A View on the Invisible

A Study of Relationships between Different Aspects of Health in Populations

AIJA DUNTAVA
Abstract


This thesis studies relationships between different aspects of health. Health is a multifaceted concept consisting of various aspects: most commonly morbidity, functional limitation, subjective health, and mortality. The relationships between these aspects, however, are not fully understood, so this thesis aims at contributing to our knowledge on the topic. Three studies are included, each with a particular aim within the general objective.

The first study is a systematic review of the articles that have attempted to study more than two aspects of health in one model. The review maps out the field of study, presenting and summarising the results of the articles selected to review, thereby also highlighting gaps in the research. One of its conclusions is that studies approaching health as one interconnected system are rare and that the relationships between the different aspects of health do not consistently show significant effects on each other. Additionally, many population groups in terms of age and place of residence are understudied. The findings from the systematic review have largely guided the scientific curiosity of the following two empirical studies.

The second study proposes and tests a parsimonious model of health structure consisting of morbidity, functional limitation, and subjective health on the adult respondents of European Social Survey (n=32,679) using structural equation modelling. The findings suggest that, in general, the proposed model holds true but there are age and gender differences in the health structure.

The third study explores the variations in the health structure of the adult population in 17 countries in three European regions (North, East, and West). The results show that the model does not apply in all the studied groups across the regions. Clear gender difference in health structure exist in the Western and Northern parts of Europe but not in the East. As to age groups, the analyses show that young adults are similar in their health structure across the regions while there are regional differences between the other two age groups.

This thesis shows that it is necessary to study the relationships between different aspects of health as one interconnected system. Furthermore, when health is at centre of scientific inquiry its multiple dimensions as well as age, gender, and regional variations should be acknowledged and taken into account.

Keywords: morbidity, functional limitation, subjective health, mortality, health, aspects of health, adult population, Europe, structural equation modelling, regional comparisons, health structure, systematic review, empirical studies

Aija Duntava, Department of Sociology, Box 624, Uppsala University, SE-75126 Uppsala, Sweden.

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To my daughter and parents, and in memory of my grandparents
List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

I. Duntava, A., Mäkinen IH, Borisova LV. In search of the holy grail of health: A systematic review of studies on the relationships between different aspects of health. Submitted to Social Science & Medicine


III. Duntava, A., Mäkinen IH, Borisova LV. The structure of health across Europe: Patterns in different populations. Under review in Scandinavian Journal of Public Health (SJPH)

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This thesis has been a long journey over small hills and high mountains, in calm and stormy weather. Much inspiration, happiness, and frustration accompanied me on the way. At some moments, I felt I had wings, while at others I felt I was becoming numb. Navigating the ever-changing terrain of PhD studies is a difficult but, nevertheless, a pleasant experience. The road is even more enjoyable when it is shared with one’s significant other and loved ones. Luckily, thanks to many people I never felt like I was travelling alone or empty-handed.

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\(^1\) Illustration credits: Illustration created by Liubov V. Borisova, using DALL-E and Canva technology.
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Aija Duntava

7 January 2024,
Stockholm
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AADL</td>
<td>Advanced activities of daily living</td>
</tr>
<tr>
<td>ADL</td>
<td>Activities of daily living</td>
</tr>
<tr>
<td>BADL</td>
<td>Basic activities of daily living</td>
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<tr>
<td>CDR</td>
<td>Crude death rate</td>
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<tr>
<td>CFA</td>
<td>Confirmatory factor analysis</td>
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<td>ESS</td>
<td>European Social Survey</td>
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<tr>
<td>FL</td>
<td>Functional limitation</td>
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<tr>
<td>IADL</td>
<td>Instrumental activities of daily living</td>
</tr>
<tr>
<td>ICF</td>
<td>International Classification of Functioning, Disability and Health</td>
</tr>
<tr>
<td>LBD</td>
<td>Lower-body disability</td>
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<tr>
<td>MLR</td>
<td>Multiple linear regression</td>
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<tr>
<td>OLS</td>
<td>Ordinary least squares regression</td>
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<tr>
<td>RMSEA</td>
<td>Root mean square error of approximation</td>
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<tr>
<td>SDR</td>
<td>Standardised death rate</td>
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<tr>
<td>SEM</td>
<td>Structural equation modelling</td>
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<tr>
<td>SH</td>
<td>Subjective health</td>
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<tr>
<td>SRH</td>
<td>Self-rated health</td>
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<tr>
<td>UBD</td>
<td>Upper-body disability</td>
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<td>US</td>
<td>United States</td>
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1 Introduction

Providing an answer to the question, ‘How is your health in general?’ can seem easy and would hardly appear troublesome for most people. However, if a person is asked to explain how s/he arrived at this judgement, it would probably require a thoughtful and lengthy answer. Certainly, in the responses, various aspects would be attributed to the notion of health. This shows that the concept of health is difficult to conceptualise and operationalise. Yet, health is one of the most precious assets a human being can possess. It greatly affects our lives by serving as both a resource and, if poor, an obstacle to fulfilling smaller and larger life goals. That is why it comes as no surprise that human minds at different phases of societal and scientific development have been so eager to embed it into their narratives.

In European culture, perhaps the very first documented reference to health was made by the Greek poet Homer\(^2\) in the eighth century B.C.E. The discussions became more sophisticated with each new epoch to come. Currently, half a million peer-reviewed articles (according to a search on the Web of Science) related to health have been written, and interest in studying health is growing. Furthermore, different disciplines—such as medicine, biomedicine, epidemiology, sociology, and psychology—where health is either at the core of the inquiry or has been dedicated a separate branch within the discipline, make it a highly interdisciplinary topic.

What is intriguing in this flourishing field of research is the multitude of ways to define and study health, and the different perspectives to apply to it, which also boost the growing body of research. More importantly, these choices exist in every discipline. This opens up numerous opportunities for research, while also running into the problem of overlooking the research gaps caused by ‘established’ views on a particular phenomenon and/or by the absence of dialogue between disciplines.

There is as of now no consensus on the exact definition of ‘health’, but this does not mean that health cannot be studied. Various definitions do agree upon the following: first, that health is a multidimensional concept (for example, Bircher 2005; Larson 1996; O’Donnell 2009; World Health Organization

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\(^2\) In Homer’s Iliad (1991; translated by Fagles), Apollo, the god of healing, sends the plague to the camp of the Greeks. The plague – or more broadly, diseases – were seen as the “wrath of the gods” both in Homer’s work and the society of that time.
2020); and, second, that it has biological, psychological, and social dimensions. This division also explains why there is no single way to operationalise the concept of health, and why no agreement has been reached as to how exactly health should be measured. However, different proxies of health are acknowledged and employed in studies. The most common of these are morbidity, functional limitation, subjective or self-rated health, and mortality.

Morbidity, in brief, refers to physical health problems or diseases, while functional limitation reflects a person’s inability to perform everyday tasks. Subjective health is the respondents’ evaluation of their general health, and mortality is the death of a person. These aspects of health are not new, and have a long history serving as health proxies in research. What stands out here is that they rarely appear simultaneously in studies. Indeed, most often just one, or possibly two, aspects are considered (see, for example, Kriegsman, Deeg, and Stalman 2004; McGee et al. 1999; Mossey and Shapiro 1982); studies that focus on three or more aspects of health are far less frequent (see, however, Bernard et al. 1997; Galenkamp et al. 2013; Idler, Russell, and Davis 2000).

In addition, it is quite common to study health as ‘fragmented’, where the links between its different aspects are assumed to depict simple, direct relationships. More specifically, many studies use statistical methods, such as least squares regression or logistic regression, which limit the unfolding of mediating variables between a predictor and an outcome. However, human health must be seen in all its complexity, where its various ‘parts’ form one entity. Relatively few studies employ such a ‘unitary’ approach, where the indirect effects mediated by different variables are included (see, for example, Golini and Egidi 2016; Hirve et al. 2014; Johnson and Wolinsky 1994). Moreover, many of the studies employing this perspective on health are limited to elderly populations and to the United States.

This thesis, as do most theses, focuses on a narrow topic and explores it. As noted above, health is a concept that is difficult to define and operationalise, yet, it is clear that different health indicators, if valid, should relate to the overall concept of health in one way or another. Therefore, instead of trying to define and operationalise the overall concept of health, this thesis studies the relationships between the most common proxies of health: morbidity, functional limitation, subjective health, and mortality.

In doing so, this thesis offers a deeper insight into the field of health research by identifying and highlighting some features of strategic importance. For example, operationalisations of the different aspects of health, the relationships between these aspects, the study populations, and different methodological approaches are explored. The first of the three studies, a systematic review, maps the research field, highlights some gaps and guides the other two empirical studies. Those studies expand the scope of previous studies on these topics by applying a model of health aspects to a European population, while
including all adult ages and extending the analysis across three European regions.

1.1 Thesis aim and structure

The main aim of this thesis, as stated above, is to study the relationships between different aspects of health—morbidity, functional limitation, subjective health, and mortality. The structure of the thesis is organised around the literature on health aspects and the relationships between them while including three separate studies. Section 2 provides arguments for the importance of studying the relationships between the different aspects of health. The sociological relevance of this thesis is addressed in Section 3. Section 4 discusses health from a sociological perspective and positions this thesis even in the sub-discipline of epidemiological sociology. The concept of health and health aspects are discussed in greater detail in Sections 5 and 6, respectively. Section 7 discusses approaches to studying the relationships between different aspects of health and introduces Study I. Previous research on the relationships between the different aspects of health, followed by the introduction of Studies II and III, is the focus of Section 8.

I. Study I is a systematic review that provides a structured study of previous research literature, where several aspects of health are analysed simultaneously. The primary goal is to investigate and characterise the research field.

II. Study II is an empirical study investigating the relationships between the different aspects of health in Europe by applying a model of the structure of health. Structural equation modelling is used on a very large dataset of the European adult population.

III. Study III explores the model of the structure of health further, comparing the relationships between the different aspects of health across three European regions.

A brief description of the studies is available in Table 2.

Section 9 links the perspectives on health to the studied aspects of health, and Section 10 presents the theoretical model. The data and methods used in all three studies are summarised in Section 11, and the summary of the results is provided in Section 12. Last but not least, the discussion in Section 13 concludes the thesis.

Finally, it also seems important to explain what this thesis is not about. It cannot provide an answer to fundamental questions such as what health ‘is’ or how it should be defined, nor will it suggest a new sociological theory. It will not provide direct solutions to improve population health.
2 Why study the relationships between aspects of health?

2.1 Studying the relationships between different aspects of health

While understanding certain aspects of health, particularly those pertaining to its physical aspects, is crucial in the field of medicine, it is of limited value in social sciences. What is of interest in this thesis is the study of relationships between health aspects. The main reasons for this are the need to investigate the consistency and validity of health measurements, and the value of composing and comparing structures of health aspects. In answering these questions social scientists will gain a deeper understanding of the relationships between the different measures of health, their patterns in various groups, and the possible context influence on these relationships. In addition, the study of the relationships will assist in the choice of health measures.

2.1.1 Consistency and validity of the measurements of health

The first reason relates to the use of the concept of health in health studies. Health can be operationalised in many different ways. The choice of one operationalisation over another is often guided by data availability, common research practice, or the—mostly unspoken—assumption that various health indicators would probably yield similar results. Whatever reasoning guides the decision, different measures of health are normally assumed to represent it correctly. However, the use of indicators is not unproblematic. It is common practice to choose only one indicator to represent an individual’s or a population’s state of health. Sometimes there is only one alternative available to the researcher. However, results will vary according to these choices. For example, morbidity and functional limitation, two widely used measures of health, could well (and do) have different relationships with many studied outcomes. Hence, these two measures, while originating from the same abstract concept, are not identical. This makes the study of the relationships between different aspects of health necessary. Such studies may give us ideas as to whether some of the most widely studied health measures can be applied with similar success, and even whether these health measures can be considered parts of the concept of ‘health’.
A similar interest lies also behind the exploration of how the different measurements of various aspects of health, originating from different operationalisations of the same, are related to each other. Studying the relationships between the different ways in which aspects of health can be operationalised would add to our understanding of their measurement validity in particular and the concept of health in general. In addition, deeper knowledge of various ways of operationalisation and the implications of the chosen alternative for the studied relationships would assist future researchers in making their choices more effectively and/or recognising their potential limitations.

2.1.2 Composing and comparing structures of health aspects

The second reason refers to health as a structure made of its different aspects. The study of the relationships between the aspects of health is important in and of itself, as it shows how two or more phenomena are related to each other. Establishing direct relationships between predictors and an outcome is arguably the most prevalent approach when studying a given phenomenon in the social sciences. While it is a common and well-established practice of studying any phenomenon, it rarely corresponds to the complex relationships found in real-life situations. These can be better described with the help of a structure that is applied to these relationships. With the help of theoretical grounds, it enables researchers to establish links and their directions between the concepts under study.

Much of the research seems somewhat indifferent to such “health structures”. However, once composed in theory, the structures can be empirically tested and even compared between different social groups. Two studies in this thesis are empirical in nature. They propose and test a model of relationships between different aspects of health. Even though some previous studies have—as described in Section 1—applied this kind of approach to study health, they have mostly been conducted in the United States and among the elderly section of the population. Moreover, there is great variation in the tested models, which makes their comparison difficult. Sometimes the models are also unnecessarily complex. This thesis, in studying the core aspects of health, explores a parsimonious model. The parsimony shows in the use of quite broad definitions and measurements of the health aspects, and also in abstaining from using control variables in the model. Comparisons of the same model across different age groups and regions constitute a step toward a more general view on the patterns of health in different groups.
3 A sociological venture

This thesis is written in the field of sociology. However, even epidemiological sociology (as described in Section 4.2 below) can be considered a home for this thesis, as the main study phenomenon is the health of populations.

3.1 Focus on populations

At the core of this thesis lies the objective of making inferences about the studied population, rather than solving individual-level problems. However, individual-level data are utilised. The patterns observed at the macro level are assumed to consist of combinations of individual reasoning (Kandler, Wilder, and Fortunato 2017). Furthermore, various characteristics; for example, knowledge, beliefs, and attitudes, are socially transmitted between people through education or imitation (Richerson and Boyd 2005). The individuals included in this dataset are representative of both the period and the locations from which they were sampled. They are analysed in groups formed either by special characteristics (such as age or gender) or the context in which they live (i.e., regions), or some combinations of the above. The persons in one group are assumed to have more in common compared to their counterparts in the other groups. The analyses aim at making macro-level patterns discernible out of micro-level data.

3.2 Differences between groups and contexts

As mentioned above (see Section 2.1.2), one of the main objectives of this thesis is to see how the relationships between different aspects of health vary across different populations in terms of both their characteristics (gender and age) and the context (region). This clearly counts as one of the many study objectives of sociology as a science. Sociology seeks to understand the conditions of life in contemporary society in general, and those of various social groups in particular: the structures and the processes that operate in relation to various groups and the factors that shape them. The groups studied here (those characterised by gender, age, and regions of living) all have a long tradition of being the focus of sociological research.
4 Health from a sociological perspective

4.1 Health in society

Health is an important aspect of life to every one of us. We need it for physical functioning to fulfil our aims, desires, and dreams. Our life, however, does not merely consist of individual goals and ambitions. These should be constantly weighted against our responsibilities toward others, and pursued in the presence of their goals and ambitions. This is where individuals start to interact with other individuals. Being in poor health brings distortion to individual lives that, similarly to a snowball effect, affect the lives of others (the children who must be taken care of, the employers who expect jobs to be done, the financial burden placed on taxpayers when receiving sick leave benefits, etc.) Thus, health and the health behaviour of individuals are crucial for the functioning of society as a whole.

