address inequities in overweight and obesity information alone are likely to be ineffective without measures to enhance the ability of low-income and marginalized groups to act on this information. Where information strategies are used, specific effort is needed to ensure that messages are designed with and for the lowest socioeconomic groups *(6)*.

5.2 Health literacy is an unrecognized obesity determinant

In Europe and beyond the impact of health literacy is receiving increased attention in policy, research and practice. Health literacy encompasses the personal knowledge and competencies that accumulate through daily activities and social interactions and across generations. Personal knowledge and competencies are mediated by organizational

structures and the availability of resources that enable people to access, understand, appraise and use information and services in ways that promote and maintain good health and well-being for themselves and those around them *(7)*. European surveys have revealed that health literacy differs within and between countries and that almost one in two people on average have limited health literacy *(8,9)*.

5.2.1 Health literacy and risk of obesity

Research on childhood obesity and parental health literacy suggests that "health literacy is a potentially unrecognized obesity determinant due to its impact on parental views about child weight loss strategies and health information-seeking preferences, as well as health knowledge, in general" *(10)*. In addition, low health literacy levels are associated with many determinants of adolescence health, including body weight *(11)*. Health literacy is also associated with lower levels of CVD risk factors such as high BMI, metabolic syndrome (MetS) in women and fatty liver disease *(12)*. Therefore, enhancing health literacy should be considered a key part of strategies to help prevent overweight and obesity in adolescents, as well as address NCDs in adults, to mitigate the public health implications of the obesity epidemic. Health literacy research on weight loss shows that the content of communication materials and the methods of communication must be both understandable and actionable to increase their impact on public awareness *(13)*.

5.3 False perceptions among health professionals and the public lead to weight stigma

In modern society, false perceptions often cause weight stigma that is prevalent among the media, in schools and workplaces, and even in health-care settings. These may include the adoption of negative beliefs that individuals with obesity are lazy, irresponsible and lack self-discipline, despite evidence that genetic, socioeconomic and environmental factors all play a role in obesity development (Box 5.1) *(14)*. Weight bias is defined as negative attitudes towards, and beliefs about, others because of their weight *(15)*. Weight stigma is associated with adverse physiological and psychological outcomes *(16)* and may lead to prejudice and discrimination. Weight discrimination increased by two thirds between 2000 and 2010 and is a growing concern *(17)*. Increased public and professional awareness is needed through actions such as the campaign to end weight stigma, which was launched on World Obesity Day 2018 by the World Obesity Federation *(18)*. The campaign highlighted five facts: (i) people with obesity can develop eating disorders; (ii) weight stigma can cause many health problems attributed to obesity; (iii) weight stigma can encourage weight gain; (iv) stigma is often perpetrated by friends and family, not strangers; and (v) weight bias can be internalized by individuals. It aimed to create awareness and ensure that weight stigma is no longer sidelined in actions, interventions and policies related to obesity *(19)*. Furthermore, in 2017 the WHO Regional Office for Europe published a policy brief on weight bias and obesity stigma *(20)*.

Box 5.1

People's experience of living with obesity: Susie [a]

Susie is 46 years old, lives in Dublin and is the Secretary of the European Coalition of People Living with Obesity [ECPO]. As a child, Susie was very active but it was very clear from a young age that Susie had issues with food and she was diagnosed with avoidance restrictive food intake disorder. This is an eating disorder where individuals display limited and selective eating habits. For Susie, it presents as an inability to eat fruit, vegetables, sauces or foods together that have come from two different packets. This was extremely difficult for her growing up. She was taken to every type of therapy possible, but nothing worked. Susie felt ashamed of this as she felt that it was her fault, and negative comments from others made her experience extremely difficult. As a consequence, it was very difficult for her to socialise. Susie would have to take her own food with her, and so would bring quick, easy food which, in turn, led to her weight increasing in her late teens.

When she was about 18 years old, Susie experienced a serious knee injury. As someone who was always very active, she entered a very difficult period with bouts of depression when she was unable to undergo knee surgery. This led her to gain weight. Susie continued to try multiple diets, convinced that if she was able to fix her food disorder she would be able to lose weight, given her already active lifestyle. She continued to battle with fluctuating weight. By the time Susie was 35 years old, she was living with obesity and suffered from type 2 diabetes, polycystic ovaries and a hernia. Susie later attended a weight management service where she finally realized there was no fixing her food disorder. Diagnosed with diabetic retinopathy despite controlled blood sugars, the only remaining solution was bariatric surgery.

Susie has experienced stigma as someone living with obesity for many years. She recalls a time when she was required to fast for a kidney test from the previous evening. When she arrived to have the test, the nurse told her that it was obvious she had not fasted, something typical of someone Susie's BMI. The nurse told her she would have to come back to do the test another time. Humiliated, Susie left and did not return for the test. She thinks that there is still a long way to go in fighting the stigma associated with obesity but believes that public campaigns are helping to slowly change people's understanding of obesity. While she has learnt to cope with external stigma, her sense of worth fluctuates with self-criticism for gaining weight. Breaking down these barriers was made easier through membership of obesity patient support groups. Susie advocates for the importance of these groups in allowing people living with obesity to realize that they are not on their own, and they are able to ask questions and speak about their struggles.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

5.3.1 Introducing weight-neutral health campaigns

To prevent weight stigma, a new public health approach focuses on weight-neutral health campaigns. Initial studies suggest that campaigns that avoid mentioning weight, use non-stigmatizing imagery and provide concrete suggestions for positive behaviour change (e.g. eating more fruit and vegetables) are received more positively by the public *(21)* and perceived as more motivating *(22)*. However, it is unclear whether they also lead to the uptake of healthy or healthier behaviours. Nevertheless, shaming people into losing weight may do more harm than good.

5.4 Applying a life-course approach to increase public awareness of obesity

Obesity is an intergenerational challenge, so applying a life-course approach may improve public awareness. A life-course approach for health and well-being builds on the interaction of multiple promotive, protective and risk factors throughout people's lives. The approach involves adopting a temporal and societal perspective on the health of individuals and generations, including intergenerational determinants of health *(23)*. Importantly, an inverse relationship between life-course socioeconomic status and obesity in women has been suggested *(24)*. To increase public awareness, Hawkins et al. recommend a multilevel approach to obesity prevention that considers individual risk factors operating "above water" (family, neighbourhood, policies) and their interaction with biology and "underwater" influences (genetics, epigenetics, physiology) and recognizes that these factors also interact across the life course, starting before birth *(25)*. Well-coordinated intersectoral national obesity prevention programmes built on a life-course framework require in-depth early life systems analyses driven by socioecological modelling *(26)*. Research shows that a large proportion of chronic diseases (such as cancer and CVD) are preventable by reducing obesity and excess weight and increasing physical activity in early life *(24)*.

5.5 Rethinking public health strategies to increase public awareness

Obesity is a public health issue: it is a complex disorder with detrimental impacts on health that affects a large proportion of the population. Many of the consequences of obesity and its resulting symptoms are chronic and tend to be cumulative (worsening over time) without proper intervention or medical attention. Without drastic measures, the epidemic of obesity and NCDs will continue; however, countering the problem of obesity is proving difficult because many policy-makers assume it is an individual responsibility and easy to reverse.

5.5.1 Calling for a whole-of-government approach

A prevention strategy is needed to counter the primary drivers of the obesity epidemic, such as the increasing mechanization and computerization of modern life that results in a reduced need for physical activity in the workplace *(27)*. In addition, commercial interests often promote unhealthy food, motorized transport modes, mechanized working practices and home entertainment, which hamper efforts towards adopting a healthy diet and physical activity. Therefore, public health strategies should include changing government policies related to public transport and urban planning to promote an everyday environment conducive to spontaneous walking. This needs to be combined with a range of measures to induce dietary changes, including fiscal measures to progressively change the price of different foods and to limit the use of unhealthy foods.

5.5.2 Strengthening interprofessional skills and teamwork

The failure of traditional obesity control measures highlights the importance of developing a new non-stigmatizing approach to public policy, coordinated by interprofessional teams. Addressing obesity requires the involvement of GPs and specialists such as dietitians, psychologists, behavioural counsellors and exercise specialists. Endocrinologists, neurologists and surgeons, as well as teachers and school health staff, may also have vital roles. In turn, public health policy-makers have a pivotal role because obesity is a preventable disease. Coordination between health-care providers and policy-makers, operating as an interprofessional team, is essential to gauge the disease burden and address barriers to seeking treatment and preventive screening *(28)*.

5.5.3 Importance of management support and leadership

Strong commitment and leadership from central and local governments are needed to pursue a whole-of-government approach to increase awareness that obesity influences the risk of disease. Collaboration with and active participation by all relevant society sectors and individual citizens are prerequisites for co-creating cohesive policies, strategies and interventions to amplify the impact of prevention and health promotion efforts in order to slow down, if not reverse, the obesity trend. Public health strategies should focus on encouraging and enabling people to lead healthy and happy lives to help prevent disease and illness. As an example, in 2020 Public Health England launched a national campaign to encourage millions of adults to kick-start their health and reduce their risk of serious illness (including COVID-19) *(29)* as part of the United Kingdom government's Tackling Obesity strategy *(30)*. The campaign encourages adults to adopt changes that will help them towards achieving a healthier weight, with a suite of free tools and apps to support them to eat better, drink less alcohol and get active. It includes a free app with a 12-week weight loss plan to help people make healthier food choices and learn skills to prevent weight gain, thereby improving their health literacy. Therefore, public health solutions should also include developing strategies to make healthy choices easier to make. Importantly, public awareness campaigns can help to sensitize policy-makers, private sector partners, medical professionals and the public at large to the issue by framing obesity as a social and environmental disease rather than an individual responsibility.

5.6 Conclusion

The way forward includes raising awareness that obesity influences the risk of disease and understanding its root causes and the actions needed to address them. To reduce the burden of obesity, it is important to raise public awareness and change people's living conditions to address contributory social attitudes, behaviours and the obesogenic environment. Notably, the global explosion in obesity might call for hard-hitting awareness campaigns, similar to those for smoking *(31)* or, in contrast, a focus on weight-neutral campaigns. Systematically integrating health literacy into the school curricula *(32)* is becoming an important strategy to mitigate the impact of obesity *(33)*, but its implementation is still in its infancy. Moreover, the lack of awareness that obesity influences the risk of disease highlights a need for public health strategies targeting those population subgroups most vulnerable to obesity (due to easy access to cheap, unhealthy foods and lack of physical activity) and for effective strategies to reduce obesity at early ages *(24)*. Essentially, the aim of building public awareness should be to educate the public about how to act and react to important issues and topics related to obesity. Improving public awareness of the potential consequences of obesity in a collaborative and non-harmful way is important to improve population health and create societies where everyone is treated with dignity and respect and no one is left behind.

Policy considerations

- Address lack of perception in the public and the medical community of obesity as a complex, multifactorial disorder in public health strategies.
- Target people in vulnerable situations with interventions that are fit for purpose and serve their needs.
- Acknowledge health literacy as a health determinant related to obesity.
- Prevent weight stigma in the media and in schools, workplaces and health-care settings.
- Adopt a life-course approach in the design of interventions.
- Strengthen obesity prevention in school curricula.

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6. OBESITY AND DISEASE

Key highlights

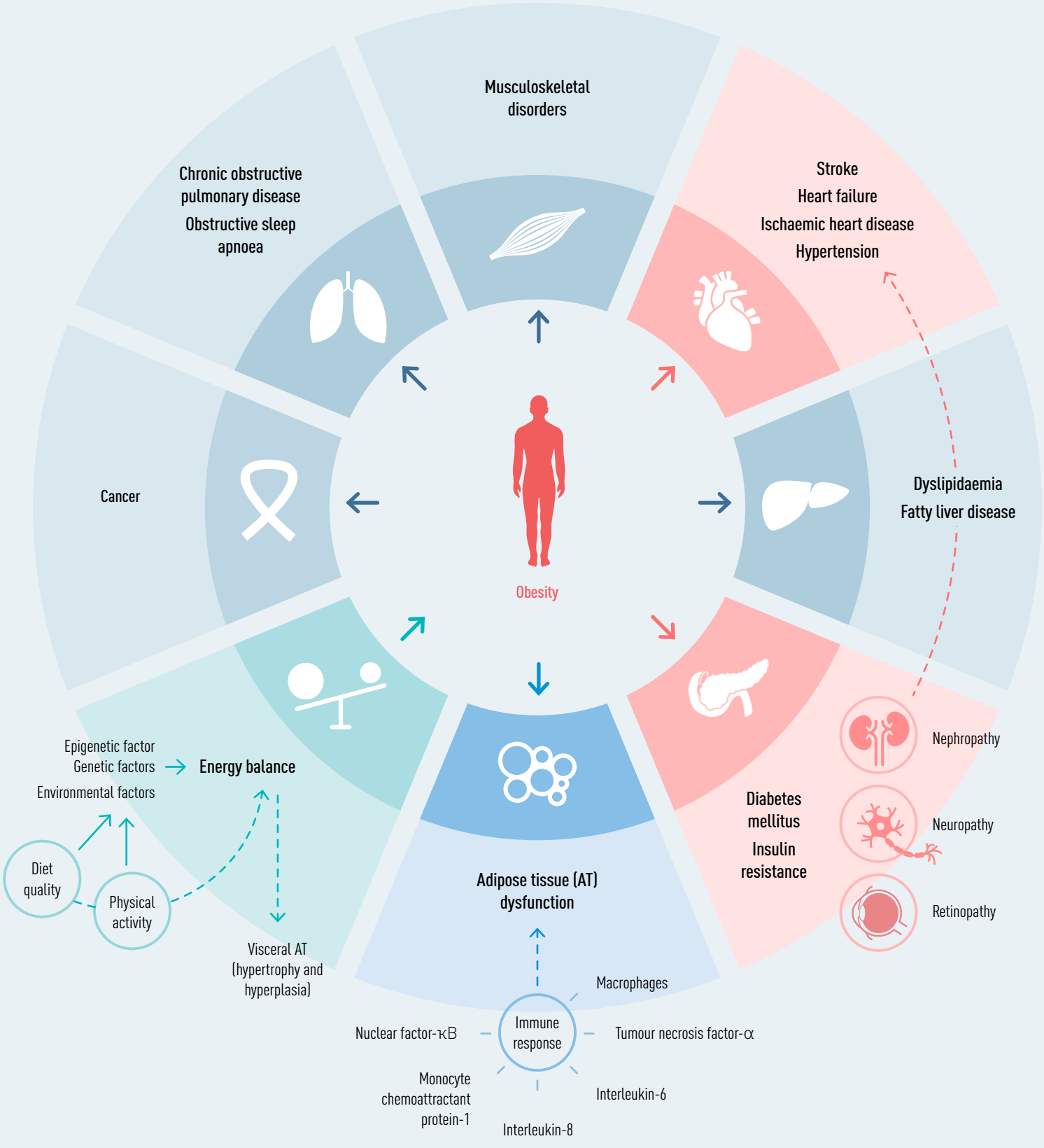
- Obesity is both a disease in its own right and a risk factor for many other diseases that affect multiple body systems.
- Adverse effects of obesity on health include those due to the mechanical effects of increased body weight, such as some musculoskeletal complications and increased cardiovascular risk, as well as the effects on mental health and metabolic effects; for example, type 2 diabetes mellitus.
- It may be helpful to consider a life-course approach to assessment of obesity and its complications, recognizing that it may have its origins in genetics and early life experiences and develops over time in response to environmental factors.
- Staging systems such as the Edmonton Obesity Staging System can be helpful as part of the clinical assessment of obesity and its complications.
- Weight loss can be a helpful approach to treatment of people living with obesity.

6.1 Introduction

This chapter focuses on the classification of obesity as a disease and explores the complexities surrounding this classification and the recognition that obesity develops as a result of interaction between the modern environment and human biology. This chapter will also review the influences of obesity on other diseases and conditions and describes how the progressive development of obesity and its complications can lead to a decline in health over time. This observation has led to the concept of staging obesity related to the number and severity of complications that are present. It is emphasized that obesity may affect almost all body systems (Fig. 6.1); therefore, it is important for all health-care professionals to understand its consequences and the potential benefits of prevention and treatment for individual and population health. As there is a specific chapter dedicated to obesity and cancer (Chapter 7), cancer has been excluded from this narrative.

Illustration of diseases and body systems associated with obesity

Fig. 6.1



6.2 Complications of obesity: epidemiological perspective

Obesity can be most simply defined as an excess accumulation of fat that impairs health *(1)*. It is recognized that, although strong environmental pressures relating to both food and physical activity environments explain the recent increase in the prevalence of obesity worldwide, underlying genetic predisposition determines which individuals are most susceptible *(2–4)*. It is clear that obesity causes ill health and reduces quality of life and life expectancy, both directly and indirectly through the other diseases that it can lead to *(5,6)*.

6.2.1 CVD

CVD represents the leading cause of death worldwide. People living with obesity have a higher risk of developing CVD, but the relationship between these two conditions is complex and often heavily intertwined with other risk factors. Recent evidence from four European cohorts shows that individuals with a BMI exceeding 35 kg/m^2 live on average six to seven fewer years in good overall health, and nine to 10 fewer years free from CVD, respiratory disease or cancer *(7)*. Internationally, data from the GBD study show that ischaemic heart disease, stroke, and hypertension are the leading causes of high-BMI disability *(8)*. Increased BMI has long been acknowledged as a risk factor for heart failure *(9)*, and more recently has also been demonstrated to increase disease risk and mortality *(10)*. Similarly, adults from the population who develop obesity have earlier onset of CVD and worse quality of life as a result *(11)*.

Findings from European cohorts with long-term follow-ups of 10 to 20 years suggest that middle-aged or older adults with obesity are at elevated risk for ischaemic stroke *(12,13)*. However, efforts to synthesize the evidence from prospective cohort studies in adults show great heterogeneity (I^2 >90%), which highlights the difficulties in evaluating obesity and stroke outcomes in epidemiological studies (where BMI is used as a surrogate measure for obesity), where other factors might influence their association *(14)*. Although evidence from intervention studies such as RCTs is limited, there is strong observational evidence from high-quality prospective cohorts showing that increased BMI is a strong, independent risk factor for CVD, with the associations being more evident in younger adults who have obesity *(15,16)*.

6.2.2 Metabolic diseases: MetS, NAFLD, T2DM, dyslipidaemias

Since Professor Reaven first proposed in the late 1980s that central obesity, hyperlipidaemias and insulin resistance are closely intertwined *(17)*, there has been growing international consensus that obesity is a central risk factor for MetS and other CVD risk factors *(18)*. In Europe MetS affects an estimated 24.3% of the adult population *(19)*. The multinational Metabolic syndrome and Arteries REsearch consortia, which included cohorts of adults from 10 European countries, showed that of the individual factors that are associated with MetS, abdominal obesity was the most common among

women *(19)*. Results from the population-based BioSHaRE-EU Healthy Obese Project multinational consortium showed that the age-adjusted prevalence of obesity among those with MetS ranged between 24% and 78%. The study also showed that, although the overall prevalence of obesity was greater among women, obesity was slightly less common among women with MetS than among men *(20)*. The study, which included a sample of over 160 000 adults, illustrated the variations in MetS phenotypes across countries, with hypertension being the commonest individual trait.

T2DM affects an estimated 60 million people in Europe (approximately 9% of the adult population), ranging between 2% and 15% by country *(21)*. These variations are influenced by the phenotype patterns of modifiable factors, which include obesity, lack of physical activity, smoking and poor diet quality, and also by several environmental, genetic and socioeconomic characteristics. The association of obesity and T2DM has been widely acknowledged *(22)* and there is overwhelming evidence for a causal link. Population-based studies using a Mendelian randomization approach show that for every one standard deviation increase in BMI the odds of T2DM increase by 67% and those of coronary artery disease by 20% *(22)*. The trends in changes of T2DM have shown a sustained increased since the 1960s, with a slower increase observed since the early 2000s *(23)*. However, the magnitude of the disease still represents a major public health challenge for the WHO European Region.

NAFLD is the fastest-growing obesity-related NCD, and a strong predictor of liver and cardiovascular mortality *(24)*. NAFLD is closely associated with obesity, MetS, T2DM and dyslipidaemias, all of which influence its incidence and progression severity *(25)*. In Europe it is estimated that 19–30% of adults have NAFLD *(26)*. Estimation of prevalence in population-based studies poses several challenges due to variations in the criteria used and the lack of adequate diagnostic tools *(25)*. Nevertheless, as obesity and MetS are strongly associated with NAFLD, it is likely that its prevalence will continue to grow worldwide over the next decade *(28)*. As is the case with other metabolic conditions discussed in this chapter, NAFLD is preventable and, depending on its clinical stage of progression, can be reversed with appropriate multidisciplinary health care that includes behavioural and clinical management. At present, it is estimated that the level of public health policies, societal engagement and epidemiological evidence are insufficient in most European countries *(29)*. Current research efforts in the Region include the European NAFLD Registry, which will characterize the distribution of disease, its severity and risk factors among adults in Europe *(30)*.

6.2.3 Chronic respiratory diseases

Chronic obstructive pulmonary disease (COPD), OSA and asthma are the most common chronic respiratory conditions worldwide and represent a major public health concern in the adult population worldwide. COPD is one of the leading causes of mortality, morbidity, and disability *(31)* in countries of all income levels *(32–33)*, affecting an estimated 10% to 20% of the adult population. OSA is found in 7–17% of adults *(35)*, with approximately one in five adults having at least mild OSA and 7% having OSA of moderate or worse severity *(36)*. OSA has a detrimental effect on health and well-being.

Asthma has increased in prevalence by at least two- to three-fold since the 1960s in most parts of Europe and the United States and continues to increase in individuals from disadvantaged communities *(37)*. Asthma may contribute to low lung function, respiratory disability and COPD *(38)*. Asthma and COPD may coexist in middle-aged and older adults *(39)* and this so-called overlap syndrome has a greater impact on quality of life than either disease alone. Lung function is a powerful marker for overall health, a better predictor of mortality than cardiac disease and is strongly related to disability.

Smoking is the primary cause for accelerated lung function decline and for COPD development *(40)*. However, considering the multifactorial nature of this disease *(41)* and the fact that not all smokers develop COPD, other lifestyle-related exposures are also likely to influence its development *(42,43)*. Multinational studies in Europe have shown that weight loss is associated with better lung function trajectories in adults *(44)*, but the role of obesity is less understood for people with COPD *(45)*. Recent findings from a large multinational cohort of 16 485 patients with moderate COPD and increased cardiovascular risk suggest that extreme obesity is associated with greater mortality in adults with COPD *(46)*.

