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Multimorbidity: its prevalence and impact in middle-income countries. A multicountry comparison using household surveys and qualitative methods

by

Sara A Morgan

Thesis for the degree of Doctor of Philosophy

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ABSTRACT

FACULTY OF MEDICINE AND SOCIAL & HUMAN SCIENCES

Epidemiology & International Public Health

Thesis for the degree of Doctor of Philosophy

MULTIMORBIDITY: ITS PREVALENCE AND IMPACT IN MIDDLE-INCOME COUNTRIES. A MULTICOUNTRY COMPARISON USING HOUSEHOLD SURVEYS AND QUALITATIVE METHODS

Sara Afshar Morgan

Multimorbidity, defined as the co-occurrence of two or more chronic conditions within an individual, is characteristic of an elderly population. Tackling multimorbidity remains one of the key challenges faced by the global community, particularly for many low and middle income countries (LMICs) facing a rapidly ageing population and an onset of non-communicable disease (NCDs) earlier in adulthood than in high income countries (HICs). Using a mixed methods approach, this thesis aimed to understand the prevalence and impact of multimorbidity in LMICs through four studies. The first study examined the prevalence of multimorbidity across 28 LMICs, and its association with socioeconomic status (SES) using education as a proxy. Multimorbidity was found to be positively associated with the female sex and with age, although it was common among younger adults in LMICs. Regional SES analyses also suggested a negative association of multimorbidity with SES. The second study further examined these relationships using the Study of Global Ageing (SAGE Wave 1, 2007-2010), with an additional focus on understanding the effect of urban living in a set of five key MICs: China, Ghana, India, Russia and South Africa. The study findings were consistent with the first study and, in China, points to a pathway of association between urban living and multimorbidity, acting through social, economic, behavioural and demographic risk factors. Using the SAGE, the third study examined the impact of multimorbidity on activities of daily living and functional disability, and found disability to be associated with age and dependent on the chronic conditions included in the multimorbidity count. Drawing on earlier findings, the final qualitative study was carried out within Greater Accra, Ghana. In total, 20 women were recruited from 3 polyclinics across urban, rural and peri-urban areas; and their experiences of living with multimorbidity were explored. The findings highlighted their reliance on the healthcare system in spite of inconsistent coverage, complexity and treatment burden; and their need for social support and holistic care.

The aims of this thesis are wide-reaching, and consider evidence for better health planning, policy, and community interventions; particularly for LMICs facing a multimorbidity burden.

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DECLARATION OF AUTHORSHIP

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

Thesis Title. 'Multimorbidity: its prevalence and impact. A multicountry comparison using household surveys and qualitative methods.'

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. [Delete as appropriate] None of this work has been published before submission [or] Parts of this work have been published as: [please list references below]:

Signed: .....

Date: .....

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Definitions and Abbreviations

ACG	Adjusted clinical groups; ACG system is an approach/ measure for measuring morbidities
ADS	Anxiety, depression, somatoform disorders (cluster of diseases)
ADLS	Activities of daily living; relate to physical functioning
CCM	Cumulative Complexity Model
CVD	Cardiovascular Disease
DALYS	Disability Adjusted Life Years
ELSA	English Longitudinal Study of Ageing
GBDS	Global Burden of Disease Study
GDP	General Domestic Product
HICs	High Income Countries
HSE	Health Survey England
IADLs	Instrumental Activities of daily living; relate to ability to live independently
LMICs	Low and middle-income countries
MDGS	Millennium Development Goals
MHI	Mandatory health insurance; national health insurance scheme in Russia
MICs	Middle- income countries
NCDs	Non-communicable diseases
NHIS	National Health Insurance Scheme
NICE	National Institute of Clinical Excellence
OECD	Organisation for Economic Development and Cooperation
SAGE	Study of Global Ageing
SDGs	Sustainable Development Goals

SES	Socioeconomic Status
SHARE	Survey of Health, Ageing and Retirement in Europe
STROBE	Strengthening the Reporting of observational studies in epidemiology
WHO	World Health Organisation
WHS	World Health Survey
UN	United Nations

Rationale of Thesis

In the previous century, there has been an observed shift of disease burden from communicable to non-communicable globally. This scientific observation was postulated by Omran as 'the epidemiological transition [3].' Economic development, and subsequent changes in social conditions and standards of living, is a major contributing factor to this observed trend. Improved access to healthcare has resulted in a reduction in infant mortality whilst, at the same time, improved hygiene and sanitation have contributed towards a reduction in infectious disease. Individuals are now largely surviving to middle and older ages, and are being exposed to a number of risk factors (largely behavioural or 'lifestyle' - a consequence of 'westernisation' or now globalisation) throughout the life course – that give rise to non-communicable disease with complex aetiologies. While the debate about the role of population ageing in epidemiological transition continues, this demographic change is occurring globally, albeit with different patterns, determinants and rapidity. Although the elderly population in low and middle-income countries (LMICs) is smaller, its growth rate will remain significantly higher than in most high-income countries (HICs) for many decades [4]. The recent Global Burden of Disease Study (GBDS) provides evidence to support theories on a global health transition, and a shift towards non-communicable disease (NCD), which are now the main cause of morbidity and mortality globally. This transition is attributed to a change in lifestyle risk - notably poorer diets, alcohol and tobacco consumption and lack of exercise. However the GBDS study suggests that global changes in risk factors and disease within the last two decades are not occurring at the same rate in Sub Saharan Africa, as compared to the rest of the globe. These findings suggest that changes in disease patterning is not occurring at the same rate across the world.

Multimorbidity is often defined as the presence of two or more chronic diseases within an individual. Such chronic diseases could be either communicable (e.g. HIV) or non-communicable (e.g. Chronic Heart Disease). Multimorbidity is a consequence of both the demographic and epidemiologic transition. As populations becoming increasingly aged, there is an expectant increase in multimorbidity prevalence. Compared to the rest of the world, upper middle income countries (MIC) have experienced the fastest growth of urbanisation since the 1950's. According to the most recent Population Ageing Report, upper middle income countries and lower middle income countries will experience the highest percentage change in those aged 60 and over from 2015- 2030; estimated at 70.2% and 65.9% respectively. Economic development in LMICs has also given rise to rapid urbanization, resulting in increased exposure to common modifiable risk factors (such as decreased physical activity or a poorer diet) that lead to chronic disease.

Despite the growing recognition of multimorbidity prevalence amongst older adults, global prevalence studies have largely remained single-disease focused [5]. Furthermore, most of the multimorbidity studies to date have been undertaken in HICs. Population prevalence studies in Spain and Germany, for instance, suggest that multimorbidity prevalence is approximately 60% for people aged 65 years and above [6, 7]. While the focus on older adults is common, multimorbidity also affects younger adults [8]. A study in Australia reported a multimorbidity prevalence of approximately 4% in adults aged 20-39 years, 15% in the 40-59 age group, and 39% in those aged 60 and older [9]. Furthermore, a recent study in Scotland suggested that those from more deprived households suffered from an earlier onset of multimorbidity, compared with those who were less deprived[10]. Multimorbidity is reportedly more prevalent for higher ages, female sex, low income, and low education in HICs [11-13]. The outcomes of multimorbidity have also been well documented in HICs, with multimorbidity being associated with reduced quality of life, decreased functional capacity, and reduced survival [14-16]. Studies have also shown the burden of multimorbidity and its relation to rising healthcare utilisation, cost and expenditure [17, 18].

As countries develop and rapidly urbanise, their health systems need to support the complexities of chronic disease brought on by increased exposure to NCD risk. Health services, even in the UK, are still not optimally orientated to support the complexities of a multimorbid population. The National Institute for Clinical Excellence (NICE) have only recently published guidelines for the clinical assessment and management of multimorbidity[19]. For LMICs, informed policy and planning are therefore needed to support this transition, and promote appropriate health care service delivery. However, there is a lack of evidence in LMICs, which is in part related to the lack of robust data systems. Low income countries (LICs), in particular, do not have the infrastructure necessary to understand the nature and extent of the multimorbidity problem. In view of (i) the dearth of information in LICs, (ii) an interest in understanding transitions in disease patterning, and (iii) the rapidly ageing population, this thesis aims to measure the prevalence and impact of multimorbidity in MICs. The study might provide evidence for better health planning, policy, and community interventions; particularly for MICs facing a rising multimorbidity burden.

Methodological approach (and summary of studies)

Mixed methods approach

The mixed method design is based on the central premise that the use of both approaches, quantitative and qualitative, provide a more comprehensive understanding of research issues than either approach alone [20]. I have chosen to approach the research questions on pragmatic, rather than ideological grounds, as a way to meet the complexity associated with healthcare research. Both qualitative and quantitative methodologies are linked to paradigms, which relate to the ontology, epistemology and methodology [21].

The quantitative studies in this thesis take a post-positivist approach to understand the prevalence and impact of multimorbidity [22]. The post-positivist approach tests a hypothesis, based on formally derived theories, and applies this to quantitative research. This approach was developed from earlier positivist approaches used to define laws directly from observations. The post-positivist approach is embedded in the understanding that it is difficult to establish an ultimate truth, particularly when comparing across different populations and culture; and that future observations may defy laws based on current observations. In contrast, the qualitative study demonstrates an interpretivist approach. Interpretivism assumes that we cannot separate ourselves from what we know, and focuses on understanding what we are studying from the perspective of the participant. Overall, the mixed method design takes a pragmatic perspective, by drawing upon what works, and valuing both subjective and objective knowledge in relation to the research problem [23]. The two differing approaches of both quantitative and qualitative methodologies will inform and substantially enhance the quality of evidence of the overall research. The former explains the 'extent' to which multimorbidity exists and impacts on individuals, whilst the latter informs the 'nature' of such experiences.

Using the taxonomy of mixed method design proposed by Palinkas et al. 2011, I have proposed the following structure, function and process for my mixed method design [24].

Structure	I will conduct a simultaneous collection and analysis of both quantitative and qualitative data.
Function	The methods will be complementary. I will use each method to answer a related question by using *elaboration* e.g. using qualitative data to provide depth of understanding and quantitative data to provide breadth of understanding

Process	I will connect the data by analysing one dataset (quantitative) and use the findings to inform the subsequent data collection (qualitative) e.g. selecting sociodemographic characteristics of research participants for interview

Each quantitative study has been discussed independently. This qualitative study will be discussed independently and then all discussion points from the studies will be integrated to form the final discussion chapter (see Chapter 7). Although the overall thesis contains more quantitative work, its analysis will greatly help to inform the structure of the qualitative study. As shown through the design (function), the qualitative study seeks to build on the quantitative findings.

The overall aims are as follows:

- **To explore the determinants (social, economic and demographic), prevalence and impact of multimorbidity in middle income countries**

The overall thesis will be split into four studies, tackling specific objectives that link back to the overall aims.

Study 1: Global prevalence patterns of multimorbidity using the World Health Surveys (WHS) and the English Longitudinal Study on Ageing (ELSA)

- To examine the distribution of multimorbidity (by age) in LMICs and compare this to HICs;
- To examine the social, economic and demographic determinants of multimorbidity, (including age, sex and education) in LMICs and HICs;

Study 2: The effect of urban living, social, economic and demographic risk factors on multimorbidity across five MICs, using the Study on Global Ageing (SAGE)

- To examine the social, economic and demographic correlates (includes age, sex, SES and education) and behaviour risk factors (obesity and hypertension) of multimorbidity in the SAGE countries;
- To examine the association of urban living with multimorbidity and the interaction of SES and urban living;

Study 3: What is the impact of multimorbidity on functional disability? A cross sectional study using the SAGE in five MICs.

- To estimate the prevalence of multimorbidity and specific comorbidities;
- To measure the impact of specific combinations of co-morbidities on functional disability - measured by activities of daily living (ADLs) and the World Health Organisation Disability Assessment Schedule (WHODAS) score;

Study 4: A qualitative study on the impact of multimorbidity in Accra, Ghana (a MIC)

- To explore the contextual factors that affect women living with multimorbidity in the Greater Accra region, Ghana
- To explore perceptions of enablers and facilitators to accessing health care systems in individuals with multimorbidity in the Greater Accra region, Ghana

To this end, evidence from several data sources will be evaluated, using a mixed-method approach.

Through the course of the thesis the context will be narrowed – in order to gain a more in depth understanding of the prevalence and impact of multimorbidity at the local level. Ghana will be used as a case study at the latter stage of the thesis (study 4). The selected study site of Accra in Ghana shares many of the characteristics of other rapidly growing urban populations in LMICs [25]. Results from the study therefore may serve as a reference for future interventions, particularly in Sub-Saharan Africa.

Chapter 1: Conceptualising multimorbidity

1.1 Summary of Chapter

Chapter one examines the definition of multimorbidity, and links it back to earlier definitions on 'comorbidity.' The distinctions and categories of comorbidity serve as a useful reference for further work on multimorbidity. Such distinctions include the relationship between diseases, how they arise and in what sequence. Next I examine recent literature on disease clustering. I present this as more than just a phenomenon, but a consequence of a number of interrelated risk factors. Following from this I examine the most common methods used to measure comorbidity, which include a simple count, the Charlson Index, and the ACG system. For future studies on multimorbidity an appropriate index will need to be applied. Therefore a review of the validated indices serves as a useful resource.

1.2 Definitions of multimorbidity

Understanding the factors implicit to "multimorbidity" can greatly assist in attempts of a definition. The term implies a number, or "multiple" number, of morbidities (disease conditions or states), co-existing (implied by the conjunction of both "multi" and "morbidity"). Attempts to define multimorbidity accurately come as a result of an emerging trend of an increasing number of diseases, co-existing within individual patients [26-32]. There is, however, a lack of consensus on how to define and measure the concept. There is further disagreement on what to count as a morbidity. Take for instance, hypertension: some would define it as a chronic disease risk factor, whilst others as a chronic condition [33, 34]. I therefore hope to address the differing opinions concerning individual morbidities, in turn, and include a justification for inclusion. This first section addresses the concept of multimorbidity, its categorization and distinctions, as well as its link back to earlier work on comorbidity.

1.2.1 Feinstein's definition of comorbidity: its distinctions and categories

Definitions of multimorbidity are often discussed in relation to Feinstein's seminal work on comorbidity in the 1970's, defining comorbidity as "any distinct additional clinical entity that has existed or may occur during the clinical course of a patient who has the index disease under study [35]." This monistic way of thinking, placing an index disease at the centre, is perhaps attributed to the medical specialism that occurred during the 19th century and beyond. Nevertheless, within specialities such as psychiatry, there is an increasing recognition of comorbidity, described as the "rule" rather than the exception [36]. This definition, however, assumes the centralness of a particular disease; and unless one disease is dominant in terms of the care and well-being of the individual, then this framework may not necessarily be advantageous when considering optimal care for patients with multimorbidity [37]. The recent NICE guidelines on multimorbidity covers optimising care for adults with multimorbidity by reducing treatment burden and unplanned care. The guidelines advocate an approach that takes account of multimorbidity in tailoring an approach to care, rather than individual disease [19].

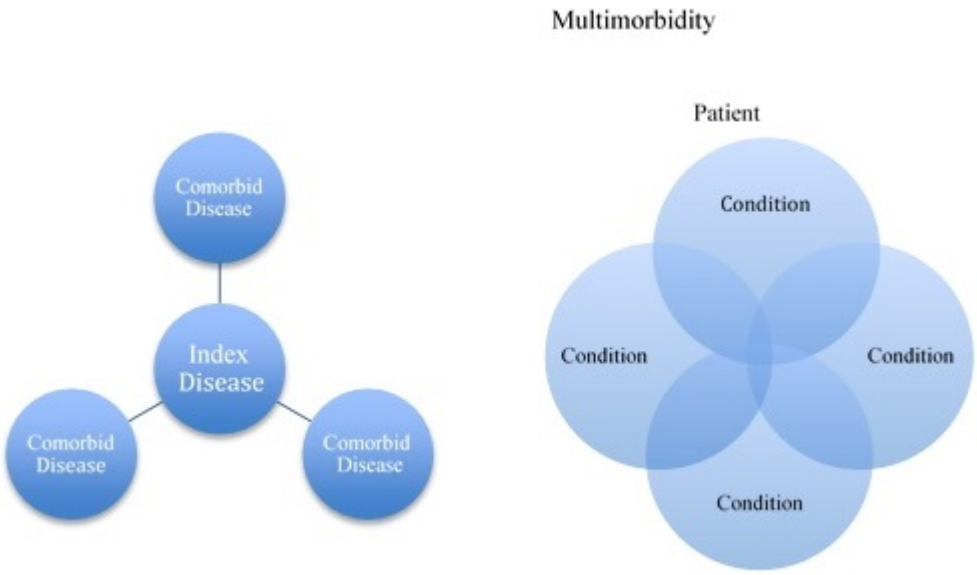


Figure 1-1 "Comorbidity" versus "Multimorbidity," a comparison of conceptual diagrams

(Adapted from Boyd and Fortin, 2010)

Figure 1.1 shows the conceptualisation of "comorbidity" as postulated by Feinstein. The concept of an index disease in relation to other comorbid diseases has benefits for specialised care services, where often greater emphasis (in terms of diagnosis, treatment plan and prognosis) is

given to the index disease, whilst consideration and often further opinion is sought from specialists particular to the individual's comorbid condition. In comparison, the "multimorbidity" concept places the patient at the centre, with an overall view of the multiple conditions, which may overlap. These overlaps may, for example, be due to common pathophysiology and psychological circumstances. This conceptualisation of multimorbidity is particularly useful for practitioners seeking a more holistic view of a patient's situation: in particular, their complexity of illness. Such concept of multimorbidity has advantages for the primary care setting, the public health and epidemiological perspective, as well as health economists and policy makers. This holistic view could, for instance, improve our understanding of shared risk factors, inform the design and implementation of preventative strategies through health promotion or clinical interventions; encourage whole society engagement, drawing on both social and health care; and develop thinking around ways to optimise the health care system.

Valderas and colleagues consider there to be four distinctions, based upon the core concept of comorbidity (as mentioned above). These four distinctions include: the "nature" of the health condition, allowing differentiation between conditions; the relative "importance" of the conditions, considering which condition is index; the "chronology" of the conditions, such as the time span and sequence of the morbidities; and the "total burden" of the types of illnesses on the individual's physiological reserves and the psychological effect; as well as the "complexity" of this burden – as the influence of the non-health related individual attributes [38]. They argue that although the focus on comorbid chronic disease can have far reaching effects in terms of healthcare, acute conditions should also be considered as they may appreciably affect the management of any other diseases. The inclusion of acute diseases into the multimorbidity count may not be achievable or realistic with a cross sectional health survey approach which often measure the health status of the population through self-report at one point in time. Such health surveys may miss the occurrence of acute illness. Equally, individuals suffering from acute illness may not be well enough to take part in the survey. Furthermore, many longitudinal health surveys take separate cross-sectional measures periodically over time (e.g. every two years). With this in mind, it is less probable that acute conditions will be captured within these 'snap-shots' of time. The subject of whether to include acute conditions in the count of multimorbidity is still debated, although inconclusive [39].

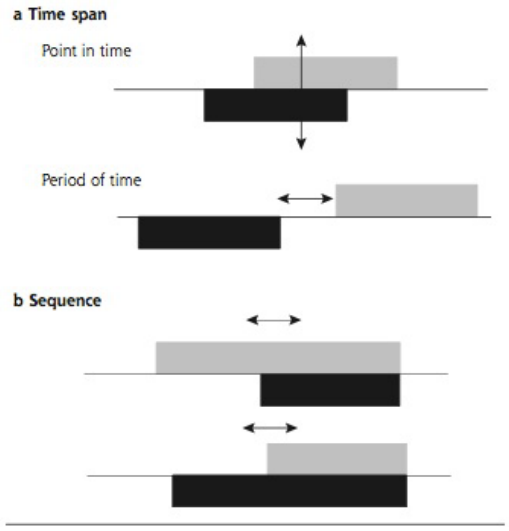


Figure 1-2 "The chronological aspects of comorbidity"

(Taken from Valderas et al. 2009)

The diagram represents the time span and sequence in which two co-occurring conditions (within an individual) may be assessed by clinicians or researchers. Figure 1.2a shows two conditions co-occurring across the same period of time. The first diagram shows two conditions co-occurring at one point of time. It is unclear whether these have occurred sequentially. The second represents two co-occurring conditions across the same period of time (but not at the same time). This would only hold true if the first condition was an acute disease. Figure 1.2b represents two co-occurring conditions that have been observed in sequence (one before the other). The sequential analysis would have more useful implication in understanding causal co-occurrence of disease (where one disease may give rise to another, and not by chance).

The chronology, given as the time and sequence in which morbidities arise, have important implications for the health services that treat index conditions. The development of a subsequent condition (whether related or not related, and before or after index diagnosis) can have an effect on the genesis, prognosis and treatment of the index condition. Likewise, understanding the timing and sequence of a new disease can provide information on aetiological association.

Van Weel & Schellevis suggest that there are four categories of comorbidity: "causal" diseases with common pathophysiology; "complicating," disease specific complicating morbidity; "concurrent" coexisting chronic morbidity without any causal relation to index disease, which is non-reversible over a long duration; and "intercurrent" interacting acute illness usually limited in

time [40]. The description of a chronic condition as 'non-reversible' relates to the characteristics of being permanent and manifesting non-reversible pathological changes. It is important to note, however, that not all chronic condition will exert both characteristics. The description of a chronic disease by the World Health Organisation (WHO) includes 'a condition that has one or more of the following characteristics: permanent, disability-causing, caused by non-reversible pathological alteration, requires special training of the patient for rehabilitation, or requires a long period of supervision and care[41].'

The different types of comorbidities here, however, suggest that Feinstein's concept of placing a single disease as the index may be problematic, especially for concurrent diseases. Concurrent morbidities are prevalent within the population, particularly amongst the aged, and there is likely to be an increase in this trend [42].

Table 1-1. Examples of the four categories of comorbidity

As postulated by Van Weel & Schellevis

Four categories of comorbidity	**Example**
Causal Common pathophysiology or disease clustering with shared common risk factors	Type II diabetes and cardiovascular disease
Complicating (Disease specific complicating morbidity) This can be expanded to include "iatrogenic" effects of prolonged medication of index disease	Kidney disease or eye disease arising from diabetes Example of an "iatrogenic effect" includes osteoporosis following long term use of steroids for conditions such as chronic lung disease

Concurrent (Coexisting chronic morbidity without any causal relation to index disease)	For example hypothyroidism and asthma are concurrent Ageing process leads to co-occurrence
Intercurrent (Interacting acute illness usually limited in time)	Diabetes Mellitus associated with increased risk of infection and of acute kidney injury if have Chronic Kidney Disease Acute respiratory exacerbation in Chronic Obstructive Pulmonary Disease

Valderas has therefore highlighted the differences between comorbidities based on four distinctions. Van der Weel, on the other hand, has highlighted the differences between comorbidities based on four categories. Both approaches to person-level comorbidities have useful application, particularly in developing specific guidelines for the care and management of people with multimorbidity. The 'distinction' approach however goes beyond simply grouping disease sets; but considers the timeframes and the possible burden (or outcome) of multimorbidity. The four distinctions (referred to as 'constructs') will, however, have differing relevancies from the point of view of the researcher. From the public health perspective, the chronology of the conditions, and whether causal comorbidities have arisen, will be of particular importance for developing suitable interventions. Such interventions include, for example, targeted measures to prevent the development of chronic disease, and clustering conditions. From a health service research angle, however, estimates of total cost and allocation will depend upon an understanding of the total burden and complexity of multimorbidity. This differing approach in emphasis is not dissimilar to the specialists and general practitioners who prefer the term 'comorbidity' and 'multimorbidity', respectively.

From a clinician's perspective, priority may be given to understanding firstly whether comorbid conditions are 'discordant' or 'concordant' so that a decision can be made about treatment management. This follows a categorical approach as shown in Table 1.1. Discordant (also referred to as 'concurrent') chronic conditions are not directly related (causally) to the index disease being treated, and may not share common disease management [43]. A discordant condition to diabetes, for instance, could be asthma or prostate cancer. Studies have shown that patients were less likely to receive high quality medical care for discordant conditions [44]. Contrary to this, concordant (causal) conditions share a common pathophysiology with the index condition and are more likely to share the same self-management plan. A concordant condition to diabetes would include, for instance, hypertension. Concordant conditions may have shared risk factors, which give rise to each individual condition. Alternatively, the first condition may cause the development of the second condition. Either way concordant conditions are causally related. (*See Appendix A for Table on Cancer and Comorbidities, with shared risk factors. The research on cancer and their risk factors is well-established. This table was developed to show how risk factors are commonly shared between comorbidities, using established data sources for cancer).* The prevalence of concordant (causal) conditions within the population has given rise to so-called 'clustering of diseases' (which will be described in the next section).

The literature suggests that current guidelines poorly address the issue of multimorbidity [45]. Points to consider include the number of drug interactions due to co-occurring conditions; which affect health outcomes as well as patient safety. Further multimorbidity guidelines are needed to support clinicians in clinical decision making. Such guidelines should consider both the categories and distinctions of comorbidities, with consultations from several perspectives.

1.2.2 Clustering of disease

Evidence suggests that multimorbidity forms groups or clusters, sharing common risk factors i.e. causal [46]. In a study by Prados-Torres and colleagues, researchers used exploratory factor analysis to identify multimorbidity patterns amongst over 200,000 patients, above the age of 14. Stratified by age and sex, they found the cardiometabolic cluster to be highest in prevalence amongst the elderly, age-dependent and overlapping with other clusters, such as neuropsychiatric conditions. The dominance of the cardiometabolic cluster is not surprising when one considers the interactions between distal and proximal risk factors that lead up to certain cardiac related outcomes, such as coronary heart disease. Proximal factors may include diet, activity level and exercise. These proximal factors directly affect the physiological factors

that result in coronary heart disease (CHD). Such proximal factors are in turn affected by distal factors, arising from the cultural and political context, which include education and poverty for instance. The interactions of the risk factors of CHD (includes proximal, distal and physiological and disease risk factors) has been well studied and documented. See Figure 1.3 below.

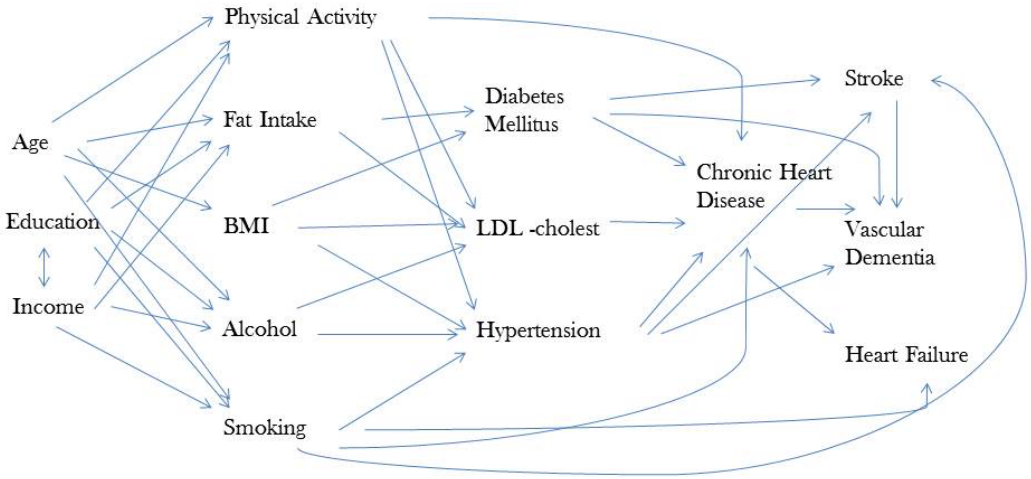


Figure 1-3. Causal web of known interactions between risk factors and conditions, for estimating the incidence of coronary heart disease

This is an example of the interactions and health determinants that lead to the onset of cardiometabolic diseases. Adapted from Murray et al. Population Health Metrics, 2003

In the study by Prados-Torres and colleagues they identify specific multimorbidity disease patterns within the population, and in so doing generate evidence regarding the underlying pathophysiological processes. The study collected data from 19 urban primary care centres in Spain. The selection of diseases were based on consensus between investigators and methods used in other studies [47]. Overall they identified five patterns of multimorbidity: the cardio-metabolic, psychiatric-substance abuse, mechanical-obesity-thyroidal, psychogeriatric and depressive. The cardiometabolic cluster was consistent with the disease pathophysiology. Whilst the development of diabetes, hypertension, obesity and dyslipidaemia was associated with younger age, the cardiometabolic cluster of diseases, however, progressed over the ages with cardiac complications being the primary outcomes in older ages. The psychiatric cluster also suggests shared psychopathological processes, such as psychosis and neurosis, both related to toxic substance abuse. In terms of the sex differences, the cardiometabolic cluster occurred for

both of the sexes analysed. The psychiatric cluster, on the other hand, appeared only in young men [48] These results may, however, reflect the context in which the sample was drawn so the generalisability of the results could be limited.

Consistent with this evidence, a study by Schafer et al analysed ambulatory data of a German statutory health insurance company (Grunder Ersatkasse), and found three factor patterns: (i) the multimorbidity of cardiovascular disease (CVD) and metabolic disorders; (ii) anxiety, depression, somatoform disorders (ADS) and pain (iii) neuropsychiatric disorders. It noted some male-female differences, with the CVD cluster being more predominant in males and the ADS and pain cluster more predominant in females. They conclude, however, that the individual multimorbidity patterns share some diagnosis groups, and influence each other, resulting in an overlap in a large part of the population[32].

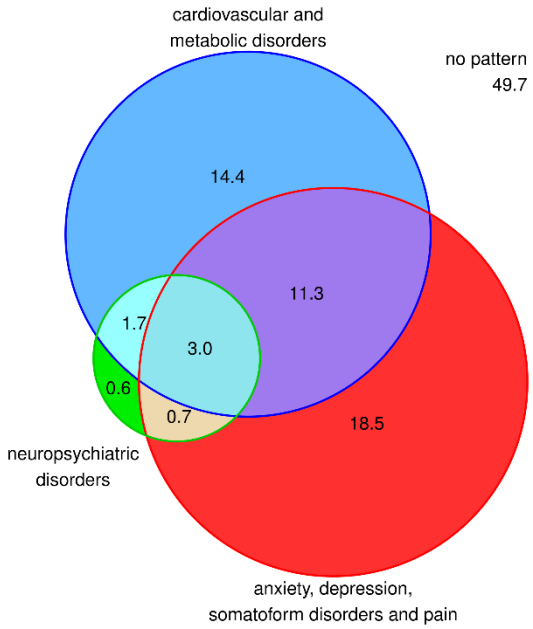


Figure 1-4 Overlapping patterns of multimorbidity related to the female population (in %)

(Source: Schafer et al. [32])

Here we note the most common patterns include the anxiety, depression, somatoform disorders and pain cluster; and the cardiovascular and metabolic disorder clusters. There is significant overlap between these two patterns. An overlapping of all three patterns (including

neuropsychiatric disorders) occurs for 3% of the female sample population. It is important to note that 49.7% of the female sample population do not fit any of these multimorbidity patterns.

There is evidence to suggest pathophysiological processes may be the primary explanatory factor in the clustering of diseases. However, this does not provide the whole picture, since co-morbidities are commonly discordant (concurrent) i.e. they are not causally related to the index disease. This means that diseases may cluster by chance. Although there is no consensus on the definition of multimorbidity, studies agree that the term reflects the co-occurrence of at least two diseases [49]. Some posit that the definition should not be confined to diseases that are chronic in nature, but include all diseases: both acute and chronic. A recent online survey conducted by the International Research Community of Multimorbidity addressed the question of 'how to define multimorbidity.' Response was given by 55 respondents, across 16 countries, all of whom have interests or are currently undertaking work in the subject of multimorbidity. In the overall response, 69% of individuals considered multimorbidity to be defined as 'multiple co-occurring chronic or long term conditions, none considered as index disease.'

Given the variability presented in these definitions, and the risk of creating further discordance, the following study upholds the definition suggested by Fortin and colleagues that, multimorbidity is *'the co-existence of two or more chronic conditions, where one is not necessarily more central than others.[37]'*

1.3 Measuring comorbidity/ multimorbidity

There are several ways to assess comorbidity. The next section describes the methods often used to measure comorbidity. These methods include the Charlson index, The Adjusted Clinical Groups System (ACG), the Cumulative Index illness Rating (CIRS), Kaplan-Feinstein and Disease counts.

One of the most widely used methods includes the Charlson index. The index has been derived and validated to predict in-hospital mortality and is therefore useful if mortality is the outcome of interest. In its development the initial cohort consisted of a 1-year follow up of approximately 600 patients with breast cancer. The number and severity of the comorbidity was recorded. The score method was then 'tested' on a second cohort of 680 women with histologically proven primary carcinoma of the breast; for a 10- year follow up. In both the training and testing (validation) cohort, the prognostically important variables for survival were

assessed. A weighted index was developed which took into account both the severity of and number of comorbid diseases. Results showed that in the 1-year follow up, the weighted index of comorbidity was a strong predictor for survival. Similarly for the validation comparison, none of the clinical or demographic prognostic predictors were significant. The only predictor of survival in this case was the presence of comorbidity and age. It was further noted that the experimental results produced remarkably similar results to the 'Kaplan and Feinstein index.' Even though the weighting system proposed by Kaplan has since been further validated, according to the literature the Charlson Index has better reliability ('the extent to which repeated measurements of the same phenomenon get similar results) and content validity (relevance of the content to measure what they claim to measure) than the Kaplan Feinstein Index.

Table 1-2. A comparison of the major indices used to measure comorbidity

The Charlson Index	**ACG system**	**The Kaplan-Feinstein Index**	**The Cumulative Illness Rating Score (CIRS)**	**Disease count**
Summary: Assigns weight from a list of 19 conditions. Total score calculated for each individual and then collapsed into an ordinal score (1, 2, 3, 4,>5).	**Summary:** Applies predictive modelling and risk adjustment to predict morbidity burden and use of healthcare resources. Focus is on commonly occurring diseases and assessment for	**Summary:** Comprised of a list of conditions grouped into 12 categories	**Summary:** Classes comorbidity by broad systems group and has approximately 14 organ subdivisions	**Summary:** Simple disease count

	all types of medical need			
Development: Developed by Charlson and colleagues in 1986 to evaluate the impact of comorbidities on patient survival; and in so doing develop a prognostic taxonomy based on comorbid conditions	**Development:** Developed in the USA to better understand health condition distributions amongst the population.	**Development:** Developed for diabetes research	**Development:** Developed to address the medical burden of chronic illness within a group of geriatric outpatients	**Development:** Commonly used in research, particularly with self-reported conditions
Outcome: Predictor of survival	**Outcome:** Predicts morbidity burden and healthcare use	**Outcome:** Predicts scores of health outcomes	**Outcome:** Burden of comorbidity	**Outcome:** Number of diseases Used to predict health outcomes (e.g. mortality and quality of life)
Limitations: Number of conditions	**Limitations:** Orientated to measure the			**Limitations:** No evidence of severity

included in the system	need for resources			
Evidence of severity: Yes; weighted index takes in consideration the number of comorbid diseases and severity	**Evidence of severity:** Yes: minor and stable versus major and unstable	**Evidence of severity:** Yes scale of 0-3	**Evidence of severity:** Yes, rates severity according to a scale of 0-4	**Evidence of severity:** None

1.3.1 Systematic review studies on comorbidity/multimorbidity measures

A recent critical appraisal examines four comorbidity measures, including the CIRS, the Kaplan Feinstein Index and the Charlson Index. In their report, they review the content validity, face validity, reliability, feasibility and generalizability of the indices. According to their findings they found the Cumulative Illness Score (CIRS) to be the most superior, whilst the CIRS has been used mainly in psychiatry and geriatric research. A summary of the results is shown below.

Table 1-3. Results from a critical review on comorbidity indices

(Adapted from Hall, 2006)

Index	**Content validity**	**Face validity**	**Reliability**	**Feasibility**	**Generalizability**
CIRS	+++	++++	+++	++++	++++
Kaplan Feinstein	++	+++	++	++	++
Charlson Index	++++	++	++++	+++	+

Notes ++++, excellent; +++ good; ++ fair, + excellent

They concluded that one of the features to consider when deciding which type of index to choose is type and completeness of information you are dealing with. All of the indices shown in table 1.3 assume a complete medical record, for example.

According to a systematic review by Huntley and colleagues on the measures of multimorbidity and their use in the primary care and community setting, the validity of the measure depends on the context in which it is used. The systematic review included 194 articles, describing 17 measures. Studies that provided data about associations between measures of multimorbidity with: patient sociodemographic characteristics, such as age, sex, and social deprivation; worse health outcomes; and process measures, such as utilization of health care, were included. Quantitative studies were chosen if they were conducted within a predominately adult population. Furthermore, individuals needed to be identified from a generalist primary care sample or a population sample. Studies suggest that the ACG shows validity in relation to patient or health service cost and that the CIRS is superior at measuring quality of life, although the Charlson is most widely used to measure quality of life (even though not a quality of life measure). Furthermore, the Disease count is described as the most common approach and is almost as effective at predicting mortality and health care utilization as more sophisticated methods which depend on complex scoring [50]. One might expect methods, such as the Charlson index or the CIRS, to be more effective as they weight diseases. However, some studies have concluded that the count method, which weight diseases equally, is just as effective whilst remaining simpler and less costly to use. A further systematic review, by Groot and colleagues, assessed the validity and reliability of the measures (in view of their use in prognostic studies and randomised control trials) and found that the Charlson index, CIRS and Kaplan are valid reliable methods to be used in clinical research. In summary, although most methods are reliable for clinical and population-based research, the validity of their use depends on the research questions and context [50].

1.3.1.1 Cut off points for counts of multimorbidity

The most commonly used cut off for simple count prevalence studies is ‘more than two chronic conditions’, however ‘more than three chronic conditions’ is also often used. A recent systematic review, however, examined the differences between using ≥2 chronic conditions as a cut-off point and ≥3 chronic conditions. Examining prevalence estimates and correlates from 52 studies, statistical models were applied to compare both cut-offs. Overall there was a ‘tight

relationship' between the prevalence of at least two or more and at least three or more chronic conditions, shown as a positive correlation between plot estimates (data was taken from 31 studies). This suggests that both are comparable and estimates can even be predicted from one and another. However, they do produce different prevalence estimates, despite being comparable. The study also considered other factors deemed important in prevalence studies. Asides from the cut off, the authors concluded that the number of chronic conditions, mean age, and the number of age groups are of common importance [51].

This section highlights some important points relating to choice and cut offs for studies on multimorbidity. One major consideration when choosing an appropriate method is the source of data, as well as its completeness. In my studies, I will be examining data from population health surveys, which have a set list of six conditions based on self-report. The main indices considered here, however, rely upon complete information being taken from medical records. Furthermore, the conditions listed in the population surveys do not have 'severity' as a factor in their measure. Therefore measures that consider severity in their scoring/weighting system cannot be optimally used. The Disease count is commonly used, simple, not costly, and is effective in predicting health outcomes. Considering all these points, the 'Disease count' this will be the most appropriate method to be used in my studies. Furthermore, in order to be consistent in methods, the cut-off for multimorbidity will be determined as two or more chronic conditions. Another important consideration is the age distribution of the sample, as well as the limitations posed with only six conditions included in the count.

1.3.1.2 Accuracy of self-reported data

The accuracy of self-reported data has been studied previously, with varying results. In one study comparing medical data and interview data, their agreements were variable, and depended on the type of data examined. Clinical and pharmaceutical information such as, for example, presence of diabetes or history of hysterectomy, led to considerable variability between sources [52]. Another study comparing self-report and medical data found 'substantial and moderate agreement' between them, although the strength of agreement varied by conditions [53]. This was also the case for a study examining exposure information. They found a limited number of medically-related exposures were accurately recalled, such as hospitalisation and hormonal exposures; whereas other exposures were 'not as good', such as history of chronic

illness [54]. In light of these findings, it is expected that self-reported could lead to inaccuracies, although the degree of such inaccuracies will vary between measures.

So far in this chapter, I have described the definitions and distinctions made for 'comorbidity', including a close consideration into what processes and features define the relationships between co-occurring conditions, as well as clusters. The study of comorbidity has led to the development of several indices, which vary in their use, depending upon the research questions and context of application. The simple disease count has been chosen as the most appropriate approach for this thesis, whilst the definition of two or more chronic conditions will be upheld as the definition of multimorbidity –consistent with previous discourse and popular choice.

In the next sections, I will discuss some global phenomena, such as the health transition, and place multimorbidity within this context. I will highlight the main evidence that supports the theory of health transition; as well as the contribution of social and economic development on health. This relationship between social and economic development and health will be later examined in the studies on multimorbidity. Overall, the discussion points in this chapter illuminate the importance of multimorbidity as a subject of study, and therefore provide grounds for this research.

1.4 The Health Transition and Social Economic Determinants of Health

Multimorbidity prevalence is increasing globally - a trend linked to a rise in ageing populations, as well as a shift away from communicable towards non-communicable disease burden [55]. The recent Global Burden of Disease Study (GBDS) provides evidence to support theories on a global health transition. The GBDS amassed evidence on the worlds' health from 291 diseases and injuries, as well as 1950 further specific sequelae. Regarded as "ambitious", the study has produced some 650 million results, comparing the historical to the present, spanning over two decades of work. The GBDS revealed key points about the state of the world's health: firstly, there is a 'demographic transformation' occurring worldwide; and that, with the notable exception of Sub Saharan Africa, there is a huge change in both fertility and mortality (both have decreased). Secondly, there is a progressive transformation in the burden of disease stemming from non-communicable diseases rather than communicable diseases and neonatal causes. Thirdly, there is a shift from premature death towards chronic disability, especially in number of middle and upper income countries; and this increase in the Disability Adjusted Life Years (DALYs) is attributed to diseases in which large-scale prevention is not yet widely effective. Fourthly, there is a huge transformation in the key risk factors, shifting away from being poverty

related towards lifestyle related factors. The final point revealed in the GBDS was that the changes in the health worldwide are not correspondingly shown in Sub-Saharan Africa; although child mortality, HIV related death, and maternal mortality have decreased, 65-70% of the disease burden can still be attributed to these aforementioned areas.

The shift from communicable to non-communicable disease has been long studied and is referred to as the health transition. It was formerly known as the 'western model' of epidemiological transition. Whilst there are differing viewpoints, the debate on the health transition considers socio-economic development to be its primary determinant [3].

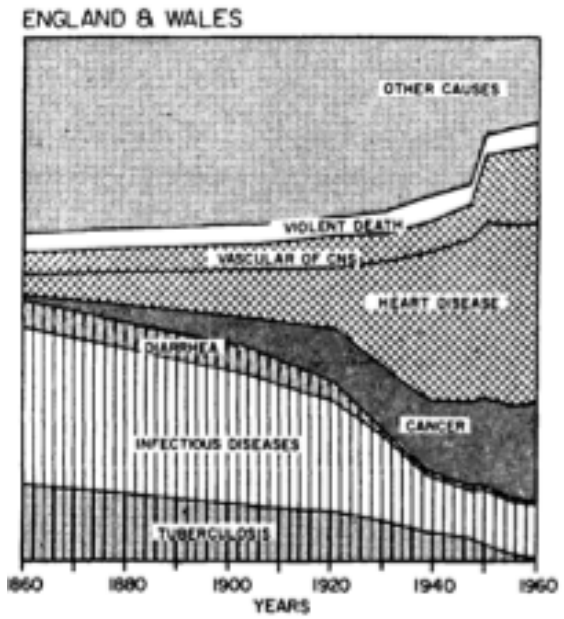


Figure 1-5 The epidemiological transition over the century (1860 – 1960) in England and Wales

[3] From the period of 1860 – 1960, infectious disease prevalence has decreased and non-communicable diseases, such as heart disease and cancer, have increased

1.4.1 The Social and Economic Determinants of Health: Evidence from the 19th centuries onwards

McKeown's approach to population health considers the absolute levels of health over time, using fundamental measurements of registered fertility and mortality. He concluded that the major influence on reduced mortality, occurring between 1700-1850, was from the advances in agriculture resulting in increased food supplies. In the period following, the 19th century and

onwards, contributions of improved food supplies to reduced mortality were further supported by an increase in the standard of living, better hygiene, and the specific interventions and therapeutic measures (the latter of which were introduced progressively through the 20th century). McKeown's approach, which has come to be known as McKeown's theory, largely delineates mortality reduction patterns over the last centuries through the relevant changes in social and economic conditions; which are necessary (or pre-requisite) for improved nutritional status.

In a paper on the *Reasons for the Decline of Mortality in England and Wales during the Nineteenth Century,* the modern rise of population observed in the 19th century was due, in part, to the reduced mortality rates of infectious diseases [56]. Based on recorded rates of tuberculosis, typhus, enteric, simple continued fever, scarlet fever, cholera, dysentery, diarrhoea and smallpox, he concluded that the determinants of reduced mortality were due to the:

i) Rise in standard of living, resulting in an improved diet; this was evidenced by the reductions in predominately TB and to a lesser extent in typhus
ii) Hygiene and sanitation changes, which were brought about by groups of sanitary reformers and influenced the decline of typhus-typhoid and cholera groups
iii) Change in the relationship between host and infective organism, which was a dominant influence in the decline of scarlet fever, and had a small contribution to that of tuberculosis, typhus and cholera

In a further paper on *The Modern Rise of the Population In Europe*, McKeown noted that the rise of population was largely attributed to the reduction of mortality arising from infectious disease [57]. Almost two-thirds of the reduced mortality recorded in the first half of the 20th century was due to the decline of deaths from infectious disease. When attributing causation to this decline, he further disregarded specific medical measures on the basis that only after 1935 specific medical measures were introduced - a long time after the decline was noted. With minimal evidence to support the influence of genetics, he concludes that the only possibility is through the improved environment. Overall these observations provide evidence to support Omran's later theory of a health transition during the twentieth century.

Despite these advancements in knowledge, further developments within the previous decades do not support McKeown's theory. Firstly, critics of McKeown claim that the empirical evidence given by McKeown is largely flawed; death records were erroneous. Such empirical errors may have exaggerated the reduction in TB mortality, for instance [58]. Secondly, McKeown's central claim that the major influence of population growth as the reduction of

mortality, rather than increased fertility, has since been disproved. Thirdly, evidence from the previous decades since McKeown's observations have shown the integral role of treatment in reducing overall mortality; this is particularly true for cardiovascular mortality in the late twentieth century. Information on the uptake and effectiveness of cardiological treatment and risk factor trends across England and Wales (between 1981 and 2000) was extracted in a recent study by Capewell and colleagues. Data source, including censuses, surveys, published trials and metal-analyses were incorporated for men and women aged between 25 and 84. Results showed a combined effect of modern cardiological treatments (the largest contribution was from secondary prevention e.g. aspirin, ACE inhibitors) and reduction in major risk factors (particularly smoking) on the reduction of cardiovascular mortality. The contribution was, respectively, 50% and 40%.

There is, however, a large amount of evidence to support the broader notion that social conditions contribute towards the health of the population. Across the previous two centuries, it was largely the rise in the standard of living and subsequent availability of food that resulted in the improved survival and reduced exposure to infectious diseases: airborne diseases such as TB, waterborne diseases; and foodborne diseases. Although some critics claim that McKeown's omission to credit the role of human agency is unfounded, many support the view that economic and social conditions play a major part in the health outcomes of the preceding centuries.

The recent Whitehall study, set up in 1967, followed a cohort of civil servants in office-based employment in and around London over 25 years. The striking results highlight health inequity: a 'twofold difference' in coronary heart disease mortality rates between those in the highest positions in the occupational hierarchy and those in the lowest over this period, independent of known risk factors [59]. *(A further discussion about 'Social and economic inequalities in the UK can be found as Appendix B)*. This evidence is indicative of a social gradient, and further supports the central argument in McKeown's theory: that a distinct relationship exists between social factors and health outcomes at the population level, within countries.

The Preston Curve points to between country differences in health equity. First described by Samuel Preston in 1975, the Preston curve further highlights the relationship between economics and health outcomes at the macro-level, displaying the logarithmic relationship between the Gross Domestic Product (GDP) of a country and the expected life expectancy at birth. The curved relationship shows that as living standards rise and countries get richer and richer, the relationship between economic growth and life expectancy weakens, and improvements cease to be related to living standards[60].

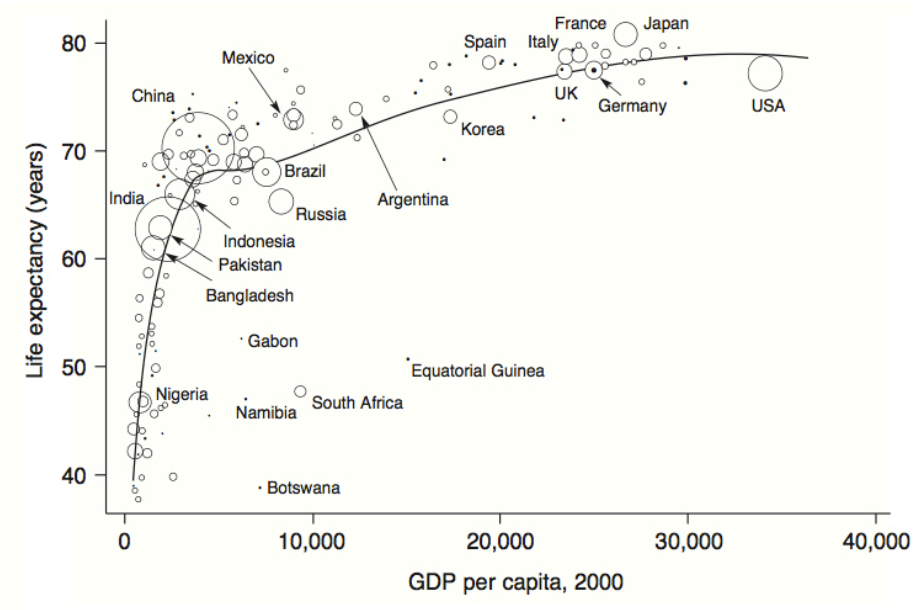


Figure 1-6. Millennium Preston Curve

Source: Deaton [61]

1.4.2 Socioeconomic status as a fundamental cause of health

According to Phelan and Link, a fundamental social cause of 'health inequalities' has four features:

1) It is not limited to a few disease outcomes but influences multiple health outcomes
2) It affects disease outcomes through multiple risk factors
3) It involves access to resources that once disease occurs can minimize risk or consequence of disease (treatment); or involves access to resources that can minimize risk of disease occurrence (prevention)
4) The association between a fundamental cause and health is reproduced over time. This is based on the observation that previous mechanisms, such as poor sanitation, that linked SES and mortality associations, over time, were replaced by mechanisms which were previously absent or weak, such as smoking or diet.

It is in line with these four features that Phelan and Link came to describe socioeconomic status (SES) as a fundamental cause of health inequalities, within and between populations [62]. With regards to the first and second feature, there is a large body of evidence to suggest that SES is associated with risk and protective factors, such as sedentary life styles smoking and a low fat diet, which in turn result in a number of concordant conditions (such as the cardio-metabolic

cluster). Such lifestyle factors have been commonly linked to socioeconomic status (SES). In high income countries (HICs), for example, there is an inverse relationship between socioeconomic status (SES) and unhealthy behaviours (risk factors) such as physical inactivity, tobacco use and poor nutrition [63, 64]. Likewise, in terms of satisfying the third feature, evidence on the SES – mortality association suggests that the association was stronger for preventable causes of death. These included diseases such as lung cancer an ischaemic heart disease [65]. The fourth feature follows the observation that despite intervening mechanisms, such as improvements to sanitation and hygiene, the association between SES and mortality has persisted.

The study of SES, as a fundamental cause of health, is of significance in its relation to health equity. The term 'equity', in the context of health, refers to the unfair health differences between groups (defined socially or geographically, for example); as well as the difference in their access to resources against the need required to maintain or improve health. By measuring SES, and its association with a health outcome - say mortality, we can confer something about the level health equity for that particular group under study. A significant association between SES and mortality or other health outcome suggests that there could be health inequities within the group under study [66, 67].

Evidence of health inequities is needed to inform policy and improve health systems and services. By addressing the relationship between SES and multimorbidity will therefore be useful in understanding questions about health equity amongst individuals with multimorbidity. In my aims I therefore plan to examine the associations between SES and multimorbidity both within countries and between countries.

Chapter 2: The patterns and prevalence of multimorbidity in LMICs: a literature review.

This chapter has two objectives. First, the aim is to examine the literature on prevalence of MM in LMICs and; by its social determinants. It is not a formal systematic review but to ensure academic rigour, the literature search will be undertaken in a systematic way, and the quality of evidence will be analysed. This way the benefits of a systematic review are upheld. Second, I compare and contrast (where possible) the patterns and prevalence of multimorbidity across countries.

2.1 Methods/ Eligibility Criteria

The main focus of the literature research was to gather the literature examining the associations of multimorbidity with social, economic and demographic factors: namely age, sex, socioeconomic status and urban living; in LMICs.

Inclusion criteria

Peer reviewed article publications (not grey literature or just abstracts) were therefore included in the literature search. Articles were included that examined evidence from different data sources, such as routine health records and population based surveys. Since the research aims to understand the prevalence patterns of multimorbidity in LMICs, the literature research was limited to peer-reviewed publications in LMICs, as per the World Bank definitions, 2016 [68]. Included in the search were studies that examined the prevalence of multimorbidity; as well as the prevalence of multimorbidity in association with age, sex, urban living, and socioeconomic status. These may have included studies that examined multimorbidity in the general population (e.g. household survey) or within a clinical setting (e.g. medical records). Studies that examined prevalence patterns across all ages were also included. Research publications were examined from 2003 to August 2016. Prior to 2003 there was also a paucity of research publications on multimorbidity. This time period was selected to capture recent evidence.

Table 2-1. Exclusion Criteria for Literature review on patterns and prevalence of multimorbidity

The following exclusion criteria were chosen. Publications that:

Published before January 1st 2003
Definition of multimorbidity was not consistent with 'two or more chronic conditions' and/or definition was omitted from article (if a systematic review, then definition should be present in all articles included)
were not peer reviewed research articles e.g. letters, editorials, conference proceedings
examined the impact of multimorbidity rather than its associations (or risk factors)
examined definition, terms, and measures of multimorbidity
focused on a specific group of diseases or a single disease as the index disease(s) (e.g. neurological, CVD, epilepsy)
were specific to a sub-group population e.g. particular ethnicities, marginalized populations
did not report either odds ratios or p-values for risk factors, associations

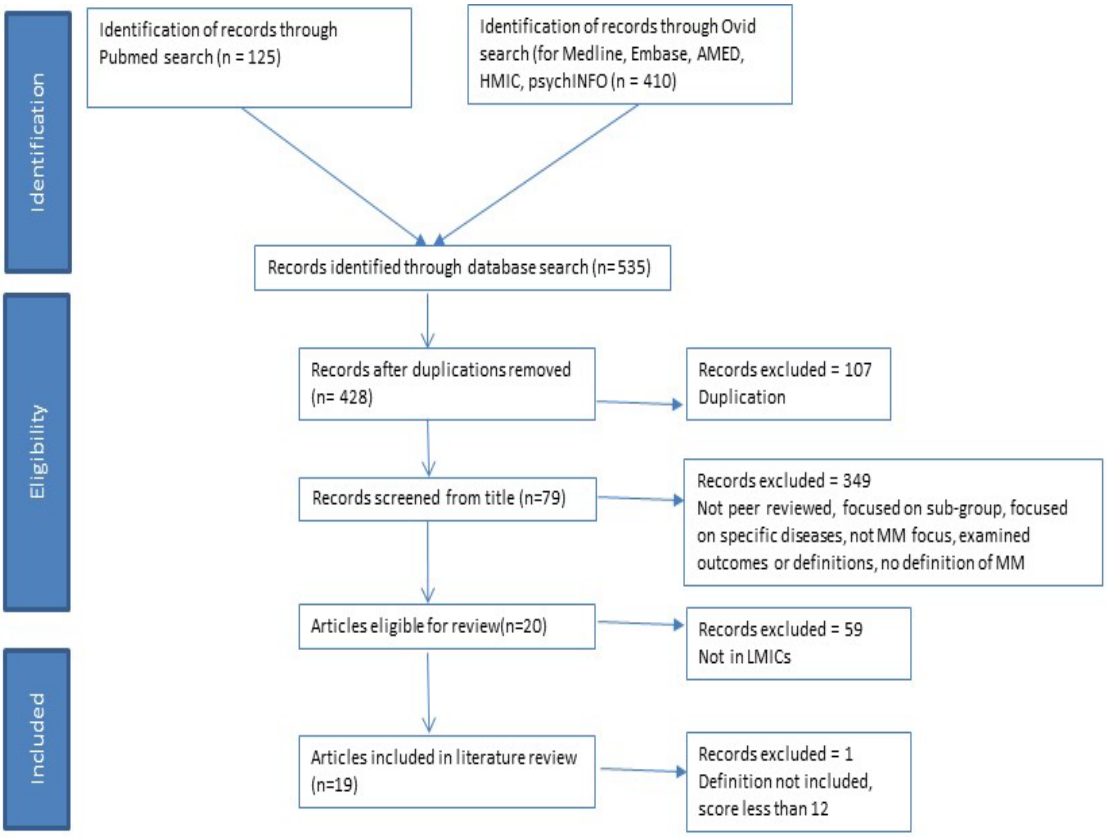
2.1.1 Quality of Evidence

The research strategy is included as Appendix C. The quality of the studies was assessed using the standard 'strengthening the reporting of observational studies in epidemiology' (STROBE) checklist. A quality scoring system has been used previously to evaluate observational studies in multimorbidity [69]. The scoring system is based on the STROBE checklist. There are 22 items (or criteria) on the STROBE checklist; each is given one point if addressed. To retain the article in the review, the articles had to have a quality score of 12 out of 22.

2.2 Results

The results produced approximately 535 publications. First duplications were removed, which resulted in 428 articles. The article titles were then screened for relevance using the exclusion criteria, whilst checking for further duplications. A further 349 articles were excluded. In total records 20 articles were eligible for review. After conducting the STROBE quality assessment, one further article was excluded. Finally, 19 articles were included in the review. The quality scores for each article are summarised as Appendix D.

Figure 2-1 Flow diagram of Methods



Most of the studies were cross-sectional studies, sampling from either the population or from primary care practice. Of the 19 studies, 16 studies were population-based surveys based on self-reporting methods for chronic disease ascertainment, and 3 studies drew their study sample from the primary care population. All the articles examined multimorbidity cross-sectionally; one study, however, although a longitudinal study, examined multimorbidity at three separate time points. The range of conditions included in these studies, and in the multimorbidity count, ranged from 8 chronic conditions to 40 conditions. All of the research articles used the simple count method to determine multimorbidity i.e. two or more chronic conditions from their list.

Table 2-2: Characteristics of studies examining prevalence and risk factors of multimorbidity in LMICs

(Next page)

Author, year of publication	**Source; Year; Study type**	**Country; Income classification; Sample size; Age;**	**Number of diseases included**	**Prevalence, % Crude not standardised**	**Risk factors, Univariate associations (Unadjusted unless stated otherwise)**					**Time trend**
					Age	*Sex*	*Socioeconomic status (SES)*	*Education*	*Urban living*	
Jovic, 2016	Population; 2013; Cross- sectional;	Serbia; Upper MIC; 13,103; ≥ 20;	16	26.9	Positive	Female	N/A	N/A	N/A	None
Ahmadi, 2016	Population; 2004-2008; Cross-sectional;	Golestan, Iran; Upper MIC; 50,045; 40-75;	8	19.4	Positive	Female	Low SES *Adjusted for key variables, including age and sex	No education *Adjusted for key variables, including age and sex	N/A	None
Nunes, 2016	Population; 2012; Cross-sectional;	Pelotas, Brazil; Upper MIC; 2927; ≥ 20;	11	29.1	Positive	Female	Low SES	Low schooling	N/A	None
Wang, 2016 (NE China)	Population; 2012; Cross-sectional;	Jilin Province, China; Upper MIC; 21435; 18-79;	18	24.7	Positive *Adjusted for key variables, including sex	Female *Adjusted for key variables, including age	Low income *Adjusted for key variables, including age and sex	N/A	Rural (slight) *Adjusted for key variables, including age and sex	None
Wang, 2015	Population 2010- 2011 Cross- sectional;	Shandong, China; Upper MIC; 1480;	16	90	Positive	Female	N/A	N/A	N/A	None

Author, year of publication	**Source; Year; Study type**	**Country; Income classification; Sample size; Age;**	**Number of diseases included**	**Prevalence, % Crude not standardised**	**Risk factors, Univariate associations (Unadjusted unless stated otherwise)**					**Time trend**
					Age	*Sex*	*Socioeconomic status (SES)*	*Education*	*Urban living*	
		≥ 60;								
Hussain, 2015	Population; 2007-2008; Cross-sectional	Indonesia; Lower MIC 9438; ≥ 40;	14	35.7	Positive	Female *Age-adjusted	High income *Age-adjusted	N/A	Urban *Age-adjusted	N/A
Mafuya, 2013	Population; 2008; Cross-sectional	South Africa; Upper MIC 3840; ≥ 50;	8	22.5	Positive	Female *Adjusted for key variables, including age	High income *Adjusted for key variables, including age and sex	No schooling *Adjusted for key variables, including age and sex	Urban	N/A
Joshi et al, 2015	Primary care; 2013; Cross-sectional	Bhopal, India; Lower MIC; 785; ≥ 18;	18	23	N/A	N/A	N/A	N/A	N/A	N/A
Ha et al, 2015	Population; 2010; Cross-sectional	South Vietnam; Lower MIC; 2400; ≥ 60;	6 broad groups of conditions	40	Positive	Females *Adjusted for key variables, including age and sex	Being illiterate *Adjusted for key variables, including age and sex	N/A	Rural *Adjusted for key variables, including age and sex	N/A

Author, year of publication	**Source; Year; Study type**	**Country; Income classification; Sample size; Age;**	**Number of diseases included**	**Prevalence, % Crude not standardised**	**Risk factors, Univariate associations (Unadjusted unless stated otherwise)**					**Time trend**
					Age	*Sex*	*Socioeconomic status (SES)*	*Education*	*Urban living*	
Hien et al, 2014	Population; 2006; Cross-sectional	Bobo- Dionalasso, Burkina Faso; LIC; 389; ≥ 60;	15	65	Positive	Not sig *Adjusted for age, sex, literacy and marital status.	N/A	N/A	N/A	N/A
Fu et al, 2014	Population; 2000-2010; Longitudinal	Taiwan; Upper MICs; 1 million; All ages;	15	(2000) (2005) 16.8 (2010)	Positive	Female	Highest relative increase in MM for middle-income group	N/A	N/A	Increase
Wang et al, 2014	Population; 2011; Cross-sectional	South China; Upper MICs; 162464; All ages;	40	11.1	Positive	Female *Adjusted for age, sex and other covariates	N/A	Low education *Adjusted for age, sex and other covariates	N/A	N/A
Nimako et al., 2013	Primary care, urban; 2012; Cross-sectional	Accra, Ghana; 1527; Lower MICs; ≥ 18;	13	38.8	Positive *Adjusted for sex, family history, marital status, education, type of	Female *Adjusted for age, family history, marital status, education, type of occupation and ethnicity	N/A	Low education	N/A	N/A

Author, year of publication	**Source; Year; Study type**	**Country; Income classification; Sample size; Age;**	**Number of diseases included**	**Prevalence, % Crude not standardised**	**Risk factors, Univariate associations (Unadjusted unless stated otherwise)**					**Time trend**
					Age	*Sex*	*Socioeconomic status (SES)*	*Education*	*Urban living*	
					occupation and ethnicity					
Alaba et al. 2013	Population; 2008; Cross-sectional	South Africa; Upper MICs; 11638; ≥ 15;	7	4	Positive *Adjusted for sex and other co-variates	Female *Adjusted for age and other co-variates	Higher SES *Adjusted for age, sex and other co-variates	Primary education *Adjusted for age, sex and other co-variates	Urban *Adjusted for age, sex and other co-variates	N/A
Jerliu et al. 2013	Population; 2011; Cross-sectional	Kosovo; Lower MICs; 1890; ≥ 65;	7 + an open ended category	45	Positive	Female *Age-adjusted	Self-perceived poverty *Age-adjusted	No education *Age-adjusted	No relationship	N/A
Khanam et al. 2011	Population, rural; 2003; Cross-sectional	Matlab, Bangladesh; Lower MICs; 625; ≥ 60;	9	53.8	Positive *Adjusted for gender, literacy, asset quintiles and marital status	Female *Adjusted for age, literacy, asset quintiles and marital status	Non-poorest *Adjusted for age, gender, literacy and marital status	N/A	N/A	N/A

Author, year of publication	**Source; Year; Study type**	**Country; Income classification; Sample size; Age;**	**Number of diseases included**	**Prevalence, % Crude not standardised**	**Risk factors, Univariate associations (Unadjusted unless stated otherwise)**					**Time trend**
					Age	*Sex*	*Socioeconomic status (SES)*	*Education*	*Urban living*	
Garin et al. 2015	Population; (Range: 2007-2012) Cross-sectional	COURAGE and SAGE countries; MICs/ HICs; 41909 (total); ≥ 50;	12	Range (45.1 – 71.9)	Positive (except South Africa) *Adjusted for other covariates including sex	Female (except Finland, Poland and Spain) *Adjusted for other covariates including age	N/A	Lower education (except China, Ghana, Mexico) *Adjusted for other covariates including age and sex	Urban in China and South Africa only *Adjusted for other covariates including age and sex	N/A
Banjare et al. 2014	Population, rural; 2011-2012; Cross-sectional	Odisha, India; Lower MICs; 310; ≥ 60;	21	57	Positive *Adjusted for other covariates including sex	None	State of economic independence *Adjusted for other covariates including age	N/A	N/A	N/A
Ataguba et al. 2013;	Population; 2005,06,07,08 Cross-sectional	South Africa; Upper MICs; 25293- 29311 households; All ages;	9	Prevalence not reported	N/A	N/A	Poor *Adjusted for age and sex	N/A	N/A	N/A

Chapter 2

Notes: N/A – area not addressed in articl

2.2.1 Summary of Findings

Across the 19 studies included in the literature review analysis, 6 studies drew nationally representative samples of their population. The age of the sampled population varied between studies; for example, 3 studies sampled all ages, and 6 studies sampled those aged above 60 years. The prevalence of multimorbidity ranged from 4% in one study in South Africa, to 65% in a study undertaken in Burkino-Faso. One study in Taiwan examined the change in multimorbidity over time, amongst a population of 1 million. The prevalence of multimorbidity within their sampled population increased from 8.8%, in the year 2000, to 16.8%, in the year 2010 [70]. The study found the highest increase in multimorbidity amongst younger people, aged 18 years and below. Between the year 2000 and 2010 there was a relative increase of 220.0%. One study estimated an age and sex adjusted prevalence of multimorbidity, at 35.7% [71] . These age-adjusted results suggest that, whilst age is a major contributive factor in driving multimorbidity prevalence in all the studies, there are other factors contributing towards an increased prevalence in multimorbidity.