Talcott Parsons, the great American sociologist of the 20th century, addressed this in the 1950s. In his sociological work on system theory, which is known as structural functionalism (Blaxter 2010) he links individual behaviour (actions) to the social system (Parsons 1951). These social actions take place in three systems: 1) personality, 2) the cultural system, and 3) the social system (Appelrouth and Edles 2008), of which the social system is of interest here. According to Appelrouth and Edles (2008), the social system can be summarised as the level where interactions between two or more actors in their particular roles take place. It encompasses the actors’ ideas, intentions, norms, and/or expectations and interdependence. These three systems, in Parsons’s view, function together to produce social order and stability. A disequilibrium appears when there is a conflict between personal needs and dominant cultural values and norms (Appelrouth and Edles 2008). Individual actions are connected to the systems (including the social system) by “pattern variables” that represent different choices guiding human action (Blaxter 2010). These are presented as five dichotomies (Appelrouth and Edles 2008):

- Universalism vs. particularism. An action is based on either general criteria, such as standards, morals, and rules, or some specific individual criteria, such as attachment and priorities.
- Affectivity vs. affective neutrality, or whether emotional attachment is taken into account.
• Self-orientation vs. collective orientation. An action is based either on the self-interest of the actor or on a common interest.
• Ascription vs. achievement. An action is rooted either in some personal attributes or in performance, which complies with a given standard.
• Specificity vs. diffuseness. An action is either grounded in some specific criteria or roles or extends beyond those boundaries.

In the context of health, the choices appropriate for, e.g., a modern doctor would be those based on universalism, affective neutrality, achievement, and specificity (Blaxter 2010). In addition, both professions (doctors, specialists, nurses, case officers, etc.) and institutions (hospitals, health centres, social insurance agencies, and others) can be seen as working to maintain an equilibrium between different systems and thus the social order. These actors and institutions, through their particular roles, attempt to cure those in need while protecting the health of the population as a whole so that the functioning of society will not be distorted. For example, special rules and prescriptions apply to those with communicable diseases: following the doctor’s prescription (staying at home and using medicine if needed) and receiving sick leave benefits provided by social insurance. The actions are aimed at getting well as soon as possible, thus satisfying the individual needs of the ill person, and achieving this in accord with prevailing societal norms and expectations.

The systems described by Parsons are not static, but are capable of change and adaptation (Appelrouth and Edles 2008). We have witnessed a vivid example of this during the recent coronavirus pandemic in 2019, where all systems were forced to adapt in a brief time. Specifically, the need for individual care and cures during its outbreak peaked. The societal norms, values, and expectations as to people’s behaviour, working life, and private life changed drastically. Accordingly, the professions and institutions adapted to the situation by changing their rules and regulations in order to maintain the health of population and order in society.

Overall, it can be stated that the structural–functional approach in sociology views health as a common or collective attribute rather than something pertaining solely to the individual. Employing this perspective, society guides human behaviour and, hence, produces health outcomes. Not all sociologists share the same view. The passive role of the individual in power relations in society is highly criticised by symbolic interactionists (Cockerham and Scambler 2010). Symbolic interactionism offers a micro-level rather than macro-level approach. One of the founders of symbolic interactionism was Herbert Mead, who in his work “Mind, Self, and Society” (1934) proposed studying individuals through their interaction processes. The individuals in his theory are seen as capable of reasoning and deciding upon their behaviour as opposed
to passively reacting to stimuli provided by the environment, as suggested by the behavioural psychologists of his time, such as John B. Watson.

William C. Cockerham (2005; Cockerham, Abel, and Lüschen 1993), a sociologist and a proponent of the symbolic interactionism approach, influenced by both Max Weber’s and Bourdieu’s sociological ideas, has proposed a theory on health lifestyles which argues for agency in human action. The central emphasis in Cockerham’s theory is on the interplay between agency and structure, which is the determinant factor in the kind of health lifestyle that a person or a group is likely to adopt.

The central terms Cockerham uses to describe the agency of the individual are life choices (*Lebensführung*) and life chances (*Lebenschansen*); two concepts introduced by Weber which together constitute a lifestyle (Cockerham 2005; Cockerham et al. 1993). The former describes the choices an individual has when choosing his/her lifestyle, and the latter describes their chance of fulfilling these choices. Individuals are not completely free to choose their lifestyles but are free to act within social constraints (Cockerham et al. 1993). There is a mutual relationship between life choices and life chances, as the former might be influenced by the latter and vice versa (Cockerham 2005). This interplay constitutes the relationship between agency and structure, where structure either enables or constrains agency and generates dispositions to act (Cockerham 2005). Dispositions to act are described as ‘habitus’, employing the concept from Bourdieu. Cockerham states that habitus is a “cognitive map or set of perceptions that routinely guides and evaluates a person’s choices and options” (2005:61). Habitus cannot be understood independently from social structures and conditions because these are included in it and mirror the normative patterns of social behaviour. Yet, agency is not determined by structure, as it is the individual experience that provides the agency with the capacity of acquiring new information through habitus that allows for creativity and change (Cockerham 2005).

The above-described examples of sociological theories point to several conclusions. First, there is the interest in and importance of studying the health of individuals from a sociological perspective. Second, using the context of health in constructing and investigating sociological theories is an important aspect of sociology. Third, knowledge of other fields—such as medicine—is often applied to studying and understanding health in sociology. All this brings sociology closer to such sciences, as, for example, medicine, epidemiology, and public health. Moreover, shared study interests (health outcomes) between sociology and other sciences have triggered the emergence of a new subfield within sociology: medical sociology.
4.2 Medical sociology and epidemiological sociology

Medical sociology emerged from general sociology in the first half of the 20th century in the US and Europe (Siegrist 2013). Some argue that sociological theory constitutes the link between general sociology and medical sociology, distinguishing medical sociology from other sciences, such as public health and epidemiology (Hill et al. 2021). Yet, medical sociology, to a large extent, was considered to lack any theoretical grounds in its formation (Cockerham and Scambler 2010). According to Cockerham and Scambler (2010), this was because too much attention was dedicated to practical problems rather than theoretical ones, and, especially in Western Europe, few medical sociologists were affiliated with sociology departments at universities. The reasons behind why medical sociology was perceived as atheoretical was connected to its emergence from and development by government funding that aimed to support research that had practical value in post-war society (Cockerham and Scambler 2010). However, with the passage of time, there has been a noticeable increase in theoretical work in the field of medical sociology, although most research continues to have a practical orientation (Cockerham and Scambler 2010).

Hill and colleagues (2021) have recently pointed out that the field of medical sociology has different names and different definitions, which create confusion as to both the scope of the science and its contribution to knowledge. They state, that given recent developments in the field, the two-subfield model (i.e. “sociology of medicine” vs. “sociology in medicine”) proposed by Straus in 1957, no longer adequately characterises medical sociology (Hill et al. 2021:5). Instead, they propose a four-subfield model, extending Straus’ model and employing a disciplinary structure approach that distinguishes between “substantive topics, theoretical orientations, and contributions to the interdisciplinary study of health” (Hill et al. 2021:6). The proposed subfields of medical sociology are: 1) social epidemiology, 2) social psychology of health and illness, 3) sociology of medicine, and 4) sociology in medicine. Their schemata and a brief summary are provided in Figure 1.
At a first glance, this thesis could be considered to belong to the field of social epidemiology, where much of the research is conducted. However, sociologist Bruce G. Link\(^3\) (2008) has raised a sound argument stating that social epidemiology has, due to education, training, and occupational positions, become a sub-discipline of epidemiology rather than that of sociology. He suggests using the term “epidemiological sociology”, where the power balance between epidemiology and sociology is restored, the latter being given full credentials in understanding the social factors in health research.

Link’s (2008) main argument is that despite the scientific development and the impressive improvements in population health, the distribution of this improvement is not even across individuals, time, and space. He claims that social factors are essential in understanding and explaining observed health and its disparities across populations. Hence, the main role in explaining any phenomenon linked to health in society is attributed to sociology. This is also literally reflected in the name “epidemiological sociology”, where “sociology [is] the subject and epidemiology the modifier” (Link 2008:369).

Summing it up, this thesis is written in field of sociology, however, it can also be considered to belong to the sub-discipline of epidemiological sociology.

\(^3\) I am grateful to Associate Professor Stefan Fors for learning of Link’s article.
5 The concept of health

The previous chapter highlighted how sociology has contributed to health studies by incorporating it into its theories and introducing new approaches to studying it, hence expanding its meaning from the strictly medical or biological to the sociologically meaningful. The discussions had the health of the individuals at their core, yet the concept of health per se was somewhat silent in these discussions. Hence, this section turns to defining and problematizing the concept of health.

Mildred Blaxter, a British medical sociologist, summarises in her book “Health” (2010) four different ways in which health can be defined:

- **Health as the absence of illness.** Healthy individuals are those who are “not biologically disadvantaged” (2010:5). They have a normal life expectancy and reproductive function. However, presenting this approach the author points at the problematics concerning normality and the presence of mental diseases, as well as subjectivity.

- **Health as balance or homeostasis.** This view on health stems from the ancient ideas emphasising the body’s ability to maintain equilibrium and, thus, cure itself.

- **Health as a function.** This definition of health is expressed in a rather positive tone: health means having the ability and capacity to do things and engage with the surrounding environment both physically and socially.

- **Health as a state or status.** In a broader sense, we may refer to health as a temporary state; for example, at present, or think of it instead as a long-term status, such as health in general. The problem with this approach, according to Blaxter (2010), is that individuals do not necessarily think in the same categories as medical professionals do; i.e. acute or chronic. Furthermore, these categories might be overlapping, as individuals may experience acute conditions chronically and chronic diseases may cause acute illnesses. Any present state, according to the author, is an unstable condition and can be very different from general health. It affects the health status “only if it (health state) derives from it or if (because of its typicality or frequency) it reflects back to be incorporated into health status” (text in italics added to Blaxter, 2010, p. 10).
The previous paragraph presented some basic ways in which health can be broadly defined. Let us now be more specific and turn to some well-known definitions of health. Probably the most accepted and widely used definition of health is that proposed by the World Health Organization (WHO) in 1948 (World Health Organization 2020:1): “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. There exist, however, other definitions proposed by researchers. For example, O’Donnell (2009) includes physical, emotional, social, spiritual, and intellectual aspects in his definition of health (2009), while Bircher (2005) sees health as:

A dynamic state of wellbeing characterized by a physical, mental and social potential, which satisfies the demands of a life commensurate with age, culture, and personal responsibility. If the potential is insufficient to satisfy these demands the state is disease (2005:336).

The aforementioned definitions vary substantially, yet all agree that health is a multidimensional concept. However, there is no agreement as to what dimensions health consists of or whether we should consider it static or dynamic. Despite the pronounced acceptance of multidimensionality of the concept in question, dimensions per se do not tell us anything more about health or how it could be evaluated. Consequently, this leaves us with broad but vague notions that are problematic to operationalise.

The definition proposed by the WHO has—despite its wide acceptance—probably faced the most criticism. The critique was particularly addressed to the words “complete” and “social well-being” (Larson 1996). Speaking in terms of “complete”, as stated by many authors, one cannot ever be regarded as healthy or, in other words, is sick all the time. Similarly to Bircher (2005), Turns and Newby (1983) note that health is not a static state, but rather a temporary one and, consequently, difficult to measure. As for social well-being, it is viewed as a factor that may directly influence health rather than constituting a separate dimension (Larson 1996). Larsson (1996) further proposes to modify the WHO definition of health by substituting “complete” with “adequate levels” of physical, mental, and social well-being, which would be influenced by culture, age, level of disability, and other background characteristics. However, it is difficult to see how Larsson’s (1996) proposal would solve the problem, as this would imply defining what constitutes an “adequate level”—adequate for whom and compared to whom. The suggested changes would turn health into a ‘relative’ concept, providing problems of its own.

In sum, there are a variety of characteristics attributed to health, and accordingly the definitions of health differ. This suggests that health consists of multiple attributes or aspects and this is acknowledged in this thesis. Hence, this thesis problematizes different aspects of health, based on a literature re-
view, and investigates the relationships between them. Instead of testing a particular definition, the aim is to see whether and how the different aspects of the multidimensional concept of health are related in a real-world population. Apart from reaching a consensus that health is a multidimensional construct, the aforementioned definitions of health indicate that health is commonly seen as having biological, psychological, and social components (Bircher 2005; Larson 1996; O’Donnell 2009; World Health Organization 2020).

Forstner (2022), in his conceptualisation of disability, employed the idea of the health sociological triad consisting of disease, illness, and sickness. These concepts, according to his view, represent the dimensions of the body, the individual, and society, respectively. In this dissertation, a similar conceptual framework is applied to the concept of health. Hence, health in this dissertation is studied from the perspectives of body, psyche, and society. The next section aims to address the most widely used aspects of health separately, considering how they could be operationalised.
6 Different aspects of health

Henceforth in this thesis, the term “health aspects” will be used instead of “health dimensions”. This is done because the term “dimension” is often associated with some particular measurement such as length or height, or even with plane quadrants that have their opposites. “Aspect” appears to be a more appropriate word for describing these phenomena, since it refers to constituent parts rather than being associated with some measurement.

6.1 Morbidity

The biological or physical component of health is related to different health conditions or different health problems and is usually termed ‘morbidity’. According to WHO, morbidity is defined as “the condition of being diseased or sick. Also the amount of sickness and disease caused by a particular agent or condition” (2014:175). Illness is yet another concept that is used concerning morbidity. Thus, morbidity is usually associated with three concepts: disease, illness, and sickness, which are often used interchangeably. Blaxter (2010) discusses the meaning of these different concepts. Following her discussion, “disease” can be understood as a medically defined pathology; that is, abstracted and generalised and therefore objective in nature. Illness, as an opposite to disease, has subjective origins and reflects the individual’s experience of poor health. Finally, sickness entails the social role of diseased or ill individuals.

To put forth and explain these concepts in detail, I will first refer to the one which is perhaps most easily explained: disease. The Oxford English Dictionary defines disease as “a sickness or instance of sickness (in a person, animal, or plant); a condition in which the function, and often also the structure, of the body or part of the body is disturbed or impaired” (2023). Eliot Freidson, an American medical sociologist, in his book “Profession of Medicine” (1970) discusses the concept of illness and, consequently, the difference between disease and illness. He makes a clear distinction between the biophysical and the social aspects of illness, where the latter was seen from the perspective of social constructionism. In Freidson’s own words, “while illness as a biophysical state exists independently of human knowledge and evaluation, illness as a social state is created and shaped by human knowledge and evaluation.”
(Freidson 1970:223). He also described the process of how human behaviour can be influenced by adding a social layer to the physical condition:

> When a physician diagnoses a human’s condition as illness, he changes the man’s behavior by diagnosis: a social state is added to a biophysical state by assigning the meaning of illness to disease. It is in this sense that the physician creates illness just as the lawmaker creates crime, and that illness is a kind of social deviance analytically and empirically distinct from mere disease. (Freidson 1970:223).