The role of obesity, high BMI and weight gain are much more clearly established for OSA *(47)*. Evidence from prospective European cohorts suggests that increased BMI, particularly in the range of overweight and obesity, is a key driver in the risk of OSA in adults *(48)*. In turn, OSA is increasingly being recognized as a risk factor for stroke, and affects short- and long-term stroke recovery and outcome *(49)*. Evidence from epidemiological studies and RCTs has confirmed a strong association between OSA, MetS and T2DM, with these conditions sharing several common underlying mechanisms and pathways that increase the risk of these cardio-metabolic diseases *(50)*.

6.2.4 Mental health

Increasing evidence suggests that there is a strong association between obesity and depression in adults *(51)*. Although the biological mechanisms underlying this relationship are not fully understood, there is relative consensus based on longitudinal population-based surveys that the relationship is bidirectional; that is, obesity increases the risk of developing depression, and depression increases the risk of obesity *(52)*. In Europe large population-based cohort studies in the Netherlands *(53)*, Spain *(54)*, and the United Kingdom *(55)* have provided insights into the relationship between obesity and depression in middle-aged adults. The 1958 British Birth Cohort Survey *(56)*, which included over 7000 participants, showed that women who had general obesity (BMI exceeding 30 kg/m^2) or abdominal obesity at baseline had 38% and 34% higher odds respectively of displaying depressive symptoms five years later. These prospective associations were independent of baseline depression symptoms and of several other important potential confounders. Cross-sectional analyses of the entire sample suggested that those who had fewer than two depression symptoms were 31% more likely to have general obesity and 25% more likely to have central obesity. The Dutch LifeLines cohort, which included over 160 000 participants, investigated the combined effects of obesity and major depressive disorder on physical and mental quality of life.

The survey showed that individuals who had both conditions had a lower quality of life than those who only had obesity or major depressive disorder, suggesting a synergic detrimental effect on quality of life *(53)*. The Spanish Atención Primaria de Navarra (APNA) study, a seven-year longitudinal study of over 20 000 women, showed that those with obesity at baseline were associated with a greater risk of developing depression *(54)*. This association was not evident for those who were overweight.

6.2.5 Musculoskeletal complications

Obesity has been associated with increasing musculoskeletal disability, affecting bones and joints (for example, osteoarthritis) as well as soft tissue (for example, chronic damage to cartilage and tendons). The prevalence of musculoskeletal diseases has increased in parallel with the prevalence of overweight and obesity *(56)*, and the association between increasing BMI and musculoskeletal diseases suggests a dose–response relationship *(57)*. Although the specific mechanism through which excessive weight damages musculoskeletal functions is not fully elucidated, it is well-established that it exerts a burden on mobility and functionality. Osteoarthritis, rheumatoid arthritis, psoriatic arthritis, lower back pain and osteoporosis are among the most common musculoskeletal disorders in adults over the age of 40 years. In European adults osteoarthritis and lower back pain affect an estimated 10% of adults over 50 years. The longitudinal multinational European Project on Osteoarthritis estimated that the prevalence of osteoarthritis in adults over 65 years was 30% *(58)*, with over half of these experiencing progressive loss of functionality (frailty) prior to the onset of osteoarthritis. This frailty is characterized by weakness, slowness, exhaustion, low physical activity and unintentional weight loss. Obesity is a key contributor to osteoarthritis in adults through its impact both on mechanical movement and on inflammation which is a central feature of osteoarthritis *(59)*. The Spanish Sistema d'Informació per al Desenvolupament de l'Investigació en Atenció Primària (SIDIAP) cohort prospectively studied risk of osteoarthritis in a sample of over 1.7 million adults using clinical and sociodemographic data collected from medical surgeries; it reported that the incidence of knee osteoarthritis was five times higher among subjects with a BMI of 35–40 kg/m^2 (grade II obesity) compared with those at normal weight. Similarly, onset of hip and hand osteoarthritis, albeit less common than knee osteoarthritis, was two to three times more likely to occur in those with obesity *(57)*.

6.2.6 Nutritional complications

Besides the defining increase in fat mass, obesity may present with additional nutritional imbalances. Higher risk of deficiency of several micronutrients is common and linked to a number of factors, including consumption of unhealthy foods and imbalanced diets, increased requirements for some micronutrients because of low-grade chronic inflammation and oxidative stress, or decreased intestinal absorption in patients with bariatric surgery *(60,61)*. Serum zinc *(62)*, selenium *(63)*, vitamin B_{12} and folate may be lower in people with obesity compared with those without obesity *(64–66)*. Vitamin D deficiency is also common in individuals living with overweight and obesity compared with individuals of normal weight, with prevalence reaching 25–35% *(67)*. These

micronutrients are involved in regulating immune and metabolic homeostasis and cardiovascular function, and their deficiency is associated with higher prevalence of infection, metabolic complications and several NCDs.

Pro-inflammatory and pro-oxidative metabolic derangements due to excess adiposity, as well as the presence of comorbidities and obesity-induced NCDs are further associated with skeletal muscle protein-catabolic changes and may lead to loss of muscle mass and function in people with obesity *(68)*. Altered body composition with high body fat and low muscle mass (also defined as sarcopenic obesity) is commonly associated with higher risk of frailty and dependency *(69)* and with high morbidity and mortality in several chronic diseases and NCDs *(70,71)* and in the general population *(72)*. Also importantly, both micronutrient deficiencies and sarcopenic obesity are most common in older people and those with NCDs; these may, therefore, synergistically enhance age- and disease-associated morbidity and mortality *(67)*.

6.2.7 Adverse impact of obesity in pregnancy

The implications of obesity on pregnancy are discussed in more detail elsewhere in this report. An estimated 7–25% of women start pregnancy with a BMI exceeding 30 kg/m^2 *(73)* and the prevalence of women with obesity during the first trimester of pregnancy doubled over a period of 15 years *(74)*. In Europe, as in other developed countries, obesity during pregnancy is often associated with socioeconomic vulnerability and lower educational attainment. The impact of obesity in the offspring has been widely documented, ranging from cardiometabolic (CVD and obesity) *(75)* to psychiatric ailments *(76)*. Similarly, two of the most common adverse outcomes related to obesity during pregnancy are gestational diabetes and hypertension, which can have long-term detrimental impacts on women's health *(77)*, and the risk of cardiometabolic disease in the child *(78)*.

6.3 Staging systems in relation to obesity complications

Staging systems are used in many diseases to help to determine disease severity and support clinical decision-making with regards to treatment. Systems suggested to be of value in the assessment of people affected with obesity include the Edmonton Obesity Staging System (EOSS) [Table 6.1] *(79)* and the King's Obesity Staging Criteria *(80)*. Both use the presence of various obesity complications to determine the severity of the disease. The EOSS has been shown to predict mortality over long periods of follow-up, as well as outcomes after bariatric surgery in people with severe obesity *(81,82)*. It has also been adapted for use in children *(83)*. As well as giving an indication of disease severity, the system also provides broad guidance to help determine appropriate treatment.

TABLE 6.1. Main characteristics of the EOSS

Stage	Description	Management
0	No apparent obesity-related risk factors (e.g. blood pressure, serum lipids, fasting glucose, etc. are within normal range), no physical symptoms, no psychopathology, no functional limitations and/or impairment of well-being	Identification of factors contributing to increased body weight Counselling to prevent further weight gain through lifestyle measures including healthy eating and increased physical activity
1	Presence of obesity-related subclinical risk factors (e.g. borderline hypertension, impaired fasting glucose, elevated liver enzymes), mild physical symptoms (e.g. dyspnoea on moderate exertion, occasional aches and pains, fatigue), mild psychopathology, mild functional limitations and/or mild impairment of well-being	Investigation of other (non-weight-related) contributors to risk factors More intense lifestyle interventions, including diet and exercise to prevent further weight gain Monitoring of risk factors and health status
2	Presence of established obesity-related chronic disease (e.g. hypertension, T2DM, OSA, osteoarthritis, reflux disease, polycystic ovary syndrome, anxiety disorder), moderate limitations in activities of daily living and/or well-being	Initiation of obesity treatments including considerations of all behavioural, pharmacological and surgical treatment options Close monitoring and management of comorbidities as indicated
3	Established end-organ damage such as myocardial infarction, heart failure, diabetic complications, incapacitating osteoarthritis, significant psychopathology, significant functional limitations and/or impairment of well-being	More intensive obesity treatment including consideration of all behavioural, pharmacological and surgical treatment options Aggressive management of comorbidities as indicated
4	Severe (potentially end-stage) disabilities from obesity-related chronic diseases, severe disabling psychopathology, severe functional limitations and/or severe impairment of well-being	Aggressive obesity management as deemed feasible Palliative measures including pain management, occupational therapy and psychosocial support

Source: Sharma and Kushner (2009). Reprinted by permission from Springer Nature *(79)*.

6.4 Effects of obesity on the treatment of other diseases

The presence of obesity may be used to limit access to treatments for other diseases and conditions; for example access to islet transplants in people with type 1 diabetes is generally limited to people with a BMI below 26 kg/m^2 *(84)*. While this may sometimes be based on evidence of reduced effectiveness, or greater operative risk (for example, cardiac surgery, transplant surgery or major joint replacement surgery) *(85,86)*, in some instances there is scant evidence that this is the case. For example, recent evidence suggests that outcomes are similar for major joint replacement surgery in people with and without obesity and independent of preoperative weight loss *(87)*. Some studies in cardiac surgery have even suggested that people with obesity are at lower risk *(88)*. Hence, restrictions on access to such interventions or requirements to lose weight prior to surgery could represent bias or stigma from health-care professionals or those commissioning services, and could perhaps be managed by explanation of risks to patients rather than complete bans based on arbitrary levels of BMI.

Many drugs are prescribed using weight-based dosing, which may not always be appropriate and may lead to potential overdosing of treatments and can create the perception that treating people with obesity may be more expensive to health-care systems. Examples include weight-based dosage for clotting factor replacement in people with haemophilia where this may not actually be necessary *(89)*.

6.5 How treatment of other conditions can exacerbate and cause obesity

Given the powerful biological drivers controlling appetite and body weight that are largely expressed in the central nervous system, it is perhaps not surprising that many classes of centrally acting drugs can contribute to weight gain. Some of these agents also have peripheral metabolic effects that increase the risk of obesity-related complications. Well-recognized examples include drugs used to treat mental illness, particularly antipsychotic medications and some antidepressants, anticonvulsants (notably sodium valproate), glucocorticoids and some drugs used to treat migraine. Other commonly prescribed drugs that can cause weight gain include treatments for diabetes such as insulin, sulfonylureas and thiazolidinediones and some antiretroviral agents used to treat HIV infection *(90)*. Conversely, some centrally acting drugs used to treat these conditions may result in weight loss, for example topiramate, which is used as an anticonvulsant and to prevent migraine.

These effects are not just confined to medications; for example, deep brain stimulation used as a treatment for Parkinson's disease has been associated with weight gain *(91)*. This again highlights the importance of the underlying biological regulation of energy balance and the importance of the brain as a key organ that helps to regulate body weight.

6.6 Benefits of weight loss on obesity complications

Given the clear associations between obesity and its cardiovascular, respiratory, metabolic, mechanical and mental consequences, it might be expected that weight loss in people with obesity would clearly confer benefits such as reductions in obesity-related diseases, including T2DM, OSA, CVD, arthritis and cancers, along with reducing associated mortality and improving quality of life. While most observational data support this view, evidence from RCTs mostly focuses on surrogate outcomes such as improvements in cardiovascular risk factors or glycaemia, rather than so-called hard clinical endpoints. It is recognized that weight loss, and in particular long-term weight maintenance, is difficult to achieve with interventions that focus on the behavioural and environmental factors that contribute to obesity (Box 6.1). Nevertheless, the accumulated evidence from observational studies that have looked at intentional weight loss, long-term case–control studies following bariatric surgery *(92)* and long-term follow up of short- to medium-term weight loss interventions such as the Chinese Da Qing diabetes prevention study and the Look Action for Health in Diabetes (Look AHEAD) trial in T2DM all suggest that weight loss is likely to be beneficial in the long term *(93–95)*. There is also evidence that incrementally greater weight loss in people with obesity is likely to lead to better outcomes, with benefits such as improvement in glycaemia and blood pressure apparent at 5% weight loss or less, whereas reductions in conditions such as OSA, fatty liver disease, remission of T2DM and CVD reduction may require weight loss in excess of 10–15% *(96)*.

Box 6.1

People's experience of living with obesity: Judit [a]

Judit has been living with obesity since she was a child. Growing up in Budapest, she was a healthy child. She swam regularly in pools for exercise and also ate a healthy diet. It did not make sense to anybody why she became affected by obesity. For most of her life, Judit would go to the gym at least twice a week, and would often hike and go for long walks. Judit was living with obesity despite being healthy and living a healthy lifestyle. When she recognized that she needed help from a doctor she was put on several different weight loss programmes where she would eat less, move more and follow a strict daily calorie intake target. She was able to lose the weight gradually over time; however, several years later, Judit developed problems with her knees and regained the weight.

These days, Judit accepts that she is still a healthy person living a healthy life, but that she is living with obesity that she has to manage and take care of. Judit discusses the fact that there are many different factors that can contribute to someone developing obesity. The understanding of doctors and other health-care professionals that obesity is not something that can be fixed simply by eating less and moving more needs to evolve to include an understanding of the various factors that can contribute to the development of obesity, including mental health issues, side-effects of illness and medications, and genetic problems. Obesity is not merely a consequence of behaviours and environments, as believed by many; it needs constant management and treatment.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

Based on obesity trends since the year 2000, current projections for European adults predict that 37% of British women and men will be affected by obesity by the early 2030s, leading the prevalence in the Region *(97)*. Losing weight appears to be one of the most effective approaches to reduce risk of obesity-related NCDs, as shown in a recent retrospective analysis of over 571 961 adults registered in the United Kingdom's Clinical Practice Research Datalink (CPRD) GOLD database. The study showed that a median weight loss of 13% in individuals with a BMI of 40 kg/m^2, compared with those who kept a stable BMI of 30 kg/m^2, was associated with important relative risk reductions of T2DM (41%), OSA (40%), hypertension (22%), dyslipidaemia (19%) and asthma (18%). The benefits of weight loss were higher in those with greater BMI *(98)*. Table A3.1 summarizes previous meta-analytic estimates from RCTs examining the effect of weight loss on obesity outcomes. The evidence from RCTs consistently shows that weight reduction through diet over a sustained period reduces the risk of all-cause mortality and improves quality of life (Table A3.1), but the evidence on mortality for CVD and cancer is less clear. The impact of weight loss on metabolic markers is not conclusive, but the quality of the evidence is limited by the inherent limitations of the primary trials.

It is also important to consider the effects of weight loss on quality of life. This has been assessed in some RCTs and observational studies. A recent meta-analysis of these effects shows that weight loss improves quality of life in people with obesity, and that the benefits of weight loss are greater in those with a higher baseline BMI *(99)*. Future work should focus on effects based on baseline severity of obesity (for example, by EOSS score).

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7. OBESITY AND CANCER

Key highlights

- Obesity is now considered a cause of at least 13 different types of cancer including cancers of the breast (in postmenopausal women), colorectum, endometrium, kidney, liver, gallbladder, ovary, pancreas, gastric cardia, oesophagus, thyroid, multiple myeloma and meningioma.
- In Europe obesity is estimated to be directly responsible for at least 200 000 new cancer cases per year. This figure is projected to rise in the coming decades.
- For some countries within the Region, it is predicted that obesity will overtake smoking as the main risk factor for preventable cancer in the coming decades.
- The biological pathways that underlie the relationship between obesity and cancer are not fully understood but likely involve dysregulation of hormonal pathways such as estrogen and insulin, as well as chronic inflammation and immune pathways.
- Obesity is associated with poorer outcomes among patients with cancer, particularly those with breast, bladder, colorectal, prostate and liver cancer.
- Intentional weight loss among people affected by overweight and obesity seems to reduce risk of certain obesity-related cancers.
- Public health policies aimed at reducing obesity will likely have important impact on the cancer burden; however, additional preventive strategies may be needed to target those at higher risk of obesity-related cancers.

7.1 Introduction

A total of 640 million adults and 110 million children and adolescents worldwide are estimated to be affected by obesity *(1)*. In parallel, there is a growing burden of cancer; in 2020 more than 19 million people worldwide were diagnosed with cancer, and this figure is projected to rise to more than 30 million new cases per year by 2040 *(2)*. Based on current understanding on the causes of cancer, at least 40% of cancer cases are preventable, with smoking, obesity and alcohol consumption being three important modifiable causes of cancer related to lifestyle. While the associations of obesity with CVD and T2DM are well established, the relation of obesity with cancer has only more recently been recognized. Based on large-scale epidemiological studies and supported by experimental evidence, the International Agency for Research on Cancer (IARC) has now classified obesity as a cause of at least 13 different types of cancer *(3)*. Obesity also appears to be associated with worse survival among some people with cancer.

Important questions remain regarding the link between obesity and cancer and, in particular, the underlying biology: whether intentional weight loss mitigates risk of cancer among those with overweight or obesity, and to what degree obesity impacts cancer survival and risk or recurrence. The rising prevalence of obesity worldwide, particularly in children and young adults, could result in an increasing number of cancer cases in the years to come. It has been estimated that obesity will supersede smoking as the primary factor associated with cancer in some countries in coming decades; therefore, interventions at both population and individual level to reduce obesity and to sever the obesity–cancer link are critical for cancer control.

7.2 Obesity and cancer risk

7.2.1 Epidemiological evidence

Beginning mostly in the 1990s and increasing through the past decades, epidemiological studies in large, long-term cohorts have reported associations between the risk of certain cancers and overweight and obesity. This evidence has been systematically reviewed in dozens of meta-analyses that have included hundreds of studies, including by the American Institute for Cancer Research, IARC and the World Cancer Research Fund *(3–5)*. On the basis of these evaluations, it is now recognized that being affected by overweight or obesity in adulthood increases the risk of cancers of the breast (postmenopausal), colorectum, endometrium (lining of the uterus), ovary, kidney, liver, gallbladder, gastric cardia, oesophagus (adenocarcinoma), and pancreas (Box 7.1). The IARC evaluation also concluded that there was sufficient evidence for an association between obesity and thyroid cancer, multiple myeloma, and meningioma. In addition, there is moderate evidence for an association with cancers of the mouth, pharynx, larynx and male breast, with advanced prostate cancer, and with diffuse large B-cell lymphoma; there was limited suggestive evidence for an association with cervical cancer. More research is, therefore, needed to elucidate clearly whether obesity is a cause for these cancer types. The strength of the association between obesity and cancer differs depending on the anatomical site (see Table 7.1). For example, relative risks range from 1.5–1.8 for the association of obesity with cancers of the colon, gastric cardia, liver, gallbladder, pancreas, and kidney. There are some notable exceptions; for oesophageal adenocarcinoma, the relative risk was 4.8 for a BMI of 40 kg/m^2 or more compared with normal weight. Obesity is also particularly strongly associated with cancer of the endometrium, where a BMI of 30 kg/m^2 confers a higher (2.5) relative risk of developing this malignancy. For women with a BMI of 40 kg/m^2 and above, the relative risk of endometrial cancer rises to 7.1 compared with women with a lower BMI. Interestingly, for premenopausal breast cancer, being affected by overweight or obesity as an adult prior to menopause reduces risk, but weight gain in adulthood increases it. The reasons for this difference in the obesity–breast cancer relationship by menopausal status are not fully understood. The majority of epidemiological studies have used BMI as the primary indicator in evaluations of the association between obesity and cancer; however, higher waist circumference as a

measure of central adiposity is also now a recognized risk factor for several cancer sites independent of overall body size. There is also growing interest in the role of fat tissue distribution in cancer development. A recent study of postmenopausal women in the United States showed that relatively high body fat levels were associated with increased risk of breast cancer irrespective of overall body size and BMI *(6)*. It is possible that anthropometric parameters such as BMI misclassify some individuals in terms of obesity-related cancer risk. The identification of alternative indicators of obesity that better predict cancer risk and that capture fat distribution as well as its metabolic consequences is an active area of research.

Box 7.1

People's experience of living with obesity: Melanie [a]

Melanie has been living with obesity since she was born and her mother, aunt and grandmother all lived with obesity as well. Melanie first considered bariatric surgery after a friend recounted her successful experience with the surgery. Melanie lost 106 kg in the 15 months following surgery and soon received the exciting news from her doctor that she was pregnant. However, throughout her pregnancy Melanie gained 70 kg due to lipidaemia and experienced a very serious bout of depression. Melanie's daughter, who is now 16 years old, also lives with obesity. Throughout her daughter's upbringing, Melanie has battled with several organizations that believed her to be incapable of looking after her child due to her weight.

When her daughter was 3 years old, Melanie visited her gynaecologist and was diagnosed with cancer. Following this, she experienced a constant battle with the health system. After being told she must undergo a CT scan, she was then informed that she was too big for the machine. The surgery proceeded despite the lack of a scan with 25 students observing, as it was so rare that a woman as young as 40 years had this type of cancer, most commonly found in women over 60 years of age. The period following surgery remained fraught as Melanie was aware that her cancer could recur at any time. Because of the inability to perform a CT scan, it was difficult to monitor her health. Melanie's experience with cancer exemplifies the problems posed by the health system when caring for people living with obesity.

Melanie has observed that with the increased awareness of the complexity of obesity has helped to shape a more positive public awareness of obesity, as the stigma related to individual blame is no longer as common. Melanie believes this is positive progress but that there is still a lot more work to be done. As there is more advocacy by medical practitioners and politicians, Melanie thinks people will start to move the blame from the individual to the many causes of obesity.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

TABLE 7.1. Strength of evidence for a causal relationship between different cancer types and obesity as evaluated by IARC

Cancer site or type	Strength of evidence
Breast (postmenopausal)	Strong
Colorectal	Strong
Liver	Strong
Pancreas	Strong
Gastric cardia	Strong
Oesophagus (adenocarcinoma)	Strong
Endometrium	Strong
Ovary	Strong
Kidney (renal cell)	Strong
Gallbladder	Strong
Thyroid	Strong
Multiple myeloma	Strong
Meningioma	Strong
Fatal prostate cancer	Moderate
Diffuse large B-cell lymphoma	Moderate
Male breast cancer	Moderate

Source: IARC, 2016 *(4)*.