2.2.1.1 The Association between Age and Multimorbidity

Overall, there was a direct relationship between multimorbidity prevalence and age in all studies. For those that sampled older populations, the prevalence was consistently higher than those who sampled younger populations (whilst taking into account the number of conditions included in the count). One study in Serbia, sampled the adult population of aged 20 and above, and estimated the multimorbidity prevalence for 16 chronic conditions [72]. The prevalence was estimated at 26.9%. In contrast, one study in Shanding, China, sampled the adult population of aged 60 and above, and estimated the multimorbidity prevalence for 16 chronic conditions at 90% [73]. Despite this there was increasing evidence to suggest that multimorbidity is not just limited to the elderly. In one study, of those with multimorbidity in Taiwan, they found the highest relative increase in multimorbidity amongst the younger population over time. In their discussion they attribute this relative increase to both the increased likelihood of developing a chronic condition, and duration of disease, as people live longer. This is consistent with other studies in HICs.

In a further study by Shafer et al., they found the prevalence of multimorbidity to be dependent upon the clusters of conditions considered [74]. They noted, for instance, that the anxiety depression somatoform and pain morbidities were more equally distributed across the ages, compared to the cardiovascular and metabolic clusters [74]. In another study conducted in two regions in Spain, they found an increase of the cardiometabolic cluster with age. However, in the same study, there was a decline in the 'mechanical cluster' for women of increasing ages. The mechanical cluster included diseases related to the structure of the body, as well as nervous system. These include osteoporosis, anxiety and neuroses, cervical pain and thyroid disease[75].

2.2.1.2 Gender and Multimorbidity

The relationship between gender and age is commonly observed globally, with women tending to live longer than their male counterparts. The majority of studies here however reported a positive association between the female sex and multimorbidity, even when adjusting for age. The sole exception was one study, in Bangladesh, which found there to be no relationship between gender and multimorbidity [76]. This is consistent with other studies in HICs. Several studies in HICs, examining the clustering of diseases, have shed some light on the fundamental differences in disease progression, for women and men. One study by Abad-Diez and colleagues noted that the mechanical cluster of disease (mentioned above) was higher in females than males [75]. Moreover, the cardiometabolic cluster (including the diseases of cardiac arrhythmia, hypertension and diabetes) were higher in males than in females. Furthermore the study by Prados-Torres et al. suggested that the evolution of the cardiometabolic cluster occurs differently for males and females [77].

These results suggest that there are fundamental differences between females and males, both in terms of the type of disease they are commonly affected by, as well as its evolution over the life course. In terms of understanding the association between gender and multimorbidity these results suggest that, although there is an expectant higher association of multimorbidity for females, the differences are dependent upon the type of conditions included in the multimorbidity count as well as the ages considered.

2.2.1.3 The association between social, and economic factors; and multimorbidity

The studies examined the social and economic associations using different variables, such as wealth/ poverty and education, to measure SES. Firstly it is important to note the range of approaches used to measure SES. In the study in Iran, for example, SES was estimated by using a 2-step cluster analysis of family asset, ethnicity, sex, employment status, age at starting first job, size, status of house, age, and the status of house [78]. In contrast, one study in Indonesia used per capita expenditure as a measure of living standards. Monthly household expenditure for consumption was used and transformed into a continuous variable representing socioeconomic status [71]. One study in India examined the association of multimorbidity with 'state of economic dependence,' which related to how much the individual is dependent on others for income [76]. Interestingly one study, in Kosovo, examined 'self-perceived poverty' in relation to multimorbidity. The study participants were asked whether they felt poor or not which, due to its subjectivity, may have also captured state of well-being and quality of life, in addition to economic wealth. Most studies examined the association of multimorbidity with socioeconomic status, producing some interesting results.

In most studies there was a direct positive association between multimorbidity and SES. I have summarised here the results of those that used objective measures of SES, including the use of assets, household expenditure, and income etc. In a study conducted in Bangladesh, amongst people aged 60 and over, the wealthiest quintile was associated with multimorbidity [79]. Similarly, a study in South Africa found household income to be strongly positively associated with multimorbidity. [80]. There were some notable patterns. In studies conducted in upper MICs, notably Brazil, China and Iran, multimorbidity was associated with low SES [73, 78, 81]. In contrast, for studies conducted in lower MICS, notably Bangladesh and Indonesia, multimorbidity was associated with high SES [71, 79]. There were two exceptions to this patterning. In one study in South Africa, an upper MIC, income was positively associated with multimorbidity [82]. In a study in Taiwan, also an upper MIC, multimorbidity prevalence was highest for the high income group. However in the same study, the highest relative increase in multimorbidity, over the 10 year period, was in the middle-income group [70].

The findings of an inverse association of multimorbidity by income is consistent with findings in HICs. In a study by Barnett et al, for example the onset of multimorbidity (defined as 2 or more chronic conditions) occurred 10—15 years earlier for people living in the most deprived areas compared to those living in the most affluent areas in Scotland [83]. These findings

suggest that there may be a transition of social patterning in multimorbidity, which occurs as a country develops their national income.

Several studies also found an association of education with multimorbidity. Interestingly, across all studies, multimorbidity was associated with no education, or low education even with adjusted for other covariates such as age and sex [78, 82, 84-89]

2.2.1.4 Association of Urban living with Multimorbidity

Several studies reported the association of multimorbidity with urban living. All studies measured urban living on a dichotomous scale of 'urban' or 'rural.' Multimorbidity was significantly associated with urban living in three studies [71, 82, 85]. In the multi-country study, there were significant associations with multimorbidity in both South Africa and China. [89] In a study in Kosovo the relationship was not significant [88]. Only two studies found rural living to be associated with the presence of multimorbidity even when adjusted for age and sex; one in North East China, and one in South Vietnam[73, 86].

2.3 Discussion

There were several notable findings from this review which have been discussed in more detail here. Firstly, a notable trend is the direct association of multimorbidity with age. Many chronic conditions included in the count of 'multimorbidity' are age related. This known association is related to a number of different interrelated factors: biological, social, and environmental. Over time individuals are increasingly exposed to factors that affect health. This is aligned with the 'life course perspective', as described earlier. Such risk factors might include environmental risks (such as pollution or smoke), for example. With age, the human body is also subjected to increasing levels of wear and tear. Therefore, at increasing levels, the ageing and degeneration processes occurring in the body lead to disease occurrence.

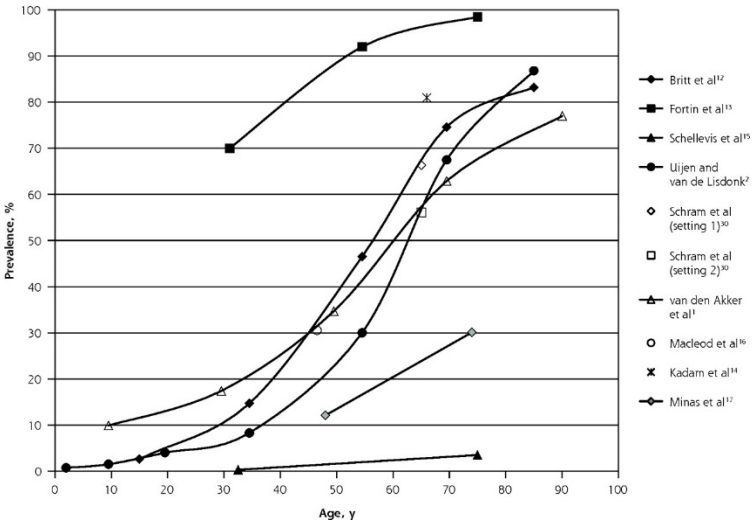


Figure 2-2 Prevalence of multimorbidity reported in primary care settings

Source: Fortin et al. 2012

Age is one of the major risk factors for chronic disease. Therefore you would expect that as a population ages, so too will the prevalence of chronic disease. However the relationship between multimorbidity and age is not linear; it has been shown to follow an s-shaped curve (see figure 2.2). In a systematic study by Fortin et al. results showed that prevalence is approximately 20% approaching 40 years of age and increased dramatically until plateauing at around the age of 70 years old [49].

Secondly, in the interpretation of such findings, it is also important to note a few theoretical considerations. According to notable trends, recent advances in life expectancy have been due to increased survival particularly amongst the older populations. In earlier chapter discussions on McKeown theory, and the GBDS, I described the observed decrease in mortality from the 19th century onwards associated with communicable disease and neonatal causes. Further still, there has been considerable discourse as to whether there has been recent "compression of morbidity" or "expansion of morbidity [90]." Fries postulated that there would be a shortening of the length of morbid life linked to a lower incidence of chronic disease and a higher age of onset of chronic disease. Gruenberg, on the other hand, believed that with a decrease in chronic disease mortality there would be a paralleled increase in disease prevalence; or 'expansion of morbidity.' Manton however understood there to be a 'dynamic equilibrium' – and that there would be neither compression nor expansion – but a dynamic state between the two [91]. Focusing on cardiovascular disease conditions, Crimmins and colleagues examined the US national Health Interview Study for such conditions and found that there was no decline of prevalence over eight years. Overall, there was an increase in the overall survival from 1998 to

2006. Capewell also identified these patterns (as described earlier). The results suggest an "expansion of life with disease and morbidity functioning loss" in recent years, with little evidence to suggest less disease prevalence [92]. The studies conducted by Capewell support the view that case fatality has reduced so people are surviving with conditions. Many attribute increasing prevalence to the use of diagnostics, and therefore increased ascertainment of disease. Diagnostics as well as the International Standardization of Disease Classification (ICD) have contributed towards the confirmation of disease prevalence, its coding and the accuracy in its specification. Alongside diagnostics there is, however, a strong body of evidence to suggest that change in lifestyles and risk factors has been a major contributive factor to the prevalence increase in multimorbidity [93]

Thirdly, there is also strong evidence to suggest a relationship between multimorbidity and gender, SES, education and urban living; even after adjusting for age and other significant co-variates. The relationship between SES and multimorbidity point to a social patterning in MICs that varies by the country's level of economic development. This supports theory of a transition in the social patterning of multimorbidity for middle income countries. One recent study examining the obesity in MIC reports a 'reversal' in the social patterning, with groups of low SES having a higher risk of obesity over two time periods, and groups of high SES having a lower risk of obesity [94]. These findings are consistent with those reported here. Overall, multimorbidity was associated with those of high SES in the lower MICs; and with those of low SES in upper MICs. These findings, however, are limited in their comparability, as several measures of SES were used across the studies. Furthermore, studies showed a significant relationship between education and multimorbidity after controlling for other risk factors, which are consistent with other studies. For example, a recent study by Marmot described a paradox in which education was always protective despite the income effect [67]. There is strong evidence to suggest that urban living is also associated with multimorbidity, although patterns may differ between countries. These findings suggest that urban living may act as a determinant of multimorbidity, particularly in MICs. The urban environment may act as a structural determinant, influencing conditions such as social, economic, demographic and life-style related risk factors.

Finally, comparability of the data reported here is limited due to differences in sampling and analytical methods. In terms of sampling method differences, both the age structure of the sampled population and the source of data differed between studies. Across the studies, there are wide variations in prevalence of multimorbidity reported. A study by Fortin et al demonstrated that there are differences when using two different sources. They compared the

prevalence of multimorbidity in the population (based on self-report) against the prevalence from a population using routine health records. The multimorbidity prevalence within the sampled population was 10.1% in males compared to 51.9% in the practice-based population [8].

2.4 Conclusion

Firstly, the literature suggests that the measured association of multimorbidity and its social, economic and demographic factors varies according to the conditions used in the multimorbidity count. In future studies examining multimorbidity by age, for example, one should consider the ages at which each individual disease commonly occurs within the population. This may include, for instance, chronic diseases that commonly affect the elderly; such as cancers, stroke, and degenerative conditions. In prevalence studies in HICs that look at clusters of diseases - such as the cardiometabolic cluster – there were different trajectories for males and females across the life course. These results suggest that it is worthwhile to examine specific clusters of diseases in order to derive useful interpretations on their associations. Secondly, the variation in methods used, for example in measuring socioeconomic status, have limited the comparability of the results. Therefore, future methods should ensure consistent methods are used to allow comparability across data sets. Thirdly, age and sex were consistently and significantly associated with multimorbidity across most studies, whilst SES and urban living were associated in some, but not all, studies. Therefore, any conceptual frameworks applied in future studies should consider these factors. Finally, there is evidence to suggest that there may be a transition in the social patterning of multimorbidity. However, no studies have examined the distribution of multimorbidity in LMICs and compared it to HICs. In light of this, the first study aims to examine the distribution of multimorbidity (by age) in LMICs and compare this to HICs.

Chapter 3: Multimorbidity and its social and demographic determinants in LMICs: a cross-sectional study of 28 countries using the World Health Surveys.

The first study is a quantitative study examining the prevalence and patterns of multimorbidity in LMICs and HICs, using nationally representative health surveys. In this chapter I will summarise the methods, results as well as discussion of this first study. This study will serve as the basis for the next quantitative chapters. This is the first of three quantitative chapters that examine multimorbidity in LMICs. The aims and study objectives are outlined in more detail below.

3.1 Aim/ Hypothesis

The following study aimed to examine the prevalence of multimorbidity and to compare it between LMICs and HICs, as well as to examine the variations of multimorbidity by age and socioeconomic status. Although there are other known risk factors for multimorbidity, as identified in the literature review, the main focus was to examine intra country differences, and therefore the study samples have only been stratified by age (and not by sex, for example).

Study Objectives:

- To examine the distribution of multimorbidity (by age) in LMICs and compare this to HICs;
- To examine the sociodemographic determinants of multimorbidity, and how this varies by age, in LMICs and HICs;

3.2 Quantitative Methodology

In this quantitative methods section, I have first summarized some methodological considerations, the surveys used for the analysis, as well as some of the statistical methods used for the analysis; including those that improve cross-country comparability. Finally I give a step-wise summary of the methods used for the first study.

Estimating True Prevalence

The literature review in the previous chapter suggests that differences in prevalence estimations are largely due to methodology differences. A recent systematic review by Fortin at al analysed the different methods included in studies of primary care, population or both. Results suggest that there are biases in methods, such as geographic setting, recruitment methods, data collection and operational definitions of multimorbidity (including the number of conditions included in study) [8]. The power of the studies also differ due to sample size. A comparison between primary care and general population showed a wide gap: with 75 years and above estimated with 95% multimorbidity prevalence in primary care, and 59% prevalence in general population. Furthermore self-reports led to prevalence estimates that were lower than GP reports. The authors concluded the following in favour of a more uniform methodology:

1. Random sampling is appropriate; either at national or at a particular geographic location
2. A multisource method e.g. triangulation is preferable to a single source method
3. The systematic use of two operational differences of multimorbidity recommended: a cut off of two or more conditions; and a cut off of three or more conditions to measure multimorbidity

I have tried to demonstrate a methodology in this quantitative chapter (and those going forward) that aligns itself with these three main points; as well as other methodological points highlighted from the previous chapter.

3.2.1 The World Health Surveys

In the next two sections I will summarise the surveys used in this first study. In this first study, The World Health Surveys of 28 countries were used, and then compared to the English

Longitudinal Study of Aging (ELSA). I will therefore describe the sampling methods and measurements of these surveys; as well as the chronic conditions covered.

Table 3-1. Summary of the World Health Surveys

Description	Retrospective (ex post facto), multi-country, cross-sectional survey, commissioned and carried out by the WHO in 70 countries. (implemented between 2002- 2004)
Objective	To strengthen national capacity and to monitor critical health outcomes and health systems. It has been developed to allow cross-country comparison, selecting countries to represent the different regions of the world
Measures	Measures the health of the adult population, as well as the effectiveness of health systems.
Sampling Design	Uses national representative samples, which are probabilistically selected, sampling adult population 18+ The WHS Sample sizes were based on feasibility and survey costs.
Weighting	Sampling weights were generated and adjusted for the population distribution with final post-stratification corrections for non-response
Chronic Diseases covered	Angina, arthritis, asthma, depression, diabetes and schizophrenia (as self-reported conditions)

Details of the sampling methods are shown in Appendix E. More detail on the survey weighting, sampling design and questionnaire are also covered below.

Survey Weights: The World Health Survey (2003)

The World Health Survey (WHS) includes two sets of weights for both the household and the individual. These two sets include *design weights* (i.e. weights that were derived during sampling of the population) and *post-stratification weights* (weights that account for non-response during

the survey period). Overall the survey weights make the data extracted from the survey more representative of the population under study.

Sampling Design

During sampling, the population under study was firstly stratified according to 3-5 factors. These include region, socioeconomic status and the presence of a healthcare facility, for example. Stratification aims to reduce sampling error, and also allows subgroups of interest to be included. Once stratified, clusters were randomly selected into the sampling frame through a multistage clustering process. Weights were applied at each stage of the multistage clustering process to ensure that the probability of selection are proportional to relative sizes. Clusters are usually selected through a hierarchy of large-to-small. For example, the household cluster is derived from a corresponding total single unit (TSU), which has been derived from a secondary sampling unit (SSU). The SSU itself has been derived from the primary sample unit (PSU), which has been selected from the strata. In the WHS, and in many household surveys, the PPS variable used for the PSU is the number of households. The selection of the individual from the household is dependent upon the number of people in the household. Each individual within the household therefore will have equal probability for selection into the survey.

Design weights correspond to the under-sampling or over-sampling, as well as disproportionate stratification during the sampling stages. This is to ensure that each stratum e.g. counties, are proportionate to its representation within the general population. These correspond to the "pweight" shown in the WHS.

Post-Stratification / Non-response Weights

Post-stratification weights were developed following the completion of the survey. The individual level post-stratification weight, shown as the "psweight" in the WHS, accounts for certain demographic characteristics that may have been underrepresented during the survey. Such characteristics included age and sex. The post-stratification weights provided by the WHS are based on the population distribution represented by the UN Statistical Division in the corresponding year, 2003 [95]. *Post stratification weights* therefore 'simultaneously compensates for non-response and non-coverage, adjusting the weighted sampling distribution for certain demographic variables so as to conform to a known population distribution [96].' As

such the “psweight”, when applied, directly standardises the study population to the known population distribution (UN Statistics). Overall, both design weights and post-stratification weights allow us to interpret data, and make conclusions about the population under study. By using the household level weights, we can generalise to characteristics at the household level e.g. poverty rate. By using individual level weights, we can generalise to a population at individual level (e.g. individual health outcomes).

Questionnaire

The questionnaire measured both individual and household data; household data included a household roster, health insurance coverage, health expenditures, and indicators of permanent income or wealth. Individual level data included sociodemographic information, health state descriptions, health state valuation, risk factors, chronic conditions, mortality, health care utilization, health systems responsiveness and social capital. These were all based on self-report methods.

Of the 70 countries, 53 participated in long version questionnaires (includes self-reported health evaluation) whereas 17 countries participated in the short version (mostly OECD countries from Northern Europe).

3.2.2 The English Longitudinal Study of Ageing (ELSA)

Table 3-2. Summary of ELSA

Description	Longitudinal survey, drawn from a representative sample of the English population aged 50 years and over
Objective	To collect multidisciplinary data, relating to health and disability, biological markers of disease, economic circumstance, social participation, networks and well-being
Measures	Measures the health of the adult population, as well as the effectiveness of health systems
Sampling Design	Uses a multistage probability sampling design to sample core adult population 50+

	ELSA has approximately 11,050 respondents, drawn from the wider sampling frame belonging to the Health Survey England. The Health Survey England is conducted annually and collects information concerning the health and health-related behaviour of people living in private households in England [97]. Three years of the Health Survey for England (HSE) were selected as the sampling frame: 1998, 1999 and 2001. Households were then dropped if they were known not to contain individuals above the aged of 50 years old; in total, 11578 households were chosen
Weighting	Sampling weights were generated and adjusted for the population distribution with final post-stratification corrections for non-response
Chronic Diseases covered	Hypertension, angina, a heart attack (including myocardial infarction or coronary thrombosis, congestive heart failure, a heart murmur, an abnormal heart rhythm, diabetes, stroke, chronic lung disease, asthma, arthritis (including osteoarthritis, or rheumatism), osteoporosis, cancer, Parkinson's disease, any emotional, nervous or psychiatric problem, Alzheimer's disease, dementia
Waves	Wave 1 – Wave 6 (present) Wave 1 conducted in 2002- 2003

Sampling Design

The ELSA was drawn from the HSE, which uses a multistage probability sampling design. The sample is drawn in two stages: firstly a random sample of primary sampling units (PSUs) was selected, based on postcode sectors. Then, within each selected PSU, a random sample of postal addresses was drawn. Both stages uses stratified random sampling. The survey sampling and probability weighting follow a complex survey methodology and is similar to the methodology used for the WHS, see Appendix E for more details.

In the first study, I will only be using the Wave 1 (cross-sectional) data; and comparing this against the WHS. Wave 1 has been conducted in the same period as the WHS and therefore is

comparable. The next section considers the subject of comparability in more detail, and discusses the methods that will be used to improve comparability.

3.2.3 Inter-country comparability

Prevalence Measures: Direct Age Standardisation

For both the WHS and the ELSA, country specific post-stratification weights adjust the weighted sampling distribution for certain demographic variables so as to conform to a known population distribution. This ensures that country data is nationally representative.

Population distributions will differ between countries, however. For example, in our first study, our research questions seek to ascertain the global prevalence patterns of multimorbidity, therefore our methodology needs to account for differences arising due to populational differences. This can be achieved by directly standardising prevalence rates to a world average – or world standard population.

1. The standard population used was the WHO's Standard Population[98]. (See Appendix F for more details about the Standard Population)
   Based on the WHO Standard (2000-2025), the following percentages were calculated for the study age groups of interest.

Age groups from study	Age specific contribution to total population/%	Age-specific proportion of study population/%
18-49	50.3	69.70 (50.316/72.191*100)
50-64	13.6	18.89 (13.640/72.191*100)
65+	8.2	11.41

		(8.235/72.191*100)
Total	**72.2**	**100**

2. Then, both the observed count, n_{agecat} and their weighted prevalence were tabulated.
3. Then, the study population $_{agecat}$ was tabulated.
4. From this the age-specific rates could be calculated:

   Age specific rate (multimorbidity prevalence) =

   Observed count, n_{agecat} / study population $_{agecat}$
5. Using the WHO World Standard age-specific proportions (as above), percentages were applied to the total study population, to produce an age-specific population distribution according to the WHO Standard.

6. Using the new standardised study population distribution, the expected number of multimorbidity counts (per age category) were calculated as follows:

   Standardised study population $_{agecat}$ * Age specific (multimorbidity prevalence) = Expected count, n_{agecat}

7. **Overall prevalence (%) was calculated from the total expected count / standardised population *100**

The above method can be applied to all national level data, in order to produce world standardized prevalence estimates. As such, this is a strategy implored to enhance cross country comparability as age confounds the relationship between multimorbidity and the variable under measurement (for example, GDP or SES).

3.2.4 Summary of Methods for First Study

Study samples

Data from the World Health Survey (WHS) and the English Longitudinal Survey of Ageing (ELSA) were used. The World Health Surveys are cross-sectional national studies, which follow a multi-stage clustering design to draw nationally representative samples. The details of the survey procedures are described elsewhere [99]. The WHS is a multi-country survey that can be used to address the research questions described here [100]. From the period of 2001-2004, 71 countries participated in the WHS. Sample sizes varied between countries depending on feasibility and cost. Individual participants aged 18 years or above were randomly selected for interview. All surveys were implemented as face-to-face interviews; except for two countries, which used phone and mail-in interviews.

Of the 71 countries that participated in the WHS, 17 countries were excluded from the analyses, as they did not complete the long version of the questionnaire covering chronic condition status; these were mostly countries from Western Europe. Countries were also excluded if the response rate to the chronic health questions was less than 90% (eleven countries) or if they did not include post-stratification weights (six countries). A total of 28 of the remaining 37 countries were randomly selected to represent all regions of the world. Six countries were selected from Africa; five countries from South East Asia; four from South Asia; eight from Eastern Europe & Central Asia; four from Central & South America; and one from Western Europe. Sampling weights were applied, as well as post-stratification weights to account for non-response.

The ELSA sample contains approximately 11,500 people born before 1st March 1952 from the private household sector in England. The sample was drawn from the Health Survey in England (HSE), which follows a multi-stage clustering design. Details of its development and findings are described elsewhere [101]. The ELSA follows a similar sampling design representative of the general population, and ascertains disease status through doctor-diagnosed, self-reported conditions. The first wave of ELSA, conducted between March 2002 and March 2003, was used to allow temporal comparability of MM prevalence with the WHS. Survey weights have been provided to support cross-sectional analyses.

Measures and variables

Using the WHS, chronic disease morbidity was defined by self-report, based on a set of six doctor diagnosed conditions. The self-reported conditions were assessed based on responses to the question, *"Have you ever been diagnosed with…?"* Multimorbidity is defined as the presence of two or more chronic diseases. A binary variable for multimorbidity was created on the presence of two or more of the six conditions: arthritis, angina or angina pectoris (a heart disease), asthma, depression, schizophrenia or psychosis, and diabetes.

The same chronic conditions from the WHS (n=6) were also included in ELSA. The conditions were included across separate variables, each coding for the presence of vascular morbidities, chronic conditions, and psychiatric conditions. For the variable on vascular morbidities, for example, ELSA respondents were asked: *'has a doctor ever told you that you have (or have had) any of the conditions on this card?'* High blood pressure or hypertension was coded as '1', angina as '2', a heart attack as '3'.

Dummy binary variables for the 'presence of multimorbidity' were then created: one based on the same six conditions from the WHS (n=6) for ELSA; and also one based on a wider set of 15 chronic conditions from ELSA for comparison. Others have considered the number of diagnoses to be the most important factor in estimating prevalence [49]. As such, we were interested to assess the effect of increasing the number of chronic conditions on the estimates of multimorbidity prevalence and could do this with ELSA data. The 15 chronic conditions included high blood pressure, angina, diabetes, stroke, chronic lung disease, asthma, arthritis, osteoporosis, cancer, Parkinson's, Alzheimer's disease, dementia, cataracts, depression and schizophrenia.

The individual level socio-demographic variables of interest were age, sex and highest level of education completed. Two different age groupings were generated: first, three groupings for those 18-49 years, 50-64 years and 65+ years; and then by two groups for those aged 55 years or older and those younger than 55 (18-54 years). The former was done to examine stratum specific differences, and the latter to examine generational differences. To examine generational differences, 55 years was taken as a cut point, representing a mid-way point within the data population. However, it is important to note that the choice to fit age as a categorical term, over a linear term, has some limitations. For example, it ignores whether age (as a nominal variable) has any partial ordering [102]. However, as discussed in the previous chapter 2, the relationship between age and multimorbidity is not linear – it follows an s-shape

curve. In this respect, treating age as a categorical variable allows one to capture more complicated relationships [103].

Level of education was used as a measure of country-level socioeconomic status (SES). *'Highest education level obtained'* was collapsed from seven categories into four: (1) university or any higher education; (2) secondary school; (3) primary school; and, (4) less than primary school (including no formal education). Inter-country differences in SES were examined by using country estimates for GDP per capita. These were obtained from the 2003 United Nations Statistical Division records. Countries were then grouped according to the cut-offs for low- middle- and high-income from the World Bank classification figures in 2003 [104].

Statistical Analysis

Survey estimates were used to calculate prevalence measures and extract nationally representative samples, accounting for non-response. To obtain valid comparisons across the countries, age-standardised multimorbidity prevalence rates were calculated using the direct method with the WHO Standard Population (2000-2025) [98]. For the descriptive analyses, populations were tested for normal distribution using the Shapiro-Wilk normality test. Significance testing for non-normally distributions included the Kruskal Wallis test (for two or more level variables) and the Wilcoxen rank-sum (for fewer than two levels). Individual countries were weighted by the survey size to produce regional estimates for comparisons of MM by age and SES. 'Prevalence ratios' of multimorbidity by education were calculated with the reference category being primary school education completion. Univariable models were fitted to analyse the association of both sex and age with multimorbidity. For the regional multivariable analyses, data were pooled at regional level. To account for the hierarchical nature of the data within regions i.e. at the country level, random effects logistic regression models were fitted (over and above a linear regression model). . Odds ratios (OR) and 95% confidence intervals (CI) are presented, with $p<0.05$ taken as statistically significant, unless stated otherwise. All analyses were done using Stata version 12. Confidence intervals have been calculated based on recommendations for crude and age-specific point estimates [105].

Non-responder Analysis

To assess whether differences between responders and non-responders were due to chance, or whether there was a significant difference, an example analysis was carried out using data from Ghana. This was to ascertain whether any differences between samples exist – as these may be a potential source of bias.

Definitions

- Responders are selected individuals (kish table) for interview – who have completed the majority of questions on self-reported morbidity, so that a **multimorbidity score has been estimated**
- Non-responders are selected individuals (kish table) for interview – who have failed to complete **ALL** questions on morbidity in the health questionnaire section.

In order to ascertain the differences between the groups of responders and non-responders, key demographic information was needed. Assuming that post-stratification adjusts for non-responders according to age, sex, residence and region, I was interested to assess differences for education and marital status.

For non-responders (n=240), the entire rotation (includes all health questions) had not been completed. Therefore, it was necessary to consult previous household data files to identify the respondents' necessary socio-demographic information. This was obtained from the household roster (data file F3) which has specific information about the household, including (i) age (ii) sex (iii) highest level of education achieved and (iv) marital status.

A summary of the records were taken for non-responders (n=240). However, further individuals had to be omitted from the non-responders sample due to the following reasons (i) the individual was less than 18 years old (ii) the household roster did not give information about which individual was selected (through kish table) for individual questioning – therefore I could not ascertain which individual was selected from across the household (iii) key information was omitted, including marital status, education category and age. In total, 173 individuals were sampled for the non-responder analysis.

Data Analysis A summary of the above information was also obtained through STATA for all responders with a multimorbidity score. The total number of responders with a calculated

multimorbidity score was 3885. Based on the final results further analysis could be carried out, including a chi-squared test for nominal variables (education and marital status). The chi-squared tests were carried out using Microsoft Excel.

Calculation of Confidence Intervals

The application of confidence intervals gives additional statistical inference from the prevalence estimates. The 95% confidence intervals infer that if subsequent samples are drawn from the population (using the same sampling methods), the true value will fall between the interval values 95% of the time. This gives us a degree of certainty from our sample estimates – in this case the estimation of multimorbidity prevalence nationally.

To construct a 95% confidence interval for a rate, the following formulae was used:

Upper limit = (1000/n) (d + (1.96 x square root of d))

Lower Limit = (1000/n) (d- (1.96 x square root of d))

Where

d = number of events upon which the rate is based

n = denominator of the rate (area population for crude birth and death rates, live births for infant death rates)

Sample Statistics

To measure the confidence interval of a sample statistic e.g. mean, the following formulae was applied

Confidence interval = sample statistic ± margin of error

3.3 Results

The results are described below

_pattern	_mv	_freq
+++++++	0	3834
.....	7	240
+++++.+	1	13
.++++++	1	13
+.+++++	1	11
+++.+++	1	10
++++.++	1	8
++.++++	1	6
+++++..	2	4
++.+++.	2	4
+++.++.	2	3
+.++++.	2	3
+++....	4	3
.+++++.	2	2
+++..+.	3	2
..++++.	3	2
++.....	5	2
++++.+.	2	1
+.+.++.	3	1
+..+++.	3	1
.++.++.	3	1
+.....	6	1

Figure 3-1. Shows the patterns of missing data across the variables of interest (all six morbidities) for Ghana

Number of non-responders are 240; number of responders are >3834. However, a total of 173 participants were sampled for the non-responders analysis, as discussed above.

Individual morbidity estimates suggest that arthritis is the most common condition across the WHS. The median arthritis prevalence was 11.6%. The median prevalence for depression, angina, asthma, diabetes and schizophrenia, respectively, were 5.7%, 5.6%, 4.3%, 3.4% and 0.7%.

Table 3-3. The crude morbidity prevalence in WHS, by region

		Crude Morbidity Prevalence, %					
		Angina	Arthritis	Asthma	Diabetes	Depression	Schizophrenia
AFRICA	Burkina Faso	11.8	12.7	2.4	0.5	2.6	1.1
	Ghana	4.6	7.0	4.2	0.9	1.5	0.7
	Kenya	2.5	4.1	2.9	1.3	5.5	0.7
	Namibia	7.7	10.1	3.6	2.1	7.7	3.0
	Morocco	5.1	17.2	3.4	3.9	3.0	0.7
	South Africa	4.7	10.0	6.3	8.6	9.0	1.2
CENTRAL & SOUTH AMERICA	Paraguay	5.4	3.8	5.9	4.2	6.7	0.5
	Uruguay	5.7	9.5	8.7	5.1	10.5	0.7
	Dominican Republic	3.8	11.3	9.6	4.0	8.5	0.9
	Brazil	6.2	9.6	12.1	5.5	18.9	1.6
EASTERN EUROPE & CENTRAL ASIA	Kazakhstan	11.8	15.2	1.8	1.9	1.6	0.5
	Bosnia & Herz	8.0	11.9	3.5	4.9	6.4	0.1
	Czech Republic	6.4	19.1	4.7	10.4	5.8	0.5
	Estonia	16.0	21.0	4.7	3.8	8.8	1.4

	Latvia	18.9	13.2	4.2	5.5	5.9	0.7
	Ukraine	18.9	17.1	4.4	3.1	3.7	0.7
	Georgia	13.6	17.5	3.8	2.6	5.4	0.5
	Hungary	16.6	25.4	6.8	8.8	8.4	2.4
SOUTH ASIA	Bangladesh	6.7	10.8	4.4	2.5	1.3	0.7
	Pakistan	3.1	13.4	4.1	3.1	2.6	1.1
	Sri Lanka	2.9	6.3	3.8	2.7	1.1	0.7
	Mauritius	4.2	7.3	4.6	9.1	6.3	0.6
SOUTH EAST ASIA	Myanmar	2.7	4.3	2.9	0.5	0.5	0.3
	Nepal	5.5	14.1	3.9	2.7	33.6	2.6
	Laos	4.7	8.0	3.4	0.5	1.9	0.4
	Philippines	5.6	12.7	8.0	2.1	3.7	0.4
	Malaysia	3.4	8.7	5.9	5.0	2.6	0.2
WESTERN EUROPE	Spain	3.8	13.8	7.2	6.7	13.8	0.5
	Median	***5.6***	***11.6***	***4.3***	***3.4***	***5.7***	***0.7***
	q3	*8.9*	*14.4*	*6.0*	*5.2*	*8.4*	*1.1*
	q1	*4.1*	*8.5*	*3.6*	*2.1*	*2.6*	*0.5*
	IQR	*4.8*	*5.8*	*2.5*	*3.1*	*5.9*	*0.6*

Individual country characteristics are described in Table 3.4. Social and demographic characteristics, including age and sex distributions are shown. There was a difference in the age structure of the population ($p<0.05$), with a mean percentage of 9.0% (95% CI, 7.1 – 11.0) in those aged 65+ compared to 72.0% (95% CI, 68.4 – 75.7) in those aged 18-49. The mean

percentage of those living in rural areas was 49.2% (95% CI, 41.3 -57.1) compared to 50.8% in urban areas (95% CI, 42.9 -58.7), although the difference was not significant. Countries in Central Asia & Eastern Europe region had a higher proportion of individuals in the 65+ age category (mean = 14.6%; 95% CI, 12.5– 16.7) compared to the African region (mean = 5.3%; 95% CI, 4.1 – 6.4; p= <0.05).

Table 3-4 Sample size, age, sex and urban/rural distributions for the selected World Health Survey Countries

WHS Countries (n=28)		N Sample	Age category, %			Sex, %	Residence, %	National income*
			18-49	50-64	65+	Female	Urban	
AFRICA	Burkina Faso	4948	82.8	12.7	4.5	52.8	17.8	LIC
	Ghana	4165	80.1	15.3	4.6	50.9	45.6	LIC
	Kenya	4640	87	9.6	3.4	51.2	39.9	LIC
	Morocco	5000	78.6	15.7	5.7	50.5	57.5	MIC
	Namibia	4379	78.5	13.4	8.1	53	33.2	MIC
	South Africa	2629	79.7	15	5.3	52	56.3	MIC
CENTRAL & SOUTH AMERICA	Brazil	5000	74.7	18.5	6.8	51.5	83	MIC
	Dominican Republic	5027	76.6	17	6.4	49.1	58.5	MIC
	Paraguay	5288	80	14.8	5.2	50.4	56.7	MIC
	Uruguay	2996	61.8	21.9	16.3	52.5	92.8	MIC
CENTRAL ASIA & EASTERN EUROPE	Bosnia & Herz	1031	66.4	21.6	12	51.1	44.6	MIC
	Czech Republic	949	57.8	27.4	14.8	52.1	73	MIC
	Estonia	1021	55.5	26.9	17.6	55.4	69.7	MIC
	Georgia	2950	60.9	23.8	15.3	53.3	51.5	MIC
	Hungary	1419	57.3	26.6	16.1	53.2	64.9	MIC
	Kazakhstan	4499	73.1	18.3	8.5	52.1	55.9	LIC
	Latvia	929	55.2	27.7	17.1	55.4	66.5	LIC
	Ukraine	2860	58.6	26.1	15.3	54.5	66.7	MIC
	Bangladesh	5942	81.1	14.7	4.2	48.5	24.3	LIC

SOUTH ASIA	Mauritius	3968	73.6	18.7	7.7	50.8	43	LIC
	Pakistan	6502	76.4	19.2	4.4	49.6	33.9	MIC
	Sri Lanka	6805	71.5	20.6	7.9	47.9	20.6	MIC
	Laos	4989	80	15	5	50.7	20.3	LIC
SOUTH EAST ASIA	Malaysia	6145	76.1	18.2	5.6	49.6	64.1	LIC
	Myanmar	6045	77	16.5	6.5	51.1	29.1	LIC
	Nepal	8822	78.1	16.8	5.1	49.5	15.2	MIC
	Philippines	10083	79.3	15.7	5.1	50.4	61.4	MIC
WESTERN EUROPE	Spain	6373	59.2	22.1	18.7	51.5	76.8	HIC
	Mean	4478.7	72	18.9	9	51.5	50.8	

Notes: *MIC = middle income country; LIC = low income country. All income groupings based on 2003 World Bank Estimates

Multimorbidity prevalence by country are shown in Table 3.5. Both age-specific prevalence and age standardized prevalence are shown for each country. The mean world standardized prevalence was 7.8% (95% CI, 6.5 – 9.1). The mean multimorbidity prevalence significantly increased with age in all countries ($p<0.05$); 3.8% (95% CI, 3.0 – 4.6) for age 18-49, 12.8% (95% CI, 10.5 – 15.2) for 50-64; and 21.3% (95% CI, 17.1 – 25.5) for 65+. The multimorbidity prevalence for England, ELSA (n=6 conditions) was similar to Spain WHS; respectively, 8.3% (95% CI, 7.8– 8.8) and 7.8% (7.1% - 8.5 %). Increasing the number of conditions included in the analysis more than doubled the prevalence estimates as the multimorbidity prevalence in ELSA (n=15 conditions) was 22.4%.

Table 3-5. Multimorbidity prevalence by age category and world standardised, with GDP per capita

	Prevalence by age category (CI)			Prevalence (CI)*	GDP (US $)**
	18-49	**50-64**	**65+**		
Myanmar	1.30 (1.0 - 1.60)	1.9 (1.0 - 2.7)	3.1 (1.7 – 4.5)	1.7 (1.4 – 2.0)	200
Nepal	10.1 (9.3 – 10.9)	24.8 (22.2 – 27.5)	30.2 (26.2 - 34.1)	15.2 (14.3 – 16.0)	264
Burkina Faso	4.8 (4.1 – 5.5)	9.7 (7.2 -12.2)	13.0 (9.0 - 16.9)	6.3 (5.6 – 7.0)	332
Laos	2.5 (2.0 – 3.0)	6.5 (4.6 – 8.4)	5.3 (2.7 – 7.8)	3.6 (3.1 – 4.1)	358
Bangladesh	2.9 (2.4 – 3.4)	10.9 (8.6 – 13.2)	12.6 (9.2 – 16.1)	6.8 (6.1- 7.5)	419
Kenya	2.1 (1.6- 2.5)	3.2 (1.8- 4.6)	11.5 (8.1 – 14.9)	4.2 (3.6 - 4.8)	440
Pakistan	3.4 (2.9 - 3.9)	8.7 (6.8 – 10.6)	14.8 (11.1- 18.5)	4.9 (4.3 – 5.4)	597
Ghana	2.0 (1.5 – 2.5)	4.4 (2.8 – 5.9)	6.6 (4.3 – 9.0)	3.6 (3.0 – 4.2)	603
Georgia	4.0 (3.0 - 5.1)	15.0 (11.8- 18.1)	27.1 (23.3 – 30.9)	9.6 (8.4 – 10.8)	874
Sri Lanka	1.2 (0.9 – 1.5)	6.6 (5.2- 8.1)	9.6 (7.1 - 12.0)	3.9 (3.4 – 4.3)	968
Philippines	3.8 (3.4 - 4.3)	12.0 (10.3 - 13.7)	17.2 (14.1 – 20.3)	7.1 (6.6 - 7.7)	1016

Ukraine	3.3 (2.4 - 4.2)	17.8 (14.6 – 20.9)	31.6 (27.1 – 36.1)	10.0 (8.8 – 11.1)	1049
Paraguay	3.2 (2.7 - 3.8)	9.4 (7.2 – 11.5)	12.0 (9.0 – 15.0)	5.7 (5.1 – 6.4)	1159
Morocco	3.0 (2.5 - 3.6)	13.6 (11.1- 16.1)	17.5 (13.8 - 21.1)	6.4 (5.7 – 7.1)	1684
Kazakhstan	1.5 (1.1 – 1.9)	10.1 (7.9 – 12.3)	45.1 (37.4 – 52.8)	8.5 (7.6 – 9.4)	2109
Bosnia & Herz	2.3 (1.0 – 3.5)	11.7 (7.3- 16.0)	30.2 (22.7 – 37.7)	7.6 (5.9 – 9.3)	2182
Dominican Republic	4.5 (3.7 - 5.2)	15.7 (13.0 – 18.5)	18.5 (14.9 – 22.1)	7.2 (6.4 – 8.0)	2210
Namibia	4.5 (3.7 - 5.2)	11.9 (8.9 – 14.9)	17.7 (13.4 – 21.9)	7.9 (7.0 - 8.8)	2489
Brazil	8.1 (7.1 – 9.0)	21.4 (18.4 - 24.4)	28.0 (23.7 – 32.3)	13.4 (12.4 - 14.5)	3039
South Africa	5.0 (3.9 – 6.0)	21.6 (16.6 – 26.6)	30.1 (20.6- 39.7)	11.2 (9.8 - 12.5)	3589
Uruguay	4.1 (3.2 - 5.0)	12.4 (9.7 – 15.1)	17.0 (13.5 - 20.5)	7.3 (6.3 – 8.2)	3622
Malaysia	2.0 (1.6 - 2.5)	9.6 (7.8 – 11.4)	14.6 (11.2 – 17.9)	5.6 (5.0- 6.2)	4607
Mauritius	3.3 (2.6 – 3.9)	15.8 (12.8 – 18.7)	19.3 (14.9 - 23.6)	7.8 (6.9 – 8.6)	4830
Latvia	2.7 (1.1 – 4.3)	16.0 (10.7 - 21.2)	35.6 (28.1- 43.0)	9.6 (7.5 – 11.7)	4872
Estonia	6.2 (4.0 – 8.4)	14.4 (9.9 – 18.8)	34.4 (26.8 – 41.9)	11.5 (9.4 - 13.6)	7350
Hungary	7.8 (5.8 – 9.9)	27.9 (22.5 – 33.3)	32.3 (26.2 – 38.3)	15.0 (13.0- 17.1)	8237

Czech Republic	3.5 (1.8 – 5.1)	11.6 (7.2 – 16.0)	39.4 (30.8 – 48.0)	9.4 (7.4 – 11.4)	9339
Spain	3.1 (2.5 – 3.8)	15.3 (13.3 – 17.3)	22.6 (20.5 – 24.6)	7.8 (7.1 - 8.5)	21035
England (n=6)	0	10.9 (10.1- 11.8)	16.7 (15.6 - 17.7)	8.28 (7.8 - 8.8)	31412
England (n=15)	0	28.0 (26.6 – 29.3)	53.7 (51.8 – 55.5)	22.4 (21.6 - 23.2)	31412

Notes * Multimorbidity prevalence (≥ 2 chronic conditions) standardised to the WHO Standard population; ** National GDP per capita recorded by the UN Division Statistical Division, 2003

Figure 3.2 shows national levels of multimorbidity by country GDP per capita. There was a positive association between multimorbidity prevalence and GDP per capita (from GDP per capita of $200 – $10,000). Above $10,000 the line flattens; countries such as Spain and England had relatively low multimorbidity prevalence for their high GDP.

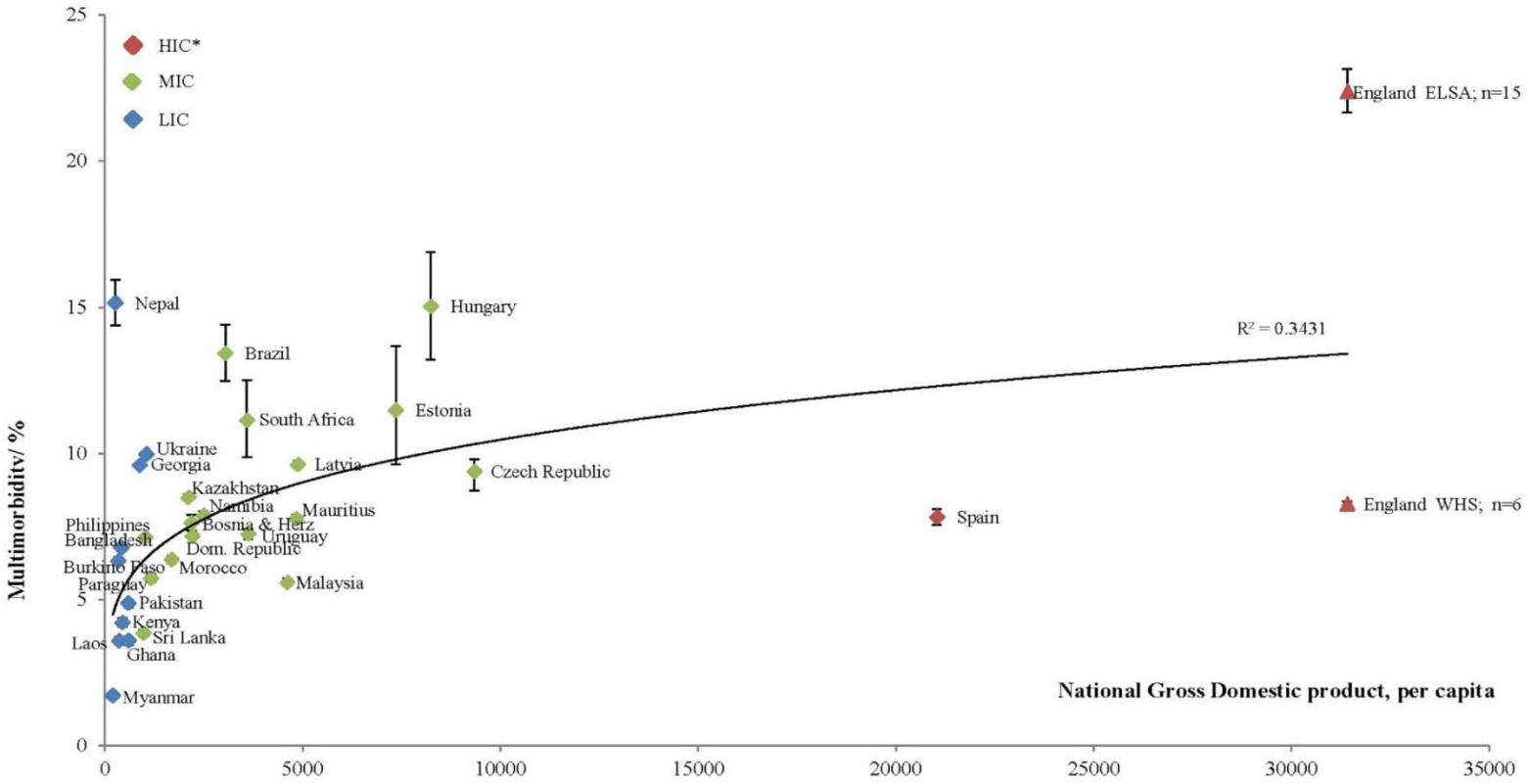


Figure 3-2. World Standardised Multimorbidity Prevalence by GDP across World Health Survey Countries (n=28) and England, ELSA in 2003 (with confidence intervals)

*HIC high income group; MIC middle income group; LIC low income group. Income groups are based on national estimates of 2001 GNI per capita, calculated using the World Bank Atlas method, and reported in the 'World Development Report 2003.'

Figures 3.3 show the socio-economic gradient of multimorbidity, stratified by age.Figure 3.3 shows the socioeconomic gradient of younger multimorbid individuals aged 18-54. Across all regions there was a distinct negative socioeconomic gradient, with the highest burden on the least educated. The socioeconomic gradient appeared steeper in Western Europe and Eastern Europe & Central Asia as compared to Africa or South East Asia.

Figure 3.4 shows the socioeconomic gradient of older multimorbid individuals aged 55 years and older. The socioeconomic gradient is flatter, compared to those aged <55 (see Figure 3.3). However, there was still a distinct negative gradient in Western Europe, with the highest burden on the least educated. South East Asia on the other hand has a positive gradient, with the highest burden on the most educated.

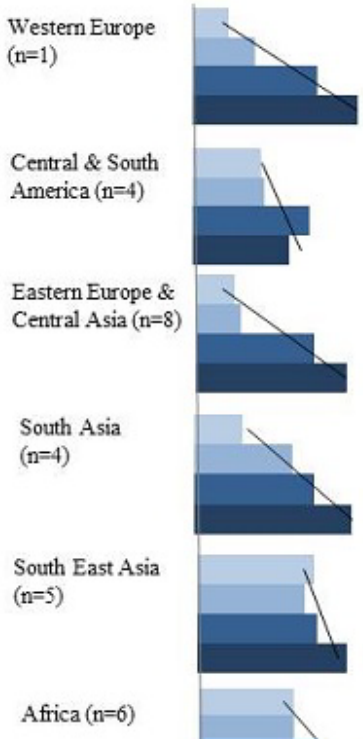


Figure 3-3. The SES gradient of multimorbidity by regions, for age category 1 (<55)

The lightest shade represents the first category (higher education achieved). The darkest shade represents final category (less than primary school education achieved). Multimorbidity prevalence ratios are based on the prevalence of multimorbidity in the first category, set at 1.

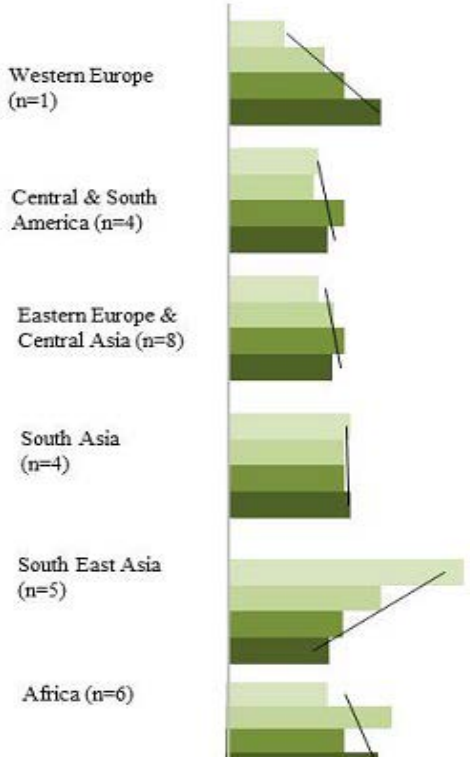


Figure 3-4. The SES gradient of multimorbidity by regions, for age category 2 (≥55)

The lightest shade represents the first category (higher education achieved). The darkest shade represents final category (less than primary school education achieved) b) Multimorbidity prevalence ratios based on the prevalence of multimorbidity in the first category, set at 1

Both univariable and multivariable analyses are shown in Table 3.6 and Table 3.7. Univariable and multivariable analyses at the country level are shown in Table 3.6, showing the social and demographic correlates of: age, sex and SES. Age was significantly associated with multimorbidity in all countries. Sex was significantly associated with multimorbidity in all but 7 countries. Multimorbidity was associated with SES in the univariable analyses, but was not significant when adjusted for both age and sex; except for certain SES categories in Bangladesh, Brazil, Hungary, Mauritius, Namibia and Spain; where $p<0.05$.

As expected in Spain, the lowest SES category was associated with a slightly higher adjusted odds ratio; whereas the higher SES categories were associated with a lower odds ratio. Similarly, having the lowest SES category was associated with a higher risk in Namibia; whereas higher SES was associated with a lower risk in Mauritius.

Univariable and multivariable analyses at the regional level are shown in Table 3.7. Similar to the country level, age and sex were both significantly associated with multimorbidity in all regions. When adjusted for age, sex and country, lowest SES category was significantly associated with a higher risk of multimorbidity in South Asia and Western Europe; and higher SES categories were significantly associated with a decreased risk of multimorbidity in South Asia and Western Europe. Adjusted for age, sex, country and region, the 'all region' model suggest that there was an overall negative SES gradient, with the higher SES categories associated with a decreased risk of multimorbidity, and the lowest SES category being associated with an increased risk of multimorbidity.

Table 3-6 Effect of age, sex and education on multimorbidity by country: Odds ratios in univariable, multivariable analysis

		Univariable						Multivariable			
		Age (OR) 18-49 as reference		Sex (OR) Male as reference	Education (OR) primary school as reference			Education (AOR)			
	N (all models)	50 - 64	65+		< primary	Secondary	higher	< primary	secondary	higher	LRTEST (Degrees of Freedom)
Burkina Faso	4788	2.2* (1.4 – 3.3)	3.0*(1.6-5.7)	0.7*** (0.6 – 1.0)	1.1 (0.6 – 2.0)	0.5 (0.2 – 1.3)	1.1 (0.2 – 6.6)	0.8 (0.5 – 1.5)	0.5 (0.2 – 1.2)	1.1 (0.2 – 6.7)	0.82(3)
Bangladesh	5459	4.1* (3.0 – 5.7)	4.9*(4.3 – 7.1)	0.9 (0.7 – 1.3)	1.1 (0.8 – 1.5)	0.7 (0.4 – 1.1)	0.4*** (0.2 – 0.9)	0.8 (0.5 – 1.1)	0.7 (0.4 – 1.1)	0.4*** (0.2 – 0.9)	0.38(3)
Bosnia & Herz	1006	5.7* (2.2 – 15.1)	18.7* (7.5 – 56.7)	0.4*** (0.2 – 0.9)	3.0** (1.4 – 6.6)	0.6 (0.2 – 1.8)	$	1.0 (0.3 – 2.6)	1.0 (0.4 – 3.2)	$	0.28 (3)
Brazil	4953	3.1* (2.5 – 3.9)	4.4* (4.4 – 3.5)	0.5* (0.4-0.6)	1.6* (1.3 – 2.1)	0.6* (0.5 – 0.8)	0.8 (0.5 – 1.2)	1.2 (0.9 – 1.5)	0.8*** (0.6 – 1.0)	0.8 (0.5 – 1.2)	0.009(3)
Czech Republic	910	3.7* (1.6 – 8.7)	18.1* (9.2 – 35.4)	0.6 (0.3 – 1.0)	2.3 (0.4 – 11.8)	0.3*(0.2 – 0.6)	0.4 (0.2 – 1.0)	1.3 (0.1 – 12.1)	0.7 (0.4 – 1.2)	0.7 (0.3 – 1.8)	0.15(3)
Dominican Republic	4489	4.0* (2.8 – 5.6)	4.8* (3.0 – 7.8)	0.3* (0.2 – 0.4)	2.0**(1.2 – 3.2)	0.7 (0.4 – 1.4)	0.9 (0.4 – 2.3)	1.3 (0.7 – 1.9)	0.6 (0.3 – 1.2)	0.8 (0.3 – 2.0)	0.13(3)
Estonia	997	2.6* (1.6 – 4.0)	8.0*(4.8 – 13.1)	0.6** (0.4 – 0.8)	1.6 (0.7 – 3.7)	0.8 (0.5 – 1.2)	0.6 (0.3 – 1.1)	0.9 (0.4 – 2.2)	1.3 (0.8 – 2.1)	0.9 (0.4 – 1.9)	0.05(3)
Georgia	2700	4.2* (2.9 – 6.2)	8.8* (6.6 – 11.8)	0.6* (0.5 – 0.8)	1.9 (0.5 – 6.9)	0.7 (0.3 – 1.8)	0.8 (0.3 – 2.0)	2.0 (0.5 – 8.2)	2.3 (0.9 – 6.1)	2.9 (1.1 – 7.8)	0.02(3)
Ghana	3839	2.2* (1.2 – 4.0)	3.5* (1.9 – 6.2)	0.6** (0.4 – 0.9)	1.2 (0.8 – 1.8)	3.0 (0.0 – 1.1)	1.2 (0.2 – 6.3)	0.9 (0.6 – 1.4)	0.3 (0.1 – 1.2)	1.2 (0.2 – 6.1)	0.17(3)

Hungary	1411	4.6* (3.0 – 6.8)	5.6*(3.9 – 8.0)	0.5* (0.4 – 0.7)	2.9 (1.0 – 8.8)	0.4* (0.2 – 0.5)	0.2*** (0.1 – 0.4)	3.4***(1.0 – 11.3)	0.8 (0.5 – 1.2)	0.5*** (0.2 – 0.8)	0.003(3)
Kazakhstan	4470	7.4*(4.6 – 12.1)	54.2* (25.2 – 116.7)	0.5*(0.3 – 1.0)	0.3 (0.1 – 1.5)	0.2* (0.1 – 0.5)	0.1*** (0.0 – 0.3)	0.5 (0.1 – 1.5)	1.1 (0.3 – 3.4)	0.8 (0.2 – 2.5)	0.70(3)
Kenya	4354	1.6* (0.8 – 3.1)	6.2* (3.2 – 11.8)	1.0 (0.5 – 1.9)	2.3* (1.1 – 4.8)	1.7 (0.6 – 4.7)	2.5 (0.7 – 9.3)	1.4 (0.7 – 3.0)	1.8 (0.6 – 4.8)	2.4 (0.7 – 8.6)	0.72(3)
Laos	4697	2.7* (1.8 – 4.2)	2.2* (1.2 – 4.0)	0.9 (0.6 – 1.4)	1.5 (0.9 – 2.5)	0.5 (0.2 – 1.2)	0.2 (0.0 – 1.9)	1.3 (0.8 – 2.2)	0.5 (0.2 – 1.3)	0.3 (0.0 – 1.9)	0.0009(3)
Latvia	829	6.9* (3.4 – 14.0)	20.0* (9.7 – 41.1)	0.4** (0.3 – 0.8)	1.6 (0.7 – 4.0)	0.9 (0.5 – 1.6)	1.0 (0.5 – 1.9)	0.7 (0.3 – 1.7)	1.7 (0.9 – 3.1)	1.3 (0.6 – 2.7)	0.19(3)
Malaysia	5962	5.2* (3.8 – 7.0)	8.2*(5.6 – 12.1)	0.8 (0.6 – 1.0)	1.8* (1.3 – 2.6)	0.5* (0.3 – 0.7)	0.5* (0.3 – 0.7)	1.1 (0.7-1.6)	0.8 (0.5 – 1.2)	0.8 (0.5 – 1.3)	0.07(3)
Mauritius	3872	5.6* (4.1 – 7.6)	7.1* (4.8 – 10.6)	0.6* (0.4 – 0.7)	2.8* (2.0 – 3.8)	0.4* (0.2 – 0.6)	0.4*** (0.2 – 0.9)	1.3 (0.8 – 2.1)	0.5* (0.3 – 0.7)	0.4 (0.2 – 1.1)	0.0001(3)
Morocco	4995	5.0* (3.0 – 8.3)	6.8* (4.0 – 11.5)	0.6*** (0.3 – 0.9)	1.4 (0.8 – 2.5)	0.5 (0.2 – 1.4)	0.4 (0.2 – 1.5)	0.6 (0.3 – 1.1)	0.6 (0.2 – 1.7)	0.7 (0.2 – 2.0)	0.35(3)
Myanmar	5871	1.4* (0.8 – 2.5)	2.4* (1.3 – 4.6)	0.5**(0.3 – 0.8)	0.9 (0.6 – 1.4)	1.4 (0.8 – 2.5)	1.3 (0.4 – 3.9)	0.6 (0.4 – 1.1)	1.5 (1.5 – 2.7)	1.2 (0.4 – 3.8)	0.02(3)
Namibia	3903	2.7* (1.7 – 4.2)	4.3*(2.6 – 7.0)	0.6**(0.4 – 0.9)	2.2*(1.4 – 3.4)	0.7 (0.4 – 1.4)	1.2 (0.4 – 3.6)	1.7***(1.1 – 2.7)	0.8 (0.4 – 1.5)	1.4 (0.4 – 4.1)	0.007(3)
Nepal	8169	2.9* (2.4 – 3.6)	3.8* (3.1 – 4.8)	1.0 (0.8 – 1.1)	1.3* (1.1 – 1.7)	0.9 (0.6 – 1.2)	1.4 (0.7 – 2.5)	0.9 (0.7 – 1.2)	0.9 (0.6 – 1.2)	1.4 (0.7 – 2.5)	0.79(3)
Pakistan	5879	2.7* (1.8 – 3.9)	4.9* (3.3 – 7.2)	0.5** (0.3 – 0.8)	1.4 (0.8 – 2.7)	0.6 (0.3 – 1.2)	1.1 (0.3 – 3.7)	0.9 (0.5 – 1.7)	0.6 (0.3 – 1.3)	1.1 (0.3 – 3.9)	0.21 (2)
Paraguay	5091	3.0* (2.1 – 4.4)	4.1* (2.7-6.2)	0.3* (0.2 – 0.5)	1.2 (0.9 – 1.6)	1.0 (0.6 – 1.7)	1.0 (0.5 – 2.0)	0.8 (0.5 – 1.1)	1.1 (0.7 – 1.8)	1.0 (0.5 – 2.2)	0.20 (3)
Philippines	9792	3.4* (2.8 – 4.3)	5.2* (3.9 – 7.0)	0.6* (0.5 – 0.8)	1.7* (1.3 – 2.3)	0.8 (0.6 – 1.0)	1.1 (0.7 – 1.6)	1.3 (0.9 – 1.7)	1.1 (0.8 – 1.4)	1.3 (0.9 – 1.9)	0.62(3)

South Africa	2244	5.3* (3.2 – 8.7)	8.3* (4.6 – 15.0)	0.6*(0.4 – 0.8)	2.4*(1.5 – 3.8)	0.8 (0.5 – 1.4)	0.5 (0.3 – 1.1)	1.6 (1.0 – 2.6)	1.1 (0.6 – 1.8)	0.7 (0.3 – 1.3)	0.26(3)
Spain	6225	5.6* (4.0 – 8.0)	9.1*(6.5 – 12.7)	0.6*(0.5 – 0.7)	1.8*(1.4 – 2.4)	0.4*(0.3 – 0.5)	0.2*(0.1 – 0.4)	1.4***(1.1 – 1.8)	0.8***(0.6 – 1.0)	0.4**(0.2 – 0.8)	0.0001(3)
Sri Lanka	6310	5.9***(3.9 – 9.1)	8.8***(4.9 – 15.7)	0.7 (0.4 – 1.3)	1.2 (0.6 – 2.4)	0.5***(0.3 – 0.7)	0.3 (0.0 – 2.1)	0.9 (0.5 – 1.8)	0.9 (0.5 – 1.4)	0.5 (0.0 – 3.6)	0.007(3)
Ukraine	2503	6.4*** (4.3 – 9.5)	13.7***(8.7 – 21.6)	0.4***(0.3 – 0.6)	0.6 (0.3 – 1.6)	0.5 (0.3 – 0.8)	0.3 (0.2 – 0.5)	0.6 (0.2 – 1.5)	1.4 (0.8 – 2.5)	1.3 (0.7 – 2.3)	0. 16(3)
Uruguay	2966	3.3*** (2.4 – 4.5)	4.8*** (3.5 – 6.6)	0.5*** (0.4 – 0.6)	2.0** (1.3 – 3.1)	0.8 (0.6 – 1.2)	0.7 (0.5 – 0.9)	1.4 (0.8 – 2.4)	1.0 (0.7 – 1.5)	0.9 (0.7 – 1.2)	0.10(3)

Notes: * p-value ***<0.05; ** < 0.01; * <0.001; (OR) Unadjusted odds ratio; (AOR) adjusted odds ratios in multivariable analysis: all countries adjusted for age and sex. $ indicates no observations within the category. For Bosnia & Herzegovina the categories of secondary and higher education were combined for both univariable and multivariable analyses. LRTEST compares final multivariable model to model with age and sex only; shows degrees of freedom.