The aforementioned demonstrates that some authors do draw a difference between disease and illness. However, Freidson’s distinction between disease and illness is different from that of Blaxter’s, as she describes illness as subjective experience rather than a socially constructed phenomenon (2010).

Hence, the different attributes—both social and psychological—can be attached to biophysiological changes in the body. This is especially vividly described in Martínez’s (2005) study. She investigated women diagnosed with cervical cancer (generally a symptomless disease in its early stages) in Venezuela and calls their condition “living in the borderlands of health, disease, and illness” (Martínez 2005:798). She states that disease and illness may occur simultaneously, or illness might be present without disease, or vice versa. She advises not drawing a clear distinction between health, diseases, and illness nor seeing these conditions as contradictory phenomena, but rather encourages us to focus on their interrelationships.

To summarise, disease and illness are separate yet related concepts, and the presence of one and the absence of the other can reveal complicated processes; hence, the two terms should not be used interchangeably.

Regarding the third term, sickness is distinguishable from both disease and illness, as it refers to the social role rather than to the physical state or the psychological experience of the sick person. The sick role concept, introduced by Parsons (1951), is widely adopted in sociology. Blaxter, for example, states that sickness is “seeking medical help, assuming or seeking ‘permission’ to give up one’s normal roles or occupations in life or experiencing special considerations” (2010:21). Also, an individual can feel ill or be diagnosed with a disease without adopting the role of the sick (Blaxter 2010). However, the relation of sickness to disease and illness is dependent on the social context in which it is applied. Hence, it will vary across the borders depending on the ‘legitimate’ diseases of a particular time, the current health of citizens, and the economic situation of the country.

Turning to the operationalisation of morbidity, there is no one self-evident way of measuring it, but different ways can be utilised to capture a particular connotation of the concept. Various measures at different levels of analysis exist. At the individual (micro) level, for example, Blane and colleagues (1996) claim that morbidity can be measured by employing physiological
markers, self-perceived well-being, and self-reported morbidity, where the latter would refer to self-reported prevalence of various diseases. Indeed, self-reported prevalence of disease is the most widely employed measure of capturing morbidity in medical sociology. Usually, it is operationalised by asking a person whether or not s/he ever has been diagnosed/suffered from the diseases/conditions/problems specified in a given list. In general, the listed (groups of) diseases or problems are those that have the highest prevalence in society. At the aggregated (macro) level, morbidity reflects the burden of diseases in society, commonly employing incidence and prevalence rates.

6.2 Functional limitation, disability, and related concepts

Disease, as mentioned above, is seen as dysfunction in the body or in an organ. Functional limitation, different from disease, reflects the difficulty performing some simple, physical tasks of daily life. Various terms are used to denote the problem(s) or difficulty(-ies) in functioning. The most common are impairment, functional limitation, and disability. Hence, the definitions of these terms and their use are of interest in this section.

The roots of these concepts come from American sociologist Saad Nagi’s (1991) disability model (see Figure 2) consisting of four concepts: active pathology, impairment, functional limitation, and disability. The latter three are described here. Impairment specifies a loss or abnormality at different levels such as anatomical, physiological, mental, or emotional. Functional limitation denotes the restrictions of a body to function as a whole. Both impairment and functional limitation encompass function, yet the former refers to the parts of organism (tissues, organs and systems), and the latter refers to an organism as an entity (performing activities such as walking, climbing, reaching, etc.). Disability refers to person’s performance of the expected social roles and tasks within a sociocultural and physical environment. Hence, disability is not related to the function of the organism but rather to the ability to function according to social expectations in a particular environment. Hence, this intersection of individual’s performance with the social and physical context in which the individual is living makes disability a relational concept.

![Figure 2. The disablement process according to Nagi (1991, simplified).](image-url)
More recent explanations of these key concepts related to problems in functioning are provided by medical sociologist Hannah Bradby (2009). Her descriptions are largely consistent with those of Nagi. More specifically, impairment, according to Bradby, is “a sensory, cognitive, or physical aspect of an individual’s functioning which shows some deficit or deviation from the norm” (Bradby 2009 p. 119). Regarding disability, Bradby (2009) sees it as originating in the interplay of the subject and his/her environment.

Organisations such as WHO have also taken an active role in defining and refining some of the aforementioned concepts. Functioning and disability stands at the centre of WHO’s International Classification of Functioning, Disability and Health (ICF) (World Health Organization 2001). Both of these terms, according to WHO (World Health Organization 2001), have two components: the body’s functions and structures, and activities and participation. These components can indicate problems which are then referred to as ‘impairments’, ‘activity limitation’, and ‘participation restriction’, respectively. Alternatively, these components can be non-problematic and referred to as ‘functional and structural integrity’, ‘activities’, and ‘participation’, respectively. The negative aspects of the three above mentioned constructs would represent disability, while the positive aspects would represent functioning. The negative aspects describing disability are discussed below.

Impairments are defined as “problems in body function or structure as a significant deviation or loss” (World Health Organization 2001:10). These refer to physical or mental problems that are not necessarily associated with disease (World Health Organization 2001). As an example, the loss of a limb would constitute an impairment, but not a disorder or a disease. Hence, impairments are more wide-ranging in their scope than are diseases or disorders (World Health Organization 2001).

Activity limitations are defined by the WHO as “difficulties an individual may have in executing activities” and participation restrictions as “problems an individual may experience in involvement in life situations” (World Health Organization 2001:10). The ICF acknowledges that it is difficult to separate activity limitations and participation restrictions. The former term refers more to individual experience while executing some tasks, while the latter is about one’s engagement in social life; however, WHO do not suggest making such a clear distinction due to global differences in approaches and theoretical frameworks. In general, disability and functioning, in WHO’s view, can be approached from three perspectives: biological, individual, and societal (World Health Organization 2001). The diagram of functioning and disability, including the interactions between their corresponding components and other factors, is presented in Figure 3. According to WHO (2001), the diagram does not model the process of functioning and disability; rather it presents guidelines for researchers on the contemporary views of the interactions between their various components.
The ICF classification was adopted in 2001, however, studies published both before and after that often use different terms and assign different meanings to them. For example, Nagi (1991), as described above, views disability from a social perspective, while functional limitation in his model resembles problems performing some physical activities. Thus, his use of the term ‘disability’ is somewhat more restricted than that suggested in ICF (World Health Organization 2001); however, this must be understood in the context of prevailing views on the ‘limitations’ of that time. Even when time is taken into account, the terminology is still not consistent across empirical studies. For instance, studies from the 1990s still speak a ‘different language’. Lawrence and Jette (1996) refer to functional limitations and disability, employing Nagi’s definitions, while Johnson and Wolinsky (1993, 1994) and Whitelaw and Liang (1991) refer to disability as a physical limitation and to functional limitations as social.

As noted earlier terminology is not used consistently across studies; hence, both functional limitation and disability can be measured in a similar way. For this particular reason, this thesis refers to the most commonly used measure.
in studies where difficulties in performing various tasks are of interest, irrespective whether it resembles functional limitation or disability; namely activities of daily living (ADL). Originally named the Index of Independence in Activities of Daily Living (Index of ADL), ADL is a tool developed by Katz and colleagues (1963) that summarises a person’s performance based on their performance adequacy in six functions: bathing, dressing, going to toilet, transferring, continence, and feeding. Since its creation, the Index of ADL was further developed, modified, and new measurement instruments have emerged (Katz 1983). Nevertheless, nowadays this index or its equivalent is still used by researchers. Most often problems related to task performance on a daily basis are captured by dividing ADL into basic ADL (largely resembling self-maintenance, such as bathing, dressing, and going to the toilet) and instrumental ADL (resembling slightly more complicated tasks than basic ADL; for example, shopping, cooking, housekeeping, etc.). Mobility is another measure of physical difficulties in managing everyday life tasks related to the ability to move, for example, walk indoors, getting outdoors, and transferring. This measure can somewhat overlap with both basic and instrumental ADL.

6.3 Subjective health

The most well-known and most widely used proxy of general health is self-rated general health (Schnittker 2005). Self-rated health is usually assessed by one single question that may have minor variations from survey to survey, but that is usually expressed as “How is your health in general? Would you say it is […]” (European Social Survey 2014:15), providing answers for a respondent to rank their own health on a five-point scale from poor to excellent.

According to sociologist Schnittker (2005), the widespread use of this measure is reflected in its easy incorporation in questionnaires and low question-specific non-response rates. Furthermore, it has a variety of desirable empirical qualities, such as predicting mortality and treatment behaviour, and is significant in assessing outcomes. However, what exactly it measures might differ from person to person and varies across cultures and ages. This is where qualitative research is of great help, as it facilitates understanding of how people evaluate and what meaning they attach to ‘health’. Yet, according to Schnittker (2005), self-rated health cannot be fully regarded as purely subjective, since it usually overlaps with a range of ‘objective’ indicators rather than constituting a unique explanation of an individual’s health.

Recognising that one single question on self-rated health is capable of capturing different domains of health and predicting health outcomes, the query about the mechanisms behind it arises. Idler and Benyamini (1997) conducted an extensive literature review and proposed explanations for the mechanisms behind the association between self-rated health and health decline; more specifically, mortality. They suggest that:
• Self-rated health is a more inclusive and precise measure, as it captures illness and even symptoms of undiagnosed disease, characterises complex human judgements, and mirrors family history.
• Self-rated health is a dynamic evaluation capable of explaining not only the current state of health but also its trajectory.
• Self-rated health influences behaviours which in turn affect one’s health state.
• Self-rated health reveals different resources; for example, social environment (income, education, living arrangements, and social networks) and a person’s resources (control over health and depression). These resources can either facilitate or offset health decline.

Given the various interpretations of why subjective health is a ‘good’ predictor of mortality and other outcomes, the question arises: What do the respondents think of when they are asked to evaluate their health? According to Hays and colleagues (1996), a person’s self-rated health is not only influenced by the “presence or absence of disease, but as well [by] coping strategies, mental health, functional and social resources, and knowledge of their disease” (1996:188). Krause and Jay (1994), in their qualitative study, investigated the meaning people attach to self-rated health. More specifically, they were interested in why people reply the way they do to the global health status question: “If you were asked to describe your health, would you say that it was excellent, good, fair, or poor?” The results showed that most often people think in terms of presence (25%) or absence (22%) of health problems, positive (13%) or negative (11%) health behaviour, physical functioning (10%) or their general physical condition (10%). Only in one percent of the respondents, did mental health guide their replies. Moreover, health comparisons (6%) and energy (3%) were also used as frame of reference when evaluating one’s own health. The authors also investigated whether differences in the grounds on which health is evaluated exist between different subgroups formed by age, gender, race, and education. The results revealed that different frames of reference are used by various age groups; namely, one’s own health behaviour by younger, and health problems by the older respondents, respectively. They also found differences across race groups, stating that whites more likely consider physical functioning, whereas non-whites use health problems as a frame of reference. Respondents with a lower level of education might use health behaviour as a frame of reference.

Similar to Idler and Benyamini (1997), Leventhal (1984) recognises the importance of illness and propose a cognitive model of illness perception. This model assumes that the perception of one’s physical limitations and diagnosed health problems causes the individual to pay attention to other health problems that otherwise might have been ignored. Moreover, the cognitive model of
illness perception suggests that the correlation between any specific health indicator and self-rated health would become more prominent with age. This assumption is empirically supported in the aforementioned study by Krause and Jay (1994), where older persons are more likely to think of particular health problems when evaluating their health, compared to younger ones.

Idler and Benyamini (1997) state that self-rated health represents an “irreplaceable” dimension of health, and, despite the fact that the question assessing self-rated health varies from study to study, the consistency of the effects show that it is relatively insensitive to semantic variations. To check this assumption, Manderbacka and colleagues (2003) conducted a study where they investigated the effects of the point of reference on the predictive validity of two self-rated questions—namely, an age-group comparative question and a global question with no explicit point of reference—both on mortality. The analysis was stratified by gender. When each of these questions were included in the model separately, the global self-rated question predicted mortality in women but not in men, while the age-referential question on self-rated health predicted mortality for both genders. Including both of these indicators in the model simultaneously resulted in age-referential question losing its predictive power for women, while the age-referential question only remained significant for men. The authors’ conclusion was that the self-rated health measure is sensitive to semantic variations and that different wordings of the question capture partly different aspects of health that differ among males and females. Hence, the authors suggest that gender differences in how health is understood when evaluating it do exist. More specifically, according to the authors, women can evaluate their health on various bases, while men evaluate their health only in relation to the health of their same-age peers.

### 6.4 Mortality

Mortality, in individual measurement, is the death of a person. This measure of health raises the least discussion and concern compared to the other health measures. Yet, different measures of mortality exist at different levels of analysis. For example, at the individual level, in studies employing event-history analysis, mortality can be measured by the death (more specifically, time to death) of the observed respondent either from a specified or non-specified cause or disease. In general, mortality studies require a long observation period (at least a couple of years) for survival data to be collected. However, at the macro level, where data come from vital statistics in a population, measures such as crude death rates (CDR) or standardised death rates (SDR) are available, where the latter take the age structure of the population into account and, hence are more desirable and reliable in comparative mortality research across the countries. Standardised death rates can also be estimated for death from specific diseases, such as ischemic heart disease, cerebrovascular
diseases, and diseases of the circulatory system, among others. Furthermore, life expectancy, measured in years at different ages—for example, at age 65—can also be used as a mortality measure.
7 Approaches to studying the relationships between aspects of health

7.1 Two methodological approaches to studying relationships

Relationships between different phenomena can be studied in various ways depending on the aims of the study, the research questions, and the data. The most common and perhaps easiest way of exploring these associations is to look at how one or more independent variables affect a variable of interest. This can be done by various methods, of which the most commonly used are ordinary least squares (OLS) regression and logistic regression. When the outcome variable is more complex and includes a temporal aspect—for example, time to a respondent’s death or to the onset of disease—different types of hazard models are practical. A common feature of these techniques is that they model the relationships with only one outcome variable. However, doing so conceals the intra-relationships between the variables. Expanding the model to include multiple dependent variables offers a deeper understanding of how these affect each other simultaneously. Fortunately, techniques such as path analysis and structural equation modelling (SEM) can assist in reaching this goal. Summing it up, two broad groups of techniques can be discerned based on relational complexity. The studies adopting the former techniques can be called multivariate studies, while those employing the latter approach can be named complex studies.

7.2 Study I

The general aim of this thesis, as stated above, is to study the relationships between different aspects of health. This is done by performing three studies, each having a particular focus on the studied relationships. The first study (Study I) is the analysis of the previous research literature with the help of a systematic review. The systematic review explores and describes the study field. Table 2 summarises the systematic review study and the other two studies included in this thesis (Study II and Study III).
7.2.1 The research questions of Study I

The first study fulfils its goals by addressing the two research questions as follows:

1. How are the studies that consider various aspects of health designed in terms of sampling the respondents, selection of the modelled health aspects, the methods used in the studies, and the locations where they are conducted?

