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THE MALE-FEMALE HEALTH-MORTALITY PARADOX: RESEARCH REPORT OF THE ERC PROJECT HEMOX

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INHALTSVERZEICHNIS

1	THE HEMOX PROJECT: OBJECTIVES, IMPLEMENTATION AND OUTCOMES	4
2	SELEKTIVITÄT DER ORDENSLEUTE	24
2.1	DIE ZEIT VOR DEM ORDENSLEBEN	25
2.2	DIFFERENCES BETWEEN OLDER CATHOLIC ORDER MEMBERS AND THEIR PEERS IN THE GENERAL POPULATION: AN EXPLORATION OF POTENTIAL PSYCHOSOCIAL SELECTION EFFECTS	36
3	ORDENSLEUTE UND GESUNDHEIT.....	44
3.1	THE HEALTH OF CATHOLIC ORDER MEMBERS: A COMPARISON WITH THE GENERAL POPULATION.....	44
3.2	THE CROSS-SECTIONAL ASSOCIATION BETWEEN HEALTH AND MORTALITY: INSIGHTS FROM THE CLOISTER STUDY.....	61
3.3	THE BIOLOGICAL COMPONENT IN SEX DIFFERENCES IN VARIOUS FACETS OF HEALTH	83
3.4	A FRAILITY INDEX TO EXPLORE AGEING IN THE MONASTIC POPULATION.....	94
3.5	OVERALL LEVEL AND GENDER DIFFERENCES IN DEPRESSIVE SYMPTOMS AMONG OLDER CATHOLIC ORDER MEMBERS AND THEIR PEERS IN THE GENERAL POPULATION.....	102
3.6	EINFLUSS DER SOZIALEN QUALITÄT EINER GEMEINSCHAFT AUF DIE GESUNDHEIT IHRER MITGLIEDER – ERKENNTNISSE AUS DER KLOSTERSTUDIE	109
3.7	DIRECT EFFECT OF EDUCATION ON MORTALITY: INSIGHTS FROM THE CLOISTER STUDY	112

1 THE HEMOX PROJECT: OBJECTIVES, IMPLEMENTATION AND OUTCOMES

MARC LUY

The purpose of the project “The Male-Female Health Mortality Paradox” (HEMOX) – funded by the European Research Council within the European Community’s Seventh Framework Programme (FP7/2007–2013), ERC grant agreement number 262663 – was to decisively advance the understanding of the still unexplained male-female health-mortality paradox that is that women live longer than men but experience worse health. The central aim was to demonstrate in a “natural experiment” that this reverse relationship between sex on the one side and health and mortality on the other is not as paradoxical as it seems. *I hypothesised that two factors are mainly responsible for causing this intuitive contradiction.* First, the overall reversal in sex morbidity and sex mortality differentials occurs because conditions that figure importantly in morbidity are not very important in mortality, and vice versa. Thus, I follow the idea that *types and severity of illnesses and disability are different among men and women.* Second, it is very likely that longevity is directly related to the absolute number of life years in ill health. Hence, *women show higher morbidity rates not because they are female but because they are the sex with higher life expectancy.* The second aspect had not been connected with the male-female health-mortality paradox until this project and combines this phenomenon with the ongoing “compression versus expansion of morbidity” debate. This chapter describes first the state-of-the-art regarding male-female differentials in health and mortality as well as the objectives of the HEMOX project and its experimental design. In the second part, it summarizes the research conducted during the project time, how new hypotheses were developed and tested, and how we ultimately disentangled the gender paradox in health and longevity by an explanation through three central factors.

MALE-FEMALE DIFFERENTIALS IN HEALTH AND MORTALITY

That women live longer than men has been known at least since the middle of the 18th century when the first sex-differentiating life tables were constructed. The finding of male excess mortality was confirmed with the introduction of official population statistics in all Western societies. The mortality differences between women and men remained more or less constant until the first half of the 20th century and started to increase thereafter. This increase in the gap coincided with a rise among men in mortality from cardiovascular diseases, cancer, and accidents and a fall in maternal mortality and in causes of death related to pregnancy. Since the beginning of the 1980s the gap between women and men in overall mortality has been slowly narrowing in the developed world, with Japan being the only exception (Trovato and Lalu 1996; Luy 2002a; Gjonça et al. 2005). At the beginning of the 21st century, a higher life expectancy at birth for men was known only for some developing countries, mainly due to an excessive female mortality among infants and in young childhood ages. In the middle of the 2000s, Barford et al. (2006) announced in a British Medical Journal editorial entitled “life expectancy: women now on top everywhere” that females outlive males now even in the poorest countries of the world.

In light of the universal observable male excess mortality it is surprising that studies on sex differences in morbidity report that on average women are in worse health than men (e.g. Leveille et al. 2000; Benyamini et al. 2003) and that women spend a higher proportion of their total life in poor health (Robine et al. 2001; Crimmins et al. 2002). Even when reproductive conditions are excluded, a sizable sex difference still remains in acute conditions and short-term disability (Green and Pope 1999). Apart from that, women show a greater rate of decline in physical function and they are less likely to recover from disability (Leveille et al. 2000). Moreover, women are reported to have a higher utilisation of health care services (Anson et al. 1993; Redondo-Sendino et al. 2006) and they generally use more prescription and non-prescription drugs than men (Roe et al. 2002). These obvious contradictions to the mortality differences between the sexes have led to numerous publications describing the phenomenon with expressions like “gender and health paradox” (Rieker and Bird 2005), “morbidity paradox” (Gorman and Ghazal Read 2006), “morbidity-mortality paradox” (Kulminski et al. 2008), or “male-female health-survival paradox” (Oksuzyan et al. 2008, 2009).

Recently the existence of such a general paradox has been increasingly questioned. Several studies have shown that gender differences in health vary by age, morbidity measure, time and social context (e.g. Haavio-Manila 1986; Verbrugge and Wingard 1987; Macintyre et al. 1996; Rieker and Bird 2005; Gorman and Ghazal Read 2006; Kulminski et al. 2008). Nevertheless, the aforementioned citations demonstrate that the idea of a general paradoxical relationship between health and mortality among women and men persists until today. This might be caused by the fact that despite the efforts of many demographers, epidemiologists, socio-medical scientists and others still very little is understood about the reasons for the paradox or its mechanisms, as concluded by Austad (2006) and Grundy (2006).

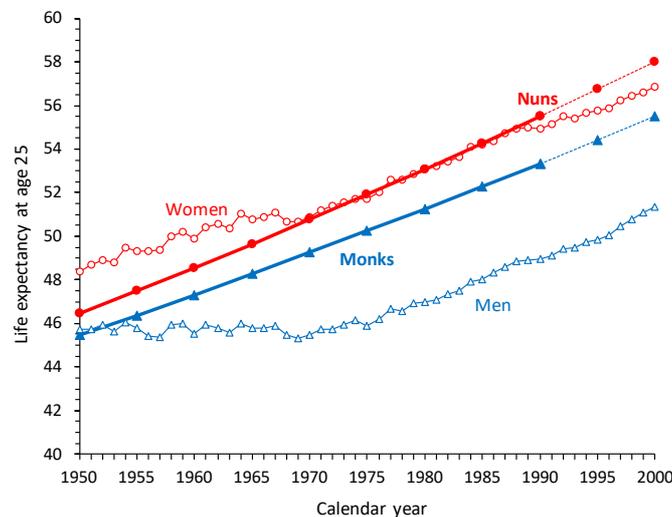
GENDER DIFFERENCES IN HEALTH AND MORTALITY: POSSIBLE CAUSES AND EMPIRICAL EVIDENCE

The suggested explanations for differences between men and women in health and mortality include biological factors, risks acquired through social roles and behaviours, types and severity of illnesses and disability, illness and prevention orientation, and health reporting behaviour. *Biological factors* (mainly genetic and hormonal differences between the sexes) and *acquired risks* (behavioural and environmental factors such as smoking, alcohol consumption, diet, reckless driving, health risks at work, social stress) are thought to explain male excess mortality (see overviews in Wingard 1984; Waldron 1985; Luy 2002a, 2003a). *Types and severity of illnesses and disability* (women have more chronic conditions than men do, but their conditions are less severe and are often not life-threatening), *illness and prevention orientation* (perception of and complaining about symptoms as well as willingness to seek medical help and cut down activities when ill or injured) and *health reporting behaviour* (completeness of reporting, gender imbalance among proxy respondents) are discussed as factors for causing female excess morbidity (see overviews in Verbrugge 1985; Verbrugge and Wingard 1987; Rieker and Bird 2005).

Intensive research during the last few decades made it clear that the extent and the trends in mortality differences between women and men are caused by a complex combination of biological factors and acquired risks. Several authors have attempted to determine the relative contributions of these two cause categories and concluded that the acquired risks are mainly responsible for the differences in life expectancy between women and men (e.g. Wingard 1984; Waldron 1983a, 1983b; Zhang et al. 1995; Lemaire 2002). My own studies contributed also to the knowledge in that area. In an extensive analysis of the mortality of almost 12,000 Catholic order members from Bavaria I could not find any differences between nuns and general population

women since the late 1960s, but considerable differences between monks and the general male population, showing a difference in favour of monks of up to four years in life expectancy at young adult ages (see Figure 1). The differences in life expectancy at age 25 between nuns and monks were therefore not greater than 2 years (see also Luy 2002b, 2003a, 2003b). These results showed (i) that the majority of the gender difference of 6-7 years, which was predominant in the general population at the same time, cannot be due to biological factors, and (ii) that the high mortality of men is the decisive parameter regarding the extent of sex differences in the general population and not, as commonly believed, the low mortality of women. Interpreting the remaining small difference in life expectancy between nuns and monks as the impact of biological factors is in line with other studies attributing genetic factors to approximately 25% of the variation in both general health (Christensen et al. 1999) and mortality (Christensen and Herskind 2007).

FIGURE 1: TRENDS IN LIFE EXPECTANCY AT AGE 25 FOR GERMAN WOMEN AND MEN AND FOR BAVARIAN NUNS AND MONKS, 1950-2000



Notes: Nuns' and monks' life expectancy is represented by smoothed trends including projected trends from 1990 to 2000 (marked by dotted lines); Data: Luy (2003a), updated until 2005

In contrast to the situation regarding mortality differences, there is still no conclusive understanding about the reasons for the contradictory picture of higher female morbidity rates. Frequently cited explanations for apparently higher rates of morbidity among women are that they are more sensitive than men to bodily discomforts, and more willing to report symptoms of distress and illness. Yet the evidence, though limited, is conflicting. Some studies have found that when one controls for specific conditions, there are either no sex differences in pain or symptom reporting or it turns out that men are more likely to complain (Macintyre and Pritchard 1989; Macintyre 1993). With regard to the widely accepted belief that women use health services more frequently than men, one can also find contradictory evidence in the literature (Hibbard and Pope 1983; Waldron 1985; Haavio-Manila 1986; Arber and Cooper 1999). Other studies failed to detect any sex differences in the reporting of health problems and health service contacts or in the readiness to mention symptoms (Kooiker 1995; Macintyre et al. 1999; Galdas et al. 2005). Ok-suzyan et al. (2009) found that hospitalised women and women taking medication are somewhat more likely to participate in a health survey than comparable men, but that the contribution of such a selection bias is only a minor component. Some other arguments regarding the different health reporting behaviours of women and men are based solely on theoretical considerations or intuitive assessments, and thus many counterarguments could be found against these explanations (see Verbrugge 1982).

OBJECTIVE OF THE PROJECT: TOWARDS AN EXPLANATION OF THE MALE-FEMALE HEALTH-MORTALITY PARADOX

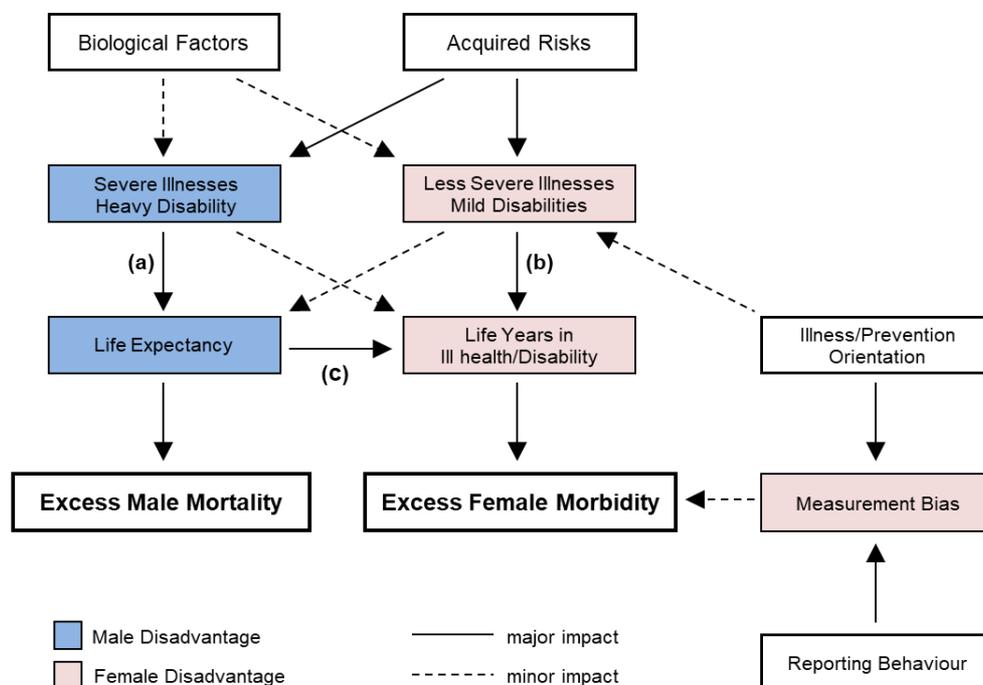
As with all phenomena of differentials in health and mortality the sex differences in morbidity are probably caused by many different factors (Luy and Di Giulio 2006). It might be that health reporting behaviours in fact contribute to the female excess in some morbidity measures, but it seems unlikely that they play a major role in the relationship between sex on the one side and health and mortality on the other. *I hypothesised that the largest component of the “gender paradox” is caused by two interrelated factors:*

(i) Women have more frequent illness and disability, but the problems are typically not serious (life-threatening) ones. In contrast, men suffer more from life-threatening diseases, and these cause more permanent disability and earlier death for them. [“Health Domain Hypothesis”]

(ii) It can be expected that longevity is directly related to the absolute number of life years in ill health and disability. Hence, women show higher morbidity rates not because they are female but because they are the sex with higher life expectancy. [“Longevity Hypothesis”]

These factors could explain the gender paradox because they cause disadvantages in health for women but at the same time they are not paradoxical to lower female mortality. Figure 2 summarises my theoretical framework for the joint existence of excess male mortality and excess female morbidity.