For 10 out of the 28 countries, the final model adjusted for age sex and education resulted in a better fit (<0.05) compared to the model fitted with age and sex alone. This suggests that the addition of education in the final model resulted in a better fits for some but not all countries (36%).

Table 3-7 Effect of age, sex and socioeconomic status on multimorbidity by region: Odds ratios in univariable and multivariable analysis

	N (all models)	Univariable					Multivariable			LRTEST (Degrees of Freedom)
		Age (OR) <55 years as reference	Sex (OR) Male as reference	Education (OR) primary school as reference			Education (AOR) $			
		≥55		<primary	secondary	higher	< primary	secondary	higher	
Africa	24131	3.3* (2.9 – 3.7)	0.6* (0.5 – 0.6)	1.8* (1.5 – 2.0)	0.8 (0.7 – 1.0)	0.7 (0.5 – 1.0)	1.2** (1.0 – 1.4)	0.9 (0.7 – 1.1)	0.8 (0.6 – 1.1)	0.0004(3)
Central & South America	17510	3.0* (2.7 – 3.4)	0.4* (0.4 – 0.5)	1.5* (1.3 – 1.7)	0.7* (0.6 – 0.9)	0.8*** (0.6 – 1.0)	1.1 (1.0 – 1.3)	0.8*** (0.7 – 1.0)	0.8 (0.6 – 1.0)	0.003(3)
Eastern Europe & Central Asia	10629	6.0* (5.3 – 6.8)	0.6* (0.5 – 0.8)	1.4*** (1.1 – 1.8)	0.5* (0.5 – 0.7)	0.5* (0.4 – 0.5)	1.0 (0.7 – 1.3)	1.0 (0.8 – 1.2)	0.9 (0.7 – 1.1)	0.73(3)
South Asia	21790	4.1* (3.6 – 4.6)	0.7 * (0.6 – 0.8)	1.7* (1.4 – 2.0)	0.6*(0.5 – 0.7)	0.6** (0.4 – 0.9)	1.2 (1.0 – 1.4)	0.7* (0.6 – 0.8)	0.6** (0.4 – 0.9)	0.0001(3)
South East Asia	34491	3.3* (3.0 – 3.6)	0.8* (0.7 – 0.9)	1.4* (1.3 - 1.6)	0.8* (0.7 – 0.9)	0.9 (0.7 – 1.1)	1.1 (0.9 – 1.2)	0.9 (0.8 – 1.1)	1 (0.8 – 1.2)	0.04(3)

Western Europe	6313	6.0* (4.9 – 7.2)	0.5* (0.5 – 0.6)	1.6* (1.3 – 2.0)	0.4* (0.3 – 0.5)	0.2*(0.1 – 0.3)	1.3** (1.1 – 1.6)	0.7* (0.6 – 0.8)	0.4* (0.2 – 0.6)	0.0001(3)
All regions (MV adjusted for region)	51433	3.7* (3.5 – 3.9)	0.6* (0.5 – 0.6)	1.5*(1.4 – 1.6)	0.7* (0.6 – 0.7)	0.6* (0.5 – 0.6)	1.2* (1.1 – 1.6)	0.9***(0.6 – 0.8)	0.8* (0.2 – 0.6)	0.0001(3)

Notes: p-value *** <0.05; ** < 0.01; * <0.001; $ Regional multivariable analyses adjusted for age, sex and country; (OR) Unadjusted odds ratio; (AOR) Adjusted odds ratios in multivariable analysis adjusted for age, sex and country. Age grouping was using to understand intergenerational differences at regional level (55 years was taken as cut point as it was mid-way through data). LRTEST compares final multivariable model to model with age and sex only; shows degrees of freedom.

For all regions, except for Central and Eastern Europe, the final model adjusted for age sex and education resulted in a better fit (<0.05) compared to the model fitted with age and sex alone. This suggests that the addition of education in the final model resulted in a better fit at the regional level.

All models were fitted with random effects. In all of the final models, the intra-cluster correlation (rho) suggests that the proportion of variance, comparing within-group variance with the between-group variance, that occurred at the county level (for country data) and at the country level (for pooled regional data) presented a small fraction of the overall variability. In all final models, rho was <0.20, which suggests the variance at the cluster level was 0.20% of the total variance.

Table 3-8. Chi-squared tests for difference 'education' between Responders and Non-responders in Ghana

"Observed"

Education	Respondents	Non-responders	Total
Less than primary school	1737	77	1814
Primary school	1716	65	1781
Secondary School	287	24	311
College	109	7	116
Total	3849	173	**4022**

Assuming a significance of 0.05 and 3 degrees of freedom, $P(X^2 > 11.5) = 0.009$.Table 3-9. Chi-squared tests for difference in 'marital status' between Responders and Non-responders in Ghana

"Observed"

Marital status	Responders	Non-responders	Total
Never married	784	64	848
Currently married	2290	85	2375
Separated	103	3	106
Divorced	295	9	304
Widowed	362	12	374
Cohabitating	58	0	58
Total	3892	161	4007

Assuming a significance of 0.05 and 5 degrees of freedom, $P(X^2 > 33.7) = 0.00001$The results show that for education and marital status there is a significant difference ($p<0.05$) between the responders and non-responders; and that this difference is not due to randomness.

3.4 Discussion

This is the first study to describe global patterns of doctor- diagnosed multimorbidity and to compare prevalence across different countries.

There are a few notable findings. Firstly, multimorbidity prevalence was positively associated with country GDP. There was however a non-linear relationship; countries such as Spain and England were outliers, with low multimorbidity relative to GDP. These results suggest an influence of other factors which may include, but are not limited to, more freedom to make better lifestyle choices and better social conditions [106]. In comparison to Spain and England, the Eastern European countries have relatively high multimorbidity prevalence. Historically, Eastern Europe has had relatively poorer population health outcomes relative to their western counterparts following the fall of communism in 1990. Such health outcomes were markedly influenced by exposure to risk factors, such as tobacco smoking and alcohol consumption [107-109]. Secondly, multimorbidity was significantly associated with age across all countries. This finding has been found consistently across several studies [11, 110-112]. Multimorbidity is also not limited to the elderly in HICs but affects younger adults in LMICs. This is not surprising given that many LMICs are faced with an ageing population which, given the consistent relationship between age and multimorbidity, will have an impact on the overall prevalence [113-115]. Thirdly, trend analyses of multimorbidity and SES suggest a transgenerational difference: a more negative SES gradient is observed for younger adults compared to older adults. Fourthly, our 'all region' model suggests that higher SES categories are associated with a decreased risk of multimorbidity, and the lowest SES category is associated with an increased risk of multimorbidity. These findings concord with what have been found in other studies in HICs [112, 116]. Finally, there are notable gender differences in multimorbidity: the female sex being associated with higher multimorbidity. This is a common observation in morbidity studies, often attributed to greater use of health services due to pregnancy and childbirth [117]. There are, however, an increasing number of studies to suggest that the gender morbidity gap is not just attributed to health care usage but other factors, including behavioural and psychosocial [118, 119].

One of aims was to examine the variations of multimorbidity by SES. Our descriptive analyses of SES show that both regional differences and generational differences exist for adults with multimorbidity. Firstly, the socioeconomic gradient was steeper in Western Europe and Eastern Europe & Central Asia compared to other regions. Secondly, for adults aged <55 years, there was negative SES gradient which was steeper than for ≥55s. Thirdly, the gradient is always negative, with one exception of older adults in South East Asia. This suggests that in South East Asia there might have been an inter-generational reversal in the socioeconomic gradient of

multimorbidity. Such results have also been found in studies on obesity where transitional economies are experiencing a reversal in socioeconomic gradient thus resulting in a similar gradient to HICs.

The global-level multivariable analyses shows a negative association of multimorbidity with SES. Results from Western Europe suggest that there is a significantly negative SES gradient of multimorbidity in HICs. In South Asia there is also a significantly negative SES gradient in multimorbidity. The SES gradient in South Asia, despite being a LMICs region, is similar to Western Europe. These findings are consistent with what was previously shown in the literature review. The previous chapter showed that in upper MICs, multimorbidity was associated with low SES [73, 78, 81]. In contrast, for studies conducted in lower MICS, multimorbidity was associated with high SES [71, 79]. Overall, this suggests that there may be a transition in social patterning, as the country develops. The SES index in the studies, however, were based on different SES measures, such as household expenditure and assets, which may be a reason for this difference. Further studies may wish to explore using index based on assets approach that are comparable across countries. An appropriate index is the permanent income approach [120]. Studies that examined education and its relation to multimorbidity, however, consistently found an association with low education or no education, which are also congruous with the findings from this study. Overall, these findings suggest that there are social inequalities within, and between, countries. As previously discussed, SES is a fundamental cause of health inequalities, which may be acting through both associated risk and protective factors. These study findings imply that social inequalities should be addressed in relation to multimorbidity, whilst considering other confounding factors. This current study did not frame the research question within a conceptual framework, examining the pathway of association between SES and multimorbidity. There may be several other factors which may be confounding the relationship between SES and multimorbidity, which may include, but are not limited to, behavioural risk factors (such as tobacco and alcohol use). Further studies should consider these factors, and consider the use of such a framework.

Strengths and Limitations

This study provides novel data on multimorbidity prevalence in nationally representative population samples using a consistent set of methods measures across multiple countries. One of the major strengths is the comparability of the data. The World Health Surveys were developed to allow comparability between countries, both HICs and LMICs. However the study had few limitations.

Firstly, prevalence estimates were based on a limited set of morbidities. By increasing the set of morbidities included in the study, prevalence will be expected to increase – as shown by the ELSA results [8, 49]. The chronic conditions included in the WHS were chosen to reflect health system coverage [121]. The conditions had to be amenable to self-report and reflect a known burden or prevalence globally. Angina and diabetes are commonly referred to as chronic conditions, which make up the global burden. There are, however, other conditions that contribute significantly to the global burden of disease, which have been not been recorded; for example stroke and HIV [122]. Both depression and schizophrenia have been included, as they relate to the burden in mental health. However, a study examining the prevalence of schizophrenia in developing countries suggested that the recorded cases of schizophrenia are often ascertained in 'Western-type facilities [123].' Therefore the numbers of true cases of schizophrenia recorded here may be an underestimate, whilst unfamiliarity with the condition may have led to gaps in understanding. The prevalence of schizophrenia was remarkably low in this study, which suggests that it may not be a useful, interpretable indicator for the burden of mental health. Furthermore, the choice of conditions should also correspond to those with greater prevalence in older populations (e.g., asthma, for instance, is more prevalent in children).

Secondly, the study presents cross-sectional data from 2003. Further investigations should use current or recent data, as well as longitudinal data, to ascertain changing patterns over time. Thirdly, only countries with a greater than 90% response rate to health status questions on chronic disease were sampled, which meant that a number of lower income countries, where response rates were low, were excluded from the analyses. Overall 16 countries were excluded altogether, which would have limited the generalisability of the results, particularly for the regional analyses. There was also low representation from HICs in Europe, as they did not complete the chronic disease questions.

Fourthly, these results were based on self-reported doctor-diagnosed measures, which may result in inaccuracies and subsequent bias [54, 124, 125]. One study notes that self-reporting leads to underreporting, particularly amongst the poor [126]. It may be that health literacy and service access impact prevalence based on self-report for countries at different levels of economic development. Self-reported diagnosis can be further validated by the auxiliary symptom reporting questions included in the survey. As the prevalence estimates are based on doctor-diagnosed conditions, an alternative explanation may point to differences in survivorship and/or underdiagnosis. To support this view, national GDP appeared to be correlated with greater healthcare system access, which would have potentially led to underdiagnosis in less advanced countries, as well as increased survivorship for countries with better health system access. As a counter-argument, however, both Spain and England, , had low multimorbidity relative to

national GDP despite having a relatively good healthcare system access; which suggest that further longitudinal investigation is needed to provide a defensible explanation. To summarise the nature of the multimorbidity prevalence reported here, as self-reported doctor diagnosed conditions, may lead to alternative interpretations which are better understood through longitudinal analysis.

Finally, results from the non-responders analysis in Ghana suggest that the absence of non-responders may have introduced some methodological bias in our results. Even though post stratification weights were provided, they only accounted for locality (province), sex and age, which meant that there may still have been bias arising from missing data (non-response) from other variables of interest. An analysis of non-responders showed that most non-responders failed to answer the whole set of questions determining their multimorbidity status (all six morbidities). The analysis also showed significant differences for marital status and education. The implications are that the study samples were not representative of their population; for example, unmarried people were undersampled. As a result, this may have led to some bias in the results, even after using post-stratification weight. In order to understand the relationship between a country's development and multimorbidity as an appropriate health outcome, further studies are needed, with more robust survey methods. Further studies may also consider examining smaller age groupings than those studied here, in order to examine age-specific effects.

3.5 Conclusion

Multimorbidity is significantly associated with age and effects individuals in both LMICs and HICs. Our findings suggest that within countries multimorbidity affects individuals of lower SES. The recent UN World Summit addressed the common risk factors of non-communicable disease to be tackled with urgent priority; namely tobacco use, unhealthy diet, harmful use of alcohol and physical inactivity. The set of chronic conditions under study here are a consequence of such common risk factors. As countries develop, changes in risk factor profiles and their ageing population will result in subsequent increases in chronic disease. Weak health systems and governance will not be able to support the complexities of a multimorbid population. Better coordination and support through informed policy and planning is needed to support this transition. Furthermore, there is a need to increase activities and expand measures to reduce the modifiable risk factors that are driving up multimorbidity.

Chapter 4: Multimorbidity, urban living and socio-economic factors in Middle Income Countries (MICs) using the Study of Global Ageing.

4.1 Introduction

The previous chapter examined the association of socioeconomic status (using education as a proxy) with multimorbidity in LMICs. The results highlighted some important areas for further research, particularly for LMICs. One important issue was the role of urban living (i.e. whether the person lives in an urban or rural environment) in the relationship between socioeconomic status and multimorbidity, and their interaction [127]. The literature review (Chapter 2) pointed to a strong association between urban living and multimorbidity, suggesting that patterns may differ between countries at different levels of economic development. These findings suggest that urban living may act as a determinant of multimorbidity, particularly in MICs, and that conceptual frameworks should consider urban living as a determinant. This study therefore focuses specifically on urban living, amongst a key set of MICs at different stages of development – including those classified as upper MICs and lower MICs. Finally, the SAGE study used here also draws upon, and has built on, the standardized instruments used in the WHS, which means that the datasets were directly comparable.

4.1.1 Urban living across the globe

Compared to the rest of the world, upper middle income countries have experienced the fastest growth of urbanisation since the 1950's. According to the World Urbanization Prospects Report, their level of urbanisation was 20% in the 1950's, rising to 63% in the present time, and is set to increase to 79% by 2050, which is not dissimilar to the 86% expected for high income countries (see figure 4.1). Although lower-middle and low-income countries have experienced a slower pace of urbanisation in the preceding

decades, these countries are also set to experience a fast pace of growth in the coming decades [128].

4.1.2 Urban living and Health

Currently, four billion (55% of the world's population) are living in urbanised areas (World Urbanisation Prospects, 2014). With an estimated 70-80% of the world's GDP in urban areas, the relationship between urbanisation and economic development is likely bidirectional. Economic development has fuelled urbanisation, whereas urbanization has had a positive impact on economic development and poverty reduction [128].

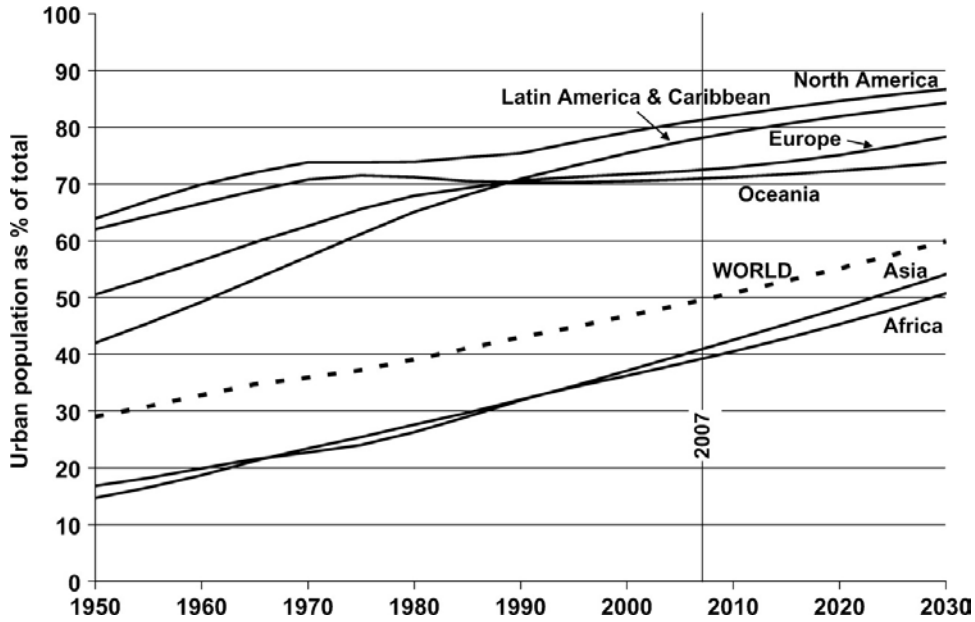


Figure 4-1 Trends and projections in urban population as a percentage of total population by world region 1950–2030

[129]

The relationship between urban living and health has been widely discussed, suggesting urban living has had both positive and, equally, negative consequences in LMICs [129-131]. On the one hand, urban living has afforded better access to sanitation, water supplies, education and healthcare services; on the other hand, urban living has led to insufficient housing, slums, and greater exposure to lifestyle behaviours that cause non-communicable

disease, such as diabetes or cardiovascular diseases. Such consequences point to a health gradient for the rich in LMICs, suggesting that the health advantages due to income growth in urbanising areas may be supressed by unhealthy lifestyle choices, such as unhealthy eating patterns, sedentary lifestyles, and tobacco or alcohol consumption. For the poor, however, social externalities – such as access to health information and facilities – may give them an advantage in urban areas over rural areas.

Another theory suggests that the SES gradient in health may be steepened by urban living; this is known as the *double jeopardy theory [132]*. According to the theory, the price of goods and services are related to the average income level; income inequality in cities mean that services in health and education are unaffordable for the poor. In a recent study in Tanzania, a LIC – however - urban residence was found to be associated with a decreased intake of traditional staple food, whereas high socioeconomic status was associated with a significantly higher BMI and a three-fold increase in obesity. In another study examining the relationship between education and obesity, household wealth protected against the obesogenic effects of increased household wealth in LMICs [133]. These findings favours the *health penalty theory,* suggesting those with high income may be at a health disadvantage compared to the poor, as they consume, and develop unhealthy diets; however education may act to counter-act this disadvantage.

In summary - for LMICs, in particular, the effects of urban living are linked to rapid economic development [134]. The relationship between urban living and in the development of chronic disease is considerably complex, and dependent upon a multitude of factors, including: increased exposure to risky behaviours; better ascertainment due to increased health care availability and utilisation; and changes in social and economic factors, including access to education.

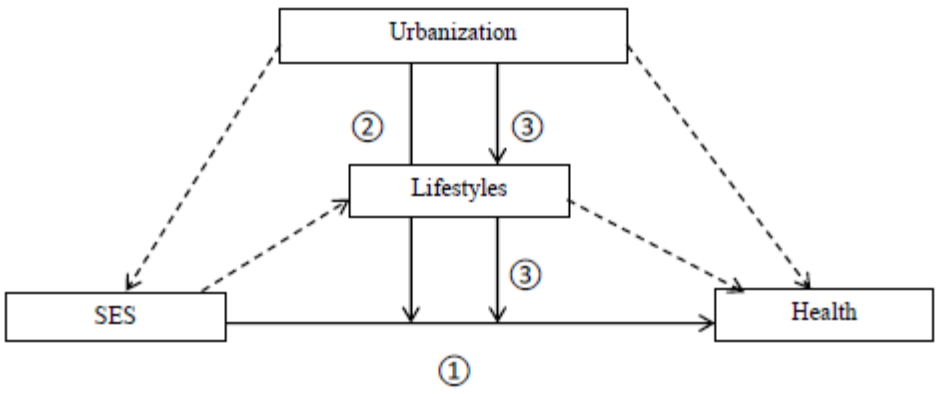


Figure 4-2 Analytical Framework of Urbanization, SES and Health.

(Miao, 2016)

Figure 4.2 shows an Analytical Framework by Maio et al, examining the relationship between urban living, SES and lifestyle; with its primary outcome of "health." In this conceptual diagram, the authors propose a SES- health relationship that varies by urbanisation level (shown as arrow 2) [127]. For example, they propose that people with high income in urbanised areas may have higher health risks than their counterparts in rural areas. According to Cockerham et al., 'lifestyle' is a bridge between both individual and population [135]. For this, Cockerham proposes two theoretical steps. He argues that, in the first step, the environmental conditions - or structural conditions - such as water, sanitation and housing, act to shape lifestyle options. An example is the availability of refined and processed food available in supermarkets over foods forming traditional diets; which may be related to access or cost. In the second step, the individual makes lifestyle choices from their environment based on their social and economic group; he describes this as 'human agency'. From this perspective, we could argue that lifestyles act as a mechanism through which urban living effects SES gradients in health (as shown by arrow 3). Based on this, I have developed a conceptual diagram related to the determinants of multimorbidity covered in this research study. The complex interaction between such determinants can be represented in a simple diagram, considering urban living as an exposure and multimorbidity as the primary outcome (see below). The arrows shown here are similar to those in figure 4.2, but visualised in a more simple way. It is important to note that the pathway between urban living and multimorbidity may be influenced by a number of factors not depicted here. For example, a number of environmental factors – such as air pollution - are not explained through this diagram. Similarly the predisposing genetic factors that act/ or influence lifestyle and health outcomes are also not covered. In the diagram, I have also included health care utilisation as a secondary outcome. The relationship between multimorbidity and health care utilisation is likely bidirectional and complex. The symptoms related to chronic disease and multimorbidity lead to greater demand for health care, and utilisation of health services. Conversely, access to healthcare lead to ascertainment of disease, as well as access to preventative care which may, in turn, act to reduce the burden of chronic disease.

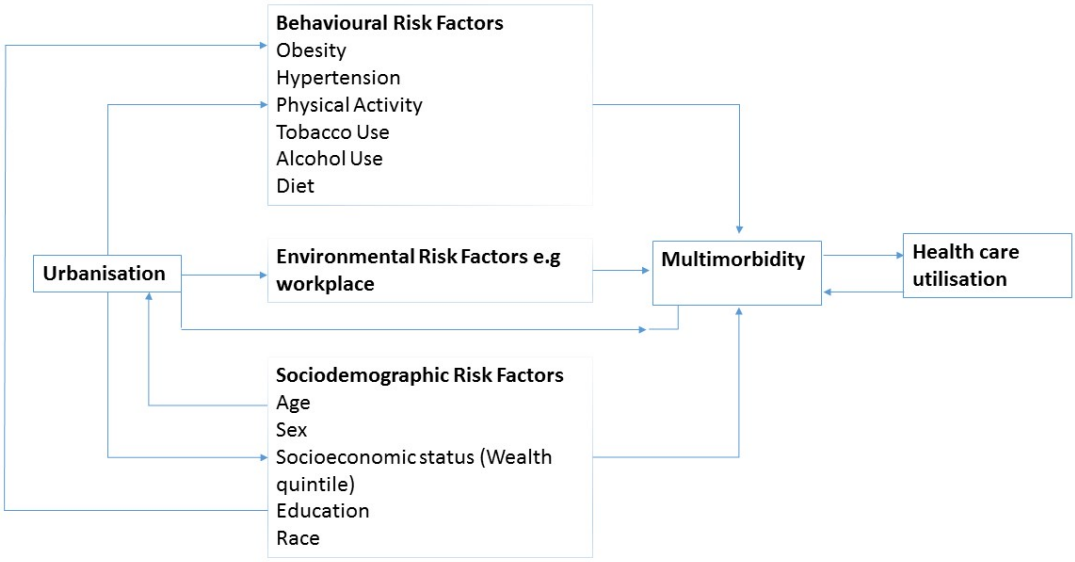


Figure 4-3 Multimorbidity risk factors, using urban living as the primary determinant

4.1.3 Measures of Urban living

In order to measure the effect of urban living on health, we need to look at measures of urban living, both at the *individual* and *area* level. In some studies, urbanisation is looked at in a binary way: whether the individual lives in an urban or rural area. However, this view is often criticised for being simplistic, as it does not consider the length of exposure to the urban or rural environment. The dichotomous view uses arbitrary and crude cut points to classify population density – and therefore mask both intra- and inter- country variations [130]. Furthermore, there is no standardised measure for 'urban' and 'rural;' measures vary across data censuses, making cross country comparisons open to bias. A number of studies use the UN dichotomy of urban/rural based on population density within an area, such as a city or town. Several problems have been described with the UN dichotomy, however, including differing definitions and measurements across different countries [136]. Rather than taking a binary view, it may be more appropriate to use the length of exposure to examine the effect of the urban environment. Length of exposure to environment draws upon life course epidemiology theory –by supposing that exposure to risk, arising from the urban environment, influences outcomes in health over time. However, *individual* measures of 'length of exposure to environment' also have their limitations. On the one

hand they underscore the importance of exposure to the environment, but in doing so assume a static environment. In reality, environments are neither rural nor urban, but are continuously evolving. The measure therefore masks the detail and complexity of the changing environment. For example, if an individual changes exposure (e.g. from rural to urban, or opposite) then it may be difficult to confirm whether this was due to migration rather than a change in the status of the environment. Therefore it is important for measures of urban living to consider *area* measures, such as health, education, housing quality, access to roads etc. Furthermore, since age is a significant determinant of NCD risk, age is also an important consideration for *individual data*. The age composition of both populations – rural and urban – may differ as a result of differential fertility, migratory and mortality patterns etc. Therefore age will confound the relationship between urban living and the health outcome; and age should be considered when interpreting results e.g. age at migration.

In summary, it is important to 'consider urbanization as *a process* rather than a static measure' [130]. The systematic review by Allender et al., found there to be little agreement about how urbanisation can be measured or studied in association with population health or other outcomes. However, measures of urbanisation should consider both individual and area effects of health, and in particular, NCD risk and its confounding variables.

4.1.4 Research Aims

To date, the influence of urban living has been relatively understudied using multimorbidity as its primary outcome. The aims of this chapter are to examine how multimorbidity, defined as two or more chronic conditions, varies by urban living across the SAGE countries (China, India, Mexico, Russia and South Africa).

Research Question1: To examine the social, economic and demographic correlates (includes age, sex, socioeconomic status and education) and behaviour risk factors (obesity and hypertension) of multimorbidity in the SAGE countries

Research Question 2: To examine the association of urban living with multimorbidity and the interaction of SES and urban living

(adjusting for confounders) ; and test the hypothesis that SES modifies the effect of urban living on multimorbidity

4.1.5 The SAGE Countries

The Study on Global Ageing (SAGE) has a specific focus on measuring health, and health-related outcomes. The SAGE countries were chosen as the study focus for a few reasons. Firstly, the SAGE countries were classified as MICs at the inception of the SAGE study. Secondly, the SAGE countries are described as emerging economies undergoing rapid economic change. Such economic change and development, as described in the background, is considered to be a fundamental driver of urbanisation. Since the overall aims of the thesis were to examine the patterns of multimorbidity (including socioeconomic status, education and urban living) in MICs, the SAGE study were both appropriate and relevant to the research questions. The literature review also suggested that there may be differences in the social patterning of multimorbidity, between MICs. The SAGE countries reflected a set of MICs at different stages of development – including those classified as upper MICs and lower MICs. Finally, the SAGE also draws upon, and has built on, the standardized instruments used in the WHS, which means that the datasets were directly comparable; allowing the systematic differences between countries to be examined.

The SAGE has been conducted across several countries, including China, Ghana, Mexico, Russia and South Africa. Outlined below is a summary of the SAGE survey.

Summary of SAGE

Table 4-1 Summary of the objectives, structure, measures and methodology of SAGE

Description	A household panel survey, which follows the same sample of households (and individuals) over time in six middle income countries; includes Ghana, Mexico, India, South Africa, Russia and China.

Objective	To address data gaps on ageing, adult health and well-being in lower and middle income countries To be comparable to surveys conducted in HICs such as the United States' Health and Retirement Study (HRS), English Longitudinal Study of Ageing (ELSA), and the Survey of Health, Ageing and Retirement in Europe (SHARE))
Measures	Measures the health, health-related outcomes and their determinants and impacts in nationally representative samples with an emphasis on populations amongst adults ≥50 years
Sampling Design	Uses national representative samples, which are probabilistically selected from adults 18+ years, with a core focus on adults ≥50 years
Weighting	Sampling weights were generated and adjusted for the population distribution with final post-stratification corrections for non-response.
Chronic Diseases covered	Angina, arthritis, asthma, chronic lung disease, depression, diabetes , stroke + obesity and hypertension (by clinical data)
Waves	SAGE Wave 0 (2002–2004); same as WHS for SAGE countries SAGE Wave 1 (2007–2010) SAGE Wave 2 (2013–2014) SAGE Wave 3 will be implemented in 2015–2016 Fund-raising for SAGE Wave 4 and beyond is ongoing.

For SAGE Wave 0, the WHS of the following six countries were used: Ghana, Mexico, India, South Africa, Russia and China.

For SAGE Wave 1, sample follow-ups were conducted for four of the above countries: Ghana, India, Mexico and Russia.

South Africa chose a new sample based on an updated sample frame from SAGE Wave 0. For China, a new sampling design was drawn from an existing national surveillance system. SAGE Wave 1 used two target populations: a large sample of persons aged 50 years and older, which is the focus of the study, and a smaller comparative sample of persons aged 18–49 years.

The SAGE survey and instruments were adapted from those used in the WHS, assessing health systems and health status from the perspective of the individual and the household. SAGE also evaluated perceptions of well-being and more objective measures of health, including measured performance tests; near and distance vision; grip strength; biomarkers, such as blood pressure and pulse rate; height and weight; hip and waist circumference; and, blood spot from a finger prick.

Standardized SAGE survey instruments were used in all countries consisting of five main parts: 1) household questionnaire; 2) individual questionnaire; 3) proxy questionnaire; 4) verbal autopsy questionnaire (VAQ); and, 5) appendices including show cards.

4.1.6 Health Profiles of SAGE Countries

Table 4.2 summaries the key health indicators in the SAGE countries, including life expectancy and NCD burden, as well as health system coverage. There were some striking similarities and differences. First, all countries are upper middle income countries, expect Ghana and India – both LMICs. Second, the percentage of people living in urban areas was particularly high in Mexico, at 78.1%, and in Russia, at 74%. Third, in India the percentage living in urban areas was low compared to other countries, at 32%. Fourth, life expectancy was particularly low - 59 years, in South Africa. Fifth, across all countries the burden due to NCDs was at least 40%, although it was a high as 86% in Russia and 87% in China. Finally, the estimated % of all-cause mortality from cardiovascular disease ranged from 18% in Ghana and South Africa to as high as 60% in Russia.

In the next section I have summarised some of the literature with matters related to achieving universal health coverage, the organisation of the health system health financing and equity; for each country.

4.1.6.1 China

In terms of their universal health coverage, China recently introduced policies – which have resulted in substantial progress to this ends. China established a New Cooperative Medical Scheme (NCMS) in 2003, which sought to reform a health care system predominantly based on market principles and to provide access to healthcare in rural areas [137]. They committed to providing affordable basic healthcare for all Chinese people. China currently has three main health insurance schemes, which include urban employee insurance, an urban residence medical scheme and a rural cooperative medical scheme (RCMS). Initially the scheme was part funded by the household, around 20%, although the service package has since been extended and co-payment has gradually reduced [138]. Current estimates suggest that China spends approximately 5.7% of their GDP on health care. However, recent studies suggest that despite the government- subsidized insurance system, the intended equity goals were difficult to realise, and that there are still major differences in healthcare access between the rural poor and those in the affluent cities [139]. Rural infant mortality rates are nearly five times higher in the poorest compared with the wealthiest communities—123 versus 26 deaths per 1000 livebirths, respectively [140]. Furthermore, market failures and insufficient government stewardship, as well as on-going needs for out-of-pocket payments, are also widening the equity gap between the rich and poor.

Table 4-2. Key health and demographic statistics across SAGE countries in China, Ghana, India, Mexico, Russia and South Africa.

Country	China	Ghana	India	Mexico	Russia	South Africa
Estimated Population in 2015*	1.4 billion	26.8 million	1.3 billion	125 million	143 million	54 million
Income Classification	Upper-middle income country	Lower-middle income country	Lower-middle income country	Upper-middle income country	Upper-middle country	Upper middle income country
Percentage of population living in urban areas	50%	53%	32%	78.%	74%	62%
Life Expectancy at Birth	75 years	62 years	66 years	76 years	69 years	59 years
Estimated percentage of all-cause mortality due to NCDs	87%	42%	60%	77%	86%	43%
Estimated percentage of all-cause mortality due to cardiovascular disease	45%	18%	26%	24%	60%	18%

Notes: Estimates based on World Bank Statistics, 2015. Other demographic and health estimates based on WHO estimates

4.1.6.1.1 Ghana

As in many other African countries, Ghana is afflicted with the double burden of both chronic and infectious diseases. The current leading causes of death include hypertension, stroke, diabetes and cancers. In 2004, Ghana introduced a National Health Insurance Scheme (NHIS), with the aim of achieving universal health coverage. The NHIS replaced the earlier cash and carry system, which had a negative impact on the access of health care,

particularly for the poor. By the end of 2011, 33% of the Ghanaian population had been covered by the scheme. A recent assessment showed that approximately 73% of households, whose members were insured under the NHIS, have their chronic disease healthcare covered [141]. Despite the move towards universal health coverage, the NHIS excludes a number of health services that deal with chronic disease, including detection and treatment of cardiovascular diseases and some cancers. A recent assessment on the effectiveness of the NHIS suggests that those who have their healthcare costs covered by their household are mostly of lower socioeconomic status. The assessment also showed that a higher number of individuals unable to afford the premiums were from rural areas, which indicate that the NHIS might not be providing equitable coverage [142].

4.1.6.2 India

Cardiovascular disease is the leading cause of death in India. Health in India is the responsibility of the state, local and also central government. Although healthcare has emerged as one of the largest service sectors in India, with 4% of its GDP spent on healthcare, the majority of healthcare services are provided by the private sector: 70% of hospitals are private. Despite improvements made to healthcare access in recent decades, there are regional imbalances in the level of infrastructure available. Under 5 mortality rates vary hugely; in Uttar Pradesh, it is reported at approximately 100 per 1000 population, and in Goa, it is 20 per 1000 population [143]. Furthermore, there is a wide preference for private healthcare, particularly for the middle class, whose purchasing power is driving growth of corporate private providers. Evidence suggests that access to the most basic healthcare is declining and, despite its major advances in eradicating a number of communicable diseases such as polio, unsanitary conditions are causing a rise in communicable disease. Out-of-pocket expenditures is rife and, as a result, the country's poorest are unable to access healthcare. Insufficient public financing is a key factor affecting equity in health financing, and only 10% of the population are under any form of social or voluntary health insurance. For individuals who need it most, access to healthcare in India is often unmet. It is widely accepted that gender equalities exist, with a wide number of unreported morbidities amongst women and less treatment use[144].

4.1.6.3 Mexico

Since establishing their Ministry of Health in 1942, Mexico provided a social security system which, in large, covered public-sector employees and their families. Up until 2003 a large number of people, mostly the poor, were not covered by social security; instead, they were covered by an 'ill defined benefit package.' In 2003 Mexico made some major reforms through the introduction of a General Health Law, which established horizontal integration of stewardship, financing and service delivery; and sought to reform the segmentation of the population groups. A Population Health Insurance was set up, offering free care at the point of delivery to a number of health- care interventions. Federal taxes currently forms the major source of funding, with a small premium paid by families, proportionate to family income. The poorest quintile of the population are exempt from contribution. With a primary focus on the MDGs, the health service reforms have also been useful in dealing with NCD risk factors, namely obesity, hypertension, diabetes and cancer [145]. As a result of these reforms, inequities in the distribution of public resources among states have been reduced, guaranteed health coverage has been given to approximately 50% of Mexicans who were not previously in traditional insurance programs, primary health care utilisation has increased, and health care related bankruptcy has been reduced by 20%. Despite these outcomes a number of challenges still exist: notably, additional public funding is needed to replace out-of-pocket expenditures, particularly for complex interventions; the distribution between the regions need to be balanced; and the health system should adequately respond to the needs of the patient by providing access to high quality treatment and care.

4.1.6.4 Russia

Russia has a predominantly public health care system. Recent estimates suggest a mere 10% of patients selected private outpatient providers. The Russian healthcare system was based on the Shemashko system, which was organised around the universal guiding principle of healthcare free at the point of use. The fall of the Soviet Union, in 1991, however, caused a major collapse of the health system although the situation began to improve [146]. In 1993, a mandatory health insurance (MHI) system was introduced, which meant that employers needed to contribute to health insurance at a rate of 5.1%. The regional budgets, from the government, currently cover the nonworking population. The

benefit package covered with the MHI includes outpatient and inpatient care. However, tertiary and specialised health care are not included in the package, making out-of-pocket payment for these services a norm. Russia has a remarkably low mortality – compared to other middle income countries – which is largely related to lack of access to higher tertiary care, making the effects of alcoholism and cardiovascular disease, both rife in the country, ever-more problematic[147]. It is also commonplace to make informal payments, as well as tips, making access to healthcare unequal at the point of use[148]. Recently there have reported disparities between urban and rural residents, with very little or no access to medical care in remote rural areas and long distances for commuting. This comes as a result of the government's "optimisation strategy", which aimed to reduce waste and eliminate smaller facilities, favouring larger hospital care[149]. Recent budget slashes have reduced the quality of care, and created a dichotomy of inefficient public services versus better quality private care.

4.1.6.5 South Africa

Together communicable disease (including HIV) and maternal, perinatal and nutritional conditions, often referred to as the diseases of poverty, account for approximately 48% of all deaths[150]. South Africa is therefore greatly afflicted by a double burden of disease. The HIV epidemic has also widened the pre-existing health inequalities that arose from South Africa's turbulent history. Even in the post-Apartheid era, health inequalities are rampant; in 2004 life expectancy ranged from 64 years for white people to 49 years for black people[151]. In South Africa there is a constitutional obligation for the individual right to health. Despite this, the country remains deeply divided by the rich, affording quality private healthcare, and the poor, who depend on the low resourced public sector. In 1994, following Apartheid, there was a major improvement in the access to basic health care. However, the 8.5% of GDP in health care expenditure was mostly invested into resources for private healthcare, whereas the public sector funds have largely stagnated. Even though 15% of the population are members of private sector medical schemes, 46% of health-care expenditure is attributable to these schemes[152]. Approximately 20% of the population access the private sector on an out-of-pocket basis, mostly for primary care, but are dependent on the public sector for hospital care. There has, however, been considerable progress made in redistributing resources between geographic regions and different levels of care through the post-1994 government. Even though there remains an integrated comprehensive national service, there are a number of

key challenges; notably the insufficient political will and leadership needed to manage the underperformance of the public sector[153].

4.2 Methods

This section outlines the methods used during survey design and collection. I have presented the key measures and variables; by describing the selected survey variables and how I developed the dummy variables. I have also explained the model used for further analysis and the statistical methods used to apply this model.

The survey method used randomised cluster sampling to ensure that a nationally representative sample was drawn from the population. The SAGE used the same sampling methodology as the World Health Survey, described in the previous chapter (see Appendix E). After data collection, post-stratification weights were applied to account for non-response. For the SAGE, household weights were post-stratified by province and locality for each country. Individual weights were post-stratified by province, sex and age-groups. Since the post stratification weights only accounted for locality (province), sex and age, there may still be bias arising from missing data (non-response) from other variables of interest. In order to understand this, I examined the degree of missingness for the variables of interest to understand how the populations differed, and therefore examine the generalizability of the results to the national population. If there was >50% missing for the selected variables, across the dataset, then the study sample was omitted. This was determined as an arbitrary cut-off point; higher percentages of missingness would increase the risk of response bias.

4.2.1 Measures and variables

4.2.1.1 Study of Global Ageing (SAGE)

Table 4-3. Summary of selected variables from SAGE Wave

Urbanicity	Residence (urban or rural), how long they have been living in this area (number of years) *

Social, economic and demographic risk factors	Age, sex, wealth, education (less than primary, primary, secondary and higher)
Behavioural risk factors	Obesity (measured using BMI), hypertension (measured using anthropometric results), hypertension (doctor diagnosed) (See below)
Health Care Utilisation **Health Care Access**	Use of secondary care in last three years (y/n); Use of primary care in the last three years (y/n) Last time you needed care did you get healthcare (y/n)
Multimorbidity; based on two or more conditions from:	Angina, arthritis, asthma, chronic lung disease, diabetes, depression, stroke (all binary variables) (all based on self-report)

*** See table 4.4 for more information about how urban/ rural was determined by country**

Table 4-4. The definitions of urban and rural by country

Country	**Definition of urban or rural**
China	Urban and rural defined by administrative district in the national sampling frame
Ghana	The rural area is defined as less than 5000 habitants
India	Rural areas defined by status as "villages." Urban areas defined by status as "wards".
Russia	Urban settlements defined as legally established populated areas such as cities, towns and urban-type settlements (industrial communities, recreation zones, summer cottages). All remainder settlements are considered as rural ones. The category of cities (towns) in the Russian Federation includes, as a rule, settlements

	with at least 12 000 inhabitants of whom not less than 85% consist of workers, employees and their family members.
South Africa	Defined by area type and service provision urban formal, urban informal, rural formal and rural informal. Semi-urban areas are classified as rural. An urban area is one which has been legally proclaimed as being urban e.g. towns, cities and metropolitan areas.

(Adapted from Oyebode et al. 2015) [154]

Chronic Disease

To determine whether the individual had the disease, they were simply asked: "Has the doctor ever diagnosed you with…….?"

Economic risk factors – Wealth

The variable for wealth was derived from dwelling characteristics (such as types of floor, walls and cooking stove), household ownership of durable goods, as well as access to services such as improved water, sanitation and cooking fuel. A total of 21 assets were included for this category, with overlaps and differences in the assets lists noted for each country. Durable goods, for example, may include number of chairs, tables or cars. Based on the multiple items per household, an asset ladder was generated. An asset ladder is essentially a scale, going from least assets to most assets. Using a Bayesian post-estimation method, households were arranged on the asset ladder, such that the income estimates were transformed into five equally spaced categories (Ferguson et al. 2003). This meant that the wealth variable mapped relative wealth, for each country. As the asset ladders were all country specific this means that, when pooled, the estimates will account for country-specific differences.

Behavioural Risk Factors

Both obesity and hypertension (measured) were calculated from the anthropometric measurements in the survey dataset. The methods of their measurement are outlined below.

Obesity

The presence of obesity was based on an individual's BMI. In the questionnaire, measurements were taken for the respondent's height and weight. From these measurements, BMI was calculated based on the following:

BMI = Weight (kg) / Height m ^{2}

If BMI was greater or equal to 30 then the individual was defined as obese. The presence of obesity was then coded as a dichotomous variable: "yes" or "no"

Hypertension (measured) The presence of hypertension was determined by calculations of an individual's systolic and diastolic pressure. Each person had their blood pressure measured three times by the interviewer (commonly a retired or unemployed nurse). These measurements were then used to calculate an average, based on all three measurements. Hypertension was calculated based on the following:

Hypertensive= Average systolic of greater or equal to 140 ***OR*** *average dystolic of greater or equal to 190*

If neither conditions applied, then the individual was not hypertensive. The presence of hypertension (measured) was then coded as a dichotomous variable: "yes" or "no"

Length of exposure to urban or rural living environment

Length of exposure to the environment is considered to be an alternative measure to the simple dichotomous measure of urban or rural (Sobngwi et al. 2003). Based on this understanding, I attempted to examine the length of exposure to the environment based on:

- The name of setting in sampling key (either urban or rural)
- How long the individual had been living there (in years)

For all individuals, I was able to ascertain whether they lived in a rural or urban area. A further subset of individuals responded to the following question:

- How long have you been living in their current residence (classified as either urban or rural) in years?

Using the pooled dataset, a further analysis was undertaken to examine how multimorbidity was distributed by length of time spent living in either urban or rural environment (in years).

4.2.2 Statistical Analysis

Using survey weights, survey estimates were used to calculate prevalence measures and extract nationally representative samples, accounting for non-response. For the descriptive analyses of pooled data, estimates were weighted according by survey size. World-standardised measures of multimorbidity prevalence were calculated for each country, by using the world standard for both age and sex. See Appendix E. Odds ratios (OR) and 95% confidence intervals (CI) are presented, with $p<0.05$ taken as statistically significant, unless stated otherwise. All other prevalence estimates were calculated as point estimates, and using the 'svy' function. The normality of the distributions, for BMI and blood pressure, were tested using the Shapiro-Wilk test. All analyses were done using Stata version 12. Confidence intervals have been calculated based on recommendations for crude and age-specific point estimates [105]. Consistent with chapter 3, age was grouped by 18-49 years, 50-64 years and 65+ years; in order to examine stratum specific differences.

To examine the prevalence of social, economic and demographic correlates, as well as behaviour risk factors of multimorbidity (research question 1): (i) the prevalence of morbidities, co-morbidities and multimorbidity were estimated, then (ii) the estimated prevalence of multimorbidity, within each category of selected social, economic and demographic factors were estimated; and finally (iii) the odds ratios, adjusted for age and sex, were calculated for each factor.

To examine the association of urban living with multimorbidity (research question 2): (i) the prevalence distributions were then compared across the categories, and chi-squared statistics were estimated. An arbitrary cut-off point of 2% was used to summarise the

difference between the two values (urban and rural). If the difference between the two values was less than 2%, then 'U=R'.

Next, (ii) to account for the hierarchical nature of the data within the countries, a random effects logistic regression model was fitted for the analysis over and above a linear regression model. .

The full model takes the form of:

$$\text{Logit}\,[2\,U_j)] = \beta 0 + \beta 1 X1_{ij} + \beta 2 X2_{ij} + \beta 3 X3_{ij} + U_j + e_{ij}$$

Where;

$_i$ is the individual

$_j$ is the country

β0 is the random intercept;

$\beta 1\ X1_{ij}$ is the cluster specific effect of education;

$\beta 2 X2_{ij}$ is the cluster specific effect of age;

$\beta 3 X3_{ij}$ is the cluster specific effect of sex etc. etc.

U_j is the random intercept which alters by countries j

e_{ij} is the random error for individuals i in country j

In the multivariable analysis using the pooled tables, interaction terms were fitted to examine the specific interactions. For example, to test for the interaction between country level and urban living an interaction term was fitted in the final model. Only significant interactions were held in the final models.

4.3 Results

The results are described below. First, I have listed the variables of interest (social, economic, demographic and behavioural risk factors) and examined the extent to which the participants responded to these questions. The full table, outlining the degree of missingness, is shown as Appendix G, using variables of interest. Second, I examined the

multimorbidity prevalence within the datasets. I analysed the standardised multimorbidity prevalence by country, and examined research question 1:

"How does multimorbidity vary by social, economic and demographic correlates (age, sex, socioeconomic status and education) as well as behavioural risk factors (obesity and hypertension)?"

Third, I examined the urban- rural distributions of the variables of interest. Fourth, using a subset of questions that determined how long the respondent had lived in their residence (urban/ rural), I examined the effect of exposure to environment on multimorbidity

Finally, I studied research question 2: "to examine the association of urban living with multimorbidity and the interaction of SES and urban living (adjusting for confounders); and test the hypothesis that SES modifies the effect of urban living on multimorbidity"

4.3.1 Country characteristics (SAGE 1): Missingness and Distribution.

4.3.1.1 Missingness.

The response rate differed between countries, and for different variables. Across all countries, except for Mexico, age sex, residence and wealth had high response. The variable on 'highest level of education achieved' had a relatively poor response rate however, with 50%, 55% and 60% missing data across Ghana, India and Mexico respectively. Similarly the anthropometric measures were not available in more than 55% of respondents in India and Mexico, which meant that there was high missing data on obesity status. Finally, the question that looked at whether an individual had medication or treatment in the last two weeks, or twelve months, was not well responded across all countries. Mexico, however, had very high missing data across all variables, ranging from 35.3% on wealth to 84% on treatment for hypertension. For the key social, economic and demographic variables, such as age sex and residence, missing data was around 50%. (See Appendix G). Owing to high missing data, Mexico was omitted from further analysis.

4.3.1.2 Distribution.

The individual country characteristics for the SAGE 1, and the summary of their missingness, are shown in Table 4.5. In total 32566 individuals were used in the analysis. The variables of interest including social, economic, demographic and behavioural risk factors; as well as health care access are reported in the Table 4.5. Survey weightings have been applied to allow for non-response, and to be generalizable to the national population according to a number of selected characteristics (see Methods section). The SAGE included a post-stratification factor weighting, similar to that used in the WHS (see chapter 3). Post stratification used the most recent estimates (2007-2010) provided by the national statistical offices of the respective countries. Both household and individual post-stratification weights were provided. The individual post-stratification factor was used in this analysis, which adjusted and accounted for estimates by region, locality, sex and age-groups.

The population age structures differed across the countries, with a mean percentage of 72.7% in those aged 18-49; 12.6% in those aged 50-59; 8.1% in those aged 60-69; and 6.7% in those aged 70+. There were some striking similarities and differences across the countries. Overall, the mean percentage of females was 50.9% versus 49.1% for males. Compared to the 53.5% mean urban population, the mean rural population was lower at 46.5%. In China and Ghana the urban-rural population distribution was more or less equal; whereas in countries such as Russia and South Africa, the majority lived in urban areas. Interestingly, India had a high percentage of people living in rural areas, at 74%. For all countries, there was a positive gradient which was also observed in the mean for all countries. In other words, there were an increasing number of individuals in the highest category within the dataset. This suggests that there may have been some oversampling of the highest wealth category (quintile 5). Another interesting finding was the absence of a distinctive education gradient across the countries. For all countries, however, there were few individuals in the highest education category (higher education); the mean was 1.8%. In most countries, respondents were educated to at least primary school level, followed by those educated to at least secondary school level.

In terms of the behavioural risk factors, there were some intriguing differences. First, compared to other countries, the prevalence estimates of obesity were particularly high in South Africa, around 35.6%. In contrast, the obesity estimate in China was very low, at 4.3%. This finding is consistent, however, with estimates found in a nationwide survey in 2007; which reported adult obesity (ages 18-69) at 3.1% [155]. Also doctor diagnosed hypertension

was particularly high in Russia, at 27%, as compared to other countries. Across all countries the prevalence of measured hypertension was much higher than the diagnosed hypertension.

In terms of health care access, across all countries, primary care was used more frequently than tertiary care, as may be expected. Mean tertiary care utilisation within the last three years was 13.3% and primary care utilisation within the last twelve months was 58.7%. Finally, I compared access to healthcare, and whether they were able to access healthcare when they last needed it, across urban and rural settings. There appeared to be higher healthcare access in urban areas, which were consistently higher in two countries: Russia and South Africa. Overall, the mean access to healthcare was 56.7 % in urban areas versus 38.9% in rural areas.

Table 4-5. Country characteristics of SAGE, showing distribution by country and across all countries

	China			Ghana			India			Russia			South Africa			Pooled
	M,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M ,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	Dist, %
N		15050			5573			12193			4947			4227	41990	32566
Country weight		0.4			0.1			0.3			0.1				0.1	
Age group	0.3			0.1			0			12			0.1			
18-49		74.1	0.1		74.4	9.9		74.8	21.7		58.7	6.9		75.9	7.6	72.7
50-59		11.7	4.2		10.4	1.4		12.3	3.6		18.7	2.2		12	1.2	12.6
60-69		8.2	26.6		7	0.9		7.7	2.2		10.2	1.2		7.4	0.7	8.1
70+		6	2.2		8.3	1.1		5.2	1.5		12.5	1.5		4.7	0.5	6.7
Sex	0.3			0.1			0			12		0	0.1			
Male		50.9	18.2		49.6	6.6		49.7	14.4		45	5.3		47.2	4.8	49.3
Female		49.1	17.6		50.4	6.7		50.3	14.6		55	6.5		52.8	5.3	50.7
Residence	0			0			0			25.1		0	0.1			
Urban		48.7	17.6		46	6.1		25.7	7.5		81.5	9.6		69.3	7	47.7
Rural		51.3	18.4		54	7.2		74.3	21.6		18.5	2.2		30.7	3.1	52.4

	China			Ghana			India			Russia			South Africa			Pooled
	M,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M ,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	Dist, %
Wealth Quintiles	0.7			0.2			0.6		0	0.1		0	0.6			0
Quintile 1 (lowest)		9.9	3.5		15.1	2		20.3	5.9		12.7	1.5		18.9	1.9	14.8
Quintile 2		15.9	5.7		18.2	2.4		21.2	6.2		12.8	1.5		19.5	2	17.7
Quintile 3		18.3	3.5		19	2.5		19.9	5.8		16.5	1.9		20.5	2.1	15.9
Quintile 4		23.4	8.4		22.4	3		21.2	6.2		23.5	2.8		19.4	2	22.2
Quintile 5 (highest)		32.6	11.7		25.3	3.4		20.3	5.9		34.5	4.1		21.8	2.2	27.2
Education	24.1			54.9			49.6		0	12.9		0	36.7			
Less than primary		34.2	12.3		15.4	2		21.2	6.2		10.1	1.2		28.8	2.9	24.5
Primary		33.7	12.1		46.6	6.2		44.7	13		2.8	0.3		32.7	3.3	34.9

	China			Ghana			India			Russia			South Africa			Pooled
	M,%	**Dist, %**	**Dist, % (All countries)**	**M, %**	**Dist, %**	**Dist, % (All countries)**	**M, %**	**Dist, %**	**Dist, % (All countries)**	**M ,%**	**Dist, %**	**Dist, % (All countries)**	**M, %**	**Dist, %**	**Dist, % (All countries)**	**Dist, %**
Secondary		32	11.5		37.6	5		30.3	8.8		87	10.2		36.1	3.6	39.1
Higher		0.2	0.1		0.4	0.1		3.8	1.1		0.1	0		2.5	0.3	1.5
Obesity	62.8	4.3	1.5	10.8	18.6	2.5	57.5	12.6	3.7	21.3	20.4	2.4	5.3	35.6	3.6	13.7
Hypertension (measured)	57.2	16.5	5.9	9.8	17.5	2.3	9.2	2.6	52.8	15	17.7	2.1	3.1	28.3	2.8	66
Hypertension (doctor diagnosed)	4.1	11.5	4.1	8.6	7.1	0.9	8	9.3	2.7	12	27	3.2	4,6	9.8	1	11.9
Medication or treatment (last two weeks)	76	76.5	27.4	76	57.5	7.6	87.7	51.3	14.9	54.4	71.9	8.5	72.7	73.1	7.4	65.8

	China			Ghana			India			Russia			South Africa			Pooled
	M,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M ,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	Dist, %
Medication or treatment (last twelve months)	76	81.1	29.1	76	67.9	9	87.7	32.9	9.6	54.4	88.5	10.4	72.7	75.2	7.6	65.6
Health care utilisation			0						0			0				
Tertiary care (last 3 years)	24.8	15.7	5.6	16.4	12.7	1.7	18.2	13.5	3.9	26	21.3	2.5	19.4	10.6	1.1	14.8
Primary care (last 12 months)	23.9	60.9	21.8	16.5	61.5	8.2	18.2	85.5	24.8		70.4	8.3		48.3	4.9	68

	China			Ghana			India			Russia			South Africa			Pooled
	M,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	M ,%	Dist, %	Dist, % (All countries)	M, %	Dist, %	Dist, % (All countries)	Dist, %
										26			19.4			
Healthcare access	24.9	94.2	33.8	16	88.2	11.7	18.2	98.8	28.7	26	97.7	11.5	18.6	95.4	9.6	95.3
Urban		41.4	14.8		43.3	5.7		32.2	9.4		78.8	0		69	6.9	36.9
Rural		52.9	19		44.8	5.9		66.6	19.3		18.9	2.2		26.3	2.6	49.1

* Notes: 1) Country individual weights applied to individual country sets; with post-stratification factor 2) M = Missing; 3) Dist = Distribution 4) Pooled data weighted by country survey size (without Mexico)

4.3.2 Distribution of morbidities – SAGE 1

Table 4-6. Weighted prevalence of morbidities using SAGE; by sex and country*, % with confidence intervals

	China		**Ghana**		**India**		**Russia**		**South Africa**	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
3 or more morbidities	0.4 (0.2 - 0.8)	0.4 (0.3 - 0.5)	0.05 (0.0 - 0.1)	0.2 (0.1 - 0.3)	1 (0.6 - 1.6)	0.5 (0.3 - 0.9)	1.3 (0.8 - 2.1)	3.2 (2.3 - 4.6)	0.4 (0.2 - 0.7)	1.1 (0.6 - 2.0)
2 or more morbidities	2.1 (1.5 - 3.0)	2.3 (1.7 - 3.1)	0.6 (0.4 - 0.9)	0.7 (0.5 - 0.8)	3.8 (2.9 - 4.9)	2.3 (1.8 - 2.9)	4.3 (2.6 - 6.9)	8.6 (6.6 - 11.2)	1.2 (0.8 - 1.6)	3.2 (2.3 - 4.4)
Angina	1 (0.5 - 1.8)	2.1 (1.5 - 2.8)	0.5 (0.3 - 0.7)	1.1 (0.6 - 1.9)	1.9 (1.3 - 2.7)	1.4 (1.1 - 1.8)	6.4 (4.1 - 9.9)	9.9 (7.3 - 13.3)	0.6 (0.4 - 0.9)	2.3 (1.2 - 4.1)
Arthritis	5.2 (3.6 - 7.3)	7.1 (5.6 - 8.8)	2.2 (1.5 - 3.2)	3.2 (2.5 - 4.2)	5.3 (4.2 - 6.6)	6.7 (5.7 - 7.8)	5.2 (3.3 - 8.2)	13.2 (10.1 - 17.1)	2.4 (1.9 - 3.1)	6.1 (4.6 - 8.1)
Asthma	0.6 (0.3 - 1.2)	0.3 (0.2 - 0.4)	0.9 (0.5 - 1.5)	1 (0.6 - 1.7)	2 (1.3 - 2.9)	1.8 (1.1 - 2.7)	0.3 (0.2 - 0.6)	0.8 (0.5 - 1.3)	0.7 (0.5 - 1.1)	1.4 (0.8 - 2.3)
Chronic Lung Disease	2.1 (1.5 - 2.9)	1.6 (0.9 - 2.7)	0.3 (0.1 - 1.1)	0.06 (0.0 - 0.1)	1.5 (1 - 2.3)	0.6 (0.4 - 0.8)	3.8 (2.6 - 5.6)	5.5 (4.1 - 7.5)	1.9 (0.4 - 9.6)	0.7 (0.3 - 1.5)
Depression	0.0 (0.0 - 0.1)	0.3 (0.1 - 1.4)	0.5 (0.2 - 1.3)	0.3 (0.2 - 0.4)	4.2 (3.0 - 5.8)	1.9 (1.2 - 2.9)	1.2 (0.6 - 2.5)	1.5 (1.0 - 2.2)	0.4 (0.2 - 0.7)	4.5 (1.9 - 10.4)
Diabetes	1.5 (0.8 - 2.7)	1.7 (1.2 - 2.4)	0.7 (0.4 - 1.3)	1.6 (1.1 - 2.6)	2 (1.5 - 2.8)	1.2 (1.0 - 1.5)	0.9 (0.6 - 1.4)	2.6 (1.7 - 3.9)	1.1 (0.7 - 1.9)	2.2 (1.5 - 3.2)
Stroke	0.4 (0.3 - 0.5)	0.4 (0.2 - 0.6)	0.8 (0.4 - 1.7)	0.5 (0.2 - 1.2)	0.2 (0.1 - 0.4)	0.3 (0.2 - 0.6)	1 (0.5 - 2.1)	1.4 (0.8 - 2.5)	0.4 (0.2 - 0.7)	1 (0.6 - 1.9)

The world standardised multimorbidity prevalence (2 or more morbidities) ranged from 1.4% in Ghana and 10.7% in Russia. The distribution of morbidities are shown as Table 4.6, categorised by sex, and Figure 5.4, showing total prevalence. Figure 5.4 shows that the prevalence of having 3 or more morbidities, angina, arthritis, chronic lung disease and stroke were highest in Russia. In contrast, asthma prevalence was lowest in Russia, and highest in India. Depression prevalence was also highest in India, whilst being very low in both Ghana and China. As for the sex differences, seen in Table 4.6, there were some striking similarities and differences. First, both angina and arthritis prevalence were consistently higher amongst the female population across all countries, except for India; where the prevalence of angina was slightly lower amongst women than men. Second, chronic lung disease prevalence was consistently higher amongst the male population across all countries, expect for Russia. Third, there were inconsistencies in the distribution of multimorbidity. In both Russia and South Africa, prevalence was consistently higher amongst females; in India prevalence was higher amongst males; and in both China and Ghana patterns were similar across males and females.

4.3.3 Distribution of multimorbidity by risk factors - SAGE 1

The distribution of multimorbidity by risk factors is reported in Table 4.7; these estimates have not been adjusted for age and sex. The univariable analysis, adjusted for age and sex, is shown as table 5.8. Across all countries, apart from China and India, multimorbidity prevalence (unadjusted, see table 4.7) was highest amongst the rural population compared to the urban population. This difference was highest in China, where the urban prevalence was 4.0% and the rural prevalence was 2.4%; followed by South Africa, where the urban prevalence was 4.6% and the rural prevalence was 3.4%.