2. What relationships are identified in the selected studies when analysing the links between morbidity, functional limitation/disability/impairment, subjective health, and mortality?

The articles included in the systematic review constitute part of the studies described and discussed in Section 8, below.
8 Research on the relationships between aspects of health

As there are different types of studies according to the methods they employ (see Section 7.1 above), the literature on the relationships between the aspects of health will be discussed accordingly. The first part will discuss multivariate studies, while the second part will focus on complex studies.

8.1 Multivariate studies

A multivariate relationship analysis was conducted in 69 of the 81 investigated articles. The country overview of these articles is provided in Figure 4. It shows that studies on the relationships between aspects of health have been undertaken on all continents (see Figure 4). However, there is variation as to both country coverage and the number of studies conducted within each continent. For example, the most represented continent is North America, with 17 studies conducted in the United States alone. Europe has been in focus somewhat less often. Even though studies have been undertaken in different parts of Europe, two points crystallise here. First, some countries, such as Germany, Greece, Sweden, and Switzerland have been studied only once. Second, Eastern European countries appear to be neglected in this type of research; alternatively, the results do not reach an international audience. Although Russia is highlighted on the map, the data come solely from St. Petersburg.
Figure 4. The countries where the multivariate studies included in the systematic review were undertaken, n=824

4 Of the analysed 69 articles studying multivariate relationships, three articles included two locations and one article 11 locations.
The distribution of the respondents’ ages is presented in Figure 5. The pie chart shows a clear pattern of elderly persons being at the centre of studies’ population of interest, where the majority of the studies (68%) study those aged 60 or 65 and older. Only a small minority of studies (7%) include adults of all ages.

Figure 5. Relative frequencies (percent) of articles by respondents’ lower age limit, n=695.

The year when data were collected is reported in Figure 6. The chart points out that most of the data that this type of research relies on were collected before 2000, with the greatest share (49%) attributed to the time interval between 1990 and 2000. A minor proportion (3%) of the studies utilise data collected in the last decade.

The category “not available” (n=4) includes articles that instead of age range provided the mean age of the respondent. In one article, the mean age of the respondents was 65.2 years while in the other articles, the mean age of the respondents was 72.4 years or older.

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5 The category “not available” (n=4) includes articles that instead of age range provided the mean age of the respondent. In one article, the mean age of the respondents was 65.2 years while in the other articles, the mean age of the respondents was 72.4 years or older.
Figure 6. Relative frequencies (percent) of the data collection (starting) years (multivariate studies), n=69

Figure 7 shows the relative frequencies of study variables (at least two aspects of health as predictors in one model) by the statistical significance of their effects on another health aspect (an outcome in the same model). Statistically significant relationships were found in 59 percent of cases (see Figure 7).

Figure 7. Relative frequencies (percent) of predictor health variables used in 69 articles by statistical significance of their effects on other health-related outcome variables\(^6\), n=740

\(^6\) The data includes at least three different aspects of health analysed simultaneously in one model, which uses at least two health aspects as predictors and one health aspect as an outcome.
The next sections will discuss findings on the relationships that are of the most interest to this thesis; i.e., the relationships between: a) morbidity, subjective health, and functional limitation; b) morbidity, functional limitation, and subjective health; and c) subjective health and mortality.

8.1.1 The effects of morbidity and subjective health on functional limitation

An article by Hirosaki and colleagues (2017) on the Japanese elderly shows that apart from self-rated health, osteoarthropathy significantly increased the risk of functional deterioration in activities of daily living (ADL) after three years of follow-up while controlling for different variables. Other morbidity-related variables, such as taking anti-hypertensive drugs or suffering from ischemic heart disease, did not have any effect on functional ability. A study by Brito and colleagues (2016) performed on elderly persons in Campina Grande (Brazil) shows that both poor subjective health and the number of non-communicable diseases increased the probability of having a functional disability. Another study by Feng and colleagues (2011) similarly shows that the number of chronic diseases, the respondents’ subjective health, and even their cognitive functioning had a significant association with disability in Shanghai and Singaporean elderly.

8.1.2 The effects of morbidity and functional limitation on subjective health

Campos and colleagues (2015) in their study found that both the absence of chronic diseases and suffering from only one chronic disease increase the likelihood of reporting good subjective health compared to those having two or more chronic diseases in both Chilean and Brazilian elderly populations when controlling for other variables. In the same analysis, the associations between functional limitations (both ADL7 and IADL8) and subjective health were significant in the pooled sample in both countries, while some gender differences emerged in a separate analysis. Cognitive impairment, however, was not a statistically significant predictor of subjective health in the pooled Brazilian sample when controlling for other variables.

Regarding the association between morbidity and subjective health, Meng and colleagues (2014) arrived at a similar conclusion in a study on the Chinese elderly population. In a multivariate analysis, they demonstrated that the number of chronic conditions, the seriousness of the illness (whether one was ill in the last two weeks), and hospitalisation predicted the state of respondents’ subjective health. The results regarding the predictive ability of

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7 ADL—activities of daily living.
8 IADL—instrumental activities of daily living.
functional limitations on subjective health in that study were less straight-forward, showing that the respondents’ ability to engage in self-care (washing and dressing) was the only (out of four total variables) functional status variable that significantly predicted subjective health. A study performed by Cabrero-García and Juliá-Sanchis (2014) on the Spanish elderly population is, in certain aspects, in accord with the studies mentioned above, showing that both physical morbidity\(^9\) and functional disability predict self-rated health in a significant manner.

Separating different diseases, a study by Hoeymans and colleagues (1999) found that coronary heart disease, stroke, respiratory symptoms, and musculoskeletal complaints were statistically significant predictors of subjective health in elderly Dutch men, while diabetes, cancer, and back pain were not. Moreover, none of the disability variables included in the same model with various diseases had a statistically significant effect on subjective health. Along with ‘heavy’ chronic diseases, even minor illnesses/symptoms were found to have an independent effect on subjective health in the general adult population of South Africa (Ardington and Gasealahwe 2014). Yet, in the same study, severe hypertension and difficulties performing activities in daily living did not affect health assessment.

8.1.3 The effect of subjective health on mortality

There are studies supporting an association between subjective health and mortality (Berger, Van der Heyden, and Van Oyen 2015; Ng et al. 2012; Vogelsang 2014). More specifically, Berger and colleagues (2015) found subjective health to be a strong predictor of 10-year mortality in the Belgian adult population. An association between subjective health and 13-year mortality was also found by Vogelsang (2014) among the oldest old in the United States. Apart from poor subjective health significantly increasing the mortality risk, negative changes in subjective health between the waves of the study also increased the risk of dying. A study in another cultural context, Indonesia, conducted on an older population by Ng and colleagues (2012) also shows that subjective health predicts short-term (three-year) mortality in both men and women.

In general, the association between subjective health and mortality has been somewhat established in the scientific world. However, some previous research points out that this association does not always hold true. For example, subjective health was not a significant predictor of male 10-year or 18-year mortality when the number of chronic diseases was included in the model (Lyyra et al. 2006). Similarly, in a study by Bath (2003) subjective health was

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\(^9\) Physical morbidity was measured by a functional comorbidity index (FCI) consisting of 16 chronic conditions in total, after excluding psychiatric conditions, anxiety, and depression.
not an independent predictor of either short- (four-year) or long-term (ten-year) mortality among men or women.

Summarising this section, previous research confirms the significant associations between different aspects of health. Yet, more research supports the association between morbidity, functional limitation, and subjective health while the association between morbidity, subjective health, and functional limitation is not clear-cut. Also, there is a great research bias regarding both location and age of the study population. More specifically, the United States and the elderly have been the centre of interest in studies trying to disentangle the connections between aspects of health.

8.2 Complex relationship studies

Section 8.1 above addressed research that has not attempted to study the aspects of health as one interconnected system. Their emphasis has rather been on how some aspects of health affect another aspect. They have relied on single-equation systems, thus estimating direct net effects. The focus of this section lies in expanding the view on health, describing research that studies health as an interconnected structure by estimating different models of health and investigating both direct and indirect effects. Such studies and their main findings are summarised in Table 1 (see below).

The interest in studying health as one interconnected system can be traced back to the 1980s and 1990s. The first developers of this type of approach to studying health were Liang (1986), Whitelaw and Liang (1991), Gibson (1991), Liang et al. (1991), Johnson and Wolinsky (1993, 1994), and Stump et al. (1997). The authors of these works have proposed and tested different models of health structure using structural equation modelling.

The first to propose a structural model of health was Liang (1986). Her model consisted of different measurements of health, such as chronic illness, sick days, physical self-maintenance, instrumental activities of daily living, and subjective health. The model was confirmed, and it shows that physical illness affects an individual’s role performance. Both illness and role performance in turn influence the respondents’ evaluation of their subjective health. However, Whitelaw and Liang (1991) considered the model, consisting of five dimensions\(^\text{10}\) measured by 23 indicators, to be too complex, and testing it on different population subgroups to be overly challenging. The authors proposed a more parsimonious three-dimensional model in order to overcome the complexity of Liang’s model (1986). Two dimensions of health, specifically

\(^{10}\) Since this section reviews the previous literature, the term ‘dimension’ (instead of ‘aspect’) is used, if this is done by the author(s) of the discussed studies.
chronic illness and functional limitation were each measured by two composites rather than by multiple indicators. The results of the improved model were in line with Liang’s finding that chronic illness has both direct and indirect effects on self-rated health and a direct effect on functional limitation. In turn, functional limitation has a direct effect on self-rated health.

A following study by Liang and colleagues (1991) was comparative in nature, with a predominant focus on testing the three-dimensional model in two different cultural settings, one Western and one non-Western, among elderly populations in the US and Japan. Age, sex, education, and marital status were added to the model in order to estimate important exogenous variables’ effects. The results suggest that the three-dimensional model fits equally well in both cultures, yet exogenous variables such as age, sex, and education have different effect patterns on the health dimensions in the two countries. Surprisingly, marital status shows no effect on any health dimension, either in the US or in the Japanese sample.

Yet another model of health structure was proposed and tested by Johnson and Wolinsky (1993) two years later. Differing from the three-dimensional model, they proposed a four-dimensional model by specifying health dimensions as follows: a) disease, b) disability, c) functional limitation, and d) perceived health. In general, the model of health structure was confirmed. The authors also suggested that diseases should be treated separately rather than summed up (Johnson and Wolinsky 1993), which was the case in previous studies (Liang et al. 1991; Whitelaw and Liang 1991). Furthermore, it was found that disability, rather than diseases, affects functional limitation, and that several diseases have a direct effect on perceived health, while a majority of the listed diseases influence subjective health indirectly through disability and functional limitation. The same four-dimensional model by Johnson and Wolinsky (1994) was further investigated from a gender and race perspective. Empirical results reveal that gender and race differences exist in the measurement model, implying that the validity of the measures varies across race and gender. Similarly, Gibson (1991) also found differences between Whites and Blacks in her measurement model. She concluded that the validity of subjective health was better for Whites than for Blacks, while the opposite was true regarding the validity of disease, while the evidence for the validity of disability remains inconclusive.

Differently from the previous studies, where the ultimate outcome variable was considered to be subjective health, Stump and colleagues (1997) tested two models with two different ultimate outcomes variables, self-rated health and depression, for Hispanic, African-American, and White adults aged 70 and older in the US. They found that lower body disability has a significant effect on both outcomes11. Yet, contrary to expectations, none of the constructs

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11 Malaise and negative affect were two outcomes interpreted by the author as dimensions of depression (see Table 1).
for the performance of activities of daily living (ADL) show direct effects on self-rated health. Regarding depression-related outcome variables, only basic ADL has a significant direct effect on malaise. At the same time, lower-body disability has a significant direct effect on all\textsuperscript{12} constructs measuring activities of daily living in both models. Diseases, treated as exogenous observed variables in both models, generally lead to poor functional status, disability, and poor subjective health. More specifically, all diseases increase the probability of disability, and all diseases, apart from psychiatric problems, worsen the respondents’ subjective health. As for functional limitation, cancer, heart diseases, and psychiatric problems do not affect any of the constructs of functional limitation\textsuperscript{13}. In the depression model, all diseases worsen lower-body functional abilities, while only psychiatric problems increase the experience of malaise and negative affect\textsuperscript{14}. The results of the impact of various diseases on the three constructs of ADL in the depression model largely resemble those found in the subjective health model.

A study conducted on the elderly Finnish population by Leinonen and colleagues (1999), aside from diseases, functional ability, physical, cognitive and psychological performance, and subjective health, also included a variable of health habits\textsuperscript{15}. The authors found that the factors that explain subjective health best among both males and females are chronic diseases and functional ability. Diseases also influence subjective health indirectly, through functional ability and physical performance. Similarly, physical performance affects both functional ability and subjective health. However, there are some gender differences. Regarding the direct effects, depressive symptoms predict subjective health among females, while among males it is cognitive performance that predicts subjective health. As for indirect effects, diseases influence subjective health indirectly through depression among females.

More recent research has expanded the health structure models (see Table 1) by including mental health (Alonso et al. 2013; Gaumé and Wunsch 2010; Golini and Egidi 2016; Li et al. 2021; Lisko, Törmäkangas, and Jylhä 2020; Schüz et al. 2011); sensory functions and bodily symptoms (Lisko et al. 2020); health behaviours (Gaumé and Wunsch 2010; Hirve et al. 2014; Li et al. 2021; Schüz et al. 2011); social support (Gaumé and Wunsch 2010; Hirve et al. 2014); locus of control (Gaumé and Wunsch 2010; Schüz et al. 2011); stigma, discrimination, and family burden (Alonso et al. 2013); quality of life (Hirve et al. 2014); and various socioeconomic characteristics (Alonso et al. 2013; 12 Basic activities of daily living, household activities of daily living, and advanced activities of daily living.

\textsuperscript{13} Authors consider the results to be statistically significant at only 0.001 level or beyond. If the threshold of 0.01 is applied, then heart disease had statistically significant effect on advanced ADL, yet the effect was in the opposite direction, suggesting a protective effect.

\textsuperscript{14} If a threshold of 0.01 is applied, then heart disease had a statistically significant effect on malaise.

\textsuperscript{15} Despite the attempt of including the health habits, such as alcohol use and smoking, the variable eventually was dropped in the final model.
Gaumé and Wunsch 2010; Golini and Egidi 2016; Hirve et al. 2014; Li et al. 2021; Schüz et al. 2011). The latter studies have redirected attention away from the ‘core’ aspects of health onto studying the effects of health determinants and other variables on different aspects of health, particularly on self-rated health.