FIGURE 2: THEORETICAL FRAMEWORK FOR THE JOINT EXISTENCE OF EXCESS MALE MORTALITY AND EXCESS FEMALE MORBIDITY



Source: author's own



The Health Domain Hypothesis is based on several findings (e.g. Verbrugge 1985; Rieker and Bird 2000; Spiers et al. 2003) which show that – caused by a combination of biological factors and acquired risks – women and men differ in types and severity of illnesses and disability. As Verbrugge and Wingard (1987: 125) concluded in their review of the empirical evidence it appears that “one sex is sicker in the short run, and the other in the long run”. This means that the overall reversal in sex morbidity and sex mortality differentials occurs because conditions which figure importantly in morbidity are not very important in mortality, and vice versa (see the paths marked with (a) and (b) in Figure 2). Consequently, there is no contradiction between sex differences in health and mortality because both point to more serious health problems for men (see also Verbrugge 1982; Grundy 2006).¹ Thus, *the Health Domain Hypothesis implies that the extent – and maybe even the direction – of gender differences in health depend strongly on how health is defined and measured.*

The Longevity Hypothesis is based on the general idea that a higher number of life years should be expected to increase the absolute number of life years in ill health and disability, as shown for instance by Crimmins et al. (1994). Analyses of the dynamics of disability revealed that the higher prevalence of disabling conditions among older women reflects their longer survival with disablement rather than differences in incidence (Manton et al. 1993; Crimmins et al. 2002). Combining these two observations, *the Longevity Hypothesis says that women show higher morbidity rates not because they are female but because they are the sex with higher life expectancy.* This relation between mortality and morbidity is marked with “(c)” in Figure 2. Apart from a brief remark in Idler (2003), this aspect had not been connected with the male-female health-mortality paradox until this project.

Note that the Longevity Hypothesis combines the gender paradox with the ongoing “compression versus expansion of morbidity” debate among demographers, gerontologists, epidemiologists and medical scientists. The “expansion of morbidity” theory states that the increase in life expectancy is caused by a reduction in the fatality rate of chronic diseases rather than by a decline in the incidence of these diseases (Gruenberg 1977; Schneider and Brody 1983). The increase in longevity should therefore go hand in hand with an increasing number of years spent in poor health. Fries (1980) proposed the contrasting “compression of morbidity” theory. This theory states that the onset of chronic diseases will be postponed while the average maximum lifespan is fixed at around 85 years. Morbidity will then be compressed into a shorter period of time at the end of life so that people who have longer lifespans will have shorter periods of disability prior to death compared to people with shorter lifespans who will be sicker for a longer time before they die. Despite the fact that there is no evidence for Fries’ hypothesis about the human lifespan being fixed (Manton et al. 1991; Oeppen and Vaupel 2002), the majority of empirical studies and literature reviews report strong or some support for the compression of morbidity theory, mainly measured through disability (e.g. Rogers et al. 1990; Doblhammer and Kytir 2001; Manton et al. 2008).

However, the overall picture regarding other types of morbidity is not clear yet. Some studies showed that although disability measures often reveal improvement, there is a simultaneous increase in chronic disease and functional impairment (Crimmins et al. 1997; Crimmins and Saito 2000; Freedman et al. 2007; Christensen et al. 2008). It seems that, as declines in the rate of disease progression delay the onset of more serious disease states, mortality reductions are associated with a stabilising or decreasing proportion of the lifespan with serious illness, whereas the proportion with moderate disability or less severe illness

¹ Case and Paxson (2005) even claimed that the difference in self-assessed health between women and men could be entirely explained by differences in the distribution of the chronic conditions they face. This conclusion, however, was criticised to be exaggerated (Shinberg and Murphy 2007).

increases. This scenario has been termed the “dynamic equilibrium” (Manton 1982) or the “relative compression of morbidity” (Robine and Mathers 1993).

The Longevity Hypothesis is also based on two technical aspects of measuring morbidity differentials. First, since mortality affects primarily ill and disabled persons (path (a) in Figure 2) it follows that the group of survivors comprises more healthy individuals in a population with higher mortality. Such selection effects in health and mortality have been described already for several kinds of health differentials, above all with regard to mortality differentials in higher age groups (e.g. Beckett 2000; Goldman 2001; Doblhammer and Hoffmann 2009). The second technical aspect concerns the measurements of morbidity and their relation to the level of mortality. For instance, assuming that the relation between life expectancy at birth and healthy life expectancy for the average of OECD countries (Mathers et al. 2003) also applies to the German life table for the years 1986/88, there is a difference between women and men in life expectancy of 6.5 years and in healthy life expectancy of 3.9 years. Thus, the female-male difference in healthy life years is 2.6 years lower than in overall life years. However, this number is influenced by the different mortality of women and men. Assuming the same overall life expectancy-healthy life expectancy ratio for both sexes still produces a female-male gap in healthy life expectancy of 0.7 years (all numbers based on my own calculations). This shows that in this case more than 25% of the lower sex difference in healthy life expectancy as compared to the sex difference in overall life expectancy is simply due to the fact that the number of life years is higher among women.

In sum, women suffering from more but less severe illnesses than men (Health Domain Hypothesis), the relative compression of morbidity, selection effects and the higher life expectancy of women (Longevity Hypothesis) must be assumed to result in a higher general morbidity for women as compared to men.

EXPERIMENTAL DESIGN OF THE PROJECT: A “NATURAL” EXPERIMENT WITH CATHOLIC ORDER MEMBERS

The initial idea of this project was to test the Health Domain and Longevity Hypotheses in a “natural experiment” among Catholic nuns and monks from Germany and Austria in comparison to women and men of the general population. Testing any hypothesis regarding the male-female health-mortality paradox is always difficult because many biological and non-biological factors influence the health and mortality of women and men and the differences between them. Above all the various dimensions of socio-economic status have a strong impact on male and female health and mortality. However, even the relation between socio-economic status and health and mortality is caused by a complex interplay of biological, behavioural and psychosocial factors (Molarius and Janson 2002). Therefore, the characteristics of cloistered life provide an ideal setting for testing my hypotheses regarding the relationship between health and mortality among women and men.

Members of religious orders are the group of women and men among whom behavioural and environmental conditions are probably as close to being equal as can be found in modern societies. Female and male order members lead a “simple lifestyle” that is determined by vows (living in poverty, chastity and obedience), with similar daily regimes as regards time for sleep, work, study and recreation, and also with respect to diet, housing and medical care. The first vows are preceded by at least a twelve months’ novitiate. During this trial period candidates are screened for psychological suitability as well as physical health. Hence, the members of religious orders form a select group of individuals in good and stable mental and physical condition at the time of entry. Furthermore, cloistered life entails no sex-specific influences of financial burdens, socio-economic status, reproductive roles, marital status or familial responsibilities. Aside from the typical internal occupations in male and



female cloisters such as household work, farming and similar occupations, most monks practice as priests while nuns nowadays mainly work as school and pre-school teachers. Yet these differences in the professions are unlikely to produce sex-specific health risks among the order members. The only exception is the outings of priests which might increase the risk of being involved in traffic accidents (Luy 2009a), but such accidents can have only minor, if any, influence on overall mortality and health. Celibacy and childlessness are likely to cause differences between cloistered and general populations in the prevalence of specific diseases, above all in respect to breast cancer and cervical cancer (Gagnon 1953; Fraumeni et al. 1969). However, the impact of these specifics on overall mortality (and even on mortality from all cancers) is minor because the corresponding advantages and disadvantages compensate each other (Luy 2009b). These preconditions make order members a valuable experimental group for the study of health and mortality in general and regarding sex differences in particular, permitting us to isolate the impact of biological factors and to control for most of the confounding non-biological factors (Madigan and Vance 1957; Luy 2003a).

Studies on health and mortality of nuns and monks have a long scientific tradition and provided path-breaking knowledge for human medicine and demography. In particular, cloister studies have helped to understand determinants and/or transmission of breast cancer (Ramazzini 1713), cervical cancer (Rigoni-Stern 1842), tuberculosis (Cornet 1890) and, more recently, Alzheimer's disease (Snowdon 2001). In the field of demography, the analysis of nuns' and monks' mortality led to the first sex-specific life tables and thus to the first empirical evidence that women live longer than men (Deparcieux 1746). Furthermore, cloister studies provided important insights on the impact of biological factors for sex differences in life expectancy in pre-war years (Madigan 1957) and in post-war periods (Luy 2003a) as well as for excess male mortality due to external causes of death (Luy 2009a). The HEMOX project followed the line of this tradition and established a database for longitudinal observation of order members' health and mortality to investigate the male-female health-mortality paradox. Such a longitudinal setting is the only way to fully analyse the relationship between health and mortality. A study like this has not been done before. The existing studies of health issues among order members investigated either nuns or monks only (see overview of cloister studies in Luy 2003a). The few comparisons of female and male order members concentrated on differentials in mortality (Madigan 1957; Luy 2003a).

A study of Catholic order members entails also another advantageous aspect. It has been shown that participation in health surveys is a problematic issue and results usually in the situation that participants are strongly selected towards better health and higher socio-economic status (e.g. Boshuizen et al. 2006; Haddow 2009). Equivalent results were found regarding health care utilisation and hospitalisation (Osler and Schroll 1992; Grotzinger et al. 1994). Selective non-response and non-participation lead to severe biases in the estimation of disease prevalence and, above all, in estimating the relationship between health and mortality (Hoeymans et al. 1998). Such problems are reduced to a minimum when studying health and mortality among Catholic order members. Every individual belonging to that population is registered with information of high relevance for health and mortality (like date of birth, date of entry, date of exit/death, education, occupation, family background) and the willingness to participate in such a study is much higher and less affected by selective non-response than in the general population. Moreover, no participant of the study will get lost to follow-up without having any information about his or her life since the previous survey as otherwise frequently observed. The least obtainable information will be the current life status of these individuals, allowing a complete mortality follow-up which is almost impossible to achieve in a sample of the general population.

IMPLEMENTATION OF THE PROJECT AND MAIN RESULTS

We started our natural experiment by creating two unique datasets which will also be very valuable as basis for follow-up research. The first is the survey sample of 1,158 Catholic order members aged 50+ (622 nuns, 536 monks) of 16 different orders from Germany and Austria, including 142 religious communities and 69 order members who live alone. The survey is based on a paper & pencil questionnaire including several complete batteries of questions, among others, SF-36, MEHM, PANAS, NEO-FFI-30, PSS-10, and LOT-R. The first wave was carried out in 2012 and the second, together with a mortality follow-up, in 2014. The sample of order members is unique for two reasons. The first is the extraordinarily high response rate which minimizes the already mentioned selection problem from which such health surveys usually suffer: 68.8 percent in wave I, and 86.2 percent of those in wave II.² The second is the fact that no participant can get lost, as mentioned already in the previous section. Even if members of the sample do not participate in follow-up waves, we know at least if they are still member of the community (and if they left the community we know the day of exit) and if they are still alive (and if they died the date of death). In addition to the sample of order members, we developed a database including numerous information about people's health, health behaviors and socio-economic characteristics from different surveys for the general populations from Germany and Austria (cross-sectional as well as longitudinal). This database includes, e.g., SHARE (Survey of Health, Ageing and Retirement in Europe), SOEP (German Socio-Economic Panel), BASE (Berlin Ageing Study), LES (German Life Expectancy Survey), the German Aging Survey (DEAS), the Austrian Health Interview Survey (ATHIS), and the European Union Statistics on Income and Living Conditions (EU-SILC). This tool enabled us to analyze the data from the different surveys – including the data of the order member survey – separately or merged, with the necessary recoding of the variables for merging the data sets being incorporated in the database.³

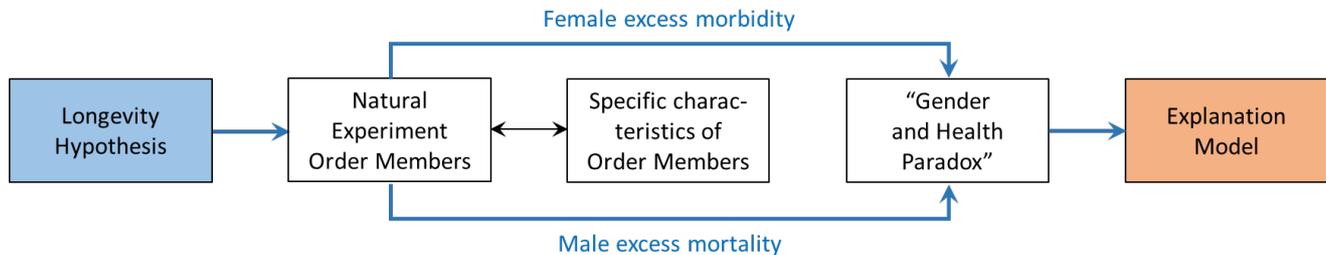
These data resources built the base for the research within the HEMOX project. Figure 3 illustrates the original work plan at the start of the project in 2010. It assumed a direct path from the central Longevity Hypothesis to the explanation model. The natural experiment to investigate the gender and health paradox was supposed to be conducted in three steps. The first two were comparisons of healthy life years of female respective male order members with women and men of the general population. Based on my preliminary research I expected mortality differences between nuns and women of the general population to be low in the observation time, with small advantages in favour of nuns, but to be substantial among men with significant advantages for monks (see Figure 1). Since the Longevity Hypothesis states that the level of mortality influences the level of morbidity (path (c) in Figure 2) I expected no significant differences between nuns and general population women in the relationship between health and mortality. By contrast, I expected significant differences between monks and general population men in the way that monks show higher morbidity than men of the general population. In addition, I expected the comparison of order members with the general population to provide new insights into the impact of biological factors and acquired risks

² The whole data collection was done by the research team. Given the pioneering character of this study an alternative outsourcing of the interviews would have provided more risks than gains. Conducting the field work by researchers who are highly motivated and interested in the study assured the highest quality regarding accuracy and completeness of the collected data. Furthermore, the typical difficulties of finding and establishing first contacts to participants, in which social research institutes are specialised, did not occur in this study because of the already established contacts from the previous studies on order members' life expectancy.