Across all countries there was a positive age gradient in multimorbidity. In Russia, for example, the multimorbidity prevalence was 3.7% amongst the age category 18-49 years and 39.2% amongst the age category 70+. When adjusted for sex, the age gradient is still observed, as shown in Table 4.8. The prevalence estimates of multimorbidity by wealth differed for all countries. No distinctive gradient was observed, except for South Africa, where the multimorbidity prevalence was 3.5% among the lowest wealth category and 10.2% in the highest wealth category.

There was not a distinct education gradient for those with multimorbidity. However in the sex/age adjusted analysis, primary school education and below was associated with an increased risk of multimorbidity in India. Higher education also had a 'protective effect' in South Africa, although the results were not significant. For all countries multimorbidity prevalence was highest amongst those with measured obesity and doctor diagnosed hypertension. For example, in China, 11.1% of the obese population had multimorbidity *versus* 2.8% among the non-obese population. In Russia multimorbidity amongst those with doctor diagnosed hypertension was 32.8% *versus* 5.5% without. The differences between multimorbidity prevalence among hypertensives and non-hypertensives, using measured data, were less pronounced across all countries.

Across all countries, the percentage of multimorbid individuals who accessed primary care and secondary care was higher than those who did not access care. In India, for example 12.8% of their multimorbid population accessed tertiary care in the last three years, as compared to 5.7% who did not access tertiary care. There were several intriguing differences within the univariable data. First, Russia had a high multimorbidity prevalence of 10.7%, compared to other countries. Secondly, multimorbidity prevalence was consistently higher amongst females, expect for in India where the multimorbidity prevalence was 7.6% amongst males and 4.6% amongst females; and the odds ratio, comparing females to males, and was 0.5 and statistically significant. Thirdly, the rural urban differences were inconsistent across countries. Multimorbidity was higher in urban areas of China and South Africa, equal in Ghana, and higher in rural areas of India and Russia. Multimorbidity was associated with 2.1 odds ratio in urban areas of China, compared to its rural areas. Fourthly, in Russia there was a stark difference in multimorbidity prevalence amongst the hypertensive and obese populations compared to the non-hypertensive and non-obese populations. Finally, use of both tertiary and primary care were associated with a statistically significant odds ratio in all countries, expect for in India; where only tertiary care was associated with an increased risk.

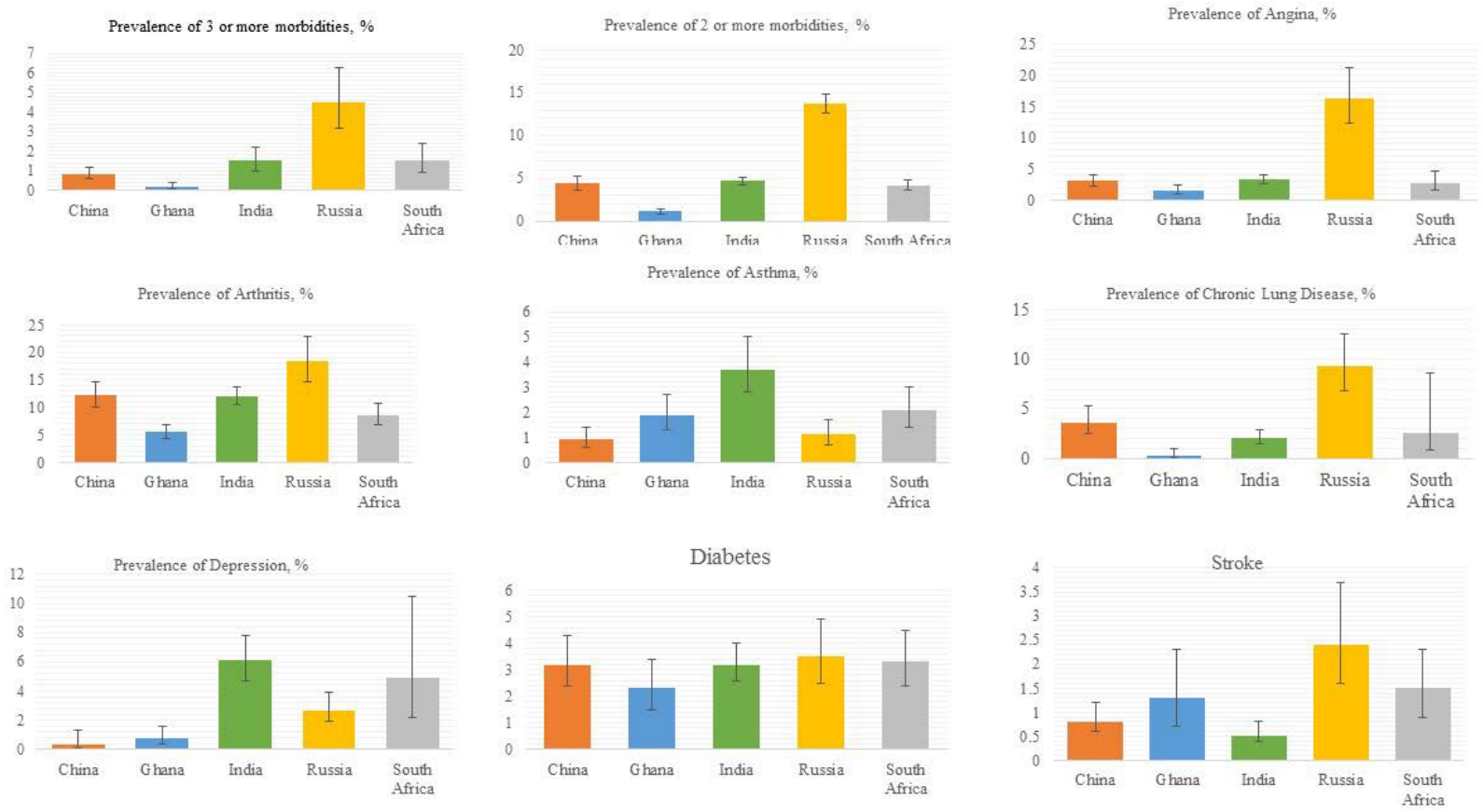


Figure 4-4. Morbidity patterns across SAGE

Table 4-7. Weighted Multimorbidity prevalence (2 or more conditions) by variables under interest using SAGE; by country*, % with confidence intervals

	China	Ghana	India	Russia	South Africa
Overall (weighted)	4.35 (0.07 - 4.68)	1.22 (0.93 - 1.51)	4.69 (4.29 - 5.09)	13.8 (12.7 - 14.8)	4.2 (3.6 - 4.8)
World standardised	4.2 (3.6 - 4.8)	1.4 (1.1 - 1.7)	5.0 (4.3 - 5.7)	10.7 (8.8 - 12.9)	4.7 (4.0 - 5.4)
Age group					
18-49	1.0 (0.42 - 2.5)	0.1 (0.0 - 0.4)	4.0 (0.3 - 5.4)	3.7 (1.9 - 7.2)	1.8 (0.2 - 4.8)
50-59	4.3 (3.4- 5.5)	2.3 (1.5 - 3.5)	9.6 (7.4 - 12.2)	17.5 (10.1 - 28.6)	8.9 (7.0 - 11.4)
60-69	13.1(10.8- 15.9)	4.4 (3.2 - 6.0)	13.6 (9.9 - 18.4)	26.4 (22.0 - 31.4)	15.2 (11.5 - 19.9)
70+	16.3 (13.7 - 19.2)	7.8 (5.5 - 10.6)	17.7(11.3 - 26.6)	39.2 (33.6 - 45.1)	14.2 (7.2 - 22.6)
Sex					
Male	2.3 (1.7 - 3.0)	1.1 (0.7 - 1.8)	7.6 (5.9 - 9.9)	10.0 (5.8 - 15.9)	2.4 (1.6 - 3.2)
Female	4.1 (2.9 - 5.6)	1.3(1.0 - 1.7)	4.6 (3.7 - 5.8)	15.3 (10.9 - 21.0)	11.1 (6.0 - 14.1)
Residence					
Urban	4.0 (3.2 - 5.0)	1.1 (1.0 - 1.3)	5.9 (4.2 - 8.2)	11.1 (8.3 - 14.5)	4.6 (4.4 - 4.8)
Rural	2.4 (1.5 - 3.8)	1.3 (0.8 - 2.0)	6.2 (5.7 - 6.8)	20.5 (12.8 - 31.1)	3.4 (3.1- 3.7)
Wealth					
Category 1 (lowest)	5.1 (3.0 - 8.6)	1.2 (0.2 - 2.9)	4.3 (2.7 - 6.6)	14.1 (8.6 - 22.4)	3.5 (2.2 - 5.1)
Category 2	3.5 (2.3 - 5.4)	2.0 (1.0 - 4.0)	5.3 (3.5 - 7.8)	19.8 (15.1 - 25.6)	2.8 (0.1 - 4.2)
Category 3	2.7 (2.0 - 3.6)	1.2 (0.4 - 29)	6.0 (4.2 - 8.5)	18.8 (13.5 - 25.6)	5.4 (3.9 - 6.0)
Category 4	4.2 (2.1 - 8.3)	0.8 (0.1 - 1.0)	7.8 (5.6 - 10.8)	9.4 (6.6 - 13.1)	4.2 (3.2 - 5.2)
Category 5 (highest)	1.9 (1.3 - 2.7)	1.0 (0.1 - 3.8)	6.6 (4.8 - 9.1)	10.2 (5.3 - 18.9)	5.3 (4.2 - 6.3)
Education					
Less than primary	1.6 (0.9 - 2.6)	0.3 (0.0 - 0.6)	4.7 (2.7 - 8.0)	26.7 (19.1 - 35.6)	4.4 (3.2 - 5.8)

	China	Ghana	India	Russia	South Africa
Primary	4.9 (3.3 - 7.2)	1.0 (0.0 - 2.7)	6.3 (4.8 - 8.2)	33.7 (23.8 - 45.3)	8.1 (7.4 - 8.6)
Secondary	1.9 (1.3 - 2.9)	0.6 (0.0 - 2.6)	4.3 (2.7 - 6.9)	10.5 (7.5 - 14.4)	2.0 (0.1 - 4.2)
Higher	0	0.00	17.1 (6.4 - 38.4)	24.4 (0.5 -71.6)	0.2 (0 - 8.4)
Obesity	11.1 (4.2- 26.1)	1.1 (0.1 - 2.9)	5.6 (2.6 - 9.6)	29.2 (21.3 - 38.6)	7.6 (7.0 - 8.2)
Not obese	2.8 (2.2 - 3.6)	1.2 (0.1 - 1.9)	6.1 (5.1 - 7.4)	8.7 (6.5 - 11.6)	2.4 (1.6 - 3.6)
Hypertension (measured)	6.7 (4.0 - 11.1)	1.5 (0.1 - 2.8)	17.6 (9.2 - 31.2)	27.2 (21.1 - 34.4)	4.7 (4.1 - 5.3)
Not hypertensive	2.5 (2.0- 3.1)	1.2 (0.1 - 1.4)	5.8 (4.8 - 7.0)	9.8 (7.1 - 13.5)	4.1 (2.8 - 5.8)
Hypertension (diagnosed)	13.6 (10.7- 17.1)	4.0 (2.6 - 5.4)	21.1 (16.0 - 27.3)	32.8 (26.1 - 40.3)	27.9 (22.2 - 33.7)
Not hypertensive	1.8 (1.3 – 2.6)	0.9 (0.7 – 1.3)	4.6 (3.7 – 5.7)	5.5 (3.8 – 7.9)	1.6 (1.1 – 2.4)
Health care utilisation					
Accessed Tertiary care (last 3 years)	7.4 (5.3- 10.3)	1.8 (1.0 - 3.3)	12.8 (9.5 - 17.0)	30.5 (20.1 - 43.3)	15.4 (2.9 - 34.9)
Not accessed tertiary care	3.1 (2.2 - 4.2)	1.2 (0.9 - 1.7)	5.7 (4.6 - 7.1)	10.2 (7.6 - 13.7)	4 (1.7 - 6.3)
Accessed Primary care (last 12 months)	4.4 (3.1 - 6.1)	1.5 (1.1 -1.9)	7.2 (6.0- 8.7)	17.2 (12.8 - 22.6)	8.4 (8.0 - 8.8)
Not accessed primary care	2.6 (2.0 - 3.5)	1.0 (0.1 - 4.5)	5.5 (3.4 - 8.8)	7.9 (4.8 - 12.4)	1.9 (0.0 - 5.1)

Table 4-8. Odds ratios and 95% confidence intervals of risk factors of multimorbidity in adulthood (univariable models) using SAGE; and adjusted for age and sex

	China	Ghana	India	Russia	South Africa
Risk Factor					
Age only (18-49 as reference)					
50-59	7.0* (2.8- 17.3)	13.1 ** (1.8 - 96.6)	3.5* (2.5 - 4.8)	4.3* (2.6 - 7.0)	3.3* (1.8 - 6.0)
60-69	19.8* (8.1 - 48.4)	33.8** (4.7 - 246.0)	5.5* (4.0 - 7.5)	9.7* (5.9 - 15.9)	4.4* (2.4 - 8.2)
70+	28.2* (11.6 - 69.0)	53.9* (7.5 - 388.1)	6.0* (4.3 - 8.4)	16.0* (9.8 - 26.1)	3.7* (2.0 - 7.0)
Sex only (Male as reference)					
Female	1.2*** (1.0 - 1.4)	2.0* (1.4 - 2.8)	0.5* (0.4 - 0.6)	1.5* (1.3 - 1.8)	1.7* (1.4 - 2.2)
Residence (Rural living as reference)					
Urban living	2.1 (1.5- 3.0)	1.4 (0.9 - 2.0)	1.0 (0.4 - 2.4)	1.0 (0.8 - 1.2)	1.4 (0.9- 2.0)
Wealth Quintiles (Quintile 1 as reference)					
Quintile 2	1.1 (0.8 - 1.5)	1.3 (0.8 - 2.2)	1.3 (0.8 - 1.9)	1.2 (1.0 – 1.6)	1.2 (0.8 - 1.8)
Quintile 3	1.0 (0.7 - 1.3)	1.0 (0.6 - 1.7)	1.1 (0.8 - 1.7)	1.1 (0.9 - 1.4)	1.9** (1.3 - 2.8)
Quintile 4	0.8 (0.6 - 1.2)	1.0 (0.6 - 1.7)	1.3 (0.9 - 1.8)	1.0 (0.9 - 1.5)	1.5 (1.0 - 2.2)
Quintile 5 (highest)	1.0 (0.7 - 1.4)	1.6 (0.9- 2.8)	1.2 (0.8- 1.7)	1.1 (0.8 - 1.4)	1.5 (1.0 - 2.3)
Education (Primary as reference)					
Less than primary	1.1 (0.8 - 1.5)	1.4 (0.5 - 4.2)	1.6*** (1.1 - 2.4)	1.1 (0.8 - 1.4)	1.0 (0.7 - 1.4)
More than primary	1.1 (0.8 - 1.4)	1.4 (0.5 - 4.2)	1.0 (0.7 - 1.6)	0.8 (0.7 - 1.0)	0.5** (0.3 - 0.8)
Obesity (No obesity as reference)	1.8* (1.3 - 2.5)	1.2 (0.7 - 2.1)	1.2 (0.7 - 2.2)	2.0* (1.7 - 2.3)	1.9* (1.5 - 2.4)

	China	Ghana	India	Russia	South Africa
Measured hypertension present (no measured hypertension as reference)	1.1 (0.9 - 1.4)	1.2 (0.8 - 1.8)	1.6*** (1.0 - 2.4)	1.4* (1.2 - 1.7)	1.0 (0.8 - 1.2)
Accessed tertiary care in last 3 years (did not access as reference)	2.7* (2.2 - 3.4)	2.1** (1.4 - 3.2)	2.3* (1.8 - 2.9)	2.3* (2.0 - 2.7)	2.6* (1.9 - 3.4)
Accessed Primary care in last 12 months (did not access as reference)	1.6* (1.2 - 2.0)	1.7** (1.1 - 2.6)	1.4 (1.0 - 1.9)	2.5* (2.0 - 3.1)	2.7* (2.0- 3.5)

* p <0.001 ** p <0.01 *** p <0.05

4.3.4 Urban-rural composition of risk factors using SAGE 1

Table 4.9 shows the summary of the urban and rural differences in social, economic, demographic and behavioural risk factors, and table 4.10 shows the breakdown in percentages. As shown in Table 4.10, the prevalence estimates were calculated within the categories of urban and rural, separately.

Across all countries, there was a statistically significant difference in age between urban and rural areas. Both Ghana and Russia had a higher number of older people in rural than urban areas. In Mexico, both the urban and rural areas had a similar age breakdown. Apart from China and India, there were an equal percentage of females and males in urban and rural areas. Interestingly, in both China and India, there were higher percentage of females in urban areas, and higher percentage of males in rural areas. The rural-urban distribution was different for wealth categories across all countries. The difference between urban and rural areas was statistically significant in all countries, apart from Russia. Furthermore in all countries, expect for Russia, the lowest category (1 and 2) were highest in rural areas. Equally the number of individuals from the highest category was highest in urban areas. This shows that there may be differences in the wealth distribution of the urban and rural population, and that the differences are more apparent at the extremes of high and low wealth. In terms of education, there was a statistically significant difference in urban and rural distribution for all countries. There was a higher proportion of individuals obtaining at least secondary school education in the urban areas of China; compared to the rural areas. This was also true for South Africa and India. Across all countries the percentage of those with secondary school education was consistently higher in the urban population than the rural population. The urban rural distribution of obesity was inconsistent between countries. The difference in urban and rural areas was statistically significant in all countries apart from in China. In Ghana, the prevalence of obesity was much higher in urban areas, 19.1%, than rural areas, 7.3%. Interestingly in Russia, this was the opposite; the obesity prevalence was higher in the rural areas, 37.8% and lower in the urban areas, 16.1%. There were also some interesting differences in hypertension prevalence. For doctor diagnosed hypertension, prevalence was higher in urban areas (15.2%) than in rural areas (8.4%) of China; and this difference was statistically significant. However, measured hypertension prevalence showed the opposite; prevalence was higher in rural areas, and statistically difference (12.2% urban,

20.3% rural). In Ghana, measured hypertension prevalence showed modest differences; however, doctor diagnosed hypertension was considerably higher in urban, at 10.8%, than rural areas, at 4.3%; and statistically different. The same pattern was seen for India. A comparison of urban and rural distribution of tertiary showed some statistically significant differences in China and Russia. Interestingly in China and Russia more people accessed tertiary care in rural areas than in urban areas. The same pattern was true for primary care in China and South Africa, and was statistically significant. In India, however, more people accessed primary care from urban areas than in rural areas.

Table 4-9. Summary of urban-rural composition of risk factors using SAGE Wave 1

	CHINA	GHANA	INDIA	RUSSIA	SOUTH AFRICA
Age group	*	*	***	**	***
18-49	U = R	U > R	R>U	U > R	U > R
50-59	R > U	U= R	U = R	R > U	R > U
60-69	U = R	U=R	U > R	R > U	U = R
70+	U > R	R > U	U =R	U = R	R > U
Sex	**		**		
Male	R > U	U = R	R > U	U = R	U = R
Female	U > R	U = R	U > R	U = R	U = R
Wealth	*	*	*		*
Category 1 (lowest)	R > U	R > U	R > U	U > R	R > U
Category 2	R > U	R > U	R > U	U > R	R > U
Category 3	R> U	R > U	U > R	R > U	R>U
Category 4	R > U	U > R	U > R	R > U	U > R
Category 5 (highest)	U >R	U > R	U > R	U > R	U > R
Education	*	*	*	*	*
Less than primary	R > U	U > R	R > U	R > U	R > U
Primary	R > U	R > U	R > U	R > U	R > U
Secondary	U > R	U >R	U > R	U > R	U > R
Higher	U = R	U = R	U > R	U = R	U > R
Obesity		*	**	*	*
Presence of obesity	U = R	U > R	U > R	R > U	R > U
Not obese	U = R	R > U	U = R	U > R	U > R

	CHINA	GHANA	INDIA	RUSSIA	SOUTH AFRICA
Hypertension (measured)	*				
Presence of hypertension	R > U	U > R	U > R	R > U	U = R
Not hypertensive	U >R	R>U	U = R	U > R	U = R
Hypertension (diagnosed)	*	*			*
Presence of hypertension	U > R	U > R	U = R	R > U	U = R
Not hypertensive	R > U	R >U	U= R	U > R	U = R
Accessed Tertiary care (last 3 years)	*			***	
Tertiary care accessed	R > U	U = R	U > R	R > U	U > R
Did not access	U >R	U = R	R > U	U > R	R>U
Accessed Primary care (last 12 months)	**		***		**
Primary care accessed	R > U	U > R	U > R	U > R	R > U
Did not access	U > R	R > U	R > U	R > U	U > R

Note: These estimates are not adjusted for age or sex.* p-value ***<0.05; ** < 0.01; * <0.001;

Table 4-10. Urban rural composition within social, economic, demographic and behavioural categories using SAGE Wave 1 (shows weighted prevalence)

	China		Ghana		India		Russia		South Africa	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Age group										
18-49	75.7	76.2	78.5	73.6	71.8	76.7	57.7	41.7	76.2	71.2
50-59	9.5	11.8	9.2	10.3	12.9	11.7	19	30.2	11.5	13.7
60-69	7.8	7.6	5.8	7.1	9.4	6.9	10.6	13.5	8.3	8.7
70+	7	4.4	6.4	9	6	4.7	12.7	14.6	4.1	6.4
	100	100	100	100	100	100	100	100	100	100
Sex										
Male	44.7	56.1	47.3	47.3	44.7	52	43.7	43.5	46.8	47.7
Female	55.3	43.9	52.7	52.7	55.3	48	56.3	56.5	53.2	52.3
	100	100	100	100	100	100	100	100	100	100
Wealth										
Category 1 (lowest)	7.8	11.6	5.4	22.3	7.5	20.6	12.9	10.9	12.7	33.1
Category 2	13.1	19.8	10.9	23.4	10.1	20.2	13.3	10.4	17.6	26.1
Category 3	16.2	20.8	12.7	24.5	23.9	21.1	12.9	16.6	19.6	22.7
Category 4	22.2	24.2	29.2	16.7	24.8	22	24.3	29.5	22.6	13.4

	China		Ghana		India		Russia		South Africa	
Category 5 (highest)	40.7	23.6	41.8	13.1	33.6	16.1	36.7	32.6	27.5	4.7
	100	100	100	100	100	100	100	100	100	100
Education										
Less than primary	29.7	38.5	19.9	10.5	17.2	23.4	7.7	20.7	27.5	35.3
Primary	18.4	48.6	37.3	56.9	38.6	48.1	2.4	4.7	29.2	41.4
Secondary	56.2	12.9	42.1	32.6	38.1	25.9	89.9	74.6	40.1	23
Higher	0.4	0	0.8	0	6.1	2.5	0.1	0	3.2	0.3
	104.7	100.1	100	100	100	100	100	100	100	100
Obesity	4.2	4.4	19.1	7.3	3.5	1.6	16.1	37.8	34.6	38.3
Not obese	95.8	95.6	80.9	92.7	96.5	98.4	83.9	62.2	65.4	61.7
	100	100	100	100	100	100	100	100	100	100
Hypertension (measured)	12.2	20.3	19.3	16.3	3.1	2.5	18.2	24.3	29.9	30.5
Not hypertensive	87.8	79.7	80.7	83.7	96.9	97.5	81.8	75.7	70.1	69.5
	100	100	100	100	100	100	100	100	100	100
Hypertension (diagnosed)	15.2	8.4	10.8	4.3	12.9	7.6	24.5	37.3	10.5	8.7
Not hypertensive	84.8	91.6	89.2	95.7	87.1	92.4	75.5	62.7	89.5	91.3
	100	100	100	100	100	100	100	100	100	100

	China		Ghana		India		Russia		South Africa	
Accessed Tertiary care (last 3 years)	11.8	18.9	14	12.1	14.8	12.6	17.7	31.6	11.9	7.7
Did not access	88.2	81.1	86	87.9	85.2	54.9	82.3	68.4	88.1	92.3
	100	100	100	100	100	67.5	67.5	67.5	67.5	67.5
Accessed Primary care (last 12 months)	51.6	66.8	65.5	51.5	82.8	85.2	72.4	60.7	49.7	53.8
Did not access	48.4	33.2	34.5	48.5	17.2	14.8	27.6	39.3	50.3	46.2
	100	100	100	100	100	100	100	100	100	100

4.3.5 Urban –rural differences in multimorbidity according to duration

A simple analysis was carried out based on the data on length of exposure to the environment using the pooled data sets. An analysis of the missing data found an average of 66.3% missingness for the response to question: "how long they have you been living in this area (number of years)." Therefore the length of exposure to environment could only be determined through a subset of individuals. First, I undertook an analysis of responders vs. non-responders using the Ghana data. This is shown in Table 4.11. The summary statistics show that across the demographic variables or age and sex, both urban and rural non-responders had a similar distribution. However, there were differences for permanent income. The urban non-responders tended to be from the higher income groups, whereas the rural non-responders tended to be from the lower income groups.

Table 4-11. Demographic, social and economic distribution of responders and non-responder in Ghana

	Non-responder		**Responder**	
	Urban	**Rural**	**Urban**	**Rural**
Count/ N	*1522.00*	*2289.00*	*735.00*	*938.00*
Age category/%				
18-49	15.11	14.42	16.60	15.67
50-59	35.15	32.55	38.78	31.02
60-69	22.54	23.20	23.27	26.12
70+	27.20	29.84	21.36	27.19
Sex/*				
Male	43.89	52.51	49.25	58.74
Female	56.11	47.49	50.75	41.26

	Non-responder		Responder	
	Urban	**Rural**	**Urban**	**Rural**
Permanent income/*				
1 (lowest)	9.23	28.28	7.35	22.73
2	13.32	25.84	10.88	22.52
3	15.29	21.43	16.33	25.61
4	26.17	16.02	24.63	18.68
5 (highest)	35.99	8.42	40.82	10.46
Multimorbidity/*	4.47	2.93	3.55	2.35

Using the data from the responders, I determined the length of exposure to the urban environment. Given that number of years in a particular location is correlated with age, the results were stratified according to age. The results showed that multimorbidity was higher by exposure to urban environment, as compared to exposure to rural environment, within the group of responders. This was true across all ages, except for the age group 18-49; where there was an inconsistent effect of duration.

Table 4-12. Multimorbidity prevalence by length of exposure to environment; and stratified by age.

Number of years living in current residence	***Multimorbidity for individuals aged 18-49 years; by residence***	
	Urban	*Rural*
0-9	0.4 (0.0 - 1.1)	0.5 (0.0 - 1.4)
10-19	3.0 (0.9 - 5.1)	2.8 (1.0 - 4.7)
20 – 29	1.7 (0.0 - 3.7)	4.3 (1.8 - 6.9)
30 – 39	6.5 (0.0 - 13.9)	8.3 (1.0 - 15.6)
40/ max	0.0 (0.0 - 0.0)	12.5 (0.0 - 37.0)

Number of years living in current residence	***Multimorbidity for individuals aged 50-59 year; by residence***	
	Urban	*Rural*
0-9	7.8 (4.6 - 10.9)	5.8 (1.5 - 10.1)
10-19	10.8 (7.6 - 13.9)	5.9 (1.8 - 10.0)
20 – 29	10.4 (7.3 - 13.4)	5.4 (2.5 - 8.3)
30 – 39	13.1 (9.8 - 16.5)	6.63 (4.3 - 9.0)
40/ max	13.9 (8.2- 19.6)	6.2 (1.9 - 10.5)
Number of years living in current residence	***Multimorbidity for individuals aged 60-69 years; by residence***	
	Urban	*Rural*
0-9	10.9 (6.4 - 15.5)	12.8 (5.2 - 20.3)
10-19	19.4 (14.1 - 24.7)	14.3 (6.5 - 22.1)
20 – 29	20.8 (15.3 - 26.4)	13.3 (6.3 - 20.3)
30 – 39	18.5 (13.8 - 23.2)	10.5 (5.3 - 15.6)
40/ max	21.4 (17.0 - 25.8)	11.4 (8.1 - 14.6)
Number of years living in current residence	***Multimorbidity for individuals aged 70/max years; by residence***	
	Urban	*Rural*
0-9	23.9 (16.7 - 31.0)	11.1 (2.2 - 20.0)
10-19	23.9 (16.8 - 31.0)	13.9 (5.3 - 22.5)
20 – 29	26.9 (19.9 - 33.8)	20.6 (9.8 - 31.4)
30 – 39	26.3 (19.6 - 33.1)	15.4 (7.3 - 23.4)
40/ max	30.6 (26.7 - 34.5)	17.4 (13.3 - 21.6)

Notes: Confidence intervals shown. Figures shown are based on pooled analysis.

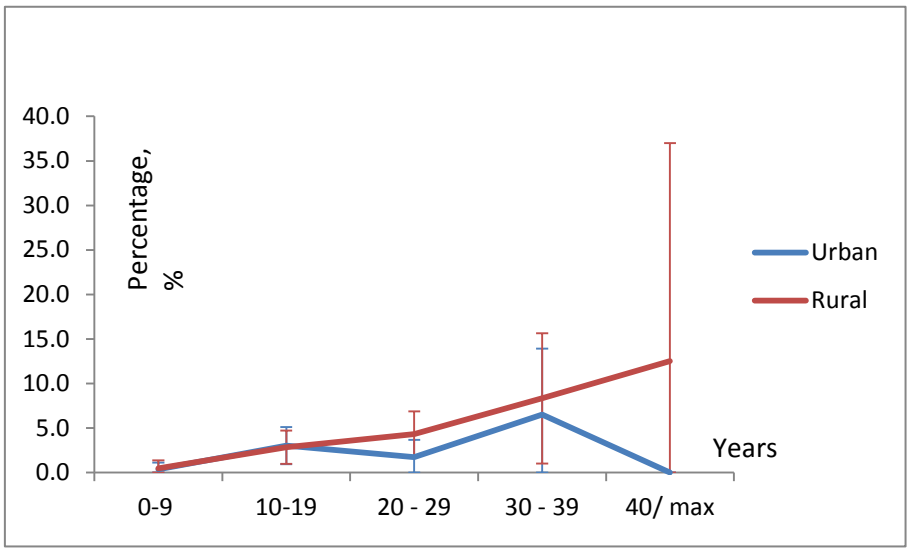


Figure 4-5. Multimorbidity prevalence for 18-49 year olds by exposure to environment; with confidence intervals

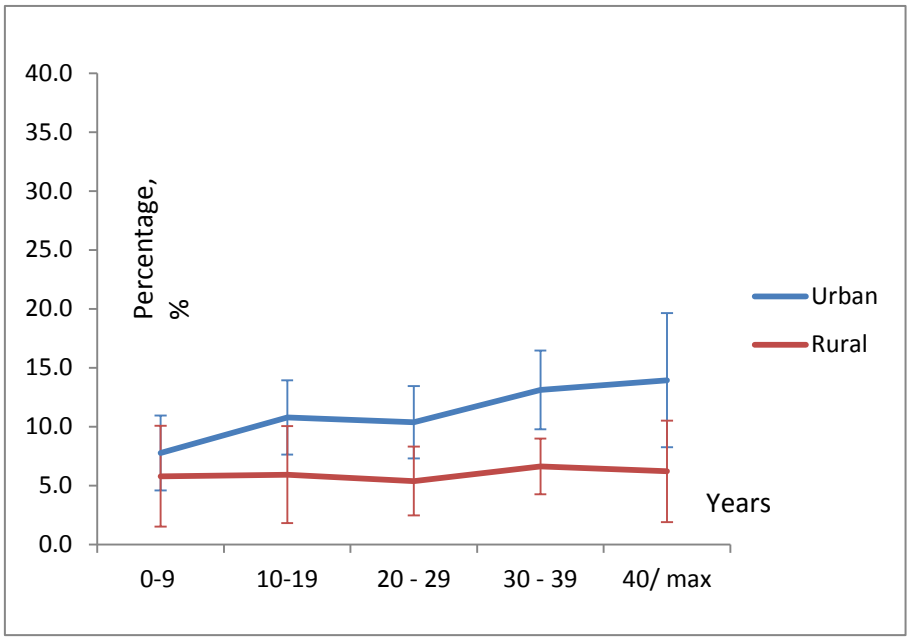


Figure 4-6. Multimorbidity prevalence for 50 -59 year olds by exposure to environment; with confidence intervals.

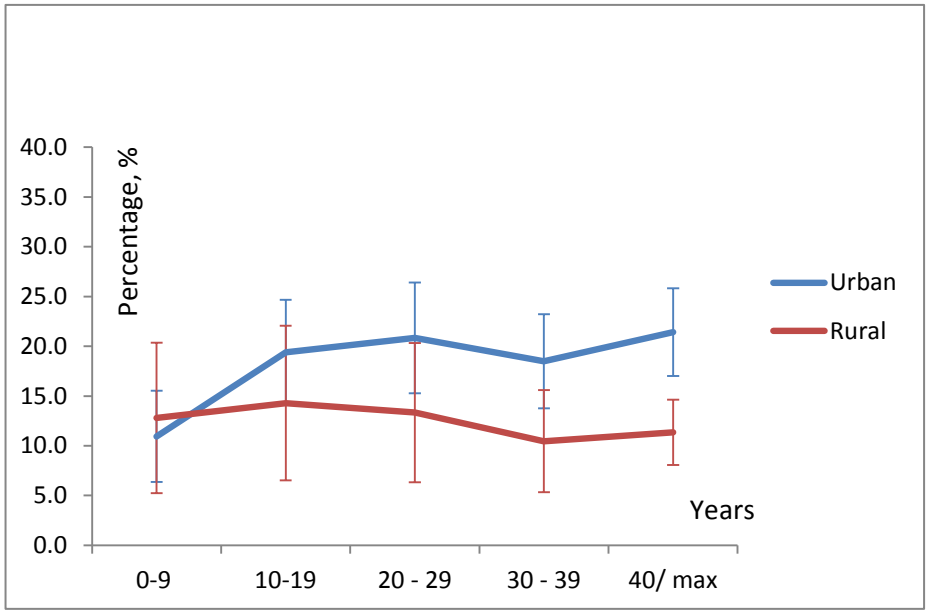


Figure 4-7. Multimorbidity prevalence for 60 -69 year olds by exposure to environment; with confidence intervals

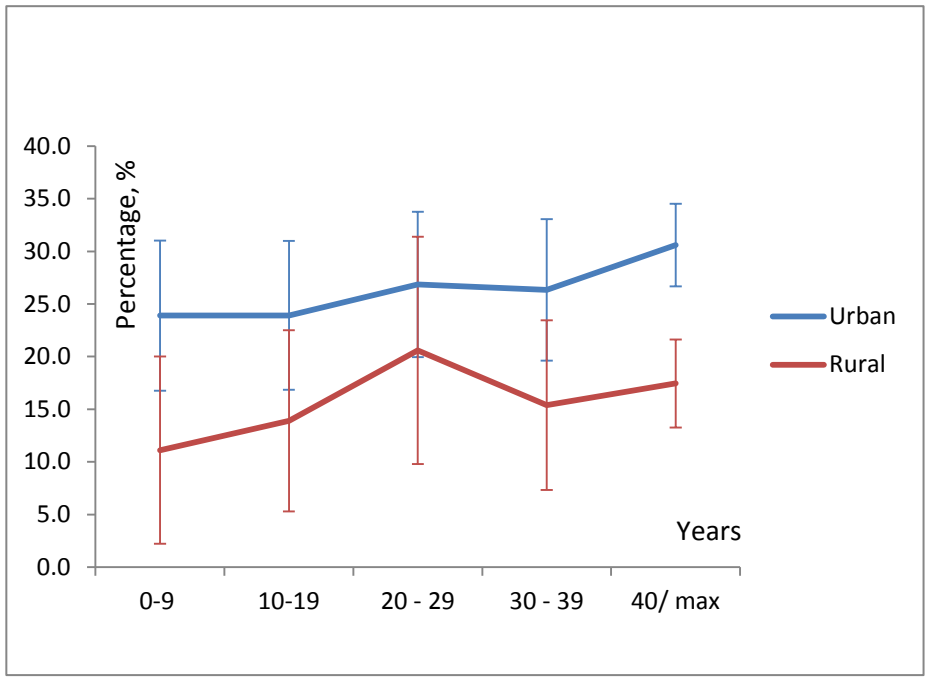


Figure 4-8. Multimorbidity prevalence for 70+ year olds by exposure to environment; with confidence intervals

4.3.6 Multivariable analysis of multimorbidity and urban living using SAGE Wave 1.

The multivariable analysis is reported in table 4.13. In all countries, expect for South Africa, age was significantly associated with multimorbidity. In the final models, multimorbidity was statistically associated with the female sex in China and South Africa; statistically associated with the male sex in India; and not significant in Ghana and Russia. In China only, place of residence was significantly associated with multimorbidity, after controlling for other risk factors. This suggests that urban living has a direct or indirect effect on multimorbidity, as shown in the schematic diagram earlier in the chapter. When the country-urban living interaction term was fitted, using China as the baseline, there was a statistically significant interaction for all other country terms, showing a reduced 'protective' effect compared to China.

As for the social, economic and demographic risk factors, education was not significant in the final models. Before fitting the wealth education interaction term, secondary school education and above was associated with a decreased risk in multimorbidity in South Africa. In India, however, primary school education and below was associated with an increased risk in multimorbidity. Wealth quintile was not statistically associated with multimorbidity except for in China, where the third and fourth quintile was associated with a decreased risk in multimorbidity, after controlling for other risk factors.

In terms of the behavioural risk factors of multimorbidity, obesity and hypertension were significantly associated in Russia, after controlling for other risk factors. In both China and Ghana, obesity was statistically associated with multimorbidity in the final model. As for use of healthcare, both tertiary and primary care were associated with an increased risk of multimorbidity in all countries, except for in Ghana; where tertiary care was associated with an increased risk of multimorbidity in the final model.

Table 4-13. Odds ratios and 95% confidence intervals of risk factors of multimorbidity in adulthood (multivariable model)

CHINA	M1 (n = 3349)	M2 (n = 3349)	M3 (n= 3349)	M4 (n= 3349)	M5 (n= 3349)	M6 (n=3349)	M7 (n=3349)	M8 (n= 3349)	LRTEST (degrees of freedom)
Urban living (rural living as reference)	2.2 (1.6 - 3.0)*	2.1 (1.5 – 2.8)*	2.2 (1.6 - 3.0)*	2.2 (1.6 - 3.1)*	2.2 (1.6 - 3.1)*	2.3 (1.6 - 3.2)*	2.3 (1.6 - 3.3)*	2.4 (1.6 - 3.4)*	
Age									
50 – 59	6.4 (2.3 - 17.7)*	6.5 (2.4 – 18.0)*	6.6 (2.4 – 18.3)*	6.3 (2.3 – 17.5)*	6.5 (2.4 – 17.9)*	6.6 (2.4 – 18.3)*	6.4 (2.6 - 15.8)*	6.1 (2.2 - 17.0)*	0.0001 (3)
60 – 69	18.9 (6.9 – 51.4)*	20.0 (7.2 – 53.3)*	19.5 (7.2 – 53.1)*	18.8 (6.9 – 51.3)*	18.9 (6.9 – 51.6)*	19.2 (7.0 – 52.7)*	18.8 (7.6 - 4.3)*	17.5 (6.4 - 48.1)*	
70+	27.6 (10.1 - 75.3)*	30.0 (10.9 – 82.0)*	29.6 (10.8 – 80.9)*	28.1 (10.2 – 77.5)*	28.3 (10.3 – 77.9)*	29.1 (10.5 – 80.2)*	30.2 (12.2 - 75.2)*	23.6 (8.5 - 65.6)*	
Sex (male as reference)		1.4 (1.1 - 1.8)**	1.4 (1.1 - 1.8)**	1.4 (1.1 – 1.8)***	1.4 (1.1 - 1.8)***	1.4 (1.1 - 1.8)***	1.3 (1.1 - 1.7)***	1.5 (1.2 - 1.9)**	0.0018 (1)
Wealth quintile									
second quintile			1.0 (0.7 - 1.5)		1.0 (0.7 - 1.5)	0.7 (0.3 - 1.5)	0.5 (0.3 - 1.1)	0.7 (0.3 - 1.5)	0.001 (4)
third quintile			0.8 (0.5 - 1.2)		0.8 (0.6 – 1.3)	0.3 (0.1 – 0.6)***	0.3 (0.1 - 0.6)**	0.2 (0.1- 0.6)**	
fourth quintile			0.7 (0.5 - 1.1)		0.7 (0.5 – 1.1)	0.4 (0.2 – 0.8)***	0.4 (0.2 - 0.8)	0.3 (0.2 - 0.8)***	
fifth quintile			0.8 (0.5 - 1.2)		0.8 (0.5 - 1.2)	0.5 (0.3 - 1.1)	0.6 (0.3 - 1.1)	0.5 (0.2 - 1.0)	

Education (primary as reference)						0.001(2)
less than primary	1.1 (0.8 - 1.5)	1.1 (0.8 - 1.5)	0.6 (0.3 - 1.1)	0.6 (0.3 - 1.1)	0.5 (0.3 - 1.1)	
secondary and above	1.0 (0.7 - 1.3)	1.0 (0.7 - 1.4)	0.4 (0.1 - 1.6)	0.3 (0.1 - 1.3)	0.4 (0.1 - 1.6)	
Wealth * Education						0.1042 (8)
second quintile * primary ed			1.8 (0.7 - 4.6)	2.0 (0.8 - 4.9)	1.9 (0.7 - 4.9)	
second quintile * higher ed			1.5 (0.3 – 8.0)	2.2 (0.4 - 11.1)	1.6 (0.3 - 8.9)	
third quintile * primary ed			4.5 (1.7 – 12.2)***	4.3 (1.7 - 10.7)**	5.0 (1.8 - 13.8)**	
third quintile * higher ed			4.3 (0.9 – 6.1)***	5.9 (1.3 - 26.2)***	5.1 (1.0 - 25.3)***	
fourth quintile * primary ed			2.4 (0.9 – 6.1)	2.1 (0.9 - 5.0)	2.2 (0.8 - 5.7)	
fourth quintile * higher ed			3.2 (0.7 – 14.3)	4.1 (1.0 - 17.2)	3.3 (0.7 - 15.5)	
fifth quintile * primary ed			1.8 (0.7 - 4.7)	1.6 (0.7 - 3.8)	1.9 (0.7 - 5.0)	
fifth quintile * higher ed			2.0 (0.5 – 8.9)	2.6 (0.6 - 10.9)	2.0 (0.4 - 9.1)	
Obesity				1.8 (1.2 - 2.6)**	2.0 (1.3 - 3.0)**	0.003 (1)
Measured hypertension (no				1.0 (0.8 - 1.3)	1.0 (0.8 - 1.4)	0.003(1)

hypertension as reference)		
Use of tertiary care (did not access care as reference)	2.8 (2.2 - 3.7)*	0.0001(1)
Use of primary care (did not access care as reference)	1.4 (1.1 - 1.8)*	0.0056 (1)

GHANA	**M1 (n = 2068)**	**M2 (n = 2068)**	**M3 (n=2068)**	**M4 (n= 2068)**	**M5 (n=2068)**	**M6 (n=2068)**	**M7 (n= 2068)**	**LRTEST (degrees of freedom)**
Urban living (rural living as reference)	**1.2 (0.6 - 2.5)**	**1.1 (0.6 - 2.2)**	**1.0 (0.5 - 2.0)**	**1.1 (0.6 - 2.2)**	**1.0 (0.5 - 2.0)**	**1.0 (0.5 - 2.0)**	**1.0 (0.5 - 2.0)**	
Age								
50 – 59	9.0 (1.2 – 68.2)***	9.3 (1.1 – 70.1)***	9.2 (1.2 - 69.5)***	8.7 (1.1 - 66.2)***	8.7 (1.1 - 65.7)***	8.2 (1.1 - 63.1)***	8.6 (1.1 – 65.9)***	0.0001 (3)
60 – 69	19.8 (2.6 – 149.4)***	21.0 (2.8 – 158.0)***	20.7 (2.7 – 156.2)**	19.9 (2.6 - 150.5)**	19.6 (2.6 - 148.2)*	19.2 (2.5 - 144.9)**	20.0 (2.6 – 151.5)**	
70+	37.7 (5.0 – 282.2)*	39.0 (5.2 – 293.1)*	38.9 (5.2 - 291.8)*	37.0 (4.9 - 277.9)*	36.5 (4.9 - 274.4)*	36.2(4.8 - 272.0)*	35.8 (4.7 – 269.8)**	
Sex (male as reference)		1.5 (0.9 - 2.6)	1.5 (0.9.- 2.7)	1.5 (0.8 - 2.6)	1.5 (0.9 - 2.7)	1.5 (0.8 - 2.6)	1.4 (0.8 - 2.5)	0.30 (1)

Wealth quintile						
second quintile	1.9 (0.5 - 7.3)		1.9 (0.5 - 7.4)	1.9 (0.5 - 7.3)	1.9 (0.5 – 7.3)	0.82 (4)
third quintile	1.7 (0.5 – 6.5)		1.8 (0.5 - 6.7)	1.7 (0.4 - 6.5)	1.6 (0.4 – 6.2)	
fourth quintile	1.7 (0.5 - 6.4)		1.8 (0.5 - 6.6)	1.8 (0.5 - 6.4)	1.6 (0.4 - 5.9)	
fifth quintile	2.3 (0.6 – 8.4)		2.4 (0.7 - 8.9)	2.3 (0.6 - 8.6)	2.0 (0.6 – 7.5)	
Education (primary as reference)						
less than primary		1.7 (0.5 - 5.9)	1.9 (0.5 - 6.5)	1.9 (0.5 - 6.5)	1.9 (0.5 - 6.6)	0.3 (2)s
secondary and above		1.9 (0.5 - 6.4)	1.9 (0.6 - 6.6)	1.9 (0.6 - 6.6)	1.9 (0.6 - 6.6)	
Obesity (no obesity as reference)				1.3 (0.6 – 2.8)	1.4 (0.6 - 3.0)	0.45(1)
Measured hypertension (no hypertension as reference)				1.2 (0.7 – 2.3)	1.1 (0.6 - 2.1)	0.45(1)
Use of tertiary care (did not access care as reference)					2.7 (1.4 - 5.3)**	0.005(1)
Use of primary care (did not access care as reference)					1.5 (0.7 – 2.8)	0.25(1)

INDIA	M1 (n = 2546)	M2 (n = 2546)	M3 (n= 2546)	M4 (n= 22546)	M5 (n= 2546)	M6 (n= 2546)	M7 (n=2546)	LRTEST (degrees of freedom)
Urban living (Rural living as reference)	1.0 (0.5 - 2.2)	1.0 (0.5 - 2.3)	1.1 (0.5 - 2.5)	1.1 (0.5 - 2.5)	1.1 (0.5 - 2.5)	1.1 (0.5 - 2.4)	1.1 (0.6 - 2.4)	
Age								
50 – 59	4.2 (2.8 - 6.4)*	3.9 (2.5 – 5.9)*	3.8 (2.5 - 5.8)*	3.6 (2.4 - 5.5)*	3.5 (2.3 - 5.4)*	3.4 (2.2 - 5.2)*	3.5 (2.3 - 5.5)*	0.0001 (3)
60 – 69	7.1 (4.7 - 10.6)*	6.3 (4.1 - 9.6)*	6.3 (4.1 - 9.7)*	5.6 (3.6 - 8.6)*	5.5 (3.5 - 8.5)*	5.3 (3.4 - 8.3)*	5.4 (3.5 - 8.5)*	
70+	6.8 (4.3 - 10.9)*	5.9 (3.6 - 9.7)*	5.9 (3.6 - 9.7)*	5.1 (3.1 - 8.5)*	5.0 (3.0 - 8.4)*	4.9 (2.9 - 8.1)*	4.5 (2.7 - 7.6)*	
Sex (male as reference)		0.8 (0.6 - 1.0)***	0.8 (0.6 - 1.1)*	0.7 (0.5 - 1.0)***	0.7 (0.5 - 1.0) ***	0.7 (0.5 - 0.9)***	0.7 (0.5 - 0.9)***	0.01 (1)
Wealth quintile								
second quintile			1.0 (0.5 - 2.0)		1.1 (0.5 - 2.0)	1.1 (0.5 - 2.0)	1.0 (0.5 - 2.0)	0.74 (4)
third quintile			0.7 (0.4 - 1.4)		0.8 (0.4 - 1.5)	0.8 (0.4 - 1.5)	0.8 (0.4 - 1.5)	
fourth quintile			1.0 (0.5 - 1.7)		1.1 (0.6 - 1.9)	1.1 (0.6 - 1.9)	1.1 (0.6 - 1.9)	
fifth quintile			0.9 (0.5 - 1.6)		1.0 (0.5 - 1.9)	1.0 (0.5 - 1.8)	1.0 (0.5 - 1.8)	
Education (primary as reference)								
less than primary				1.5 (1.0 - 2.3)***	1.5 (1.1 - 2.3)***	1.5 (1.0 - 2.2)***	1.5 (1.0 - 2.2)***	0.02 (2)
secondary and above				1.0 (0.6 - 1.5)	1.0 (0.6 - 1.5)	1.0 (0.6 - 1.5)	0.9 (0.6 - 1.5)	
Obesity (no obesity as reference)						1.6 (0.8 - 3.0)	1.7 (0.9 - 3.2)	0.14 (1)

Measured hypertension (no hypertension as reference)	1.5 (0.8 - 2.7)	1.5 (0.8 - 2.8)	0.14(1)
Use of tertiary care (did not access care as reference)		2.4 (1.7 - 3.4)*	0.0001 (1)
Use of primary care (did not access care as reference)		1.7 (1.1 - 2.7)***	0.02 (1)

RUSSIA	**M1 (n = 3248)**	**M2 (n = 3248)**	**M3 (n= 3248)**	**M4 (n= 3248)**	**M5 (n= 3248)**	**M6 (n= 3248)**	**M7 (n=3248)**	**LRTEST (degrees of freedom)**
Urban living (rural living as reference)	1.1 (0.9 - 1.3)	1.1 (0.9 -1.3)	1.0 (0.9 - 1.3)	1.2 (0.9 - 1.4)	1.2 (0.9 - 1.4)	1.2 (1.0 - 1.4)	1.2 (1.0 - 1.5)	
Age								
50 – 59	4.2 (2.5 - 7.0)*	4.3 (2.5 - 7.1)*	4.3 (2.5 - 7.1)*	4.2 (2.5 - 7.0)*	4.2 (2.5 - 7.0)*	3.6 (2.1 - 6.0)*	3.5 (2.1 – 5.9)*	0.0001(3)
60 – 69	9.2 (5.5 - 15.3)*	9.3 (5.6 - 15.4)*	9.2 (5.5 - 15.3)*	8.8 (5.3 - 14.7)*	8.8 (5.2 – 14.7)*	7.4 (4.4 - 12.4)*	6.9 (4.1 - 11.7)*	
70+	14.8 (8.9 - 24.5)*	14.7 (8.9 - 24.4)*	14.5 (8.7 - 24.1)*	13.1 (7.8 - 21.9)*	13.0 (7.8 – 21.8)*	11.4 (6.8 - 19.2)*	10.2 (6.0 - 17.3)*	
Sex (male as reference)		1.3 (1.1 - 1.5)**	1.2 (1.1 - 1.5)***	1.2 (1.1 - 1.5)*	1.2 (1.0 - 1.5)*	1.1 (0.9 - 1.3	1.0 (0.9 - 1.3)	0.62 (1)

Wealth quintile						
second quintile	1.2 (1.0 - 1.6)		1.2 (1.0 - 1.6)***	1.2 (0.9 - 1.6)	1.2 (0.9 - 1.5)	0.40 (4)
third quintile	1.0 (0.8 - 1.3)		1.1 (0.8 - 1.4)	1.1 (0.8 - 1.4)	1.0 (0.8 - 1.4)	
fourth quintile	1.1 (0.8 - 1.4)		1.1 (0.9 - 1.5)	1.1 (0.9 - 1.5)	1.1 (0.8 - 1.4)	
fifth quintile	1.0 (0.8 - 1.3)		1.0 (0.8 - 1.3)	0.9 (0.8 - 1.3)	0.9 (0.7 - 1.2)	
Education (primary as reference)						0.006 (2)
less than primary		1.1 (0.8 - 1.4)	1.1 (0.8 - 1.4)	1.1 (0.8 - 1.5)	1.2 (0.9 - 1.6)	
secondary and above		0.8 (0.7 - 1.0)***	0.8 (0.7 - 1.0)	0.8 (0.7 - 1.0)	0.8 (0.7 - 1.0)	
Obesity (no obesity as reference)				1.8 (1.5 - 2.1)*	1.7 (1.4 - 2.0)*	0.0001(1)
Measured hypertension (no hypertension as reference)				1.3 (1.1 - 1.5)**	1.3 (1.1 - 1.5)**	
Use of tertiary care (did not access care as reference)					2.2 (1.9 - 2.7)*	0.0001(1)
Use of primary care (did not access care as reference)					2.5 (2.0 - 3.0)*	0.0001(1)

SOUTH AFRICA	M1 (n = 2044)	M2 (n = 2044)	M3 (n= 2044)	M4 (n= 2044)	M5 (n= 2044)	M6 (n= 2044)	M7 (n= 2044)	LRTEST (degrees of freedom)
Urban living (rural living as reference)	1.4 (0.9 - 2.2)	1.4 (0.9 - 2.2)	1.3 (0.8 – 2.0)	1.4 (0.9 - 2.2)	1.3 (0.8 - 2.1)	1.3 (0.8 - 2.1)	1.4 (0.9 - 2.1)	
Age								
50 – 59	2.8 (1.5 – 5.4)**	3.0 (1.6 – 5.8)*	3.0 (1.5 – 5.7)*	2.6 (1.3 - 5.1)**	2.5 (1.3 - 4.8)**	2.4 (1.2 – 4.7)**	2.4 (1.2 – 4.8)***	0.03 (3)
60 – 69	3.3 (1.7 – 6.3)*	3.5 (1.8 – 6.8)*	3.4 (1.8 – 6.6)*	2.9 (1.5 - 5.7)**	2.7 (1.3 - 5.3)**	2.6 (1.3 - 5.2)**	2.6 (1.3 - 5.3)**	
70+	3.0 (1.5 – 5.9)**	3.2 (1.6 – 6.3)*	3.0 (1.5 - 6.0)*	2.6 (134 - 5.2)	2.3 (1.1 - 4.7)***	2.4 (1.2 – 4.8)**	2.3 (1.1 - 4.8)***	
Sex (male as reference)		2.0 (1.5 - 2.7)*	2.0 (1.5 - 2.7)*	1.9 (1.4 - 2.6)*	1.9 (1.4 - 2.6)*	1.8 (1.3 - 2.4)*	1.8 (1.3 - 2.4)*	0.0003(1)
Wealth quintile								
second quintile			1.6 (0.9 - 2.8)		1.6 (0.9 - 2.9)	1.6 (0.9 – 2.8)	1.5 (0.8 – 2.7)	0.42 (4)
third quintile			1.8 (1.0 - 3.2)**		1.9 (1.1 - 3.4)***	1.8 (1.0 – 3.2)***	1.7 (0.9 – 3.0)	
fourth quintile			1.6 (0.9 - 2.8)		1.8 (1.0 - 3.1)***	1.6 (0.9 – 2.8)	1.4 (0.8 – 2.5)	
fifth quintile			1.6 (0.9 - 2.8)		2.0 (1.1 - 3.6)***	1.8 (1.0 - 3.3)	1.7 (0.9 - 3.0)	
Education (primary as reference)								
less than primary				1.0 (0.7 - 1.4)	1.1 (0.7 - 1.5)	1.1 (0.8 - 1.5)	1.0 (0.7 - 1.5)	0.01(5)
secondary and above				0.5 (0.3 - 0.8)**	0.5 (0.3 - 0.8)**	0.5 (0.3 - 0.8)**	0.5 (0.3 - 0.8)**	

Obesity (no obesity as reference)	1.7 (1.3 - 2.3)*	1.6 (1.2 - 2.1)**	0.002(1)
Measured hypertension (no hypertension as reference)	0.9 (0.7- 1.2)	0.9 (0.7 - 1.2)	0.002(1)
Use of tertiary care (did not access care as reference)		2.3 (1.6 - 3.3)*	0.0001(1)
Use of primary care (did not access care as reference)		3.1 (2.1 - 4.3)*	0.0001(1)

POOLED	**M1 (n = 16740)**	**M2 (n = 16740)**	**M3 (n= 16740)**	**M4 (n= 16740)**	**M5 (n= 16740)**	**M6 (n=16740)**	**M7 (n= 16740)**	**M8 (16740)**	**LRTEST (degrees of freedom)**
Urban living (rural as reference)	1.3 (1.2 - 1.5)*	1.3 (1.2 - 1.5)*	1.3 (1.2 - 1.5)*	1.4 (1.2 - 1.5)*	1.4 (1.2 - 1.5)*	1.4 (1.2 - 1.6)*	1.4 (1.3 - 1.6)*	2.6 (2.0 – 3.3)*	
Age									
50 – 59	3.6 (2.9 - 4.5)*	3.8 (3.1 - 4.8)*	3.9 (3.1 - 4.8)*	3.8 (3.0 - 4.7)*	3.8 (3.0 – 4.8)*	3.6 (2.9 – 4.5)*	3.7 (3.0 - 4.7)*	3.8 (3.0 – 4.7)*	0.001 (3)
60 – 69	7.1 (5.7 - 8.8)*	7.5 (6.0 - 9.3)*	7.4 (6.0 - 9.3)*	7.3 (5.8 - 9.0)*	7.3 (5.8 – 9.1)*	6.9 (5.5 – 8.6)*	7.0 (5.6 – 8.7)*	6.9 (5.5 – 8.7)*	

70+	10.1(8.1 - 12.5)*	10.7 (8.5 - 13.3)*	10.6 (8.5 - 13.2)*	10.0 (8.0 – 12.5)*	10.0 (8.0 – 12.6)*	9.6 (7.6 – 12.0)*	9.0 (7.2 – 11.3)*	8.8 (7.0 – 11.0)*	
Sex (male as reference)		1.2 (1.1 - 1.4)*	1.2 (1.1 - 1.4)*	1.2 (1.1 - 1.3)*	1.2 (1.1 - 1.3)*	1.2 (1.0 - 1.3)*	1.2 (1.0 - 1.3)**	1.2 (1.0 – 1.3)**	0.006(1)
Wealth quintile									
second quintile			1.2 (1.0 - 1.4)		1.2 (1.0 - 1.4)	1.2 (1.0 - 1.4)	1.2 (1.0 - 1.4)	1.2 (1.0 - 1.4)	0.0001(3)
third quintile			1.0 (0.9 - 1.2)		1.0 (0.9 - 1.2)	1.1 (0.9 - 1.2)	1.0 (0.9 - 1.2)	1.0 (0.8 - 1.2)	
fourth quintile			1.0 (0.9 - 1.2)		1.1 (0.9 - 1.3)	1.1 (0.9 - 1.3)	1.0 (0.9 - 1.2)	1.0 (0.8 - 1.2)	
fifth quintile			1.0 (8.2 - 1.1)		1.0 (0.9 - 1.2)	1.0 (0.9 - 1.2)	0.9 (0.8 - 1.1)	0.9 (0.8 - 1.1)	
Education(primary as reference)									
less than primary				1.0 (0.9 - 1.1)	1.10 (0.9 - 1.1)	1.0 (0.9 - 1.2)	1.0 (0.9 - 1.2)	1.1 (0.9 – 1.2)	0.0001 (2)
secondary and above				0.8 (0.7 – 0.9)**	0.8 (0.7 – 0.9)**	0.8 (0.7 - 0.9)**	0.8 (0.7 - 0.9)**	0.8 (0.7 – 0.9)**	
Obesity						1.4 (1.2 – 1.5)***	1.3 (1.2 – 1.5)*	1.3 (1.1 – 1.3)**	0.0001(1)
Measured hypertension (no hypertension as reference)						1.2 (1.1 - 1.4)***	1.2 (1.1 - 1.3)	1.2 (1.1 – 1.3)**	0.0001(1)
Use of tertiary care (did not access care as reference)							2.5 (2.2 - 2.8)*	2.5 (2.2 – 2.8)*	0.0001(1)
Use of primary care (did not access care as reference)							2.0 (1.8 - 2.2)*	2.0 (1.8 – 2.4)*	0.0001(1)

Urban living*Country		0.0001(4)
Urban living*China	1	
Urban living*Ghana	0.4 (0.3 – 0.6)*	
Urban living*India	0.5 (0.3 – 0.6)*	
Urban living*Russia	0.7 (0.4 – 1.0)	
Urban living*South Africa	0.4 (0.3 – 0.8)**	

Notes: $ indicates omitted because of collinearity.

All models were fitted with random effects. In all of the final models, the intra-cluster correlation (rho) suggests that the proportion of variance, comparing within-group variance with the between-group variance, that occurred at the county level (for country data) and at the country level (for pooled data) presents a small fraction of the overall variability; in most cases rho was <0.08, which suggests the variance at the cluster level was 0.08% of the total variance. The results are as follows: China , rho= 0.012; Ghana , rho = 0.009; India , rho = 0.002; Russia, rho =0.002; South Africa, rho=0.06; and for pooled data , rho = 2.8×10^{-13} [156].

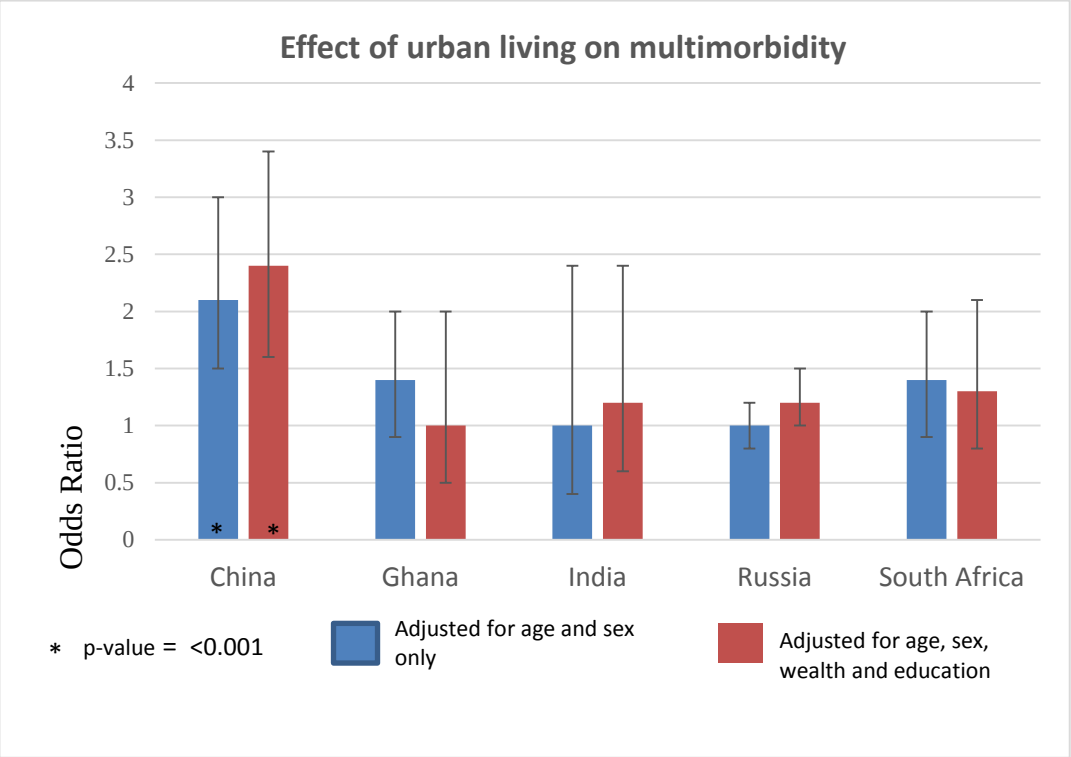


Figure 4-9. Effect of urban living on multimorbidity, univariable and multivariable analysis

Figure 4.9 shows the effect of urban living on multimorbidity, as univariable analysis (adjusted for age and sex only) and multivariable analysis (adjusted for all variables). Here we observe the increase in the estimated odds ratio in China, after controlling for other variables. This suggests that the variables, such as high quintiles of wealth, are potentially acting as opposing risks and therefore, once adjusted for, result in an increased risk of urban living on multimorbidity. Indeed both wealth quintiles 2 and 3 seemed to have a protective effect on multimorbidity in China. In Ghana there was a decrease in odds ratio, between univariable and multivariable. This decrease occurred once both wealth quintile and education were added to the models, which suggest that both variables may confound the relationship between urban living and multimorbidity.