In general, it can be concluded that complex relationship studies, like multivariate studies, are mostly performed in the United States (Gibson 1991; Johnson and Wolinsky 1993, 1994; Liang 1986; Stump et al. 1997; Whitelaw and Liang 1991). In those cases when other countries are in focus, they are mostly limited to single-country or sub-group analyses. There are, e.g., studies from Italy (Golini and Egidi 2016), Germany (Schüz et al. 2011), India (Hirve et al. 2014), Finland (Lisko et al. 2020), and the Tibetan population in the Chinese plateau (Li et al. 2021). Only a few studies consider the country/cultural context. The exceptions are studies by Liang et al. (1991), Alonso et al. (2013), and Gaumé and Wunsch (2010). The study by Liang and colleagues (1991) compared the model between two very distant cultures: Western and Asian. Alonso and colleagues (2013) studied 22 countries based on an economic principle by grouping them into three categories according to the country’s income level. The study by Gaumé and Wunsch (2010) focused only on the three Baltic States.

Gender or age differences within or across cultures are seldom investigated. Another common feature found in the previous studies is that the models are predominantly tested on the elderly population; for instance, on those 50 years or over (Hirve et al. 2014; Li et al. 2021); 55 and over (Gibson 1991); 60 and over (Liang et al. 1991); 65 and over (Golini and Egidi 2016; Liang 1986; Schüz et al. 2011; Whitelaw and Liang 1991); 70 and over (Johnson and Wolinsky 1993, 1994; Stump et al. 1997); and 90 and over (Lisko et al. 2020). The only exceptions are the two studies by Alonso and colleagues (2013) and Gaumé and Wunsch (2010) as discussed above, studying all adult ages.

For a summary of the studies, see Table 1 below.

8.3 Study II

The main objective of the first empirical study is to test a parsimonious health structure model (specifying the relationships between morbidity, functional limitation, and subjective health) on the European adult (18 years or over) population, and to investigate whether gender or age differences exist in the health structure of the Europeans. An overview of Study II is provided in Table 2.
8.3.1 The research questions of Study II

1. What are the relationships between morbidity, functional limitation, and subjective health in the European population?
2. Does the structure of the observed relationships vary between males and females, and between different age groups in Europe?
3. Is the strength of the relationships (in terms of their effect size) similar across these groups?

8.4 Study III

The third study sets out to test the health structure model (the relationships between morbidity, functional limitation, and subjective health) on the adult population in three European regions and identify the possible gender and age differences in health structure within and across these three regions. Table 2 provides an overview of Study III.

8.4.1 The research questions of Study III

1. Does the proposed model of health structure hold true in Eastern, Western, and Northern Europe?
2. Is health structured differently among men and women, or among different age groups across these three European regions?
Table 1. Summary of studies investigating complex relationships between different aspects of health. In chronological order. Abbreviations are provided at the end of the table.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Age of resp.</th>
<th>Measurement of incl. the number of indicators*</th>
<th>Other variables included in the model</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liang (1986)</td>
<td>US</td>
<td>65+</td>
<td>Latent variable: Chronic illness (8)</td>
<td>No.</td>
<td>The relationships are supported with two exceptions (inconclusive effect of sick days on instrumental ADL and of self-maintenance on SRH).</td>
</tr>
<tr>
<td>Whitelaw and Liang (1991)</td>
<td>Cleveland and Virginia US</td>
<td>60+</td>
<td>Latent variable: Chronic illness (2) (no. of current illnesses; no. of medicines)</td>
<td>No.</td>
<td>All relationships are supported.</td>
</tr>
</tbody>
</table>
| Liang et al., (1991)   | US and Japan     | 60+          | Latent variable: Chronic illness (1) (no. of chronic illnesses) | Latent variable: Self-rated health (4)  | 1. All relationships between health constructs supported in both the U.S. and Japanese samples.  
2. Some differences regarding sociodemographic characteristics (age, sex, education) in the model were |
Johnson and Wolinsky (1993) | US | 70+ | Diseases (12) | Latent variables: Lower body disability (5) Upper-body disability (3) | Latent variables: Basic ADL (4) Household ADL (3) Advanced ADL (1) | Latent variable: Perceived health (3) | Age, sex, race, education. | 1. The model was confirmed with some exceptions (LBD did not affect AADL; UBD, BADL, and AADL did not influence subjective health).
2. Some diseases have a direct effect on subjective health, other an indirect effect. Overall, there are more indirect effects.
4. Diseases should be put in the model separately.

The analysis was stratified by sex and race. | 1. In general, the model is confirmed. Gender differences were found in the structural part and both racial and gender differences were found in the measurement model.
2. No effect was found of household ADLs on subjective health for males.
3. Effects of LBD on both basic ADL and subjective health is higher for white males than for white fe-
No significant differences were observed in the effect of LBD on advanced ADL for white females compared to white males. The effect of UBD on basic ADL is lower for white males than for white females. The effect of advanced ADL on SH is significant for white males, no effects appear for white females. The opposite is true for the effect of household ADL on subjective health when comparing both blacks and whites by gender.

4. Most diseases have an indirect effect on subjective health through disability and functional limitation.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stump et al. (1997)</td>
<td>US</td>
<td>70+</td>
<td>Diseases (7)</td>
<td>Lower body disability (4)</td>
<td>Basic ADL (4)</td>
<td>Household ADL (2)</td>
<td>Advanced ADL (3)</td>
<td>Perceived health (1)</td>
<td>Malaise (3)</td>
<td>Negative affect (2)</td>
<td>Stratified by sex and race.</td>
</tr>
</tbody>
</table>

1. The measurement model was supported with two exceptions: a) UBD and one item of advanced ADL were omitted and b) a correlation error term for two items measuring LBD was added. No substantial differences were found across race and gender.
The structural models were supported with one exception in both: none of the ADL constructs affected SRH (Model 1) and only basic ADL affected malaise (Model 2).

In model 1, overall, diseases led to poorer SRH and poorer functional limitation, and all diseases increased LBD. Similarly, in model 2, diseases led to poorer functional status, and all diseases increased LBD. Psychiatric problems had a significant effect on malaise and negative affect.

Leinonen et al. (1999) Jyväskylä, Finland 75 Number of chronic conditions Sensory capacity (cognitive) (2) Functional ability (PADL) Subjective health Depression, health habits (smoking, physical activity, alcohol use).
The analysis was stratified by gender.

1. Some indicators were omitted from the final model in gender-wise analyses.
2. The predictors that influenced subjective health most were functional abilities of daily living and the number of chronic diseases. Gender differences were observed for some constructs, suggesting that health models differ for males and females.
<table>
<thead>
<tr>
<th>Authors</th>
<th>Location</th>
<th>Age</th>
<th>Measures</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schüz et al., (2011)</td>
<td>Germany</td>
<td>65+</td>
<td>Number of illnesses</td>
<td>Functional status (BADL)</td>
</tr>
<tr>
<td>Alonso et al., (2013)</td>
<td>22 countries, grouped into three</td>
<td>18+</td>
<td>Chronic physical/mental</td>
<td>Disability: cognition, mobility, self-care,</td>
</tr>
</tbody>
</table>
The analysis was stratified by country income level. 
1. Functional ability affected SRH.
2. No statistically significant effect of chronic illness on SRH.
Note: No path between function and chronic illness was investigated.
3. Quality of life did not have a statistically significant effect on SRH.

1. Functional ability affected SRH.
2. No statistically significant effect of chronic illness on SRH.
Note: No path between function and chronic illness was investigated.
3. Quality of life did not have a statistically significant effect on SRH.

|---------------------|-----------|----------------|-------------------------------|------------------|--------------------------------------------------------------------------------|

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**groups by income level**

**conditions (19)**

getting along, role functioning, stigma, discrimination, family burden

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**Hirve et al., (2014)**

India 50+

Chronic illness

Latent variable: Function (8)

Self-rated health

Risk behaviours, social network, socio-economic status, quality of life, sex, age.

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**Golini and Egidi, (2016)**

Italy 65+

Latent variable: Chronic diseases (4)

Latent variable: Functional health (3)

Self-rated health

Emotional health, gender, age, education.
| Authors            | Location | Age | Variable Description | Latent Variables | Self-rated Health | Fatigue, dizziness, hearing, vision, depression. | In the model for the full sample, significant, direct associations between SRH and fatigue, dizziness, depression, problems in mobility, deficits in vision, and heart diseases were found. |
|--------------------|----------|-----|----------------------|------------------|------------------|-------------------------------------------------| 1. In the model for the full sample, significant, direct associations between SRH and fatigue, dizziness, depression, problems in mobility, deficits in vision, and heart diseases were found. |
| Lisko et al., (2020) | Finland  | 90+ | Diseases (7)         | Latent variables: ADL (3) Mobility (2) | Self-rated health | Fatigue, dizziness, hearing, vision, depression. | 2. In the full sample, dementia and arthritis had an indirect effect on SRH via difficulties in mobility, depression, and fatigue. |
|                    |          |     |                      |                  |                  |                                                  | 4. Dementia weakened many of the direct and indirect effects on SRH. |
3. Health behaviours had the greatest total effect on SRH, followed by chronic diseases and mental health.

4. Age and mental health affected SRH via mediators such as physical health, health behaviours, and chronic diseases.

*Specified where possible.

ADL—activities of daily living. AADL—advanced activities of daily living. BADL—basic activities of daily living. IADL—instrumental activities of daily living. PADL—physical activities of daily living. LBD—lower-body disability. UBD—upper-body disability. SH—subjective health. SRH—self-rated health. The number of items that, each variable is measured by, is provided in the brackets.
Table 2. A brief description of the studies

<table>
<thead>
<tr>
<th>Description of the Studies</th>
<th>Aims</th>
<th>Research questions</th>
<th>Health aspects in focus</th>
<th>Setting</th>
<th>Study type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study I: A systematic review of studies on the relationships between different aspects of health.</td>
<td>Explore the study field.</td>
<td>1. How are the studies that consider various aspects of health designed in terms of sampling the respondents, selection of the modelled health aspects, the methods used in the studies, and the locations where they are conducted? 2. What relationships are identified in the selected studies when analysing the links between morbidity, functional limitation/disability/impairment, subjective health, and mortality?</td>
<td>Morbidity; Functional limitation/Disability/Impairment; Subjective health; Mortality.</td>
<td>Global</td>
<td>Systematic review</td>
</tr>
<tr>
<td>Study II: An explorative study of the relationships between different aspects of health in the Test the proposed health structure model on the European adult population.</td>
<td></td>
<td>1. What are the relationships between morbidity, functional limitation, and subjective health in the European population?</td>
<td>Morbidity; Functional limitation; Subjective health.</td>
<td>Europe</td>
<td>Quantitative</td>
</tr>
</tbody>
</table>
Identify the possible gender and age differences in Europeans' health structure.

2. Does the structure of the observed relationships vary between males and females, and between different age groups in Europe? Is the strength of the relationships (in terms of their effect size) similar across these groups?

Study III: An explorative study of the relationships between different aspects of health in three European regions (Eastern, Western, and Northern) by gender and different age groups.

Test the proposed health structure model on the adult population in three European regions. Identify the possible gender and age differences in the health structure across the three European regions.

1. Does the proposed model of health structure hold true in Eastern, Western, and Northern Europe? Is health structured differently among men and women, or among different age groups across these three European regions?

Morbidity; Functional limitation; Subjective health.

Europe by regions Quantitative
9 Perspectives on health and its aspects

This section links the health concepts employed in this thesis to the broader perspectives on health; i.e., physical, psychological, and social, as mentioned in Section 5 above.

Morbidity, as discussed in Section 6.1 above, is a complex notion, and there are differences in its operationalisations, hence the choice of these should be guided by the purpose of the study. In this thesis, morbidity is assumed to reflect the *biological aspect of health* or the body perspective. Therefore, its measure should represent an ‘objective’ measure of the physical state of the human body. It should capture unambiguous and noticeable physical changes in the body that are reported by the person himself or herself or are diagnosed by a physician. Hence, physical health problems or diseases are of interest in Study II and Study III.

Section 6.2 above discussed functional limitation and disability, showing that the phenomenon of disability ‘is born’ and ‘lives’ in the interaction between an individual and the social and physical environment. Hence, limitations or restrictions in this thesis are assumed to reflect a *social perspective* on health. The question capturing this particular perspective on health in Study II and Study III (see Section 11.3 below) is as follows: “Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?” This question imposes no restrictions on what is understood by “daily activities“, hence, it offers a wide range of interpretation: from physically getting out from a bed to being able to take a bus, meet family and friends, or attend social events. It allows capturing disablism and, hence, the individuals’ perception of being included in or excluded from society. The differences in the social welfare systems can also likely be captured in the question mentioned above, offering a unique dimension of resource allocation (or its absence) to promote (or not) the individuals’ inclusion as active members of society.

Subjective health was discussed in Section 6.3 above. That section emphasised that people may use different and/or multiple criteria to evaluate their general health. Furthermore, individuals might view the same health problem

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16 Sociologist Carol Thomas refers to disablism as to “the *social* imposition of *avoidable restrictions* on the life activities, aspirations and psycho-emotional well-being of people categorized as ‘impaired’ by those deemed ‘normal’. Disablism is *social–relational* in character and constitutes a form of *social oppression* in contemporary society—alongside sexism, racism, ageism, and homophobia” (2010:37).
differently and have different personal capabilities and resources for dealing with it; hence, subjective health in this thesis is assumed to broadly reflect the psychological perspective on health. The question in the survey asks the respondents to evaluate their general health, including both physical and mental health. However, the evaluation of general health is a psychological product in and of itself because psychological processes and current states are consciously or unconsciously involved in the assessment process. This is especially true more for subjective health aspects than for the other aspects of health employed in this thesis.

It should be noted that regarding individuals, there is hardly any clear-cut difference between the body, the psyche, and the society. Hence, these perspectives might overlap within each aspect of health. Nevertheless, it is assumed that each of the aspects of health employed in this thesis would represent the corresponding perspective (as discussed above) on health to a greater degree than would the other aspects.

The objective of this thesis is to study the relationships between the various aspects of health. This implies the creation of a model where, based on the theory, the relationships between health aspects are proposed and tested. The theoretical model in this thesis is guided by definitions of health that do not say anything about the order in which these aspects are to be placed. Hence, the objective of the next section is to discuss previous health models and describe the one used in this study.
10 The model

The proposed model in this thesis is based on the two models discussed in Section 8.2 above. The first model was specified by Johnson and Wolinsky (1993).

This model, which the authors constructed and tested in order to study health structure, is largely informed by Nagi’s (1965) conceptual framework of disability. Nagi’s disability model is described in Section 6.2 above (see Figure 2). It must be noted that Nagi uses different terminology than Johnson and Wolinsky (1993): in Nagi’s view (Johnson and Wolinsky 1993; Nagi 1991), performance limitation and disability reflect the physical and social definitions of functioning, respectively, while they are interpreted in the opposite way in the study by Johnson and Wolinsky (1993). Apart from the different use of terminology, Johnson and Wolinsky (1993) apply some modifications to Nagi’s model: a) altering the causal sequence between different dimensions by specifying alternative paths in the model; b) omitting physiological impairment; and c) specifying subjective health as the ultimate outcome variable. Hence, their final model consists of diseases, disability, functional limitation, and subjective health. As for the specified relationships, Johnson and Wolinsky (1993) suggested that diseases, being the starting point of model, both directly and indirectly through disability and functional limitation affect subjective health. Hence the model reflects a “natural progression from body to mind” (1993:107). Moreover, as it is almost impossible to distinguish between cause and consequence in cross-sectional studies, another assumption is made based on the “natural sequence of events” (Johnson and Wolinsky 1993:107). This assumption reflects the order in which the events are likely to happen in real life17. Both of these assumptions are employed in this thesis.