³ Both databases were continued after the end of HEMOX project. The surveys on order members were transferred into a permanent long-term project labelled the "Ageing Study of Catholic Order Members" (ASCOM). In 2017, we carried out a third survey wave and we labelled the three waves ASCOM I, ASCOM II, and ASCOM III. Information about the ASCOM I wave can be found in Wiedemann et al. (2014). Details about ASCOM II and III are presented in an extra research report (VID Forschungsbericht No. 41). The database on surveys for the general population is currently extended by international surveys.

in the health-mortality relationship among females and males, leading to a better general understanding of female excess morbidity and male excess mortality (paths (a) and (b) in Figure 2).

FIGURE 3: ORIGINAL WORK PLAN FROM THE LONGEVITY HYPOTHESIS TO THE EXPLANATION MODEL AT THE BEGINNING OF THE HEMOX PROJECT

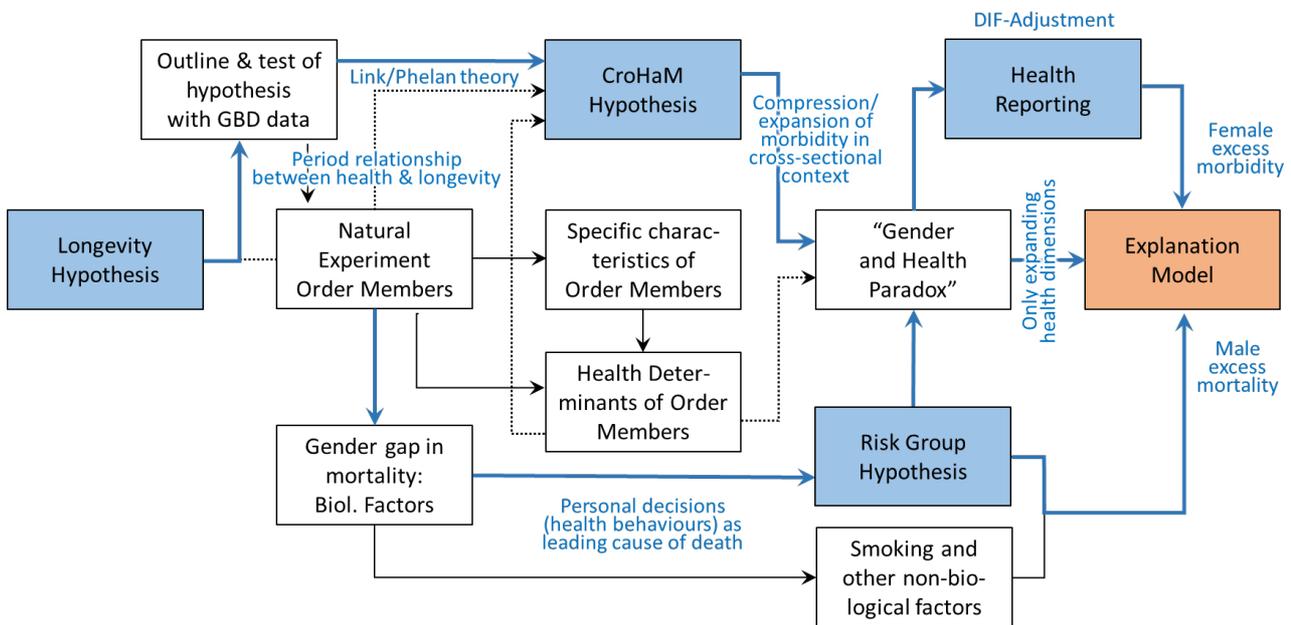


Source: author's own

As a third step I planned a comparison of cloistered and general populations regarding the sex differences in the health-mortality relationship. The results of my preliminary studies and the described expectations of future mortality trends of nuns and monks led to the expectation that mortality differences by sex will be considerably smaller in the cloistered population during the study time of the project. Since the Health Domain Hypothesis states that women and men differ in respect to types and severity of illnesses and disability and that these differences are caused mainly by acquired risks, I expected significantly fewer differences in types and severity of illnesses and disabilities among order members. Thus, this third step was supposed to shed further light into the impact of paths (a) and (b) in Figure 2 on gender differences in the relationship between health and mortality and thus to provide further insights into the mechanisms of the male-female health-mortality paradox. In addition to the analysis of nuns' and monks' health and mortality I planned to investigate the possible selectivity of Catholic order members. A general or sex-specific selectivity of order members towards biological characteristics that influence health and mortality would have significant consequences on the results and, above all, on the interpretation and the conclusions to be drawn from the study. Thus, the ultimate idea was that the order members are in the centre of all analyses and the key to understand the gender and health paradox.

In the end, however, the project developed very differently over the five-year project period. Nonetheless, the starting and end points remained identical. Just the path between them became more complicated and not as straightforward as originally envisaged. Moreover, the focus of the analyses shifted from order members to the general population. Figure 4 shows the actual analytical steps and branches from the Longevity Hypothesis at the beginning to the explanation model at the end of the project. The main pathways which led to the explanation model – which turned out to be in line with the theoretical framework shown in Figure 2 – are indicated by bold blue arrows. Analytical steps which led to interesting findings that are relevant for the explanation model but not directly related to it are indicated in black solid arrows. Finally, we gained insights, inspirations and new ideas about the most relevant factors for better understanding the gender paradox in health and mortality which led to new theoretical connections and empirical test strategies. These are represented by black dotted arrows.

FIGURE 4: ACTUAL WORK STEPS FROM THE LONGEVITY HYPOTHESIS TO THE EXPLANATION MODEL UNTIL THE END OF THE HEMOX PROJECT



Source: author's own

I will not go into detail with regard to each analytical step and theoretical development during the five years of project time. Rather, I try to give an impression about the most important elements of the pathways from the Longevity Hypothesis at the beginning to the explanation model at the end, and how the original work plan was amended and extended during this journey. The natural experiment on the basis of order members' health and mortality was carried out as planned originally. The analysis of order members' health and mortality helped us to get better ideas about the potential selectivity of nuns and monks and a better understanding of the health determinants in this specific subpopulation. The main results from these analyses are summarized in this report, either as full papers or as summaries in case of studies that were published elsewhere. The gained insights on female excess morbidity and male excess mortality from the natural experiment with order members were important but ultimately not sufficient to fill and verify the explanation model. Nonetheless, they provided us the decisive ideas about the central mechanisms which connect female and male morbidity and mortality (see pathways starting with or influenced by the natural experiment of order members in Figure 4). The final explanation of the gender paradox would not have been possible without the insights gained from these natural experiments. In the end, they led the originally two hypotheses being turned into three decisive hypotheses which are directly related to each other. These are highlighted in blue boxes in Figure 4:

1. The "Risk Group Hypothesis" states that the current extent of the gender gap in life expectancy is caused by the disproportionate high mortality levels of specific male sub-populations which are primarily related to socio-economic status. The hypothesis was introduced by Luy and Gast (2014) and demonstrated by a large meta-analysis which included data for the general population as well as order members.
2. The "CroHaM hypothesis", with CroHaM being the abbreviation for "Cross-sectional association between Health and Mortality", has developed from the "Health Domain Hypothesis". It states that the well-established longitudinal relationships between health and mortality (i.e., a postponement of functional limitations and disabilities with higher levels of life

expectancy, but an increase in chronic diseases and conditions) exist equivalently in a cross-sectional context regarding health differences between subpopulations with different levels of life expectancy. It roots in the “Risk Group Hypothesis” and builds on Link and Phelan’s (1995) “theory of fundamental social causes”. The hypothesis has been introduced and tested with the data for order members by Luy (2020) (see also the corresponding chapter “The Cross-sectional Association between Health and Mortality: Insights from the Cloister Study” in this volume).

3. The “Longevity Hypothesis” became particularly meaningful because it connects the Risk Group and the CroHaM hypotheses and states—as described above—that women spend more years in poor health than men not in spite of living longer, but because they live longer. The original hypothesis was introduced by Luy and Minagawa (2014) with data of the Global Burden of Disease project (GBD).⁴ The CroHaM hypothesis specifies the Longevity hypothesis in the way that the extent of the “longevity effect” depends on the particular health domain considered. In fact, we found that the “gender paradox” exists only among expanding health domains, but not among compressing health domains.

In the course of the project, we extended the empirical test of the CroHaM Hypothesis from the natural experiment with order members to an analysis of 30 particular subpopulations with data from the collected surveys. Here we also switched the perspective from healthy life years to unhealthy life years. This was done because the focus on unhealthy life years is more in line with both the general idea of the gender paradox and the health domain effects which are one the central pillars of the CroHaM hypothesis. The analyses confirmed that the paradoxical relationship between health and mortality exists only in expanding health domains, such as chronic diseases. The sex differences within the 30 subpopulations were then used to test the Longevity Hypothesis. In this way we found that, in line with our hypothesis, most of the gender gap in unhealthy life years is due to the longevity effect.

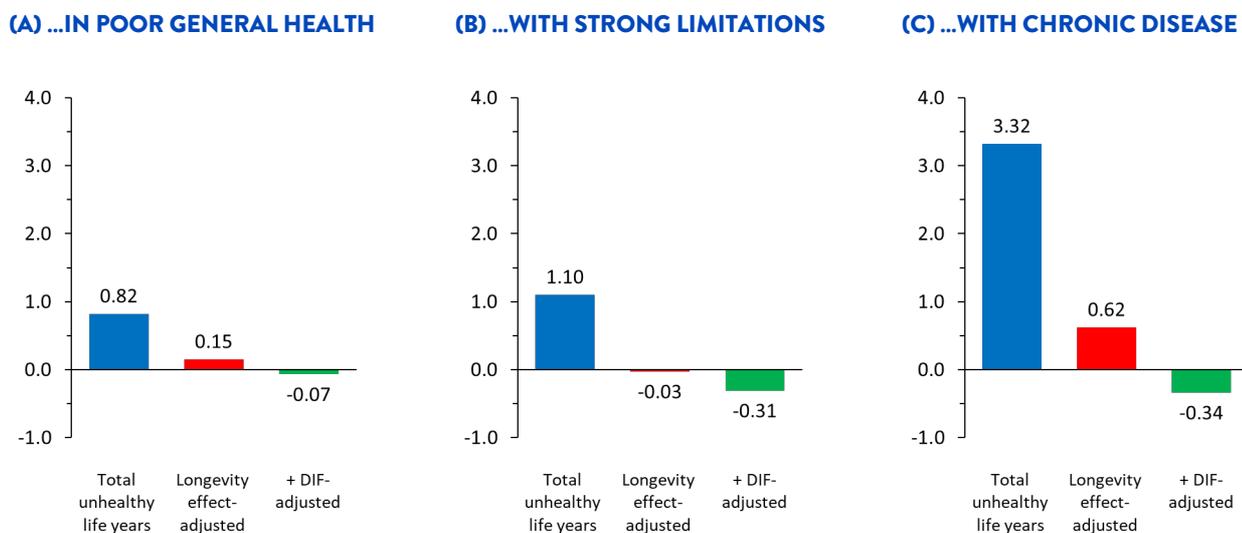
The remaining differences after controlling for the longevity effect can be explained by health reporting behaviour, i.e. the so-called “different item functioning” (see blue box “Health Reporting” in Figure 4). Thus, the gender paradox in health and mortality can be explained by only three factors:

1. the health domain,
2. the longevity effect, and
3. different item functioning.

Figure 5 demonstrates these main findings of the HEMOX project with empirical data. The figure consists of three graphs showing the gender difference (women minus men) in the total number of life years at age 50 spent in poor general self-rated health (Figure 5a), with strong limitations in activities of daily living (Figure 5b), and with chronic health problems (Figure 5c). Each of these graphs includes three bars. The first bar on the left-hand side (coloured in blue) shows the gender differences in total unhealthy life years, the bar in the middle (coloured in red) shows the gender differences once the longevity effect is controlled for, and the bar on the right-hand side (coloured in green) shows the gender difference after additional adjustment for the different reporting behaviour of women and men.

⁴ Descriptions and download options for the GBD data can be found at: <http://www.healthdata.org/gbd/data>

FIGURE 5: GENDER DIFFERENCE (WOMEN MINUS MEN) IN THE TOTAL NUMBER OF LIFE YEARS AT AGE 50 SPENT...