The associations between obesity and cancer risk can differ within subgroups of the population: for certain cancers, stronger effects are observed for women than men, and for older versus younger populations. The association between obesity and colorectal cancer is stronger in men than in women for reasons that are not currently understood *(3,4)*. The relationship between obesity and cancer may also vary by race and ethnicity; for example, the association between obesity and breast cancer risk was found to be stronger for women of Asian ethnicity than for women from other ethnic groups *(7)*. Certain other factors are known to modify the association between obesity and cancer. For example, higher BMI increases risk of postmenopausal breast, endometrial and ovarian cancer, but only among women who have not used menopausal hormone therapy. Women affected by obesity who are current or past users of menopausal hormone therapy do not appear to have elevated risk of these cancers *(4)*.

7.2.2 Genetic evidence

Genetic studies also support a causal relationship between obesity and risk of certain cancers. Genome-wide association studies have now identified hundreds of genetic variants that are robustly associated with obesity and single nucleotide polymorphisms (SNPs) comprising these genetic variants have been investigated in relation to different cancer endpoints. These studies have demonstrated clear, positive associations between SNPs for higher BMI and both oesophageal adenocarcinoma and cancers of the colorectum, pancreas, kidney, ovary (non-high grade serous), and endometrium *(8–13)*. Additionally, genetic studies support a positive association between obesity and lung cancer, specifically for squamous and small cell lung cancers, despite observational epidemiological studies reporting inverse associations. Interestingly, the strength of risk estimates between the genetic instruments linked with obesity and cancer are markedly stronger than those reported in epidemiological studies, and it has been suggested that the impact of obesity on cancer risk may be greater than previously thought *(14)*.

7.2.3 Biological plausibility

Experimental models have shown that obesity in rodents promotes cancer and increases the incidence of cancers of the colon, pancreas, liver, mammary gland, colon, liver, prostate (advanced stage) and skin, as well as, to a lesser extent, leukaemia *(15,16)*. Conversely, caloric or dietary restriction in experimental animal models leads to a preventive effect on lymphoma, leukaemia and cancers of the mammary gland, colon, liver, pancreas, skin and prostate.

Understanding the biological pathways that lie at the intersection of obesity and cancer is currently an area of intense research activity, and while the precise mechanistic links between obesity and cancer are not fully delineated, current thinking posits that obesity engenders a physiological state whereby cells that carry a cancer-causing mutation are more likely to survive and undergo clonal expansion. Obesity is associated with significant metabolic and endocrinological abnormalities and to date, three major mechanisms have emerged to explain the link between obesity and cancer. These entail dysregulation of sex hormone metabolism, enhanced insulin and insulin-like growth factor signalling, and adipose tissue-derived inflammation *(3,17,18)*. The extent to which these different pathways play a role in the obesity and cancer relationship likely varies depending on the cancer in question. For example, for postmenopausal breast cancer it has been established that exposure to higher levels of the sex hormone estrogen is a causal risk factor. In postmenopausal women, adipose tissue is the primary site for estrogen synthesis and there is a positive correlation between BMI and circulating levels of estrogen. Therefore, it is likely that the higher levels of estrogen produced by adipose tissue in postmenopausal women with obesity are an important contributor to the obesity–breast cancer relationship. Insulin has also emerged as a likely key player in the obesity–cancer link. In addition to its role in glucose metabolism, insulin can function as a growth factor and has been shown to activate various cellular pathways implicated in cancer development *(19,20)*. Numerous large-scale epidemiological studies have shown that individuals with higher levels of insulin (or biomarkers of

insulin secretion) have a higher risk of developing different cancers including those of the colorectum, endometrium, postmenopausal breast, liver and pancreas *(3,4)*. Consistent with these findings, large-scale genetic studies involving thousands of individuals have demonstrated that those with higher genetically determined insulin levels are at greater risk of developing colorectal, breast, endometrial, kidney, lung, and pancreatic cancers *(9,21–24)*. Finally, obesity is recognized as a pro-inflammatory condition characterized by elevated systemic levels of inflammatory cells and proteins within adipose tissue. Inflammation is a hallmark of cancer and both experimental models and epidemiological studies support a causal link between inflammation and cancer development *(3,4)*. Ongoing research is likely to uncover additional mechanistic pathways that link obesity with cancer. Emerging hypotheses include the role of gut hormones and the gut microbiota, given that both are dysregulated in obesity and have physiological effects that may promote cancer development.

7.2.4 Intentional weight loss and cancer risk

Although the link between obesity and cancer risk is now well-established, an important yet unresolved question is how intentional weight loss might influence cancer risk. In the absence of RCTs that directly investigate intentional weight loss in relation to cancer development, we currently rely on evidence from a small number of observational studies and from studies of patients undergoing bariatric surgery. In a recent analysis conducted in a large cohort of American women, statistically significant reductions in the risk of obesity-related cancer (and especially endometrial cancer) were observed in women who intentionally lost more than 5% of their body weight *(25)*. Bariatric surgery, which achieves substantial weight loss and resolution of metabolic dysfunction among individuals affected by obesity, has been shown to reduce risk of breast and endometrial cancer among others *(26)*, although evidence is limited and conflicting for other cancer endpoints *(27)*. A potential cancer-preventive effect of intentional weight loss in overweight individuals is also supported by biological data. There is evidence from RCTs and other intervention studies to suggest that intentional weight loss (either through physical activity or dietary modification) can cause favourable changes in obesity-related biomarkers *(4,28,29)*. Preclinical studies on the effect of weight loss achieved through calorie-restricted diets or bariatric surgery have also shown favourable effects on obesity-related biological pathways in target tissues (for example, the colorectum or endometrium), as well as on markers of cancer-related processes such as cellular proliferation, inflammation and the immune micro-environment *(30,31)*. Although more research is needed in this area, these studies suggest that among individuals affected by overweight or obesity, losing weight is likely to be at least partially beneficial in reducing cancer risk, regardless of age or the degree of excess weight.

7.3 Obesity and cancer survivors

Improvements in cancer treatment and early detection of some cancers over the past decades have led to a growing population of cancer survivors worldwide. In Europe it is estimated that there are more than 12 million cancer survivors, many of whom remain at

risk of recurrence and other comorbidities and mortality. There is understandably huge interest in understanding factors that may be associated with recurrence and survival among people with cancer. Epidemiological studies generally indicate that patients with cancer who are also affected by overweight or obesity at the time of diagnosis have worse outcomes than those of lower weight. For example, a meta-analysis of 82 studies reported a 35% increase in breast cancer-related mortality and a 41% increase in all-cause mortality in women with breast cancer affected by obesity, compared with those who were normal weight *(32)*. Similarly, meta-analyses suggest that obesity is further associated with poorer survival outcomes in patients with bladder *(33)*, prostate *(34)* or liver cancer *(35)*.

A large-scale dietary intervention trial in women with early-stage breast cancer found some correlation between women who lost weight in the intervention group and those who had a lower risk of breast cancer recurrence; in particular for estrogen receptor-negative breast tumours *(36)*. Further, small-scale trials have demonstrated the effects of intentional weight loss on circulating biomarkers of cancer and cardiometabolic risk, including changes in insulin sensitivity *(37)*, levels of circulating sex hormones *(38)* and inflammation markers *(39)*. Weight-loss trials have also been undertaken in endometrial cancer survivors; however, overall results have been inconclusive *(40)*. Currently no trial has shown the effect of intentional weight loss on survival following a cancer diagnosis but several RCTs on intentional weight-loss in breast cancer survivors are ongoing in Europe and in North America and are expected to report their findings in the coming years.

7.4 Obesity and the cancer burden

In 2014, 1.97 billion adults and more than 338 million children and adolescents were classified as affected with overweight or obesity *(1)*. The prevalence of obesity is increasing in countries of all income levels, a major reflection of the effects of industrialization and the increase in sedentary habits occurring globally. Approaching 2040, the largest increases in overweight and obesity are projected to occur in low- and middle-income countries, while, in parallel the global burden of cancer is also increasing. In the EU 2.7 million people were diagnosed with cancer in 2020 and 1.3 million lost their lives to cancer. Ongoing trends in the prevalence of obesity are expected to result in a substantial increase in cancer incidence worldwide. Globally, the proportion of cancers attributable to obesity has recently been estimated as ranging from less than 1% to approaching 9.5%, depending on the cancer and the location *(41,42)*. The highest proportions of cases attributable to obesity are found in Europe, North America and the Middle East; with lower rates in sub-Saharan Africa and Asia, corresponding to the prevalence of obesity in those regions. In Europe specifically it is estimated that in 2012 more than 200 000 cancer cases were directly caused by obesity. For colorectal cancer, the third most commonly diagnosed cancer in Europe and the third leading cause of cancer death, at least 20% of cases are likely directly attributable to obesity, amounting to almost 40 000 new cases per year.

7.5 Conclusion

The established link between obesity and certain cancers raises important questions regarding cancer prevention and control. Maintenance of a healthy weight is an obvious step to potentially reducing the risk of obesity-related cancers. However, the determinants of obesity are complex and multifaceted, and a multilevel approach is likely necessary to combat the obesity epidemic globally. Behavioural change at both individual and societal levels is strongly suggested. Public health strategies that reduce obesity, promote physical activity and discourage the consumption of high-calorie obesogenic foods are being implemented in many countries. Although such strategies could lead to a reduction in the burden of cancer if successful, obesity prevalence is still increasing according to global data. A better understanding of the biology underlying the link between obesity and cancer could provide opportunities to tailor specific preventive strategies or therapies, such as drug repurposing or behavioural interventions, in susceptible individuals.

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8. OBESITY AND COVID-19

Key highlights

- The physiological and anatomical characteristics associated with obesity can worsen the outcomes of COVID-19, primarily through respiratory and immunological compromise.
- People with obesity are at heightened risk for clinically severe disease and mortality with COVID-19.
- Unfavourable shifts in food consumption and physical activity patterns have taken place during the COVID-19 pandemic.
- Vaccines show equal efficacy for populations with or without obesity.
- Environmental drivers of obesity have accelerated with population-level prevention measures especially during periods of restricted movements (for example, restrictions related to work; school closures; restrictions in access to sport clubs, public and recreational space; and scaling back of preventive and health promotion services by health services).
- Multisectoral and governmental policy and action on upstream factors for obesity are needed for pandemic response.

8.1 Introduction

The COVID-19 pandemic continues to have profound impacts on individuals, health systems, and the obesogenic environment *(1–3)*. People living with overweight and obesity have been disproportionately affected by the consequences of COVID-19, with an increased risk of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and unfavourable prognosis *(4)*. This pandemic has also reversed many gains made by nutritional and physical activity policies through unfavourable shifts in food consumption and physical activity patterns *(5–8)*. This chapter will explore the pathogenic link between COVID-19 and obesity; discuss COVID-19 incidence, prevalence, and outcomes for people with obesity; and examine the broader disruptive effects of COVID-19 on society and health systems. The chapter concludes with suggestions for optimizing policy to ensure that the prevention and management of obesity and overweight remain a priority in the response to the COVID-19 pandemic. In order to inform this chapter, we conducted an informal literature review to provide a brief narrative description of the available information on associations between overweight and obesity and COVID-19. The methods of this informal literature review were as follows: We searched PubMed, Medline, major journal groups, and grey literature produced by international obesity societies and WHO. English search terms were used and included combinations of "obesity", "overweight", "COVID-19", "SARS-CoV-2", "health policy", "management", "pathophysiology", "childhood obesity",

"environmental risk factors", "obesogenic environment", "outcomes", "incidence", "prevalence" and various synonyms for these key search terms, selecting peer-reviewed reviews and grey literature sources published from 2020 onwards. Relevant studies were sourced from these reviews. Grey literature was sourced from the WHO website by searching for COVID-19 and obesity literature. Affiliated organizations with WHO who publish policy statements relevant to obesity within Europe were also searched. Due to the nature of this work (this was not a formal systematic review), there were no explicitly defined inclusion and exclusion criteria related to study type, exposure, outcome and population group. The identified sources were supplemented by information derived from consultations with several stakeholders, experts and Member States. The literature included is intended to showcase reviews and large trial data and provide the current views on topics related to COVID-19 and obesity. However, the data from large trials and longitudinal studies are almost exclusively from the United Kingdom and the United States. More work is needed to get large trial and prospective data from other parts of the WHO European Region. Every effort has been made to highlight commonly described gaps in understanding and areas for future research.

8.2 Biological link

The physiological and anatomical characteristics associated with obesity can worsen the outcomes of COVID-19, primarily through respiratory and immunological compromise. Individuals with obesity are also more likely to have comorbidities that play a role in exacerbating the clinical course of COVID-19, such as hypertension, CVD, T2DM and OSA *(1)*.

At a mechanistic level, multiple plausible biological pathways suggest a causal link. As a putative receptor of viral entry for SARS-CoV-2 into host cells, angiotensin-converting enzyme 2 (ACE2) receptors are overexpressed in adipose tissues, and accordingly in individuals with obesity *(9)*. Dysregulation of the renin–angiotensin–aldosterone (RAAS) axis and mechanistic target of rapamycin (mTOR) pathways are also theorized as underlying mechanisms of increased COVID-19 severity in obesity.

Reduced baseline cardiorespiratory fitness, diminished respiratory compliance, elevated work of breathing and poor gas exchange resulting from obesity contribute to the respiratory complications that can result from COVID-19 *(10)*. Obesity is also associated with low-grade chronic inflammation, causing an upregulation of proinflammatory cytokines and adipokines and overactivation of the complement system, impairing both the innate and adaptive immune response and increasing susceptibility to infection *(11)*. Obesity can lead to a prothrombotic state and, in combination with the cytokine storm potential induced by SARS-CoV2, increase thrombogenic potential.

The combination of the high basal inflammation of obesity and inappropriate hyperinflammatory response to SARS-CoV2 underlies the degree of severity of pulmonary and extrapulmonary manifestations of COVID-19 in these individuals (Fig. 8.1) *(12)*. Pulmonary manifestations may include hypoventilation-associated pneumonia, pulmonary embolism, and pulmonary fibrosis. Numerous neurological, gastrointestinal, cutaneous and ophthalmic sequalae have also been observed *(13)*.

Fig. 8.1 **Mechanisms of SARS-CoV-2 severity in obesity**

SARS-COV-2 IN PEOPLE WITH OBESITY

ASSOCIATED CARDIOMETABOLIC DISEASE

Cardiovascular disease, diabetes mellitus, prediabetes, chronic kidney disease, hypertension, dyslipidaemia, obstructive sleep apnoea

BIOMECHANICAL FACTORS

- Increased airway resistance
- Impaired gas exchange
- Decreased lung compliance
- Reduced functional residual capacity
- Respiratory muscle insufficiency
- Increased oesophageal and gastric pressure

DYSFUNCTIONAL IMMUNE FACTORS

- Chronic low-grade inflammation
- Increased proinflammatory cytokines
- Impaired lymphocyte development, phenotype and function
- Poor lymphoid tissue integrity
- Decreased macrophage activation
- Decreased memory T-cell number
- Hyperactivation of complement system
- High programmed cell death protein 1 (PD1) and programmed death-ligand 1 (PD-L1)

IMPAIRED SYSTEMIC AND METABOLIC FACTORS

- Insulin and leptin resistance
- Decreased adiponectin
- High reactive oxygen species (ROS)
- Chronic activation of renin-angiotensin-aldosterone system (RAAS)
- Endothelial dysfunction
- Upregulated expression of angiotensin-converting enzyme 2 (ACE2)
- Impaired glucose regulation
- Increased thromboembolic risk

INCREASED INFECTION RISK AND SEVERITY OF COVID-19

POTENTIAL CONSEQUENCES

CELLULAR AND ORGAN

- Hyperinflammation
- Coagulopathy
- Increased cell invasion by SARS-CoV-2
- Glycosylation of ACE2 and viral spike protein
- Increased systemic inflammation and oxidative stress
- Cytokine storm
- Impaired viral clearance
- Rapid progression of COVID-19
- Tissue hypoxia
- Interstitial lung damage
- End-organ damage

CLINICAL

- Severe pneumonia
- Multiorgan failure
- Acute respiratory distress syndrome
- Thrombosis
- Viral shedding
- Death
- Post COVID-19 condition

8.3 COVID-19-related impacts and outcomes

8.3.1 Incidence

People affected by obesity are at increased risk of contracting COVID-19 compared to people within healthy weight ranges (Box 8.1) *(4, 14, 15)*. Pre-existing data from biobanks and primary care in the United Kingdom estimated a 1.41- to 1.55-fold increase in the odds of a positive test for COVID-19 for people affected by obesity compared with those of healthy weight *(14, 15)*. In the United States an analysis of 148 494 adults who received a diagnosis of COVID-19 across 238 hospitals in 2020 found that 28.3% had overweight (excluding obesity) and over 50% had obesity *(16)*. More recent data from 2021 showed similar estimates for obesity *(17)*. When stratified by age and vaccination status the obesity estimates were as follows: for adults under 65 years of age hospitalized with COVID-19, 47% of fully vaccinated people and 56% of those not fully vaccinated had obesity. And among people aged 65 years or over, 32% of fully vaccinated patients and 35% of those not fully vaccinated had obesity.

Box 8.1

People's experience of living with obesity: Solveig [a]

It was when Solveig was 12 years old that obesity started to be a problem for her. When Solveig was a child, she was sexually abused and this was the starting point of her battle with her weight. It was not until later in life that Solveig learned about the stress children suffer from abuse and the impact that this can have on mental and physical health. Solveig used binge eating as a form of punishment: something she did in private because she felt worthless. For years she would hide and eat nonstop until she would purge. At the time, she did not realize that she needed help. Solveig continued to gain weight and no one could work out why such a young girl constantly did so. The only solution that she was offered for many years was to diet, and so for years she went from diet to diet, gaining weight, losing weight and regaining weight again. After many years of diets and ineffective advice, Solveig finally found help when she was 45 years. She made contact with an obesity clinic which she had seen advertised on television. The clinic was life-changing for her. The clinic approached obesity with a multidisciplinary focus, combining doctors, nurses, physiotherapists, psychologists, gym classes and cooking lessons.

Solveig is also concerned about the public's and health-care professionals' understanding of obesity, which she believes will not change until education on obesity is introduced into the health-care system. During the COVID-19 pandemic, for example, Solveig had to e-mail her GP to ask if she was able to have the vaccine early as she believed that she was at risk of becoming very sick from COVID-19 due to her obesity. This was a difficulty for many people living with obesity in Iceland, as those who had a GP unaware of the risks posed by obesity were told they were not allowed early access to the vaccine and they had to isolate at home. It was only those who had a GP who had an understanding of obesity who were allowed to receive the vaccine. Solveig also points out the difficulties with technology that came to light during the COVID-19 pandemic. There are many people who are not comfortable using technology and, therefore, their access to medical consultations including obesity treatment or therapy online was reduced throughout the periods of restricted movements. This is especially pertinent for populations such as the elderly living with obesity who also often live alone, making it difficult for them to ask for assistance.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

8.3.2 Morbidity and mortality

People with obesity who become infected with COVID-19 seem to be at higher risk of severe disease. Initial studies at the onset of the pandemic of cohorts from France and the United States demonstrated an association of escalation of treatment with obesity *(18,19)*. Subsequent larger studies followed, reporting a range of primary and composite endpoints (hospitalization, intubation, mechanical ventilation, and intensive care unit (ICU) admission) provide consistent support to the higher risk of severe COVID-19 in patients with obesity *(20)*. A genome-wide association study conducted in Italy and Spain has shown increased risk of severe COVID-19 associated with a higher genetically modelled BMI (odds ratio (OR), 1.75; 95% confidence interval (CI), 1.20–2.57) *(21)*. In a prospective, community-based cohort study in England of linked datasets of almost 7 million individuals, a linear increase was found in the risk of severe COVID-19 leading to hospital admission and mortality, starting from a BMI of more than 23 kg/m^2, after adjusting for demographics, behavioural factors and related co-morbidities. Following adjustment, a linear increase was also found across the BMI range for the need for ICU admission *(22)*.

One study from the United States found that obesity at hospital admission was a significant independent predictor of severe respiratory disease (OR, 3.39; 95% CI, 1.26–9.10) *(23)*. Pooled analyses of 75 studies confirmed that individuals with obesity had an increased risk of a diagnosis of COVID-19 (+46%), of hospitalization (+113%), and of ICU admission (+74%) *(4)*. While the pooled analysis also showed a 48% increased risk of mortality from COVID-19, more recent studies have cast uncertainty regarding the relationship with obesity; a large prospective study from the United Kingdom did not find an independent association with mortality but rather increased risk attributable to obesity-related conditions, such as CVD and T2DM *(24)*.

Infection with COVID-19 can result in inflammation or even potential organ failure with systemic complications. This can in turn lead to immobilization, contributing to muscle loss and increased malnutrition risk *(25)*, an independent risk for morbidity and mortality in most conditions *(26)*. Evidence from COVID-19 datasets confirms that there is a high prevalence of malnutrition across studies (14–70% depending on patient population) *(27)*.

8.3.3 Children

In step with changes in the adult population, there are growing signals that obesity in children has worsened since the onset of the pandemic. Data from the United States shows that this trend is more prominent among those already vulnerable to unhealthy weight gain *(28)* and indicated a surge in childhood obesity levels during the pandemic, with prevalence rising five times faster than pre-pandemic levels by an estimated 0.37% a month *(29)*. Likewise, the rates of BMI increase almost doubled compared with the period before the pandemic, with rates increasing most among children aged 6–11 years. The pandemic has also exacerbated racial, ethnic, and neighbourhood socioeconomic differences in childhood obesity rates in the United States since its onset *(30)*.

Efforts to reduce SARS-CoV-2 transmission have likely played a role in the increase in obesity rates. Child weight gain is influenced by nutrition, physical activity and sleep. All

of these things are likely to be interrupted when schools are closed. During the COVID-19 pandemic, many schools were closed and schools switched to remote learning. Away from schools, many children were exposed to increased screen time, lower levels of physical activity), and greater access to unhealthy foods for example as has been shown by data from Italy and the United States *(5,31)*. This is more pronounced for children from deprived households, who are often reliant on healthy meals from schools *(30,32)*. Physical activity levels have decreased because of restrictions in access to public and recreational spaces, sport clubs, and play areas among others. In addition, there has been an increase in consumption of foods high in saturated fats, sugars, and salts, which also most likely played a role in the observed increase of obesity rates (5,6). Previous findings of increased weight gain during school holiday periods have supported the observations from school closures *(31)*. In the United Kingdom a survey found that 30% of children did not leave the house on a typical day during periods of restricted movements *(33)*.