Largely informed by Johnson and Wolinsky’s (1993) study, the model proposed in this thesis also consists of morbidity, functional limitation and subjective health. As for functional limitation, the question “Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?” includes all restrictions, both physical and social, due to different reasons such as illnesses, disability, and/or mental problems. This broad definition of limitations/restrictions that an individual might face on a daily basis allows functional limitation to be a comprehensive variable and represent the social perspective on health. As this thesis, rather

17 This is an assumption. Alternative ways might exist.
than focusing on very specific models, aims to study a parsimonious model that can be applied to the general population, a broad and encompassing definition of limitations/restrictions is also desirable.

A second model, suggested by Whitelaw and Liang (1991), was also used in developing the framework in this thesis. Similar to Whitelaw and Liang, the model proposed in this thesis consists of three concepts—morbidity, functional limitation, and subjective health.

In this study—unlike those of Johnson and Wolinsky (1993) and Whitelaw and Liang (1991)—self-rated health and functional limitation are captured by one observed variable each, instead of latent constructs, which are captured by two or more indicators. However, morbidity, similar to the study by Whitelaw and Liang (1991), is captured by a latent construct. Yet, no indices are constructed by summing the number of current illnesses and number of medicines for measuring a latent morbidity variable, as done by Whitelaw and Liang (1991). In a modification of Johnson and Wolinsky’s (1993) suggestion to treat all diseases individually, the diseases in the model proposed in this thesis are treated as separate indicators of the latent variable rather than having a direct effect on the other health constructs. Morbidity, as discussed in Section 6.1 above, is assumed to be a complex concept that can be measured by many different diseases. Therefore, instead of exploring how every single disease affects the other health aspects, the interest here lies in investigating the common underlying factor shared by these health problems and what effect it has on the other health constructs. This is a different way of approaching morbidity rather than summing up different health conditions. Consequently, improving the model this way—apart from revealing how well or poorly each disease reflects the latent variable of morbidity—also allows for the examination of whether or not this underlying variable influences both functional limitation and self-rated health. Additionally, the parsimoniousness of the proposed model is an especially desirable characteristic that allows us to reach the objectives of this thesis to investigate: a) the complex relationships between different aspects of health in adults of all ages; b) the differences in these relationships within and across geographical/cultural regions; and c) to do this using the most recent data.

A related point of consideration is that both of the aforementioned models, like most others, have been tested mostly on elderly adults. The objective of this thesis is to test the model on the entire adult population. Since there are differences in how each age group can perceive their health, it suggests some room for variation in the effect sizes. Indeed, Twaddle (1974) states that signs of illness, despite being considered objective, are not fixed and are subject to variation due to changes in the biological aspect of the life cycle of growth, development, and deterioration. For example, biological capacities increase from the time we are born to the young adult years. After young adulthood, the process of cellular deterioration exceeds that of cellular regeneration, which, given time, inevitably results in death. Thus, it is widely accepted that
any sign is assessed as being normal or abnormal relative to the age of the individual, and consequently this might influence the magnitude of the relationships between different age groups.

The model proposed in this thesis is illustrated in Figure 8. As stated above, similar assumptions as those in the study by Johnson and Wolinsky (1993) are made where both “progression from body to mind” and the “natural sequence of events” are assumed. However, this thesis cannot claim to draw conclusions about causality, as it studies the relationships between different aspects of health using cross-sectional data. Any model should have a structure, hence the relationships predominating in real life are reflected in the hypothesised model. Morbidity, which reflects the physical state of the body, in many cases leads to difficulties performing every-day tasks more often than the other way around. Both the body’s physical condition and inability to perform typical tasks of daily life are very likely to guide peoples’ evaluation of their general health. In addition, this also suggests that the evaluation of general health to some extent might depend on whether or not the physical state of the body impacts the ability to perform daily tasks. Hence, as to the specific relationships, morbidity, placed at the beginning of the process, is assumed to have direct effects on both functional limitation and subjective health. Morbidity is also expected to indirectly affect subjective health through functional limitation, so functional limitation serves as a mediating variable in the model.

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Figure 8. A conceptual model of the relationships between morbidity, functional limitation, and subjective health. The oval form represents a latent variable, while rectangles represent observed variables. Straight arrows indicate direct effects.
11 Data and methods

The first part of this section presents the data employed in this study. The sample and the variables used are described in the second part. Finally, this section is concluded by presenting the methods employed.

11.1 Data for Study I

Data for Study I come from the Scopus database. The objective was to retrieve all scientific articles that had simultaneously studied at least three out of the four selected health aspects: morbidity, functional limitation/disability/impairment, subjective health, and/or mortality. The detailed search syntax is provided in the Supplement of Study I. In total, 81 articles were selected for data extraction and analysis. The search was performed on July 2, 2018. Data were extracted and coded into an Excel template specially designed for the purpose. Data were processed in Stata 17 and in Excel. Elementary statistical methods were employed.

11.2 Data for Study II and Study III

The data employed in Studies II and III come from the 7th round of the European Social Survey (ESS), administrated in 2014 (European Social Survey Round 7 Data 2014). The 7th round of the ESS included a special rotating module called “Social inequalities in health and their determinants” that added specific questions on different health conditions and on other health-related information to the standard questions on subjective health and functional limitation in the main questionnaire (European Social Survey 2015). Out of the total sample size of 40,185 respondents from 21 countries, the analysis was performed on 18 countries\(^{18}\). Estonia is omitted due to a wrongly coded question on health problems for Russian-speaking respondents (European Social Survey 2016). Portugal was excluded, as approximately 18 per-

\(^{18}\) Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Lithuania, Netherlands, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.
cent of respondents have missing data on the variable capturing health problems. Additionally, as European countries are the focus of this thesis, a non-European country, Israel, was left out. Spain was not included in Study II because it was the single country representing Southern Europe, and could not represent a region alone.

The age of respondents in the survey ranges from 14 to 114 years. Because the interest of this thesis lies in adult health only, the lower age limit was set to 18. Cases with missing information on age, gender, or on any of the health variables of interest were omitted. All the aforementioned and applied restrictions resulted in the sample sizes of 32,679 and 30,815 respondents for Study II and Study III, respectively.

As the aims of Study II and Study III differ, the analyses in these studies are carried out for different groups. For Study II, the analyses were performed for 12 groups in total: a) the entire sample; b) males and females; c) three age groups (18–44 years, 45–64 years, and 65 years old and older); and d) the three age groups by gender. In the regional analysis in Study III, 24 groups were analysed: a) the entire sample; b) the entire sample by gender; c) the entire sample by age groups; d) three regional samples; e) the regional samples by gender; and f) the regional samples by age groups. Data modification was performed in Stata 14.3 (StataCorp 2015) and all statistical analyses were carried out in LISREL Student version 9.3 (Jöreskog and Sörbom 2017).

11.3 Variables
Table 3 below presents the original survey questions from the European Social Survey (2014) with the answer alternatives and final variables used in Studies II and III. In order to measure morbidity, six binary variables were created by aggregating diseases into groups. These six groups were created in consultation with a medical doctor. Functional limitation and subjective health were dichotomised, resulting in two binary variables, capturing those reporting as being very hampered in their daily life activities and people assessing their subjective health as bad or very bad, respectively.
Table 1. Variables created from the initial ESS data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Original survey question</th>
<th>Data management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity</td>
<td>“Which of the health problems on this card have you had or experienced in the last 12 months, that is since [MONTH, YEAR]?”</td>
<td>Eleven health problems were aggregated into 6 binary variables as follows: Cardiovascular diseases</td>
</tr>
<tr>
<td></td>
<td>Heart or circulation problem</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High blood pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breathing problems such as asthma attacks, wheezing or whistling breathing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Allergies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Problems related to skin condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Muscular or joint pain in hand or arm</td>
<td>Musculoskeletal diseases</td>
</tr>
<tr>
<td></td>
<td>Muscular or joint pain in foot or leg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe headaches</td>
<td>Chronic pain</td>
</tr>
<tr>
<td></td>
<td>Back or neck pain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td>Diabetes</td>
</tr>
<tr>
<td></td>
<td>Problems related to your stomach or digestion</td>
<td>Gastrointestinal diseases</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Functional limitation</td>
<td>“Are you hampered in your daily activities in any way by any longstanding illness, or disability, infirmity or mental health problem?”</td>
<td>This variable was dichotomised. Categories, “yes to some extent” and “no” were coded 0, and categories “yes a lot” coded 1.</td>
</tr>
<tr>
<td></td>
<td>“yes a lot”—1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“yes to some extent”—2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“no”—3</td>
<td></td>
</tr>
<tr>
<td>Subjective health</td>
<td>“How is your health in general? Would you say it is…”</td>
<td>A binary variable was created. Categories “very good”, “good” and “fair” were coded 0, and categories “bad” or “very bad” coded 1.</td>
</tr>
<tr>
<td></td>
<td>“very good”—1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“good”—2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“fair”—3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“bad”—4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“very bad”—5</td>
<td></td>
</tr>
</tbody>
</table>

* Physical and mental

11.4 Methods

In Studies II and III, structural equation modelling (SEM) is employed. This multiple-equation–system technique is closely linked to path analysis, which
was first introduced by geneticist Sewall Wright in 1921 (Hox and Bechger 1998). Further development of SEM and its availability in different statistical software packages have led to this method being widely applied in many disciplines, such as sociology, psychology, and economics, among others.

SEM can be thought of as an extension of multiple linear regression (MLR) while at the same time offering several advantages (Edwards et al. 2012). *Firstly*, unlike MLR, where variables are assumed to be measured without error, SEM relaxes this assumption of perfect reliability and allows us to take measurement errors into account. *Secondly*, differently from MLR, SEM estimates more than one regression equation at a time, thus allowing more than one dependent variable to be included in a single model. *Thirdly*, SEM offers modelling of numerous manifest (observed) and latent (unobserved) variables. Additionally, both latent and manifest variables can be specified as independent (exogenous) or dependent (endogenous) variables (Lei and Wu 2007).

SEM consists of two parts: a measurement part and a structural part. The former evaluates how well the indicators (observed variables) measure the latent constructs, while the latter estimates hypothesised or theory-driven structural relationships among the variables (Lei and Wu 2007). In the measurement model, multiple manifest variables are usually used to reflect an underlying hypothetical construct, the latent variable (Edwards et al. 2012). Performing a regression of a manifest variable on a latent variable “quantifies the relationship between an item and the latent factor” (2012:197), hence the regression coefficient (also called a factor loading (lambda)) measures the strength of the relationship between the indicator and the latent variable (Edwards et al. 2012). The structural part is an extension of multiple regression analysis, while the measurement part is based on confirmatory factor analysis (CFA) (Lei and Wu 2007). Besides the direct effects, indirect and total effects can be estimated in structural equation modelling.

### 11.5 Model specification

As mentioned above, a structural equation model consists of two parts; namely, the measurement part and the structural part. According to Bollen (1989), the measurement part is given by the equations

\[ x = \Lambda x \xi + \delta, \]

1

\[ y = \Lambda y \eta + \epsilon, \]

2

71
where the $x$’s are the observed indicators of $\xi$ (ksi), $\xi$ is a vector of the latent exogenous variables, $\Lambda_x$ is a lambda coefficient matrix relating $x$ to $\xi$, and $\delta$ (delta) represents the errors of the measurement vector for $x$. In the second equation, $y$ corresponds to the observed indicators of $\eta$ (eta), $\Lambda_y$ to a coefficient matrix relating $y$ to $\eta$, and $\epsilon$ (epsilon) to the errors of the measurement vector for $y$.

The structural part is given by the equation

$$\eta = B\eta + \Gamma \xi + \zeta,$$

where $\eta$ is a vector of the latent endogenous variables, $\xi$ is a vector of the latent exogenous variables, $B$ is a coefficient matrix for latent endogenous variables, $\Gamma$ is a coefficient matrix for latent exogenous variables, and $\zeta$ (zeta) is a vector of the errors of latent variables.

The measurement part of the proposed model has a reflective measurement model, representing a simple regression equation where the observed variable is the dependent variable and the latent construct is the explanatory variable. If the latent variable changes, the simultaneous variation in all manifest variables is also expected to change, which is a key characteristic of the reflective model (Diamantopoulos, Riefler, and Roth 2008). The graphic illustration of the path diagram of the proposed model for Studies II and III is presented in Figure 9. A detailed model specification consisting of equations is found in the Appendix.
Figure 9. Graphic illustration of the path diagram. $x_{1-6}$ are the observed indicators of the latent exogenous variable $\xi_1$ (ksi) and $\delta_{1-6}$ (delta) are the corresponding measurement errors in $x$. $\lambda_{11-61}$ (lambda) are coefficients relating corresponding $x$’s to $\xi_1$. $y_{1-2}$ are observed indicators of $\eta_{1-2}$ (eta) and $\epsilon_{1-2}$ (epsilon) are measurement errors in corresponding $y$. $\beta_{21}$ is a coefficient for the endogenous latent variable $\eta_1$ and $\gamma_{11-21}$ are regression coefficients for the latent exogenous variable $\xi_1$. $\zeta_{1-2}$ are the errors of corresponding latent variables $\eta_{1-2}$, $\xi_1$, $\eta_1$, and $\eta_2$ represent morbidity, functional limitation, and subjective health variables, respectively. FL—functional limitation. SH—subjective health.
12 Results

12.1 Summary of Study I


Duntava A, Mäkinen IH, Borisova LV.

12.1.1 Background and aim

Defining health is a challenge to researchers from various disciplines. The absence of a commonly recognised definition of health leaves room for various ways to measure it. The most often used proxies of health are morbidity, functional limitation, self-rated health, and mortality. There is extensive research focusing on the binary associations between two aspects of health, but studies where three or even more aspects of health are included into a single analysis are much rarer. Additionally, how different aspects of health are operationalised and studied varies considerably across studies and disciplines. In general, there is a lack of systematic reviews that would try to identify the patterns of both study characteristics and the relationships found between different aspects of health. Hence, the aim of Study I is to map the field where at least three out of the four frequently used aspects of health (morbidity, functional limitation, subjective health, and mortality) are studied simultaneously and to summarise the results. This is achieved by addressing the specific study objectives of a) studying the design in terms of the sampling of respondents and selection of the modelled health aspects, the methods used in the studies, and the locations where they are conducted, and b) studying the relationships in the selected studies when analysing the links between morbidity, functional limitation/disability/impairment, subjective health, and mortality.