Notes: gender difference in life expectancy at age 50 = 4.8 years; DIF = different item functioning; source: author’s own calculations with the decomposition method of Nusselder and Looman (2004); data: life table 2011/13 for Germany (German Statistical Office), GEDA survey 2012 (Robert Koch Institute).

The results shown in Figure 5 relate to the German population in the year 2012. At this time, the gender difference in life expectancy at age 50 was 4.8 years in favour of women. The blue bars show all positive values, i.e., they confirm the gender paradox because women spent more life years in poor health compared to men, regardless which of the three health domains is considered. However, the different values reveal that—in line with the CroHaM hypothesis—the extent of the gender paradox depends strongly on the health domain. The disadvantage of women is smallest for life years spent in poor general health (0.8 years) and it is largest for life years spent with chronic disease (3.3 years). As outlined by Luy (2020) and in the corresponding chapter of this volume, this difference between the health domains is due to their different severity, i.e. the level of mortality risk associated with them. The red bars show that most of the gender differences in unhealthy life years can be explained with the “longevity effect”, thus confirming the Longevity Hypothesis. Once the different total number of life years of women and men is controlled for, the gender gap in unhealthy life years disappears completely for life years spent with strong limitations and almost completely for life years spent in poor general health. Even for the life years spent with chronic disease, the disadvantage of women decreases from 3.3 to 0.6 years once the longevity effect is controlled for.

Finally, the green bars demonstrate that, as mentioned above, the remaining disadvantages of women regarding life years spent in poor general health and life years spent with chronic disease disappear completely once the different item functioning – as several studies have shown, women tend to report the same health state more negative than men – is taken into account. Thus, once both the longevity effect and different item functioning are controlled for, women spent a lower number of life years in poor health for all three health domains. Interestingly, this advantage of women is even largest for life years spent with chronic disease, i.e., the health domain for which they have the largest disadvantage in the total number of life years. More details about these results were presented at several conferences and will be published soon.



As ultimate outcome of the HEMOX project it can be summarized that the gender paradox in health and longevity is not as paradoxical as it seems. It can be fully explained by the health domain effect (the theoretical reasoning is outlined in the CroHaM Hypothesis), the longevity effect (the theoretical reasoning is outlined in the Longevity Hypothesis) and the different health reporting behaviour of women and men. It is important to note, however, that these central findings of the HEMOX project are based on – and are valid for – the populations and data used for the analyses. Further tests of our hypotheses and findings with data for other populations are necessary to see to what extent they can be generalized. In this way, our explanation model for the “gender and health paradox” will provide the basis for new interdisciplinary follow-up research on gender differences in health and mortality, with different foci and country-specific contexts.

Last but not least, the project work included also the application-driven development of three innovative methods to estimate life expectancy and healthy life years for specific subpopulations from longitudinal respective cross-sectional survey data and to analyze the variations between them:

1. The "Modified Orphanhood Method" (MOM) estimates life expectancy for specific sub-populations in developed countries from survey information on parents' survival. It is a modification of the classic indirect approach used in developing countries (Luy 2012).
2. The "Longitudinal Survival Method" (LSM) produces cross-sectional life tables on the basis of cohort-specific survival experiences from longitudinal survey data. Its logic is adopted from the MOM with the difference that the basic survival experiences do not refer to the survey respondents' parents, but to the respondents themselves (Luy et al. 2015).
3. The "Serendipity-based Meta-Analysis" was developed to test our Risk Group Hypothesis (details below). The method differs from the classic meta-analytic approach because it summarizes or reanalyses the results of studies which do not deal with the same topic as the meta-analytic study itself (Luy and Gast 2014).

SUMMARY

The main objective of the HEMOX project was to decisively advance the understanding of the so-called “gender and health paradox” – describing the phenomenon that women live longer than men but experience worse health – by demonstrating that the reverse relationship between gender on the one side, and health and mortality on the other, is not as paradoxical as it seems. We extended the state-of-the-art by introducing the “Longevity Hypothesis” and the “CroHaM Hypothesis” which state, building on each other, the existence of a direct relationship between longevity and live years spent in poor health regarding less severe health dimensions, i.e., those health domains which are not closely associated with the risk of dying. Consequently, we hypothesized that women show higher morbidity rates than men for longstanding illnesses not because they are female, but because they are the sex with higher life expectancy.

We tested these hypotheses in a series of quasi-experimental settings in which we investigated the association between longevity and life years spent in poor health – measured by different health indicators with strong or weak relationships to mortality – across subpopulations with different levels of life expectancy and corresponding gender gaps. The initial tests were done with Catholic nuns and monks who show higher life expectancies than the general population. We collected data on the health of order members in two surveys conducted in 2012 and 2014. The surveys were based on self-administered questionnaires and include individuals aged 50 years and older. In total, 1,158 order members of 16 different orders from Germany and Austria



participated to the first survey (response rate: 68.8 percent). Of those still alive in 2014, 936 filled and returned the questionnaire of the second survey wave (response rate: 86.2 percent). For the general populations of Germany and Austria we used data from the different surveys, restricted to ages 50 and above. These data were used to estimate healthy and unhealthy life years for 30 subpopulations defined by different characteristics, e.g., education level, income, BMI and smoking status. Life tables for Catholic order members were based on the continuously extended nuns' and monks' mortality data base of the Cloister Study collected from order archives. Life tables for the other subpopulations were estimated with the specifically developed "Longitudinal Survival Method", using data from health surveys with mortality follow-up, national population statistics and the Human Mortality Database.

The results confirmed our hypotheses and revealed that the direction and the extent of gender differences in healthy life years are not universal but depend on the definition of health, i.e., the "health domain". A female disadvantage in healthy life years exists in particular among those health dimensions which are not (closely) related to mortality, such as chronic diseases. We found that this disadvantage of women is in fact mostly a direct consequence of their advantage in longevity. It reduces to a minimum when mortality differences between women and men are controlled for. The remaining disadvantages of women in healthy life years are eliminated when gender differences in health reporting are adjusted for. On the basis of these results, we developed an explanation model for the "gender and health paradox", based on three central factors:

1. the definition of health ("health domain"),
2. the longevity effect, and
3. gender-specific health reporting behaviour.

This explanation model can serve as basis for new interdisciplinary follow-up research on gender differences in health and mortality and it can help to advance the general understanding of the mechanisms behind healthy ageing.

To sum up, the project resulted in three central conclusions:

1. The "gender and health paradox" is not a general phenomenon but restricted to those health domains which are not closely linked to mortality (CroHaM Hypothesis). The female disadvantage in these health domains can be explained by (a) a longevity effect which results from the fact that higher life expectancy is directly associated with an increase in life years spent with health impairments (Longevity Hypothesis), and (b) different health reporting behaviours of women and men which result in a relative over-estimation of female prevalence values.
2. The well-established longitudinal effects of health compression and expansion exist equivalently in a cross-sectional context regarding health differences between subpopulations with different levels of life expectancy (CroHaM Hypothesis).
3. The current extent of the gender gap in life expectancy is caused to a large extent by the disproportionate high mortality levels of specific male sub-populations which are primarily related to socio-economic status (Risk Group Hypothesis). I did not include this hypothesis and its meaning for the central results in this chapter. Details can be found in Luy and Gast (2014).

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2 SELEKTIVITÄT DER ORDENSLEUTE

Eine große Herausforderung, die sich bei der Analyse von Daten von Ordensmitgliedern ergibt, ist die Frage, inwieweit sich gewonnene Ergebnisse auf die Allgemeinbevölkerung übertragen bzw. inwiefern sie sich mit jenen der Allgemeinbevölkerung vergleichen lassen. Ein häufig verwendetes Gegenargument ist, dass es sich bei den Ordensleuten um eine selektierte Teilbevölkerung handelt und dadurch nur bedingt Rückschlüsse für die Gesamtbevölkerung gezogen werden können. Dem entgegenzusetzen ist, dass es zuerst die zugrundeliegende Forschungsfrage zu berücksichtigen gilt. Im Rahmen des HEMOX Projektes werden die Geschlechterunterschiede in der Gesundheit und Sterblichkeit untersucht. Gerade die postulierten Gegensätze der Ordensbevölkerung zur Allgemeinbevölkerung betreffend die Lebensführung sind hier gerade die Stärke des Untersuchungsdesigns. Das Ordensleben bedingt, dass die Lebensweise von Frauen und Männer homogener bzw. wesentlich ähnlicher als in der Allgemeinbevölkerung ist. Somit kann ein Vergleich von Geschlechterunterschieden in der Gesundheit zwischen Ordens- und Allgemeinbevölkerung Aufschluss über relevante Einflussfaktoren bringen. In Bezug auf Ergebnisse der Gesundheitsforschung in den Orden wäre Selektion jedoch dann ein Problem, wenn Ordensleute bestimmte gesundheitsrelevante Charakteristika – die nicht mit dem Ordensleben per se in Verbindung stehen – aufweisen, die sich in der Ausprägung von jenen der Allgemeinbevölkerung unterscheiden. Stehen wie im vorliegenden Projekt Geschlechterunterschiede im Erkenntnisinteresse, ist zudem relevant, ob Ordensfrauen und Ordensmänner auf unterschiedliche Weise hinsichtlich solcher Charakteristika selektiert sind.

Dieses Kapitel gliedert sich in zwei Teile, die sich mit der Selektionsfrage beschäftigen. Der erste Teil fokussiert auf die Zeit vor dem Eintritt in die Ordensgemeinschaft, also vor allem Kindheit und Jugend der Ordensleute. Die Darstellung verschiedener sozioökonomischer Aspekte, der Zufriedenheit vor dem Ordenseintritt, dem Alter der Eltern sowie der Eintrittsmotivation trägt zum Verständnis bei, ob Ordensleute potenziell außergewöhnliche gesundheitsrelevante Lebensbedingungen in der Zeit vor dem Ordensleben vorgefunden haben bzw. aus der Familie „mitbekommen“ haben. Im zweiten Teil wird auf psychosoziale Aspekte eingegangen, nämlich Persönlichkeitsmerkmale und den Optimismus bzw. Pessimismus. Wie auch die Lebensbedingungen in der Kindheit und der Jugend sind diese Variablen mögliche Einflussfaktoren für die Gesundheit. Die Analysen dieses Teils umfassen auch einen Abgleich mit entsprechenden Werten aus der Allgemeinbevölkerung, wodurch eine genauere Betrachtung allgemeiner bzw. geschlechtsspezifischer Selektionseffekte ermöglicht wird. Ein zusätzlicher interessanter Aspekt der mit den Ausführungen in diesem Abschnitt einher geht ist, dass allgemein ein näherer Einblick über die Merkmale und Eigenschaften dieser Bevölkerungsgruppe gewonnen werden kann.

2.1 DIE ZEIT VOR DEM ORDENSLEBEN

DESIREE KRIVANEK UND ANGELA WIEDEMANN

Ordensleute erfahren ab dem Alter 50 weniger Lebenszeit mit gesundheitlichen Beeinträchtigungen als die Frauen und Männer aus der Allgemeinbevölkerung (siehe Kapitel 3.1). Des Weiteren weisen sie eine höhere Lebenserwartung auf als Menschen aus der Gesamtbevölkerung (Luy 2002, 2003). In diesem Kapitel wird nun untersucht, ob diese vergleichsweise vorteilhafte Gesundheit dadurch hervorgerufen wird, dass vorzugsweise Menschen mit sich positiv auf die Gesundheit auswirkenden Charakteristika bzw. erfahrenen Lebensumständen in ein Kloster eintreten. Um dieser Frage der Selektion näher auf den Grund zu gehen, liegt der Fokus in diesem Kapitel auf einer retrospektivischen Beschreibung über das Leben vor dem Ordenseintritt.

Bisherige wissenschaftliche Studien haben gezeigt, dass die familiäre Haushaltsgröße das Armutsrisiko und die Vulnerabilität von Familien beeinflussen können (Radcliff et al. 2012, Vandecasteele 2011). Vor allem Großfamilien (Eltern mit drei Kindern und mehr) und alleinerziehende Eltern haben ein erhöhtes Risiko materiell, sozial und/oder emotional gefährdet zu sein (Fusco et al. 2010; Graaf-Zijl & Nolan 2011). Des Weiteren weisen Menschen mit niedrigerer Bildung ein höheres Vulnerabilitätsrisiko auf (Fusco et al. 2010, Riederer & Wolfsbauer 2011, Vandecasteele 2011), was sich negativ auf die Gesundheit auswirken kann (Prevoo & ter Weel 2014, Riederer & Wolfsbauer 2011). Menschen mit einem höheren Bildungsniveau hingegen leben länger als Menschen mit einer niedrigeren Bildung (Brunello et al. 2011, Luy et al. 2015). Dies ist insofern von Bedeutung, da Kinder von Eltern mit hohem sozialwirtschaftlichem Status einen höheren Bildungsstatus erreichen als Kinder von Eltern mit mittlerem oder niedrigem sozialwirtschaftlichen Status (Stull 2013). Darüber hinaus können nachteilige Lebensbedingungen in der Kindheit langfristig negative Effekte auf die Gesundheit in späteren Lebensphasen haben (Montez, Hayward 2011).

Indem der familiäre Hintergrund (u.a. Familienstruktur und sozialwirtschaftlicher Status), die Zufriedenheit während der Kindheit und die Eintrittsmotivation von Ordensleuten analysiert werden, können einerseits allgemein Einblicke über das Leben von Ordensleuten vor dem Klostereintritt gewonnen werden und andererseits potenziell selektive Faktoren identifiziert werden. Darüber hinaus wird anhand des Sterbealters der Eltern annäherungsweise eine mögliche genetische Disposition für Langlebigkeit untersucht.