8.3.4 Obesogenic environment

Horizontal measures employed to contain the COVID-19 pandemic, including periods of restricted movements, social distancing and self-isolation, have led to significant changes for many *(3)*. First, these measures have had short- and long-term socioeconomic effects, including furlough or idling of workers or a move to working from home. This has further fuelled a widening of societal inequality, particularly in middle- and low-income countries *(3,34)*. Long-standing disparities in social determinants of health that predispose individuals to obesity and related conditions also play a role in severity of COVID-19 in the United States *(35)*.

Increased social isolation, home confinement and financial hardships can lead to psychosocial stress response, which in turn can increase energy intake by enhancing impulsive eating behaviours and altering food cue exposure *(3,36)*. Short-lived periods of excess energy intake can have sustained negative consequences on weight and metabolic health *(37)*.

Food supply chains have been strained by the pandemic, including disruptions in the fruit and vegetables sector in many countries *(38)*. At the same time, the food and beverage industry has used the pandemic to promote its products and capitalize on the situation, particularly for alcohol, sugary drinks, and unhealthy food *(39)*; for example, employing marketing tactics that focus on promoting home delivery and drive-through *(34,40)*.

During the pandemic, demand for unhealthy foods has increased. Systematic reviews confirm this shift towards modified eating behaviours, with increased snacking frequency and a preference for unhealthy foods high in saturated fats, sugars and salts, at the expense of healthy food intake *(7,8)*.

These changes to a more obesogenic environment may play a part in the observed weight gain during the pandemic; a meta-analysis of body weight change during the first period of restricted movements (March–May 2020) revealed a significant increase of 1.57 weighted-mean difference (85% CI, 1.01–2.14) after the first period of restricted movements eased compared with before *(41)*.

8.3.5 Health systems

Despite the prevailing rise of environmental drivers of obesity during the pandemic, health services have at the same time scaled back preventive and health promotion services and clinical services for obesity. Reduced access to ambulatory care, multidisciplinary team management and weight loss programmes and the cancellation or postponement of elective surgeries (such as for bariatric surgery) have all had an impact on people living with obesity across Europe *(2)*. Referrals for new or at-risk patients have also been affected, delaying diagnosis and treatment. The WHO Pulse survey found that 70% of countries have experienced disruptions to essential NCD services which include community weight management, dietetic services, bariatric surgery and diagnosis and treatment of obesity-related complications *(42)*. The COVID-19 health emergency has diverted resources away from NCD management to communicable diseases. A survey of accredited adult and paediatric multidisciplinary obesity treatment centres in Europe revealed that 61% of respondents had staff reassigned to COVID-19 pandemic-related roles from routine work at the obesity clinic, with about half of the centres reporting that more than 75% of staff were redeployed *(43)*.

Patients with obesity and COVID-19 have increased needs when hospitalized and are at heightened risk of needing ICU care and mechanical ventilation. Inadequate provision of bariatric devices and services within hospitals may play a role in hampering delivery of care for patients with obesity, for example access to imaging, positioning and transportation *(44)*. Challenges also arise from interpreting imaging, as well as difficulty with airway management and the insertion of cannulas *(45)*.

8.4 COVID-19 and health care

8.4.1 Preventative and primary care

The rollout of vaccinations has been a pivotal stage in the response to the pandemic. Multi-centre, global RCTs of Pfizer-BioNTech BNT162b2, Moderna mRNA-1273, Janssen/Johnson and Johnson Ad26.CoV2.S and AstraZeneca ChAdOx1-S have demonstrated vaccine efficacy related to hospitalization and death from COVID-19, and equivalent efficacy between populations with and without obesity *(46,47)*. It is important to consider the long-term efficacy of vaccinations in high-risk populations: people with obesity have been shown to have reduced responses to vaccination against viral infections, such as influenza, because of a decreased number of T cells and dysfunctional T-cell memory *(11)*. Similarly, the efficacy of SARS-CoV-2 vaccines may be attenuated in patients with obesity *(48)*. Adjuvant targeted inventions for obesity and related metabolic pathologies have been proposed to overcome a potentially less-robust vaccine response *(20)*. Assessment of the longer-term effectiveness of vaccines will require long-term follow-up of vaccine immunogenicity for cohorts living with obesity with appropriate power to detect differences across subgroups *(46)*. Data from the United States also suggest that obesity and metabolic disease may augment risk of vaccine breakthrough SARS-CoV-2 infections *(49)*.

In addition to vaccination, health promotion programmes to prevent obesity at the community level are important *(20)*. Health professionals and politicians should now, more than ever, promote the health benefits of physical activity and healthy eating and support efforts to implement programmes and policies to facilitate increased physical activity and healthy eating. WHO has provided advice to the public for ways to stay healthy at home *(50)*.

8.4.2 Secondary health care

A study from the United States suggested that due to the predisposition of individuals with obesity to COVID-19 a more progressively intensive approach may be warranted at earlier stages of the disease to reduce likelihood of progression to severe disease *(16)*. In addition to well-established supportive and intensive care treatment of patients with COVID-19, the approval of therapeutic agents, including antiviral drugs, immunosuppressive agents and monoclonal antibodies, offer new management options to limit viral replication or modulate complications of COVID-19 to lessen severity and mortality *(51)*. Close clinical monitoring for signs of clinical deterioration, such as rapidly progressive respiratory failure and shock, and immediate response with supportive care interventions are warranted *(52)*.

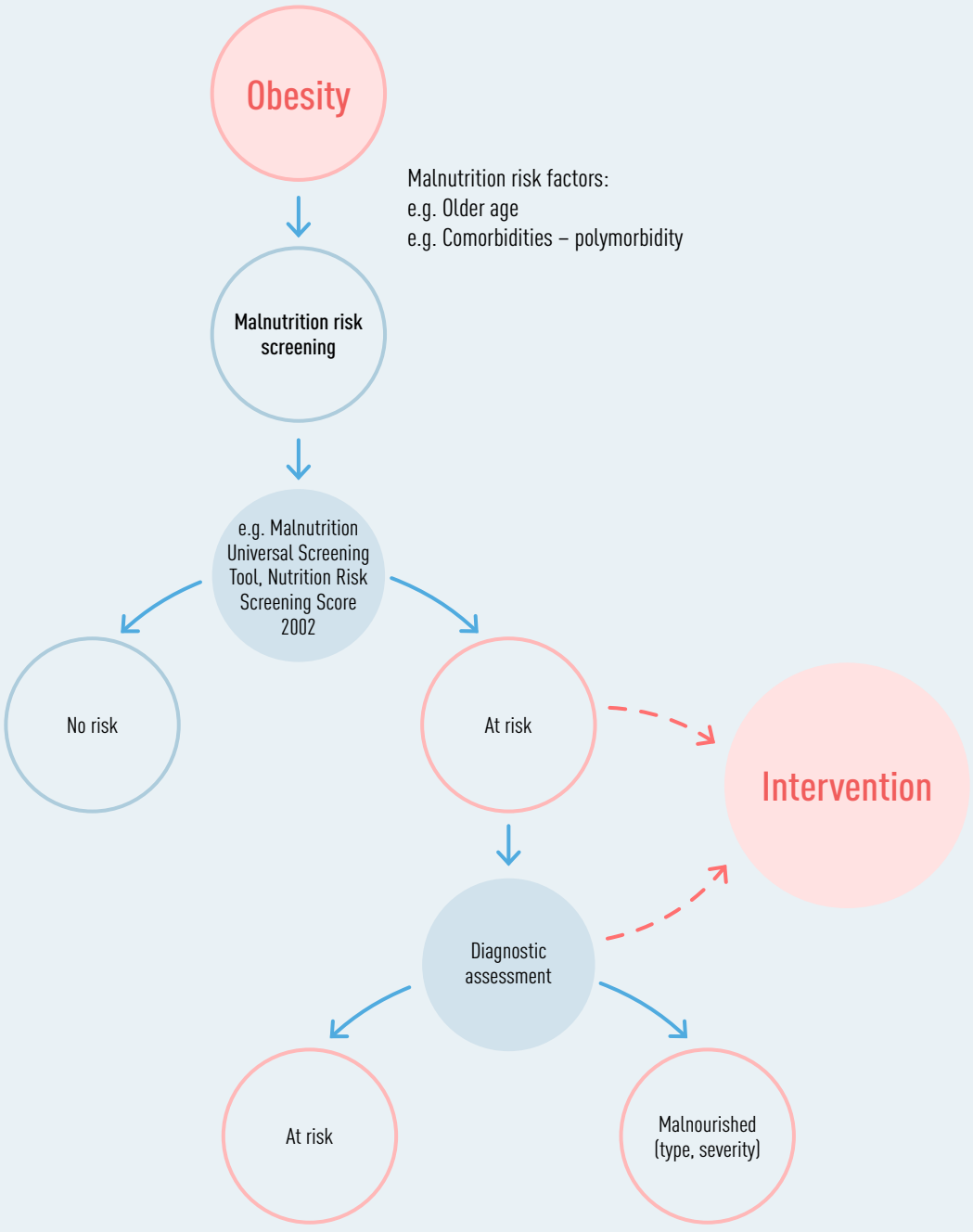
Screening for malnutrition may be beneficial for COVID-19 patients with obesity, particularly those of older age, with polymorbidity and/or with additional risk factors for malnutrition or severe SARS-CoV-2 infection *(25)*. This could be done by using validated and easy-to-use screening tools, such as the Malnutrition Universal Screening Tool (MUST) or mini nutritional assessment *(53,54)*. Additionally, the European Society for Clinical Nutrition and Metabolism developed an algorithm for malnutrition risk screening, malnutrition diagnosis and assessment in patients with obesity (Fig. 8.2) *(25,55)*.

Patients with obesity who have been identified as malnourished may require nutritional advice to optimize their intake and aid recovery *(25,54)*. In brief, both adequate energy and protein intake are advised, which in combination with muscle strengthening exercises will optimize the primary goal of intervention *(25,54)*. Additionally, adequate micronutrient replacement is essential to maintain immune function against infection (56); deficiencies are frequently noted in patients with obesity and malnutrition *(57-59)*.

Chinese data shows that individuals recovering from COVID-19 may present with numerous clinical sequelae usually 3 months from the onset of COVID-19, ranging from simple fatigue or weakness to psychological distress that lasts for at least 3 months *(60)*, termed post-COVID condition, and may presage longer-term issues for people living with obesity *(61)*.

A positive legacy stemming from the pandemic has been the adoption and integration of tele-health to deliver routine care. This is a practical solution to overcome geographical barriers and periods of restricted movements, and it can aid adherence to seeking medical care. The European Association for the Study of Obesity (EASO) reported that 87.1% of survey respondents had realigned obesity services to a virtual format provided by interdisciplinary health-care professionals *(43)*.

Fig. 8.2 **Algorithm for malnutrition risk screening, malnutrition diagnosis and assessment in people with obesity for health-care professionals**



Source: adapted from Barazzoni et al. (2021). Reproduced with permission of Elsevier; article is available in Elsevier's COVID-19 resource centre *(25)*.

8.5 Conclusion

The convergence of the COVID-19 and obesity pandemics has highlighted the importance of the prevention and control of obesity and related NCDs. Obesity and metabolic health are recognized as determinants of severe COVID-19. Focusing efforts on policies and strategies that target the root causes of obesity and metabolic health, particularly among vulnerable and racial/ethnic minority populations, continue to be critical. The modifiable risk of obesity warrants acute attention from stakeholders at all levels.

Policy considerations

- International, national and local focus and investment on obesity and NCD prevention in view of its impact on COVID-19 pandemic and to build resilience in health systems post-pandemic.
- Expansion of digital health solutions to increase accessibility of health care and to ensure universal health coverage.
- Strategies and programs for all individuals to maintain healthy eating patterns and regular physical activity, even during periods of restricted movements.

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9. MANAGEMENT OF OBESITY

Key highlights

- Following a careful medical evaluation, people living with obesity may benefit from receiving individualized care plans that address the causes of their obesity and provide support for behavioural change and adjunctive therapies (psychological, pharmacological and/or surgical interventions).
- Orienting obesity management towards improving patient-centred health outcomes, rather than weight loss or maintenance alone, is advised.
- Stigmatization of people with obesity should be prevented in health-care settings.
- Multicomponent behavioural change interventions may achieve small reductions in body weight for children and adolescents of all ages.
- Pharmacological options for adolescents are limited in the WHO European Region; when available, it is advised to combine them with a multicomponent behavioural intervention.
- It may be beneficial for adolescents (10–19 years) with severe obesity to be referred early to specific metabolic and bariatric surgery programmes.
- In adults, a 5–10% weight loss may be sufficient to obtain substantial health benefits from decreasing obesity-related comorbidities.
- A continuum of care from childhood to adulthood is advised through implementing health promotion, obesity prevention and management, as components of universal health coverage.

9.1 Introduction

Obesity is associated with many other NCDs, such as CVD, T2DM, certain types of cancer and mental health issues *(1)*. Despite the major health, societal and economic burden of obesity, only a small fraction of people living with obesity who could benefit from treatment have access to quality care. This chapter provides a scoping review on different treatment options for children, adolescents and adults, evidence for effectiveness and barriers to obesity management.

9.2 Obesity management in childhood and adolescence

Obesity in childhood and adolescence lays the foundation for obesity and related NCDs in adulthood, impacting health and well-being over the life course *(2)*. During growth, obesity is related to an increased prevalence of risk factors for cardiovascular changes (dyslipidaemia, elevated blood pressure, chronic inflammation, endothelial dysfunction), endocrine conditions (glucose dysregulation, T2DM, polycystic ovary syndrome, precocious puberty), respiratory conditions (OSA, asthma, exercise intolerance), musculoskeletal problems (malalignment, balance problems, fracture, slipped upper femoral epiphysis, Blount's disease), digestive disorders (NAFLD, gallstones), and psychological ill health (depression, anxiety, poor self-esteem or eating disorders) *(3)*. Obesity is also commonly associated with weight bias and stigma, reduced health-related quality of life, impaired social functioning and impeded academic attainment. In addition, children with disabilities are at greater risk for obesity, particularly those children with intellectual disabilities *(4)*.

In recognition of the need for a greater and sustained impact, recent work has focused on obesity prevention, in particular on modification of the built and social environments, food systems and education that influence diet and physical activity *(5–7)*. However, as long as the prevalence of obesity remains high in children and adolescents, easy access to quality care should be provided as a component of universal health coverage to help to improve their immediate health and well-being, prevent the premature development of related NCDs and reduce the burden of obesity on individuals, economies and societies.

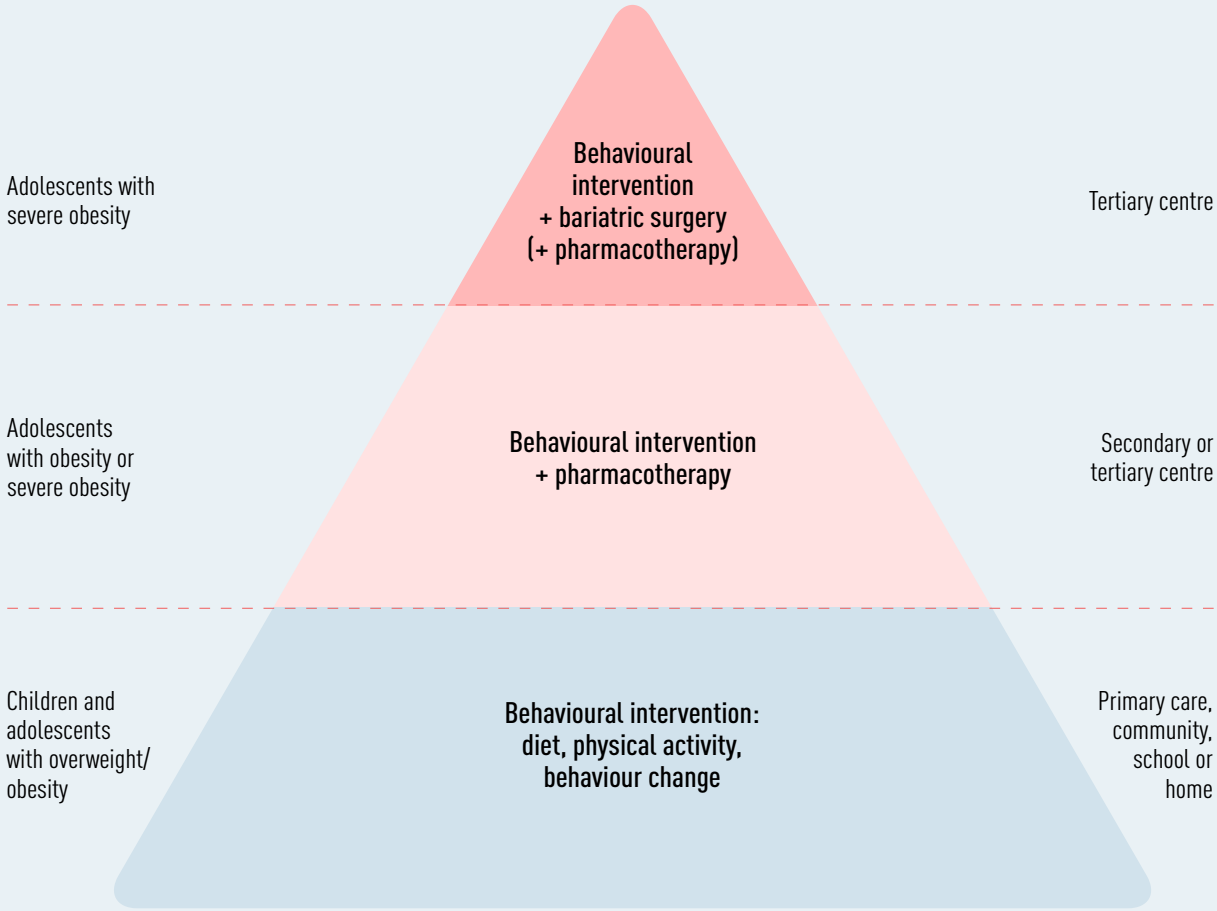
9.2.1 Treatment options in children and adolescents

The treatment of obesity has progressed since the late 2000s, and more options are now available for children, adolescents and families *(3,6–11)*. However, a so-called silver bullet solution is not available to respond to the complex reality of treating obesity. The objectives of treatment are to reduce energy intake and increase energy expenditure; reduce weight gain; improve body composition, physical function and quality of life; and to prevent or reduce obesity-related comorbidities. Untreated, the natural history of obesity in children and adolescents worsens over time *(12)*. To date, several guidelines for childhood and adolescent obesity management have been produced in the WHO European Region and at global level.

In 2017 WHO issued guidelines to provide guidance on appropriate assessment and management of infants and children aged less than 5 years at primary health-care facilities, in order to reduce the risk of overweight and obesity among children, including those living in settings where both undernutrition and overweight/obesity are prevalent *(13)*. Where infants and children are identified as having overweight, WHO recommends providing counselling to parents and caregivers on nutrition and physical activity including promotion and support for exclusive breastfeeding in the first 6 months and continued breastfeeding until 24 months or beyond. If children are living with obesity, they should be further assessed and an appropriate management plan should be developed. In 2021 WHO has convened a Guideline Development Group to support in the process of establishing guidelines for obesity management in children and adolescents aged 5-19 years using a primary health-care approach. The guidelines of the American Academy

Treatment options in children and adolescents with overweight or obesity

Fig. 9.1



of Pediatrics (AAP) propose a so-called chronic care approach to management, with different types and intensity of treatment dependent upon severity of obesity *(14)*. The categories of treatment may be divided into those that can be delivered to children or adolescents with overweight or obesity in a primary care or a community-based setting, and intensive multicomponent interventions, pharmacotherapy and/or metabolic and bariatric surgery (MBS) that are usually delivered to adolescents with obesity or severe obesity in a secondary or tertiary care setting (Fig. 9.1). A careful medical evaluation should be carried out before all options are presented by clinicians and discussed with the patient and family, as with other chronic diseases *(15)*. The choice of treatment(s) should be guided by the patient's age, sex, pubertal status, severity of obesity, psychosocial factors, obesity-related comorbidities, anticipated adaptations to fat mass, patient and family preferences, and their readiness to change. Adolescent obesity management strategies are more reliant on active participation than those for childhood obesity and are advised to recognize the emerging autonomy of the patient.

9.2.2 Behavioural interventions

Multicomponent behavioural interventions (healthy and energy-balanced diet, eating behaviours, physical activity, sedentary behaviours and psychological therapies) are generally considered to be the optimal treatment approaches for children and adolescents living with obesity *(10,16)*. Family behavioural therapy was initially developed to modify the shared family environment, provide role models and support child behaviour changes.

A recent analysis of six high-quality Cochrane reviews evaluated the effectiveness of behavioural change interventions in children and of interventions that targeted only the child's parents *(10)*. The evidence suggests that multicomponent behaviour–change interventions may achieve small reductions in body weight for children of all ages. Adverse events were rarely assessed and few were reported. Despite the small effects of this type of intervention on BMI *z*-score, the reduction in risk for comorbidities is an important and achievable result *(17)*. Favourable cardio-metabolic changes are related to reductions in fat mass, especially in the abdomen. As BMI is not a direct measure of fat mass and fat-free mass, it is advised that therapeutic interventions address body composition and comorbidities instead of only weight loss and BMI (or BMI *z*-score) reduction *(18)*.