12.1.2 Data and methods

The search was performed in the Scopus database on July 2, 2018. There were 6754 initial hits. After two rounds of the screening process, 81 articles were included in the final analysis. The data were extracted to an Excel sheet template specially designed for the purpose, and analyses were performed in both Excel and Stata 17.
12.1.3 Main results

The results of the study show that the interest in research on the relationships between different aspects of health is inclined toward the elderly population and to the United States. The health of young adults and middle-aged adults are often left unattended, as is the health of central and eastern Europeans. The detailed analysis of the combinations of the selected aspects of health indicates that morbidity is never considered as an outcome in the analysed articles. As for the analysis of the relationships between the different aspects of health, the results do not show a clear pattern in the predictive power of various health aspects on each other. Morbidity and functional limitation, however, more often show significant effects on subjective health (in 70% and 66% of the studies, respectively) than on functional limitation (55% and 53%, respectively) or mortality (55% and 60%, respectively). Subjective health has a significant effect on functional limitation in 49 percent of the cases and on mortality in 52 percent of the cases. However, the results are more nuanced when the analyses are performed by various indicators of the health aspects on the other aspects of health. In general, combined measures of morbidity and functional limitation—rather than any single measure—affect the other aspects of health. In regard to control variables, the results suggest that apart from the ones commonly used in health research (such as age and gender) the control variables employed in the studies vary by the studied outcome, signifying an absence of universal control variables set in health research.

12.1.4 Conclusion

The systematic review shows that no aspect of health represented by a variety of indicators overshadows the others in terms of being the most reliable predictor. This suggests that researchers should adopt a holistic view on health and include multiple aspects of health in their studies. Perhaps this view on health can be incorporated into a more powerful, but (as this study showed) less frequently used technique for studying health structures. This is a prospective avenue for further research. Furthermore, as shown in this systematic review, research should aim their attention at the health of understudied populations; i.e., young and middle-aged adults and those living outside the United States.
12.2 Summary of Study II


Duntava A, Borisova LV, Mäkinen IH.

12.2.1 Background and aim

The main aim of the second Study is to investigate the relationships between three commonly used aspects of health using a parsimonious health model. Previous research has shown that in the studies on health structure, young adults and middle-aged adults are often neglected. Additionally, much of the research have been conducted in the United States, leaving the health structure of Europeans in the shadows. For this reason, the focus of this study is the structure of health of the European population of all adult ages. The specific study objectives are to: a) investigate the relationships between morbidity, functional limitation, and subjective health in the European population; b) explore whether the structure of the observed relationships vary between males and females and between different age groups; and c) explore whether the strength of the relationships (in terms of their effect size) is similar across these groups.

12.2.2 Data and methods

The study utilised recent data from the 7th round of the European Social Survey (2014), comprised of 32,679 respondents from 18 European countries and employed structural equation modelling (SEM), SEM multi-group analysis and t-tests. In total, analyses are performed on 12 groups: a) the entire sample, b) two samples divided by gender, c) three age groups (18–44, 45–64, and 65 years or over) and c) six age-gender groups.

12.2.3 Main results

In general, both the model and the proposed relationships are confirmed. Morbidity influences both functional limitation and subjective health directly and significantly. Moreover, functional limitation has a significant effect on subjective health. Functional limitation is also found to be a mediating variable between morbidity and subjective health. Yet, the strength of some of the investigated structural relationships vary significantly across gender and age. More specifically, significant gender differences are found in the effects of both morbidity and functional limitation on subjective health; the former being higher for males and the latter higher for females. Significant age differences are observed for all relationships between young and middle-aged adults and old adults.
adults, while there is less variation between the young and the elderly, and the middle-aged and the elderly. Looking at the health structure model as a whole (both the measurement and the structural parts) when both gender and age are accounted for, the differences were more prominent among elderly men and women than among genders of the other two age groups.

12.2.4 Conclusion
This study shows that the model can be successfully applied to European adults of all ages. However, it also suggests that the effect size of some relationships varies across the studied subgroups and, therefore, gender and age should be taken into consideration when the health structure of adults is in focus. To what degree the model can be considered universal is an open question.
12.3 Summary of Study III

The Structure of Health across Europe: Patterns in Different Populations.

Duntava A, Mäkinen IH, Borisova LV.

12.3.1 Background and aim

Most previous studies on the health structure of adults have focused on one country, population subgroup, or on a pooled analysis of multiple countries. The few studies that can be considered exceptions to this rule are comparative in nature. However, to the authors’ best knowledge, none of these studies investigate the health structure of adults across European regions. Hence, the aim of this study is to address this research gap and study the structure of the health of Europeans by testing a parsimonious health model on gender and age groups across three European regions (East, West, and North). The research questions of Study III are as follows: a) does the proposed model of health structure hold true in Eastern, Western and Northern Europe; and b) is health structured differently among men and women or among different age groups in these three European regions.

12.3.2 Data and methods

The analysis was carried out on 17 European countries divided into three regions (East, West, and North) with a total of 30,815 respondents. In order to reach the study goals the structural equation modelling, cluster analysis, and $t$-tests were performed on 24 samples in total.

12.3.3 Main results

The results of this study show that the model does not hold in all the studied groups across the regions. As for specific relationships, diabetes was not a statistically significant indicator of morbidity in young adults in Eastern and Northern Europe. Furthermore, the effect of functional limitation on subjective health is not significant in Northern European men nor among middle-aged persons in Northern Europe. The model fit was poor in the Northern European sample and in the subsamples of men and young persons in this region.

The regional analysis by gender shows that women display more similarity across regions than men, with Eastern Europe being an exception. In this region, men are more similar to women in terms of the relationships between the different aspects of health, but are more distant from the men of the other two regions. Hence, the structure of health is different between genders in Western and Northern Europe, but not in Eastern Europe.
The regional analysis by age reveals that young adults are similar in their health structure across the regions. Furthermore, the health structure of the young is more similar to that of the elderly (with the exception of the elderly population in Western Europe) than it is to the health structure of the middle-aged. What accounts for this health structure division based on age is the strong effect of functional limitation on subjective health in all three groups of young adults and the two groups of elderly individuals.

In addition, when comparing the European regions, a surprising inverse pattern between the number of reported health problems and subjective health is observed: fewer reported health problems go together with a more negative evaluation of one’s health. Possible explanations for this paradox are discussed.

12.3.4 Conclusion
This study shows that the model is applicable to a majority of the studied groups, but it does not suit them all. The health structure does follow different patterns across age, gender and regions. In general, gender or age—rather than region—is the driving force for most of the observed differences in the health structure of Europeans, the exception being the Eastern European region. The gender differences in this region are blurred, perhaps due to less developed health-care systems and less favourable socio-political contexts.
The main objective of this thesis was to study the relationships between different aspects of health. For this purpose, three studies, all of which had specific aim within the general objective of the thesis, were conducted.

13.1 The model

The results of Study II and III show that even though the proposed and tested model fits the data in the majority of the studied groups, there are exceptions. Measured in terms of root mean square error of approximation (RMSEA), the model fits the data better in the elderly group but less well among the young adults, irrespective of whether the analyses are performed on the pooled sample or on the samples split by gender (Study II) or region (Study III). The exception to the model’s good fit among the elderly is Eastern Europe, where the model fit among the elderly is similar to that among the middle-aged. Also, in all groups of the elderly, the estimated relationships were statistically significant. Since the most marked health decline in the human body takes place in older ages, it is not surprising to see the importance of morbidity and functional limitation be reflected in the subjective evaluation of general health in that group more clearly than in others. Indeed, Krause and Jay (1994) found that elderly persons are more likely to use their health problems as a point of reference when evaluating their general health, where young adults think of their health-related behaviours.

As to gender, the results of both Study II and III show that the model fit is better for men than it is for women in the total sample. However, differences appear when the gender-wise analysis is stratified by either region or age. In the regional analyses, the model fits data better among men than among women in both Eastern and Western Europe, while the opposite is true in Northern Europe.

In the gender-wise analyses stratified by age groups, the model fit is better in middle-aged and elderly men than among women of the same age categories. The opposite was true for youngest age group. This might suggest that the model fit is generally better for men than for women, and the worse model fit among young men found in Study II can perhaps be explained by the peculiarity of the Northern region (Study III), where the model fit was worst in the
pooled sample, men, and in young adults. This might be explained in two ways. *First*, a health model for women might require other health-related variables than those currently included. Indeed, a study by Manderbacka and colleagues (2003) suggest that women could use multiple criteria when evaluating their health compared to men. *Second*, the peculiarities of the Northern European region, whatever they might be, can suppress some relationships and hence worsen the model fit.

13.1.1 Alternative models with reciprocal relationships

In Studies II and III, only one model has been proposed and tested. This is not the only possible model. The model assumed a “natural sequence of events” (Johnson and Wolinsky 1993:107) and a progression from “body to mind” (Johnson and Wolinsky 1993:107), but different assumptions might be employed and alternative models may be tested. For example, the assumption ‘from body to mind’ might not be valid all the time, especially in the case of psychosomatic diseases. Therefore, the effects between the different aspects of health might be reciprocal. Study I, however, shows that such effects are seldom assumed. Also, there was no study with morbidity as an outcome variable. Why is this the case? There might be different reasons underlying this tendency in health research. *First*, the dominating view of the underlying causes of diseases are likely to be physical, rather than a combination of both physical and psychological. *Second*, the studies where morbidity is an outcome might exist in the field of medicine but are then likely to be concentrated on specific diseases. Furthermore, these studies usually control for different biomarkers rather than functional ability and self-reported health. *Third*, the reason might be related to the statistical analysis itself. Under certain circumstances using cross-sectional data, non-recursive models (the ones that contain reciprocal effects) may not be identifiable; hence, their testing and interpretation becomes problematic (Wong and Law 1999).

13.2 The ‘meaning’ of health aspects and interpretations of their relationships

Study I shows that there are many ways of operationalising aspects of health. The common aim of Studies II and III was to test a parsimonious model of health where each aspect of health would denote a particular perspective on health. Hence, the choice of particular variables was guided by the study objective.
13.2.1 Morbidity

An interpretation of questions related to different diseases; e.g., whether an individual has a particular health problem or not, is straightforward. The latent variable called ‘morbidity’ serves here as an umbrella term for physical health problems. The name for a latent variable should come naturally and reflect what its indicators are supposed to measure; yet its name is given by the researchers. One of the interests of this thesis was to see whether the most common (groups of) diseases and those prevalent in society could be considered meaningful parts of common morbidity. By doing so, the morbidity variable can be considered to represent the vulnerability of an individual to different health problems, suggesting that the occurrence of the diseases shares a common underlying factor. This way of treating diseases puts a purely biological or physical perspective on the health of an individual, which was intended in this thesis. Studies II and III show that vulnerability to diseases influences how well people cope with their tasks of daily life and how they evaluate their general health. This suggests that this way of approaching morbidity can also be employed in research. The same approach has been previously employed in some studies (for example, see the studies by Golini and Egidi (2016) and Li and colleagues (2021)).

The results of Study II show that all the (groups of) diseases were significant indicators of morbidity. The results are in line with those of the study by Golini and Egidi (2016) which approach some health problems in the same way in their model. Their results show that cardiovascular diseases, respiratory diseases, arthritis, and multi-chronicity (i.e., suffering from at least two diseases from a list of nine) all were significant indicators of the latent variable ‘chronic diseases’. A study by Li and colleagues (2021), similar to Studies II and III in this thesis, used hypertension and diabetes along with other diseases such as hyperlipidaemia and obesity as indicators of ‘chronic diseases’. The results of Studies II and III are in line with the two studies mentioned above. These studies found that morbidity affects functionality (Golini and Egidi 2016) and subjective health (Golini and Egidi 2016; Li et al. 2021). One of them estimated the effect of functional limitation on morbidity (Li et al. 2021), that is, the reverse of to that specified in this thesis both in Study II and Study III and found functional limitation (consisting of pain, ADL, mobility, and self-care) to affect morbidity. Such results confirm that alternative models, discussed in Section 13.1.1 above, can be successfully employed.

Study III suggests that not all indicators of morbidity are significant when the analysis is stratified by regions. Diabetes was not a significant indicator of morbidity among young adults in Eastern and Northern Europe. This might be explained by the improved treatment of diabetes (Eliasson and Boström 2006). Diagnosis at an early age might prevent its negative spread to some other systems and organs of the body. However, this does not explain why it is still a significant indicator of morbidity among young adults in Western Europe if
its treatment is largely similar across Europe. The explanation could be attributed to various factors, such as obesity, lifestyles, and/or peculiarities of the healthcare system (for example, timely access to treatment, medicine, and supervision).

13.2.2 Functional limitation

This thesis (Studies II and III) approaches functional limitation from a social perspective allowing for a broad interpretation that would encompass both physical and social restrictions. The question on functional limitation which was employed in both studies can be understood as an individual’s subjective experience of the restrictions s/he might face in a given society. Hence, the reply to the question is influenced by the cultural, social, political, and economic context of, for example, the respondent’s region of living. The results of Studies II and III show that in most of the studied groups, there is a link between functional limitation and subjective health. However, in some cases this link is absent. More specifically, Study III fails to find an effect of functional limitation on subjective health in men and middle-aged persons in Northern Europe.

It is possible that the lack of relationships between functional limitation and subjective health in the Nordic context can be interpreted in the light of the hypothesis of cumulative advantage. The American sociologist Robert K. Merton (1988) described cumulative advantage\(^{19}\), as dealing with the “initial” advantages of various kinds and the resources available for the individual that provide a subsequent growth of the advantage so that the differences between people increase. In general, the hypothesis implies that when a person has gained an advantage of some kind s/he will continue to accumulate it over the life course, with better results than those with less initial success. This reasoning can be applied to different spheres of life, such as wealth, career, social status, and health.

The Northern European welfare states, prioritising equal rights and opportunities to their inhabitants, might be considered a place where the cumulative advantage hypothesis becomes visible when compared to other European large-scale regions. The Eurostat data on education, employment, and leisure among respondents with limitations in work caused by health conditions or difficulties in performing basic activities support this hypothesis. For example, according to the Eurostat database (Eurostat 2019a), young persons in Sweden, Finland, and Denmark with functional limitations in work were (in

\(^{19}\) “[…] the ways in which initial comparative advantages of trained capacity, structural location, and available resources make for successive increments of advantage such that the gaps between the haves and the have-nots […] widen until dampened by countervailing processes” (Merton 1988:606).
2011) those least likely to leave education or training compared to other European countries. Likewise, tertiary education attainment (Eurostat 2019b) and employment rates (Eurostat 2014a) were among the highest for persons with functional limitations in work in Sweden and in Finland (both countries were ranked in the top five in Europe). Also, higher proportions of individuals with functional limitations in work and living in Denmark, Finland, Sweden and Norway were socially active (e.g., going to cinema, live performances, or cultural sites) compared to their counterparts in other European countries in 2006 (the four countries were ranked in the top seven) (Eurostat 2014b). These facts suggest that the residents of Northern Europe already at an early stage of life enjoy some advantages created by the universal welfare system that allows them to participate actively in education, work, and social life. This early advantage sets the starting point for continuous accumulation of various benefits (for example, economic independence, social relationships, and health). In conclusion, functional limitation does not necessary lead to a negative evaluation of one’s general health if adequate and equal opportunities are provided.