DATEN UND METHODEN

Die Daten über die Ordensleute stammen aus der ersten Welle des Gesundheits-Surveys der Klosterstudie. Der Datensatz basiert auf einem von den Befragten selbst auszufüllenden Fragenbogen und zielte auf 50+-jährige Ordensleute aus Österreich und Deutschland ab. Die erste Welle des Surveys umfasste insgesamt 1.158 Teilnehmer (Wiedemann et al. 2012). Sofern nachstehend nicht anders ausgewiesen beziehen sich die Analysen auf 1.150 Personen, davon 535 Männer und 615 Frauen. Acht Fälle mussten aufgrund fehlender bzw. unpassender Information zum Alter ausgeschlossen werden. Wird zusätzlich nach Bildung der Ordensleute differenziert, reduziert sich aufgrund 17 fehlender Angaben das Sample auf 1.133 (532 Männer und 601 Frauen). Die Einteilung der Bildungsgruppen basiert auf der International Standard Classification of Education (ISCED). Es werden Personen mit niedrigem bzw. mittlerem Bildungsabschluss (ISCED 1-4) und hohem Bildungsabschluss (ISCED 5-6) verglichen.

Die Lebensbedingungen in der Kindheit wurden deskriptiv untersucht. Die Geschwisteranzahl wurde direkt erfragt. Die Bildung der Eltern von Ordensleuten wurde anhand von vier Antwortmöglichkeiten gemessen: „keinen Schulabschluss“, „Volksschule/Hauptschule“ (niedrige Bildung des Elternteils), „höherer Schulabschluss“ (hohe Bildung des Elternteils) und „weiß nicht“. Die Berufe der Eltern wurden jeweils anhand einer offenen Frage erfasst und im Zuge der Auswertungen einer von sieben vordefinierten Kategorien zugeordnet (siehe unten). Das Alter der Elternteile wurde jeweils anhand von einer Frage zum Überlebensstatus und einer offenen Frage zum heutigen Alter bzw. Sterbealter gemessen. Die Zufriedenheit der Ordensleute über deren Kindheit bis zum Alter 16 wurde für sieben verschiedene Domänen ermittelt. Die Antwortmöglichkeiten wurden in zwei Kategorien unterteilt: zufrieden („sehr unzufrieden“, „eher unzufrieden“, „weder noch“) und nicht zufrieden („eher unzufrieden“ und „sehr unzufrieden“). Die Motivation zum Ordenseintritt wurde durch eine offene Frage ermittelt, die im Rahmen der systematischen Aufbereitung kategorisiert wurde.

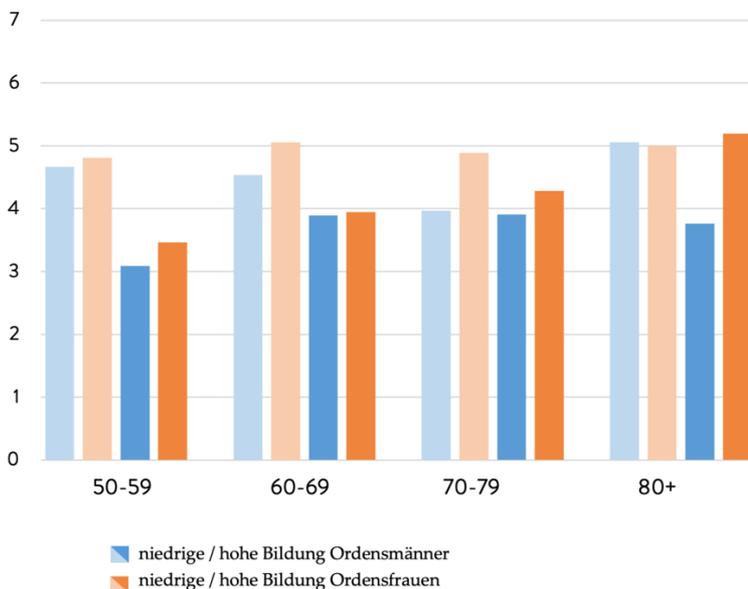
ERGEBNISSE

FAMILIÄRER HINTERGRUND

ANZAHL DER GESCHWISTER

Die meisten Ordensleute stammen aus Großfamilien. Sie sind in der Regel keine Einzelkinder und hatten im Durchschnitt unabhängig von Alter, Geschlecht und Bildung mindestens drei Geschwister (siehe Abbildung 1). In der Regel haben Ordensfrauen durchschnittlich mehr Geschwister als Ordensmänner und Ordensleute mit geringer Bildung mehr als Ordensleute mit hoher Bildung.

ABBILDUNG 1: DURCHSCHNITTLICHE ANZAHL DER GESCHWISTER NACH ALTER UND BILDUNG DER ORDENSLEUTE

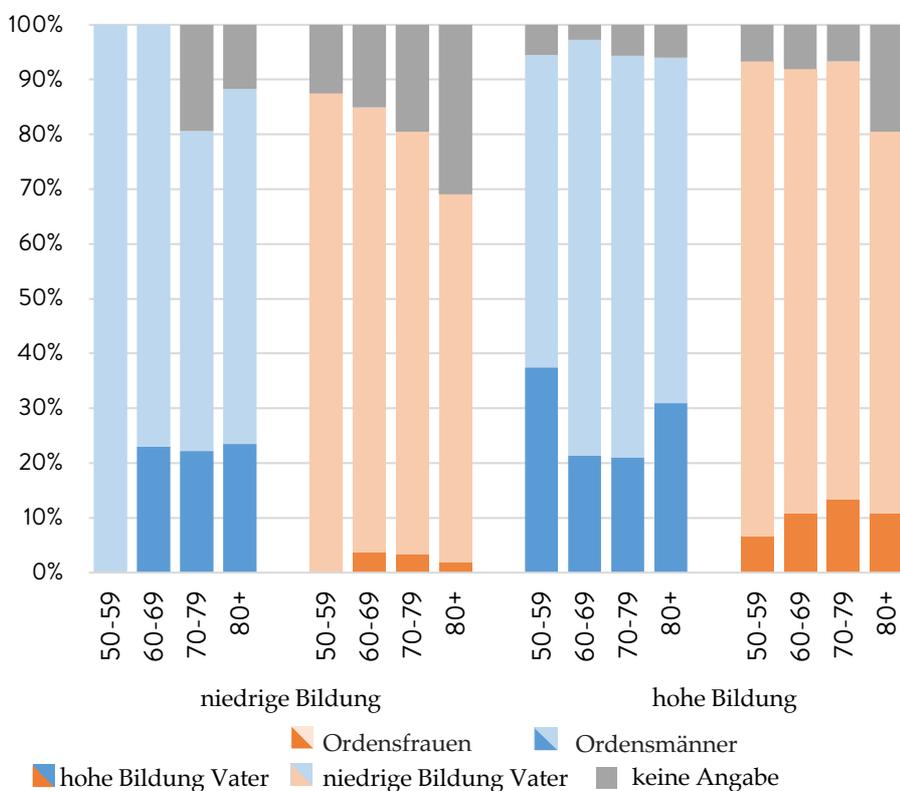


Quelle: Eigene Berechnungen

BILDUNG DER ELTERN VON ORDENSLEUTEN

Die meisten Väter der Ordensleute hatten bzw. haben eine niedrige Bildung. Der Anteil der Väter mit hoher Bildung ist höher bei den Ordensmännern als bei Ordensfrauen. Dies trifft in beiden Bildungsgruppen der Ordensleute zu. Auch wenn die Anzahl der Fälle insbesondere in den einzelnen Altersgruppen eher klein ist, ist eine leichte Tendenz ersichtlich, dass der Anteil an höher gebildeten Ordensleuten mit einem höher gebildeten Vater größer ist, als die Anzahl niedrig gebildeter Ordensleute mit einem höher gebildeten Vater (siehe Abbildung 2). Bei den Müttern von Ordensleuten zeigen sich dieselben beschriebenen Muster (nicht dargestellt). Festzuhalten ist auch, dass der Prozentsatz an fehlenden Angaben bei den Ordensfrauen jenen der Ordensmänner zumeist übersteigt.

ABBILDUNG 2: BILDUNG DER VÄTER NACH ALTER UND DER ORDENSLEUTE



Quelle: Eigene Berechnungen

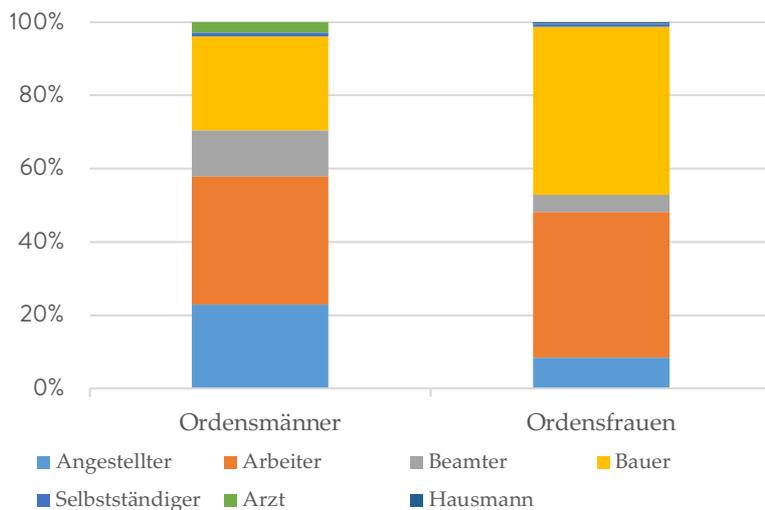
BERUF DER ELTERN VON ORDENSLEUTEN

Die Berufe der Eltern wurden im Zuge der Auswertungen einer der folgenden Kategorien zugeordnet: Angestellte/Angestellter, Arbeiterin/Arbeiter, Beamtin/Beamter, Bäuerin/Bauer, Selbständige, Ärztin/Arzt und Hausfrau/Hausmann. Insgesamt machten 517 Ordensmänner und 581 Ordensfrauen Angaben zum Beruf der Mutter und 523 Ordensmänner und 584 Ordensfrauen zum Beruf des Vaters, also jeweils mehr als 94% der befragten Ordensmänner und Ordensfrauen. Da Mehrfachantworten Berücksichtigung fanden, lagen zum Beruf des Vaters schlussendlich 1.133 und zum Beruf der Mutter 1.242 Angaben vor. Die meisten Väter der Ordensleute waren als Bauern oder Arbeiter tätig (siehe Abbildung 3). Es zeigen sich einige Geschlechterunterschiede: Die Väter von Ordensmännern waren mehrheitlich Arbeiter. Bei den Ordensfrauen waren die Väter mit 46%

am häufigsten in der Landwirtschaft und assoziierten Berufen tätig (fast doppelt so viele wie bei den Ordensmännern mit 25%). Hingegen waren die Väter der Ordensmänner mehr als doppelt so häufig Angestellte oder Beamte als jene der Ordensfrauen.

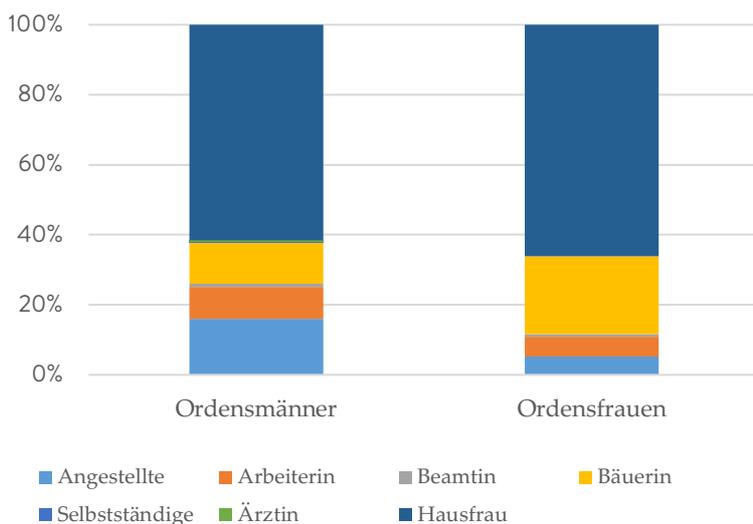
Im Gegensatz zu der beruflichen Tätigkeit der Väter, hatten die meisten Mütter der Ordensleute keinen Beruf ausgeübt und waren zum Großteil als Hausfrauen tätig (über 60%; siehe Abbildung 4). Unter den berufstätigen Müttern war die Mehrheit der Mütter der Ordensfrauen in der der Landwirtschaft tätig, bei den Ordensmännern waren sie zumeist Angestellte.

ABBILDUNG 3: BERUF DER VÄTER VON ORDENSLEUTEN



Quelle: Eigene Berechnungen

ABBILDUNG 4: BERUF DER MÜTTER VON ORDENSLEUTEN



Quelle: Eigene Berechnungen

ALTER DER ELTERN

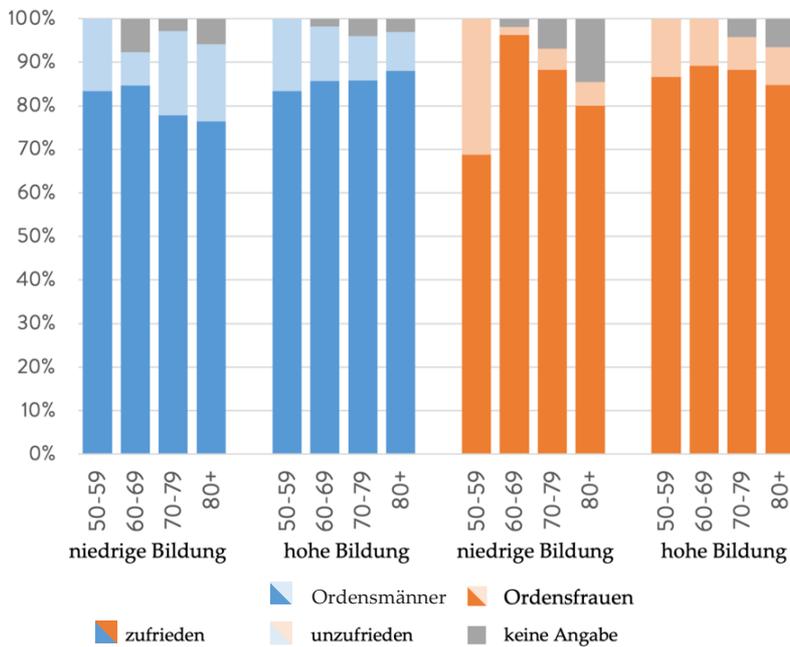
Die Mehrheit aller Befragten machten Angaben zum Überlebensstatus der Elternteile (jeweils ca. 98%) und spezifizierten für 94% der Väter und 95% der Mütter das heutige Alter bzw. Sterbealter. Anteilsmäßig waren sowohl bei Ordensmännern als auch Ordensfrauen mehr Mütter als Väter noch am Leben. Dennoch war der Großteil der Eltern der Ordensleute bereits verstorben (97% der Väter bzw. 92% der Mütter gemessen an den gültigen Antworten).