9.2.3 Pharmacological treatments

Pharmacotherapy has been proposed for adolescents with obesity who respond suboptimally to intensive multicomponent behavioural interventions and for those with impaired glucose tolerance, nonalcoholic steatohepatitis, ovarian hyperandrogenism or a family history of diabetes, myocardial infarction or stroke *(8,19)*. However, options are extremely limited in the WHO European Region. Orlistat, a lipase inhibitor, is the only medication approved by the United States Food and Drug Administration (FDA) for long-term paediatric obesity treatment (⩾12 years) and is not approved by the European Medicines Agency (EMA) *(20,21)*. Clinical use is believed to be limited because of the modest efficacy (~3% BMI reduction over 12 months) and adverse effects such as oily spotting and flatus with discharge. Other weight-loss medications with limited evidence of effectiveness include phentermine, a norepinephrine reuptake inhibitor which is also approved by the FDA but not the EMA *(20)*. The few high-quality studies of topiramate and recombinant growth hormone have not shown benefits for BMI reduction in children *(20)*. Several more recent high-quality studies have evaluated the effectiveness of liraglutide, a glucagon-like peptide-1 agonist used for adult T2DM, in children with genetic causes of obesity, adolescents with obesity and T2DM, and adolescents with obesity alone *(22–24)*. A reproducible, statistically significant and clinically meaningful weight loss of approximately 4–5 kg after six months of treatment has been demonstrated. The FDA has recently approved an updated label for liraglutide 3 mg for use in the treatment of obesity in adolescents aged 12–17 years with a body weight of at least 60 kg and an initial BMI corresponding to 30 kg/m² or greater for adults. In general, the side-effects of liraglutide in adolescents are similar to those in adults (mainly mild gastrointestinal complaints), with possibly a more pronounced effect on hypoglycaemia. Recently, the EMA recommended the approval of liraglutide for the treatment of obesity in adolescents (12–17 years). No current evidence supports weight loss medication use as a monotherapy and clinicians prescribing these medications to adolescents should provide or refer to intensive behavioural support for patients and families as an adjunct to pharmacotherapy.

9.2.4 MBS in children and adolescents

As described in the recent AAP policy statement and accompanying technical report on the use of MBS in children, the most severe forms of obesity among young people are widely accepted as being a so-called epidemic within an epidemic that may contribute to the premature development of numerous related NCDs, diminished long-term health status and shortened life expectancy *(25,26)*. Large contemporary and well-designed prospective observational studies comparing adolescent cohorts undergoing MBS intervention with adolescents receiving lifestyle-only interventions or non-surgical controls have shown that MBS is both safe and effective for paediatric patients in comprehensive bariatric surgery settings with experience of working with young people and families *(27)*. As in adults, paediatric patients receiving bariatric surgery experience an enduring reduction in BMI, as well as significant improvement in weight-related quality of life, reduction in CVD risk factors and significant improvement or complete amelioration of several important obesity-related NCDs, including hypertension, T2DM and dyslipidaemias *(27–29)*. Psychological and physical maturity, the ability to provide informed consent and the availability of family support and continuing postoperative behavioural intervention should also be considered *(30)*. The benefits from the Roux-en-Y gastric bypass (RYGB) may outweigh the risks in most adolescents with severe obesity; however, any young person who smokes or lives with those who smoke is at a significantly higher risk of complications after RYGB surgery *(31)*. Caution should be exercised with adolescents who have significant issues with medication compliance because of the requirement for vitamin supplementation after surgery. Vertical sleeve gastrectomy may be the preferred choice for MBS in adolescents because of the lower risk of complications compared with RYGB *(32)*.

9.2.5 Health system response to childhood obesity

Because obesity among children and adolescents is so widespread, usual approaches to care based on the traditional patient–provider relationship may not provide adequate solutions to treatment. It is advised that obesity in childhood and adolescence is treated with both intensive and long-term care strategies, with the provision of medical diagnosis and monitoring of associated comorbidities and ongoing access to treatment *(33)*. However, the accessibility of treatment options for children and adolescents remains limited *(34)*. While much has been learned about the physiopathology of obesity, it remains difficult to treat in children. Intensive behavioural modification interventions are relatively effective but are both personally and financially demanding and also time consuming for families. The total number of centres or programmes is usually insufficient to provide access to quality care for children and adolescents affected by obesity who require treatment. The distance from the provider may also be a limitation. Finally, pharmacotherapeutic and surgical approaches are at present limited to health-care centres that have experience in administering these treatments.

In 2019 the WHO Regional Office for Europe assessed the response of health-care delivery systems to the childhood obesity epidemic in 19 countries in the WHO European Region *(34)*. Overall, health system responses to childhood obesity were lacking. Several shortcomings were identified in the areas of governance, integrated delivery of services, financing and education of the health workforce. The most commonly mentioned barriers were fragmentation of care (no clear pathways), a shortage of adequate personnel (for

example, childhood obesity specialists, nutritionists and psychologists), inadequate funding for childhood obesity management or health care in general, insufficient collaboration among sectors and settings and a lack of parental support and education. However, several good practices and examples have been reported across the Region. Childhood obesity management services may include systematic screening, consistent criteria for diagnosis and assessment, stepwise care with clear pathways and equal access and long-term follow-up. Establishing and organizing these services may place pressure on health-care delivery systems as they require dedicated human and financial resources from an already stretched situation. Governments should, therefore, take a political decision to reorganize care and eventually to allocate additional resources to tackle these issues. Although there is still a lack of consensus on the definition of integrated care, the concept is attracting attention as a framework for better, more effective health-care delivery *(35)*. It is, however, unlikely that clinical approaches alone will resolve the current obesity epidemic. Self- or family management is central to the ability of families to manage childhood or adolescent obesity; however, because the success of treatment depends heavily on environmental support for weight control, changes in the family, school and community environment are as important as changes in the medical system to achieve successful management.

9.3 Obesity management in adults

Obesity in adults is associated with increased all-cause mortality and with a higher proportion of adults with disability having obesity compared with adults without disability *(2)*. People living with obesity are frequently subject to stigma and bias, even among health-care providers, which in turn has an impact on the support and treatment that they receive *(36)*. Obesity also impairs individuals' lifetime educational attainment and labour market outcomes, and places a significant burden on health-care systems, family, employers and society as a whole *(2,37)*. People living with obesity have a significantly higher risk of developing severe forms of the COVID-19 disease than people with no obesity, and there is a positive association between COVID-19 mortality and the proportion of overweight in a country's adult population (see Chapter 8 for more details) *(38,39)*. There is a need to provide a continuum of care from childhood to adulthood through implementing health promotion, disease prevention, diagnosis, assessment, treatment and management of obesity, as components of universal health coverage. Specific attention should be given to identifying at-risk populations, including marginalized populations who may experience barriers in accessing essential health services and specific obesity management services *(40)*.

9.3.1 Treatment options in adults

The evidence regarding the pathophysiology of obesity (for example, appetite regulation) has supported the development of new treatment approaches to reduce body weight (for example, pharmacotherapy and MBS) and, more importantly, prevent or treat obesity-related comorbidities and improve well-being. The focus of obesity management could be moved towards improving patient-centred health outcomes rather than weight loss alone. Following a careful medical evaluation, people living with obesity may benefit from receiving individualized care plans that address the causes of their obesity and

provide support for behavioural change (for example, nutrition, eating behaviours, physical activity and sedentary behaviours) and adjunctive therapies, which may include psychological, pharmacological and surgical interventions *(41)*. Ideally, a comprehensive obesity management plan should be created by a multidisciplinary team working with the individual. Evidence suggests that primary-care referral to an open-group behavioural programme is an effective strategy *(42)*. Higher attendance in the first 12 weeks is associated with enhanced weight loss for up to two years *(42,43)*.

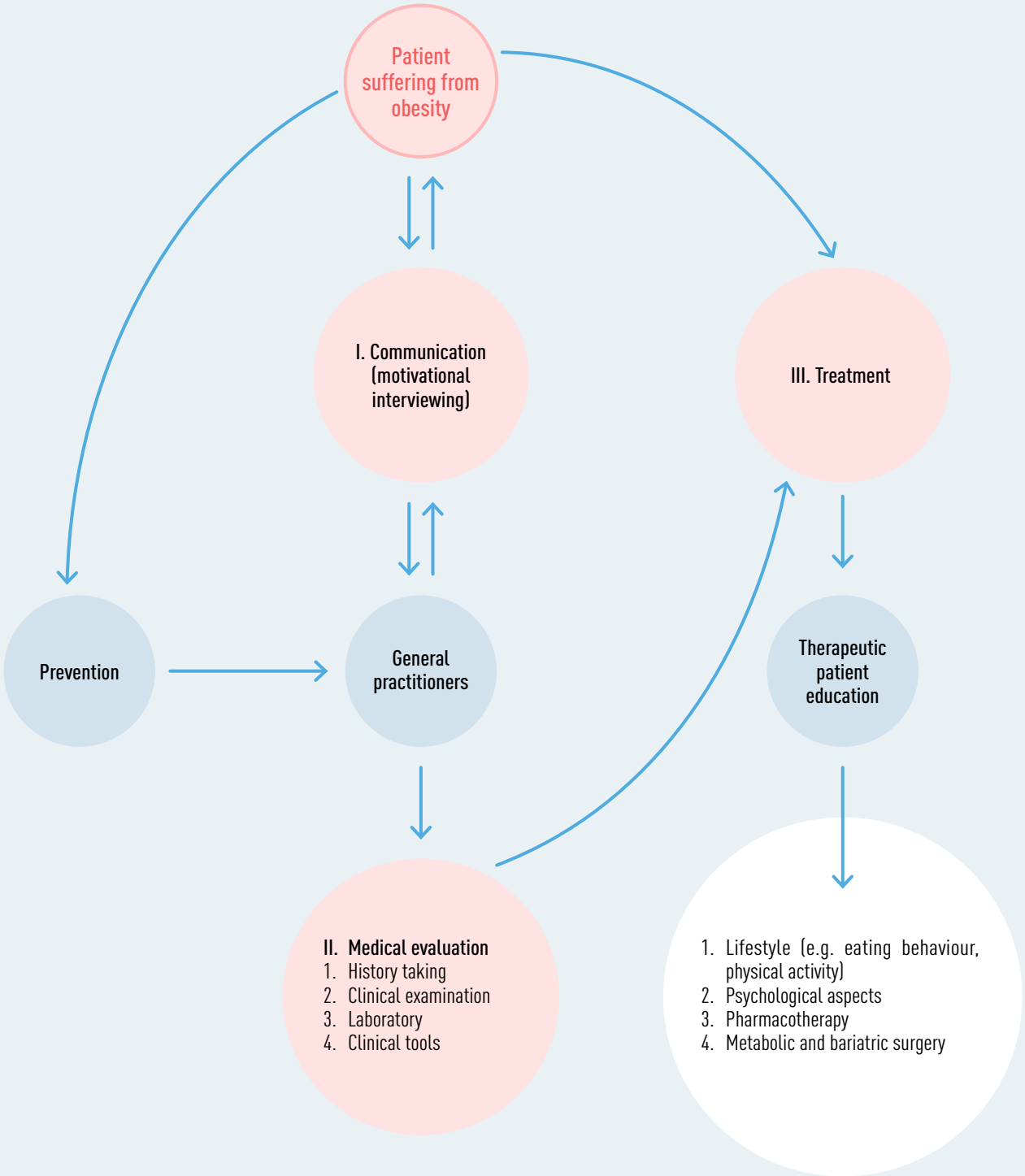
Several clinical guidelines have been recently published in the WHO European Region, as well as in North America *(41,44)*. In 2019 EASO developed clinical practice and patient-centred guidance for GPs, supporting a practical patient-centred approach *(44)*. This guidance focuses on GP communication and motivational interviewing, as well as on therapeutic patient education, and it describes the importance of avoiding stigmatization in health-care settings. The guidance also highlights the importance of managing the psychological aspects of obesity, such as improving self-esteem, body image and quality of life. Achieving maximum weight loss in the shortest possible time is not the key to successful treatment or to sustainable results. Indeed**,** evidence suggests that a 5–10% weight loss is sufficient to obtain substantial health benefits from reduced obesity-related comorbidities. Reducing waist circumference may be even more important than weight loss per se, as it is linked to a decrease in visceral fat and associated cardiometabolic risks. Finally, preventing weight regain is important for lifelong treatment for any weight loss techniques used. Table 9.1 presents the rationale for the approaches advised for obesity management and Fig. 9.2 presents the overall synopsis of these approaches.

TABLE 9.1. The rationale for the approaches advised for obesity management

Approaches/measurements used	Rationale/explanations
Improve communication and motivation	Motivation is essential for adherence to treatment; readiness to change will be evaluated over the long term using motivational interviewing
Avoid stigmatization in a health-care setting	Stigmatization is very frequent in health-care settings; the consequences may be an increase in eating disorders, which can worsen the degree of obesity, as well as an increase in depression, suicidal thoughts or even, in the worst cases, suicide; stigmatization can be decreased through motivational interviewing
Measure waist circumference	A good indicator of visceral fat and a useful predictor of cardiometabolic diseases, it can be measured at regular intervals to monitor the decrease of visceral fat
Treat comorbidities	Comorbidities, mainly cardiometabolic diseases, should be treated as a priority to decrease mortality
Use a multidisciplinary team	A multidisciplinary team (obesity medical specialist, dietitian or nutritionist, specialist in physical activity, psychiatrist or psychologist, nurse and patient's GP), working as a network, is more efficient
Assess weight loss	A 5–10% weight loss from initial weight may be a sufficient initial step towards decreasing comorbidities
Consider lifestyle behaviour change	Behavioural modifications can induce 5–15% weight loss and will also help to improve body image, self-esteem, self-affirmation and quality of life
Increase physical activity	Fit patients with obesity have a lower mortality risk, all etiologies included, than sedentary patients of healthy BMI Moreover, regular physical activity can decrease weight regain and the risk of weight cycling after weight loss
Avoid weight cycling	It may be beneficial to give particular attention to support patients to avoid weight regain and weight cycling; patients can weigh themselves approximately every 2 weeks and could be advised not to wait too long before visiting their GP to be assessed if 3–4 kg is regained quickly

Source: adapted from Durrer Schutz et al. (2019). Reproduced with permission of Karger Publishers under Creative Commons CC-BY-NC-ND 4.0 license *(44)*.

Fig.9.2 **Overall synopsis of approaches advised for obesity management**



Source: adapted from Durrer Schutz et al. (2019). Reproduced with permission of Karger Publishers under Creative Commons CC-BY-NC-ND 4.0 license *(44)*.

9.3.2 Exercise training in adults

In 2021 the EASO Physical Activity Working Group published a new report on exercise training in the management of obesity in adults *(45)*. It was based on seven systematic literature reviews carried out by a group of experts from across Europe and resulting in the proposal of several considerations. Of these, the following were considered based on high-quality evidence (Grade A). For loss in body weight, total fat, visceral fat, intra-hepatic fat and for improvement in blood pressure, an exercise training programme based on aerobic exercise at moderate intensity was preferentially advised. Expected weight loss with exercise training is, however, less than 3 kg on average. For preservation of lean mass during weight loss, an exercise training programme based on resistance training at moderate-to-high intensity was advised. For improvement in insulin sensitivity and for increasing cardiorespiratory fitness, any type of exercise training (aerobic, resistance, and combined aerobic or resistance) or high-intensity interval training (after a thorough assessment of cardiovascular risk and under supervision) could be advised. For increasing muscular fitness, an exercise training programme based preferentially on resistance training alone or combined with aerobic training was advised. The other recommendations from the Physical Activity Working Group dealt with the beneficial effects of exercise training programmes on energy intake and appetite control, bariatric surgery outcomes, and quality of life and psychological outcomes in management of overweight and obesity.

9.3.3 Pharmacological treatment in adults

In Europe pharmacotherapy is usually advised for weight loss and weight-loss maintenance for individuals with BMI ⩾ 30 or BMI ⩾ 27 kg/m^2 with adiposity-related complications to support behavioural and psychological interventions *(46,47)*. Pharmacotherapy can augment the magnitude of weight loss beyond that which health behaviour changes can achieve alone and is important to consider in the prevention of weight regain *(48–50)*. To date, very few obesity drugs have received EMA approval for clinical use in obesity management: orlistat, liraglutide and the combination of bupropion and naltrexone. The availability of these drugs varies within European countries, and they can be subjected to prescription limitations according to national rules. In 2021 the FDA approved once-weekly injectable semaglutide 2.4 mg for chronic weight management in adults with obesity or with overweight and at least one weight-related condition; however, EMA approval is pending *(51)*. Pharmacological development of anti-obesity drugs continues and phase 3 studies have given encouraging results.

9.3.4 MBS in adults

Evidence from clinical research suggests that MBS is highly effective in the management of obesity (Box 9.1). In 2020 the European Association for Endoscopic Surgery published clinical practice guidelines on laparoscopic bariatric surgery, which have been endorsed by the European Chapter of the International Federation for the Surgery of Obesity and Metabolic Disorders, EASO and the European Society for the Peri-operative Care of the Obese Patient *(52)*. This document aims to facilitate evidence-informed clinical decisions and support authoritative actions by policy-makers and other stakeholders. Laparoscopic bariatric surgery may be considered for adults (age > 18 years) with a BMI ⩾ 40 kg/m^2

or a BMI ⩾ 35 kg/m^2 with associated comorbidities that are expected to improve with weight loss. Other guidelines on T2DM from the American Diabetes Association and the European Association for the Study of Diabetes suggest lower cut-offs for MBS in some ethnic populations, for example in people of Asian ancestry *(53)*.

Box 9.1

People's experience of living with obesity: Diana [a]

Diana has been living with obesity from a very young age. As well as being overweight, she suffered from other health problems, including not menstruating, diabetes, high blood pressure and joint pain. For Diana, her battle with weight gain comes from a complex past. While her mother and grandmother were also overweight, Diana suffered mistreatment from her mother, both physically and psychologically; she was constantly criticized, berated with cruel insults and was made to feel inferior. For her, food was a way of coping and distracting herself from emotional pain.

Diana has a son who is now 13 years old. When he was younger, life for her was extremely difficult due to her weight. She was unable to play with him or take him outside for activities because her joints hurt and she would quickly tire. Diana never felt comfortable leaving the house and socializing. She did not feel at ease with others and would stay at home with her son. Diana decided she wanted to make a change in her life. After a lot of online research, Diana decided upon bariatric surgery. She was terrified that something would go wrong with the surgery and that she would not be there for her son, but she knew that the ongoing risks she faced were far worse. In the first two years after her surgery, Diana lost 50 kg and continued to lose 20 kg more in the following years.

Before surgery, life was very difficult; Diana struggled to find a job as many workplaces turned her away because of her weight. When she applied to work in a cosmetics store, they declined her application because she did not look the way they wanted their staff to look. When she applied to work washing dishes in a restaurant, they turned her away because it was a very small kitchen and they believed there would not be enough space for her to work. Diana was not even given the opportunity to try and work; she was simply turned away. She felt constantly embarrassed and did not want to meet or speak to people. She was embarrassed to eat in public because she felt as if she was being judged. Diana felt as if no one understood her situation; doctors merely told her to eat less and move more. She was locked up in her house because she was unable to speak to anyone about how she felt. It was her determination to have a second chance at life after surgery that enabled Diana to begin to speak to people. Since having her surgery, Diana insists on the importance of regular medical check-ups to monitor her weight and her health and she is now monitored regularly by a team of doctors. Furthermore, her work with EASO has enabled her to help others living with obesity who also feel unable to seek help or speak about their struggles. Diana is encouraged by the fact that she is contributing to a change in the way the world sees and understands obesity.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

9.3.5 Clinical guidance and pathways for the management of obesity in adults

In 2021 the National Institute for Health and Care Excellence in the United Kingdom released new pathways for childhood and adult obesity management *(54)*. Obesity Canada and the Canadian Association of Bariatric Physicians and Surgeons recently developed the Canadian Adult Obesity Clinical Practice Guidelines, which provide a much-needed evidence- and experience-based, patient-centred framework for health-care professionals, patients and policy-makers *(41)*. The Guidelines represent the most extensive review yet of published evidence on obesity worldwide. Five steps (the 5 As) are described in the patient arc to guide a health-care provider in the care of people living with obesity: (i) recognition of obesity as a chronic disease by health-care providers, who should ask the patient's permission to offer advice and help to treat this condition in an unbiased manner; (ii) assessment of an individual living with obesity, using appropriate measurements, and identifying the root causes, complications and barriers to obesity treatment; (iii) discussion of the core treatment options (medical nutrition therapy and physical activity) and adjunctive therapies that may be required, including psychological, pharmacologic and surgical interventions; (iv) agreement with the person living with obesity regarding goals of therapy, focusing mainly on the value that the person derives from health-based interventions; and (v) engagement by health-care providers with the person with obesity in continued follow-up and reassessments and encouragement of advocacy to improve care for this chronic disease.

9.4 Conclusion

This chapter has reviewed the different treatment options for children, adolescents and adults living with obesity and the evidence for their effectiveness and barriers to management. Obesity continues to be mainly treated as a self-inflicted condition, which may affect the type of interventions and approaches that are implemented by governments or covered by health insurance. The education of health-care providers to be able to deliver effective, evidence-informed obesity care is insufficient. In addition, the development and implementation of clinical practice guidelines requires targeted policy action, as well as advocacy efforts and engagement from people living with obesity, their families and health-care providers.

In 2020 the European Commission officially recognized obesity as a chronic disease, and committed to prioritize obesity as a major NCD, and to collaboratively drive the implementation of measures that would effectively address obesity as a chronic disease and to embrace policy interventions that would go beyond primary prevention and ensure long-term management across the life course. Since 2021, the informal MEP Interest Group on Obesity and Resilient Health Systems has focused on implementing obesity as an NCD *(55)*. The ambition of the Group is to ensure that obesity is recognized as a chronic disease in definition, scope and how it is treated beyond primary prevention within policy instruments. The group also goes beyond obesity and considers resilient health systems and ecosystems more broadly.

Policy considerations

- Shift the focus of obesity management towards improving patient-centred health outcomes, rather than weight loss alone.
- Provide a continuum of care from childhood to adulthood through implementing health promotion, disease prevention, diagnosis, assessment, treatment and management of obesity, as components of universal health coverage.
- Identify at-risk populations, including marginalized people who may experience barriers in accessing essential health services and specific obesity management services.
- Prevent stigmatization and discrimination of people living with obesity.
- Develop national clinical practice guidelines and pregraduate/postgraduate/continuous education programmes for health-care professionals to be able to deliver effective, evidence-informed obesity care.
- Conduct comprehensive analyses of policy measures that address the management of obesity, and monitor policy implementation.
- Engage people living with obesity in developing and implementing policy measures.
- Invest in research and development to provide innovative treatment options.