4.4 Discussion

There were several key findings from the results, which have been described in the respective sections below. In each section I have drawn on the literature to examine whether these findings are consistent with previous findings.

Urban and rural differences within social, economic and demographic categories

In both Ghana and Russia the rural population was slightly older than the urban population. The distributions were similar in other countries; except for in China and India, where the populations of those aged 60 and above was slightly higher in urban areas. However, the urban-rural differences were greatest for wealth. In all countries, except for Russia, there were more people within the richer categories of wealth living in urban areas; conversely, there were more people within the poor categories of wealth living in the rural areas. Furthermore, the urban were more educated across all countries. Although there were inconsistencies in the patterning of urban-rural hypertension, doctor-diagnosed hypertension was more prevalent in urban areas.

In the pooled analysis effect of living in an urban area was significant, even when controlled for other risk factors. Across all countries, despite there being a higher multimorbidity prevalence among the urban population, the effect of urban setting on multimorbidity was not significant in the multivariable analysis after controlling for other covariates; except for in China. This is consistent with other studies, reporting the association of urban living and multimorbidity [89]. These findings show that there are individual country differences; notably that urban-rural differences are most apparent in China, where urban-rural inequality is a known phenomenon[157]. Interestingly there was no association found between urban living and multimorbidity in South Africa after adjustment in the multivariate analysis, which contradicts findings from an earlier national study conducted in South Africa[82].

For China, once all variables were put into the final model, there were modest changes, with an odds ratio of 2.4 (CI: 1.6 - 3.4). Wealth quintile, which had

a protective effect amongst middle categories of wealth, may have been confounding the relationship between urban living and multimorbidity. Wealth quintile was significant univariably, and in earlier models, however it was not significant in the final multivariable models. This was also observed in Ghana; when both education and wealth quintile were added to the model, there was a modest decrease in risk of urban living environment. These findings suggest that there may be a pathway of association between urban living and multimorbidity, which may be confounded by both wealth and education. The SES pattern differed between countries, once adjusted for other confounders. In China, for example, there was a U-shaped curve; the second lowest and highest levels of socioeconomic status were associated with a decreased risk of multimorbidity. By contrast, in Russia, there was a negative gradient in SES; the highest levels of socioeconomic status were associated with the lowest risk of multimorbidity.

The pooled analysis of urban exposure, stratified by age, showed differences between the multimorbidity prevalence amongst those exposed to urban and rural environments. For the highest age strata (aged 70+), there was a more pronounced difference in multimorbidity prevalence between urban and rural areas, and no cross-over of confidence intervals. These results suggest that multimorbidity prevalence is highest amongst the elderly with long term-exposure to urban environments, compared to rural environments. Owing to missing data on the duration of exposure, however, interpretation was met with caution as the results may have been susceptible to bias. The responder vs. non responder analysis in Ghana, for example, suggested that there were differences in the wealth distribution of the responders and non-responders. Given the proposed relationship of urban living-SES-health, as outlined in the introduction, these differences in wealth may have potentially been an underlying factor influencing the relationship between urban living and health.

Social, economic and demographic risk factors

The association of the social, economic and demographic risk factors with multimorbidity were examined in previous chapters. This analysis points to some interesting findings, which are discussed here. Similar to the previous studies, across all countries age was a significant risk factor of multimorbidity; odds ratio

increased with increasing age. The only exception was in South Africa, which had a modest increase between the third age category (60-69 years) and the fourth age category (70+). Despite the prevalence of multimorbidity being higher amongst the female sex in all countries, except in India where the opposite was true, sex was a statistically significant risk factor in China and India only. In China, the female sex was associated with a higher risk, whereas in India the female sex was associated with a lower odds ratio. An analysis of prevalence by sex, in Table 4.6, found chronic lung disease and diabetes to be highest amongst males than females in India. These morbidities may be contributing to the difference in multimorbidity risk. It is also widely accepted that gender inequalities exist in India, with a wide number of unreported morbidities amongst women [158]. Here, the gender differences in health seeking behaviour, and health reporting, may be an underlying factor in the low prevalence of doctor diagnosed conditions. In table 4.13, in Russia only, sex was significant univariably mbut not multivariably, which suggests possible confounding by other variables included in the final models.

As for other notable sex differences in morbidity, the cardiometabolic set of morbidities, notably angina and diabetes, were consistently higher amongst the female population; except for in India. This finding is consistent with other studies, which report higher cardiometabolic clustering amongst the female population [77], although angina is commonly more prevalent amongst males globally [159]. Chronic lung disease prevalence was higher amongst the male population, which is consistent with studies that found an association between males, higher tobacco use and exposure to occupational pollutants, particularly in LMICs [160].

For wealth, none of the categories remained significant in the final models. In the multivariable analysis, there was no obvious gradient in wealth, which is surprising given that the previous literature review (Chapter 2) suggested that there may be some inequalities in wealth. These results could support a theory of a flattened SES gradient. Such theories suggest that the health benefits for the rich are outweighed by the health penalties that come with increased risky behaviour in urban areas [130, 131, 161]. In contrast, the urban poor may experience improved health due to better access to health care facilities and services. These associations are discussed in further detail in the following sections.

In contrast, the gradient in education was more pronounced, particularly in India and South Africa – where lower education was associated with an increased risk of multimorbidity. This is consistent with the literature review (Chapter 2) which showed that multimorbidity was associated with no education, or low education in MICs [78, 82, 84-89]. The addition of education into the multivariable model was significant (likelihood ratio test <0.05) in all countries except for in Ghana. The pooled data, however, pointed to a protective effect of education; secondary school education and above was associated with a decreased risk of multimorbidity. This may be a result of their being more power in the study. There was, however, a wealth-education interaction for the third quintile in China only. This suggests that, for this level of wealth, the effect of wealth on multimorbidity differs as a function of education. No significant wealth-education interactions were found for other countries, however, and therefore are not reported in the table. Overall, these results indicate that inequalities may exist, and that multimorbidity may have a higher burden on the least educated, even in middle-income countries. These findings have clear implications for policy and health service planning; the least educated are the most vulnerable and would therefore benefit from targeted intervention for prevention and access to health services. Although economic development may lead to greater investments in education, further investment may be needed to bolster the effects of education on ill health. Overall these findings support a pathway from urban living to multimorbidity (Refer to figure 4.3, conceptual model). Urban living is likely to be a structural determinant, influencing social, economic and demographic changes which, in turn, are driving multimorbidity.

Behavioural Risk Factors

As expected obesity was statistically associated with an increased risk of multimorbidity in China, Russia and South Africa, even after controlling for other risk factors. This suggests that obesity is likely to play a significant role in understanding the risk of multimorbidity; particularly in relation to the development of cardiometabolic diseases, such as diabetes and angina, which were both captured in these data.

In Russia, hypertension was statistically associated with an increased risk of multimorbidity in the final multivariable analysis after controlling for other factors. For other countries, hypertension was not significant in the final models. In Russia, multimorbidity amongst those with doctor diagnosed hypertension was 32.8% versus 5.5% without. By contrast, in China, multimorbidity prevalence amongst those with doctor diagnosed hypertension was 13.6% versus 1.8% without. The differences between multimorbidity prevalence among hypertensives and non-hypertensives, using measured data, were less pronounced across all countries. For example, in China, multimorbidity prevalence using measured data was 6.7% versus 2.5% without. There may have been some misclassifications which may have influenced the results. First, there may have been inaccuracies in the measurement of hypertension, which may have resulted in false negatives and, equally, false positives. Second, the population defined as 'non hypertensive' from the measured data may include doctor-diagnosed hypertensives whose hypertension is currently being controlled by anti-hypertensive drugs. As such, multimorbidity prevalence in the non-hypertensives (measured) is therefore expected to be higher than the multimorbidity prevalence in the non-hypertensives (doctor diagnosed).

Overall the multimorbidity prevalence amongst the doctor diagnosed hypertensive population was higher than the measured hypertensive population. This finding is expected, given that those with doctor diagnosed hypertension are more likely to have accessed health care, have increased use of healthcare services and, subsequently, are more likely to have other morbidities diagnosed. The effect of hypertension, however, was not statistically significant for the final models, apart from in Russia. It was therefore unclear whether hypertension had an effect on multimorbidity, although the inaccuracies of the measurement made interpretation difficult. Other studies, consider hypertension to be a morbidity, and not a risk factor; from this perspective, hypertension may have an effect on the prevalence of multmorbidity, if classified as a morbidity [162].

In the final models, shown in Table 4.13, both obesity and hypertension resulted in a better fit model with significance of <0.05 when applied to China and South Africa and pooled data. Obesity only resulted in a better model with significance of <0.05 when applied to Russia data.

One effect of urban living is the subsequent change to a western lifestyle, such as unhealthy foods [161]. However, owing to high missing data (i.e. data that was not collected), we were limited by the variables used to represent behavioural risk. For example, neither nutrition intake, tobacco or alcohol use have been investigated in the SAGE survey here – which make interpretation on the effect of behavioural risk limited. In terms of the research question, there is some evidence to suggest that there were differences between the risk factor profiles of urban and rural areas. Interestingly in China, where there were significant urban-rural differences in the final model, there were not significant differences for obesity between urban and rural areas. However, obesity was higher in the urban populations of both Ghana and India, which suggests that risk factor profiles may differ between the urban and rural environment, although its effect is not significant enough to cause noticeable changes in the multimorbidity risk of the respective populations. We were unable to perform longitudinal analysis using the SAGE – as we felt that the short time lapses between SAGE 0 (2002-2004) and SAGE 1 (2007 – 2010) would not produce differences of epidemiological significance. At the time of undertaking the research, SAGE 2 (2013 -2014) was still being completed and was not yet available for analysis.

Other studies suggest that risk factor profiles are different in urban and rural areas. In one study in India for example, smoking, smokeless tobacco consumption and poor consumption of fruit and vegetables were more prevalent in the rural population [163]. This suggests that poor health outcomes in rural and urban areas are likely to be influenced by different behavioural determinants. This needs to be explored with further study. The relationship between economic and behavioural risk factors has also been studied, more recently, in LMICs. There is evidence to suggest that socioeconomic status confers protection from obesity up to a level of USD$2500 per capita per year, after which point inequities in obesity start to appear [164]. Furthermore the social patterning of obesity may differ for LICs and MICs. One study found that in low income countries, the more affluent and educated were more likely to be obese, and in middle income countries, for women only, the less affluent and less educated were more likely to be obese [165]. Although relatively understudied in LMICs, evidence suggest that changes in the social patterning of behavioural risk factor profiles are subsequent to urban living[166]. Consistent with this, the previous literature review (chapter 2) showed

differences in the social patterning of multimorbidity, between lower MICs and upper MICs. Overall, multimorbidity was associated with those of high SES in the lower MICs; and with those of low SES in upper MICs. Although most of the studies were taken cross-sectionally, there is evidence to suggest that as countries develop (and income improves), there are transitions in patterns of multimorbidity. The cross-sectional data therefore provide a 'snap-shot' of processes that are on-going, and have been occurring.

Use of healthcare services

Across most of the countries, health service use was significantly associated with multimorbidity in the final models. The use of tertiary care resulted in a better fit model (<0.05) in all countries; whilst the use of primary care resulted in a better fit model in China, India, Russia, South Africa and in the pooled dataset (<0.05). In China and India, tertiary care was associated with a higher effect on multimorbidity compared to primary care. This may reflect the healthcare needs of the multimorbidity population, suggesting outpatient or hospital care; or, it may reflect the organisation of the healthcare system – and a higher use of specialised tertiary hospitals. In South Africa, however, the opposite was true. Primary care was associated with a higher risk compared to tertiary care. It is expected that the relationship between doctor diagnosed multimorbidity and healthcare usage is bidirectional. The presence of illness related to morbidities will increase healthcare use. In turn increased healthcare usage increases the possibility of disease ascertainment (Lusignani et al. 2013). The implications are that multimorbidity has a direct impact on the use, and cost of health care service provision. Therefore considerations should be made for health service planning, by considering the direct financial impact of multimorbidity to the healthcare system.

Strengths & Limitations

This study used nationally representative samples from five middle-income countries (China, Ghana, India, Russia and South Africa). All five countries are currently undergoing rapid economic development and urbanisation, which are relevant to the study aims. The cross-sectional data therefore provide a snapshot of

the dynamic change occurring at the country level. The survey also used standardised tools, which were consistent across the survey datasets, allowing cross country comparisons. Another key feature were the type of measures used, including objective measures, such as anthropometric measures taken by registered nurses. The number of key economic variables included in the study, such as socioeconomic status, as well as healthcare service use, meant that adjustment could be made for possible confounding. However, it is important to note that certain key variables that may have been possible confounders, such as race, may not have been included in the analysis.

There were several limitations. There was a lot of missing data (i.e. not collected) for certain variables, such as the behavioural risk factors, including tobacco and alcohol use; environmental exposures through the work place; as well as length of time at current residence, which was used to determine exposure to environment. The small sample sizes for these analyses meant that there was less precision and accuracy. Several variables used in the analysis, such as wealth and education, were accounted for in post-stratification; which may have affected the generalisability of the results to the national population. The morbidity count was also limited to seven morbidities, which were also based on self-report and not on diagnostic measures. As discussed in Chapter 3, with the World Health Surveys, multimorbidity prevalence was based on self-reported doctor diagnosed conditions, which are acknowledged in the interpretations of our findings. For example, the low prevalence of chronic lung disease and diabetes were highest amongst males than females in India; which may be due to differences in health seeking behaviour and possible underdiagnosis amongst the female population. Access to healthcare services has been adjusted for in the final models, however, there may still be limitations in this approach; as the variable used examines whether the individual has accessed healthcare services in the previous two years, rather the accessibility of healthcare services due to geographic location or financial ability etc. Further studies should also include a wider set of prevalent conditions, including common cancers, and chronic infectious diseases, such as HIV; as well as neurodegenerative conditions common to the elderly, such as Parkinson's disease and Alzheimer's.

Finally the countries varied in their definitions of urban and rural living, as well as wealth index, which may have caused some inaccuracies in the cross-country comparisons. The dichotomous measure of urban living used in this study

does not capture the multi-dimensional, shifting scales of urbanicity. Other studies have captured the critical domains association with urbanicity, related to community, social and economic systems; as well as physical infrastructure, related to health [167]. These measures have been mapped to capture different localities, such as big cities, towns, little cities etc. Future studies should therefore consider a robust measure of urbanicity, which is directly comparable between survey-sets.

4.5 Conclusion

These SAGE countries represent a group of emerging economies undergoing rapid economic change and urbanisation. Concurrently, there will be new challenges and threats for the health of the population. It is widely believed that urban living gives rise to changes in behavioural risk factors, notably increased risk behaviour through tobacco and alcohol consumption, increased sedentary behaviour and poor nutrition. At the same time, the urban-SES- health relationship is still contended, and the results are both varied and often ambiguous. These results further support the underlying complexities of the urbanisation story. Country specific data suggest that the effect of urban living varies from country to country. In China, the effect of urban living on multimorbidity is most apparent. The distribution of wealth differed between urban and rural areas. In all countries, the urban population were wealthier, more educated and slightly younger. These findings are consistent with those reported using panel data in Europe [168]. There was a surprising *flatness* in the relationship between SES and multimorbidity, which suggest that the health benefits for the rich are outweighed by the health penalties that come with increased risky behaviour in urban areas. Furthermore, evidence from China suggest that education may moderate the effect of socioeconomic status on multimorbidity. This finding supports a pathway between urban living and multimorbidity, which is acting through both economic and behavioural risk factors. In terms of the demographic risk factors, age is a major driver of multimorbidity. Sex, on the other hand, varied in its effect across all countries. Using pooled data education, however, was protective against the risk of multimorbidity which in urban areas, where people are more educated, may be counteracting the effect of

risky behaviours. Therefore as countries urbanise, individual changes to lifestyle, wealth and access to education, may be interacting to influence multimorbidity. Finally there is a direct impact of multimorbidity to the health system, in both urban and rural settings. Increased healthcare usage for patients with multimorbidity was consistently found across all countries, supporting the need for further healthcare service planning for a multimorbid population. Urbanisation has had a positive impact on development, poverty reduction and access to education [128]. Despite this, lifestyle changes may be counteracting the health benefits in urban areas. Following on from the Habitat III conference – where global policy makers met to discuss sustainable urban development – considerations should be made to encourage healthy living within the rapidly urbanising LMICS. Urban development should seek to promote healthy active lifestyles, and equally, prepare for an aged population with increasingly complex healthcare needs. Despite rapid urbanisation, however, rurality still continues to exist globally; therefore health systems should also continue to provide and integrate health and social care across both urban and rural boundaries.

Chapter 5:What is the impact of multimorbidity on functional disability? A cross sectional study using the SAGE in five MICs.

The literature review examined the prevalence of multimorbidity in MICs (chapter 2), the first study examined the prevalence of multimorbidity, and its association with education, in LMICs and HICs; (chapter 3) and the previous chapter examined the prevalence of multimorbidity in 5 key MICs, using the SAGE (chapter 4). The focus of this study (and the next study) is in understanding the 'impact' of multimorbidity on the individual in MICs. This research is aimed at understanding the impact of the presence of multimorbidity on an individual's daily life including, but not limited to, their ability to live independently. This research is of particular relevance to MICs - where provisions in social care are limited; and more evidence is needed on the impact of multimorbidity on individuals, families and communities. The previous chapters provided evidence to suggest that multimorbidity is present within MIC and, furthermore, that it may be occurring at similar (or higher) rates than HICs. To this ends, health and social care should meet the needs of the population. This research study therefore aims to examine the impact of multimorbidity on disability, and understand how multimorbidity influences activities of daily living. One could hypothesise that certain comorbid conditions would have less/more effect on disability depending on (i) how well they could be managed (and healthcare provision) and (ii) their severity. Overall, you would expect some combinations of diseases to be disabling than others.

5.1 Background

5.1.1 Measures of disability

Previous studies examining the relationship between multimorbidity and disability have used different standardised methods to measure individual disability [169, 170]. The term 'disability' is often used interchangeably with, or in relation to, functional status. One

study by Fried et al. reported the effect of self-reported physical disability by examining the ability of women to undertake 15 tasks related to daily life [171]. The questions within the disability questionnaire related to 'how difficult' the individual finds a particular task and are reported on a Likert-scale. Similarly, other papers used both activities of daily living (ADLs) and instrumental activities of daily living (IADLs) to ascertain an individual's functional status; also reported on a Likert-scale [172]. Indicators of ADLs relate to physical functioning and may include, for instance, their ability to bath, dress, and eat. By contrast, an IADL relates to their ability to live independently, such their ability to manage the household. Most of the standardised instruments that assess disability examine an individual's ability to undertake ADLs. One study in India, for example, used a 'Rapid Disability Rating scale' composed of two parts: one that addresses ADLs and one that addresses indicators related to the natural process of aging; such as communication, hearing, and sight etc. [173].

5.1.2 Multimorbidity, disability and their association with social, economic and demographic risk factors

Several studies in both MICs and HICs have examined the impact of multimorbidity with disability, and noted key differences between social, economic and demographic risk factors. A recent study used the COURAGE study, sampling over 3625 participants aged 50 years and older in Spain. They found that worsening disability was associated with number of chronic conditions, and for all conditions, (except for asthma, depression and anxiety) women had worse disability scores compared to men [169]. These sex differences in disability were also found in a recent study in India, sampling 200 individuals aged 60 and above [173]. Other demographic differences were noted in a recent study sampling 1820 Israelis with multimorbidity, from the age of 75-94 years. They found that disability increased with age, and was higher for women [172]. These findings are consistent with a study undertaken in Sweden, which showed that multimorbid individuals living with disability were more likely to be older, female, and widowed [174]. Furthermore, a study exploring the differential impact of chronic diseases on disability showed that a higher proportion of individuals from lower economic groups spent their lives with chronic morbidity and disability [175]. In summary there is evidence to suggest that multimorbid individuals who were female, older, and from a lower economic group were more likely to suffer from disability compared to their counterparts. These findings, however, appeared to be dependent on their conditions; some, not all conditions, resulted in key differences

between economic and demographic groups. Overall, these findings suggest that age, gender and socioeconomic status affect disability outcomes independent of multimorbidity.

5.1.3 Previous work with SAGE on disability and conceptual model

During the course of this thesis, a parallel paper was undertaken by the SAGE team examining the effect of multimorbidity on a number of health-related outcomes. I did not wish to replicate the works of this paper, but wanted to build on what they have previously shown. The paper examined the relationship between multimorbidity and health-related outcomes, namely lower self-rated health, depression, limitation in activities of daily living (ADLs) – commonly used to measure disability, and poorer quality of life [162]. Evidence from the SAGE paper suggested that the prevalence of having one or more ADL limitations, poor self-rated health, and depression increased with the number of diseases even after adjustment with other background characteristics (age, sex, wealth, residence, schooling) . The ADL limitations (taken as having one or more ADLs) increased sharply with increasing number of conditions. This was consistent across all countries used in the study. By contrast, quality of life declined steadily with increasing number of conditions

One paper by Marengoni et al. followed up a group of elderly people in Sweden, over the course of two years. Using the Katz index, composed of six core ADLs, the paper examined the change in functional status, defined as functional decline as well as survival. They found that baseline disability highly increased the risk of dying, independently of the number of diseases [170]. These results suggest that the health-related outcomes of multimorbidity, such as quality of life, are dependent on the disability experienced by the individual, independent of the number of conditions they have. One of the limitations of the recent SAGE paper was that it did not examine, in detail, the relationship between multimorbidity and functional status. Instead an arbitrary cut off was taken as a measure of disability status; the ability to partake in one or more ADLs, out of a possible 16, was coded into a dichotomous variable. This approach meant that little could be understood about how disability varies by multimorbidity. Based on these findings I have proposed a

simplified conceptual model below, as the basis for further investigation and for this study.

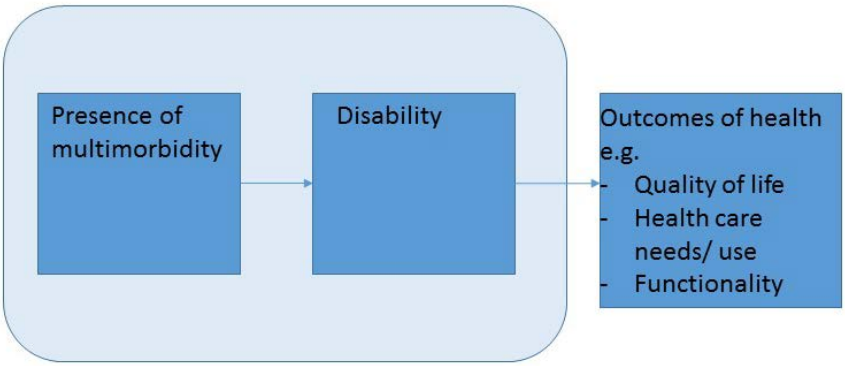


Figure 5-1. Simplified conceptual model to show the relationship between multimorbidity, disability and outcomes of health

Marengoni et al. suggest that presence of disease increased the risk of disability, but that disability increased the risk of survival, independent of number of diseases present. This chapter aims to examine, in more detail, the relationship between presence of multimorbidity and disability (functional status) (association shown within shaded box).

5.2 Aims

The aims of the following study were:

- To examine how functional disability, measured by six core ADLs and the World Health Organisation Disability Schedule 2.0 (WHODAS-II), varies according to multimorbidity; and whether this is modified by key social, economic and demographic risk factors

5.3 Methods

The current study uses the SAGE survey Wave 1, undertaken between 2007 -2010. The SAGE survey instruments are standardised instruments, which have been used to assess health status and health systems within the household, and for the individual. The sampling methods used in the SAGE have been described elsewhere in this thesis (See

Appendix E). The SAGE survey was conducted in China, Ghana, India, Mexico, Russia and South Africa. Wave 2 is currently being finalised, and future plans are being made to undertake Wave 3. Previous results found there to be a low response rate in Mexico. (See Appendix G). Therefore, Mexico has not been included in this analysis. For this analysis, the Wave 1 data from five countries (China, Ghana India, Russia and South Africa) was pooled. A total of 21140 individuals was used in this study, aged between 18 and above.

5.3.1 Predictor Variables

The predictor variables used within this study were based on self-reported chronic NCDs, which included angina, arthritis, asthma, chronic lung disease, depression, diabetes and stroke. Multimorbidity was estimated by producing two dichotomous variables, one representing two or more conditions, and one representing three or more conditions (out of the list of seven). To examine specific disease combinations, the five most common comorbidities in the pooled data were included in the analysis. Furthermore, a set of social, economic, demographic and behavioural risk factors were also included in the analysis. These included age, gender, education, health care utilisation, hypertension, obesity, residence, and wealth. The prevalence of obesity was estimated by calculating the individual's BMI from their height and weight. The estimates of hypertension were based on self-reported diagnosis, named hypertension (diagnosed); and by calculating an individual's systolic and diastolic pressure (average across three measures), named hypertension (measured). The same quantitative groupings has been applied, consistent with the previous chapter. A full description on these predictor variables, including how each variable was developed, has been reported previously in this thesis (see section 5.2).

5.3.2 Outcome Variables

The outcome variables used in this analysis (ADL and WHODAS) were taken from the section of the questionnaire that examines an individual's health state, including aspects of their physical and mental status, and includes questions related to health outcomes, such as quality of life. The section also included a 'functioning assessment' which entails the 12-item WHODAS, examining an individual's disability status; as well as items defined as ADLs. A more detail description, including each item within the health state section, is

shown as Appendix H. In the Appendix, I have also described how these items relate to other known validated instruments.

5.3.2.1 Activities of Daily Living

The functioning assessment assessed the difficulties an individual faces due to their health conditions. The set of questions asked specifically about the difficulty they experience, in day-to-day activities, commonly known as activities of daily living, ADL. A set of six core ADLs were chosen from the functioning assessment, which related to core activities. The ADLs chose are based on the Katz Index of independence, although 'continence' could not be ascertained as it was not included in the SAGE questionnaire [176]. See Table 5.1. These core activities included eating, bathing, dressing, getting up from lying down, getting to the toilet and walking 100 metres. Initial responses were given on an ordinal Likert scale (*none, mild/ moderate, severe/extreme – cannot do)* and have been recoded into dichotomous variables: '0,'for those who responded *no, mild or moderate*; and '1,' for those who responded *severe or extreme (cannot do).* Two further variables were then developed to include: those who had one ADL only, and those who had two or more ADLs. This differs with the previous SAGE analysis, which chose a cut-off of less than one, and one or more, ADLs [162].

Table 5-1. Six core ADLS

ADL 1	In the last 30 days, how much difficult did you have with eating (including cutting up your food)?
ADL 2	In the last 30 days, how much difficult did you have in bathing/ washing your whole body?
ADL 3	In the last 30 days, how much difficult did you have in getting dressed?
ADL 4	In the last 30 days, how much difficult did you have with getting to and using the toilet?
ADL 5	In the last 30 days, how much difficult did you have with getting up from lying down?
ADL 6	In the last 30 days, how much difficult did you have in walking 100 meters?

Note: Two out of the six core ADLs were also included in the 12-item WHODAS schedule (ADL 2 and ADL 3).

5.3.2.2 World Health Organisation Disability Schedule 2.0 (WHODAS v2.0)

The WHODAS 2.0 is based on the conceptual framework of the International Classification of Functioning Disability and Health, and measures functional disability. The WHODAS v2.0 has previously been validated in several populations [177]. The instrument consists of a set of 12 questions, which are respondent on an ordinal Likert scale (none*, mild/*

moderate, severe/extreme – cannot do). Each response is given a score and, using simple summing, an individual is given a total disability score that ranges from 0 (least disability) to 60 (worst disability). The 12-item list of questions is described below in Table 6.2.

Table 5-2. 12-Item WHODAS Score

When scoring WHODAS, the following numbers are assigned to responses: 1 = No Difficulty 2 = Mild Difficulty 3 = Moderate Difficulty 4 = Severe Difficulty 5 = Extreme Difficulty or Cannot Do		
		Score
S1	Standing for long periods such as 30 minutes?	0
S2	Taking care of your household responsibilities?	0
S3	Learning a new task, for example, learning how to get to a new place?	0
S4	How much of a problem did you have in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	0
S5	How much have you been emotionally affected by your health problems?	0
S6	Concentrating on doing something for ten minutes?	0
S7	Walking a long distance such as a kilometre [or equivalent]?	0
S8	Washing your whole body?	0
S9	Getting dressed?	0
S10	Dealing with people you do not know?	0
S11	Maintaining a friendship?	0
S12	Your day-to-day work/school?	0

5.3.3 Statistical Analysis

The statistical analysis was undertaken using STATA Version 13. The data were weighted by using post-stratified individual probability weights, which were based on the selection

of probability at each stage of selection. For each country, individual weights were post-stratified by province, sex, and age groups. Consistent with the previous chapters, age was fitted as a categorical variable. Once pooled, the post-stratification weights could still be applied. The estimates have therefore been adjusted for the multistage stratified cluster sample design of the study, as well as post-stratification, by using survey weighting set through the 'svy' function. Weighted percentages have been reported unless stated otherwise. Both 95% confidence intervals (CIs) and the p-value are reported. To establish whether a linear regression model could be applied to the WHODAS, the distribution of the WHODAS was examined using a histogram. The results showed that the WHODAS was not normally distributed (negatively skewed). Next the WHODAS was log transformed; however it was The transformation of the WHODAS was considered and applied; however it was felt that this would potentially lead to bias and therefore misinterpretation of the results. The WHODAS was therefore split into quartiles. Therefore multinomial logistic regression was applied to examine the effect of the presence of comorbidity on disability (categorised); and adjusting for potential confounders..

5.4 Results

The distribution of morbidities, within categories of interest, are shown in Table 6.3. The most common comorbidities, across the dataset, are reported in the table and their prevalence estimates are shown as Figure 5.3. There were several key findings of notable interest. First, amongst those with no morbidities, there was a negative gradient for age; the prevalence of those with no-morbidities decreased as age increased. Contrary to this, however, across the ages the prevalence of those with both one or more, and two or more, morbidities was relatively equally distributed. In terms of education, multimorbidity and morbidity prevalence was lowest amongst those with higher education and above. By contrast, a noticeable gradient in prevalence for the other categories of education was absent. In terms of wealth, the common comorbidities 'arthritis- diabetes' and 'asthma-chronic lung disease' were highest amongst the wealthiest. Both hypertension and obesity were consistently high amongst those with multimorbidity and amongst the common comorbidities. Finally, although the use of

primary care was consistently high across the groups, it was also high (around 70%) amongst those with no morbidities.

Prevalence estimates for all morbidities are shown in Figure 5.2, including the prevalence of having multimorbidity; whereas arthritis was the most common morbidity within the pooled data, at 8.3%, and more common than having 'two or more' conditions. The co-occurrence of angina and arthritis was the most common comorbidity within the survey-set, at 1.3%, whereas having both arthritis and stroke was the fifth most common comorbidity within the survey-set, at 0.1%.

Table 5-3. Distribution of morbidities and comorbidities within category of interest, using the pooled data (Confidence intervals shown)

	0	1 +	2+	Angina - CLD	Arthritis – Angina	Arthritis – Stroke	Arthritis - Diabetes	Asthma - CLD
Population, n	25672	4074	1112	148	736	159	385	176
Age								
18-49	79.0 (77.9 - 80.0)	36.1 (30.6 - 41.9)	23.8 (15.9 - 34.0)	26.6 (8.0 - 60.0)	38.5 (24.2 - 55.1)	11.2 (2.0 - 43.3)	31.1 (16.7 - 50.4)	34.5 (11.0 - 69.2)
50-59	11.0 (10.3 - 11.7)	19.9 (16.1 - 24.3)	22.2 (17.2 - 28.2)	13.9 (7.4 - 24.6)	20.1 (9.3 - 38.3)	20.3 (11.6 - 33.0)	22.1 (15.4 - 30.6)	21.8 (11.7 - 37.1)
60-69	6.1 (5.7 - 6.4)	19.9 (17.9 - 22.1)	23.1 (19.0 - 27.9)	22.0 (12.5 - 35.6)	16.5 (12.0 - 22.3)	33.4 (21.7 - 47.5)	27.0 (19.6 - 35.9)	22.2 (12.3 - 36.7)
70+	4.0 (3.6 - 4.3)	24.1 (20.7 - 27.9)	30.9 (25.4 - 37.1)	37.5 (21.0 - 57.6)	24.9 (16.8 - 35.1)	35.1 (24.0 - 48.1)	19.9 (14.1 - 27.2)	21.6 (11.6 - 36.6)
Sex - Female	49.1 (47.4 - 50.8)	53.5 (48.0 - 59.0)	51.1 (43.3 - 58.9)	41.3 (23.6 - 61.5)	61.3 (43.3 - 76.6)	58.1 (45.2 - 70.1)	62.1 (48.0 - 74.5)	29.6 (15.8 - 48.5)
Residence - Urban	43.1 (36.4 - 50.0)	53.6 (45.2 - 61.9)	54.8 (44.0 - 65.2)	57.1 (33.9 - 77.5)	59.7 (41.7 - 75.3)	55.9 (40.0 - 70.7)	47.9 (32.9 - 63.3)	47.9 (23.6 - 73.2)
Education								
< primary	28.0 (25.3 - 30.9)	23.9 (19.1 - 29.6)	30.7 (21.7 - 41.5)	30.4 (10.8 - 61.1)	21.9 (12.8 - 34.8)	16.7 (9.8 - 26.9)	16.9 (10.7 - 25.7)	14.7 (6.3 - 30.7)
Primary	20.1 (25.9 - 32.4)	33.2 (27.1 - 39.8)	25.3 (19.7 - 31.8)	32.4 (16.3 - 54.3)	28.2 (13.7 - 49.3)	57.5 (42.5 - 71.3)	49.1 (33.7 - 64.7)	62.0 (34.6 - 83.4)
secondary	41.3 (37.1 - 45.7)	41.0 (34.4 - 47.9)	41.2 (31.9 - 51.2)	35.8 (18.3 - 58.1)	49.9 (33.2 - 66.7)	25.8 (14.0 - 42.6)	33.7 (20.2 - 50.3)	23.3 (10.0 - 45.4)
Higher	1.7 (1.1 - 2.5)	2.0 (0.8 - 4.9)	2.8 (0.8 - 9.2)	1.3 (0.3 - 5.7)	0	0	0.4 (0.05 - 2.6)	0.02 (0.002 - 0.20)
Wealth quintile								
Lowest - 1	14.8 (12.9 - 16.9)	15.6 (12.5 - 19.2)	17.7 (12.8 - 24.0)	27.9 (10.3 - 56.6)	18.3 (11.7 - 27.7)	11.8 (6.6 - 20.3)	6.7 (3.4 - 12.6)	11.0 (5.9 - 19.7)

2	17.8 (15.9 - 19.9)	17.3 (14.3 - 20.7)	18.6 (13.4 - 25.3)	17.8 (9.0 - 32.1)	14.8 (8.6 - 24.2)	18.6 (11.0 - 29.6)	12.8 (7.7 - 20.6)	23.2 (12.0 - 40.0)
3	18.7 (16.9 - 20.7)	18.6 (15.6 - 22.0)	21.7 (16.6 - 28.0)	17.8 (6.5 - 40.5)	12.6 (8.4 - 18.7)	23.6 (13.8 - 37.5)	11.3 (7.3 - 16.9)	12.2 (6.1 - 23.2)
4	20.8 (19.0 - 22.7)	20.3 (16.7 - 24.4)	19.0 (13.8 - 25.5)	23.1 (10.4 - 43.8)	18.3 (11.2 - 28.3)	17.1 (10.3 - 27.2)	36.2 (22.3 - 53.2)	12.2 (6.2 - 22.5)
Highest - 5	27.9 (24.1 - 31.9)	28.3 (23.0 - 34.2)	22.9 (16.4 - 31.1)	13.4 (7.2 - 23.6)	16.0 (22.5 - 52.1)	28.8 (15.1 - 47.9)	33.0 (21.5 - 47.0)	41.4 (17.2 - 70.7)
Obesity	54.6 (51.4 - 57.8)	58.7 (53.3 - 63.9)	62.4 (54.8 - 69.4)	61.8 (41.4 - 78.7)	63.3 (48.9 - 75.6)	55.8 (40.6 - 70.0)	65.3 (54.4 - 74.9)	85.1 (72.6 - 92.5)
Hypertension (measured)	49.1 (45.6 - 52.5)	64.3 (58.8 - 69.4)	65.0 (57.2 - 72.1)	54.5 (32.3 - 75.0)	79.3 (68.9 - 86.9)	62.8 (46.3 - 76.8)	68.1 (53.6 - 79.8)	61.2 (39.0 - 79.5)
Hypertension (diagnosed)	7.6 (6.9 - 8.5)	46.8 (41.3 - 52.4)	61.9 (54.4 - 68.9)	41.0 (23.8 - 60.6)	49.5 (34.7 - 64.4)	53.0 (38.6 - 66.8)	48.8 (35.2 - 62.6)	13.8 (6.8 - 26.0)
Health care utilisation								
Primary care use	70.6 (67.4 - 73.5)	80.5 (76.2 - 84.2)	81.4 (74.0 - 87.0)	71.4 (49.8 - 86.2)	86.5 (81.4 - 90.5)	72.0 (17.8 - 41.2)	69.8 (53.0 - 82.6)	83.5 (75.3 - 89.3)
Tertiary care use	12.6 (11.3 - 13.9)	33.9 (29.7 - 38.3)	41.8 (35.1 - 48.9)	24.6 (14.0 - 39.5)	32.1 (19.2 - 48.4)	29.7 (19.8 - 41.8)	25.4 (15.5 - 38.7)	26.3 (17.4 - 37.7)

Notes: Estimates made using ‘svy’ function within the pooled data set.

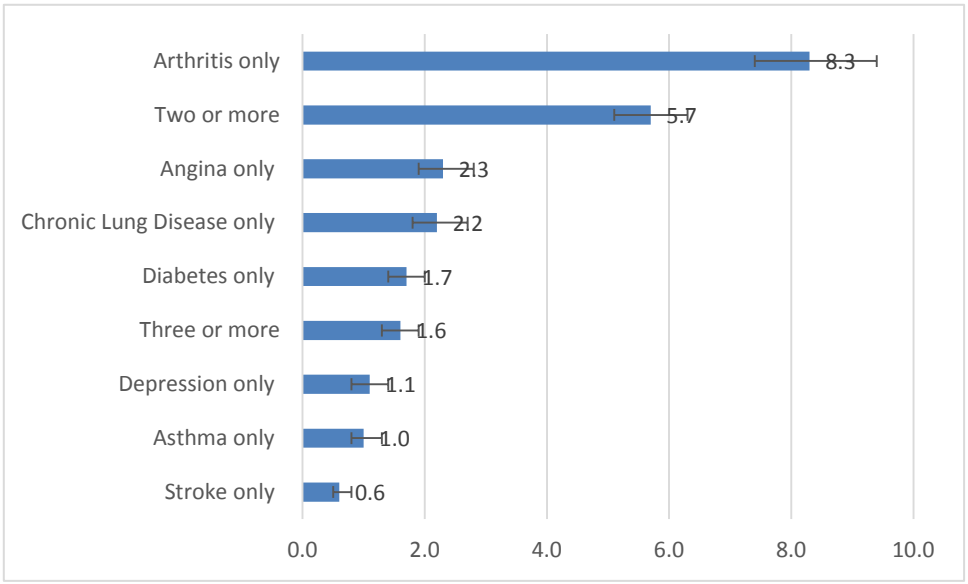


Figure 5-2. Prevalence estimates of morbidities, using pooled data (confidence intervals shown)

Notes: Data was pooled. Point prevalence estimates were calculated by dividing total number of cases by total population

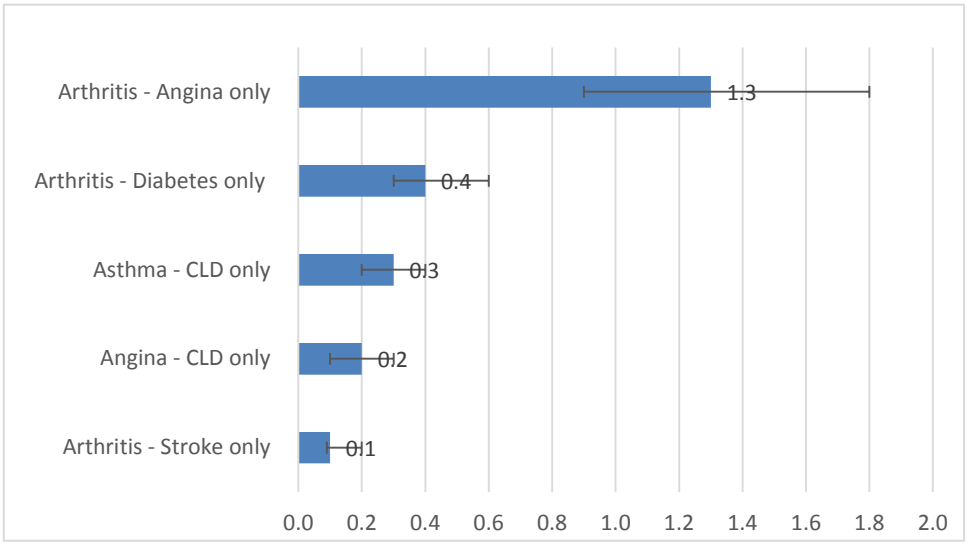


Figure 5-3. Prevalence estimates of comorbidities, using pooled data (confidence intervals shown)

A descriptive analysis into the distribution of ADLs within category of interest was undertaken. This is reported as Table 5.4, and summarised into separate figures for categories of interest; by morbidity, comorbidity, age and sex are shown as Figures 5.4, 5.5, 5.6 and 5.7; respectively. For all single morbidities, the prevalence of those with one ADL was similar, or slightly more than, those with two or more ADLs. The only exception was for stroke, where there was a positive gradient; the prevalence increased with number of ADLs. Similarly, the only positive gradient for the common comorbidities was seen for both 'arthritis- stroke' and 'angina- chronic lung disease.' Across the dataset, females had slightly higher prevalence than males at each category of disability; likewise, ADL prevalence was slightly higher in rural areas than urban areas. No clear gradient was observed for education. There was, however, a gradient in wealth; such that those with the highest prevalence of disability were from the lowest category of wealth, and those with the lowest prevalence of disability were from the highest category of wealth. This was true across all categories of disability. Next, those who were obese had a higher prevalence of disability, across all categories, compared to those who were not obese. Similarly those who had hypertension (diagnosed) had a higher prevalence of disability, across all categories, compared to those who did not have hypertension (diagnosed). This was also true for the lowest and highest category of disability (2 or more ADL) for those with hypertension (measured) only. Finally, in terms of health care utilisation, those who used primary and tertiary care in the last two years had a higher prevalence of disability, than those who had not accessed care.

Table 5-4. Distribution of activities of daily living (0, 1 and 2+) within category of interest, using the pooled data (Confidence intervals shown)

	0 ADL	1 ADL	2 or more ADL
Overall Population	88.9 (87.3 - 90.3)	6.9 (6.0 - 7.9)	4.2 (3.6 - 4.9)
No conditions	91.2 (89.6 - 92.5)	5.9 (4.9 - 7.1)	2.9 (2.4 - 3.6)
Two or more conditions	70.4 (65.8 - 74.7)	14.8 (12.2 - 17.9)	14.8 (11.8 - 18.3)
Three or more conditions	56.9 (48.3 - 65.2)	18.0 (13.1 - 24.2)	25.1 (18.3 - 33.3)
Angina	82.5 (75.9 - 87.5)	10.7 (6.6 - 17.0)	6.8 (4.5 - 10.2)
Arthritis	81.7 (77.9 - 85.1)	10.1 (8.1 - 12.5)	8.2 (6.3 - 10.6)
Asthma	68.4 (59.2 - 76.3)	16.3 (10.7 - 23.9)	15.4 (10.0 - 23.0)
CLD	88.6 (82.1 - 93.0)	8.2 (4.4 - 14.7)	3.2 (1.8 - 5.6)
Diabetes	84.0 (78.0 - 88.5)	7.7 (5.1 - 11.5)	8.4 (5.0 - 13.7)
Stroke	73.5 (63.1 - 81.9)	10.3 (6.0 - 17.3)	16.1 (9.9 - 25.2)

Angina - Arthritis	72.4 (62.7 - 80.4)	17.6 (11.0 - 26.9)	10.0 (6.8 - 14.4)
Arthritis - Stroke	50.6 (34.6 - 66.4)	19.4 (9.8 - 34.9)	30.0 (15.3 - 50.4)
Diabetes - Arthritis	79.4 (69.0 - 86.9)	9.7 (5.4 - 16.7)	10.9 (6.2 - 18.6)
Chronic lung disease - Asthma	68.5 (47.6 - 83.9)	18.2 (9.1 - 33.1)	13.3 (6.2 - 26.1)
Angina - Chronic lung disease	72.9 (50.4 - 87.7)	10.4 (4.9 - 20.6)	16.8 (5.2 - 42.6)
Age			
18-49	92.4 (90.9 - 93.6)	5.4 (4.5 - 6.6)	2.2 (1.8 - 2.8)
50-59	85.5 (83.3 - 87.5)	9.2 (8.0 - 10.7)	5.2 (4.3 - 6.3)
60-69	78.4 (75.2 - 81.3)	10.8 (9.5 - 12.2)	10.8 (8.7 - 13.4)
70+	67.5 (64.0 - 70.8)	14.7 (12.7 - 16.9)	17.8 (15.4 - 20.5)
Sex			
Male	91.9 (90.6 - 93.1)	5.1 (4.2 - 6.0)	3.0 (2.4 - 3.8)
Female	85.9 (83.6 - 87.9)	8.7 (7.4 - 10.3)	5.4 (4.6 - 6.3)
Residence			
Urban	91.0 (88.4 - 93.0)	5.8 (4.4 - 7.5)	3.3 (2.5 - 4.4)
Rural	87.3 (85.3 - 89.1)	7.8 (6.6 - 9.1)	4.9 (4.1 - 5.9)
Education			
< primary	93.3 (91.2 - 94.9)	4.1 (3.0 - 5.7)	2.6 (1.8 - 3.7)
primary	86.5 (83.6 - 89.0	8.5 (6.8 - 10.5)	5.0 (4.0 - 6.4)
secondary	95.6 (94.6 - 96.5)	3.2 (2.5 - 4.1)	1.2 (0.8 - 1.6)
higher	90.1 (80.2 - 95.3)	5.1 (1.6 - 15.6)	4.8 (1.7 - 13.1)
Wealth quintile			
Lowest - 1	81.6 (78.6 - 84.2)	11.0 (9.1 - 13.1)	7.5 (6.1 - 9.2)
2	85.8 (83.2 - 88.0)	8.5 (6.8 - 10.4)	5.8 (4.7 - 7.1)
3	87.7 (85.3 - 89.7)	8.0 (6.5 - 9.8)	4.4 (3.6 - 5.3)
4	90.8 (88.5 - 92.6)	6.2 (4.9 - 7.8)	3.1 (2.3 - 4.2)

Highest - 5	94.3 (92.8 - 95.6)	3.4 (2.6 - 4.5)	2.2 (1.6 - 3.0)
Obesity	84.8 (81.2 - 87.9)	10.0 (7.4 - 13.5)	5.2 (4.1 - 6.6)
No obesity	87.8 (85.5 - 89.7)	7.6 (6.3 - 9.1)	4.7 (3.8 - 5.7)
Hypertension (measured)*	87.3 (84.1 - 90.0)	7.0 (5.2 - 9.4)	5.7 (4.4 - 7.3)
No hypertension	87.5 (85.2 - 89.5)	7.9 (6.7 - 9.5)	4.6 (3.7 - 5.6)
Hypertension (diagnosed)	80.6 (77.5 - 83.3)	11.3 (9.5 - 13.4)	8.1 (6.7 - 9.8)
No hypertension	89.4 (87.7 - 90.9)	6.7 (5.7 - 7.8)	3.9 (3.3 - 4.6)
Health care utilisation			
Primary care use	85.4 (83.3 - 87.4)	9.2 (7.9 - 10.7)	5.4 (4.6 - 6.3)
No primary care	92.7 (91.1 - 94.1)	4.5 (3.5 - 5.8)	2.8 (2.2 - 3.5)
Tertiary care use	81.7 (78.4 - 84.6)	10.4 (8.6 - 12.5)	8.0 (6.4 - 9.9)
No tertiary care	88.3 (86.6 - 90.1)	7.5 (6.4 - 8.8)	4.1 (3.5 - 4.8)

Notes: Estimates made using 'svy' function within the pooled data set. * A pearson correlation test showed positive correlation 0.22 between measured and diagnosed hypertension ($p<0.0001$)

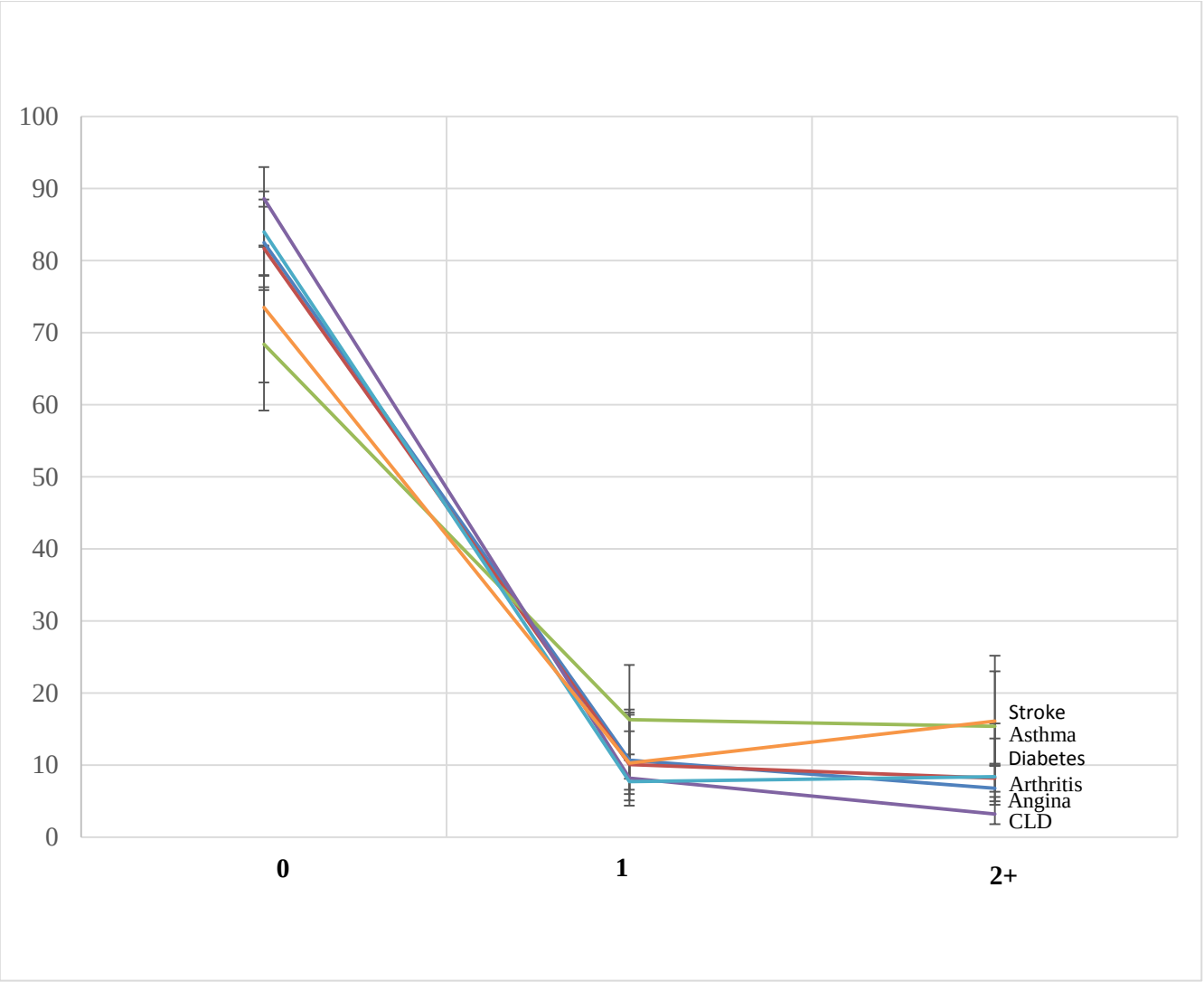


Figure 5-4. Percentage distribution of activities of daily living (0, 1 and 2+) by morbidity, using the pooled data (with confidence intervals)

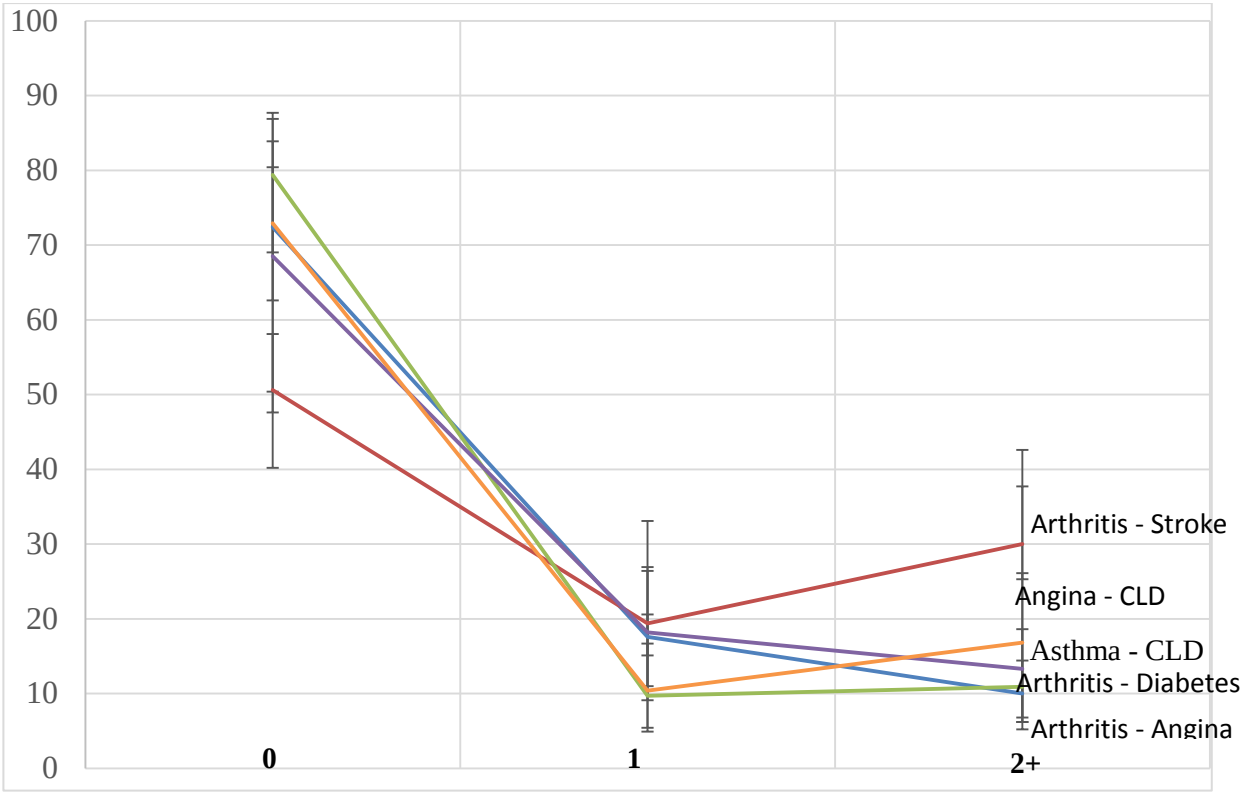


Figure 5-5. Percentage distribution of activities of daily living (0, 1 and 2+) by comorbidity, using the pooled data (with confidence intervals)

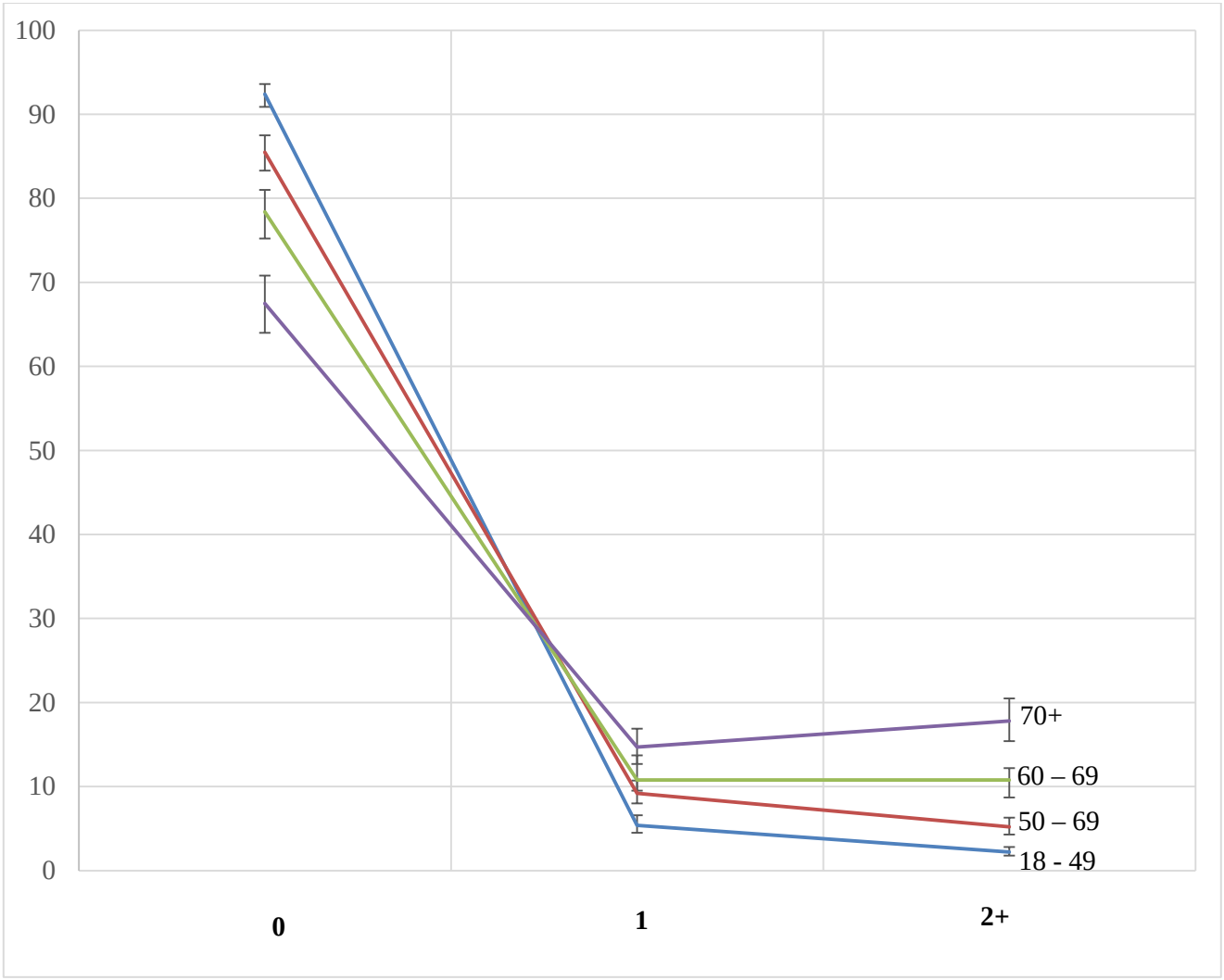


Figure 5-6. Percentage distribution of activities of daily living (0, 1 and 2+) by age, using the pooled data (with confidence intervals)

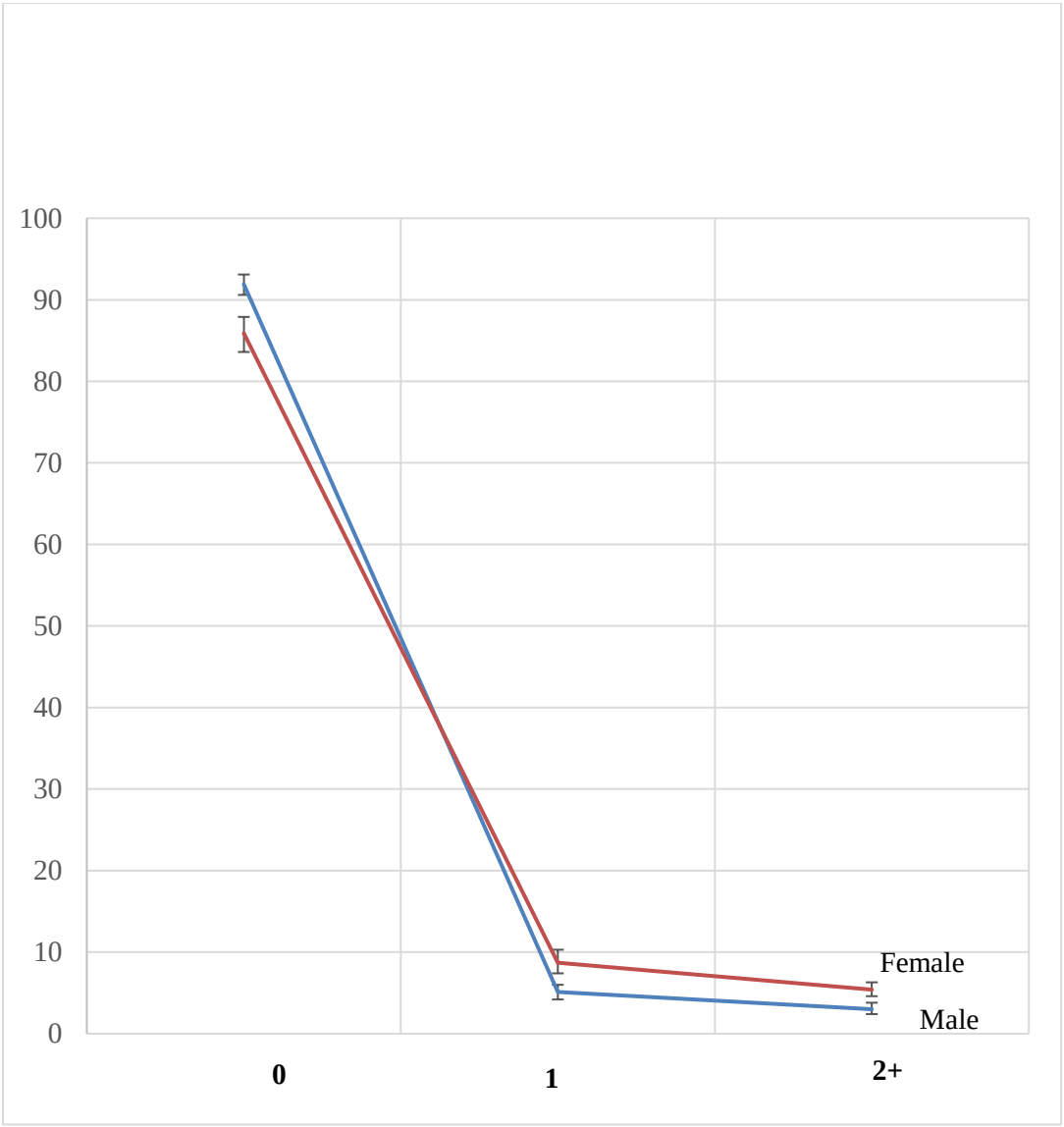


Figure 5-7. Percentage distribution of activities of daily living (0, 1 and 2+) sex, using the pooled data (with confidence intervals)

5.4.1 Effect of co-morbidities on disability

Table 5.5 shows the median WHODAS score and interquartile range, by category of interest. The patterns shown within Table are consistent with those described previously for the distribution of ADL by category of interest. The median WHODAS score increased with number of morbidities. Both stroke and asthma had the highest median WHODAS score, and arthritis-stroke resulted in the highest MM score. The median score increased with age, was highest amongst females than males, and those in rural areas. There was no clear education gradient. However, as with ADL, the median score was highest in those from the lowest wealth quintile, and lowest in those from the highest wealth quintile. The score was also higher for those with obesity, hypertension (measured) and hypertension (diagnosed);

compared to those without. Finally, the median score was higher amongst those who had accessed primary and tertiary care recently, compared to those who had not.