Allgemein erreichen bzw. erreichten die Mütter im Vergleich zu Vätern ein höheres Alter. Ein näherer Blick ausschließlich auf die verstorbenen Elternteile zeigt, dass Väter im Schnitt im Alter von 72 Jahren verstarben (sowohl bei Ordensfrauen als auch Ordensmännern), hingegen Mütter mit 77 Jahren fünf Jahre später (76 Jahren bei Ordensfrauen und 78 Jahren bei Ordensmännern). Dieses Muster steht im Einklang mit den bekannten Geschlechterunterschieden in der Lebenserwartung zugunsten der Frauen in der Allgemeinbevölkerung. Betreffend die Hochaltrigkeit lässt sich folgender interessanter Unterschied ausmachen. Bei den Ordensmännern erreichten im Vergleich zu den Ordensfrauen anteilmäßig sowohl mehr Mütter als auch Väter ein Alter von 91+ Jahren. Insgesamt gab es – der Langlebigkeit der Frauen im Vergleich zu den Männern entsprechend – prozentuell mehr Mütter (>20% bei den Ordensmännern und >15% bei den Ordensfrauen) die dieses Alter erreichten.

ZUFRIEDENHEIT DER ORDENSLEUTE WÄHREND KINDHEIT UND JUGEND

Mindestens 60% jeder Subanalysegruppe (nach Geschlecht, Alter und Bildung) waren zufrieden mit den unterschiedlichen Lebensbereichen (Gesundheit, Ausbildung, Wohnsituation, Freizeit, soziales Umfeld und Lebensstandard) während der Kindheit und Jugendzeit. Vergleichsweise hoch war die Zufriedenheit mit sozialen Beziehungen. Mindestens rund 80% (bis auf die jüngsten Ordensfrauen mit niedriger Bildung) betrug die Zufriedenheit der Ordensleute in der Kindheit mit der Familie (siehe Abbildung 5). Ähnlich zufrieden waren die Ordensleute mit den Freundschaften im Kindes- und Jugendalter (hier nicht dargestellt). Ebenso auffallend war das Ergebnis, dass ein vergleichsweise hoher Prozentsatz von zirka 20-30% in vielen Subanalysegruppen unzufrieden mit der Freizeit im Kindes- und Jugendalter war (siehe Abbildung 6).

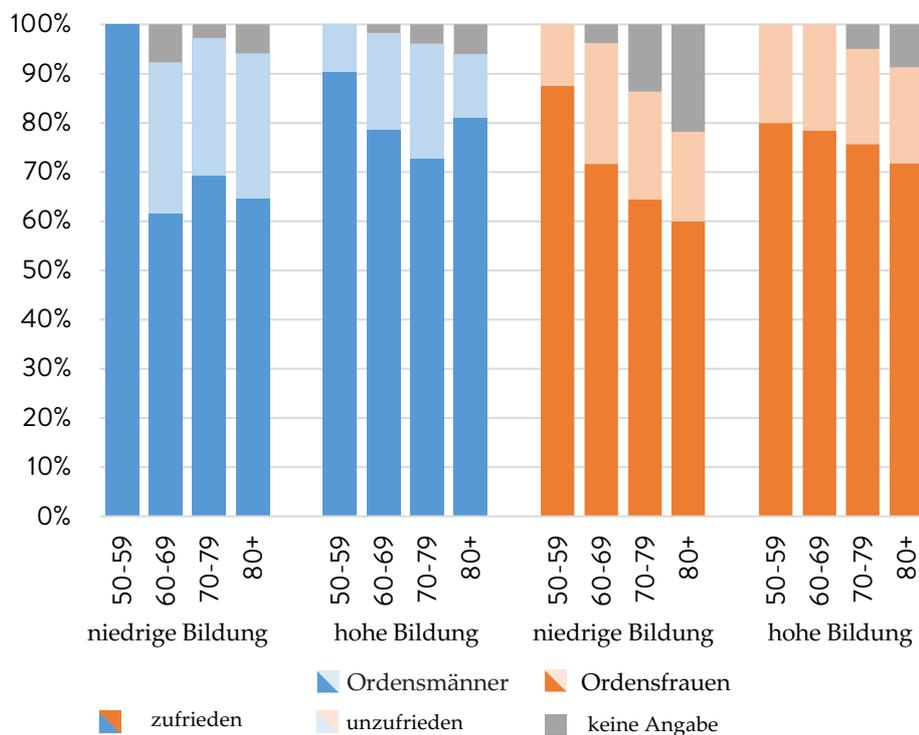
ABBILDUNG 5: ZUFRIEDENHEIT DER ORDENSLEUTE IN KINDHEIT UND JUGEND: FAMILIE



Quelle: Eigene Berechnungen

Aufgrund des gesundheitlichen Fokus dieses Artikels wird die Zufriedenheit mit der Gesundheit im Kindesalter explizit thematisiert. Die Ergebnisse folgen im Allgemeinen dem Muster, dass die Mehrheit der Ordensleute zufrieden mit der Gesundheit in ihrer Kindheit war. Der Anteil der Ordensfrauen, die mit ihrem gesundheitlichen Status während der Kindheit zufrieden waren, ist in fast allen Alters- und Bildungsgruppen höher als bei den Ordensmännern. Es sind ebenso Bildungsunterschiede zu erkennen: Ordensleute mit einer niedrigen Bildung waren weniger zufrieden mit der Gesundheit in ihrer Kindheit als Ordensleute mit einer höheren Bildung.

ABBILDUNG 6: ZUFRIEDENHEIT DER ORDENSLEUTE IN KINDHEIT UND JUGEND: FREIZEIT



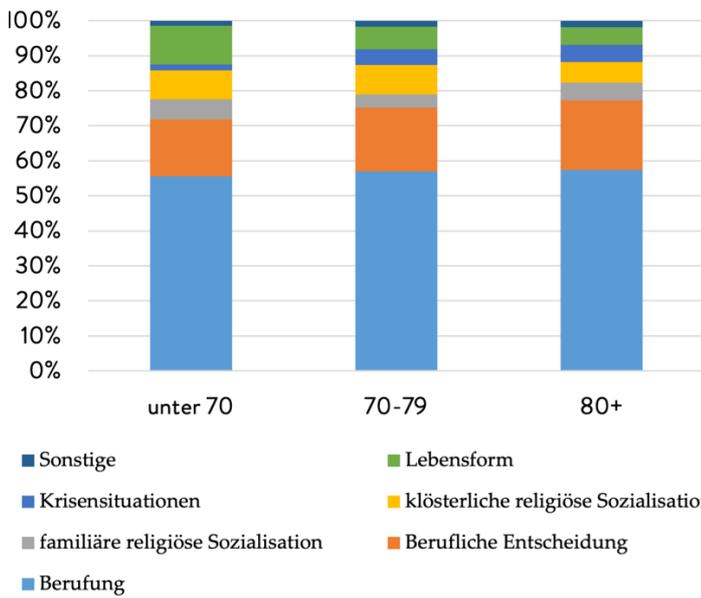
Quelle: Eigene Berechnungen

EINTRITTMOTIVATIONEN VON ORDENSLEUTEN

Von den geschilderten Beweggründen für den Klostereintritt waren zirka 60% Mehrfachantworten, etwa ein Drittel nannten nur einen Grund und rund 10% der Befragten haben keinen Grund genannt. Die in einer offenen Frage gegebenen Antworten wurden einzeln analysiert und in folgende sechs Kategorien eingeteilt (siehe auch Abbildung 7 und Abbildung 8): religiöse Berufung, berufliche Entscheidung, Lebensform, Krisensituationen bzw. -erfahrungen, (familiäre / klösterliche) religiöse Sozialisation oder sonstige Gründe.

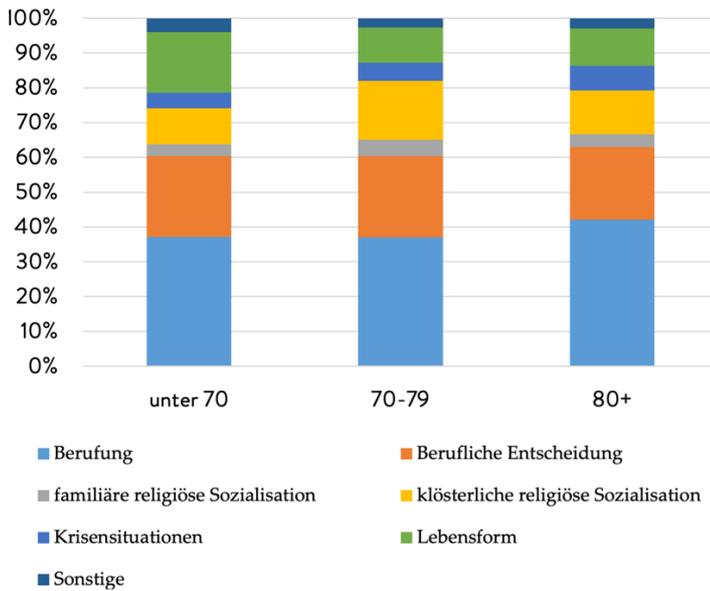
Unabhängig von Geschlecht und Altersgruppe war der meistgenannte Grund für einen Eintritt die religiöse Berufung (z.B. der Ruf Gottes, mystische Erfahrungen etc.), jedoch spielte sie für Ordensfrauen eine bedeutsamere Rolle im Vergleich zu Ordensmännern. Gemessen an allen gegebenen Antworten wurde die berufliche Entscheidung als zweithäufigste Motivation genannt. Das Kloster wird demnach als Ort der Bildung und beruflichen Verwirklichung (z.B. Menschen helfen) wahrgenommen. Dieses Motiv hat bei jüngeren Frauen eine geringere Bedeutung als bei älteren. Des Weiteren sind Ordensmänner allgemein stärker beruflich motiviert in das Kloster einzutreten als Ordensfrauen. Die dritthäufigste Motivation ist zumeist die religiöse Sozialisation (familiär oder klösterlich z.B. durch Kontakt mit Ordensleuten). Dieser Aspekt spielte anteilmäßig für Ordensmänner eine größere Rolle als für Ordensfrauen. In der jüngsten Altersklasse der Ordensmänner ist hingegen die Lebensform (u.a. der Orden als Ort Gleichgesinnter z.B. hinsichtlich Kleidungs- und Lebensstil, Norm- und Wertvorstellungen, etc.) die am drittmeisten genannte Kategorie. Krisensituationen bzw. -erfahrungen (z.B. Todesfälle, Krankheiten, Gewalterfahrungen) und andere Gründe spielten allgemein eine eher untergeordnete Rolle.

ABBILDUNG 7: EINTRITTMOTIVATION VON ORDENSFRAUEN



Quelle: Eigene Berechnungen

ABBILDUNG 8: EINTRITTMOTIVATION VON ORDENSMÄNNERN



Quelle: Eigene Berechnungen

DISKUSSION

Dieses Kapitel liefert einige Einblicke über das Leben von Ordensleuten vor der Zeit im Kloster, indem die Merkmale der Ordensleute hinsichtlich deren familiären Hintergrundes, Lebenszufriedenheit in der Kindheit, sowie die Eintrittsmotivation beschrieben wurden. Leitgebend war die Frage, inwiefern selektive Effekte ausgemacht werden können, welche die Gesundheit und Langlebigkeit von Ordensleuten beeinflussen könnten.