However, the cumulative advantage hypothesis does not explain why the effect of functional limitation on subjective health is present in women in the Northern European region. One interpretation of this could be a result of shifting gender roles. While gender roles are changing for both genders (Barnett 2004), the change is more rapid for women (Lewis, Campbell, and Huerta 2008). The demands and standards posed by society on women are high, especially in the Northern European context, as compared, for example, with the Eastern European region where more traditional gender roles prevail. For example, Nordic countries are the only countries where the dual full-time working model prevails (Lewis et al. 2008). Along with this, women are still in charge of the home and of children. A qualitative study on Swedish full-time working mothers (Elvin-Nowak and Thomsson 2001) shows that women are exposed to different risks if the balance between employment and motherhood is undermined. Specifically, if family and children are assigned less priority than employment, the mothers’ femininity might be questioned; while in the contrary case, their position as both mothers and women is cast in doubt. Increasingly, the so-called ‘do it all’ women are expected to successfully navigate multiple roles as workers, mothers, caregivers, and friends. This navigation can create stress. Constant adherence or desire to fulfil ‘general’ requirements of how a modern woman should be like while already being limited in one way or another is perhaps likely to spill over to one’s evaluation of general health.

Also, since social roles may vary across borders, the interpretation of questions—e.g., what it means to be ‘hampered’ \(^{20}\), or what ‘daily activities’ are—

\(^{20}\) The term comes from the research question on functional limitation described in Section 9 above (see also Table 3 above).
might vary as well and thus give the answers a different content. The dominating views in society and the structure of the welfare system (as discussed above) are likely to make a difference in how people with restrictions in everyday life evaluate their general health.

13.2.2.1 Functional limitation as a mediator between morbidity and subjective health

Functional limitation, in addition, was found to be a statistically significant mediating variable across all groups, again apart from men and the middle-aged age group in Northern Europe (Study III). In general, the direct effect of morbidity on subjective health is greater for men than it is for women, while its indirect effect on subjective health via functional limitation is lower (with the exception of the Eastern European region). Somewhat consistently, among women, approximately 50 percent of the effect of morbidity on subjective health is mediated through functional limitation. For men, the results are less consistent as the effect sizes vary greatly across the regions, being of the same size as among women in Eastern Europe, and much lower elsewhere.

Among women, irrespective of the region, the high proportions of the indirect effects of the total effect suggest that just having diseases might not always be sufficient to create a reaction in subjective health. Subjective health is influenced most when there are either some difficulties in performing one’s everyday activities, or when these are combined with diseases. For men (at least in the Northern and Western regions), the high proportions of the direct effects and the low proportions of the indirect effects of the total effect on subjective health would suggest that diseases in and of themselves are enough to influence men’s subjective health. In other words, there are gender differences in the process of evaluation of one’s subjective health.

Women are more likely to include both diseases and limitations in the evaluation of their health than men are. Moreover, the results suggest that disrupted daily routines due to some health problems play a crucial role in health evaluation among women, whereas for men, having diseases is directly translated into the health evaluation, and practical difficulties seem to be of minor importance. Hence, there are several possibilities to interpretation. First, there may be gendered differences in the severity of the experienced problems. In general, men suffer more often from life-threatening chronic conditions (for example, coronary heart disease, cerebrovascular diseases, emphysema, kidney disease, and atherosclerosis) than do women (Vlassoff 2007). Besides, there is a gendered pattern in health care utilisation: men are less likely to seek medical help than women (Bertakis et al. 2000). These two risks—greater exposure to some health conditions and delayed treatment—might, when combined, result to more negative evaluations of one’s health due to the severity of the conditions. Second, there are gender differences in the perception of task performance. A qualitative study by Kvam and colleagues (2013) on the
gender differences in participation experiences among respondents with musculoskeletal pain in vocational rehabilitation showed that men, despite reduced ability to perform domestic work, reported no changes in doing it. Moreover, the decreased ability in performing household activities was seen as unproblematic and was often delegated to spouses. Third, there is a possibility of gender-based perspectives on health. In general, women might view health as an asset to fulfilling some aims and tasks. Men, however, might see health as a property or a characteristic that needs to be ‘in proper order’.

Irrespective of the reason, the complex interplay between gender and context needs to be taken into account. Context, in some cases, might blur the gender differences. As shown in Study III, this is the case of Eastern Europe, where the results for men are more similar to women.

13.2.3 Subjective health

The question on individuals’ evaluation of their own general health in this thesis (and Study II, and Study III) represents a psychological aspect of health captured by a broad question, allowing for different and multiple criteria to be used in that evaluation. Previous studies have shown that different factors could serve as the basis for health evaluation (Kaplan and Baron-Epel 2003; Krause and Jay 1994).

The meaning that people attach to subjective health would determine the observed relationships with the other aspects of health. For example, if the respondents’ evaluation of subjective health is based on the absence/presence of diseases, a connection between these two concepts is likely to appear. However, if other criteria are dominating in one’s health evaluation to a large extent, the connection between diseases and subjective health could even be absent. The results in Studies II and III suggest that people—irrespective of age and gender—include morbidity in the evaluation of health as statistically significant relationships between morbidity (physical health) and subjective health were observed in all studied groups. This is consistent with the study by Krause and Jay (1994), where 47 percent of the sample used either presence or absence of diseases as a first choice when evaluating their health. Somewhat similar results were obtained in a study by Kaplan and Baron-Epel (2003), where 41 percent of respondents used diseases in their evaluation of general health. The incorporation of different functional abilities/difficulties in the health evaluation process is reported to a lesser degree than that of morbidity: this was the case for 10 percent of respondents (Krause and Jay 1994). The results from Study III, as discussed in Section 13.2.2 above, support this finding, however, suggesting that a specific context might be responsible for not including functional abilities in the evaluation of general health.

Culture might dictate how health should be perceived and reported. A good example is Bangladesh. Rahman and Barsky (2003), conducting research in this cultural context, state that people—even when in good health—will tend
to understate it to avoid ‘the gods’ attention’. The effect of the ‘gods’ is so strong in this cultural context that it has influenced the way of dichotomising the variable in research. This suggests that religious beliefs in some cultures might serve as a strong factor in both evaluation and reporting of subjective health. Not only subjective health is likely to be influenced by culture. A respondent’s awareness of disease could also depend on the cultural context. For example, in a Japanese context, a diagnosis of cancer was historically often not disclosed to the patient (Elwyn et al. 1998).

Out of the discussion above the question arises: do researchers understand the meaning people attach to the different health concepts? Despite the benefits of the quantification process in health research, a more elaborated way of approaching health would be of great value. A study by Ferraro and Feller (1996) shows a novel way of approaching health. They asked an open-ended question as follows: “At this stage in your life, what are your most important problems, worries, or concerns?” Indeed, identifying health and specific problems related to it (such as diseases, pain, inability to perform tasks meaningful to a respondent, etc.) without being asked for it could provide a benefit in health research. This might also make it possible to observe less talked-about health concerns, changes in trends, and emerging worries related to health in a rapidly changing world. In this context, the commonly used question on general health rating would become more meaningful. Perhaps this mixed methods approach is the most promising way to go.

13.3 Reflections on the importance of the relationships between aspects of health

In Section 2 above some important reasons for undertaking studies on the relationships between different aspects of health were highlighted. How did these expectations fare during the studies?

13.3.1 Consistency and validity of the measures of health

It has been shown here that different measures of health, even when originating from the same abstract concept, are not identical. It was found (Studies II and III) that different aspects of health have significant effects on the other aspects of health: both morbidity and functional limitation influence the evaluation of subjective health, albeit to a different degree. Hence, all three measures of health studied in this thesis can be assumed to represent ‘parts of the whole’, but not all of them. This also implies that a single measure of health—whatever it is—cannot capture the whole complexity of the notion of health adequately. The researchers should strive for incorporating various aspects of health when ‘health’—and not a particular aspect or a single measure
of health—is the objective of the study. Alternatively, researchers should be specific as to the measures used and cautious when interpreting results.

13.3.2 Comparing structures of health aspects

This thesis suggested and tested a parsimonious model of health with a particular structure. This particular structure was explored in Studies II and III, finding, e.g., an indirect effect of morbidity on subjective health via functional limitation. This result highlights the complexity embedded in how the different aspects of health might relate to each other in the real world. This has implications for further research, suggesting that ignorance of easily overlooked relationships might limit the potential of much of the research on health.

In addition, this indirect effect has been found to be gender- and context-dependent, which might not have been as evident had the gender and region variables been included into the model as control variables. The stratification offered a nuanced view on the health structure of various groups.

Here, a specific structure of relationships was investigated. However, other links between the different aspects of health are theoretically possible, as previously stated (see Section 13.1.1).

13.4 Determinants of health in research

Studies II and III do not employ control variables apart from gender, age, and region. However, exploring the effect of various determinants of health on its aspects is not the aim of Study II or Study III. The plethora of control variables used by others; however, was closely studied in Study I (the systematic review).

The results of Study I show that there is variation in both the total number of control variables used and the frequency of specific control variables according to the health related outcome variable. In addition, there are some control variables that have rarely been employed. An example of those is heredity. A study by Atkins and colleagues (2016) studying a large sample (186,151) of British middle-aged adults with deceased parents has shown that parents’ longevity affects both mortality and morbidity in their children. More specifically, the age of parents was inversely associated with the risk of death and with the incidence of cardiovascular diseases (peripheral vascular disease, heart failure, stroke, hypertension, anaemia, hypercholesterolemia, and atrial fibrillation) in their children. The systematic review (Study I) identified only one study that controlled for parents’ longevity on mortality. This study by Borawski and colleagues (1996), albeit modest in terms of sample size (885), shows that the mother’s age at death or her current age if alive but not that of the father significantly decreased the risk of mortality. The role of heredity
and environment and their interplay on various health outcomes should be addressed in further research on health structure.

13.5 Conclusions

There is a growing interest in health structure research using structural equation modelling, and the literature is expanding. Recent studies have attempted to expand the models by including various determinants of health and other health-related variables. These models often are tailored to groups of elderly persons in specific contexts. Since both the models and the contexts are very different, the results cannot be compared. That is why more comparative studies are needed in this type of research, which is what this dissertation aims to do. The two studies in this dissertation are the first empirical studies that test a parsimonious model of health structure in the European adult population of all ages. The proposed model, while fitting the majority of subgroups, did not apply to them all and there is therefore room for elaboration. Also, this study shows that gender and age differences in health structure exist. It might also be affected by the regional context, whatever that might encompass. Elaborating on the model by tailoring and expanding it can be beneficial to society in many ways. By developing the model further, preferably using a mixed-methods approach, it can be utilised in health-care policy planning. Given the ever-increasing digitalisation and rapid technological advancement, such health structure models can be used in smartphone applications to improve and promote the health of individuals.
14 References


StataCorp. 2015. “Stata Statistical Software: Release 14.”


15.1 The equations for the proposed model in Figure 9

\[ \eta_1 = \gamma_{11} \xi_1 + \zeta_1 \]
\[ \eta_2 = \gamma_{21} \xi_1 + \beta_{21} \eta_1 + \zeta_2 \]
\[ x_1 = \lambda_{11} \xi_1 + \delta_1 \]
\[ x_2 = \lambda_{21} \xi_1 + \delta_2 \]
\[ x_3 = \lambda_{31} \xi_1 + \delta_3 \]
\[ x_4 = \lambda_{41} \xi_1 + \delta_4 \]
\[ x_5 = \lambda_{51} \xi_1 + \delta_5 \]
\[ x_6 = \lambda_{61} \xi_1 + \delta_6 \]
\[ y_1 = 1\eta_1 + \epsilon_1 \]
\[ y_2 = 1\eta_2 + \epsilon_2 \]

From the equations above both the structural and measurement parts can be written in the matrix form.
\[
\begin{pmatrix}
  x_1 \\
  x_2 \\
  x_3 \\
  x_4 \\
  x_5 \\
  x_6
\end{pmatrix}
= \begin{pmatrix}
  \lambda_{11} & \lambda_{12} & \lambda_{13} & \lambda_{14} & \lambda_{15} & \lambda_{16} \\
  \lambda_{21} & \lambda_{22} & \lambda_{23} & \lambda_{24} & \lambda_{25} & \lambda_{26} \\
  \lambda_{31} & \lambda_{32} & \lambda_{33} & \lambda_{34} & \lambda_{35} & \lambda_{36} \\
  \lambda_{41} & \lambda_{42} & \lambda_{43} & \lambda_{44} & \lambda_{45} & \lambda_{46} \\
  \lambda_{51} & \lambda_{52} & \lambda_{53} & \lambda_{54} & \lambda_{55} & \lambda_{56} \\
  \lambda_{61} & \lambda_{62} & \lambda_{63} & \lambda_{64} & \lambda_{65} & \lambda_{66}
\end{pmatrix}
\begin{pmatrix}
  \xi_1 \\
  \xi_2
\end{pmatrix}
+ \begin{pmatrix}
  \delta_1 \\
  \delta_2 \\
  \delta_3 \\
  \delta_4 \\
  \delta_5 \\
  \delta_6
\end{pmatrix}
\]

\[
\begin{pmatrix}
  y_1 \\
  y_2
\end{pmatrix}
= \begin{pmatrix}
  1 & 0 & 0 & 0 & 0 & 0 \\
  0 & 1 & 0 & 0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
  \eta_1 \\
  \eta_2
\end{pmatrix}
+ \begin{pmatrix}
  \epsilon_1 \\
  \epsilon_2
\end{pmatrix}
\]

\[
\begin{pmatrix}
  \eta_1 \\
  \eta_2
\end{pmatrix}
= \begin{pmatrix}
  0 & 0 & 0 & 0 & 0 & 0 \\
  0 & 1 & 0 & 0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
  \eta_1 \\
  \eta_2
\end{pmatrix}
+ \begin{pmatrix}
  \gamma_{11} \\
  \gamma_{21}
\end{pmatrix}
\begin{pmatrix}
  \xi_1 \\
  \xi_2
\end{pmatrix}
+ \begin{pmatrix}
  \zeta_1 \\
  \zeta_2
\end{pmatrix}
\]

The covariance matrix of \( \xi \) is

\[
\Phi = (\varphi_{11}) = Var(\xi) = 1
\]

The covariance matrix of \( \zeta \) is

\[
\Psi = \text{diag}(\psi_{11}, \psi_{22}) = \begin{pmatrix}
  \psi_{11} & 0 & 0 \\
  0 & \psi_{22} & 0
\end{pmatrix}
\]

The covariance matrix of \( \epsilon \), a diagonal matrix, is

\[
\Theta \epsilon = \text{diag}(\theta_1 \epsilon_{11}, \theta_2 \epsilon_{22})
\]

The covariance matrix of \( \delta \), a diagonal matrix, is

\[
\Theta \delta = \text{diag}(\theta_1 \delta_{11}, \theta_2 \delta_{22}, \theta_3 \delta_{33}, \theta_4 \delta_{44}, \theta_5 \delta_{55}, \theta_6 \delta_{66})
\]
A doctoral dissertation from the Faculty of Social Sciences, Uppsala University, is usually a summary of a number of papers. A few copies of the complete dissertation are kept at major Swedish research libraries, while the summary alone is distributed internationally through the series Digital Comprehensive Summaries of Uppsala Dissertations from the Faculty of Social Sciences. (Prior to January, 2005, the series was published under the title “Comprehensive Summaries of Uppsala Dissertations from the Faculty of Social Sciences”.)