The estimated effect of the most common comorbidities on the disability score were calculated using multinomial logistic regression models (with the first WHODAS quartile as the baseline category), and are reported in Table 5.6 and Figure 5.8. Both the independent effects of age and education were apparent from the models. After adjusting for social, economic and demographic characteristics, for the comorbidities 'angina- chronic lung disease', 'arthritis- angina' and 'arthritis-stroke,' the odds of disability increased, between the second to fourth quartile. For 'arthritis-stroke', there was a large increase in odds between the third quartile (OR = 2.3; 95% CI = 1.0 - 5.5) and fourth quartile (OR = 4.8; 95% CI = 2.2- 10.6). By contrast, for 'asthma- chronic lung disease' there was a decreased odds between the third quartile (OR = 2.1; 95% CI = 0.9 - 4.7) and fourth quartile (OR = 0.6; 95% CI = 0.5- 0.8). For the comorbidity 'arthritis-diabetes', its effect was not significant and there was no gradient.

Table 5-5. Median WHODAS score and interquartile range (0 - 60) within category of interest, using the pooled data

	Median WHODAS score	Interquartile range
Population	15.0	12.0 – 21.0
None	15.0	12.0 – 20.0
One or more	21.0	15.0 – 28.0
Two or more	23.0	17.0 – 31.0
Angina	17.0	14.0 – 22.0
Arthritis	17.0	13.0 – 24.0
Asthma	20.0	15.0 – 27.0
CLD	15.0	13.0 – 20.0
Diabetes	15.0	13.0 – 21.5
Stroke	20.0	15.0 – 31.0

Angina - Arthritis	21.0	16.0 – 28.0
Arthritis - Stroke	23.0	15.0 – 32.0
Diabetes - Arthritis	19.0	14.0 – 25.0
Chronic lung disease - Asthma	21.0	15.0 – 30.0
Angina - Chronic Lung disease	18.0	15.0 – 25.0
Age		
18-49	13.0	12.0 – 18.0
50-59	14.0	12.0 – 19.0
60-69	16.0	13.0 – 22.0
70+	20.0	14.0 – 28.0
Sex		
Male	14.0	12.0 – 20.0
Female	16.0	12.0 – 22.0
Residence		
Urban	14.0	12.0 – 20.0
Rural	16.0	12.0 – 22.0
Education		
< primary	14.0	12.0 – 18.0
primary	15.0	13.0 – 21.0
secondary	14.0	12.0 – 18.0
higher	14.0	12.0 – 17.0
Wealth quintile		
Lowest - 1	18.0	13.0 – 24.0
2	17.0	13.0 – 22.0

3	17.0	12.0 – 22.0
4	16.0	12.0 – 20.0
Highest - 5	14.0	12.0 – 18.0
Obesity	18.0	12.0 – 20.0
No obesity	16.0	13.0 - 22.0
Hypertension (measured)	17.0	12.0 – 20.0
No hypertension	16.0	13.0 – 22.0
Hypertension (diagnosed)	18.0	13.0 – 24.0
No hypertension	15.0	12.0 – 21.0
Health care utilisation		
Primary care use	18.0	13.0 – 23.0
No primary care	15.0	12.0 – 19.0
Tertiary care use	18.0	13.0 – 24.0
No tertiary care	16.0	13.0 – 22.0

Table 5-6. Effect of comorbidity on WHODAS, disability: Odds ratio in multinomial logistic regression model, using the pooled data (Confidence intervals shown)

	DISABILITY CATEGORY				
	N	Second quartile	Third quartile	Fourth quartile	LRTEST (degrees of freedom)
Angina – Chronic Lung Disease	9383	1.7 (0.7 – 4.1)	1.7 (0.6 – 4.3)	3.3 (1.4 – 8.0)***	0.0001(9)
Arthritis – Angina	2077	3.6 (2.3 – 5.7)*	5.8 (3.8 – 9.0)*	11.3 (7.4 – 17.3)*	0.0001(9)
Arthritis – Stroke	9361	1.5 (0.6 – 3.3)	0.8 (0.3 – 2.2)	4.8 (2.4 – 9.7)*	0.0001(9)
Arthritis - Diabetes	9471	0.7 (0.4 – 1.3)	2.4 (1.6 – 3.7)	3.5 (2.3 – 5.3)*	0.0001(9)
Asthma – Chronic Lung Disease	9336	13.6 (1.7 – 110.6)*	18.9 (2.4 – 150.00)**	45.0 (5.9 – 346.0)***	0.0001(9)

Notes: **p*-value *** < 0.05; ** < 0.01; * <0.001; Adjusted for age, sex and education. Adjusted for age, sex and education. First quartile used as base reference for WHODAS. LRTEST compare final model (adjusted for age, sex and education) against model without adjustment.

In all models shown in Table 5.6 the likelihood ratio test (goodness of fit test) for the final model is significant at 9 degrees of freedom, compared to the model without adjustment for age, sex and education.

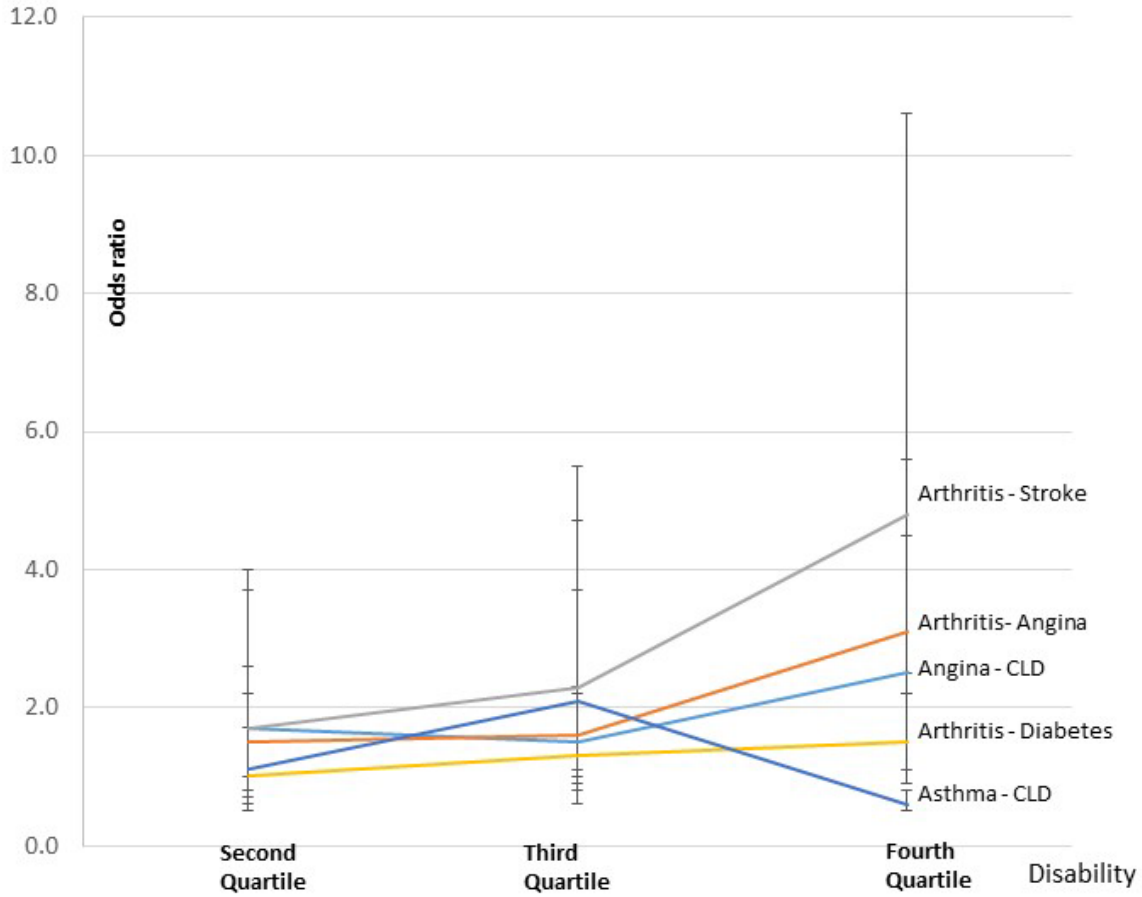


Figure 5-8. Effect of comorbidity on WHODAS, disability: Odds ratios in multinomial logistic regression model, using the pooled data (Confidence intervals shown)

Notes: Adjusted for age and sex; Base category for WHODAS as first quartile.

5.5 Discussion

This is the first study to examine how functional disability varies by doctor-diagnosed multimorbidity, and common comorbidities, across a key set of MICs. There were several key findings from the study that are discussed below.

Firstly, multimorbidity and the most common doctor-diagnosed comorbidities were quite common amongst the lowest age category (18-49 years), (notwithstanding that prevalence increased with age) which support the findings previously shown in the thesis - that multimorbidity is not merely a phenomenon of ageing, particularly in MICs. However, the association with age is dependent on the morbidity included in the count and the progression of the disease with age; some morbidities are more common in younger people, such as asthma. Secondly, a closer examination into the comorbidities showed some economic and education patterning not previously shown. At the highest level of disability of angina-chronic lung disease, education was also most protective, which suggests that education plays an important role for some combinations. The co-occurrence of 'arthritis-diabetes' as well as 'asthma-chronic lung disease were common amongst the wealthiest. The previous study (Chapter 4) did not find any distinct patterns when examining the relationship between multimorbidity and wealth. From this perspective, we might consider that the social patterning in multimorbidity is nuanced by the type of condition considered in the count.

Third, some combinations of disease had more or less impact than others and the presence of more conditions led to higher disability e.g. three or more morbidities. Previous SAGE studies have examined the interactional effect of morbidities on disability, comparing their effect to single morbidities. These studies found that the effect of multiple disease on disability are equal to or less than the combined effect of each disease on the individual [162, 178]. This study adds to what has previously been shown by investigating the independent effect of common comorbidities on disability, in order to understand whether some comorbidities may be more (or less) disabling than others. The regression analyses showed some interesting differences concerning the effect of specific diseases on disability. The comorbidity arthritis- stroke seemed to be the most disabling compared to other disease combinations, with increasing risk across categories of disability; even after controlling for known confounders. By contrast, the co-occurrence of arthritis-diabetes led to no significant gradient across categories of disability. These differences, however, may reflect the severity of the conditions, which may be driving such differential effects on disability (discussed in more detail below). These findings are consistent with other studies, which note that specific disease pairs are more highly associated with disability than others [174]. The co-occurrence of asthma-chronic lung disease is also an interesting finding, and points to the critical role of environmental exposures in adult age, which are known to predispose subjects with asthma to chronic lung disease later in life [179]. Without longitudinal data and

no information on environmental exposures, however, the causal relationship could not be established; which was true for all comorbidities examined here. Overall, these findings support the notion that it is not simply the number of morbidities that effect disability, but the nature of the morbidities included in the count.

Fourth, and consistent with what has been shown previously the prevalence of disability, amongst those with multimorbidity, was higher amongst women than men. This was true for both outcomes of disability, ADLs and the WHODAS. The self-reported nature of the disability questions (and indeed the other variables included here) however raise the possibility of over-reporting or underreporting which may have led to spurious findings regarding these sex-differences. On the other hand validation studies, examining disability assessment questionnaires, suggest that there is good correlation between that undertaken by self-report and that by medical evaluation [180]. Previous validation studies on WHODAS, however, have not examined reporting differences in detail [177].

Fifth, there were consistent patterns in wealth for both disability outcomes. Wealthier individuals, for example, had a lower median WHODAS score. This gradient in wealth may be related to differential access to resources such as supportive care (physiotherapy, access to disability-friendly facilities, nurses and carers), which may be influencing their capacity, including their functional status. Across the SAGE countries studied here, social welfare support is variable, and therefore wealthier individuals with disability may have a distinct advantage in terms of facilities and support. The recent World Social Protection Report, produced by the International Labour Organisation (ILO), suggests that many middle income countries have made attempts to expand health coverage. Despite this, countries ranged in their ability to achieve effective social security coverage- the measurement of which was based on levels of poverty, the extent of the informal economy and fairness of health-financing mechanisms. Across the SAGE countries, the level of vulnerability ('the extent to which population potentially enjoyed coverage in the extent of any contingencies') ranged from 'low' in South Africa, to 'very high' in India and Ghana [181].

Sixth, both hypertension and obesity led to higher prevalence in disability, which is unsurprising given that they are both risk factors for chronic disease in SSA and obesity has direct impact on function [182]. This is also consistent with the finding that both hypertension and obesity were high amongst those with multimorbidity and amongst the common comorbidities. Finally, another important finding was the use of healthcare. As you would expect, respondents who had used primary and tertiary care in the last two years had a higher prevalence of disability, than those who did not access care. This may also reflect the health service use, amongst those with multimorbidity, which is dependent on the degree of disability experienced by the individual. Overall, these findings suggest that there is an impact

on the healthcare service, which has cost implications for both the individual and the health system accessed.

Strengths and Limitations

As discussed in the previous chapter, the SAGE includes nationally representative samples from five middle-income countries (China, Ghana, India, Russia and South Africa). The survey also used standardised tools, which were consistent across the survey datasets, allowing cross country comparisons. Compared to other variables, the WHODAS and ADLs were responded well, which meant that there was low missing data (i.e. data that was not collected) and reduced risk of bias. Furthermore, the patterns of ADL were consistent with the patterns of WHODAS, which suggest that there were consistencies in the self-report across the health state questionnaire.

There were, however a few limitations. Firstly, the lack of data on severity meant that the severity of the conditions included in the count could not be assessed; and were possibly confounding the relationship with disability. Further studies should consider addressing this issue but providing a means of assessing severity, through self-report, or using an index that establishes severity such as the Charlson or the Katz Index (previously described in Chapter 1). Secondly, the direction of the association could not be ascertained through cross-sectional data. Therefore, it is not possible to understand whether functional disability 'causes' the doctor-diagnosed conditions reported here, or vice versa. Equally, there could be reverse causality for the effect of disability on income as some may become unemployed due to ill health. Thirdly, the number of conditions were based on doctor-diagnosed conditions and were limited to the seven included in the survey. This means that the findings here may have been biased by those who were able to access healthcare services and, equally, those with doctor diagnosed conditions are possibly more likely to survive, and manage, their conditions due to health service availability. Fourth, the number of cases of those with comorbidity were small, resulting in less accuracy in estimates. Fifth, there was no data on the impact of disability on an individual's wider context, such as their work status or their family responsibilities; which meant that the 'burden' of the diseases could not be understood beyond the impact on core activities.

5.6 Conclusion

This study adds to previous findings on the impact of multimorbidity in MICs by examining, in more detail, the impact of the most prevalent comorbidities on a well-validated disability score; and its associated risk factors. These findings show that functional disability varies according to the 'type' of conditions included in the count, that some combinations of diseases are more disabling than others;

and that disability is a function of age, gender, SES and education; where education is known to be protective for some disease combinations, particularly at higher levels of disability. The presence of certain conditions, such as stroke, appeared to be more disabling; which supports the need for improvements in stroke prevention and care. The implications of these findings are that the impact of multimorbidity varies from individual to individual. To improve the health outcomes of multimorbidity, therefore, an 'individualised' approach is needed within health and social care, which is also consistent with the recent guidelines for multimorbidity in the UK [19]. Health care systems in MICs may benefit from more evidence into the effect of multimorbidity on functional disability, as well as the populations that are most vulnerable which, in the long term, may help to reduce healthcare costs and healthcare utilisation. The lack of social welfare coverage amongst MICs continues to be a major challenge; therefore efforts to direct care according to need will be an important step in responding to an ageing, multimorbid population. The presence of multimorbidity within the population will continue to be a drain for the economy, which highlights the need for earlier prevention, particularly for conditions that result in long term disabilities.

Chapter 6: Exploring women's experiences and perceptions of living with multimorbidity: a case study of Ghana.

6.1 Introduction

This qualitative study draws on findings from the previous chapters examining the prevalence and impact of multimorbidity in low- and-middle income countries (LMICs). Firstly, earlier quantitative work consistently found a higher association of multimorbidity with the female gender. (Chapters 3 and 4) These findings are the premise for further investigation into the experiences of *women* in Ghana. Furthermore, studies in MICs suggest that women tend to use healthcare services more than their male counterparts [183]. Based on this, there is reason to suggest that sampling would be easier when the study sample were drawn from the female population. Secondly, I have chosen to focus the fieldwork in Ghana (one of the countries sampled in the quantitative studies) given its location in Sub-saharan Africa (SSA). Its location makes it a useful case study and reference, particularly for neighbouring countries in SSA undergoing rapid urbanisation and development. Thirdly, my results point to some urban-rural differences in multimorbidity, although these were not statistically significant. I sampled individuals from both rural and urban areas, and examined the qualitative evidence between settings. Finally, the previous chapter (chapter 5) examined the effect of multimorbidity, and specific combinations of multimorbidity on the functional disability of the individual. I found that the effect of morbidity on functional disability is highly dependent upon the type of condition (physical, mental etc.) experienced. I planned to sample women with different types of co-occurring chronic conditions, so that I could better understand the qualitative evidence related to their functional disability.

6.1.1 Summary of Literature

To date there have been no qualitative studies examining the experiences of individuals living with multimorbidity in LMICs. All qualitative studies on multimorbidity have been conducted in high income

countries. It is not within my research scope to provide a narrative synthesis of the qualitative evidence related to living with multimorbidity; however, I have summarised some of the findings below. The evidence was found through a literature search of published academic papers, and have been summarised according to the main themes that emerged out of the literature, including: 'contextual factor of health experiences'; 'health outcomes of multimorbidity'; and 'treatment burden/ health systems.'

Contextual factors of health experiences

Women's health and illness experience depends on their contextual factors such as the environment and social situation, including their living environment, available carers and financial resources etc. According to Baylis et al., the contextual factors of their experience can be conceptualised through 'different levels.' These include the 'person', the 'family', the 'community', the 'healthcare system' and 'policy.' Where, for example, the person level encompasses an individual's medical characteristics, personal goals or cultural factors, and the community level refers to the physical characteristics of the community and demographics. Overall, the contextual factors, or levels, influence the individual's health experience [184]. *Social connectedness* is also considered as an important factor in an individual's experience of living with multimorbidity. For example, membership of a religious group may encourage strong ties with others in the congregation – who are supportive in times of crises [185]. The role of social connectedness has previously been noted as a factor for healthy ageing, allowing older people to maintain social roles and a sense of independence [186]. When describing their experience, patients often recall their symptoms in relation to their illness. In one study, patients varied in their ability to link symptoms to individual conditions [187]. Furthermore, patients placed greater priority on conditions that affect functioning. When describing their overall burden of symptoms, however, some patients state that multimorbidity leads to additional burden; whereas others felt additional multimorbidity contributed less to the total burden of disease. This difference is understood through emotional representations, specifically related to *resilience*, whereby additional disease does not necessarily equate to additional burden.

Health outcomes of multimorbidity.

Many of the contextual factors described in the previous section are also described in relation to health outcomes. In one study, for example, patients were asked to record their experiences of illness onset. Patients described common experiences of limitations and difficulties following illness onset, which affect relationships (marital and social relationships) as well as loss of personal power to manage their

own lives. However, patients were able to adapt themselves to their new situations, through spirituality and resilience [188]. In another study, they found the type of disease combinations play an important role in an individual's health outcome. For example, mental-physical multimorbidity led to a loss of agency, heightened uncertainty and poor well-being [189]. A pervasive theme across one study group was the 'drive to return to former health and diminish reliance on others.' Furthermore, participants noted that despite their resilience, they were concerned that worsening multimorbidity might tip them into a *'downward spiral'* by worsening their health, pain, quality of life; but also their independence [190].

Treatment Burden/ Health System.

The previous sections highlight the role of contextual factors, social connectedness and loss of personal power in their overall experience of living with multimorbidity. Studies that examine the role of the health system and burden of treatment varied in their findings. These studies also varied in setting – and included those conducted in Canada, Germany, Netherlands, US and UK. One study conducted in the Netherlands concluded that the management of multimorbidity needs to focus on 'individualisation', with a need to adapt to personal circumstances, such as retaining independence as an ultimate goal [191] However, a recent study conducted in Canada identified a number of health system barriers affecting the management of individuals with multimorbidity. Such challenges included the lack of coordination of health services, and a need for services orientated towards chronic disease management [192]. These have also been described as 'tipping points' into poor health, summarised as actors that contribute to decline, functioning at provider level (late diagnosis) and health care system level (poor care transitions) [193]. Some patients remain ambivalent towards taking medication and describe the communication between clinicians and patients as being often problematic [194, 195]. Non-adherence to treatment has also been attributed, in the USA, to side effects and costs [196]. Rising costs continues to be a major issue, particularly for patients who have to pay out of pocket for treatment (as opposed to those who can access treatment free from the point of delivery e.g. through insurance or taxation). The dismissal of symptoms by healthcare providers has also been explained through limitations due to 'contextual pressures', such as the way in which they organise services and make decisions in the UK [197]. In Germany, limitations in time, for example, meant GPs prioritise diseases that affect prognosis, and defer other problems for later consultations[198] Another common research finding is the need to engage the patient in self-management, through the motivation and capacity of the patient, and equally the shared responsibility between patient and practitioner [189]. Current national policy and clinical practice guidelines, however, are often orientated towards single

disease [83]. Such findings have important ramifications for policy development and healthcare organisation and clinical practice. The recently published NICE guidelines (UK) on multimorbidity attempts to recognise, and counteract, some of these issues; by establishing an approach that takes account of multimorbidity. The guidelines advocate for a greater focus on an individual's need, as well as improved quality of life through reduced treatment burden; for instance.

The literature asserts the importance of an individual's social environment in their lived experiences of multimorbidity. Such factors include, but are not limited to, their family, community and health care systems. Studies report differences in the way individuals describe their symptoms and prioritise their illnesses. Where patients experience concerns around a loss of independence, proposed strategies include those that engage self-management and adherence to treatment. Across all health systems under study, recurrent findings include a lack of coordination of health services and issues of communication - which are all exacerbated by the contextual pressures, such as lack of time. Overall, the research studies propose national policies and guidelines aimed at better coordination and clinical practice for patients with multimorbidity. Given the lack of data in the developing world, this study aims to understand whether patient experiences are consistent with those found in the literature. Little is known and understood about the experiences of women living with multimorbidity in Ghana; in particular, there are gaps in understanding the health needs of the multimorbid population and how the health system responds to these.

6.1.2 Conceptual Framework

Miles and Huberman (1994) defines a conceptual framework as a visual or written product, one that *"explains, either graphically or in narrative form, the main things to be studied—the key factors, concepts, or variables—and the presumed relationships among them. [199]"* There are a few reasons for using pre-existing theories at the start of this qualitative study. First, to examine and identify the *factors (themes)* related to a patient's experience of chronic disease (and multimorbidity). Second, to develop an *a priori* knowledge about what possible themes may emerge from the dataset. Third, to draw upon this knowledge in order to refine goals, develop realistic and relevant research questions within the topic guide. Overall this helps to justify the research [200].

Within the academic literature there are several theoretical models that relate to an individual's health experience; and help to explain, predict and change human behaviours. These are commonly referred to as psychosocial theories within the field of health psychology. Some models, for example, seek to explain why people use healthcare, whereas others may relate to their responses to a health

threat[201]. In this section I have summarised one theoretical model used for research into chronic illness and multimorbidity: the cumulative complexity model (CCM)

The cumulative complexity model proposed by Shippee and colleagues is a patient-centred model that integrates the multiple factors encompassing 'patient complexity.' In particular, the model relates to the complexities experienced by individuals with multiple conditions (multimorbidity) [202]. At the core of the model they consider the interplay between 'patient capacity' and 'patient workload.' Both are central to determining whether and how patients will effectively access, use and enact care; and, in turn, affect their health outcomes. 'Patient workload' encompasses all the demands in the patient's life, including their daily responsibilities. Their demands may include, for instance, the amount of work needed to attend clinics (travel/transportation); or, the amount of care they do in the home. Broadly speaking these demands relate directly to the individual's social environment. 'Patient capacity' on the other hand encompasses the resources that affect the patient's ability, such as their physical or mental functioning. Such factors considered at the level of a 'patient's capacity' include social, biomedical and psychological resources.

The cumulative complexity model had more breadth in terms of the factors it considers than other models studied. The cumulative complexity model considers the interplay of a wide number of factors (social, cultural, biological), which relate to both the individual and their society. This moves beyond the linear/ causal understandings of disease outcomes, and therefore brings to light the intersubjective context of illness experience and action; through social, biomedical and psychological realms. Whilst being developed to understand the UK context, the model CCM has not considered, in much detail, the influences of culture and belief. In a recent study about living with diabetes in Ghana, it is believed that biomedical goals are 'undermined by traditional notions and structures of illness management. [203]' Therefore, I have built on the CCM model to incorporate factors related to belief systems (see figure 7.1) and therefore adapt my own conceptual framework.

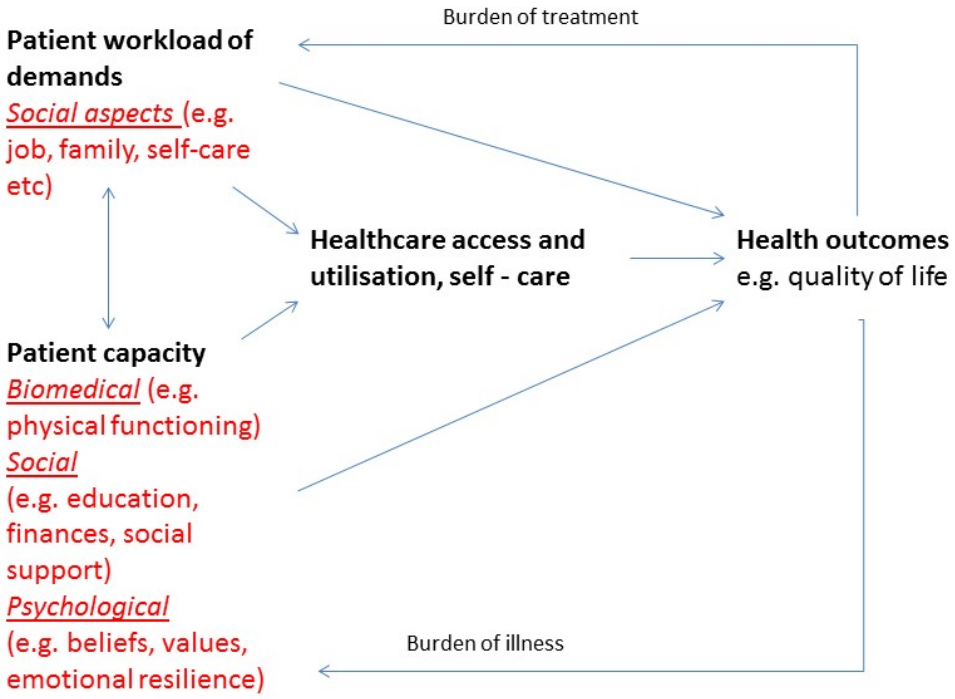


Figure 6-1 The 'cumulative complexity' conceptual framework for study

(Adapted from Shippee et al to include uniquely identifying realms within 'patient workload' and 'patient capacity' relevant to both a local and international context – highlighted in red)

In this study I used the cumulative complexity framework to guide and strengthen the questions and assist in the development of the topic guide. The different realms described in the CCM model (such as *patient capacity, patient workload and health outcomes)* offer a useful starting point to help structure the topic guide, whilst the different factors within each realm (*such as physical functioning or education*) have informed several questions related to the contextual factors. Overall, the model is a comprehensive framework that extends upon previous work on illness experience, whilst considering the complexity of multiple illnesses.

6.1.3 Aims & Objectives

The aim was to explore the perceptions and experiences of women living with multimorbidity in the Greater Accra region, Ghana.

The objectives were to:

- To explore the contextual factors that affect women living with multimorbidity in the Greater Accra region, Ghana
- To explore perceptions of enablers and facilitators to accessing health systems in individuals with multimorbidity in the Greater Accra region, Ghana

6.1.4 Ontology and Epistemology

According to Creswell, a paradigm framework consists of philosophy, reality (ontology) knowledge of that reality (epistemology) and the particular ways of knowing that reality (methodology) [21, 204].

6.1.4.1 Ontology

To tackle qualitative inquiry in the field of global health, it is common to use ethnographic research. Although I am not conducting ethnographic research, it has been useful to examine its ontological position in relation to this study. Ethnographic research commonly takes a relativist position, which assumes that there is no universal truth that governs all, and that cultures should be understood in their own terms, and not judged by the beliefs or values of other cultures [205]. Relativism is the perspective that there is no shared reality, only a series of different individual constructs [206]. The relativist viewpoint asserts that there are underlying factors constituting an individual's own reality, and that such reality is subjective and varies between individuals. The current research aims to explore the experiences of women living with multimorbidity in rural and urban Ghana; and therefore I have taken a 'relativist' view to be an appropriate ontological position.

6.1.4.2 Epistemology

Interpretivism is one of the major philosophies concerned with epistemiology. With the interpretivist view, I will aim to understand what I am studying from the participant's perspectives. I aim to explore and understand the phenomena of multimorbidity by deriving interpretation and meaning from interviews with participants [207]. Interpretivism assumes that we can't separate ourselves from what we know; I will have prior ideas about what knowledge, how it is obtained and what we know. At the

start of the project, I will use existing theory and research to help plan the project. However, the fieldwork will be aimed at understanding patient experiences, in an open ended manner.

Another epistemological issue is concerned with the relationship between the researcher and what is being researched [208]. The process of studying individuals may lend itself to situations whereby a researcher can't be neutral, and an interactive relationship is formed between the researcher and the social phenomena being studied. In order to circumvent the issues that may undermine the neutrality of the researcher, I will aim to make my assumptions and values transparent by being reflexive about the research process; and the relationship between myself and the participant.

6.2 Methodology

6.2.1 Qualitative research

The experiences of living with multimorbidity are highly subjective; for this reason, qualitative studies are a useful method to explore an individual's experience. Qualitative research is situated within the interpretivist paradigm and is derived from a range of disciplines with a number of theoretical and philosophical underpinnings. This means that qualitative research is considerably diverse, and includes a wide range of approaches and methods. Broadly speaking, however, qualitative research is often described as a naturalistic, interpretative approach, concerned with exploring phenomena from individuals' subjective experience or perception [209]. Denzin and Lincoln state that by studying things in their natural settings and the meanings that people attribute to phenomena that this then makes the world visible [210]. Qualitative research therefore enriches our understanding of perceptions and experiences, by drawing on an individual's own language.

In order to fully understand the experiences and perceptions of living with multimorbidity in the study population a methodology was required that would allow a full exploration of the subject matter. An inductive qualitative methodological approach was seen as the only way to meet the study aims. Qualitative methodology can be used to better assess the experiences of individuals with multimorbidity and better inform the development of patient-centred care models.

6.2.2 Methods

6.2.3 Recruitment and sampling

A feasibility trip was carried out in March 2015 in order to develop the recruitment strategy, meet with the host supervisor and undertake ethical submission to the Ghana Health Services Ethical Committee. Ethical approval was sought and granted by the University of Southampton, Faculty of Medicine Research Ethics Committee on the 5th May 2015 (ID: 14535). Furthermore ethical approval was granted on the 27th May 2015 (Protocol ID NO: GHS-ERC 06/05/15) by the Ghana Health Services Ethical Committee.

Fieldwork was undertaken in the summer of 2015, alongside a team of researchers at the host institution which was the Faculty of Public Health, University of Ghana. This included three research assistants, two transcribers and the host supervisor, Professor Philip Adongo. Participants recruited for the study included women seeking treatment and/or care who have at least two chronic conditions. Chronic disease was defined as "conditions that last a year or more and require ongoing medical attention and/or limit activities of daily living [211]." Polyclinics are primary care centres that are based across Ghana. Both of the polyclinics chosen as recruitment sites were located in the Greater Accra region. Both polyclinics served the local population and ran a diabetes clinic, hypertension clinic, HIV clinic and mental health clinic weekly. Recruitment took place from the clinics, as well as from the general outpatient departments (OPD).

One polyclinic was The Shai OsuDoku district hospital which was located in the *Dodowa* – the district capital of Shai OsuDoku, formerly 'Dangbe West' (see Figure 6.2). The hospital served the local population of Shai OsuDoku -estimated at 100,000. Given its proximity to the capital Accra, parts of Dodowa were defined as *peri-urban*, and formed the interface between the urban outskirts of the capital city and the rural countryside. However, the polyclinic served the entire district, which was composed of both *rural* and *peri-urban* residents. The second polyclinic was Maamobi Polyclinic based in the Accra Metropolis – an *urban* area – and was therefore also situated in the Greater Accra region.

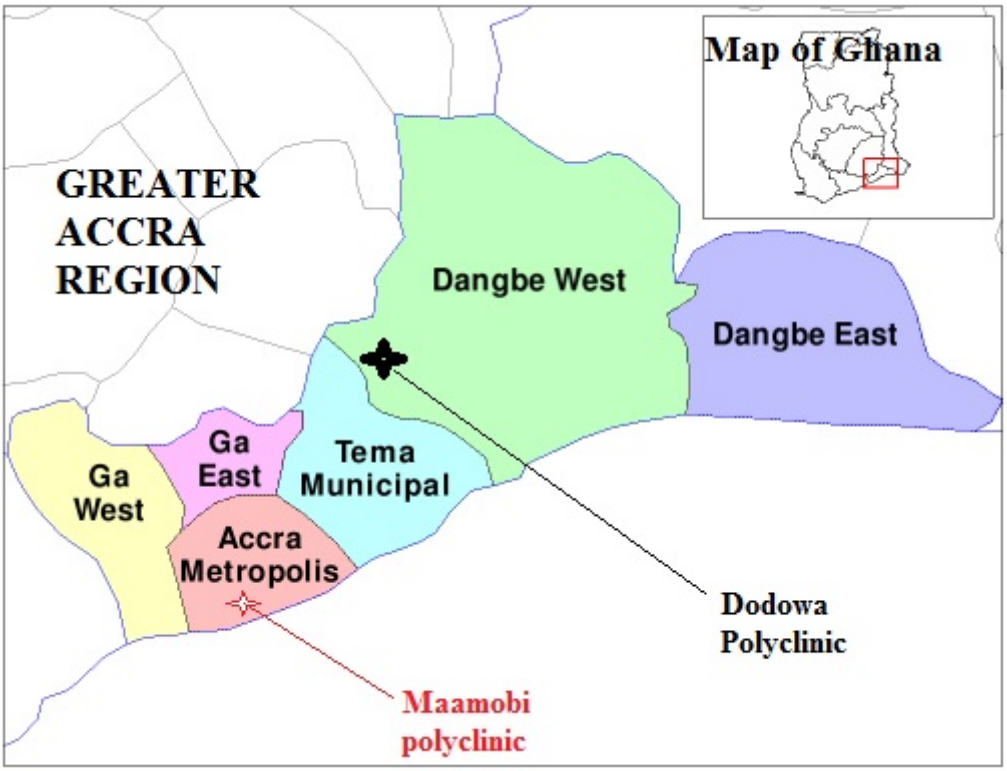


Figure 6-2. Location of the recruitment sites

(Maamobi polyclinic and Dodowa Polyclinic, within the Greater Accra Region)

I used stratified purposive sampling, based on two characteristics of interest, residence (urban, peri-urban and rural) and education (less than secondary, secondary and above) based on self-report at interview [212]. These criteria were based on earlier quantitative findings. Evidence shows that patterns of multimorbidity vary according to residence, such as whether the individual lives in an urban or rural area ; as well as their education [213]. Therefore the main goal of this approach was to capture major variations according to the different strata e.g. urban/rural; as well as education. Multimorbidity is also more common with age – and therefore we decided to select a group of participants between 35-75 years old [31]. The eligibility criteria was as follows:

Eligibility criteria:

Included:

- Females living with two or more chronic conditions (since recruitment took place at the clinics, the chronic conditions included at least one of diabetes, hypertension, HIV and a mental health condition).
- Ages between 35 – 75 years
- Females who are permanently residing in rural, urban or peri-urban area

Excluded:

- Females who are unable to communicate easily due to disability or illness

Before research commenced, approval letters was sought from the local health directors. The local health directors operate at the national, regional and district level. There are 10 regional directors across Ghana; each is responsible for the overall management of the health services within the region. Under each region there are a number of districts, headed by the district director of health services, who ensure the implementation of the health services at the district level.

Before commencing the study it was necessary to get permissions from the regional director of Accra, as well as both district directors (both study sites). During the week of the 15th July – 21st July, signed letters were obtained from the regional director, the district health director of the Accra metropolitan area, and the district health director of the Shai Osudoku area. These letters were then presented to the medical superintendents at both facilities: Maamobi polyclinic and Dodowa polyclinic. Once the approval letters were shown, the medical superintendents each appointed a nurse to facilitate the recruitment process.

The nurses acted as 'gatekeepers' to the patients, gaining access to patient files [214]. As many of the patients were illiterate, their diagnosis was confirmed from their clinical folders. Outside of the scheduled recruitment time, the head nurse or doctor of the department identified eligible patients and scheduled the interview. During the scheduled recruitment time, I was responsible for recruitment. Eligibility checking took place mostly from the diabetes clinic, hypertension clinic, HIV clinic and mental health clinic.

The main languages spoken by the patients at the polyclinics were English, Ewe, Ga, Gadangme, Hausa and Twi. Three research assistants formed part of the research team, and their primary responsibility was translation during both the interview and recruitment stage. At least one research assistant was conversant in the spoken languages. Before data collection commenced, two days of training and familiarisation was conducted at the School of Public Health. I carried out the training and familiarisation sessions in order to orientate the field research team on the research protocol, recruitment and data collection process. The research assistants (Angela, Lucy and Nanayaw) were all present at the training sessions, and also offered constructive feedback about the recruitment and data collection process; which were incorporated into the fieldwork.

Once eligible participants were identified, the field research team (myself and the research assistants) contacted them to see if they would like to participate in the study. During the clinic times,

patients were approached in-person by the research team (research assistants and myself). There were also a number of clinical files which were stored at the clinic. Outside of clinic hours, we consulted the clinical files to check for eligible patients, and gained consent from the nurses to contact them by phone. During the initial conversation, the participant was informed about the research questions, what the research would be used for, and the format of the interview. If the participant agreed to be interviewed, an interview date was scheduled at their convenience. During eligibility checking, the participants were asked which language they would like the interview to be held in. Once confirmed, the research assistant with the required language skills was contacted to assist in the interviewing. Some participants preferred to be interviewed in their home, whereas some participants were willing to meet at the polyclinic.

6.2.3.1 Summary of feasibility issues encountered with recruitment

There were a few minor changes made during the recruitment process to account for any deviation from the initial recruitment strategy whilst ensuring maximum variation during sampling.

- At the Dodowa polyclinic, there were few patients from a predominantly *rural* area; most were from the area surrounding the clinic, which I defined as *peri-urban*. I was unable to recruit at a more rural polyclinic due to limitations to budget and time restrictions

- Only approximately 25% of the women screened for eligibility were educated at secondary level education or above. I therefore had to relax the initial recruitment strategy of a 1:1 ratio between those of less than secondary school education, and those of secondary school education and above

- Due to possible in-accuracies of self-report, as well as missing information from the clinical files, I was unable to confirm whether a patient had been diagnosed for at least two years with a particular condition

6.2.4 Data collection

The in-depth interview is effective at exploring a participant's views, experiences and beliefs [215] Talking to those that have knowledge and experience of living with multimorbidity can help us to understand

what it is like to live with multimorbidity and any difficulties encountered [216] The in-depth interview gives the chance to explore the experiences of an individual's experience in detail.

The interview was chosen over a focus group discussion for several reasons. First, a focus group discussion would have been difficult to organise and inconvenient for the participants. This was because they lived in different locations, and had limited free time due to various responsibilities within the home or at work. Second, although both focus group and interviews capture in depth data, interviews are more appropriate for personal experiences and perceptions, whereas focus groups are more appropriate for group experiences. Third, the data gained at a focus group is primarily a construct of the interaction between a group of participants, and I was primarily interested in the views of the individual.

One of the key features of the interview is the ability to combine structure and flexibility; this is known as a semi-structured interview [214] The structure comes from the topic guide. For our research we developed a topic guide based on the conceptual framework, and our research questions. The development of the topic guide was undertaken through several discussions with our host supervisor in Ghana, the research assistant, and the research team in the UK. In order to move beyond the surface level, I also developed some tentative probing questions as exemplars. Probing techniques are essential to gain 'a fuller understanding of the participant's experiences and the meaning they hold for that individual [214].' However, the structure used was sufficiently flexible to allow the participant to discuss issues they felt were important, and shape the content of the interview to some extent. Furthermore, the order in which the topics were discussed was to follow its natural course in discussion, rather than the exact flow in the topic guide. The topic guide can be seen as Appendix I.

All in-depth interviews were recorded using a digital recorder which was operated by either myself or the research assistant. Most interviews took place face-to-face. Two interviewees requested a phone interview, as they lived in very remote areas and were unable to meet at the polyclinic; nor were the research team able to allocate time to visit their homes. The face-to-face interviews took place either within a private room at the polyclinic, or a private room in the patient's home. Throughout all the interviews both myself and one of the research assistants (translator) was present. Most of the interviews were conducted in their local language – with the exception of two interviews, which were conducted in English. For the interviews conducted in English I was the main interviewer and there was no need for translation, although the research assistant remained present.

All interviews were undertaken with only the participant present, with the exception of two interviews; in one interview, the participant requested for the healthcare worker to be present, and in another interview, the husband wanted to be present due to cultural reasons. For the latter, both the

lady interviewed and her husband were Muslim, and although cultural reasoning was not explicitly mentioned, the husband was present throughout the interview. On average, the interviews lasted between 60-90 minutes. All interviews were conducted with myself present; this was to ensure quality and rigor, so that all interviews were conducted in a similar manner. During the interview, each response was directly summarised in English, so that I could follow the key points at interview, ensure that we were probing appropriately, and clarify any points. At the start of the interview, the participant shared their key demographic information, which is summarised in table 6.4. I undertook some field notes prior to and after the interview; the field notes related to the environment of the interview, such as the location, people present, and personal reflections. The field notes also included details on how well the topic guide functioned and general observations about emerging codes. An extract of the field notes is shown as figure 6.4.

All interviews were later transcribed by two transcribers, who were able to translate all languages. The data was transcribed directly into English using Word, and anonymised by checking and anonymising any references to names and places. Direct translation involves translating directly from the local spoken dialect into written English. This was the preferred method – as the languages were primarily 'spoken languages' and it was more common to use their spoken form rather than their written form. The transcribers felt that transcribing from the local spoken dialect into the written form, before translating into English, would potentially lead to missing information. The transcripts were later exported into NVivo v.10, a qualitative data management software package. Data was transcribed verbatim, including interruptions in speech, cross-talking and incomplete sentences (orthographic transcripts). Major interruptions, such as pauses to go to the toilet or to answer a mobile phone, were noted and contextualised against the breaks in speech. Once the transcriber had transcribed the interviews I checked all transcripts for accuracy and clarified any areas that had led to any confusion; for example, where there may be misunderstandings of speech due to poor tone of voice [217]. All Word files were kept on the computer and password protected and regularly backed up. Once the transcripts were checked for accuracy, an agreed cleaned version of the transcription was used for analysis.

6.2.4.1 Ethics and Consent

Before the start of each interview, formal consent was sought from the interviewee. The consent form was spoken out loud for all participants. For face to face interviews (18 out of 20 interviews) the participants either signed or made a thumb print, depending on their preference and ability to write. For telephone interviews, (2 out of 20 interviews) verbal consent was given by the participant. Throughout the process, the researcher team ensured that the participant fully understood the materials provided. The consent form and the patient information sheet are included as Appendix J.

Upholding ethics, good governance and quality in practice was central to all processes. This included upholding the ethical research governance of the University of Southampton, the University of Ghana, and the local regulations/ laws. There were a number of central tenets that were maintained throughout the research. These included moral principles guided by four main principles of bioethics - suggested by Beauchamp and Childress [218]. The principles are autonomy (informed consent), non-maleficence (do no harm), positive beneficence (benefits of research outweigh the risks) and justice (research strategies and procedures are just and fair). The considerations made to the research are summarised in Appendix K ('Ethical considerations')

6.2.5 Summary of feasibility issues encountered with interviewing

Owing to the unpredictable nature of real life situations, there were a few adaptations made to the research protocol to ensure that all people involved in recruitment and interviewing, including the patient as well as the hospital staff, were at ease with the research proceedings. These adaptations included:

- Allowing the community nurse to be present at a home interview with one patient – to make the patient feel more at ease
- Conducting the interviews behind a screen, close to a public area. This allowed the nurses to continue with their work as they needed all rooms available

6.3 Research Credibility.

The trustworthiness and quality of qualitative research is often questioned by positivist researchers who suggest that the concepts of validity and reliability cannot be applied in the naturalistic settings of qualitative research [219]. In response to these assertions, Guba proposed four main criterion that should be considered by qualitative researcher to ensure trustworthiness in their research and these criterion collectively refer to the credibility of the research [21].

The four main criteria include:

a) Credibility (corresponds to internal validity)
b) Transferability (corresponds to external validity/ generalisability);
c) Dependability (corresponds to reliability);
d) Confirmability (corresponds to objectivity).

6.3.1 Credibility and Transferability

The credibility of the research study examines how congruent the findings are with reality [220] Several provisions that have been suggested by Shenton (2004) were employed to ensure credibility [21, 219]. These are outlined in table 6.1. The transferability of the research relates to how generalizable the findings are to contexts outside the population studied. 'Generalisability' or 'transferability' is believed to depend upon the congruence between the 'sending context' within which the research is conducted and the 'receiving context' to which it is applied.

Table 6-1. Provisions made to ensure credibility and transferability

Provisions	**What was carried out to achieve this**
Credibility	
a) established research methods	a) training in qualitative methods, getting insight from previously established projects and qualitative researchers
b) familiarity with local culture and context	b) an initial trip to Accra and the field sites
c) no coercion	c) gave women time to decide before enrolment; voluntary withdrawal
d) negative case analysis	d) looked for cases that appeared to contradict patterns from the data set and refined analysis to account for all cases
e) feedback from research team and peers	e) protocol critically reviewed by peers; carried out daily meetings with research team to discuss problems and get feedback
f) progressive subjectivity g) credibility of main researcher and research team h) credibility of main researcher and research team	f) research notes were carried out to evaluate the effectiveness of the techniques that had been employed, and give some reflective commentary on the process which included my developing thoughts, or constructs, on analysis g) shared background information, qualifications and experience before the start of each interview h) credibility of main researcher and research team

i) relating findings to previous knowledge	i) examined findings reported here in relation to previous findings
j) second coding	j) second independent qualitative researcher coded the data and ensured the themes were directly informed by the data
Transferability a) understanding the contextual environment b) studying similar populations	a) information about the contextual environment was written up as field notes b) quantitative and qualitative literature from similar populations was reviewed – related to different subjects as literature on multimorbidity was limited

6.3.2 Dependability and Confirmability

The dependability of the qualitative study relates to how repeatable the study is; in other words, if the study were to be repeated in the same context, would it produce similar results. The confirmability relates to the extent to which the ideas and experiences are directly informed by the participants, rather than the opinion and views of the researcher. According to Malterud (2001), "*a researcher's background and position will affect what they choose to investigate, the angle of investigation, the methods judged most adequate for this purpose, the findings considered most appropriate, and the framing and communication of conclusions [221]*."

Table 6-2. Provisions made to ensure dependability and confirmability

Provisions	**What was carried out to achieve this**
Dependability a) processes of the study were reported	a) reporting in: - research design and implementation - process of data collection - reflexive appraisal of project
Confirmability	

a) developing audit trail (see figure 7.3) b) reflexivity	a) carried out an audit trail to show the step-by-step process with the decisions made b) reflexive commentary within field notes (see figure 4)– attentive for judgements or assumptions that may undermine research

The audit trail was used to ensure confirmability – to make explicit the process, so that we can be assured that the data is directly informed by the participants, and not that of the researcher. Below is the development of the audit trail.

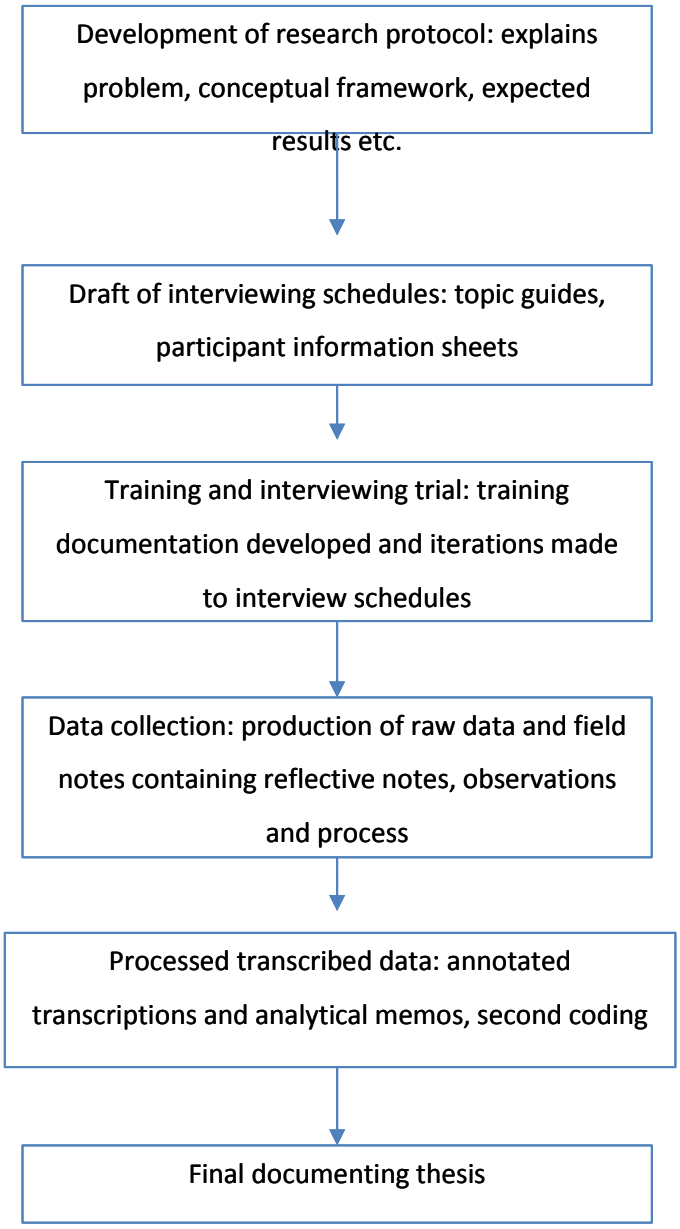
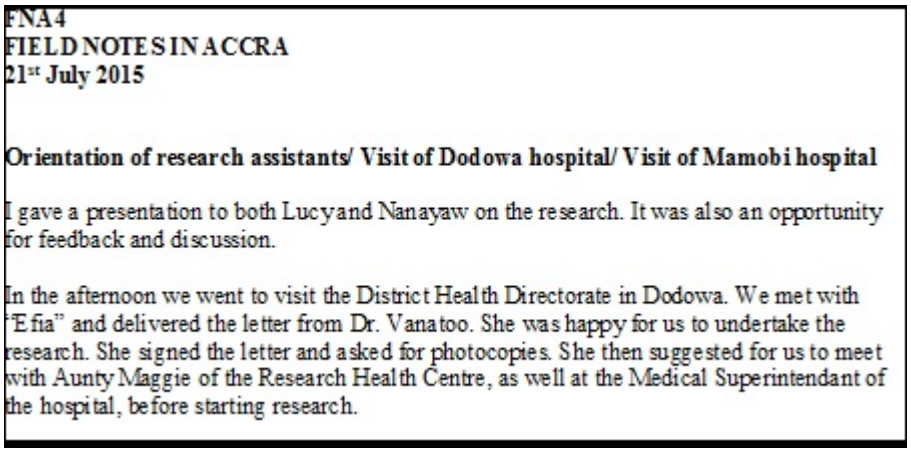


Figure 6-3. Components of audit trail

Field notes were an essential part of assuring research credibility, with respect to confirmability, dependability, transferability and credibility. An extract of the field notes are shown below.



FNA4
FIELD NOTES IN ACCRA
21st July 2015

Orientation of research assistants/ Visit of Dodowa hospital/ Visit of Mamobi hospital

I gave a presentation to both Lucy and Nanayaw on the research. It was also an opportunity for feedback and discussion.

In the afternoon we went to visit the District Health Directorate in Dodowa. We met with "Efia" and delivered the letter from Dr. Vanatoo. She was happy for us to undertake the research. She signed the letter and asked for photocopies. She then suggested for us to meet with Aunty Maggie of the Research Health Centre, as well at the Medical Superintendant of the hospital, before starting research.

Figure 6-4. Extract from field notes

Taken on the 21st July 2015

6.4 Data Analysis

During the fieldwork, initial data management was undertaken, which involved checking over the transcriptions and gathering some preliminary thoughts/ideas, and recording them in a field notebook. A significant portion of data analysis however took place after the fieldwork. There are several ways to analyse qualitative data. The thematic approach was chosen as an appropriate method for this research study, as the steps are easy to follow for novice qualitative researchers. Thematic analysis is the most commonly used analytical method for qualitative data [214]. Furthermore, thematic analysis is more consistent with the pragmatic approach taken, as compared to other methods [222]. Using the thematic approach as outlined by Braun and Clark, I carried out a six phase process in which patterns were identified, analysed and reported within the data set. Such reported patterns were described as 'themes.' The different stages in the process are summarised in figure 6.5 [223].

Phase 1, familiarisation with data: Once transcribed, the anonymised transcripts were uploaded to the NVivo 10 data management software. I read through each transcript several times, and made written notes with any initial thoughts and queries that emerged whilst reading the transcripts. Throughout the analysis, I kept short memos to record any thought processes, ideas, queries, key words and phrases. The analysis was an iterative, reflexive process. I continued to re-read sections of transcripts in order to

challenge my thoughts, and compare beliefs or views between participants; at each phase. An example of this process is shown in table 6.3. During Phase 2, I started labelling portions of the text as initial codes. This involved reading the transcripts and looking for words, or groups of words, that conveyed what the speech was describing. Once these initial codes were generated, then the codes were then clustered. This involved reading the codes and examining how the initial codes could be clustered into groups. This was a process that involved the examination of the relationship between codes, and within clusters of codes. Once this process was complete, several initial themes were developed. The next phase, Phase 4, involved reviewing the initial themes to ensure that they formed a cohesive pattern at two levels: the first level involved checking the themes worked in relation to the coded extracts, and the second level involved checking the themes across the entire dataset. The second level therefore involved checking relationships between themes, and checking for consistencies, overlaps, accuracy and meaning. Once these were checked, a 'thematic map' was produced. Phase 5, involved naming and defining the themes: there was an ongoing analysis during which time the specifics of each theme were generated. During this phase the 'essence' of the theme was defined. The final phase 6 involved refining the names and definitions; which meant searching for key factors or processes that accounted for patterns of association in the data and arriving at the most logical inference. Several transcripts were second coded by my supervisor, Dr. Caroline Eyles, to ensure that the codes were directly informed by the data, enhancing the credibility of the research.

6.4.1 Data saturation

Data saturation occurs when no new major ideas or themes emerge from new data, and therefore interviewing can be ceased [224] Ideally, data saturation should be reached during qualitative interviewing. Given that I had restrictions in time and budget, I was unable to continue interviewing until data saturation was reached. Therefore it is likely that additional interviews may have contributed some emergent themes which were not covered here.

Phase 1: Familiarisation with data.

Once transcribed, the data was read, re-read and initial ideas noted. Points of interests were noted and memos were made.

Phase 2: Generating the initial codes

Initial codes were generated by labelling portions of the text using the computer assisted data analysis software *Nvivo version. 10.*

Phase 3: Clustering codes into initial themes

The initial codes were then collated into clusters, which involved assigning each code to a relevant theme.

Phase 4: Reviewing the themes

The themes were reviewed to see if they form a cohesive pattern at two levels: the first level checked themes worked in relation to the coded extracts, whereas the second level checked the themes across the entire dataset. Once these were checked a 'thematic map' of the analysis was produced.

Phase 5: Naming and defining the themes

In this phase, there was an ongoing analysis during which time the specifics of each theme, including their names and definitions, were generated. It was important to capture the 'essence' of each theme when naming and defining the themes.

Phase 6: Refining the names and definitions

The final stage involved searching for key factors or processes that accounted for patterns of association in the data and arriving at the most logical inference. Overall this process was systematic and interpretative. This involved carefully combing the data to look at the interpretative patterns. During this phase there was an ongoing analysis: refining the specifics of the theme, generating clear definitions and names for each theme.

Figure 6-5. The six stage process used for the thematic analysis[223]

During Phase 2 portions of the text were coded into initial codes. Table 6.3 gives an example of how one respondent's answer was coded into initial codes.

Table 6-3. An example of an initial coding framework

Interview Transcript	Initial Coding Framework
Interviewer: I just want you to describe to me what happens when you go to your appointments at the clinic? Do you go alone or you go with somebody?	
Respondent: Sometimes I go alone, sometimes too I go with my father. Sometimes, they order me to bring him there. They ask him what I am going through. So they go and ask him and he tells them, then they increase the medicines. Sometimes, they tell me that I should come alone, I shouldn't let him come and I go alone, they inject me and give me medicines. Every month, I go	Support from family Treatment prescribed by the doctor Keeping to appointments

Table adapted from Burnard et al. 2008 but using own raw data

Table 6-4. Final coding framework after reduction of the categories in the initial coding framework

(Full version with quotes in Appendix L)

Initial coding framework	Final coding framework (sub-themes)	Final coding framework (themes)
Individual responsibilities Emotions Spirituality (inner world)	The influences that relate to the self: emotions and spirituality	The influences on their health experience
Employment and sources of income Belief systems, culture and environment Social support network	The influences relating to events or people in their environment	

Willingness to improve health	Expressed reasons for going to the hospital	Seeking care and the responsiveness of the healthcare system
Trust in health system		
Describing symptoms	Disruption of everyday life due to symptoms	
Words describing satisfaction with the healthcare system	Words describing satisfaction with the healthcare system	
Information given by clinicians	Communication	
How their conditions are diagnosed		
Health insurance coverage	Access to prompt attention from clinicians	
Continuity of care		
Waiting times		
Focus on only one of their diseases through vertical healthcare	How much choice in healthcare do they have?	
Use of private healthcare providers		
Availability of treatment	Treatment	How patients manage healthcare demands
Adhering to treatment		
Getting to appointments	Keeping to appointments	
Scheduling of appointments		
Good health outcomes	How able are they to continue daily life?	Outcomes due to ill health
Independence		
Loss of independence		
Out of pocket payment		
Ability to pay		
Financial burden due to ill health	Economic circumstances due to health needs	

6.5 Interview participants

A total of 20 participants were interviewed. The first characteristic criteria was to include females who are permanently residing in either a predominately 'urban' predominately 'rural' area in Ghana. In the research time, I recruited 3 participants living in a rural area (n= 3) from a peri-urban area (n=5) and from an urban area (n=12). The mean age was 55.6, 54.0 and 52.7 respectively. The second characteristic criteria was to include women of below secondary school education, and secondary school/above. Initially we recruited very few participants were from the secondary school/above category, particularly from the urban area. This was because the area of 'Maamobi' was particularly deprived, and women were of a lower education level. To ensure purposive sampling, I chose a third recruitment site, Legon hospital, also within the Accra metropolitan area. This was both a primary and secondary care facility, which was in a less impoverished area. The permissions were granted and the amendments were made to the protocol. In total I recruited a total of 5 women with secondary school education and above. The patient demographic characteristics are shown in Table 6.5.

Table 6-5. Summary of the demographic characteristics of the participants (n=20)

	Residence		
Demographic Characteristics	**Urban**	**Peri-urban**	**Rural**
Total number of participants	12	5	3
Mean Age ± standard deviation	55.6 ± 10.0	54.0 ± 11.1	52.7 ± 10.0
Mean Household members	4	5.8	5
Mean Chronic conditions	2.3	2.8	4
Employment status			
Number in full time employment	4	5	1
Number in part time employment	2	0	0
Number unemployed	6	0	2
Education			
Number with below secondary	9	4	2
Number with secondary and above	3	1	1
Religion			
Number of Christian religion	8	5	3
Number of Muslim religion	4	0	0
Marital Status			
Number Married	5	2	2
Number Separated	2	0	0
Number Widowed	5	3	1

Patients were recruited if they had one or more chronic conditions. The diagnosis of these conditions were confirmed from the patient's clinical notes. The major chronic conditions included in the sampling were arthritis, diabetes, hypertension, heart disease, HIV, schizophrenia and tuberculosis. The full details of each patient, their social and demographic characteristics; and chronic conditions are shown as Table 6.6 (next page).

Table 6-6. Participants' social, demographic and chronic disease status

Participant	Age	Chronic condition 1	Chronic condition 2	Chronic condition 3	Chronic condition 4	Education	Employment	Household members	Marital status	Religion	Residence
001R	52	Diabetes	Arthritis			Below secondary	Full time	4	Married	Christian	Peri-urban
001U	50	Asthma	Diabetes			Below secondary	Part time employment	25	Married	Muslim	Urban
002R	52	Diabetes	Heart pain	Arthritis		Below secondary	Full time	9	Married	Christian	Rural
002U	65	Diabetes	Osteoarthritis	Unassigned		Below secondary	Full time	8	Widowed	Muslim	Urban
003R	43	Asthma	HIV	Hypertension		Secondary and above	Unemployed	3	Widowed	Christian	Rural
003U	71	Diabetes	Osteoarthritis			Secondary and above	Full time	3	Widowed	Christian	Urban
004R	36	Diabetes	HIV			Below secondary	Full time	6	Widowed	Christian	Peri-urban
004U	38	HIV	Schizophrenia			Secondary and above	Unemployed	3	Separated	Christian	Urban
005R	58	Hypertension	Arthritis	Peripheral Neuropathy		Below secondary	Full time	7	Widowed	Christian	Peri-urban
005U	48	HIV	Osteoarthritis			Below secondary	Full time	5	Married	Christian	Urban
006R	63	Asthma	Hypertension	Diabetes	Schizophrenia	Below secondary	Unemployed	3	Married	Christian	Rural
006U	66	Diabetes	HIV			Below secondary	Unemployed	6	Widowed	Christian	Urban

007R	65	Diabetes	Hypertension	Arthritis		Below secondary	Full time	9	Widowed	Christian	Peri-urban
007U	64	Diabetes	Hypertension	Osteoarthritis		Below secondary	Unemployed	6	Widowed	Muslim	Urban
008R	59	Hypertension	Diabetes	Glaucoma	Lumbar spondylitis	Secondary and above	Full time	3	Married	Christian	Peri-urban
008U	51	Asthma	Hypertension	Diabetes		Below secondary	Unemployed	6	Married	Christian	Urban
009U	63	Hypertension	Diabetes	Osteoarthritis		Below secondary	Unemployed	3	Widowed	Muslim	Urban
010U	52	Diabetes	Heart disease	Musculoskeletal pain		Secondary and above	Part time employment	2	Married	Christian	Urban
011U	53	HIV	TB			Below secondary	Unemployed	4	Married	Christian	Urban
012U	46	HIV	Osteoarthritis			Below secondary	Full time	2	Separated	Christian	Urban

6.6 Findings

Following reduction of the initial codes, four themes emerged from the dataset. These are summarised below.

Theme 1: The influences on their health experience

Theme 2: Seeking care and the responsiveness of the healthcare system

Theme 3: How patients manage healthcare demands

Theme 4: Outcomes due to ill health

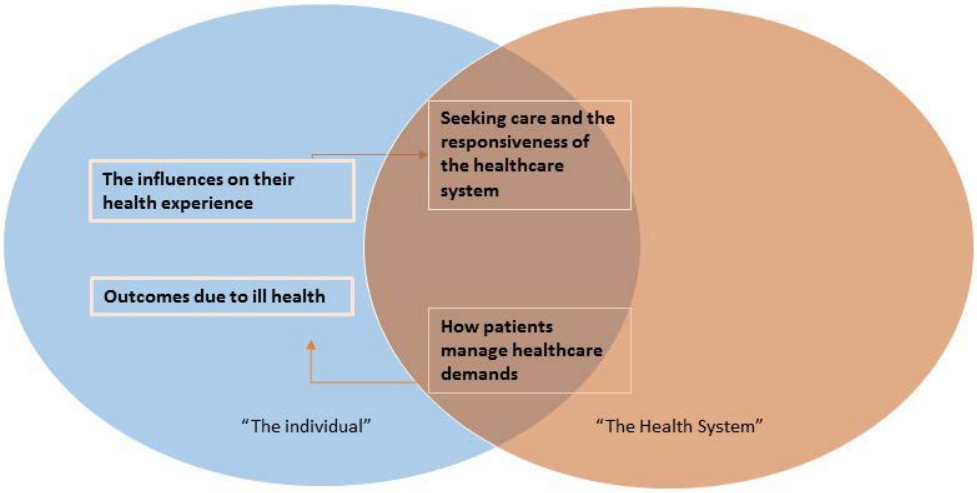


Figure 6-6. Major themes associated with women's experiences living with multimorbidity

Figure shows the interaction between the individual and the health system

I have written up the findings by theme. Under each theme, I have also described the 'sub-themes.' Where necessary, I have used illustrative quotations to support the description and interpretation. At the end of each section, I have summarised the main points for each theme.