Anhand der Analysen zum familiären Hintergrund von Ordensleuten wurde deutlich, dass eher keine für die Gesundheit besonders vorteilhaften sozioökonomischen Lebensbedingungen vorherrschten. Es wurde deutlich, dass Ordensleute eher aus einer niedrigeren sozialen Herkunftsschicht stammen, welche meist ein erhöhtes Risiko zur Vulnerabilität aufweisen (Brunello et al. 2011, Fusco et al. 2010; Graaf-Zijl & Nolan 2011). Die meisten Ordensleute stammen aus Großfamilien und hatten mehrere Geschwistern. Die Eltern hatten zumeist einen niedrigen oder mittleren Bildungsabschluss und die Väter waren mehrheitlich als Bauern oder Arbeiter berufstätig, während die meisten Mütter Hausfrauen waren bzw. in der Landwirtschaft gearbeitet hatten. Zudem erreichten die Eltern von Ordensleuten kein auffallend hohes Sterbealter. Des Weiteren zeigten die Auswertungen, dass Ordensleute mit den abgefragten Teilbereichen ihrer Kindheit und Jugendzeit (soziale Beziehungen, Lebensstandard, Wohnsituation etc.) zufrieden waren. Gemeinsam mit den Erkenntnissen aus der Auswertung der berichteten Eintrittsmotivation liegen keine Indizien für besonders einschneidende oder traumatische Ereignisse in der Kindheit vor, die auf eine bezüglich der Gesundheit relevante Besonderheit hinweisen würden. Anhand der Eintrittsmotivation wurde zudem deutlich, dass die meisten Ordensleute in das Kloster aufgrund der religiösen Berufung bzw. zur Berufsausübung eingetreten sind. Analog zur weltlichen Bevölkerung scheint auch hier bewusst eine Entscheidung über die weitere berufliche Laufbahn getroffen worden zu sein. Nichtsdestotrotz ist ein wichtiger Aspekt bezüglich einer möglichen gesundheitlichen Selektion von Ordensmitgliedern, dass sie sich, vor allem in früheren Jahren, zum Zeitpunkt des Eintrittes einer gesundheitlichen Überprüfung unterziehen müssen (siehe Luy 2003). Wird eine Person psychisch oder körperlich als nicht genügend geeignet eingeschätzt, um den Arbeitsalltag im Kloster und in der Ordensgemeinschaft zu leben, wird der Eintritt aus Schutz für die Personen und die Gemeinschaft verwehrt. Allerdings ergaben Zusatzanalysen der Umfragedaten, dass die meisten Ordensleute bereits in einem jungen Alter (Anfang / Mitte der 20er) eingetreten sind und gesundheitliche Beeinträchtigungen in diesem Alter vergleichsweise unbedeutend sind, woraus sich schließen lässt, dass ein gesundheitsrelevanter Selektionseffekt – wenn überhaupt – wohl eher gering wäre.

Abschließend sollen noch knapp die geschlechtsspezifischen Unterschiede zusammengefasst werden, da die Selektion für beide Geschlechter eine unterschiedliche Rolle spielen und dies möglicherweise einen Einfluss auf die geschlechtsspezifische Gesundheitsunterschiede haben könnte, die ja eine zentrale Rolle in der Klosterstudie spielen. Einen eindeutigen Hinweis auf eine unterschiedliche Selektion von Ordensfrauen und -männern gibt es nach den Daten unserer Erhebung nicht. Vielmehr treten Muster zutage, wie sie auch in der Allgemeinbevölkerung üblich sind. So zeigen die Analysen des Sterbealters der Eltern das gängige Mortalitätsmuster, demzufolge Frauen im Schnitt länger leben als Männer. Des Weiteren zeigte sich eine gewisse Tendenz für die intergenerationale Übertragung von Bildung. Allerdings war der Anteil an Ordensmännern, deren Eltern einen hohen Bildungsstatus hatten oder haben höher als jener der Ordensfrauen. Inwieweit dies einen unterschiedlichen Einfluss auf die Gesundheit und Lebenserwartung der Ordensfrauen und -männer haben könnte, muss jedoch an einer anderen Stelle untersucht werden.

Analog zur weltlichen Bevölkerung lässt sich auch eine gewisse „Vererbbarkeit“ von Bildung vermuten (vgl. Stull 2013), da höher gebildete Ordensleute öfters als Ordensleute mit niedrigem Bildungsabschluss einen Elternteil mit höherer Bildung haben. Obwohl Ordensmänner im Schnitt weniger Geschwister haben, stammen sie in der Regel wie die Ordensfrauen aus Großfamilien. Die Analyse der Eintrittsmotivationen ergab zwar, dass Ordensmänner stärker beruflich motiviert sind in ein Kloster einzutreten als Ordensfrauen. Dennoch waren die Haupteintrittsgründe nicht allzu sehr unterschiedlich zwischen den Geschlechtern.

CONCLUSIO

Ordensleute scheinen in Bezug auf Gesundheit und Langlebigkeit keine besonderen Bedingungen in Kindheit und Jugendzeit erfahren zu haben, die ihre im Vergleich zur Allgemeinbevölkerung höhere Lebenserwartung entscheidend erklären könnten. Dies würde bedeuten, dass in den Klöstern Strukturen geschaffen sein müssen, welche die Langlebigkeit und die Gesundheit positiv beeinflussen und ein gesundes und qualitatives Altern ermöglichen.

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2.2 DIFFERENCES BETWEEN OLDER CATHOLIC ORDER MEMBERS AND THEIR PEERS IN THE GENERAL POPULATION: AN EXPLORATION OF POTENTIAL PSYCHOSOCIAL SELECTION EFFECTS

CATHERINE E. BOWEN

INTRODUCTION

One aim of the German-Austrian Cloister Study is to compare Catholic order members (i.e., nuns and monks) with their peers in the general population in order to draw conclusions about the extent to which (gender differences in) later life health and mortality are related to modifiable social and lifestyle factors. It is therefore important to know whether people with characteristics that predispose them to having better or worse later life health and mortality are also more likely to become nuns and monks. If so, then differences in later life health and mortality between the order population and the general population may be due to “selection effects” (i.e., people with characteristics that predispose them to having better or worse later life health and mortality are also more likely to become nuns and monks) as opposed to “treatment effects” (i.e., the structure and characteristics of order life result in different health-related outcomes). It is also important to know whether female order members are selected differently than male order members.

In this study, I explore the extent to which order members represent a selected population with regard to their psychosocial characteristics, as well as whether female order members are selected differently than male order members. In the absence of data prior to order entry, I compare the psychosocial characteristics of older order members and their peers in the general population. I focus on characteristics that are (a) related to health and mortality and (b) are relatively stable across adulthood such that the available data represents a reasonable proxy of characteristics earlier in life (i.e., young adulthood/prior to order entry). Accordingly, I focus on the personality traits neuroticism, conscientiousness and optimism/pessimism.

BACKGROUND

Personality refers to individual differences in characteristic patterns of thinking, feeling and behaving. The “Big Five” model of personality includes five personality traits: openness to experience (the breadth, depth, originality, and complexity of an individual’s mental and experiential life), conscientiousness (socially prescribed impulse control that facilitates task-and goal-directed behavior, such as thinking before acting, following norms and rules), agreeableness (prosocial and communal orientation toward others, altruism, trust, modesty), neuroticism (negative emotionality, sensitivity to negative stimuli, tendency to feel anxious, nervous; the reverse of emotional stability), and extraversion (energetic approach to the social and material world; sociability, activity, assertiveness, positive emotionality) (McCrae and Costa 2008). *Optimism* refers to the extent to which a person expect that the future holds positive outcomes, whereas *pessimism* refers to the extent to which a person expects that the future holds negative outcomes (Scheier and Carver 1985). Pessimism and optimism are typically weakly negatively correlated (e.g., Glaesmer et al. 2012).

Of the Big Five personality traits, neuroticism and conscientiousness appear to be the most relevant for mental health, physical health and longevity (e.g., Deary, Weiss & Batty 2010; Goodwin and Friedman 2006; Lahey 2009). There is strong empirical evidence that neuroticism is cross-sectionally and prospectively associated with a wide range of particularly mental, but also physical health outcomes such as depression, somatic complaints, cardiovascular disease, metabolic syndrome and longevity. Part of the relationship between (mental) health and neuroticism appears to be explained by shared genetic components. There is also evidence that neuroticism causally affects health through several non-exclusive mechanisms. People higher in neuroticism have a higher risk of experiencing negative life events (e.g., divorce). Furthermore, people higher in neuroticism tend to have and use fewer effective coping resources (e.g., social support, fewer problem-solving strategies) for dealing with stress. Higher neuroticism is associated with stronger and more prolonged physiological reactions to stress. Finally, neuroticism is associated with a range of negative health behaviors, such as smoking and unprotected sex (see Lahey 2009 for a review).

There is also strong and consistent empirical evidence that conscientiousness is cross-sectionally and prospectively linked to health outcomes such as diabetes, high blood pressure, physician-rated illness burden and longevity (Hill et al. 2011; Roberts et al. 2007). Health behavior appears to be the primary link between conscientiousness and health/longevity. People high in conscientiousness, for example, tend to eat healthier, be physically active, are more likely to seek out and adhere to medical advice and are less likely to smoke (Bogg and Roberts 2004; Lodi-Smith et al. 2010; Roberts, Walton & Bogg 2005).

Finally, research has consistently shown that higher optimism is related to positive health outcomes, including fewer physical symptoms, less pain and better recovery. People who are more optimistic tend to be more persistent in the face of adversity and pursue their goals with more determination. It is therefore not surprising that higher optimism is related to more positive health behaviours. Optimism may also buffer the experience of stress (see Andersson 1996 and Carver, Scheier and Segerstrom 2010 for reviews).

Given their robust relationships with health, it is highly relevant to investigate potential selectivity of order men and women with regard to neuroticism, conscientiousness, optimism and pessimism. Moreover, higher religiosity tends to go along with higher conscientiousness (for a literature review and meta-analysis, see Saroglou 2010) and higher optimism (e.g., Koenig et al., 2014; Vitorino et al. 2018). It thus seems likely that people high in conscientiousness and optimism may be more likely to choose order life than their less conscientious and less optimistic peers. There does not seem to be a consistent link between either neuroticism or pessimism and religiosity.

Importantly, meta-analysis has indicated that the rank order stability (i.e., the extent to which people high/low in a trait relative to their peers tend to remain high/low in a trait across the life course) of neuroticism and conscientiousness are relatively high across both the male and female adult life course (circa .5; Roberts and DelVecchio 2000). In other words, it is reasonable to assume that people high/low in neuroticism and/or conscientiousness in later life were also relatively high/low earlier in life. Little research has investigated the extent to which optimism and pessimism remain stable across time, not to mention across the adult life course. In one study, the test–retest correlation for optimism in a large, age-heterogeneous sample over a four-year period was .61, providing first evidence that dispositional optimism is moderately stable during adulthood, at least over shorter periods of time (Chopik, Kim and Smith 2015).

Current study: I examined whether older order men and women were particularly low/high in conscientiousness, neuroticism, pessimism and optimism as indicators of a general selection process, and (b) whether gender patterns in the order population

were similar to those usually observed in the general population (as indicators of a gender-specific selection process). In the general population, women tend to score higher than men on scales of neuroticism. There is less consistent evidence of a gender difference in conscientiousness (e.g., Costa, Terraciano and McCrae 2001, Weisberg, DeYoung and Hirsh, 2011), also in German samples (Donnellan and Lucas 2008, Lehmann et al. 2013). Previous analysis of representative German data has revealed little evidence of gender differences in either optimism or pessimism (Glaesmer et al. 2012).

DATA AND METHOD

A convenience sample of Catholic order members in Germany and Austria were recruited to take part in a health survey. Data was collected in 2012. All members 50 years or older of the consenting orders received a paper-and-pencil questionnaire and a return envelope by mail. Further details about sample recruitment are available in a project report (Wiedemann et al. 2014). A total of 1,158 participants completed the questionnaire (response rate: 68.8%).

Neuroticism and *conscientiousness* were measured with adaptations of the German-version of the NEO Five-Factor Inventory (Borkenau and Ostendorf 1993). The six items of each scale were slightly modified to make them easier to understand. Answers could range from 1 (*completely agree*) to 5 (*completely disagree*). Responses were recoded so that higher scores indicate higher values of the trait. Neuroticism was based on an average of item responses (Cronbach's $\alpha = .77$). The internal reliability of the six-item conscientiousness scale was low (Cronbach's $\alpha = .35$). I therefore excluded one item that had particularly low inter-item correlations (*I work hard to achieve my goals*). Conscientiousness was based on an average of the remaining five items (Cronbach's $\alpha = .61$). Scores on both scales were calculated for all participants that answered at least three items.

Optimism and *pessimism* were each measured with three items and scales ranging from based on the German-version of the Revised Life Orientation Test (Glaesmer et al. 2008). Responses could range from 1 (*completely agree*) to 5 (*completely disagree*). Responses were recoded such that higher scores indicate higher levels of optimism/pessimism. Missing item scores were replaced with the mean of the available item scores. Item scores were then summed.

I examined mean neuroticism, conscientiousness, optimism and pessimism scores of male and female order members across different age groups. For optimism and pessimism, I used the norm scores of the German general population as a basis for comparison (Glaesmer et al. 2012). No corresponding data for the general Austrian or German population was available for conscientiousness or neuroticism.

RESULTS

NEUROTICISM AND CONSCIENTIOUSNESS

Figure 1 displays the mean neuroticism scores of nuns and monks by age group. Consistent with gender differences in the general population, nuns had higher neuroticism scores than monks, especially in the older age groups.