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10. POLICY

Key highlights

- As no single intervention can halt the growth in the obesity epidemic on its own, a comprehensive approach is needed.
- Promotion of health and prevention of obesity across the life course is vital.
- A national strategy must provide clear definitions and monitoring frameworks for all stakeholders including national governments, NGOs, industry actors and local government, which has a particularly important part to play in creating supportive environments and tackling inequalities.
- The support of lower socioeconomic population groups should be a priority in any obesity prevention strategy, as these groups face more constraints and limitations on making healthy choices.
- Health system response for the management of obesity needs to be strengthened with appropriate guidelines and training for multidisciplinary teams under universal health coverage.
- Governments need to "build back better" after the COVID-19 pandemic, recognizing that human, animal and environmental health are all connected.

10.1 Introduction

Obesity is a complex multifactorial disease, defined as abnormal or excessive accumulation of fat that presents a risk to health. The main focus of this report, and this chapter in particular, is the population-level prevention of obesity. The WHO Regional Director for Europe has established an Advisory Council on Innovation for Noncommunicable Diseases (NCD Advisory Council), which brings together renowned experts on NCDs and representatives of special interest groups *(1)*. Working with this NCD Advisory Council and the two Signature Initiatives developed on childhood obesity and marketing, the WHO NCD Office will continue to take the agenda forward *(1)*. Future work of the WHO NCD Office will also include the strengthening of health systems in tackling obesity, including focusing on diagnosis, treatment and management as well as working with families as we continue to build on the Report on the Commission on Ending Childhood Obesity *(2)*.

No single intervention can halt the rise of the growing obesity prevalence on its own *(2)*. Coherent and comprehensive strategies are needed to prevent and manage it on a population level *(3)*. Investment in policies focused on obesity prevention, along with investment in the resources to implement such policies, could have benefits not only in major reductions in health-related costs but also in broader societal benefits arising from improved well-being and quality of life (Box 10.1) *(4)*. Policies focused on improving diet and reducing physical inactivity have been identified as having the potential to impact on population health if developed to tackle inequalities and target risk factors throughout the life course *(5,6)*.

Box 10.1

People's experience of living with obesity: Steffy and Hana [a]

As a young girl, Steffy was a swimmer. However, she relocated to Germany with her family when she was a young teenager and opportunities for swimming were greatly reduced. With limited opportunity to exercise, Steffy gained weight. When she initially decided she should seek advice from a doctor about her weight, she was told to lose weight but was not told how. Dissatisfied with the help she was receiving, Steffy took the initiative to find help by herself. In 2006 she sought medical help to lose weight, and gastric bypass surgery was the solution offered to her. Following the initial approval from her health insurance, it was not until 2009 that she was able to get final approval to have the surgery. Steffy's experience from the surgery has been incredibly positive: she lost 90 kg and has been able to manage her weight successfully since.

Steffy feels that a lot of stigma remains surrounding obesity. She feels that there is still a general belief that people living with obesity are lazy and do not exercise. From her experience of being unable to find any useful advice or guidance, Steffy's management and treatment as someone living with obesity was mostly self-guided. As a result, she felt motivated to dedicate her time assisting people living with obesity to find help and so she joined the ECPO.

Hana is a 70-year-old mother of two children and grandmother to three. She was born in Czechoslovakia and now lives in Slovakia, working as a pharmacist. Despite being a very slight child, she began to gain weight as she grew older. At school, children teased Hana and made fun of her weight. She was embarrassed and avoided talking about it. As children, Hana and her brother were not allowed to be fussy eaters and had to eat everything given to them despite being given very large portions of food for such young children. Hana also recalls her parents smoking frequently when she was a child. It was not until much later in her life that Hana realized that passive smoking can be a factor contributing to childhood obesity.

Although Hana's mother encouraged her to seek treatment for obesity, her grandmother would not allow it. So when Hana reached high school, she began saving money during the holidays and used the money to fund a weekly weight-loss programme. While she did lose weight, it was difficult to maintain. While she was a student, she made a conscious effort to adjust her daily routine, making sure that she took part in various types of physical activity. Consequently, Hana was able to lose 57 kg. However, in the following years after marriage and having children and with the combined stresses of work and motherhood, she gained further weight. Hana enrolled in an obesity training course and started exercising frequently, even taking up Nordic walking. With these changes, she managed to lose 82 kg.

According to Hana, many doctors advise their patients to lose weight but do not offer any guidance on how to do this. Hana advocates for the importance of this guidance, as the general population needs education in the ways they can change their lifestyles to prevent overweight and obesity. Hana also believes that education must teach the factors associated with obesity, as she does not think that many people are aware of the health risks related to obesity. This is important not only for patients' health but also for the future health of their children and future generations.

a This story is based on an interview with a person living with obesity in the WHO European Region. These are their perceptions and not necessarily reflecting the position of WHO.

There are a number of policy tools available to Member States to prevent and control obesity *(7)*. However, their development and implementation can be challenging due to the complexity of obesity causation and political factors *(8)*. For new policies to be effective, they must embrace the policy remit of numerous government departments and other important sectors and must avoid so-called policy cacophony in which "noise is drowning out the symphony of effect" *(4,8)* such that positive action in one area is not undermined by well-intentioned but opposing forces in another *(9)*. For policies to be effective, they must also be based on an in-depth understanding of the behavioural, cultural and structural factors that affect health-related decisions and behaviours.

In order to be successful, any policy must have high-level long-term political commitment, strong political leadership and supportive government administrations *(10)*. Policy approaches to prevent obesity require leadership from national governments through involvement and investment at all levels *(9,11)*. National guidance and funding can lead to effective and sustainable action at a population level *(12)* and should ensure equitable coverage, reaching vulnerable population groups that are at high risk of developing obesity through exposure to obesogenic environments and social inequalities *(2)*. Provision of support for lower socioeconomic population groups, who face more constraints and limitations on making healthy choices, should be a priority in any obesity prevention strategy *(7)*. Local circumstances should also be considered and strategies must reflect local conditions, needs and aspirations. A national strategy must, therefore, provide clear definitions for the role of local government *(9)*, which has an important part to play in creating supportive environments and tackling inequalities *(7,13,14)*.

Although the repercussions of obesity are most commonly seen within health systems, ministries outside of health *(15)* have an essential role in health-promoting policies and actions *(7,15)*, with a range of ministries and sectors involved in implementation and development *(7,16)*. Indeed, a number of policy options that target obesity may also benefit other sectors. In particular, the challenges facing action on obesity and action on climate change are closely aligned *(17)*. Such action through alignment with other major policy issues is critical in order to maximize the engagement of a broad range of stakeholders *(18–21)*, which is crucial for successful implementation for any policy or programme *(22,23)*. A focus should be placed on implementation and implementation research, in response to a shift in the public health agenda, and questions raised on how best to deliver evidence-informed policies *(22,24–26)*.

10.2 Implementation

Despite a wide range of global, regional and national approaches to prevent and tackle chronic diseases such as obesity, the impact on health outcomes has not been as hoped *(26)*. In part, this is because of challenges in how to take recommended evidence-informed interventions and implement them in the real world *(22,26)*. Adopting recommended interventions and approaches when political, social, economic and health systems are not strong enough to support them is unlikely to lead to sustained or effective implementation *(23,24)*. In addition, obesity prevention policies have often faltered at

implementation because of a historical focus on interventions that require agency and individual responsibility, rather than those that tackle structural determinants *(27)*. Efforts must be made to identify barriers and facilitators at each phase of the implementation process, with implementation supported through advocacy, capacity-building and dissemination *(24–26)*.

Alongside gaining policy support for the prevention of obesity, a focus on the implementation of evidence-informed policy and approaches should be adopted *(23,24,26)*. Contextual factors have hampered implementation in many cases, particularly in low-resource settings *(24)*, and Member States must move from simply promoting a focus on obesity towards strengthening their capacity to implement recommended interventions *(26)*. An intervention or policy needs to fit the specific social, cultural, economic, political, legal and physical environments in which it is being implemented, as well as the institutional settings, if it is to be effective *(22)*. Factors such as stakeholders, health system and political structures, along with the culture, language, age and socioeconomic status of the target population, can change not only between regions, countries and locality but also over time *(24)*.

Other powerful players, such as business interests, the media, public and private financing bodies, regulatory agencies, civil society organizations and religious leaders all need to be considered in how they may shape both policy and implementation. The implementation of obesity prevention policies can, therefore, be viewed as a partnership of relevant stakeholders, first to enable identification of the many aspects of an implementation strategy that could fail and then to find solutions. Involving stakeholders and encouraging them to support implementation of comprehensive long-term approaches is, therefore, crucial for effective population-level strategies *(5,16,28)*.

The broad and multifaceted dimensions of obesity prevention, management and treatment require consideration of a range of individuals involved in health and social services, including government and non-State personnel *(25)*. These could include those within national and local government, provider organizations, local implementers, front-line workers and communities, among others *(23)*. However, stakeholders in obesity programmes may view implementation challenges differently and have different priorities, such that conflicts of interests arise *(25)*. It is important that key stakeholders are identified and their influence on the adoption and implementation of any population-level approach recognized, if it is to be effective at a population level *(24)*.

10.3 Stakeholders

The making of public health policy is an inherently political process based on competing values, interests and beliefs leading to opposing interests placed upon policy-makers *(14,29)*. The viability of policy is not just what works in theory but what works in a manner that stakeholders find acceptable *(4)*. Effective action on the risk factors and determinants of obesity, including social, economic and environmental determinants, requires multisectoral and multistakeholder support *(30,31)* if the policies are to have long-term effectiveness and sustainability *(24)*. This cross-sectoral approach is often referred to by

WHO as Health in All Policies or whole-of-government and whole-of-society approaches *(2,32,33)*. Such an approach requires the building of partnerships between stakeholders including those from national, subnational and local government *(7)*.

Stakeholders from all levels of policy-making, prevention and management, along with those engaged with implementation such as front-line workers, communities and individuals should be included from the planning stages onwards to ensure appropriate and effective implementation. Decisions and behaviours related to healthy diets (such as purchasing, preparing and consuming foods) and physical activity are influenced by a range of psychological, cultural and structural factors. These factors influence how people respond to public education or awareness campaigns or how effective some interventions are, such as nutritional labelling. Behavioural insights relate to understanding these factors and the broader evidence on effective behaviour change interventions and using them to ensure the design and implementation of effective policies *(34,35)*. In particular, in order for a policy to be implemented and effective it must be socially valid; that is, it must address problems considered relevant by consumers and implementers and do so in a manner that is acceptable to both *(26)*. This is particularly important given the multidimensional determinants of obesity *(24)*. Such a multistakeholder governance model was formalized by the United Nations in the 2015 in the 2030 Agenda for Sustainable Development and its SDGs *(36)*. This actively invites stakeholders to participate and calls on Member States to encourage and promote effective public–private and civil society partnerships *(36,37)*.

However, inviting a wide range of actors including the private sector to the policy-making table carries the risk that opportunities may be provided for industries whose products are associated with a higher risk of obesity to influence policy-making on obesity. This can lead to a tension between the target to reduce obesity and lending legitimacy to partnerships with the private sector without acknowledging they may undermine public health goals *(37)*. Efforts to prevent obesity must put the public interest and public health at the forefront of policy decisions, rather than that of economic operators. Such efforts must, therefore, counter the business interests of economic operators and support a focus on the so-called commercial determinants of health *(38)*; this is a relatively new term that is defined as "the strategies and approaches used by the private sector to promote products and choices that are detrimental to health" *(39)*.

10.4 Commercial determinants of obesity

In response to the promotion of a Health in All Policies approach there is a need to define and understand commercial determinants more fully *(40,41)*, particularly with the recognition that they have often been excluded from conceptual frameworks of the social determinants of health *(40,41)*.

The commercial determinants of obesity and related health problems include broad facilitators such as the globalization of trade, regulatory systems, articulation of social and economic power, neoliberal and capitalist ideologies, plus a range of corporate structures and activities *(42)*. It has been argued that the system of multistakeholder governance

frames the food industry as a legitimate and necessary partner in policy-making *(37)*, with the food industry often described as "an accepted actor" in NCD policy *(37,43)*.

The food industry has traditionally been viewed in a more favourable light than the tobacco industry, primarily based on perceived differences in product harmfulness and the relative heterogeneity of the food industry *(37)*. While the Framework Convention on Tobacco Control Article 5.3 precludes tobacco industry involvement in policy-making a role for the food industry has been facilitated recently by the United Nations Framework for the Sustainable Development Goals and the Framework of Engagement with Non-State Actors (FENSA) *(44)*. FENSA has been described as an open door for engagement with commercial actors *(37,45)*, in particular due to the official relations status for which organizations can apply. This status brings with it privileged access, such as participation in WHO governing bodies' meetings *(37)*. FENSA was adopted in 2016 after four years of negotiations and was welcomed by the private sector, but it is considered insufficient by those within public health *(37,46)*.

Multinational companies involved in the sale of unhealthy food and beverage products, along with their representatives such as coordinated business associations *(37)*, have been seen to engage in corporate political activity to prevent, delay, or weaken regulatory policies *(37,47,48)*. This activity is seen as a key barrier to the development and implementation of effective obesity-related public health policy; in particular development of regulatory approaches for the industry itself *(37,49)*. The continuing expansion and concentration of power in transnational food and beverage corporations, with a larger share of the market being taken up by a reducing number of companies, leads to concerns about the increasing influence of a decreasing number of stakeholders, arguably leading to an accelerated nutritional transition from more traditional diets to highly processed foods *(50)*.

Corporate spheres of action allow the food industry to pursue their business, marketing and political objectives with the aim of selling product *(50)*. Food industry actors are active in lobbying Member States to support industry positions *(37)*, funding and disseminating research favourable to their commercial interests and challenging unfavourable evidence, often misrepresenting the evidence base *(37)*. Alongside this approach, they promote the concept that good governance requires working with industry and actively challenge statutory regulation, suggesting that there is a lack of evidence to support regulatory approaches and arguing that they are unnecessary as the industry is already regulating itself. They also cite the complexity of obesity determination, arguing that it is too great for such simplistic approaches to work and that unintended consequences may arise from government regulation *(37)*; however, these arguments do not align with the public health evidence *(37)*.

10.5 Review of policy approaches in the WHO European Region

Still in many countries changing individual behaviours remain the main focus of obesity-related policies, rather than addressing structural drivers of obesity, despite overwhelming evidence of the wider social determinants of obesity *(27,51)*. Attempts to transition the

complex nature of obesity into policy have been challenging, and the complexity of obesity determination is often used by the industry in their criticism of policy development *(51)*. In addition, policies that have been proposed have been criticized for not readily leading to implementation, with high demands on individuals and a lack of evaluation and monitoring *(27,51)*. A review of current policy approaches in the Member States of the Region found that 60% of countries had a policy, strategy or action plan for reducing overweight/obesity. Nearly all Member States (50 of 53) had a national policy, strategy or action plan that integrated several NCDs and their risk factors, with 48 (89%) of the 53 Member States including the harmful use of alcohol, 49 (92%) healthy diet and 49 (92%) physical activity. In addition, 89% of Member States included NCDs in the outcomes or outputs of their current national health plan. To support these policies, 92% of Member States reported that technical or professional staff in the unit/branch/department dedicated a significant proportion of their time to unhealthy diet (92%), whereas 85% did so in relation to physical inactivity.

The most commonly implemented population-level interventions were national public education and awareness campaigns, with 81% of Member States reporting that they had implemented such campaigns for diet in the previous two years and 94% reporting they had done so for physical activity. National physical activity guidelines were available in 31 Member States (58%) and national food-based dietary guidelines were available in 44 (83%). Mandatory policies targeting a reduction in the impact on children of marketing of HFSS foods and beverages were available in 34 Member States (68%) while 17 (32%) had voluntary policies. Similarly, 14 (26%) Member States had mandatory front-of-pack labelling policies, while in eight (15%) these were voluntary.

Despite almost all Member States in the Region (52 of the 53) having fiscal interventions on alcoholic beverages, only 12 (23%) had similar fiscal policies for SSBs and only three countries had policies on HFSS foods (6%). In addition, only three (5%) had price subsidies for healthy foods, with none having both food taxes and subsidies in place. Nine (17%) Member States had taxation incentives to promote physical activity.

Although 51 of the 53 Member States reported measuring weight and height in primary health-care facilities (public or private health sector), only 27 had national guidelines, protocols, or standards for the management of overweight/obesity available through a primary care approach and only 13 reported that this was utilized in at least 50% of health-care facilities. Similarly, 26 Member States reported having national guidelines, protocols or standards for the management of physical inactivity available through primary care, with 14 reporting that these were utilized in at least 50% of health-care facilities.

10.6 Perceptions of key stakeholders on factors contributing to success in addressing obesity

In support of this report on obesity, researchers in collaboration with the WHO Regional Office for Europe conducted 11 consultations with policy actors from nine Member States across the WHO European Region to explore the perceptions of key stakeholders regarding regional policy successes and failures in addressing obesity in order to inform

future WHO efforts. These included five high-income and four upper-middle-income countries (using the World Bank classification). Eight of these countries are part of COSI. The information derived from these consultations are summarized below.

Many countries in the WHO European Region have successfully adopted and implemented policies for obesity prevention, but these are mainly focused on the individualistic approach. A particular priority has been primary health-care initiatives and raising population awareness of both the health consequences of obesity and the importance of prevention. Several countries in the Region have also successfully adopted school-based obesity prevention initiatives, SSB taxation, active transport initiatives, nutrient labelling and voluntary standards and targets for reformulation to reduce sugar, salt and fat content in foods.

A major factor contributing to the adoption of obesity prevention policies has been identified as the growing understanding of the scale and severity of the problem by policy-makers and politicians. Data on the prevalence of obesity at national and subnational level, and its health and economic consequences, have been critical in increasing political will for policy action. Regular surveillance, of children in particular, has demonstrated the scale of the problem and trends over time. Surveillance data have increased awareness within the health sector and this has resulted in mobilization and advocacy by medical, research and other health professionals. Capacity for surveillance in the Region has increased since the early 2000s, supported by WHO in some countries. The health sector has been able to effectively communicate data on obesity prevalence, trends and consequences to decision-makers, including through the media. Communicating effectively with economic sectors of government has been critical for impact, particularly with regard to evidence on the cost of obesity, the economic benefits of obesity prevention, and the externalities that justify regulation for obesity prevention. Effective frames for communication regarding obesity prevention have included a focus on children, and on the economic benefits for government and society through reduced health system costs and increased productivity.

Support by external stakeholders was also identified as critical for success in obesity prevention policy. Partnerships and alliances among nongovernmental organizations, civil society and researchers can be very influential for politicians as well as for raising public perceptions and awareness of the importance of obesity prevention. Important sources of support from outside the health sector have also included the prioritization of obesity prevention (or related priorities such as diabetes) in whole-of-government strategy documents, and broad support for well-being at the subnational and local government level. In many cases, integration of obesity with relevant cross-sectoral policy priorities is facilitated at the subnational and local government levels because they are smaller and tend to operate cross-sectorally as a matter of course. At the national level, ministries in charge of education, urban planning, transport and sport are often supportive collaborators within government because of their shared policy priorities regarding child health and physical activity (including active transport). Political will for reducing the prevalence of obesity – and particularly the willingness to adopt regulation despite strong opposition from industry – has been fostered by perceptions of public support and reference to external technical experts, such as WHO.

There are several challenges faced by governments in the WHO European Region in the implementation of key obesity policy options (Box 10.2).

Box 10.2

Barriers to implementing obesity policy:

- The continuing narrative that addressing obesity is the responsibility of the individual, and not the responsibility of wider society including governments.
- The upstream determinants of obesity (including obesogenic digital environments) are not always prioritized for action.
- Economic priorities often take precedence over health, including obesity policies.
- Cross-sectoral engagement and impact delivery is challenging.
- Interventions that impact the food industry face significant opposition and low political will. This is a key barrier for cross-sectoral engagement.

First, perceptions and understandings of obesity by policy-makers and the public are not always conducive to policy action on obesity prevention. These include a narrative of individual responsibility, which has suppressed public demand for government intervention on obesity, and a perceived tension between food poverty/insecurity and obesity prevention (rather than a common benefit arising from access to affordable healthy food). Health sector expertise also often leads to a tendency to focus on the health system dimensions of obesity prevention, including population education, screening and treatment. These interventions based on the health system are important but need to be complemented by approaches to prevention that address the environments in which people live. In addition, other sectors of government tend not to see health as a priority or as part of their policy mandate, and obesity prevention is often perceived as a lower priority than economic policy issues and concerns, particularly employment and business outcomes.

Secondly, cross-sectoral policy engagement remains challenging, and initiatives that need to be adopted, implemented and/or enforced outside the health sector tend to have lower uptake. Obesity prevention initiatives tend to be considered as owned by the health sector, despite the fact that core recommended policy interventions such as labelling, marketing restrictions, school-based initiatives, environments that promote physical activity and SSB taxes require policy action by non-health policy sectors. Other sectors are, therefore, being asked to pursue health objectives, but the link to their sectoral mandate and remit is often implicit rather than explicit and as such sustained commitment may not occur. The capacity of health sector actors to work with other sectors is often limited; effective engagement requires deep understanding of the other ministries' core mandates and policy agendas. In many cases engagement with other sectors on obesity prevention is also hampered by a lack of institutional mechanisms within government for ongoing multisectoral policy dialogue. Similar challenges can also occur in achieving coordination on obesity prevention policy across jurisdictions. School meals, kindergarten meals, institutional food, primary care centres, urban planning and education interventions often need to be implemented at subnational levels of government. However, provincial and local governments respond to local priorities and may have different perspectives and priorities.

Furthermore, interventions that directly impact the food industry face significant opposition and low political will. Industry actors often threaten legal action and withdrawal of investment when governments propose regulation and argue that regulation will lead to negative impacts on trade and increase cross-border shopping. They also use effective framing of policy issues that emphasizes the priorities of economic sectors of government, including individual responsibility for obesity prevention and the economic importance of the food industry. Proposed front-of-pack labelling, restrictions on marketing and taxation initiatives have been highlighted as facing particularly strong industry opposition. Industry actors strongly support self-governing and voluntary approaches, which are less effective from a public health perspective, and advocate for participation in policy design and decision-making, which tends to lead to weaker policy approaches.

Engagement with industry in obesity policy presents a challenging issue for governments, particularly in relation to policy that requires collaboration with sectors in which industry is considered a key stakeholder. For policy issues where industry is one of the key implementers, such as food reformulation and labelling, strategic engagement with industry may be necessary to ensure feasibility. Collaborative approaches with industry are also seen as politically attractive, particularly for governments with a high priority for economic growth. However, interests of industry actors are often at odds with public health. Despite long-standing efforts towards reformulation, improvements towards obesity prevention have been minimal via these collaborative efforts. As such, management of conflicts of interest in obesity policy, including through a high standard of transparency in industry consultations and collaborations, is a priority.