I have written previous quantitative chapters in the third person, where possible, in order to sound objective in my approach. In this qualitative chapter, however, I have decided to write in the first

person to acknowledge that I interacted with the participants as an individual. The choice of writing in the third person, although implying distance and neutrality, does not acknowledge the integral role of the researcher to the research process [225].

6.6.1 Theme 1. The influences on their health experience

The influences relate to the context, or circumstances, that affect their health experiences. These influences underlie an individual's experience of ill health and differ for each participant. For example, a widowed woman may express a strong belief in a higher being, which gives her the faith and courage to overcome certain symptoms. Whereas, another woman may depend upon the emotional support of her husband. Overall, the influences have been categorised into two subthemes: 'the influences that relate to the participants' self or "internal world" such as to their emotions and spirituality, and the influences that relate to events or people in the participants' "external world" or environment.

6.6.1.1 Subtheme 1.1. The influences that relate to the self: emotions and spirituality

Spirituality has been used here to describe matters that relate to their belief in a higher being (such as God) rather than the participant's interaction with a religious group. This sub-theme consistently emerged across the dataset and across the sociodemographic characteristics, including different residential status and education. Interestingly, women from both main religions (Christianity and Islam) discussed their health experiences within the context of their spiritual values:

> *"I don't know why. I am given medications monthly when I come for checkups at the hospital but still I am not feeling any better. I have faith in God that it would be well so I don't joke with my medications. "* ***(Respondent with diabetes and osteoarthritis. Lives in urban area.)***

Many participants expressed gratitude to God, and spoke of their faith in relation to being healed, particularly those who suffered from potentially life-threatening illnesses such as HIV and diabetes. When discussing why they became ill, few women attributed the disease to 'spiritual causes.'

> *I sometimes dream of my first husband trying to have sexual relationship with me. I have been to several prayer camps and am being told the same story that the man who appears in my dream is the cause of my diseases so I believe it's spiritual…'* ***(Respondent with diabetes and HIV. Lives in urban area.)***

In the last quote, the participant dreams about her former husband. Later in the interview, I learned that she was infected with HIV through having a sexual relationship with him. Interestingly, she relates her dreams to her disease, suspecting a spiritual and not purely a physical cause.

Unsurprisingly some expressed emotions when talking about their health experiences. Participants with a co-occurring mental health condition, in particular, expressed emotion during their interviews. Participants with HIV also discussed their emotions in relation to the stigmatisation they have suffered. Stigmatisation was only mentioned by those with co-occurring HIV. They expressed not being able to talk to many people about their illnesses, including family.

> *"At first I was worried but now I am use to it. Around last year December it really worried me and I even left my community but still I have the courage to stay there whether they point finger at me or not I will still stay there."* ***(Respondent with HIV and osteoarthritis. Lives in urban area).***

As supported by the line in the previous quote '*I have the courage….'* women with co-occurring HIV often expressed a positive attitude, despite experiencing emotions brought on by the stigmatisation of HIV. As the quote above also shows, the participant considered moving to a new community. The same respondent also struggled to find work because of the stigma; this was common amongst others with HIV.

As this quote shows, often the social perceptions held about HIV are untrue, which is what leads to the stigmatisation of HIV sufferers.

> *"They don't think evil of us, the illness is there, we have the illnesses so we need to be pampered and be loved. If you touch some people, they will say they will get infected so don't touch them but when I touch you, it's not true, you can't get infected. I can eat with you as well. ."* ***(Respondent with HIV and osteoarthritis. Lives in urban area).***

Fear was another strong emotion felt by a number of participants. In most cases, the participants feared what the disease would do to them. To this end, they made sure they honoured all their appointments and took their treatment. When asked about both their conditions, participants often feared one over the other: usually the one they perceived as being more life threatening, or one that they had least experience with managing. As this quote clearly illustrates,

> *"For now it is the diabetes which worries me more because I know that I have been living with the asthma for long and I know how to manage it."* ***(Respondent with asthma, diabetes and hypertension. Lives in urban area.)***

6.6.1.2 Subtheme 1.2. The influences relating to events or people in their environment

This subtheme examines the influences related to the participant's external environment. The external environment encompasses everyday interactions with their family, community and work-place; as well as the constructs belonging to these groups, such as culture and religion. The role of their religious community is mentioned by women of urban and rural areas; and different levels of education. Several women reported going to church frequently, whereas others felt the church placed some unattainable demands on them concerning money and so didn't visit regularly.

> *'When we went there for the first time, I didn't go again because it is all about money issues and I don't have money. When you get there, the money you put in the bowl is that which God will look at and solve your problem.'* ***(Respondent with diabetes, heart disease and musculo-skeletal pain. Lives in urban area.)***

In contrast to the previous quote, some women discuss loyalty to their religion in a positive way, expressing it as a way of moral guidance, as shown in the following quote:

> *"When the church announces for a prayer meeting, I also joined to pray in order to learn the word of God well. It helps one to restrain him/herself from bad deeds."* ***(Respondent with HIV and arthritis. Lives in urban area).***

Some women also discussed the use of herbal medicine, or leaves, bought from the church or local vendors. Although it was not a common belief across women, a few women learnt that 'leaves' were able to help their illnesses, even though the outcomes were not always good, as shown by the following quote.

> *"…Bible tells us that we should use the leaves as medicine to cure our illnesses, when I continue to prepare the herbs the illness can't go****." (Respondent with HIV and osteoarthritis. Lives in urban area).***

Some participants purchased herbal medicines from their local sellers and either used them instead of, or at the same time as, the treatment regime prescribed by the doctor.

> *"The one who was selling the herbs told me that I should stop taking the orthodox medications and take only the herbs so I stopped taking the orthodox medications."* ***(Respondent with diabetes, heart disease and musculo-skeletal pain. Lives in urban area.***

In contrast, other participants took a pessimistic view on the herbal medicines.

> *"I don't really trust alternative medicine so I stick to the hospital and aside that it's not advisable to mix orthodox medicine with her herbal medicine.* ***(Respondent with asthma, hypertension, diabetes, schizophrenia. Lives in rural area).***

Most participants described their experiences of working within the community. When it came to describing their work, most women described their inability or ability to work in relation to their ill health. Some women reported difficulty in continuing their work; for these women, their work usually involved physical activity, such as selling food in the street. When their physical health was compromised, they report not being able to go to *'sell.'* One woman, despite not having a physically laborious job, described being excluded from her clerical work on account of her illnesses.

> *"I have worked there before but I don't know why they don't want to employ me. I want to work there but the management there do not agree and I don't understand."* ***(Respondent with HIV and schizophrenia. Lives in urban area)***

6.6.1.3 Theme 1: Summary of Findings

- In relation to the factors that influenced their health experiences, there were no apparent differences between those that lived in rural or urban areas within the study sample
- Emotions were frequently expressed amongst women with co-occurring mental-health conditions, although 'stigmatisation' seemed to be an important factor effecting the circumstances of those with HIV (over and above their other conditions)
- Spiritual values were important for most participants, although the importance of an organised religious community varied across the study population
- Participants with illnesses affecting their physical health, and signs of severe symptoms, found it difficult to meet employment demands
- There were no consistent patterns on the use of herbal medicine

6.6.2 Theme 2. Seeking care and the responsiveness of the healthcare system

The second theme examines the participant's motivations for seeking healthcare from a health facility; and the way in which the healthcare provided responds to, or satisfies, the needs and choice of the patients; as well as all their conditions. In particular it describes whether the health system offers proper communication, timely and adequate services. It examines whether the respondent feels fulfilled with the service provided for their conditions. It also explores the extent to which they have been given choice, or freedom, in their health matters. Here some beliefs and preconceptions about ill health were discussed. Notably, there was a cultural narrative that related the cause of ill health to supernatural

forces. This was expressed by a few women. Despite this underlying belief for some women, all participants chose to access healthcare. Some participants, for example, followed the advice and opinion of others, such as family members; or those from their social network. Likewise, participants clearly had a number of disruptive signs or symptoms, which could not be dealt with elsewhere, prompting them to seek healthcare. Furthermore, women often felt that the health system did respond to their entire needs, and focused on one condition rather than the other(s). Some patients lacked choice, and often did not receive the required care or treatment for all their conditions.

6.6.2.1 Subtheme 2.1. Expressed reasons for going to the hospital

Each woman expressed a different rationale for going to the outpatient clinic. It was interesting to understand the reasons for those living in rural areas. Interestingly, there exists a powerful narrative relating ill health to superstitious beliefs or values, as expressed by the following quote from a participant living in a rural area:

> *'Sometimes if someone falls sick the person starts thinking it's a witch, not for me I went to the hospital when I was told what was wrong with me.' (**Respondent with Diabetes, heart pain and arthritis. Lives in rural area.)***

Despite acknowledging this common belief, the participant goes on to express her will to visit the hospital. Another woman, also living in a rural area, describes visiting a traditional healer before taking someone's advice to visit the hospital. For this woman, it was easier to access the traditional healer from her community. Once her symptoms persisted, she looked for alternative help. There were no barriers to choosing healthcare, such as opposition by family or community members, described by these women. To the contrary, women were commonly advised and informed about hospital treatment, and therefore decided to seek healthcare. Many women took advice from close family members. These findings suggest that hospital medicine may not be the go-to choice, particularly for women living in rural areas where access to hospitals and medical facilities may be more difficult; and perceptions of ill health are still based on traditional, or superstitious, values. However, these findings also suggest that the community values modern medicine, and that these values may supersede the traditional views that underpin traditional healing.

> *'I went to him and he told me that I had diabetes and my sister advised that, if that is the case, then I should go to the polyclinic for proper medical care.' (**Respondent with asthma and diabetes. Lives in urban area.)***

Some women reported a willingness to improve health as a fundamental reason for visiting the hospital. Women express the need '*to be cured*', to '*have a healthy body*'; and believed that they have no choice but to take care of their health. For many women, the need to be cured was also discussed in relation to their personal circumstances, such as their income. In Ghana, there is not a proper welfare system that can financially support them during times of ill health and, equally, the healthcare costs of treatment place a burden on these women, as supported by the following quote:

> *'The thinking, how to be cured, if I feel, at times, actually when I don't have money and I know the medication is almost finished, then I become too much stressed on where to get money.'* ***(Respondent with hypertension, diabetes and glaucoma. Lives in peri-urban area).***

This quote conveys the influence of a woman's personal circumstances (described in more detail in theme 1) on their ability to seek healthcare.

6.6.2.2 Subtheme 2.2. Disruption of everyday life due to symptoms

The majority of participants reported choosing to go to a health facility on account of their symptoms. The symptoms included coughing severely, growing lean, urinating very often, feeling faint/ dizzy, and having severe pains. In most cases the symptoms disrupted their everyday life, and presented a matter of urgency.

> *"I was always feeling sleepy most to the times and I have been to the hospital several times to report on it. Most of the times too, I urinate very often and I was advised to go the hospital."* ***(Respondent with HIV and TB. Lives in urban area.)***

Some participants chose to self-medicate by using local vendors, such as local chemists, or herbal stores. Despite self-medication, however, women reported poor health.

The persistence of symptoms made some women to decide to visit a healthcare facility.

> *"aside that a friend of mine took me to a herbalist where I was given some drugs to take care for six months but when I went for a check-up, my blood pressure was still increasing so I was advised to stop taking that drug and till now I haven't tried any other drug aside the ones am being given by my doctor." (****Respondent with diabetes and HIV. Lives in urban area)***

For women living in rural areas, there seemed to be no perceived barriers in gaining access to health facilities. Once they decided to visit the hospital, they were able to do so. This following quote is taken from a woman living rurally, who travelled to the next region to visit the polyclinic. She describes the

faith she has in dealing with her ill health, and then goes on to describe how she manages her work responsibilities ('smoking fish') on the day of her appointment. She then takes a whole day off from her work, and travels some distances to attend her appointment.

> *The little money you have when you are sick you have to use it before family can also help when you don't have any… I put my trust in God, and pray and go to church God can help in in some ways….God provides when you least expect…. The day of my appointment I don't smoke fish…Usually I smoke it before I go.* ***(Respondent with diabetes, heart pain and arthritis.)***

6.6.2.3 Subtheme 2.3. Words describing satisfaction with the healthcare system

Regardless of whether they lived in an urban, peri-urban or rural area, many women expressed general satisfaction with the health care they received for their conditions. Satisfaction was understood when the patient expressed positive words or feelings about their healthcare experience. Words such as *'makes me happy'* or *'well'* were often used within this context, as illustrated by the following quote.

> *'Even when you go to the hospital very early, there are protocols so they will be attended to before you, so you just have to exercise patience before it gets to your turn. Some of the things that makes me happy is that am able to tell the doctor my problems and he gives me medication.'*
> ***Respondent with diabetes, arthritis and hypertension. Lives in peri-urban area.***

This woman seemed to have a positive outlook, particularly where she states '*some of the things that makes me happy…'* although this statement was balanced by the downsides of her experience, notably the long waits and early arrival. Other women also report satisfaction in relation to how well they are looked after:

> *'Their treatment are really good, that one I won't tell lies they really take good care of us.'*
> ***Participant with HIV and osteoarthritis. Lives in urban area.***

As the above quote also illustrates, when women described satisfaction with the healthcare system, it was discussed in relation to the care received, such as treatment given or support from workers. The role of communication between clinician and patient is discussed in the next sub-theme.

6.6.2.4 Subtheme 2.4. Communication

This subtheme explores the role of communication in addressing the concerns or needs of the patient. Women often discussed the information given by the clinicians, such as the doctor or nurses. Interestingly, information was given about some conditions and not others. When asked about what

information she received about her conditions, the following participant relates the information given about her HIV:

> *'We are being told not to have unprotected sex with your partner if you are married and even if you are not married and you want to have sex, you should protect yourself but in terms of food we are free to eat anything.'* ***Respondent with asthma and HIV. Lives in rural area.***

A common perception amongst women with chronic arthritis, however, was the lack of information given by the clinicians concerning their condition. This was particularly common amongst women who had presented on the specific clinic days, for example: for HIV, diabetes, and mental health etc. For these women, they received more information and guidance concerning their other conditions:

> *'They don't tell me anything about the chronic arthritis.'* ***Respondent with diabetes and osteoarthritis. Lives in urban area.***

Whereas most women were satisfied with the information received by the clinician, some felt that they were not given enough information, and were not treated in a good manner. As this quote illustrates,

> *'The doctor is supposed to be patient and give us the teachings. They are not patient at all for example, the one who took care of me yesterday' (**Respondent with diabetes, hypertension and osteoarthritis. Lives in urban area.)***

Related to this sub-theme, the next examines to what extent patients were able to receive prompt attention from the clinicians.

6.6.2.5 Subtheme 2.5. Access to prompt attention from the clinicians

Most participants discuss the long waiting times as one of the barriers to receiving prompt attention. For the most part, the women are expected to arrive before their scheduled appointment and begin queuing, and often spend an entire day at the clinic to see the clinician. This has a direct impact on other factors, including loss of work and finances. Despite this, the women make a conscious effort to make their designated appointments on account of their ill health, and did not seem deterred. This may reflect their willingness and need to be treated, as captured by the previous theme, but also it shows an acceptance of long waiting times; which seemed to be the 'status-quo.' As this quote shows, they respect the need to wait to see the clinician, and therefore exercise patience in doing so:

> *'they give us the best of treatment but the only problem is it takes a very long time before you are able to go to the consulting room to see the doctor, you would have to be in a long queue until it*

gets to your turn to go to the consulting room and you end up wasting eventually the whole day there, so you just have to be patient until it's your turn to be attended to.' ***Participant with hypertension, arthritis and peripheral neuropathy. Lives in a peri-urban area.***

Most of the participants report being able to see the doctor without any prolonged difficulty. However, as this participant describes, the lengthy waiting times may be problematic for those with severe symptoms. Furthermore she recalls a number of systematic issues, such as not always being able to retrieve the patient's folder in a timely, organised manner.

'but this place you sit there and they will be doing their own things at times, even getting your folder is a problem….but before you reach the doctor personally am not happy, if the sickness is very severe for you then what will happen.' ***Participant with hypertension, diabetes, glaucoma and lumbar spondylitis.' Lives in a peri-urban area.***

6.6.2.6 Subtheme 2.6. How much choice in healthcare do they have?

This sub-theme explores how much choice women have in choosing their health care. This relates to either the place of care, such as the clinic, or the service given.

As this quote shows, most women had little choice about visiting a private over a public health facility. This meant that they visited the closest public facility to them.

'That is a private facility and this place is a public or general hospital so I felt that it is proper to seek medical treatment in a government facility. Besides treatment at the Suleman clinic was very expensive.' ***Participant with diabetes, hypertension and osteoarthritis. Lives in an urban area.***

If attending a specific clinic day, then the patient will be seen by a specialized doctor for that particular condition. Otherwise, they will be attended by another primary care doctor at the outpatient department. Most women attended specific clinics on their assigned days. For example, diabetic patients attended the diabetes clinic on their scheduled appointment days. If they showed signs or symptoms related to their other co-occurring conditions however, they were not always given adequate treatment or care for that particular condition. The following quote was from a woman attending the diabetes clinic:

'When your leg is paining you, they should have patience and treat that one too but they tend to focus more on the diabetes and hypertension more than the leg....' ***Participant with diabetes, hypertension and osteoarthritis. Lives in a rural area.***

She describes how she was unable to get adequate care for her chronic arthritis. The same lady goes on to suggest that if the same doctor cannot treat all your conditions, then you should be referred for further care. This reflects the fact that some patients lack choice, and often do not receive the required care or treatment for all their conditions. This was a common finding across women, particularly for women attending specific clinic days e.g. diabetes, hypertension, HIV and mental health.

6.6.2.7 Theme 2. Summary of Findings

- Showing persistent signs and symptoms of ill health, as well as expressing a need to get better, contributed towards their decision to visit a healthcare facility
- Some participants were not conflicted by traditional beliefs and pursued modern medicine to seek diagnosis and treatment
- Family members played an important role in encouraging participants to visit a healthcare facility
- There seemed to be no perceived barriers in accessing healthcare for participants living in the rural areas
- Women generally felt satisfied about the care they received, even though they did not have much choice in which facility to go to, their care and appointment time (for specific clinic days)
- There were inconsistencies on how information was communicated. Some women felt that they were given adequate information about their conditions, whereas others felt that the information was lacking
- Some women felt frustrated about the long waiting times and the abrupt manner of some clinicians
- Although patients received adequate information and care for their conditions on the specific clinic visits, women felt that the care received for their other conditions was inadequate during those visits

6.6.3 Theme 3. How patients manage healthcare demands

This theme captures how the women deal with the demands, or requirements, placed on them by the healthcare system in order to manage their illnesses. Unsurprisingly, the different requirements placed on each participant depended on their presenting conditions and symptoms. For example, some women

reported having only mild symptoms for conditions, such as chronic arthritis, and therefore used treatment infrequently. This is illustrated by the following quote,

'If it is not serious I don't take drugs…. Maybe four or six months' **(Respondent with asthma and HIV. Lives in rural area).**

However, some women had more severe symptoms and, as a result, were more careful about taking their prescribed medication daily.

Women also varied in their ability to manage both their treatment, and their hospital visits. Here the contextual influences, described as theme 1, played an important role in understanding how women adhered to treatment, and how they were able to honour their appointments. For example, some women had financial support from their family, which meant they could purchase certain treatments not covered by their health insurance. These aspects have been described in more detail below.

6.6.3.1 Subtheme 3.1. Treatment

This subtheme captures the various different opinions, and experiences, related to their treatment regime and the management of their ill health. Women varied in how they felt about their treatment. Some women described positive health outcomes; whereas others described negative health outcomes, related to treatment. Women who kept up with their recommended treatment regime described feeling better, as this quote illustrates:

> '*It is because two weeks ago, I did not have the medication. I became uncomfortable with severe headaches so yesterday I came and took my medications. That is why today I am here chatting with you feeling a little better. This is about the diabetes.'* ***Participant with diabetes, hypertension and osteoarthritis. Lives in urban area.***

However, satisfaction in treatment-related health outcomes for one particular condition did not necessarily mean satisfaction for their other conditions. As this quote illustrates,

> *'The chronic arthritis. The pains in knees and waist are unbearable. Because I take medication for the diabetes, I hardly experience that one.'* ***Participant with diabetes, hypertension and osteoarthritis. Lives in urban area.***

A common perception was that treatment was not always available, which meant that women could not keep up with the clinical advice given by the doctor. Most women were under the national insurance scheme, which meant that a number of essential medicines were covered and available for free. However,

a number of women reported paying for some of their medications, as these were not available under the scheme. This is illustrated by the following quote,

> *'It is my sickness that I want to calm down. Sometimes too, when they ask you to go and buy your drugs, they would tell you that those ones are not on the national health insurance. Today I bought medicines worth GH¢45.00 and yesterday I bought some, today I bought some and I am run down so it is something that they have to include in the national health insurance (NHIS). (**Participant with diabetes and osteoarthritis. Lives in urban area.')***

One participant reports not renewing her the health insurance coverage, as she felt that it didn't give her any benefits. As her medication was not covered by the national insurance scheme she therefore felt that she didn't need to be covered.

> *'… but for the HIV medication, whether you are on the NHIS or not, you pay GH¢5.00. Even if you have the health insurance, it will not cover the HIV medication that is why I have not bothered renewing it. When I started with this medication, I have not been that sick and sent to the hospital.' **(Participant with HIV and osteoarthritis. Lives in urban area.)***

Some women struggled to work because of their ill health, which meant that they were dependent on others to provide for them when they needed to pay for treatment. Others who were elderly, or retired, found themselves in a similar situation. Some women found themselves in difficult financial situations, where they were borrowing money in order to pay for medicines. This quote explores such issues. This participant explains that she is unable to continue working on account of her age and ill health. Since she had been hospitalised with high blood pressure, she has had to ask her sister's child for money.

> *'That is why I say the NHIS should help us especially the aged because the aged are not working. When I sell GH¢10 or GH¢15, the children would eat, I would also eat so it becomes difficult to save some. As I am here, I don't know how my water business is doing, I need to give the children money that is why I told you that I sought help from my sister's child and he/she came around to give me GH¢100 for drugs.**' (Participant with diabetes, hypertension and osteoarthritis. Lives in urban area).***

In contrast, some women were able to cover these expenses through their work, as the following quote illustrates.

> *'When I work small, the money get use it to buy it.' **(Participant with HIV and osteoarthritis. Lives in urban area).***

Some women describe not buying treatment as they are unable to afford it. To avoid not taking treatment altogether, they only took the treatment that was freely available under the health insurance scheme, as the following quote illustrates:

> '*The money really affects me. This was the medication I use to buy but I have stopped buying that because I can't afford that now. I told the doctor that I do not have money so when he/she prescribes that, I do not buy it. That particular drug too would help with my heart condition and the health insurance doesn't cover that medication. I buy these ones because the health insurance covers them.'* ***(Participant with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

For this woman with both heart disease and diabetes, she was able to get the drugs for her diabetes under the health insurance scheme, but was not able to get a 'particular drug' for her heart condition. This meant that she was not medicating as prescribed by the doctor. Women with diabetes frequently reported being able to get treatment easily under the national insurance scheme, as illustrated by the following quote.

> *'The diabetes we are given the medications but with the hypertension we are told some drugs are not covered. But the injection (for schizophrenia), we pay 7 Cedis every month. When am injected I shiver so a drug is prescribed for me and I go and buy.'* ***(Participant with asthma, hypertension, diabetes and schizophrenia. Lives in rural area.)***

However, even for drugs covered by the national insurance scheme, women report not always being able to get them due to medication shortages. The medication would frequently be out of stock at the pharmacy, as this quote illustrates:

> *'The medication shouldn't get out of stock or finish so that one alone wants me to be consistent so that my condition does not worsen.'* ***(Participant with HIV and asthma. Lives in rural area)***

There were several factors that influenced whether a participant decided to take treatment for a particular condition, including whether the prescription was easily obtained by the doctor, the treatment was available on their health insurance scheme, the treatment was in stock, and whether they had the financial means to purchase treatment. Therefore for women with co-occurring illnesses, the risk was that one of their conditions would be left untreated if they were unable to purchase the medication themselves, as this quote illustrates:

> *'When I came here the only thing they did for me was to give me a note that I go do a test for them to know the severity of the diabetes, but I was told nothing about the HIV, but when they read the report from the other hospital they decide to give me drugs so I can take, even that I was*

> *told they did not have the drugs so I was given prescription to go and buy from the drug store so that later I can come for the drugs, but today I have been given drugs for diabetes.'* ***(Patient with diabetes and HIV. Lives in rural area.)***

These quotes summarise the inconsistencies in the availability of free treatment. Furthermore, it highlights the inevitable financial difficulties for those who were unable to pay, particularly those who were not able to work. Some women depended on family members to purchase their medication, whereas a couple of women reported asking their pastors for help. Some women also report avoiding a particular drug altogether if they were unable to afford it. Clearly some women were unable to meet the demands of the health system with regards to their treatment.

Women were also asked by the clinicians, both doctors and nurses, to make changes to their lifestyles in order to manage their ill health. For example, there were recommendations made to restrict certain foods. This information was shared with the patients, as illustrated by the following quote:

> *'There are certain foods that we are forbidden to take like eggs and eat more green leaves in our diets like kontomire, alefie….To help get rid of the starchy foods in our system.'* ***(Participant with asthma, hypertension, diabetes and schizophrenia. Lives in rural area.)***

However the information given to the women was not limited to recommendations in food intake, but also included physical activity. Women were often recommended to do light exercises, such as walking, as illustrated by the following quote:

> *'They tell us to be careful of the food we eat, how to walk and the exercises to do.'* ***(Participant with hypertension, diabetes and osteoarthritis. Lives in urban area)***

Women understood the effect of certain types of food on their ill health, and therefore tried to incorporate changes in their diet. Women described the foods that triggered their symptoms, and what they did to try to avoid them. This participant explains how salt in her food causes her heart to beat faster:

> *'I don't have any reaction to food, but I have come to realize that whenever the food is salty my heart begins to beat faster after eating, so then I tell my children to reduce the salt the next time they are preparing my food.'* ***(Participant with hypertension, arthritis and peripheral neuropathy. Lives in peri-urban area).***

There were women, however, who were not able to incorporate changes to their diet, as they did not have a choice about what to eat. This lack of choice was related to their financial situation. Some women

felt that fruits and vegetables were quite expensive, and were only able to eat cheap foods, which were often not good for the health. This predicament is highlighted in the following quote:

> *'That is why I told you that I don't eat them every day because they are expensive. One mango costs GH¢3.00, one pawpaw cost the same, you see? They are all expensive. A little cabbage cost 3 or 2 cedis. The day you don't have money, you eat without them.'* ***(Participant with diabetes and osteoarthritis. Lives in urban area).***

This quote also suggests that some women were better off than others in terms of what food they were able to purchase. Furthermore, some women had to prioritise their need for *any* food over their need to stick to the recommended diet, as illustrated by the following quote:

> *'What I lay my hands on is what I eat. I know that God will also take care of me and nothing will happen to me. I do not reject any food. I eat any food.'* ***(Participant with HIV and TB. Lives in urban area).***

6.6.3.2 Subtheme 3.2. Keeping to appointments

The process for scheduling appointments during clinic days was the same for all women. Interestingly, most of the scheduled appointment times were set for specific clinic days, which provided care for one of their conditions. During their appointment a follow-up appointment is scheduled by the doctor. The date and time is then written down for the patient, as the following quote illustrates:

> *'They write it for me. I have a book for that and I give it to my child for keeps.'* ***(Respondent with asthma and diabetes. Lives in urban area.)***

This quote illustrates the support given by family members regarding their ill health, and visits to the doctor. This was also true for those needing financial support to travel to and from their appointment, as this quote illustrates:

> '*It worries me if I have to walk here. If my brother's son sends me money, I pick a taxi here. I also feel that I am supposed to come and see the doctor so I force to come and see the doctor once every month.'* ***(Respondent with hypertension, diabetes and osteoarthritis. Lives in urban area.)***

As discussed in the quote above, most women took public transport or taxis. Women generally preferred to take the cheaper option which was the public bus, or *tro-tro*; however some women felt they were not able to walk the distances needed to get from the bus stop to their appointment. These women preferred to take taxis. Given that they could not choose their appointment day, many women expressed the need to honour all their appointments, regardless of their situation. They were almost

fearful of missing their appointments, as illustrated by the following quote:

> *I am able to honour all my appointments. Tomorrow I am due to go and I will attend. If you do not go when it is your time, they will sack you.* ***(Respondent with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

This woman highlights a key issue surrounding the doctor-patient relationship, which was also expressed by other women; they did not have the freedom to choose their appointments. In many ways the issue regarding scheduled appointments highlighted an almost paternalistic doctor-patient relationship in which the patient was submissive towards the doctor's requests. Most women honoured their appointment times; the exception were women who suffered from severe symptoms. This woman with osteoarthritis, reports not being able to make her appointments when she has severe pains:

> *'I am able to come unless the pains are severe.'* ***(Participant with diabetes, hypertension and osteoarthritis. Lives in urban area.)***

Overall the women were very conscientious about making their appointments, and would only miss their appointments when their symptoms were severe. For some women transportation costs also placed a financial burden on them. The desperation to get to their appointments is conveyed in the following quote:

> *I plead for people to help me with transportation to come to the hospital.* ***(Participant with HIV and TB. Lives in urban area.)***

6.6.3.3 Theme 3. Summary of Findings

- There was an expressed need for the prescribed treatment to be freely available under the health insurance scheme
- Women were often able to get free treatment for one of their conditions, but not for the others and appointments were scheduled for clinics that addressed one (not all) conditions
- Patients could not predict when the prescribed treatment would be in stock at the pharmacist
- The need to purchase treatment and manage their illness placed a 'financial burden' on patients, who would often turn to family, friends and pastors for support
- Women visiting specific clinics for their chronic condition did not have a choice in the date or time of their appointment – these were arranged by the doctor
- To ensure that they made their appointments, women often depended on family members for

both organisational and financial support

- Women seemed to be very conscientious about honouring their appointments, and were concerned about getting into trouble because of a missed appointment

6.6.4 Theme 4. Outcomes due to ill health

Throughout the interviews, participants expressed how their ill health had impacted their daily lives. As they discussed their illness, it was common for them to relate their ill health to their ability to perform everyday tasks. They often recounted what changes they had encountered, from the point that they began developing symptoms to the present day. Furthermore, they discussed the impact on both their physical being, as well as the social aspects; such as their ability to work and socialise. I have described these as 'outcomes due to ill health.'

6.6.4.1 Subtheme 4.1. How able are they to continue daily life?

This particular sub-theme examines how well the participants can continue their daily life as before. The women often related their symptoms to their ability to continue activities, such as work or socialise. They also discussed the changes in their symptoms on account of taking treatment and managing their ill health. This sub-theme therefore also examines how their ability to carry out daily activities has changed since seeking healthcare.

Many women reported an improvement in their symptoms on account of seeking healthcare, and taking the prescribed treatment. Their improved symptoms encouraged them to continue taking the prescribed medication and to visit the health facility, as illustrated in this quote:

> *'When I came here, the symptoms that I use to get all stopped so I saw the need to continue to seek treatment.'* ***(Participant with HIV and osteoarthritis. Lives in urban area.)***

Some women first experienced a decline in ill health, and later an improvement in ill health due to treatment. However, they recount not being able to completely resume their daily activities, despite noting an improvement in their symptoms. This has been illustrated in the following quote:

> *'My health has changed completely from the way I use to be when I became very sick…..I am now able to walk, eat. It is only left with how I will become strong like I use to be. So I think I am quite better.' (**Participant with HIV and TB. Lives in urban area.)***

As a consequence of their ill health, some women have experienced a loss of independence.
This loss of independence extended to various aspects of their former daily lives, including

their ability to do work, as this quote illustrates:

> *'Yes it does, you know to smoke fish you need energy, but now I can't get that kind of energy... This disease has entered my bones so I can't work anymore, I would have to hire people to smoke the fish for me.* ***(Participant with diabetes, heart pain and arthritis. Lives in rural area)***

This quote also highlights their dependence on others to continue work, which also has some financial ramifications for the participant. Despite not being able to continue work herself, she finds the means to sell her fish with the help of others. In contrast to this, some women are able to continue work as before, as illustrated by the following quote:

> *'I am able to do everything, before when the condition was worse I could not do anything but now I can do all that I use to do, am able to go to the market and buy my goods to sell, which is a form of exercise.'* ***(Participant with diabetes and arthritis. Lives in a peri-urban area.)***

The idea of a 'loss of independence' is apparent for some, but not all women. For some women they continue to remain independent, and try to continue their activities as before. Some women rely on others for help for certain activities, but not for others, as illustrated by the following quote:

> *'I do, but who will do all for me if I don't do them. If I get tired, I sit and rest and call people to get/bring me things as and when I want. I have the assumption that if you sit and do nothing, the conditions would become worse. So I do my chores little by little.'* ***(Participant with diabetes and osteoarthritis. Lives in urban area).***

This participant states *'...but who will do all for me if I don't do them.'* Here she is referring to tasks such as bathing and dressing. It was unclear whether she was unwilling to ask others for help or whether she simply did not have anyone to help her in this regard. She further explains that the activity she endures whilst doing her chores will help her condition. This was also discussed by others, who tried to pursue physical activity in order to improve their health, in spite of the symptoms that they suffered.

Some women experienced a change in how much they were able to do socially. For some women, their social activities were restricted by their finances (discussed in the next section), but for others they were unable to take part in social activities on account of their ill health, as this quote illustrates:

> *'I am not able to go to church on Sundays because when you are unwell, you do not feel like going anywhere. Most programmes that I am invited to, I can't go because most of these invitations comes in at the time that I am unwell.' (****Participant with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

Some women described not being able to take up social activities on account of their dietary restrictions. This meant that they often have to miss out on social occasions and prioritise their ill health, as illustrated by the following quote:

> *'I have certain kinds of food that I am supposed to eat. If the place is too far and I go, I may not be able to eat the right type of food when it is time for me to eat.'* ***(Participant with diabetes, hypertension and osteoarthritis. Lives in urban area.)***

When asked about the limitations to their daily activities, women often attributed their limitations to the 'pain' they feel. For some women they could not relate the feeling of pain to a particular condition, but were sometimes able to locate the sensation, as illustrated by the following quote:

> *'If my heart is not paining me, I am able to do everything but when it is paining me, then I can't do anything. It would be like a year since I stopped doing household chores.'* ***(Participant with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

For some women, they felt a number of symptoms, which restricted them for continuing with their daily activities.

> *'If I walk for a while, I become very tired. When I walk on the scorching sun, I feel pains within my knees, my heart begins to pant and the cough follows afterwards.'* ***(Participant with HIV and TB. Lives in an urban area.)***

In summary, their limitations in daily activities were related to a few points. First, the extent to which treatment and management had improved symptoms for the participant. Second, the severity of the symptoms experienced. Third, both the participant's need for independence and the available support from others, taking into consideration the financial implications of both.

The next subtheme examines more closely the changes in economic circumstances (such as savings, spending) on the participant, as a result of their health needs.

6.6.4.2 Subtheme 4.2. Economic circumstances due to health needs

The majority of women experienced some financial difficulties in the face of healthcare costs. As discussed in the earlier subtheme on 'treatment', women incurred a number of costs related to their healthcare care; from diagnostic tests to medication. They did not pay a fee for service and treatment for certain conditions were free and available under the national health insurance scheme. However, at times, there were shortages in stock, which meant that women were forced to purchase medication themselves.

Some women were able to pay for their healthcare costs themselves. However these were mostly women in full time employment. The majority of women were either employed part-time or unemployed. For these women, they either had to depend on their savings or get financial support from others. Getting financial support from others was not an easy task for some women. They often felt reluctant to borrow money, as this quote illustrates:

> *'Sometimes I feel reluctant when I have to go for money from the church to go to the hospital.'* **(Participant with asthma, HIV and hypertension. Lives in rural area).**

The quote also highlights the role of the church community in supporting women, although this sentiment was not felt by all women. Only some church-going women depended on their church for financial support. Other women were adamant not to borrow money, as they did not want to be indebted to others, as illustrated by the following quote.

> *'No, if you borrow you will think a lot. How will I be able to pay back, am someone who do not borrow, I only owe God. As in human I don't owe anyone.' (**Participant with HIV and osteoarthritis. Lives in urban area.)***

In contrast to this, another participant described borrowing sums of money from a work colleague, and was indebted to a number of people, in order to pay for her treatment:

> '*Now I don't even have a Pesewa. My money is all gone….that is the exact thing. The last time I took GH¢200.00 from a woman here to buy some wares and trade with. That was the period that I was admitted so I have to use that money as part payment for my treatment. I am owing a lot of people as we speak now.' **(Participant with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

One participant describes counselling others with her condition as a way to earn income, and pay off her debt. This situation was not commonly described amongst participants, however. Unfortunately she could not continue supporting others because of her high blood pressure. Her situation shows how supporting others can have a positive effect for the individual, more than just the enjoyment out of helping others.

> *'Formally when I was in business, I went for a loan and was paying it in instalments but during the process I couldn't work any longer to pay so they introduced me to some ambassadors of Sexually Transmitted Infections I was introduced and I was appointed as an ambassador to counsel and help seek support for people in that same condition so within that process, and I was earning some income out of that so I used some of the money in paying off my debt but the contract ended and I couldn't get money anymore to sustain me so now am not working and because of my high blood*

> *pressure I wouldn't want to go for another loan.'* ***(Participant with asthma and HIV. Lives in rural area).***

The majority of women depended on close family members for financial support. This would often be their husband, children, nieces or nephews; as shown by the following quote:

> *'There was a time that a medication was prescribed for me and that costs GH¢150.00. It was my sister's child who gave me money to purchase that medicine.'* ***(Participant with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

The need for money was expressed as a cause of 'stress' for many women. When discussing their financial problems, it was apparent that this was a cause of stress. Many women showed emotion during the interview when discussing their financial situation. A few women broke down in tears. The next quote highlights the sheer desperation felt by some women concerning the need to cover their healthcare costs. Unlike other women, this participant was unable to depend on her husband for finances as he recently lost his job.

> *'The thinking, how to be cured, if I feel, at times, actually when I don't have money and I know the medication is almost finished, then I become too much stressed on where to get money... I manage things with my husband but right now he is also in a fixed position, he is not working, he has been retrenched for some time now so the responsibility lies solely on me, so at times I think of that too and that also gives me stress.'* ***(Participant with diabetes, hypertension, glaucoma and lumbar spondylitis. Lives in peri-urban area).***

In contrast to the others, one woman described her very vulnerable financial situation, which not only meant that they struggled with healthcare costs, but that they could not even buy the basic necessities, such as food. She also did not receive much financial support from her family.

> '*..as for that one my child, eating is even difficult for us. …The time that I am supposed to eat, I don't get food to eat…. It is only the boys who support me a little. It is almost one year since I got paralyzed and none of them have called on phone to find out how I am doing. If I don't call them, then I would not hear from them. They are all into businesses but they do not mind me, let alone to support me financially.'* ***(Participant with HIV and TB. Lives in urban area.)***

It was evident that many women felt pressured to keep up with their treatment regimes, and purchase the prescribed medication. This put them under a lot of stress if they could not afford to keep up with the healthcare requirements. The next quote highlights this fact.

> '*When he came back again, we have not purchased the medications neither have I done the test because there was no money at that time. He told me that since I have not bought the drugs, he*

*not a magician to know what is happening to me.' (**Participant with diabetes, heart disease and musculoskeletal pain. Lives in urban area.)***

As illustrated above, the participant was not able to take the diagnostic test or buy the drugs. On her next appointment, she was given a pointed remark by the clinician, stating that he was unable to diagnose her without the necessary tests. On the one hand this highlights the lack of empathy for her financial situation, whilst on the other hand it shows the potential time wasting that takes place within medical facilities in the absence of free health care.

The financial burden placed on women as a result of their ill health has also limited their ability to continue their daily-life, as before they were ill. Many women describe the impact this has had on their social lives, as illustrated by the following quote.

*'my movement has become difficult because when I am going to church now I need to pick a taxi which is very expensive so I am not able to go to places I would have love to go.' **(Participant with diabetes, hypertension and arthritis. Lives in peri-urban area).***

As described above, this woman is unable to take public transport because of her restrictions in movement. She has no other choice but to take a taxi, but even then, she is unable to afford it. This conveys the lack of choice women face on account of their ill health and its financial implications. This particular participant describes going to church, but the same restrictions are also felt by women of other cultural backgrounds, as conveyed by the following quote from a Muslim woman:

'*Formerly, I take taxi to the mosque on Fridays but because of my finances, I stopped going to the mosque.' **(Participant with diabetes, hypertension and osteoarthritis. Lives in urban area).***

6.6.4.3 Theme 4. Summary of findings

- Some women experienced improved symptoms on account of seeking healthcare and taking the prescribed treatment. This may have been the case for one but not all of their conditions
- As a result of their ill health, some women felt a loss of independence and, in some cases, this resulted in an increased dependency on others
- Limitations in their daily activities was commonly attributed to the 'pain' they experienced. Therefore morbidities that resulted in pain e.g. chronic arthritis contributed more to their limitation, over and above other conditions
- All women experienced a financial burden as a result of their healthcare needs

- There was a reliance on financial support from several sources, including family, church and friends
- Some women expressed not being able to keep up with the financial demands of the healthcare system

6.7 Discussion

6.7.1 Ghana

The country of Ghana is situated in western Africa and is home to approximately 26.44 million people, according to the latest estimates. Ghana, whose political leadership is based on democratic governance, is classified as a middle-income country according to the World Bank [9]. The literacy rate in Ghana is approximately 72%. Of the total population, approximately 67% of the total population speak English [10]. Twi is the principle native language spoken over the majority of the south of Ghana – over 58% of the population speak Twi. The country has witnessed a number of improved health outcomes, particularly within the areas of focus on the Millennium Development Goals (MDGs); notably in maternal and child health. Like many other African countries, Ghana is afflicted with the double burden of both chronicand infectious diseases. Furthermore, the leading major causes of death have shifted from communicable to chronic non-communicable diseases (NCDs). Ghana's National Health Insurance Scheme (NHIS) was introduced in 2004, with the aim of achieving universal health coverage. The NHIS replaced the earlier cash and carry system, which had a negative impact on the access of health care, particularly for the poor. The government enacted the National Health Insurance Act (Act 650), predating the start of the NHIS in 2004. By the end of 2011, 33% of the Ghanaian population had been covered by the scheme. As a function of the scheme, beneficiaries are given cards that enable them to receive treatment in any hospital in the country, including access to outpatient services, inpatient services, oral health, maternal care and emergencies. A recent assessment showed that approximately 73% of households, whose members were insured under the NHIS, have their chronic disease healthcare covered. Despite the move towards universal health coverage, however, the NHIS excludes a number of health services that deal with chronic disease, including detection and treatment of cardiovascular diseases and some cancers. In response to the growing burden of NCDs researchers have urged: a more rapid response; for health services to be strengthened, and; the development of guidelines relating to chronic disease management [13].

6.7.2 Strengths and Limitations

The experiences of women living with multimorbidity is under-studied, particularly amongst women residing in LMICs. This qualitative study was therefore a useful opportunity to explore the experiences of women in Ghana, a middle income country in West Africa. The sampling methods considered both their type of residence and their level of education. There were, however, some limitations in how well the stratified purposive sampling strategy was achieved. The initial sampling strategy attempted to recruit, in equal measure, women from both higher education relative to their context (secondary school education and above), and lower education (less than secondary school education). However, few women were of the higher education category. Furthermore, few women resided in rural areas, and therefore it was not possible to have equal strata of urban, peri-urban and rural. Despite this, the attempts to ensure maximum variation in sampling were made by recruiting across several clinics within the recruitment sites, and by using a relatively wide age range. In total 20 women were interviewed, and the main objectives of the research study were realised. Furthermore, a fair degree of both breadth and depth was attained by using the semi-structured interview approach; several key themes emerged, whilst at the same time, there was variety in detail. The extent to which these results are generalisable to the national popuation is limited, however, as no men were sampled and interviewed. Furthermore, generalisability to other MICs may also be limited by the social, cultural and economic context specific to Ghana; notably, for example, the influence of the national health insurance schemef.

6.7.3 Discussion of main findings

Overall there were four themes emerging from the dataset. The first theme explored the context in which the women experienced in health, ranging from influences related to the individual, such as their emotions; to their environment, such as their interaction with the community. The second theme explored why women chose to seek healthcare and, after seeking healthcare, how well the healthcare system satisfied their needs and freedom to choose. The third theme explored the work women had to do to manage their disease as a result of their ill health; for example, their treatment and diet. Finally, the fourth theme looked at the outcomes of their ill health and their ability to continue with daily life, encompassing a variety of factors; including social factors, such as their ability to socialise, and economic factors, such as their ability to work and support themselves financially. These themes have some similarites and contrasts with other qualitative studies conducted in HICs. These have been referred to throughout the discussion.

There were several interesting findings, which have been discussed here. The first theme examined the influences related to the self and to events or people in the environment. An interesting finding was the lack of dissonance in these influences, between those in urban areas or rural areas; and those of lower education or higher education. The sole exception were those who experienced stigmitisation as a result of their morbidities, notably HIV. For these women, their community and environment seemed to have a powerful effect on their health experience and their decision-making. For example, a couple of women reported moving homes to avoid stigmitisation, and experienced both a lack and loss of support from their community. Both environment and community play a critical role in the stigmitisation process. As specified in their conceptual model, Holzemer and colleagues describe a stigmitisation process that is dependent upon 'agent' (such as people, workplace and community), 'healthcare system' and 'environment' (such as culture, economics and politics) [226]. Stigmitisation of HIV is a known phenomenon in Ghana, and encompasses the three domains described in this model [227]. These findings undoubtely emphasise the complexity of disease burden which, for some, is mired by social perceptions and behaviours. It was uniquely apparent that those who experienced stigmitisation were more vulnerable to such social barriers, which influenced their health experience. For them, a greater emphasis was placed on their stigmitising condition over and above their other comorbidities.

Within the study literature, there exists a discourse on the role of 'healer shopping' in Ghana. The term healer shopping relates to the use of a second healer, without the endorsement of a biomedically trained clinician [228]. The phenomenon of healer shopping is attributed to the spiritual belief-systems that underlie the health narrative, specifically illness causation[229]. Despite these influences, women were motivated to seek proper biomedical healthcare. This is consistent with the literature, which suggests that most partipants seek biomedical care in the first instance. The decision to seek biomedical care is related to the public legimitisation of heath causes, which supersedes the lesser causation models offered by spiritual healers [230]. There were, however, few women who attributed their ill health to spiritual causes despite the health education they received at the clinic. Such findings highlight the nature of belief, and its influence on women. Although the majority of women did not seek help from spiritual healers, spirituality still seemed to influence their health experiences. For the minority, spirituality was important for sensemaking, or giving meaning to their experience. For the majority, however, spirituality gave them a sense of hope and courage in the face of their illness experience. The latter was most often understood through references to 'God' and having 'faith in God, ' which was akin to women of both major religions, Christianity and Islam. The role of spirituality and increased resilience was also understood to be a common response for patient's with multimorbidity, in a study conducted in the USA [188]. Overall, both stigmitisation and spirituality are shown to play a significant role in influencing the health experience. Argueably both relate to an individuals psychological, and

social, capacity which relate to their overall complexity (see figure 7.1). In this respect, the cumulative complexity model should ascribe more value into the underlieing mechanisms that influence an individual's capacity; extending to their interactions with their community, and the event or people around them.

The second theme explored women's reasons for going to the healthcare facility; and how the healthcare provided responds to, or satisfies, the needs and choice of the patients. For women living in both urban and rural areas, discussion of symptoms with the family was an important trigger to health seeking. Such findings are consistent with the literature carried out in the UK [231, 232]. A further factor that influenced women to visit a healthcare facility was the severity of their symptoms; specifically how they perceived their symptoms and its severity. In a recent study by Danso-Appiah et al., perceived symptoms was evidenced as the most important determinant in seeking healthcare in Ghana [233]. Although women expressed general satisfaction with the healthcare services, there was a common perception that the service they received was not always timely and that they were, on occasion, treated with an 'abrupt manner.' The latter relates to the engagement of quality interpersonal relations, which is considered to be an intrinsic factor to patient-centred care [234]. Women also felt that they lacked choice in the care that they were given and that they did not receive the required care or treatment for all their conditions. With such a reality, one might expect the lack of choice to engender a sense of powerlessness for women with multimorbidity; however women seemed to be accepting of their role within the doctor-patient relationship. These findings lead us to question the extent to which patient-centredness, expressed as the how well the clinician responds to the patients needs and preferences, is priortised for women. Although not explored in much detail here, this is an interesting topic for futher research. Further to the lack of patient-centredness, patients were not always treated holistically. Holism is defined as 'an approach to the study of the individual in totality, rather than as an aggregate of separate physiologic, psychologic, and social characteristics[235] .' For the majority of women, the focus was on individual disease management, which included the prescription of drugs, information about their illness and the scheduling of a follow-up appointment; for only one of their conditions. The focus on individual disease management rather than a holistic approach is common across health systems in HICs, and is understood to be related to the expansion of specialised services [192] [236]. On the one hand individual disease management promotes efficiency and continuity of care, on the other hand it results in the neglect of other comorbidities not under management. Despite meeting the clinician to treat one of their conditions and its associated symptoms, women frequently reported their others symptoms, related to other conditions. In relation to the cumulative complexity model, the patient's workload may be skewed towards a particular condition which, in turn, results in further limitations of the neglected condition(s) and the patient's capacity. Therefore, to attain a

balance between patient's workload and capacity, the healthcare system should respond to, and address, the needs of all symptoms and diseases within an individual.

The third theme explored how women managed the demands placed on them by the healthcare system. There were several interesting points that emerged from this theme. Firstly, there were inconsistencies on the provision and accessibility of treatment under the national health insurance scheme. Some women reported accessing free treatment easily; some reported not being able to get treatment without paying; and some reported treatment shortages, which meant that they were unable to access treatment which would otherwise be freely available. In Ghana, treatment for some chronic diseases are covered under the national health insurance scheme, whereas others have been excluded from coverage. HIV antiviral drugs, for example, are excluded from the national health insurance scheme but are heavily subsidised by the national AIDS program [237]. It was evident that women did not clearly understand which treatments were available to them and which were not. Furthermore it was common for women to pay out of pocket payments, even whilst under the insurance scheme. One woman admitted to avoiding the renewal of her national insurance scheme as it did not cover her HIV treatment anyway. Clearly lack of coverage for some treatment was a deterrent to being insured. The issues faced through lack of coverage resulted in a complex scenario for women with multimorbidity. Overall, for such women, an apparent risk was that one of their conditions would be left untreated if they were unable to purchase the medication themselves.

As emphasised earlier in the discussion, women lacked choice in their healthcare, and were also unable to choose their appointment times. As a result of this, they had to fit their other responsibilities around appointment times. Many women were self-employed and belonged to the informal sector, such as street trading: they were more likely to express an ability to make these appointments. In contrast, those who were more likely to be of higher education and employed within the formal sectors, such as at school teachers or clerical staff, expressed the difficulty they experienced in getting to their appointments. This resulted in an increase in their 'workload' which, for women with limited capacity, presented key challenges. Despite this, all women expressed a need to honour their appointment times and, at times, appeared to be almost fearful of what would happen if they did not. These findings reinforce the idea that the health system procedures are bereft of 'patient-centredness,' and heavily skewed towards the needs and demands of the clinicians.

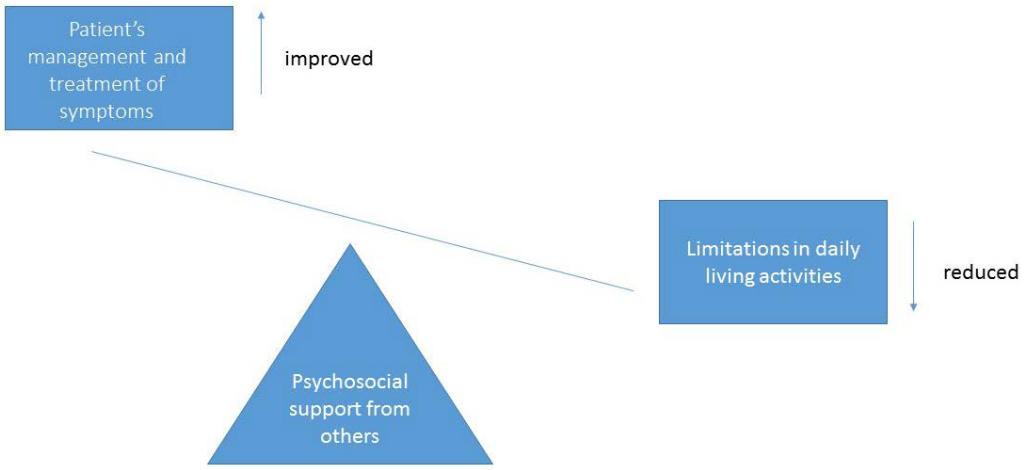
Throughout the interviews, participants expressed how their ill health had impacted their daily lives. This is explored in theme 4. Overall, women were unable to socialise as before. Social loss, in addition to physical loss, has been previously noted as an outcome for individuals with multimorbidity [238]. Such social loss relates to the inability to engage in social activities due to the limitations of their health experience. With regards to getting to their appointments, the majority of women depended on

close family members, friends and church members for organisational support. All women experienced a financial burden as a result of their ill health, and this was a recurent point throughout most interviews. Some women were able to offset their financial burden through employment, and others had financial support from lenders, family, friends and community members. The majority, however, experienced a financial burden that pushed them further into difficulty, and exacerbated their psychosocial burden. Psychosocial refers to both the psychological effects, such as on mental health, belief and values; as well as the social effects, such as financial resource, family support, ability to work and socialise. This finding is consistent with other studies, which examined the effect of financial burden of chronic disease. One review points to diminished family support as a possible outcome of chronic disease [239]. Contrary to this finding, however, family support seemed to be paramount, at least for women with close relations to family members. There were some exceptions, such as women who were either estranged from family and preferred not to depend on them for support; as well as women who were widowed with small children. For the latter, it was common for them to depend on their church community, and gain financial support from their local pastors. This was, however, only an option for some church-going women. Others also depended on friends, or took loans from lenders. Women all expressed the need to take care of their health; they tried to find the means with which they could match the demands placed on them by the healthcare system. The psychosocial effect of this financial burden, as well as the biomedical effects of their ill health, was evident. They were often stressed about meeting the financial demands, and worried about being struck off by the clinicians if they did not meet their healthcare demands. The underlieing financial burden is therefore hugely influential on and individual's capacity to manage their ill health. As described in the cumulative complexity model, an individual's capacity is dependent on the amount, controllability and extensiveness of their financial ability[202]. This, in turn, influences their access, utilisation and ability to self-care which, in turn, influences their health outcomes. The ability to finance their health needs is therefore an integral part of the cumulative complexity model.

Some women described improved symptoms on account of the management and treatment of their health. Others recall experiencing some improvements to their symptoms, but were still unable to resume their daily activities as before. Interestingly, preserved autonomy or 'independence' were noted as an important factor for women, which is consistent with findings in other studies on multimorbidity [240]. Limitations in their daily activities were often described in relation to their symptoms. Those who were able to manage and treat their symptoms, through consistent use of healthcare and treatment, were able to reduce their symptom burden which, in turn, affected their ability to continue daily life as before. Their ability to manage their disease was also influenced by a variety of social factors, notably financial and emotional support from friends, family and community members. Overall this can be

conceptualised as a see-saw between an individual's ability to manage and treat their symptoms and the limitations in their daily activities. Improvements in the management of treatment and symptoms of their diseases help to reduce their limitations in daily activities. Conversely, failure to manage their symptoms results in increased limitations in their daily activities. Meanwhile, support from others is a critical external factor that helps optimise the relationship between optimum management and limitations in daily activities (see Figure 6.7). The ability to manage treatment and symptoms was often not the same for all of their conditions, which meant that the women were limited by the symptoms of one condition over the other(s). Pain was often described as the most difficult symptom, which is consistent with other study findings on multimorbidity [238]. Therefore morbidities that resulted in pain (e.g. chronic arthritis), when not managed were more limiting than their conditions, which were either currently being managed or resulted in milder symptoms.

Figure



6-7. Conceptualising outcomes of multimorbidity.

The outcomes of multimorbidity can be visualised as a see-saw between the patient's management and treatment of symptoms, and their limitations in daily activities; which is dependent on the psychosocial support received from others.

The cumulative model sets out the central mechanism that drives patient complexity as the balance between 'patient workload' and 'patient capacity.' The original model proposed by Shippee and colleagues described the resources and limitations affecting patients' ability or readiness to do work; and set out physical/mental functioning, pain, symptoms, fatigue, finances etc. as examples of patient

capacity. My adaption argues that patient capacity can be exemplified through the discrete domains of biomedical, social and psychological capacity. The findings from this study suggest that both psychological domains (belief, values) as well as social (family support and finances) are integral to patient's experiences of multimorbidity, and have an influence on both 'workload', an example is the organisational support from family to make appointments; as well as 'capacity', an example is the financial and psychological support offered from members of the church community. Psychosocial support, referring to both psychological and social domains, is essential for the relationship between patient workload and patient capacity. Future iterations of the cumulative complexity model, particularly for application in MICs, should therefore seek to examine in greater detail the psychosocial mechanisms that influence both the capacity and workload of patients with multimorbidity.

As discussed here, there were a few notable findings of this study, in terms of understanding the impact of having multiple diseases versus a single disease. Firstly, women felt that the health system did respond to their entire needs, with a focus on one condition than the other(s). Secondly, given the lack of full coverage, there was a high risk that (at least) one of their conditions would be left untreated if they were unable to purchase the medication themselves, thereby adding to their financial burden and, in turn, reducing their individual capacity. The focus on one condition was further exacerbated by the organisation of their healthcare which routinely scheduled visits for specific clinics (e.g. diabetes, HIV, mental health); during which time care for their other conditions was often neglected. Thirdly, 'pain' was commonly described as the symptom the most difficult symptom which, if left untreated, meant that pain-causing illnesses were often more disruptive to their activities of daily living. Similarly, stigmatising conditions caused huge disruptions to quality of life and, for some, caused them to make life-changing decisions. In order to explore these discussion points, future studies may consider sampling (i) patients with multimorbidity, as well as (ii) patients with single morbidities; in order to compare and contrast these differences further.

6.7.4 Reflexivity and the influence of the main researcher

Reflexivity refers to acknowledging the role of the researchers in actively co-constructing the situation which they want to study [209]. Throughout the research process I critically reflected on how my perspective may have influenced the research [208]. These reflexive notes were written as field notes; and the main points are summarised here.

Prior to conducting the field research, I had little or no knowledge of the culture and environment of study; having spent only a limited time in Ghana. I therefore had very little prior expectations and preconceptions of the culture, and therefore little influence within this regard. On the other hand, it became apparent during the research that some locals had negative perceptions about foreigners, particularly westerners. It is not within the scope of this study to explore these perceptions in detail. However, any perception, good or bad, acts to influence the relationship between the researcher and that which is being researched. To counteract any perceptions that existed prior to conducting the research, I ensured that I shared all the information necessary so that the participants could make a neutral and objective decision about the research. Furthermore, I worked with native speakers to ensure that all information about the study could be shared, understood and realised. To appease the local customs and etiquette, I made extra effort to treat others in a manner that they were used to, such as addressing them in the correct way. It was also important to uphold universal principles in research, such as neutrality. For example, on a couple of occasions one of the research assistants physically comforted the participant. This sort of approach may have been considered appropriate by the local customs, but I restrained from being doing so, as it did not seem appropriate within my framework of practice. The field notes, with reflexive comments, can be found as Appendix M.

6.8 Conclusion

As the first qualitative study on multimorbidity in Ghana, this study provides an invaluable insight into the experiences of women living with multimorbidity in the Greater Accra region. These findings may have help shape the future of multimorbidity research, health service organisation, or policy-making in Ghana and elsewhere. However, any future changes will also have financial implications, which poses a major challenge for health systems in MICs that may already be resource constrained. Nevertheless, the results of this study here will be shared with the respective organisations concerned, including key collaborators in Ghana, such as the School of Public Health and the Ministry of Health in the Greater Accra region.

This study suggests that women with multimorbidity are motivated to seek biomedical care regardless of their location and, consistent with other studies, that family act as an important trigger to their health-care seeking behaviour. Events or people in the environment have a powerful influence on women who experience stigmatisation as a result of their disease; such women placed greater emphasis on their stigmatising disease over and above their other comorbid conditions. Individual disease management has led to the proper management and treatment of individual disease, although this has been at the expense of a more holistic approach to care. The limited and inconsistent coverage of

chronic disease treatment under the national health insurance scheme may be a barrier to achieving holistic care, and is also placing a considerable financial burden on women and their families. Patient-centred care does not seem to be a priority for women, whilst the clinician-patient relationship seems to be skewed towards the demands of the clinician, particularly with regards to the scheduling of appointments. Consistent with other studies, women with multimorbidity experienced social loss due to their ill health, due to both their lack of finances and their symptoms – the most common of which was 'pain.' Finally, the availability of psychological and social support is essential for the treatment and management of their disease burden, and reducing the limitations in their daily activities. Without a robust welfare system to support those with ill health, the role of family and community is therefore critical, particularly in offsetting the financial burden of their health needs.

Chapter 7: Discussion and Conclusion

Using a mixed methods approach, the aims of this thesis were to explore the determinants (social, economic and behavioural), prevalence and impact of multimorbidity in MICs. There were several key findings, which have been summarised here. First, multimorbidity was significantly associated with age, female sex, behavioural risk (obesity, hypertension) and health care utilisation in MICs. Although health care utilisation is partly due to ascertainment, as the associations are based on doctor diagnosed conditions, it is likely that the presence of multimorbidity contributes a significant burden on the healthcare system; particularly for the elderly population. Second, multimorbidity is not only a problem in HICs, there was evidence of high multimorbidity prevalence even in LMICs. Third, although there were inconsistent patterns of wealth, with no obvious gradient, education was consistently protective across the studies. Fourth, the effect of urban living varied from country to country. In China, the effect of urban living on multimorbidity was higher than in Ghana, India, Russia and South Africa. In all countries, however, the urban population were wealthier, more educated and slightly younger. Fifth, some combination of diseases were more disabling than others; it was not simply the number of morbidities that affect disability, but the nature of the morbidities included in the count. Sixth, multimorbidity presented a huge burden for patients living with multimorbidity in the Greater Accra region in Ghana. The qualitative findings showed that women had inconsistent insurance coverage for all of their conditions, and therefore were at high risk of having at least one of their conditions untreated if they were unable to purchase the medication themselves, thereby adding to their financial burden and, in turn, reducing their individual capacity. Overall this research has implications for policymakers and health service planners in MICs facing an increasingly multimorbid population. The evidence suggests that there is a need for improvements to holistic care, better disease coverage, social support and patient-focused care. Furthermore, investments in primary prevention may address changes in risk factors, subsequent to urbanisation and other associated changes, which may be predisposing individuals to chronic disease. Overall, a focus on prevention and public health will help to improve the sustainability of the healthcare system and improve economic prosperity. In the UK – a HIC, for instance, there has been a recent call for a '*radical upgrade in prevention and public health*' with a particular focus on preventing the exposure to risk factors for chronic disease; and reducing the burden on the healthcare system [241]. Further suggestions include a need to address the balance between an individual's right to choose an unhealthy lifestyle, such as smoking, and the impact that such behaviour on wider society.

The premise of this study is founded in the observation that: MICs are undergoing rapid development, urbanisation and, as a consequence of improved survivorship and declining fertility, facing a rapidly ageing population. Evidence suggest that in LMICs, the growth rate of the elderly population will remain significantly higher than in most HICs for decades to come. The multimorbidity issue is known to be characteristic of an elderly population. Estimates of age-standardised multimorbidity prevalence (number of conditions, n=6 using WHS) ranged from 1.7% in Myanmar (a LIC) to 15.0% in Brazil (a MIC). By contrast, age-standardised multimorbidity prevalence in MICs only (n=7 using SAGE) ranged from 1.4% in Ghana and 10.7% in Russia. Overall there were wide differences in multimorbidity prevalence. There was a notable trend observed using the WHS: multimorbidity prevalence was positively associated with country GDP. There was however a non-linear relationship; countries such as Spain and England were outliers, with low multimorbidity relative to GDP. However, it is also important to note the limitations in that few HICs were available for analyses – as they did not fill out the long version questionnaire related to chronic disease.

Consistent with other studies, particularly in HICs, multimorbidity was significantly associated with age. This relationship was found across all studies. Furthermore, there were notable differences in the occurrence of multimorbidity. In Brazil and South Africa, both MICs, the prevalence of multimorbidity was 21.4% and 21.6% respectively, amongst those aged 50-64; compared to the Czech Republic and Spain, both HICs; where the prevalence was 11.6% and 15.3%, respectively. These findings suggest that multimorbidity may be occurring earlier in adulthood in MICs, and at a higher prevalence than HICs. Previous studies in MICs have also confirmed an earlier onset of multimorbidity: a study in Indonesia, also a MIC, reported a third of adults over 40 years having multimorbidity [71].

Parallel to this there were several notable associations in the quantitative studies. First, the evidence suggested that multimorbidity was associated with the female gender in Chapters 2 and 3, and 4. In the multivariable analysis in Chapter 4, multimorbidity was significantly associated with the female sex whilst adjusting for other possible confounders including healthcare use; with the exception of India where multimorbidity was associated with the male sex. The association of the female gender with morbidity is commonly found, and partly attributed to a higher use of health services amongst the female population due to access during pregnancy and childbirth. However, studies also suggest these gender differences are not only due to health seeking behaviour but due to other behavioural, psychosocial factors and hormonal changes that occur at older ages. Previous studies also suggest that the cardiovascular disease cluster is more common among females than males. Angina and stroke, both cardiovascular diseases, were both included in the count here (two out of seven conditions) whilst diabetes is a known risk factor for CVD. The association or causality of this gender gap, however, were not addressed in this thesis; but may be an area for further research. At the population level this gender gap may have implications for communities where women have responsibilities as the primary care

giver, and the impact of multimorbidity will affect the wider family unit. Given the higher prevalence of multimorbidity within the female population, there was a rationale for sampling women in the qualitative study (chapter 6). However, it is also important to note that the choice to sample women in the Greater Accra region was also based on feasibility – as it may have been difficult to recruit men from clinics during the recruitment period. Second, the association with obesity and hypertension (both based on anthropometric measures, rather than self-report) point to some differences between countries which, overall, suggests that there are varying levels of risk (exposure) for the MICs included here. Reported in Chapter 4, obesity was statistically associated with an increased risk of multimorbidity in China, Russia and South Africa; even after controlling for other risk factors including healthcare use. By contrast hypertension was statistically associated with an increased risk of multimorbidity in Russia only, after controlling for other confounders. Third, the analysis of urban –rural differences found obesity to be higher in the urban populations of both Ghana and India, which suggests that risk factor profiles may differ between the urban and rural environment. In general, the urban population were wealthier, more educated and slightly younger. The effect of urban living on multimorbidity however was not apparent, except for in China; where there was a statistically significant association. Fourth, the association of multimorbidity with health care utilisation and, in particular - the use of tertiary care, was consistently shown across the MICs used in chapter 4. These findings have implications for healthcare systems in MICs. For example, health system planners and policy makers need to prepare for the cost implications of a multimorbid population, and an increased burden on the healthcare system. Fifth, education had a protective effect across all studies (chapters 2, 3 and, 4). In most articles included in the literature review in chapter 2, multimorbidity was associated with no education, or low education, even when adjusted for other covariates such as age and sex. In the analysis of the WHS (chapter 3), additional years of education was protective, even after adjustment. There was further evidence of a generational difference in the education gradient between those younger than 55; and those aged 55 and older. Education may also have moderated the effect of urban living on multimorbidity. In the study using the SAGE (chapter 4), there was evidence of an interaction between wealth and education in China and South Africa. Finally, despite there being known associations between multimorbidity and wealth in chapter 2, the associations between multimorbidity and wealth were less pronounced using the SAGE (chapter 4), and suggest that there is a flattened wealth gradient. A flattened wealth gradient could also be indicative of a possible 'transition' in social patterning; where previously there was a health penalty for the rich, those from lower SES are increasing their chronic disease risk through changed patterns of behaviour, as their countries develop. In order to capture further evidence of such a transition, longitudinal studies are needed to examine the clustering of risk factors, particularly SES,

over the life-course and how these may impact on the progression and development of chronic conditions, leading to multimorbidity.

The study into the effect of multimorbidity on disability (chapter 5) also provided evidence to suggest that some disease combinations are more disabling than others. The impact of multimorbidity on the functional ability of the individual (measured through the WHODAS) was dependent upon the type of conditions included in the multimorbidity count; as well as the ages considered. The comorbidity 'arthritis- stroke' seemed to be the most disabling; even after controlling for known confounders. The recent GBD study found that the increase in disability adjusted life years globally may be attributed to diseases in which large scale prevention is not yet widely effective. These findings suggest that to reduce DALYs, more work is needed to address the cause and prevention of disabling conditions; for example earlier detection and management of hypertension could lead to the prevention of stroke. Further research is needed to understand the risk factors that lead to disabling conditions, such as osteoarthritis.

The final qualitative study provided evidence of the 'nature' of multimorbidity for women living in Ghana. Overall these women felt that there was an imbalance in their care needs, with a focus on one condition than the other. Furthermore there was a lack of full coverage for their conditions, which meant that they often had to pay out of pocket and depend on their social support network for financial support. The healthcare providers routinely organised their appointment: these were mostly to care for specific conditions, not other presenting ailments or symptoms. This finding is consistent with trends in other Sub-Saharan countries, such as South Africa, where disease-specific clinics in primary care have been established for chronic disease [242]. Such clinics, however, do not address the complexity of multimorbidity – nor integrate care for complex patients.

Events or people in the environment had a profound effect on women, particularly for those who had a stigmatising condition. Women tended to experience a social loss due to their ill health, as a result of financial problems and specific symptoms. Pain was considered to be the biggest contributor to social loss, and lack of independence. These findings highlight the need for support (both treatment and care) for illnesses that cause pain, rather than those that cause milder symptoms. According to the recent 2015 estimates from the GBD study, lower back pain and neck pain were the leading cause of disability in most countries globally. These qualitative findings are therefore consistent with these observations. Furthermore, the GBD study note that NCDs accounted for 18 of the leading 20 causes of age-standardised years lived with disability (YLD), globally [243]. The participants recruited into the qualitative study commonly had diabetes and osteoarthritis, which are ranked as the 6th and 13th leading cause of YLDs respectively.

In the qualitative study, there was evidence to suggest that, despite the presence of traditional beliefs, women tended to seek biomedical care if their symptoms persisted. Overall the study pointed for a need to attain holistic patient-centred care, better disease coverage, and improved social support for women with multimorbidity. The use of the 'cumulative complexity model' as a conceptual model made light of a few points, related to its applicability to a study population in Ghana. Notably, the influence of both psychological and social demains were integral to women's experiences. Both domains had a profound influence on their workload and capacity. Based on these findings, future iterations of the cumulative complexity model should specifically address the psychosocial mechanisms that influence both the capacity and workload within similar study populations. The role of family and community are plausibly linked to the lack of wider social welfare support. The quantitative findings in chapter 5 suggested that wealthier individuals may have a distinct advantage – as they consistently had lower levels of disability relative to the rest of the population. The lack of social welfare coverage, including access to facilities and care support (such as home nursing, physiotherapy and income support), remains a major challenge for MICs, where spending capacity is already stretched. In light of these findings MICs may benefit from an integrated system for health and social care which would minimise disruption, improve coordination and efficiency. Such an integrated system does not even exist within many HICs. Therefore policymakers in MICs should avoid the simple replication of what has been done in developed countries, but seek to develop a more novel, efficient approach to health and social care that responds directly to the needs of a multimorbid population.

Health systems that employ chronic care management are associated with low costs, better outcomes and higher patient satisfaction [244]. However, there is continued debate around what consititutes optimum health service delivery for complex multimorbid patients. The innovative care for chronic conditions (ICCC) framework, for instance, does not fully incorporate the known complexity associated with multimorbidity [245]. The focus of the model is around care for individual chronic conditions; however, there is evidence to suggest that coordination of care for patients with complex needs and long-term illness is poor. Recent iterations of the ICCC model has suggested incorporating patients perspectives in to the care of complex patients; as well as understanding coping mechanisms, patient choice and prioritisation. As shown in the studies here, the type of condition experienced will determine the patients experience, disability and their choices; in terms of their interaction with the health care system. The King's Fund propose several key components to better care coordination of patients with complex needs [246]. This includes a focus on immediate care, case management and support to home-based care; and the development of community based multi-professional teams. In HICs, there are several examples of how coordinated care can be succesfully delivered through the integration of both health and social care; although such examples are mostly taking place at the local

level, and not the regional or national level. Successful models have incorporated intermediate care services, such as the appointment of health and social care coordinators; worked closely with the voluntary sector; and integrated the acute sector. In the UK, for instance, there is evidence to suggest that by bringing care closer to home, and investing in intermediate care servvices, the use of hospital beds and emergency hospital admissions can be reduced [247]. In countries such as Ghana, where there is strong social cohesion within the community, establishing community based teams may be an effective way to improve care coordination for complex patients. In South Africa, for instance, community adherence clubs are part of a decentralised model of care which brings delivery of Anti-Retroviral Therapy to some parts of South Africa, and provides appropriate support to the community. Such care models may be appropriate in countries such as Ghana; not only can community clubs help adherence to treatment, but they can also encourage social support within the community by creating a forum for patients to interact with each other.

The prevalence and impact of multimorbidity in MICs is relatively understudied despite growing recognition of its importance. Qualitative methods, in particular, are rarely used in MICs. Therefore, the study exploring the experiences of women living with multimorbidity was novel in its content and its approach. As the conditions included in the quantitative studies are based on doctor diagnosed conditions, and participants in the qualitative study were recruited through clinics, these findings are almost certainly influenced by the role of health system access and utilisation. In light of this, the undereporting of symptoms and undiagnosed conditions within the community should not be overlooked, particularly in countries where health care access may be limited. In Ghana, for instance, secondary and tertiary care hospitals are more dominant in urbanised areas, which make access to healthcare facilities, and access to registrations offices for healthcare insurance, more challenging. For MICs undergoing rapid development, such as Ghana, short term investments should seek to strengthen the healthcare system through (i) the optimal configuration of the health and social care system; (ii) an increased role of primary care; (iii) improving access to specialised services in underserved populations, such as rural areas; and (iv) better coordination of chronic disease care within the community[248]. Such investments would address the issue of under-reporting by increasing healthcare access, particularly for chronic conditions; and increasing the chance of obtaining a correct diagnosis. A barrier to achieving these aims may result from the lack of retention and recruitment of trained staff into underserved populations. A recent study in Ghana suggests, however, that such limitations can be mitigated through improved infrastructure and equipment, increased supportive management for staff, free basic housing and increased salary [249].

Overall this mixed methods study here had several notable strengths. Firstly the issue of comparability, highlighted from the literature review (chapter 2), could be addressed by using nationally representative surveys with standardised tools to allow for cross-country comparisons. Furthermore the

roll-out of the surveys across a wide number of countries meant that a wide range of countries were used here, representing different levels of development. Another strength was the availability of anthropometric data in the SAGE, which ascertained the presence of chronic disease risk factors such as hypertension and obesity. The availability of subjective validated measures linked to individual data, such as the WHODAS, was another key strength of the datasets. The quantitative methods used here were integral to understanding the scale of the multimorbidity issue, and informing the sampling strategy of the subsequent qualitative chapter. Therefore, a strength of the qualitative study was the ability to draw on previous quantitative findings, such as considering both their type of residence and their level of eduation. The qualitative study was a useful opportunity to explore the experiences of women in Ghana, a middle income country in West Africa.

The findings here should be considered in light of several important limitations, however. First, multimorbidity estimates were limited to the diseases included in the count. These conditions were not representative of the most common conditions within the population. The WHS, for instance, included schizophrenia – a rare disease. A further limitation was that the conditions included in the count were based on doctor-diagnosed conditions. The observed inter-country differences may simply have been related to differential access to healthcare services. The relationship between doctor diagnosed multimorbidity and healthcare use is likely to be bidirectional, although the direction of association could not be addressed in these studies. As the estimate of multimorbidity is based on doctor diagnosed conditions, estimates reflect those that have been able to access healthcare services and are more likely to receive treatment. This would lead to the possibility of survival bias, as those that access healthcare services may be more likely to survive their condition, avoiding premature mortality. However, it was not possible to offer such interpretations due to the cross-sectional nature of the data. Second, a lack of understanding of the severity of each illness, however, was one of the limitations of the datasets used. The effect of multimorbidity on functional disability may have been related to the severity of the illness included in the count. To understand the relationship between multimorbidity and functional disability, the severity of each illness should be taken into account. This may include, for instance, adopting the use of an index scoring system for severity (and complexity) within multi-country health surveys. Third, longitudinal analyses of the SAGE data were not possible during the course of this thesis, as the SAGE team was still in the process of identifying follow-up individuals and matching the datasets. This meant that the data could only be examined cross-sectionally, and causation could not be ascertained. Fifth, there may have been several other confounding factors that were not included in the analysis. Ethnicity, for instance, is a dependent variable which was not examined in these studies, even though there was some evidence of its association with multimorbidity (chapter 2). Further studies could consider a wider set of determinants, including ethnicity/ race, wealth (based on income rather than assets), exposure to

urban environment, distance to a healthcare facility and ease of access. Sixth, missing data was a key issue which meant that certain variables and datasets (such as Mexico) had to be excluded from the analysis. These included several key risk factors for chronic disease, including both alcohol and tobacco use. Seventh, although certain variables were directly comparable, there may have been inconsistencies in some variables; for example, the definition of 'urban' and 'rural' varied between countries. Finally, there were limitations in the transferability of the qualitative study to the male population. Further studies may consider sampling the male population; and could explore any gender similarities or differences. Furthermore, even though Ghana has some similarities to other MIC, including both its rapid development and urbanisation, its generalisability to other MICs may be limited by the social, cultural and economic context specific to Ghana.

In light of these limitations, survey methods should seek to ascertain and examine multimorbidity through robust comparable measures that consider a wider set of commonly diagnosed chronic conditions and risk factors. Improvements to the knowledge-base will be an important step in responding to an ageing, multimorbid population. In countries where there are not yet full-scale national surveys, investment should be taken as an urgent priority with the aim of monitoring, and improving the evidence base for chronic conditions. Furthermore, an understanding into the effect of the urban environment are somewhat limited by inconsistencies in its measurement. Consistent measures could include exposure to urbancity – including years lived within a particular place and accounting for the fluctuations in the environment. There is evidence to sugest that risk factors, such as obesity and hypertension, determine the pathway towards multimorbidity. This highlights the need for earlier prevention, particularly for conditions that could result in long term disabilities (such as stroke). However, further research is needed to understand how exposing risk leads to the long term progression of chronic disease, and multimorbidity.

Evidence suggests that the NCD burden (which does not include HIV in its definition) can be effectively reduced through the effective implementation of interventions for prevention and control [250]. The WHO state that around 86% of premature deaths occur in LMICs. In HICs the probability of premature death from the four main NCDs (cardiovascular disease, diabetes, cancer and chronic respiratory disease) is low, which suggest that efforts to reduction risk through public health intervention and improved disease management have been effective. The recent Global Action Plan on NCDs set up by the WHO has created a momentum around NCDs – and ignited a response from Ministries and Heads of States who wish to enact the proposed agenda[250]. To this end, the objectives outlined in the Plan around tobacco consumption, nutrition, physical activity and alcohol consumption, as well as universal health coverage, are being incorporated into national and regional health agendas in LMICs. The Global Action Plan advocates for a reduction in modifiable risk factors for NCDs, and underlying social determinants, through the creation of health-promoting environments; as well as

strengthening health systems to address prevention and control of NCDs through primary health care and universal health coverage. Outlined in the report are a number of voluntary targets, particularly around risk factors. For tobacco, for instance, it advocates for the legislation of tobacco free environments in indoor workplaces, public transport and indoor work places. For alcohol, there are 10 target measures set out including, for instance, drink-driving policies and counter measures, pricing policies and monitoring and surveillance. According to recent estimates, almost 40% of the worlds population has implemented at least one tobacco control demand reduction measure. However, there is evidence to suggest that these gains are not happening globally: there is increasing tobacco use in some region, including the African regions[251]. Another finding suggests that tobacco use is more prevalent amongst the poorest, which supports the need for universal coverage through prevention and healthcare.

To conclude, multimorbidity is becoming of global significance and, in MICs, this may be affecting both men and women earlier in adulthood than in HICs. Given the high prevalence of multimorbidity across MICs, health systems will face a considerable challenge to deliver appropriate patient centred care, particularly where healthcare systems are under-resourced and prioritising other healthcare needs, such as maternal and child health. Whilst improvements to education may help to reduce risky behaviours, further public health interventions - such as increasing the price of, and restricting access to, tobacco and promoting active lifestyles - are needed to target populations that may be at risk. Worldwide there is an observed increase in the prevalence of (Type 2) diabetes, which is also correlated to paralleled increases in obesity. Investments should be made into the early screening of chronic conditions, particularly those that have a high impact or burden. Even though primary and secondary prevention should be a focus of improving NCD outcomes, access to treatment should also be given priority. As shown in this study, pain is commonly attributed to loss of independence and disability. Therefore access to pain medications and interventions to address chronic pain (such as improving public parks and access to fitness centres) should not be overlooked – as access can be a cost effective way of reducing DALYs within the population. Access to vaccines and medicine is also advocated for in the SDGs; primarily through the support of research and development of vaccines and medicine that affect developing countries. In line with this, there should be further commitment to provide access to affordable essential medicines and vaccines for NCDs. In the absence of universal health coverage, the financial burden on patients with multimorbidity will become increasingly apparent. Governments in MICs therefore need to develop policies, implementation and monitoring; in order to meet universal coverage. Finally, an integrated care system is needed to allow people to live independently within the community. In response to an adult population with complex needs, health care systems should not only improve access to ambulatory and in-hospital care but consider managing multimorbidity within

the community. This can be achieved by developing innovative, effective, integrated models of care for complex needs. Such models need to be context specific and culturally appropriate, but also orientated around the patient and their family.

As highlighted in this discussion, there is clearly an evidence gap in understanding the true extent of multimorbidity within LMICs as well as their pre-disposing risk factors; whilst more research is needed to understand how to implement effective prevention and care pathways for an increasingly multimorbid population.

Appendices

Appendix A The risk factors and comorbidities of common cancers

	Dietary Risk Factors								**Lifestyle RF**		**NCD Risk Factors**	**NCD**	Communicable Risk Factors: Viruses					Communicable Risk Factors: Bacterial
Type of Cancer	*Alcohol Intake*	*Red Meat*	*Processed Meat*	*Fish*	*Dairy Foods*	*Fruit & Vegetables*	*High Fibre Diet*	*Vitamin D*	***Physical Activity***	*Smoking*	*Obesity*	*Diabetes (Type)*	Hep B	Hep C	HPV	EBV	HIV	H Pylori
Bowel	✓✓✓ rectal but not colon cancer	✓✓✓	✓✓✓	[✓✓]	[✓✓+]	[✓✓]non starchy; [✓✓] folate; [✓✓] fruit [✓✓+] garlic	[✓✓+]	[✓✓]	**colon[✓✓✓]**	✓✓✓	✓✓✓	(colon) ✓✓ (I+II)						
Bladder					[✓✓]					✓✓✓		✓✓						
Breast	✓✓✓								**post-menopausal [✓✓+]**	✓✓	✓✓✓ Women post							

											menopausal							
Cervix Uteri						[✓✓] carrots				✓✓✓					✓✓ ✓ (*2)		✓✓ ✓	
Endometrial		✓✓				[✓✓] non starchy veg			**[✓✓+]**		✓✓✓	✓✓ (I+II)						
Oesophagus	✓✓✓	✓✓	✓✓			[✓✓] foods containing folate; pyridoxine; vitamin E [✓✓+] non starchy veg; fruits; food containing beta carotene	[✓✓]			✓✓✓	✓✓✓							
Kidney										✓✓✓	✓✓✓							
Leukaemia										✓✓✓			✓✓	✓✓✓		✓✓ ✓	✓✓ ✓	✓✓✓
Liver	✓✓✓					[✓✓] fruits				✓✓✓		✓✓ (I+II)	✓✓✓	✓✓✓			✓✓	

Lung		✓✓	✓✓			[✓✓] food containing quercetin; [✓✓] foods containing selenium; [✓✓+] foods containing carotenoids			[✓✓]	✓✓✓								
Melanoma																		
Oral Cavity	✓✓✓									✓✓✓					✓✓ ✓ (*3)			
Ovarian						[✓✓] non starchy ;				✓✓✓								
Pancreas	✓✓	✓✓				[✓✓] fruits ; [✓✓+] folate in foods			[✓✓]	✓✓✓	✓✓	✓✓ (I+II)						
Pharynx	✓✓✓					[✓✓+] foods containing carotenoids;				✓✓✓					✓✓ ✓ (*4)			

						non starchy veg; fruit												
Prostate			✓✓		✓✓ milk and dairy ✓✓+ diets high in calciu m	[✓✓] pulses(*1) ; [✓✓+] foods containing lycopene; selenium												
Stomach			✓✓			[✓✓] pulses; food containing selenium; [✓✓+]non starchy veg/ allium veg/ fruit				✓✓✓	cardia ✓✓							✓✓✓

(*1) >1.5g/day diets that contain calcium and fortified calcium

(*2) HPV 16, 18, 31, 33, 38, 39, 45, 51, 52, 56, 58, 59

(*3) Type 16

(*4) Type 16

✓✓✓	Strong Link of increased risk
✓✓	Link of increased risk but more evidence needed
✓	Weak L
[✓✓✓]	Strong Link of protective effect
[✓✓]	Link of protective effect but more evidence needed
[✓]	Weak Link of Protective Effect

This table was developed by SA in consultation with the International Agency for Research on Cancer (IARC) website and other academic publications [252-257].

Appendix B Social and economic inequalities in the UK

In 1980 the Department of Health and Social Security published a report, which came to be known as the 'Black Report.' The report described the wide inequalities in health within the UK population; stating that since the introduction of the NHS, these inequalities had widened. Such inequalities were not, however, due to shortfalls in the NHS, but rather the social aspects of health, namely income, education, housing, diet, employment, and conditions of work. The report outlined 37 recommendations, aimed at reducing poverty and improving health education, particularly among the lower working classes. These were later dismissed by critics, and the report was not widely used [258]. Following from this, however, the Whitehead report was published in 1988, arriving at the same conclusions. Further still, the report stated that the inequalities between classes had indeed widened since the publishing of the Black Report. Later Whitehead evidenced the social gradients in mortality rates between social classes; noting a two-fold difference between the highest and lowest class [259]. The same pattern was also observed throughout the life cycle. The Acheson Report, published in 1988 under the Labour government, mirrored the same findings as its predecessors, concluding that in order to improve the health of the population we must reduce the gap between the richest and the poorest. Acheson put forward evidence of this gap showing that 17% of professional men, aged between 45-64 years, suffered from long term illness, compared to 48% of lower class men [260]. The latest Marmot Review in the UK, named 'Fair Society Health Lives,' reiterates the importance of addressing the social determinants of health. Marmot asserts that health inequalities are a matter of social justice [67]. New evidence brought forward in the report, include the 'life course perspective' – stating that ill health is due to an accumulation of risk over the life time. Therefore, one of the key recommendations is to improve social conditions, and therefore health inequalities, for children. Notable in the report is the evidence on the association of type of work and ill health - a consequence of the Whitehall studies. Marmot associates the gradient of ill health to the psychosocial aspects of the working environment, such as the amount of control and support. This is commonly referred to as 'isostrain.' Amongst a cohort of civil servants in the Whitehall studies, the lowest occupational grade (clerical staff) reported the least control and support, and the highest incidence of metabolic syndrome; whereas the highest occupational grades had the most control and support with the lowest reported incidence of

metabolic syndrome. The Whitehall Study II also reported that those in the lower occupational grade reported decline in physical functioning twelve years earlier than those in higher occupational grades, which highlights the different social gradients, particularly amongst the aged population. This suggests that occupational differentials may be a determinant of unequal health outcomes. Marmot notes that the opportunities available to each individual will inevitably contribute to their individual health outcomes

Appendix C Review of literature: Research strategy

The literature search was performed using Ovid and PubMed. The search terms ‘multimorbidity’, ‘multiple chronic conditions’, ‘multimorbid’, and ‘multi-morbidity;’ were used in conjunction with (‘AND’) the term ‘prevalence.’ The flow diagram describes the process of screening, screening for eligibility and identification; and is shown as figure 3.1.

Reference of Lists (Ovid)

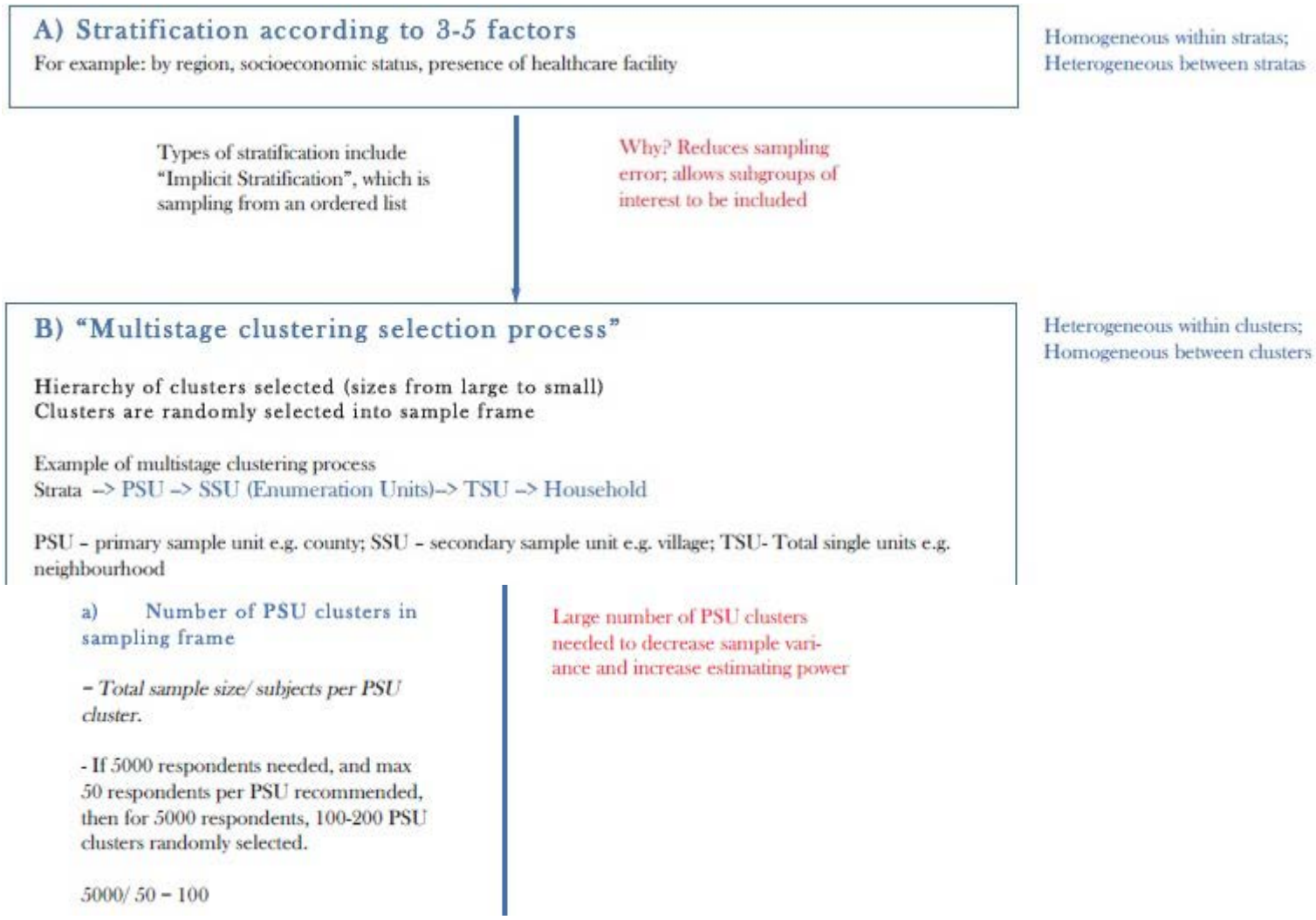
1. multimorbidity.mp
2. multiple chronic conditions.mp
3. multimorbid.mp
4. multi-morbidity.mp
5. 1 or 2 or 3 or 4
6. Prevalence.mp or Prevalence/
7. 5 and 6
8. Limit 5 to yr=”2003” to present

Appendix D Quality scoring of eligible articles, using STROBE checklist

Publication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
Jovic, 2016	●	●	●	●	●	●	●	●			●		●	●	●	●	●	●		●		●	19
Ahmadi, 2016	●	●	●	●	●	●		●				●	●	●	●		●	●	●	●			15
Nunes, 2016	●	●	●	●	●	●	●	●				●	●	●	●		●	●	●	●			16
Wang, 2016 (NE China)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	22
Wang, 2015		●	●	●	●	●		●					●	●	●	●	●	●	●	●		●	15
Hussain, 2015	●	●	●	●	●	●	●	●	●		●		●	●	●		●	●	●	●	●	●	19
Mafuya, 2013	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●		●	●	●	20
Joshi et al, 2015	●	●	●	●	●	●							●	●	●	●	●	●		●			14
Ha et al, 2015	●	●	●	●	●	●	●	●	●	●	●		●	●	●			●	●	●	●	●	19
Hien et al, 2014	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	21
Fu et al, 2014	●	●	●	●	●	●	●	●	●	●	●	●		●	●			●	●	●	●	●	19

Publication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
Wang et al, 2014	●	●	●	●	●	●			●	●		●	●	●	●	●	●	●	●	●	●	●	19
Nimako et al., 2013	●	●	●	●	●	●	●	●			●			●	●	●	●	●	●	●	●		17
Alaba et al. 2013		●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●		19
Jerliu et al. 2013	●	●	●	●	●	●	●	●	●		●	●		●	●	●	●	●	●	●		●	19
Khanam et al. 2011	●	●	●	●	●	●	●	●		●	●		●	●	●	●	●	●		●		●	18
Garin et al. 2015	●	●	●	●	●	●					●	●	●	●	●		●	●	●	●	●	●	17
Banjare et al. 2014	●	●	●	●	●	●	●	●			●		●	●	●	●	●	●		●		●	17
Ataguba et al. 2013;	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●		20

Appendix E Complex survey sampling methods



5000/ 50 = 100

- Total no. of PSUs should be 5x higher than no. of PSUs randomly selected, therefore total would be 100x5= 500PSUs

N.B. Need to always account for 20% non-response rate, so 120% should be used.

C) Probability Sampling

Weights assigned.
Probability of selection into survey sample proportional to relative sizes

Probability selection (Cluster A) = Population (Cluster A) / Total population (all clusters)

Weight (Cluster A) = 1/Probability selection (Cluster A)

The weights are applied to each stage of the multistage clustering process e.g. PSU –> SSU –> TSU
Final weights describe the number of persons in the sampling frame represented by each person in the cluster. i.e. if the weight is 13 therefore the cluster represents 13 people.

Clusters are randomly selected.

* Exceptions: **"Disproportionate Allocation"** – Since sample size of strata chosen that is proportional to the size of the strata, disproportionate allocation acceptable when stratum comprises a small % of population and poportionate number not sufficient for analysis.
"Self- selecting sample" - when a cluster should be included into the survey sample, e.g. a cluster that makes up 70% of population, and if randomly not chosen, then it may be considered for inclusion in study.

D) Systematic Sampling (used at SSU, TSU and household level)

Example

Country X

Selection

TSU (e.g. "Block G") N= 289

Selection

Households N= 26

Linear Systematic sampling

A random number is generated between 1 and 10 (10 is interval size)

Therefore, if 8 selected, 8th house, 18th house, 28, and so on until n=26 selected

Circular Systematic sampling

A random number is generated between 1 and 289

Therefore, if 271 selected, 271st house, 281st house, 2nd, 12th, and so on until n=26 selected

** *this is the preferred method*

F) Selection of Individuals from Households

Member of household - Defined as someone who stays in household, sleeps and shares meals, address as primary residence, spends more than 6 months living there

All members enumerated into household roster; therefore, those not participating in survey can be used to estimate non-reponse bias (note: increasing the sample size by 20% does not account for non-repsonse bias, as non reponders are different to responders in terms of key variables.

discuss methods used for non-response rate post stratification

Method of selection

- Respondent for survey selected among all eligible members using KISH TABLE (pre-assigned table of random numbers used for selection)
- This way each member of household have **equal** probability of selection into survey.

Probability Respondent = 1/ No. of people in the Household

Weight (Respondent) = Number of people in the Household / 1

****base weight - accounts for their unequal probabilities of selection*

Considerations

Demographic Coverage

include all male and female adults who are NOT out of the country during survey period

- if member insitutionalised, interviewer should travel to institution to interview selected indidividual

Geographic Coverage

Must cover 100% of the population. All provinces or territories should have a chance of being included

- if certain areas can not be included due to conflict of accessibility, must constitute a "coherent area" for exclusion

post stratification for non-coverage??? discuss methods used

Geographic Information System

Need to collect geographic information to analyse health in complex ways (modelling health related outcomes) e.g. mapping positions of hospitals, bodies of water, roads etc.

Info shared to allow for mapping should include:
(i) sampling unit names (ii) census information (if used) (iii) sampling unit maps (iv) setting e.g. urban/peri-urban/rural should be communicated (v) administrative level linkage (v) positional data e.g. latitude, longitude, altitude

Appendix F WHO World Standard Population Distribution (%)

Table 4. WHO World Standard Population Distribution (%), based on world average population between 2000-2025	
Age group	World Average 2000-2025
0-4	8.86
5-9	8.69
10-14	8.60
15-19	8.47
20-24	8.22
25-29	7.93
30-34	7.61
35-39	7.15
40-44	6.59
45-49	6.04
50-54	5.37
55-59	4.55
60-64	3.72
65-69	2.96
70-74	2.21
75-79	1.52
80-84	0.91
85-89	0.44
90-94	0.15
95-99	0.04
100+	0.005
Total	100

Appendix G Missing data amongst SAGE variables of interest

		china			ghana			india			mexico			russia			south africa		
code	**variable of interest**	**n**	N	%	**n**	N	%	**n**	N	%	**n**	N	%	**n**	N	%	**n**	N	%
agecat	age	41	15050	0.27	8	5566	0.14	0	12193	0.00	2693	5448	49.43	592	4927	12.02	2	4214	0.05
q1009	sex	41	15050	0.27	8	5566	0.14	0	12193	0.00	2706	5448	49.67	592	4927	12.02	2	4214	0.05
q0104	residence	0	15050	0.00	2	5566	0.04	0	12193	0.00	2706	5448	49.67	1238	4927	25.13	6	4214	0.14
qunitile _c	wealth	99	15050	0.66	12	5566	0.22	78	12193	0.64	1922	5448	35.28	6	4927	0.12	24	4214	0.57
BMI	Obesity	9450	15050	62.79	602	5566	10.82	7008	12193	57.48	3010	5448	55.25	1050	4927	21.31	223	4214	5.29
avrsys	hypertension	8609	15050	57.20	545	5566	9.79	1126	12193	9.23	2966	5448	54.44	738	4927	14.98	130	4214	3.08
avrdys		946	15050	6.29	538	5566	9.67	1127	12193	9.24	2947	5448	54.09	729	4927	14.80	133	4214	3.16
q3001	tobacco (ever)	451	15050	3.00	481	5566	8.64	972	12193	7.97	2814	5448	51.65	632	4927	12.83	189	4214	4.49
q3002	tobacco (current)	10249	15050	68.10	4326	5566	77.72	7479	12193	61.34	4462	5448	81.90	3582	4927	72.70	2781	4212	66.03
q3010	alcohol	10587	15050	70.35	2582	5566	46.39	10737	12193	88.06	4166	5448	76.47	1716	4927	34.83	3112	4214	73.85
q5005	secondary	3732	15050	24.80	910	5566	16.35	2224	12193	18.24	3102	5448	56.94	1279	4927	25.96	817	4214	19.39
q5026	primary	3598	15050	23.91	918	5566	16.49	2224	12193	18.24	3102	5448	56.94	1279	4927	25.96	819	4214	19.44
q4014	angina	500	15050	3.32	481	5566	8.64	972	12193	7.97	2814	5448	51.65	635	4927	12.89	195	4214	4.63
q4022	diabetes	501	15050	3.33	481	5566	8.64	972	12193	7.97	2914	5448	53.49	635	4927	12.89	195	4214	4.63
q4010	stroke	476	15050	3.16	481	5566	8.64	972	12193	7.97	2814	5448	51.65	635	4927	12.89	195	4214	4.63
q4001	arthritis	462	15050	3.07	481	5566	8.64	972	12193	7.97	2814	5448	51.65	635	4927	12.89	195	4214	4.63
q4040	depression	481	15050	3.20	481	5566	8.64	972	12193	7.97	2815	5448	51.67	635	4927	12.89	195	4214	4.63
q4025	chronic lung disease	486	15050	3.23	481	5566	8.64	972	12193	7.97	2814	5448	51.65	635	4927	12.89	195	4214	4.63
q4033	asthma	515	15050	3.42	481	5566	8.64	972	12193	7.97	2814	5448	51.65	635	4927	12.89	195	4214	4.63

Notes: ‘n’ denotes numbers missing,

‘N’ total for each category and;

percentage ‘%’ is percentage missing i.e. n/N*100

Appendix H Health status matrix (SAGE)

SAGE QUESTIONS: HEALTH STATE

Variables	Details	most similar to:	degree of likeness
	OVERALL HEALTH: The first questions are about your overall health, including both your physical and your mental health		
q2000	In general, how would you rate your health today? *Very Good/ Good/ Moderate/ Bad/ Very Bad*	SF-12 (1); SF-36 (1)	
q2001	Overall in the last 30 days, how much difficulty did you have with work or household activities? *None/ Mild/ Moderate/ Severe/ Extreme(Cannot Do)*	SF-36 (13,14,15,16 combined)	
	MOBILITY		
Q2002	Overall in the last 30 days, how much difficulty did you have with moving around? *None/ Mild/ Moderate/ Severe/ Extreme(Cannot Do)*	EuroQOL 5D (1)	
Q2003	In the last 30 days, how much difficulty did you have in vigorous activities, such as running 3 km (or equivalent) or cycling?	SF-36 (3)	
	SELF CARE		

Q2004	Overall in the last 30 days, how much difficulty did you have with self- care, such as washing or dressing yourself?	SF-36 (12)	
		EuroQol 5D (2)	
Q2005	Overall iIn the last 30 days, how much difficulty did you have in taking care of and maintaining your general appearance (e.g. grooming, looking neat and tidy etc.)	ADL	NONE
Q2006	Overall in the last 30 days, how much difficulty did you have staying by yourself for a few days (3 to 7 days)?	ADL	NONE
	PAIN AND DISCOMFORT		
Q2007	Overall in the last 30 days, how much of bodily aches or pains did you have?	SF-36 (21)	
Q2008	Overall in the last 30 days, how much bodily discomfort did you have?	EUROQOL (4)	
Q2009	Overall in the last 30 days how much difficulty did you have in your daily life because of your pain?	SF-36 (22)	
		HUI-3 (Pain)	
	COGNITION		
Q2010	Overall in the last 30 days, how much difficulty did you have with concentrating or remembering things?	HUI-3 (Cognition)	
Q2011	In the last 30 days, how much difficulty did you have in learning a new task (for example, learning how to get to a new place, learning a new game, learning a new recipe etc.)?	WHODAS-II (S3)	

	INTERPERSONAL ACTIVITIES		
Q2012	Overall in the last 30 days, how much difficulty did you have with personal relationship or participation in the community?	SF-36 (32); SF-12 (12)	
Q2013	Overall in the last 30 days, how much difficulty did you have in dealing with conflicts and tensions with others?	NONE	NONE
Q2014	Overall in the last 30 days, how much difficulty did you have with making new friendships of maintaining current friendships	WHODAS-II (11)	
Q2015	Overall in the last 30 days, how much difficulty did you have with dealing with strangers?	WHODAS-II (10)	
	SLEEP AND ENERGY		
Q2016	Overall in the last 30 days, how much of a problem did you have with sleeping, such as falling asleep, waking up frequently during the night or waking up too early in the morning?	SF-36 (23; 27; 31)	
Q2017	In the last 30 days, how much of a problem did you have due to not feeling rested and refreshed during the day (e.g. feeling tired, not having energy)?	SF-36 (23; 27; 31)	
	AFFECT		
Q2018	Overall in the last 30 days, how much of a problem did you have with feeling sad, low or depressed?	SF-36 (28; 30)	
Q2019	Overall in the last 30 days, how much of a problem did you have with worry or anxiety?	SF-36 (24)	

VISION

Q2020	When was the last time you had your eyes examined by a medical professional?	Adapted from HUI-3 (1)
Q2021	Do you wear glasses or contact lenses to see far away?	Adapted from HUI-3 (1)
Q2022	Do you wear eyeglasses or contact lenses to see up close?	Adapted from HUI-3 (1)
Q2023	In the last 30 days, how much difficulty did you have in seeing and recognizing an object or a person you know across the road (i.e. from a distance of about 20 meters)?	Adapted from HUI-3 (1)
Q2024	In the last 30 days, how much difficulty did you have in seeing and recognising an object at arm's length (for example, reading)?	Adapted from HUI-3 (1)

FUNCTIONING ASSESSMENT

These next questions ask about difficulties due to health conditions. Health conditions include diseases or illnesses, other health problems that may be short or long lasting, injuries, mental or emotional problems, and problems with alcohol or drugs.

Think back over the last 30 days and answer these questions thinking about how much difficulty you had doing the following activities. Some of these questions may seem repetitive, but we do need your attention and it is important to give us answers to each question.

Q2025	In the last 30 days, how much difficult did you have in sitting for long periods? *(None/ Mild/ Moderate/ Severe/ Extreme(Cannot Do)*	ADL
Q2026	In the last 30 days, how much difficult did you have in walking 100 meters?	ADL
Q2027	In the last 30 days, how much difficult did you have in standing up from sitting down?	ADL

Q2028	In the last 30 days, how much difficult did you have in standing for long periods?	WHODAS-II (S1)
Q2029	In the last 30 days, how much difficult did you have with climbing one flight of stairs without resting?	ADL
Q2030	In the last 30 days, how much difficult did you have with stooping, kneeling or crouching?	ADL
Q2031	In the last 30 days, how much difficult did you have in picking up things with your fingers (such as picking up a coin from a table)?	ADL
Q2032	In the last 30 days, how much difficult did you have in taking care of your household responsibilities?	WHODAS-II (S2)
Q2033	In the last 30 days, how much difficult did you have in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	WHODAS-II (S4)
Q2034	In the last 30 days, how much difficult did you have in extending your arms above shoulder level?	ADL
Q2035	In the last 30 days, how much difficult did you have in concentrating on doing something for 10 minutes?	WHODAS-II (S6)
Q2036	In the last 30 days, how much difficult did you have in walking a long distance such as a kilometer?	WHODAS-II (S7)
Q2037	In the last 30 days, how much difficult did you have in bathing/ washing your whole body?	WHODAS-II (S8)
Q2038	In the last 30 days, how much difficult did you have in getting dressed?	WHODAS-II (S9)
Q2039	In the last 30 days, how much difficult did you have in your day to day work?	WHODAS-11 (S12)
Q2040	In the last 30 days, how much difficult did you have with carrying things?	ADL

Q2041	In the last 30 days, how much difficult did you have with moving around inside your home(such as walking across a room?	ADL
Q2042	In the last 30 days, how much difficult did you have with eating (including cutting up your food)?	ADL
Q2043	In the last 30 days, how much difficult did you have with getting up from lying down?	ADL
Q2044	In the last 30 days, how much difficult did you have with getting to and using the toilet?	ADL
Q2045	In the last 30 days, how much difficult did you have with getting where you want to go, using private or public transport if needed?	IADL
Q2046	In the last 30 days, how much difficult did you have getting out of your home?	ADL
Q2047	In the last 30 days, how much have you been emotionally affected by your health condition(s)?	WHODAS-II (S5)
Q2048	In the last 30 days, how much difficult did these difficulties interfere with your life?	ADL
Q2049	Besides any vision aids (eyeglasses or contact lenses) do you use any other assistive devices (cane, walker or other) for any difficulties you experience?	ADL

Key	
	Highest degree of likeness
	Average degree of likeness
	Least similar to
	Core ADL
	BMC Public Medicine paper

Appendix I Topic Guide (In-depth Interviews)

Note to interviewer: The in-depth interview will take place in a quiet room, where the conversations cannot be overheard by any others – nor can other private conversations be picked up by the recordings.

Before beginning the interview, the interviewer will do the following:

1. **Introduction**
    a. Introduction to researcher and University affiliations
    b. Study topic
    c. Explanation of the aims and objectives of the study
    d. Explain confidentiality and anonymity
    e. Explain recording, length, nature of discussion, outputs/reporting and data storage
    f. Go through consent issues including that they can withdraw at any time
    g. Check for questions
    h. Check that all happy to continue

This is a rough guide of the issues to be covered. Not all the questions presented here may need to be asked, and other questions may be deemed more appropriate to enable flow during the conversation – and therefore will be responsive to what the participants find important.

2. **Background/ Demographic profile**

    Aims: to gather background information about individuals in the group and their current circumstances

- How many people are there within your household, including yourself?
- Are you currently in full time employment?

3. **Perceptions of ill health**

    Aims: to explore perceptions of ill health for women living with multimorbidity

- **Tell me about your symptoms in your own words?**
    - Is there one symptom that is worse than the other symptoms?
    - Do you think your symptoms are getting better?
        - If not, why?

- **How do your illnesses effect your everyday living, such as your ability to do housework?**
    - How do your illnesses effect your ability to do work?
    - How do your illnesses effect your ability to self-care e.g. dressing, bathing etc?
    - How do your illnesses effect your ability to socialise?

4. **Coping with competing health needs**

Aims: to address how living with more than one condition may lead to competing interests and how the individual copes with this

- **Tell me about your illnesses, and when you developed each?**
    - Which was your first illness (1)?
    - Which was your second illness (2)?
    - Which was your third illness (3)?

- **Is one illness more difficult to cope with than the other(s)?**
    - If so, why?

5. **Self- Care**

- **In a day, tell me how you manage illness (1)**
    - paying for treatment, scheduling appointments, taking the bus to go to the doctor etc.
- **In a day, tell me how you manage illness (2)**
    - paying for treatment, scheduling appointments, taking the bus to go to the doctor etc.
- **Do you have any stress in relation to your conditions? If so, how do you cope with the stress of dealing with your conditions?**
    - How do you relax your mind about it?
    - Do you go to anyone to relieve the stress of dealing with your conditions?

- **Describe how you have adapted to better cope with your conditions**
    - For example, do you use a wheelchair, have you changed your home, attempted weight loss?

6. **Support networks**

- **Please describe the networks that you have to support you through your illnesses.**
    - For example, do you have support from family members, religious members?
    - How do they support you?
        - Do they provide financial assistance and or physical support?

7. **Interaction with the healthcare system**

- **Why did you decide to seek healthcare at a health facility?**
- **Did you seek treatment elsewhere before visiting a health facility?**
- **Tell me about the different actions you have to take in order to seek healthcare for your illnesses?**
    - E.g. making an appointment, organising time off work, make savings (financial)

- **Do the doctors give you information about your illnesses? If so, what information do they give?**

- **What would you say were the major barriers to getting healthcare?**
    - This may be, for example, financial resources, lack of information?

- Could you describe, from your experiences, when you had difficulty in getting care?
- How would you improve the care you have received for your conditions?

- **How do you feel about taking medication?**
  - How are your financial resources affected by your need for treatment, if any?
  - How is your physical health affected by your need for treatment, if any? Do you experience any ill effects from the medication? If so, what do you do about it?
  - How often do you take medication for your illnesses? Please describe.

Appendix J Informed Consent Form (includes information sheet and consent)

STUDY TITLE: Exploring the experiences of women living with multimorbidity in rural and urban Ghana

UNIVERSITY AFFILIATION:

School of Public Health, University of Ghana (East Legion); in collaboration with the University of Southampton, United Kingdom

BACKGROUND

I have come from the University of Southampton, in the United Kingdom, to work with colleagues from the University of Ghana. My research subject is multimorbidity, which is defined as living with two, or more, long term illnesses. This study in Ghana will contribute towards my PhD, which is a research qualification. As part of my research I have already looked at multimorbidity in other countries, including China, India, Mexico, Russia and South Africa. Now I would like to gain a further understanding about what it is like for women to with multimorbidity in Ghana.

This study is being done in order to gain some understanding about how women think about their illnesses, how they are affected by it (in what ways), and how the health services support women living with multimorbidity.

Lead Researcher: **Ms Sara Afshar. Contact tel:** 020 642 1434

Department of Social & Behavioural Sciences, School of Public Health, University of Ghana. East Legion

Email: sa2706@soton.ac.uk

Local Supervisor: **Associate Professor Philip Adongo**

School of Public Health, University of Ghana. East Legion

Contact tel:

Contact Ethical Review Committee:

Dr. Hannah Frimpong

Mobile: 0244712919

Mobile: **233 (0) 243235225 or 0507041223**

Email: Hannah.Frimpong@ghsmail.org

: INFORMED CONSENT FORM (INFORMATION SHEET)

PROCEDURE

We have asked you to take part in this study as we know that you currently living with two or more chronic conditions, and we would like to know about your experiences.

The interview will last up to 60 minutes. During this time you can take a break, for example if you need to go to the toilet, and we will provide you with refreshments.

We would like to ask you some questions about your experiences living with multimorbidity and how this affects your everyday life. We will take notes of the discussion and a recording will also be made using a voice recorder. After the interview, we will not need to ask you further questions. All the information gathered today will be treated by us in a confidential manner i.e. we will not share any of the information given to us about you, in a way that it can be traced back to you. All the records of the interview will be kept securely in locked filing cabinets and offices.

FREQUENTLY ASKED QUESTIONS

Can I stop being in the study?

You are free to stop participating in the study at any time. Just tell us right away if you would like to stop the interview.

What other choices do I have if I do not take part in this study?

You are free to choose not to participate in the study. If you decide not to take part in this study, there will not be a penalty.

What are the costs of taking part in this study? Will I be paid for taking part in this study?

We will provide you with a small fee (10 Cedis) for your time in this study. Furthermore, we will arrange transportation costs to/from the interview. At the interview light refreshments will also be provided.

Who can answer my questions about the study?

You can talk to the researchers about any questions or concerns you have about this study. Contact myself, on telephone numbers 020 642 1434 any time.

RISKS AND BENEFITS

There are no benefits in taking part in the interview, but the information that you share with us will help researchers and policy-makers how best to improve services for women living with multimorbidity. There are no high risks from being involved in this study. The only risk, which is small, is the loss of privacy. You may be asked to share some experiences that you feel are private or personal. In this case, if you do not wish to share these experiences do not feel that you have to.

CONFIDENTIALITY AND ANONYMITY

In our research we are expected to conform/comply/ listen to our University Policy – which ensures that all participants in the study are treated in a confidential manner. This means that none of the information you share with us can be given to another person who is not authorised.

During the analysis and write up of the research, we will not be using your names; however, there is a possibility that the information you give us can be linked to your name if needed. Please let us know if you are not happy with that.

BEFORE GIVING CONSENT TO PARTICIPATE IN THIS STUDY

You can keep this information sheet if you wish. You have the right to decline to participate in the study, or to withdraw at any point without penalty.

If you do not wish to take part in the study kindly inform the researcher now, or before the start of the interview.

You can talk to the researchers about any questions or concerns you have about this study. Contact myself, on telephone numbers 020 642 1434 any time.

OUTCOME AND FEEDBACK

The results from the study will be written up as part of a PhD research program and research publication. There will be no further follow-up. If you would like any feedback about the research please contact the number listed above.

FUNDING INFORMATION

This research project is being financed by the University of Southampton, United Kingdom

INFORMED CONSENT FORM (SIGNATURE PAGE)

Study Title: Exploring the Experiences of Individuals living with multimorbidity in Greater Accra region, Ghana

PARTICIPANT STATEMENT:

- The study has been explained to me in a language that I understand. All the questions I had about the study have been answered. I understand what will take place during the interview and what is expected for me.
- I have been informed that it is my individual right the refuse to take part in the interview today and that if I choose not to take part I do not have to give a reason, and that will not prejudice the care that I can expect to receive now, or in the future.
- I have been informed that anything I say during the interview today will remain completely confidential: my name will not be used nor any other information that could be used to identify me.

Circle response:

I agree to take part in the study and for my data to be used for the purpose of this study	Yes	No
I agree that my own words may be used anonymously in the report	Yes	No
I understand that my participation is voluntary and I may withdraw at any time without any penalty	Yes	No

Signature of participant:

ID NUMBER	SIGNATURE (or thumb print)	DATE

Signature of researcher taking consent:

INTERVIEWER STATEMENT:

I have discussed the study with the respondent named above, in a language he/she can comprehend.

I believe he/she has understood my explanation and agrees to take part in the interview.

NAME	SIGNATURE	DATE

Appendix K Ethical considerations

Principle	Actions taken
Autonomy	Data was protected using password protected computers, ID numbers were assigned to retain anonymity, confidentiality upheld. Research was independent, voluntary and free from coercion. All participants could with draw at any time.
Non-maleficence	No unreasonable demands placed on participants. Risks assessed and addressed throughout the process. All interviews were held in a safe place with ease of access. No research interview was attended alone. The School of Public Health (University of Ghana) were informed when the research team were out recruiting/ interviewing
Beneficence	The benefits, risks and costs were analysed during the research design stage. There were no direct benefits for patients taking part in the study, although the findings will be written up to inform evidence. All participants were informed of this
Justice	All participants were treated in a fair and equal way. The contribution for participation was the same for all participants (a picture frame and 20 Cedis to cover transport costs).

Appendix L Interview coding and development

"Because if I take my medication it stops and then I realize later what I did and feel remorseful and ashamed for my actions and makes me waste money because I board a car and go to peoples house to chat."	Emotions	1.1 The influences that relate to the self: emotions and spirituality	1.The influences of their health experience
"I can't really tell because all that I know is that it has a spiritual basis."	Spirituality (inner world)		
"….I also joined to pray in order to learn the word of God well. It helps one to restrain him/herself from bad deeds. I use to go to the prayer camp way before I had this condition"	Belief systems, culture and environment		

"Oh they helped me some visited and brought me provisions, some supported me financially."	Social support network	1.2 The influences relating to events of people in their environment	
I: So why did you decided to seek health care at the hospital. R: "So that I get cured, because if I don't seek treatment it will become worse"	Reasons for going to the hospital/ facility		
Its only the doctor that can heal, even my husband advised that I use herbal medicine but I told him I was okay with the hospital medications	Trust in health system		
"ooh! I was in town walking from Makola Square there and I saw that, I couldn't go more, then my joints were paining me so there was a chair there. "	Describing symptoms	2.1 Expressed reasons for going to the hospital	2. Seeking care and the responsiveness of the healthcare system
"They treat me well. They do not even see me as someone with a psychiatric problem…..They always come around. They love me so much."	Words describing satisfaction with the healthcare system		

"yes because I don't really understand my condition very well, all the hospital does is to give you drugs and that is all, they don't really explain things to you."	Information given by clinicians	2.2 Disruption of everyday life due to symptoms	
" It was the machine that diagnosed what was in my brain and the paper that came out of the machine indicated that my sugar level had risen to 180 and BP too was 180. That was the main reason why I couldn't talk."	How their conditions are diagnosed	2.3 Words describing satisfaction with the healthcare system	
"in seeing the doctor I do not pay anything because of the health insurance. The last time, the health insurance did not function for two months and so we had to pay for the drugs that were prescribed to us. Now it is functioning, so we get the drugs free with the exception of these ones that I bought them yesterday for GH¢8.00"	Health insurance coverage	2.4 Communication	

"Formally I used to go every week, but I was asked to come after every two weeks but yesterday when I went there he said I should come in three days' time."	Continuity of care		
"They give us the best of treatment but the only problem is it takes a very long time before you are able to go to the consulting room to see the doctor...."	Waiting times	2.5 Access to prompt attention from the clinicians	
"I am only given appointments to see the doctor with regards to the diabetes. I complain to the doctor when I come for the diabetes clinic. However, days when I am not in pains, I do not complain of the chronic arthritis."	Focus on only one of their diseases through vertical healthcare		
"that is a private facility and this place is a public or general hospital so I felt that it is proper to seek medical treatment in a government facility. "	Use of private healthcare providers		

"No us diabetic patients its only when your drug is finished that they will write it for you to go and buy, but they don't take money from us, even for lab test we don't pay."	Availability of treatment	2.6 How much choice in healthcare do they have?	
"I am cautious of the days that I am supposed to go and see the doctor and when it comes to the financial aspect...I started saving towards my medications."	Adhering to treatment		
"That is what I have been doing since we moved to Taifa to cut down the transportation cost. I come here once every three months."	Getting to appointments	3.1 Treatment	3. How patients manage healthcare demands
"I go and see the doctor once a month for the diabetes. If you are due to see the doctor and you don't go, he would be furious as to why you didn't come when your time was due so for me, I always go when my date is due."	Scheduling of appointments		

"I am able to do everything, before when the condition was worse I could not do anything but now I can do all that I use to do, am able to go to the market and buy my goods to sell, which is a form of exercise."	Good health outcomes	3.2 Keeping to appointments	4. Outcomes due to ill health
"I am able to do all that. I bath myself and wear my dresses. Nobody does it for me."	Independence		
"This disease has entered my bones so I can't work anymore, I would have to hire people to smoke the fish for me."	Loss of independence	4.1 How able are they to continue daily life?	
"Apart from her medications, most of them are given to them for free but there are payments that I make when I come to the hospital – the RBS, so in terms of payment for treatment, that one is very difficult for me to pay."	Out of pocket payment		
"No, if you borrow you will think a lot. How will I be able to pay back, am someone who do not borrow, I only owe God. As in human I don't owe anyone."	Ability to pay		

"my movement has become difficult because when I am going to church now I need to pick a taxi which is very expensive so I am not able to go to places I would have love to go."	Financial burden due to ill health	4.2 Economic circumstances due to health needs	

Appendix M Example field note in Accra

FNA15

FIELD NOTES IN ACCRA

4th August 2015

Interview 12 13, 14 (Dodowa)

We interviewed two patients that had been recruited from the HIV clinic. In the first interview there were so many interruptions – and we had to move rooms twice.

The second interviewee was less talkative.

Reflections

The interruptions did not seem to effect the overall flow of the conversation.

The second interviewee had recently been widowed, and later found out that she was HIV positive. This may have been the reason why she was less talkative. She was perhaps fearful anxious about the situation. I was also taking notes, so she might have been a bit paranoid about this.

On one occasion the interviewer tried to change the subject – to avoid the participant from thinking negatively about her death. This is something to query i.e. role of interviewer should not be as councilor. Also, the interviewer was also interpreting/analysing as they go along. To prevent this, then transcription should simply state questions and responses, and miss out the translations.

Interview 14 was conducted in her compound. The participant was not aware of her peripheral neuropathy. She thought that it was related to her hypertension. She also did not describe any conditions related to her arthritis. Either her symptoms were very mild or it was a mis-diagnosis.

Emerging Questions/ Analysis

Themes of impact of disease.

Stigmatisation related to psychological as well as community values

Physical limitations closely related to financial

Financial reserves are related to (i) actual severity of illness (ii) family situation (iii) community – religious

For widows, the emotional support usually comes from siblings, children and the religious community

There may be a difference between “perceived severity” and “actual severity”

Community values still exist within the rural areas.

Muslims and Christians may interact with their religious communities in different ways. Is this due to the role of women in the religious community, and/or acceptability of women there?

In analysis – look for differences between religious groups.

Future Action

None

Publications, Awards & Conferences during candidature

CONSULTANCY WORK

World Health Organisation *Cairo, Egypt (May – September 2015)*

- Short term research assignment at the World Health Organisation EMRO regional office in Cairo, Egypt on the "Comparative analyses of the GCC countries" using the World Health Survey Plus. Collaboration between the University of Southampton School of Human and Social Sciences (under direction of Associate Professor Amos Channon)
- For this, I planned, analysed and reported research comparing diabetes and its co-morbidities across 4 GCC countries; using a Poisson model to estimate the effects of a number of determinants on the co-occurrence of diabetes.

COLLABORATIONS AND GRANTS

- Research collaborations with the World Health Organisation Study of Global Ageing Team (WHO SAGE); resulting in co-publications, and presentation of findings at the WHO Kobe Centre, Japan.
- Recipient of NIA Grant for qualitative field work in Ghana; provided by the US National Institutes of Health./ National Institute of Aging through the Global Demography of Aging Program at the Harvard School of Public Health. (Grant Holder Allan Hill; $37,000 total)
- Conference Attendance Awards 2015 (£500) and 2016 (£500)

PUBLICATIONS

- Afshar S, Roderick PR, Hill A, Dimitrov BD, Kowal P. (2015) *Multimorbidity and the inequalities of global ageing: a cross-sectional study of 28 countries using the World Health Surveys.* BMC Public Health
    - *Listed as one Top articles of 2015 in BMC Public Health*
    - *In the top 5% of all research outputs scored by Altmetric Attention Score compared to outputs of the same age and source (95th percentile)*
- Arokiasamy P, Uttamacharya, Jain K, Biritwum RB, Yawson AE, Wu F, Guo Y, Maximova T, Salinas-Rodriguez A, Phaswana-Mafuya R, Afshar S, Sanghamitra Pati,

Naidoo N, Chatterji S, Kowal P. (2015) *Multimorbidity, subjective wellbeing and mental health of adults in low- and middle- income countries: what does the Study on global AGEing and adult health (SAGE) reveal?* BMC Medicine

- Kowal P, Arokiasamy P. Afshar S. Pati S. Snodgrass JJ. (2015) *Multimorbidity: health care that counts "past one" for 1.2 billion older adults*. The Lancet
- Afshar S. (2016) *Multimorbidity: Living in a Complex World.* Pan European Networks: Science and Technology 18.
- Afshar S. (2016) *ABC of Multimorbidity: A Book Review.* Ageing and Society 36(06):1333-1334 · June 2016
- Afshar S et al. (2016) *Prevalence of and factors associated with frailty and disability in older adults from China, Ghana, India, Mexico, Russia and South Africa.* Journal of Maturitus. Volume 91 Pages 8-18.
- Afshar et al. (2017) *Global patterns of multimorbidity*. Book chapter. In: Hoque N ed. Applied Demography and Public Health in the 21st Century.
- Afshar S et al (2017). *"Examining the correlates of diabetes and its comorbidities across four Gulf Cooperation Council countries: using the World Health Survey Plus*" (forthcoming publication)
- Afshar S et al. (2017) *Urban living and multimorbidity: a cross-sectional study using the Study of Global Ageing in five countries*. Journal of Urban Health (forthcoming publication)
- Afshar S et al. (2017) *Are some comorbidities more disabling than others? A cross-sectional study in five middle-income countries.* (forthcoming publication)
- Afshar S et al. (2017) *Exploring women's experiences of living with multimorbidity: a qualitative study in Greater Accra, Ghana.* BMC Public Health (forthcoming publication)

CONFERENCE PRESENTATIONS

- Afshar S. *The Global Burden of Multimorbidity*. (2014) Oral presentation at 'Tackling Population Health Challenges.' Summer Conference. University of Southampton
- Afshar S. *The Global Burden of Multimorbidity.* (2014) Poster presentation at the Faculty of Medicine Conference. University of Southampton
- Afshar S, Roderick PR, Hill A, Dimitrov BD, Kowal P. (2015) *Multimorbidity and the inequalities of global ageing*. Oral presentation at the Population Association of

America Conference, April 30- May 2 2015, San Diego, USA.

- Afshar S, Roderick PR, Hill A, Dimitrov BD, Kowal P. (2015) *Multimorbidity and the inequalities of global ageing*. Oral presentation at the 2nd International Conference on Demography and Anthropologic Studies, 15th June – 16th June 2015, Athens, Greece.
- Afshar et al. (2015) *A global comparison of multimorbidity.* Pitch presentation at the 8th European Public Health Association Conference (EUPHA) Milan, Italy.

INVITED PRESENTATIONS

- Guest speaker at 'Meeting the Challenge of Healthy Ageing in the 21st Century.' Organised by Euroscicon Life Science Events. 24th February 2017

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