Overcoming challenges to obesity prevention policy will require concerted and strategic support for the health sector. One key facet is the continued provision of evidence both for the existence of problems and for effective solutions in order to support action. Data on health, health system and productivity costs as well as on the economic benefits of obesity prevention are crucial. In addition, evidence of benefits to other sectors is needed to support cross-sectoral engagement; for example, educational benefits for children from healthy food and activity and the urban and environmental benefits of active transport. Evidence-informed policy considerations and guidance from WHO has proven invaluable for obesity and other health issues and will also be crucial in addressing new and emerging issues such as aggressive marketing by food delivery services.

There is also significant potential for strategic investment in capacities for health sector actors to support adoption of effective obesity prevention policies beyond the health sector. Training in systems thinking can support innovative and effective obesity prevention initiatives. Building country capacity for generating and interpretation of evidence is also essential. In addition, investments are needed for capacity for effective cross-sectoral engagement; specifically to provide insights into how other sectors with a role in obesity prevention operate, what their priorities are and how to engage effectively to support policy change for obesity prevention. Moving cross-sectoral action forward will also require concrete policy recommendations that are grounded in the priorities of the sector; this relies on having access to experts with knowledge

within these sectors who can help with communication. There is also an opportunity for such cross-sectoral engagement to be fostered at a regional level through conferences and training that bring sectors together (or are even led by non-health sectors). Resources are also needed to enable both government and nongovernment actors to build alliances with other supportive stakeholders and communicate data effectively for policy change.

A final element of support is the potential for WHO and others to enable policy learning between countries. Learning from the experiences in other countries, for example, through case studies of policy success, can shed light on policy design to maximize impact as well as policy processes and strategies to support adoption and implementation. This could be augmented with targeted learning and collaboration and cooperation within subregions that have more commonality than the Region as a whole.

10.7 Suite of interventions

To conclude this chapter, a suite of interventions and policy options are presented that Member States should consider in preventing and tackling obesity in the WHO European Region, with an emphasis on building back better after the COVID-19 pandemic through a One Health approach. This requires action at all levels of society, with the aim of reducing inequities and creating environments that promote health and progress towards sustainable development *(52,53)*. The global COVID-19 pandemic has led to an increased focus on obesity because of the link between high BMI and COVID-19-related health outcomes. In addition, responses to the pandemic have had an impact on the dietary and physical activity behaviours of individuals, leading some to predict a rise in overweight and obesity prevalence *(54)* and a widening of inequalities *(52)*.

As there is no one single intervention that can halt the rise of the obesity epidemic on its own *(2)*, a range of policies and interventions could be implemented together to target the prevention and control of obesity for individuals across the life course. These policies are synergistic and more than the sum of their parts, such that a range of policies will support each other in being effective (for example, labelling policies can incentivize reformulation of products). In addition, ongoing monitoring and evaluation should be used to support any policy approaches in order that adjustments can be made to achieve maximum effect or to respond to any environmental, social or cultural change. In addition to identifying barriers for the implementation of singular policies, evaluation and monitoring of the overall policy environment is needed to identify major gaps, including potential shortcomings in how a policy is translated into the respective context. Consequently, these findings can provide valuable guidance for policy priority-setting *(55)*.

The considerations for interventions and policies are presented for specific stages across the life-course stage, beginning with a range of options that are population-wide and may reach individuals of all ages.

10.7.1 Across the life course

Interventions and policy options that may influence people across the life course include those that focus on reducing sales of unhealthy foods. Incorporated in these are a number of effective interventions and other recommended interventions based on the WHO list of "best buys" to address NCDs *(56)*, and an update of Appendix 3 of the Global Action Plan for the Prevention and Control of NCDs 2013–2020 *(56,57)* (Table 10.1).

TABLE 10.1. Considerations for interventions across the life course

Target	Intervention
Diet	Implement nutrition labelling to reduce total energy intake (kilocalories/kilojoules), sugars, sodium and fats *(56)*
	Limit portion and package size to reduce energy intake and the risk of overweight/obesity *(56)*
	Implement subsidies to increase the intake of fruits and vegetables *(56)*
	Reduce sugar consumption through effective taxation on SSBs *(56)*
	Implement nutrition education and counselling in different settings (e.g. preschools, schools, workplaces and hospitals) to increase the intake of fruits and vegetables *(56)*
	Implement mass media campaigns on healthy diets, including social marketing to reduce the intake of total fat, saturated fats, sugars and salt and promote the intake of fruits and vegetables *(56)*
	Broaden taxes to incorporate unhealthy food products including those high in fats, sugar and salt *(58)*
	Restrictions on multi-buy and other price promotions on unhealthy food *(59,60)*
	Restrictions on the marketing of unhealthy foods, tobacco, alcohol and baby formula milk including through new opportunities such as social and digital media *(61,62)*
	Make mandatory clear front-of-pack labelling on all foods *(63)*
	Regulate where and how food outlets can operate, in terms of geographical areas or buildings, to influence the food environment *(64)*
	Implement healthy public food procurement and service policies, requiring that all foods and beverages served or sold in public settings contribute to the promotion of healthy diets *(64)*
	Recognize that the digital environment is a determinant of health *(65)*
Physical activity	Provide convenient and safe access to quality public open space and adequate infrastructure to support walking and cycling *(56)*
	Ensure that macro-level urban design incorporates the core elements of residential density, connected street networks that include sidewalks, easy access to a diversity of destinations and access to public transport *(56)*
	Implement a community-wide public education and awareness campaign for physical activity that includes a mass media campaign combined with other community-based education, motivational and environmental programmes aimed at supporting behavioural change in physical activity levels *(56)*
	Provide physical activity counselling and referral as part of routine primary health-care services through the use of a brief intervention *(56)*
	Promote physical activity through organized sport groups and clubs, programmes and events *(56)*
Management	Provide equitable access to integrated health-care services for management of overweight and obesity as part of universal health coverage *(66)*
	Provide equitable access to family-based, multicomponent, lifestyle weight management services for children and young people who are living with obesity *(2)*
Surveillance/ monitoring	Monitoring of obesity across the life course to help support policy efforts through systems such as COSI and the STEPwise Approach to NCD Risk Factor Surveillance (STEPS) *(16,57,67,68)*
	Include other important indicators, such as socioeconomic status to help inform and monitor policy action to address the social determinants of health *(16,57)*
	Continue monitoring food and physical activity environments – including digital environments – and policy actions at country level *(57,69)*

10.7.2 Preconception and prenatal care

A woman's nutritional status during preconception and in the prenatal period may influence her offspring's health and susceptibility to obesity and a range of NCDs *(70)*. Member States could implement interventions to support a healthy diet and physical activity in women in this age group (Table 10.2).

TABLE 10.2. Considerations for interventions in preconception and prenatal care

Target	Intervention
Diet	Provide food vouchers for new parents to subsidize the purchase of healthy foods *(58)*
Monitoring/ counselling	Provide monitoring and counselling on nutrition and exercise before and during pregnancy, which can be used to improve health literacy as well as diet and physical activity behaviours *(70,71)*

10.7.3 Infancy (0 to 12 months)

Infancy is considered to be the first year of life and is an important time for development and growth and a key target in preventing obesity in populations. There is evidence that an individual's propensity to develop obesity may be influenced during fetal development and infancy *(70)*. The promotion and support of exclusive breastfeeding for the first 6 months of life through a range of interventions and policy options is recommended (Table 10.3) *(56)*.

TABLE 10.3. Considerations for interventions in infancy

Target	Intervention
Breastfeeding	Promotion and support of exclusive breastfeeding for the first 6 months of life *(56)*
	Implement the Baby Friendly Hospital Initiative to help mothers to breastfeed babies and provide lactation support training for health professionals *(72,73)*
	Implement supporting policies and legislations from the range available to support breastfeeding, including universal paid maternity leave, national labour policies and workplace support for breastfeeding, along with laws to protect breastfeeding in public *(74)*
	Implement restrictions on the inappropriate marketing of products that compete with breast milk, as detailed in the international Code of Marketing of Breast Milk Substitutes *(75,76)*
Infant food	Encourage a healthy introduction to solid food through reformulation of infant food to improve its nutritional profile along with tackling appropriate marketing of infant and baby foods and accurate labelling of these products *(77)*
Monitoring/ counselling	Monitor children's growth and the micronutrient status of both parent and newborn; provide counselling to improve health literacy and diet and physical activity behaviours *(16,57)*

10.7.4 Childhood (1 to 10 years)

In the first 10 years of life children are exposed to a range of key settings impacting their later health and these should be targeted by structuring children's environments to encourage activity and discourage consumption of unhealthy foods (Table 10.4) *(2)*.

TABLE 10.4. Considerations for interventions in children aged 1–10 years

Target	Intervention
Physical activity	Implement whole-of-school programmes that include quality physical education, availability of adequate facilities and programmes to support physical activity for all children *(56)*
	Encourage active travel through provision of safe footpaths and cycle lanes in the local environment and the creation of walking buses for children attending local educational facilities *(78)*
Diet and physical activity	Support by extending health-promoting frameworks from schools to nurseries and kindergartens *(79)*
Diet	Implement mandatory national food standards for child-care settings, recreation facilities and schools *(80,81)*
	Provide free meals in these settings, in particular in early school years or for those from low-income households, thus supporting healthy dietary intake for all children *(80,81)*
Education	Make nutrition education statutory in educational curricula, in addition to the approaches above *(56)*
	Include teaching of food and nutrition practical skills in the educational curricula, such as cooking classes

10.7.5 Adolescence (10 to 19 years)

Adolescence is a crucial time in the development and establishment of health behaviours. Recognized as a transitional phase, habits developed during adolescence will often carry over into adulthood, which can have implications for the development of overweight and obesity *(82)*. Interventions that target this age group in particular can focus on schools as a key setting (Table 10.5).

TABLE 10.5. Considerations for interventions in adolescents aged 10–19 years

Target	Intervention
Physical activity	Implement whole-of-school programmes that include quality physical education, availability of adequate facilities and programmes to support physical activity for all children *(56)*
Education	Implement nutrition education and counselling in schools to increase the intake of fruits and vegetables *(56)*
Diet and physical activity	Support healthy eating and physical activity through the implementation, maintenance and scaling-up of measures to make every school a health-promoting school *(83)*
Diet	Control the clustering of unhealthy food outlets around secondary schools to support efforts within schools for healthy eating *(64)*

10.7.6 Adulthood (19 to 60 years)

It is important to continue obesity prevention and control across the life course, including specific policies that target adults. Individuals of employment age can be specifically targeted through improving work places. However, policies and interventions should also be instituted that reach beyond the workplace, targeting the unemployed, to ensure that inequalities are not widened (Table 10.6).

TABLE 10.6. Considerations for interventions in adults (19–60 years)

Target	Intervention
Physical activity	Implement multicomponent workplace physical activity programmes *(56)*
Education	Implement nutrition education and counselling in workplaces to increase the intake of fruits and vegetables *(56)*
	Provide opportunities to learn food and nutrition practical skills in community-based programmes, such as cooking classes
Diet and physical activity	Supported through workplace wellness programmes, that promote health and safe and resilient places of employment *(84,85)*
	Create community health promotion programmes to reach out-of-work adults *(86)*

10.7.7 Older people (60 years and older)

Older individuals can often be missed in obesity prevention and control programmes, so it is important to ensure that policies and approaches support healthy living in those in later life (Table 10.7).

TABLE 10.7. Considerations for interventions in older people aged 60 years and older

Target	Intervention
Diet	Implement nutrition education and counselling in hospitals to increase the intake of fruits and vegetables *(56)*
Diet and physical activity	Development of age-friendly environments, leading to cities and communities that enable people of all ages to realize their full potential for health in a sustainable and equitable way *(87)*
	Support provision of healthy community centres, primary health-care programmes, assisted living facilities, hospitals and home care services *(87)*
	Promote physical activity and healthy nutrition in health-care settings and residential homes and promote physical activity and nutrition by improving the quality of advice that health professionals give to older people *(71)*

10.8 Conclusion

There are a number of policy tools available to Member States to prevent and control obesity. No single intervention can halt the growth in the obesity epidemic on its own. Policy approaches must be comprehensive, based on an in-depth understanding of human behaviour and local context, reaching individuals across the life course and targeting inequalities. Efforts to prevent obesity need to consider the wider determinants of the disease; policy options should move away from solely individualistic approaches and address the structural drivers of obesity. Management within the health-care sector needs to be comprehensive: encompassing primary health care, utilizing multidisciplinary teams and with effective guidelines to support activities. Multisectoral and multistakeholder approaches are also essential in order for policy development and implementation to occur with support from a partnership of relevant stakeholders. However, caution must be taken in working with private entities and efforts taken to counter the commercial determinants of obesity. Specific opportunities to enhance policy in the WHO European Region include continued support for evidence to support action, building health sector capacity to support adoption and implementation of obesity prevention policies in other sectors and enabling policy learning between countries. We have learned that no single Member State within the WHO European Region was able to implement a comprehensive package simultaneously. To address the burden of overweight and obesity in the region, it is important for countries to prioritize their areas of action. Currently, some of the policy areas which have gained attention are SSB taxation, marketing restrictions to children and strengthening health systems to better prevent and manage obesity and overweight.

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CONCLUSIONS AND NEXT STEPS

This report has addressed the social determinants of obesity throughout its various chapters, but future work should examine in more detail how obesity contributes to inequalities and inequities in society and how countries can better support vulnerable groups, including how to ensure that everyone, regardless of socioeconomic status, has access to high-quality care for the prevention and management of obesity. Low socioeconomic groups face many barriers to making healthy choices, and multisectoral action is needed to better ensure equitable access to healthy foods, opportunities for physical activity and obesity prevention and management as part of universal health coverage. Special efforts need to be made for vulnerable groups within the population including refugees and migrants, women, children and elderly people.

Future work is also needed to better understand environmental influences on obesity. In addition to looking at built, fiscal, food and retail environments among others, work is needed to better understand how other factors such as environmental chemicals act to influence obesity risk. Digital environments are another determinant of health, and more work is needed to restrict the advertising of unhealthy products online, especially to children. This work can be aligned with broader efforts to address the commercial determinants of health. Marketing of unhealthy products extends beyond unhealthy foods and beverages to alcohol and tobacco, and efforts to curb adverse marketing practices should include the full scope of unhealthy products. These efforts should be aligned with parallel efforts and digital media-related policies such as tackling online misinformation, data privacy and harm reduction. There are also opportunities to strengthen media literacy among the population; for example, by integrating these concepts into the education system for children.

This report structures policy opportunities across various stages of the life course, from preconception to the ageing adult population, but another useful way to conceptualize policy options is to consider them in terms of settings, such as healthy schools, workplaces, cities, hospitals, care homes and others, in line with salutogenic health promotion principles. In December 2021 the Geneva Charter on Wellbeing was developed, which "highlighted the need for global commitments to achieve equitable health and social outcomes now and for future generations, without destroying the health of our planet". Many countries are already developing green space planning guidelines for promoting urban health, and there are opportunities for WHO to convene Member States and to share best practices and lessons learned. Further support should also be provided to Member States with the implementation of a 'Health in all policies' strategy, as Member States encounter many barriers in trying.

Healthy decisions and behaviours are influenced by a range of psychological, cultural and structural factors and these factors influence how people respond to behavioural change interventions, using a behavioural and cultural insights (BCI) approach is

recommended for the design and implementation of effective policies. A framework for the practical application of BCI interventions in nutrition, physical activity and obesity to improve the uptake of health policy will support countries in using this approach. Further obesity interventions should consider its complex cultural and social influences on health, and lessons can be learned from linking this work with behavioural scientists.

As food systems contribute substantially to climate change, biodiversity loss and the depletion of natural resources, changes in food systems will increasingly need to promote a shift towards environmentally sustainable diets. Countries will need support to promote healthy and sustainable diets. The report by the Pan-European Commission on Health and Sustainable Development (2021) highlights the importance of acknowledging how human, animal and planetary health are interconnected. More investment from countries is needed in promoting healthy and sustainable diets that will contribute to the health of both the planet and humans.

As countries encounter industry interference in the policy development process, they could benefit from clearer WHO support on how to effectively navigate problems related to conflicts of interest in policy discussions. For example, the food industry crafts sophisticated narratives to counter public health recommendations; for example, they might argue that they produce these unhealthy products as a response to consumer demand and that the so-called unhealthy environment has, therefore, been created by consumers. It is important that public health officials insist upon full disclosure of potential conflicts of interest. Furthermore, the research community can help examine the evidence behind some of these narratives and assertions. Additional efforts must, therefore, be made to avoid conflicts of interest in research funding. Furthermore, the discussion on the development of a roadmap for engagement with industry should be continued and an accountability framework could be developed to steer interactions with industry as suggested by some Member States.

Additional work is needed to compile evidence related to efforts to incentivize the adoption of healthy food options, such as global subsidies on fruits and vegetables and their effects on population consumption. More research is also needed on optimal strategies such as collective agreements to encourage industry reformulation of unhealthy foods.

There is the potential to strengthen health-care management and prevention of obesity through so-called brief interventions within primary health care, or through other methods such as the establishment of a structured network of specialized obesity centres as France has recently done within their 2019–2022 roadmap. WHO is committed to supporting countries as they work to strengthen their health-care systems and more work is needed to provide structural support, clear information, capacity-building and mechanisms for monitoring, evaluating and improving quality of care for obesity management in health care.

Important opportunities exist to provide countries with WHO guidelines for childhood and adolescent obesity. WHO has convened a Guideline Development Group to support the process of establishing guidelines for obesity management in children and adolescents, and additional work will be needed to build capacity among health-care practitioners. Additionally, the WHO Regional Office for Europe will be facilitating policy dialogues at the country and subregional levels where necessary to accelerate ongoing conversations among policy-makers related to universal health coverage including obesity management, referral systems and health financing to ensure equitable access to obesity management and treatment.

This report relied upon BMI for defining overweight and obesity. There are limitations to the use of BMI as the sole measure for defining overweight and obesity. Future work is needed to explore the possibility of integrating other measures of adiposity such as waist circumference, waist-to-height ratio, body adiposity index (BAI) and body shape index (BSI). Member States within the WHO European Region have requested a review and if necessary an adaptation of the 2007 WHO Child Growth Standards.

This report presented data from published WHO sources only; however, there are many additional sources of obesity and overweight data from national, subnational and regional sources such as the NCD Risk Factor Collaboration (NCD-RisC), the European Health Interview Survey (EHIS), and Eurostat with the two latter ones using self-reported anthropometric data. Efforts should be made to collect and produce timely, comparable and high-quality data which can be used for reporting on the burden of obesity and overweight in the Region.

The authors of this report had to make difficult choices about what to include and this report does not give a full picture of the complexity of factors associated with and health consequences of obesity, including all its associated conditions and rare diseases associated with obesity such as Prader-Willi syndrome. Further work is needed to summarize the various mechanisms by which obesity influences health including visceral fat and inflammation, mental health and awareness of obesity as a disease among the public, healthcare professionals and media. This report highlights some of the perceptions of people living with obesity and their experiences in day-to-day life. Future work could build upon this by also exploring not only how gender influences the experience of living with obesity and access to obesity treatment, but also how stigmatization affects the experiences of people living with obesity and how raising awareness can overcome this.

ANNEX 1
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ANNEX 2
AGE-STANDARDIZED PREVALENCE ACROSS THE LIFE COURSE, BY COUNTRY

TABLE A21.1. Age-standardized prevalence of overweight and obesity among adults, 2016

	Age-standardized prevalence (%)					
	Overweight (including obesity) [a]			Obesity [a]		
Country	Both sexes	Males	Females	Both sexes	Males	Females
Albania	57.7	64.4	51.1	21.7	21.6	21.8
Andorra	63.7	70.3	56.9	25.6	25.9	25.3
Armenia	54.4	54.2	54.4	20.2	17.1	23.0
Austria	54.3	61.8	46.8	20.1	21.9	18.3
Azerbaijan	53.6	52.9	54.1	19.9	15.8	23.6
Belarus	59.4	62.6	56.3	24.5	22.1	26.3
Belgium	59.5	67.6	51.4	22.1	23.1	21.0
Bosnia and Herzegovina	53.3	59.7	47.0	17.9	17.1	18.4
Bulgaria	61.7	68.9	54.4	25.0	25.5	24.3
Croatia	59.6	66.2	53.0	24.4	24.1	24.5
Cyprus	59.1	65.2	52.7	21.8	21.9	21.6
Czechia	62.3	69.5	55.0	26.0	26.4	25.4
Denmark	55.4	63.6	47.3	19.7	22.3	17.0
Estonia	55.8	59.6	51.9	21.2	20.3	21.8
Finland	57.9	65.6	50.0	22.2	23.7	20.6
France	59.5	66.9	52.2	21.6	22.0	21.1
Georgia	54.2	54.6	53.5	21.7	19.2	23.8
Germany	56.8	64.9	48.5	22.3	24.2	20.4
Greece	62.3	68.2	56.2	24.9	24.2	25.4
Hungary	61.6	69.6	53.8	26.4	28.2	24.6
Iceland	59.1	67.5	50.5	21.9	24.2	19.4
Ireland	60.6	66.1	55.2	25.3	25.1	25.5
Israel	64.3	70.9	57.8	26.1	25.9	26.2
Italy	58.5	65.3	51.5	19.9	20.1	19.5
Kazakhstan	53.6	54.3	52.6	21.0	18.9	22.7
Kyrgyzstan	48.3	47.4	48.8	16.6	14.0	18.6
Latvia	57.8	60.9	54.9	23.6	21.6	25.1
Lithuania	59.6	62.6	56.5	26.3	24.2	27.8
Luxembourg	58.7	66.8	50.6	22.6	24.5	20.7
Malta	66.4	73.0	59.6	28.9	29.2	28.5
Monaco	–	–	–	–	–	–
Montenegro	59.4	66.3	52.5	23.3	23.3	23.1
Netherlands	57.8	65.4	50.2	20.4	20.8	20.0
North Macedonia	58.1	64.9	51.2	22.4	22.6	22.1
Norway	58.3	65.0	51.4	23.1	23.6	22.5
Poland	58.3	65.6	51.1	23.1	23.7	22.2
Portugal	57.5	63.1	52.0	20.8	20.3	21.2
Republic of Moldova	51.8	53.5	50.1	18.9	16.2	21.1
Romania	57.7	64.3	51.1	22.5	23.4	21.6
Russian Federation	57.1	58.2	55.7	23.1	18.1	26.9
San Marino	–	–	–	–	–	–
Serbia	57.1	63.8	50.5	21.5	21.1	21.8
Slovakia	56.2	63.6	48.8	20.5	21.0	19.9
Slovenia	56.1	62.1	49.9	20.2	19.4	21.0
Spain	61.6	68.9	54.1	23.8	24.6	22.8
Sweden	56.4	64.2	48.5	20.6	23.1	18.1
Switzerland	54.3	62.6	45.9	19.5	22.2	16.9
Tajikistan	45.3	44.2	46.3	14.2	11.6	16.7
Turkey	66.8	64.0	69.3	32.1	24.4	39.2
Turkmenistan	51.8	52.0	51.5	18.6	15.9	20.9
Ukraine	58.4	61.4	55.5	24.1	22.0	25.7
United Kingdom	63.7	68.6	58.9	27.8	26.9	28.6
Uzbekistan	48.2	47.3	48.9	16.6	13.8	19.0
WHO European Region	**58.7**	**62.9**	**54.3**	**23.3**	**21.8**	**24.5**

a Overweight is defined as BMI > 25 kg/m² and obesity is defined as BMI > 30 kg/m².
–: no data available.

TABLE A2.2. Age-standardized prevalence of overweight (including obesity)[a] among children (both sexes) under 5 years of age, 2020

Country	Age-standardized prevalence (%)
Albania	14.6
Andorra	–
Armenia	10.8
Austria	–
Azerbaijan	9.4
Belarus	6.8
Belgium	5.1
Bosnia and Herzegovina	12.8
Bulgaria	5.7
Croatia	–
Cyprus	–
Czechia	6.6
Denmark	–
Estonia	5.7
Finland	–
France	–
Georgia	7.6
Germany	4.1
Greece	13.9
Hungary	–
Iceland	–
Ireland	–
Israel	–
Italy	–
Kazakhstan	8.8
Kyrgyzstan	5.8
Latvia	–
Lithuania	–
Luxembourg	–
Malta	–
Monaco	–
Montenegro	10.2
Netherlands	5.0
North Macedonia	10.0
Norway	–
Poland	6.7
Portugal	8.5
Republic of Moldova	4.3
Romania	6.7
Russian Federation	–
San Marino	–
Serbia	10.8
Slovakia	–
Slovenia	–
Spain	–
Sweden	–
Switzerland	–
Tajikistan	3.5
Turkey	–
Turkmenistan	3.8
Ukraine	17.0
United Kingdom	–
Uzbekistan	5.0
WHO European Region	**7.9**

a Overweight is defined as weight for height value > +2 standard deviation from the median of the WHO Child Growth Standards.
–: no data available.

TABLE A2.3. Age-standardized prevalence of overweight and obesity among school-aged children (5-9 years), 2016

	Age-standardized prevalence (%)					
	Overweight (including obesity) [a]			Obesity [a]		
Country	Both sexes	Boys	Girls	Both sexes	Boys	Girls
Albania	28.2	33.0	23.0	10.7	13.3	7.9
Andorra	38.4	41.8	34.8	15.7	18.3	13.0
Armenia	21.0	20.9	21.2	6.7	7.4	5.8
Austria	28.1	31.3	24.8	10.5	13.0	7.8
Azerbaijan	20.6	20.9	20.2	6.7	7.4	5.8
Belarus	24.8	29.3	20.1	9.8	13.0	6.4
Belgium	25.5	25.4	25.7	8.7	9.8	7.4
Bosnia and Herzegovina	24.2	28.6	19.4	8.0	9.6	6.3
Bulgaria	31.2	37.0	25.2	13.7	17.1	10.2
Croatia	31.9	37.2	26.3	15.0	18.3	11.6
Cyprus	36.6	40.2	32.7	15.9	19.6	12.0
Czechia	30.0	35.4	24.2	12.3	15.7	8.8
Denmark	27.6	29.8	25.2	9.3	11.9	6.6
Estonia	22.8	25.5	19.9	8.5	10.3	6.5
Finland	29.5	32.7	26.3	11.7	15.6	7.8
France	32.4	34.0	30.7	10.4	11.7	8.9
Georgia	21.8	23.2	20.3	8.5	10.9	6.0
Germany	28.7	30.8	26.6	11.4	13.7	9.0
Greece	41.0	45.2	36.5	17.8	21.2	14.2
Hungary	31.4	36.2	26.3	14.3	17.3	11.2
Iceland	30.9	33.8	27.8	12.6	15.7	9.4
Ireland	33.9	34.9	32.8	12.5	13.6	11.3
Israel	37.7	40.9	34.3	14.8	17.6	11.9
Italy	42.0	44.7	39.2	17.8	20.5	14.9
Kazakhstan	21.4	22.4	20.3	8.2	10.2	6.2
Kyrgyzstan	17.6	18.0	17.1	5.2	6.6	3.8
Latvia	23.5	27.0	19.8	9.1	11.5	6.5
Lithuania	22.9	26.2	19.5	9.1	11.7	6.5
Luxembourg	29.0	31.4	26.5	11.1	13.8	8.4
Malta	39.9	43.3	36.4	17.0	19.7	14.2
Monaco	–	–	–	–	–	–
Montenegro	27.5	33.1	21.4	10.3	13.0	7.3
Netherlands	26.9	28.3	25.3	9.2	11.1	7.1
North Macedonia	28.8	34.3	23.1	12.3	15.7	8.8
Norway	29.2	31.1	27.2	11.1	12.7	9.3
Poland	29.5	35.5	23.1	12.5	16.8	8.0
Portugal	37.1	37.2	37.0	14.7	15.0	14.4
Republic of Moldova	19.1	21.5	16.5	5.8	7.0	4.5
Romania	27.2	32.0	22.2	10.9	13.5	8.2
Russian Federation	25.7	29.9	21.2	10.9	14.9	6.8
San Marino	–	–	–	–	–	–
Serbia	31.2	36.7	25.5	13.7	16.9	10.4
Slovakia	26.2	31.1	21.0	10.7	13.6	7.7
Slovenia	30.5	34.7	26.1	12.5	14.6	10.3
Spain	37.9	40.8	34.8	14.9	17.5	12.1
Sweden	25.2	27.0	23.3	8.3	10.3	6.1
Switzerland	23.0	24.1	21.8	7.1	8.2	6.0
Tajikistan	16.1	15.7	16.4	4.2	4.8	3.5
Turkey	32.7	34.2	31.2	14.9	16.0	13.8
Turkmenistan	19.7	20.2	19.2	6.4	7.8	5.0
Ukraine	23.4	27.0	19.5	9.0	11.6	6.3
United Kingdom	32.5	32.9	32.2	11.5	12.7	10.2
Uzbekistan	18.3	18.4	18.1	5.5	6.7	4.4
WHO European Region	**29.5**	**32.1**	**26.6**	**11.6**	**14.0**	**9.1**

a Overweight and obesity are defined as BMI-for-age value > +1 Z-score and > 2 Z-scores, respectively, using the 2007 WHO recommended growth references for school-aged children.
– = no data available.

TABLE A2.4. Age-standardized prevalence of overweight and obesity among adolescents (10–19 years), 2016

	Age-standardized prevalence (%)					
	Overweight (including obesity) [a]			Obesity [a]		
Country	Both sexes	Boys	Girls	Both sexes	Boys	Girls
Albania	23.8	27.7	19.5	6.4	8.0	4.6
Andorra	34.4	37.1	31.6	11.1	13.1	9.0
Armenia	18.3	17.4	19.4	3.8	4.2	3.4
Austria	25.8	28.6	22.9	7.8	10.3	5.1
Azerbaijan	17.8	17.4	18.3	3.9	4.2	3.6
Belarus	21.5	24.9	17.9	6.4	8.7	3.9
Belgium	23.1	22.7	23.6	6.1	7.2	4.9
Bosnia and Herzegovina	20.5	24.1	16.8	4.6	5.4	3.7
Bulgaria	27.1	31.9	22.0	9.2	11.8	6.6
Croatia	25.7	30.6	20.6	8.9	11.6	6.1
Cyprus	31.5	34.4	28.4	10.5	13.6	7.2
Czechia	25.9	30.7	20.8	8.1	10.7	5.3
Denmark	23.8	25.6	21.8	6.2	8.2	4.0
Estonia	19.4	21.4	17.2	5.0	6.3	3.7
Finland	25.4	27.8	22.7	7.8	10.8	4.5
France	28.9	29.8	27.9	6.9	7.4	6.4
Georgia	19.0	19.5	18.3	5.7	7.4	3.8
Germany	25.3	26.9	23.6	7.8	9.8	5.7
Greece	35.3	39.2	31.3	11.7	14.4	8.8
Hungary	26.9	31.0	22.6	9.5	11.9	7.1
Iceland	27.0	28.9	25.0	8.5	10.8	6.1
Ireland	29.4	30.0	28.8	8.2	8.6	7.8
Israel	33.5	35.9	30.9	10.2	12.2	8.0
Italy	34.2	36.7	31.5	9.8	11.5	8.1
Kazakhstan	18.5	18.7	18.3	5.4	6.6	4.1
Kyrgyzstan	15.3	15.0	15.6	3.0	3.9	2.1
Latvia	20.4	23.0	17.7	5.9	7.5	4.1
Lithuania	19.2	21.4	16.9	5.5	7.1	3.8
Luxembourg	24.8	26.3	23.2	7.0	8.8	5.1
Malta	35.2	37.8	32.5	11.8	13.9	9.6
Monaco	–	–	–	–	–	–
Montenegro	23.5	28.2	18.6	6.3	8.1	4.3
Netherlands	23.7	24.1	23.2	6.1	7.1	5.0
North Macedonia	24.5	28.9	19.8	7.8	10.2	5.3
Norway	26.5	27.6	25.3	8.1	9.2	6.9
Poland	23.6	28.6	18.3	7.2	10.4	3.8
Portugal	30.2	31.2	29.2	8.5	8.7	8.2
Republic of Moldova	16.5	18.1	14.8	3.3	4.0	2.5
Romania	23.1	27.7	18.4	6.7	9.2	4.0
Russian Federation	18.6	21.0	16.2	4.7	6.4	3.0
San Marino	–	–	–	–	–	–
Serbia	25.6	30.7	20.3	8.0	10.4	5.4
Slovakia	21.8	26.0	17.4	6.7	8.7	4.6
Slovenia	25.4	29.0	21.7	7.3	8.5	6.0
Spain	31.9	34.9	28.8	8.5	10.6	6.3
Sweden	22.9	24.2	21.5	5.8	7.7	3.9
Switzerland	21.2	22.1	20.1	5.2	6.3	3.9
Tajikistan	13.9	13.2	14.7	2.3	2.6	1.9
Turkey	27.9	28.4	27.3	9.8	10.2	9.4
Turkmenistan	17.1	16.8	17.4	3.7	4.6	2.9
Ukraine	20.1	22.7	17.4	5.8	7.5	4.0
United Kingdom	30.3	29.7	31.0	9.4	9.9	9.0
Uzbekistan	15.7	15.2	16.2	3.2	3.9	2.4
WHO European Region	**24.9**	**26.7**	**22.9**	**7.1**	**8.6**	**5.6**

a Overweight and obesity are defined as BMI-for-age value > +1 z-score and > 2 z-scores, respectively using the 2007 WHO recommended growth references for school-aged children
– : no data available.

TABLE A2.5. Age-standardized prevalence of overweight and obesity among school-aged children (7–9 years) from data collected from COSI [a]

	Age-standardized prevalence (%)			
	Overweight (including obesity) [b]		Obesity [b]	
Country	Boys	Girls	Boys	Girls
Albania	23.2	16.5	10.7	5.3
Austria	30.3	22.3	12.4	6.2
Bulgaria	30.2	28.6	15.7	11.4
Croatia	37.1	28.5	16.2	10.3
Cyprus	43.0	43.1	21.5	19.2
Czechia	22.9	19.1	10.9	5.5
Denmark	17.6	20.1	4.9	5.1
Estonia	28.6	23.3	11.4	7.9
Finland	28.3	26.7	11.5	9.0
France	24.6	23.4	8.9	6.2
Georgia	26.1	22.2	10.3	7.2
Greece	42.0	37.8	20.1	14.3
Hungary	28.0	27.8	14.1	11.2
Ireland	27.1	19.8	9.3	5.3
Italy	41.9	38.5	21.0	14.0
Kazakhstan	17.5	19.8	4.8	6.2
Kyrgyzstan	10.9	8.8	3.5	1.6
Latvia	24.8	20.6	8.8	6.5
Lithuania	28.5	22.9	12.2	7.8
Malta	37.0	34.6	18.0	14.9
Montenegro	37.4	28.8	18.9	8.7
North Macedonia	32.2	29.5	17.3	12.9
Norway	24.0	22.4	7.2	4.7
Poland	31.7	28.8	14.3	10.5
Portugal	29.0	32.4	12.0	10.7
Romania	30.6	25.8	15.0	8.8
Russian Federation (Moscow only)	27.0	22.4	10.2	6.5
San Marino	39.1	32.2	19.5	8.7
Serbia	32.6	28.5	15.0	9.7
Slovakia	30.1	23.3	12.4	10.5
Slovenia	24.3	24.5	10.5	8.4
Spain	42.2	40.4	18.7	16.8
Sweden	27.5	28.2	10.4	7.1
Tajikistan	9.4	5.2	1.8	1.1
Turkey	27.3	25.4	12.7	8.8
Turkmenistan	11.5	11.4	3.6	2.3
COSI average [c]	**29**	**27**	**13**	**9**

a Data relate to round 4 data collection (2015–2017): (i) 7-year-old children in Bulgaria, Czechia, Denmark, Estonia, Finland, Georgia, Greece, Hungary, Ireland, Kyrgyzstan, Latvia, Lithuania, Malta, Montenegro, Portugal, North Macedonia, Russian Federation (Moscow only), Serbia, Slovakia, Slovenia, Spain, Tajikistan, Turkmenistan and Turkey; (ii) 8-year-old children in Albania, Austria, Croatia, France, Italy, Norway, Poland, Romania, San Marino and Sweden; and (iii) 9-year-old children in Cyprus and Kazakhstan.

b Overweight and obesity are defined as BMI-for-age value > +1 *Z*-score and > 2 *Z*-scores, respectively, using the 2007 WHO recommended growth references for school-aged children and adolescents.

c COSI average represents the average value across the countries that provided relevant information.

–: no data available.

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TABLE A2.6. Age-standardized prevalence of overweight (including obesity) [a,b] among adolescents (11, 13 and 15 years), from data collected from the HBSC study, 2018

	Age-standardized prevalence (%)					
	11 year olds		13 year olds		15 year olds	
Country	Boys	Girls	Boys	Girls	Boys	Girls
Albania	37	21	33	17	28	10
Armenia	26	18	23	13	23	9
Austria	26	19	27	17	25	16
Azerbaijan	28	26	18	10	17	5
Belgium (Flemish)	18	12	15	13	13	15
Belgium (French)	23	17	26	15	24	16
Bulgaria	30	21	37	16	24	14
Croatia	31	21	30	21	23	13
Czechia	29	16	27	18	26	14
Denmark	17	12	11	13	20	13
England	–	–	–	–	17 [c]	14 [c]
Estonia	30	20	27	17	23	15
Finland	26	14	29	17	22	15
France	17	13	15	13	17	11
Georgia	33 [c]	19 [c]	32	18	21	9
Germany	21	14	27	15	24	18
Greece	33	22	30	20	31	13
Hungary	29	25	32	23	28	18
Iceland	24	15	22	16	23	18
Ireland	21 [c]	14 [c]	19 [c]	13 [c]	15 [c]	12 [c]
Italy	37	19	32	15	25	12
Kazakhstan	16	8	11	8	9	6
Latvia	30	23	24	17	19	13
Lithuania	29	19	24	16	19	11
Luxembourg	31	21	28	18	24	20
Malta	44 [c]	34 [c]	38 [c]	35 [c]	41 [c]	30 [c]
Netherlands	17	9	13 [c]	10 [c]	14	9
North Macedonia	42	23	39	24	34	17
Norway	18 [c]	9 [c]	20	15	22	14
Poland	34	18	32	16	23	8
Portugal	33	22	26	23	22	22
Republic of Moldova	23	12	16	10	14	7
Romania	32 [c]	22 [c]	30	15	27	15
Russian Federation	27	14	21	13	19	12
Scotland (United Kingdom)	30 [c]	20 [c]	32 [c]	15 [c]	24 [c]	13 [c]
Serbia	31	17	29	15	28	15
Slovakia	34	16	27	14	23	12
Slovenia	27	17	29	17	26	16
Spain	29	19	26	17	21	14
Sweden	24	17	24	16	17	14
Switzerland	19	10	19	11	21	13
Ukraine	25	17	20	11	16	9
United Kingdom (Wales)	29 [c]	21 [c]	24 [c]	19 [c]	23 [c]	16 [c]
Average [d]	**28**	**18**	**25**	**16**	**23**	**14**

a Overweight (including obesity) is defined as BMI-for-age value > +1 *Z*-score using the 2007 WHO recommended growth references for school-aged children and adolescents.
b BMI was calculated using self-reported height and weight.
c BMI is missing for more than 30% of sample.
d Including all countries from table plus Greenland and Canada.
–: no data available
Source: adapted from Inchley et al (2020). Reproduced with permission of World Health Organization under Creative Commons Attribution CC BY-NC-SA 3.0 IGO Licence *(40)*.

ANNEX 3
HEALTH EFFECT OF WEIGHT LOSS

TABLE A3.1. Effect of weight loss on cardiovascular and mortality outcomes from high-quality systematic reviews

Systematic review	Characteristics of RCTs and participants	Participants	Primary outcomes studied	Pooled effect size (95% CI)	Quality assessment reported
Ma et al., 2017 *(100)*	54 RCTs examining the effects of any type of weight loss diet for ≥ 1 year RCTs from Asia, Europe, North America, South America	30 206 adults (mean or median age, ≥ 18 years), mean BMI ≥ 30 kg/m^2 at baseline 36 RCTs included participants with a mean or median BMI < 35 kg/m^2; 14 RCTs included participants with a mean or median BMI ≥ 35 kg/m^2	Mortality: all-cause, cardiovascular, cancer	Relative risk All-cause mortality, 0.82 (95% CI, 0.71 to 0.95; I^2 [heterogeneity] = 0) Cardiovascular mortality, 0.93 (95% CI, 0.67 to1.31; I^2 = 0) Cancer mortality, 0.58 (95% CI, 0.30 to 1.11; I^2 = 0)	Evidence grade: all-cause (high), cardiovascular (moderate), cancer (very low)
Khasteganan et al., 2019 *(101)*	8 RCTs comparing the effects on CVD risk factors of conventional weight loss (CWL) and "health, not weight loss, focused" approach promoting physical activity and healthy eating only (HNWL) Interventions lasted between 8 and 104 weeks RCTs from Australia, Canada, United Kingdom, United States	846 adults (mean age, 43 ± 8.92 years), mean BMI across all RCTs 35 ± 5.4 7 RCTs included only women	Changes in the following outcomes at 53–104 weeks: ratio total cholesterol to high density lipoprotein, systolic blood pressure, diastolic blood pressure, weight change	**Cardiovascular-related outcomes:** 2 RCTs were included in analyses, both of which had high risk of bias due to incomplete outcome assessment Mean difference (CWL vs HNWL): Ratio total cholesterol to high density lipoprotein, −0.21 (95% CI, −3.91 to 3.50; I^2 = 0) Systolic blood pressure, 1.14 (95% CI, −3.56 to 5.84; I^2 = 0) Diastolic blood pressure, 0.15 (95% CI, −3.34 to 3.64; I^2 = 53) **Weight change:** 8 RCTs Mean difference (CWL vs HNWL), −0,28 (95% CI, −2.00 to 1.44; I^2 = 94.3) Sensitivity analysis with low-risk bias RCTs only, −1.30 (95% CI, −3.14 to 0.54; I^2 = 92)	Grade: low–moderate for 2 RCTs for cardiovascular-related outcomes; low–moderate for 8 RCTs for weight change
Buckell et al., 2021 *(99)*	5 RCTs examining behavioural weight loss as indicating intention to lose weight[a]	8881 adults (≥ 18 years; mean age, 53 ± 10.7 years) with overweight or obesity at baseline (BMI ≥ 25 kg/m^2; mean BMI at baseline 33.3 ± 6.3 kg/m^2) who had recently lost at least 8% of their body weight	Association of BMI and health-related quality of life	Cross-sectional association per-unit BMI decrease associated with a 0.13 standard deviation (SD) unit increase of quality of life: −0.13 (95% CI, −0.14 to −0.12) Longitudinal change of BMI per-unit decrease in BMI associated with a 0.09 SD unit higher quality of life: −0.09 (95% CI, −0.10 to −0.08)	RCTs of moderate–high quality
Capristo et al., 2021 *(102)*	28 RCTs (26 double blind placebo-controlled RCTs) comparing efficacy of weight-loss drugs (liraglutide, orlistat, lorcaserin, phentermine + topiramate, bupropion + naltrexone) in adults with overweight or obesity; median follow-up, 52 weeks	50 106 adults (≥ 18 years) with overweight or obesity	All-cause mortality, cardiovascular mortality, non-fatal cardiovascular events, weight loss	Risk ratio All-cause mortality, 1.03 (95% CI, 0.87 to 1.21; I^2 = 0) Cardiovascular mortality, 0.92 (95% CI, 0.72 to 1.18; I^2 = 0) Non-fatal cardiovascular events: no evidence of associations reported with risk of myocardial infarction, stroke, hospitalization for angina, coronary revascularization/reperfusion, or risk of heart failure Weight loss, mean difference −3.34 (95% CI, −3.96 to −2.81; I^2 = 93)	RCTs were judged to be suboptimal because of potential biases on allocation concealment, blinding of outcome assessors, and funding

a The five RCTs included in this systematic review were: Diets with High or Low Protein Content and Glycaemic Index for Weight-Loss Maintenance (DioGENES); Diabetes Prevention Programme (DPP); Look AHEAD; Trials of Hypertension Prevention (TOHP); and the Extended and standard duration weight-loss programme referrals for adults in primary care (WRAP).

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