FIGURE 1 : NEUROTICISM OF MALE AND FEMALE ORDER MEMBERS BY AGE GROUP

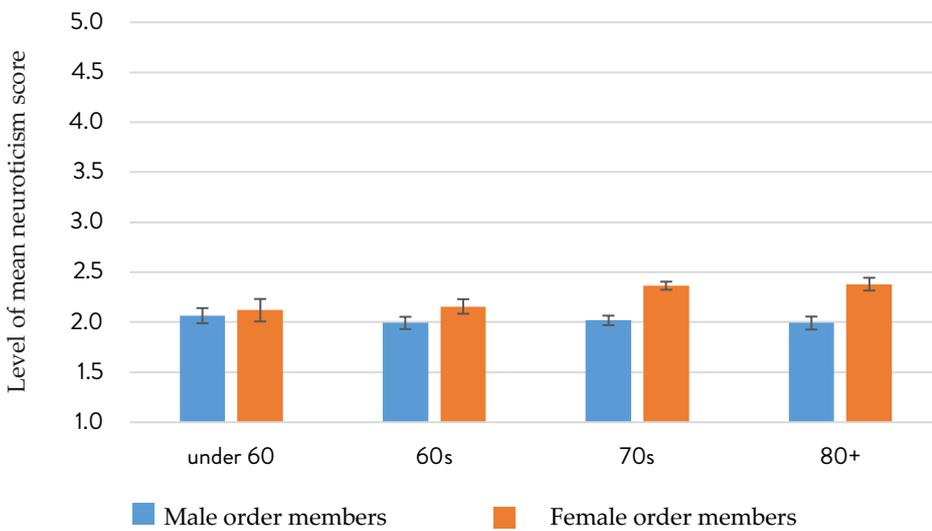
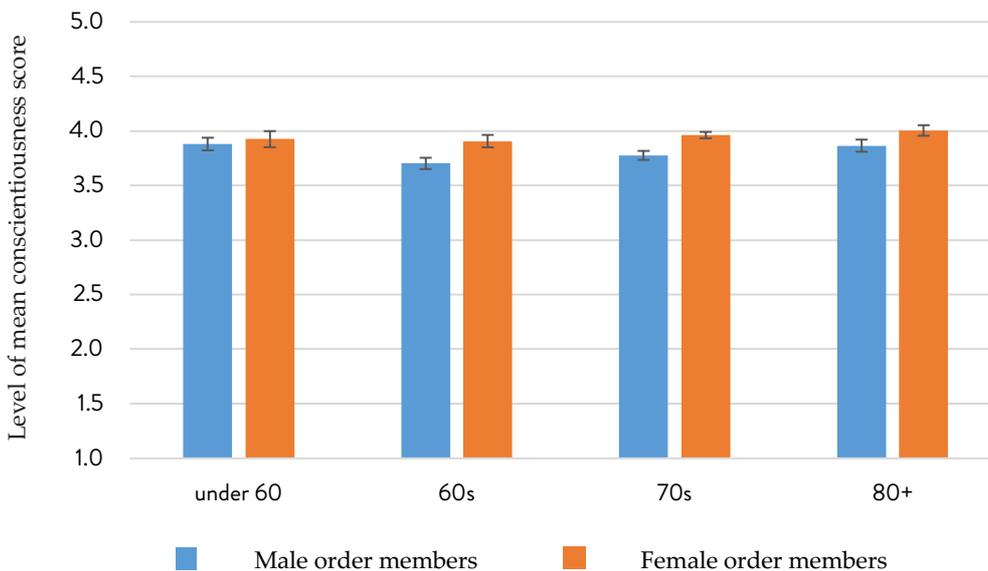


Figure 2 displays the mean conscientiousness scores of nuns and monks by age group. Notably, average conscientiousness among order members was approximately 4 out of a possible 5, suggesting that order members as a group are quite conscientious (Saroglou 2010). Among order members in their 60s, 70s, and 80s, nuns were slightly more conscientious than monks. There is thus some indication of a small gender difference in conscientiousness in the order population.

FIGURE 2: CONSCIENTIOUSNESS OF MALE AND FEMALE ORDER MEMBERS BY AGE GROUP



In general, mean neuroticism and conscientiousness was similar across age groups. Only nuns' neuroticism scores were marginally higher for those in their 70s and 80+ compared to the mean scores of the younger age groups.

OPTIMISM/PESSIMISM

Figure 3 displays the mean optimism of nuns and monks and men and women in the general population by age group according to published norms for the German general population based on the same scale (Glaesmer et al. 2012). Notably, order members had consistently higher optimism scores than their peers in the general population across both genders and all age groups, potentially indicative of a general selection effect. There was no indication of gender-specific differences; that is, the magnitude of differences between monks and general population men was about the same as the magnitude of differences between nuns and general population women.

FIGURE 3: OPTIMISM OF MALE AND FEMALE ORDER MEMBERS AND THE GENERAL POPULATION BY SEX

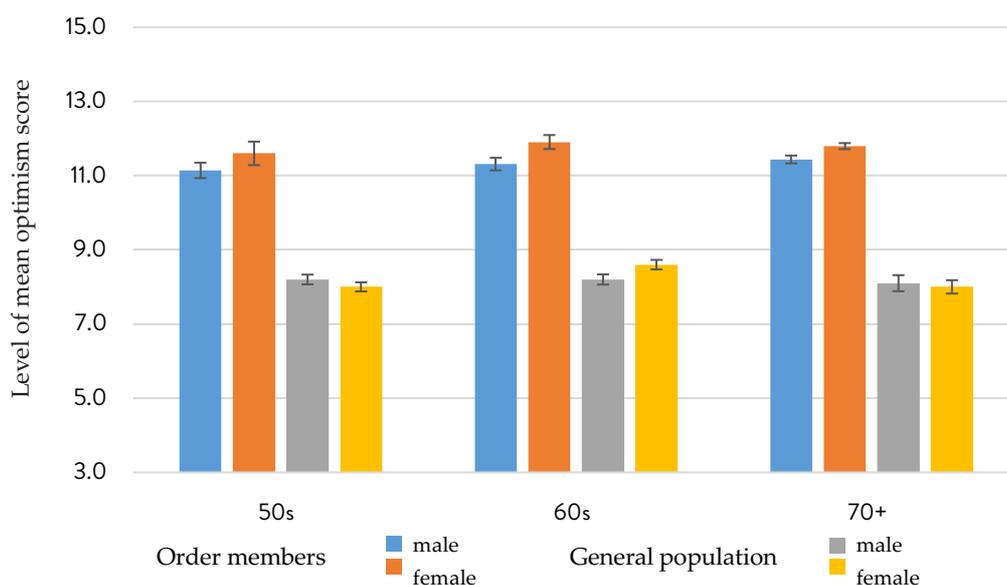
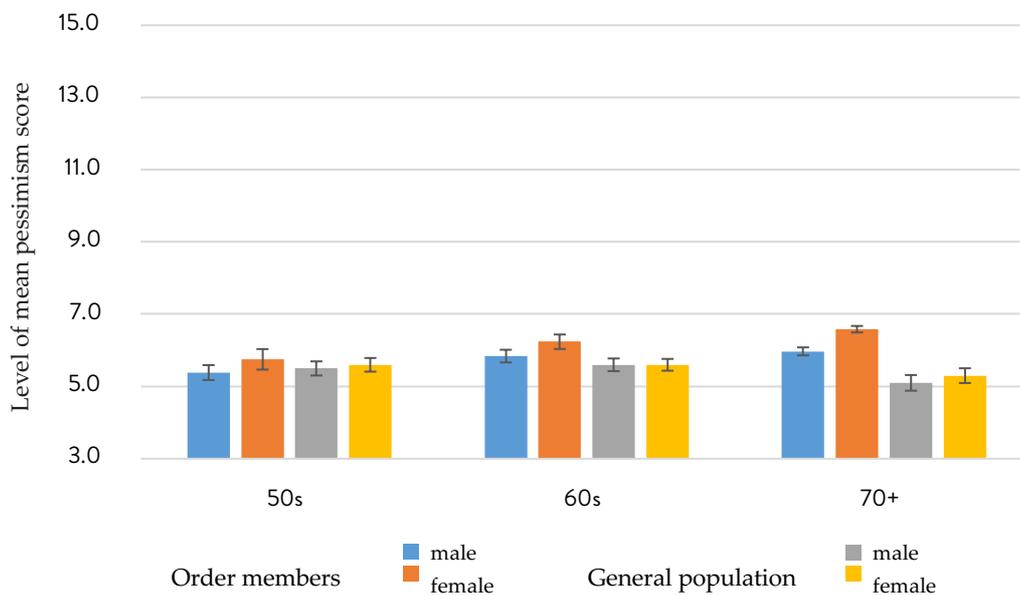


Figure 4 displays the mean pessimism scores of nuns and monks and men and women in the general population by age group. There were no differences between order members and the general population for either gender in the youngest age group. However, in the two older age groups, nuns were more pessimistic than monks and people in the general population. The results thus point to a potential gender-specific selection effect.

There were no obvious age differences in either optimism or pessimism in the observed populations.

FIGURE 4: PESSIMISM OF MALE AND FEMALE ORDER MEMBERS AND THE GENERAL POPULATION BY AGE GROUP



DISCUSSION

The present study analyzed the extent to which order members might represent a selected population with regard to psychosocial characteristics relevant for later-life health and longevity. I was particularly interested in assessing potential gender-specific selection, that is, whether nuns are selected differently than monks.

The results suggest the existence of general selection effects with regard to optimism and conscientiousness. Namely, order members appear to be more optimistic and more conscientious than their peers in the general population. Order members' high optimism and high conscientiousness is in line with previous research linking higher optimism and higher conscientiousness with higher religiosity.

The results also suggest the existence of gender-specific selection effects with regard to pessimism and conscientiousness. At least in the two older age groups, nuns indicated higher pessimism than their peers in the general population; the difference between nuns and general population women was larger than the difference between monks and general population men. Unlike in the general population, there was also a small gender difference in conscientiousness between nuns and monks. Gender differences in the order population with regard to optimism and neuroticism were consistent with the (lack of) gender differences observed in the general population.

Limitations: Data was available only for order members aged 50+ years. Because the current analysis of potential selection effects was limited to data collected several decades after order entry, I focused on psychosocial characteristics that are relatively stable across adulthood. Nevertheless, it is only possible to draw some very tentative conclusions about the selection of nuns and monks into order life. Normative changes in adult personality are thought to be driven at least in part by investment in the "developmental tasks" of adult life. Notably, the developmental tasks associated with order life diverge from the developmental tasks of secular life (e.g., participating in paid work, establishing and maintaining a romantic partnership, raising

children). (Gender) differences between older order members and their peers in the general population may therefore be due to selection effects (i.e., differences between order members and the general population at order entry) and/or due to differences in how their psychosocial characteristics developed in the decades following order entry.

CONCLUSION

The results of the current study suggest that Catholic order members may be selected in ways that are relevant for their late life health and mortality. Older male and female order members are clearly more optimistic than their peers in the general population and appear to be particularly high in conscientiousness. Nuns tend to be slightly more conscientious than monks, whereas there is no evidence of a gender difference in the general population. Older nuns also appear to be particularly pessimistic. Potentially, the propensity of people with high optimism and high conscientiousness, and women high in pessimism, to enter order life may explain (gender) differences in later-life health and mortality between the order and general populations. Any positive health effects of nuns' high conscientiousness and high optimism may be essentially cancelled out by their higher pessimism.

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3 ORDENSLEUTE UND GESUNDHEIT

3.1 THE HEALTH OF CATHOLIC ORDER MEMBERS: A COMPARISON WITH THE GENERAL POPULATION

CHRISTIAN WEGNER-SIEGMUNDT AND MARC LUY

INTRODUCTION

Previous studies revealed a survival advantage of Catholic order members compared to the general population. Especially monastic men have a higher life expectancy since the middle of the 20th century while the life expectancy of nuns started to become higher than those of women of the general population only recently (Wiedemann et al. 2014). Beside the longer life, the particular social and socio-economic conditions in Catholic monasteries are of special interest for demographers and epidemiologists. The main characteristics of order life are the absence of socio-economic differences, the standardized daily routines and the lifelong inclusion in a community. Thus, several of the main risk factors for mortality do not differentiate between the members of a monastic community. This controlled setting provides a kind of “quasi-natural experiment” for analyzing causes of mortality, for example to estimate the impact of biological factors on the gender gap in life expectancy (Luy 2002, 2003, 2016).

Within the HEMOX project, we expanded this quasi-natural experiment to analyze whether order members do not only have a survival advantage but also a health advantage compared to worldly women and men. Thus, the particular question of this chapter is: does the specific environment of life in a religious community lead to a better health status of order members and to a smaller gender gap in health compared to the general population?

These questions are of special interest because they deal directly with the debate whether longer life is associated with longer lifetime in good or poor health. During this still ongoing debate, three hypotheses were formulated to explain the association between mortality and morbidity. The “expansion of morbidity” approach assumes that longer life is associated with an increase of lifetime with health impairments (Gruenberg 1977). According to this hypothesis, the incidence of chronic diseases is not related to the reduction in mortality, but the fatality of these diseases declines during the process of survival improvement. In contrast, the “compression of morbidity” hypothesis states that the incidence of chronic diseases shifts to higher ages (Fries 1983). Although Fries postulated his compression approach by assuming a fixed maximum of the human lifespan, his idea can also be applied to a scenario of continuously increasing life expectancy with a parallel faster postponement of chronic diseases. The third hypothesis, the “dynamic equilibrium scenario,” states that the progress of mortality reduction is associated with—but also caused by—a reduction of severe chronic diseases (Manton 1982). In contrast to the two other approaches, it is assumed that the incidence of severe chronic diseases decreases or that severe diseases change to moderate diseases as a result of medical innovation or an increasing understanding and awareness of health risks. Consequently, the relative lifespan with severe health impairment remains constant during the increase of life expectancy.

From our previous research we know that Catholic order members have a survival advantage compared to the general population, but it is unknown whether they have a health advantage as well. In the following, we present our analysis of the health comparison between the monastic and the general population. Instead of focusing on only one health indicator, we used multiple health indicators to cover several dimensions of individual health status such as subjective & objective health and limitations & impairments in physiological and psychological constitution. We compare our ASCOM sample of German and Austrian order members with 13 different representative surveys of the general populations of Germany and Austria. The data and methods section describes the characteristics of each survey and the contained health indicators. Moreover, it explains how we adjusted our analyses of health differences for the distinctly higher age of the sample of order members. The third section presents the results of our analysis, namely the health comparison of monastic and general population separately for women and men, and the differences in the gender gap in health between the monastic and the general population. The last section summarizes the results of this study and offers some conclusions in light of the general discourse about the relationship between health and longevity.

DATA AND METHODS

DATA

The central survey of the health comparison between the cloistered and general population is the first wave of the Ageing Study of Catholic Order Members ASCOM (Wiedemann et al. 2014). The ASCOM data, collected in 2012, includes a basic stock of 1,158 Catholic order members at ages 50 or older (53.5% females, 46.5% males) from Germany, Austria and partly from Italy and Switzerland. The second wave was conducted in 2014 and the third wave in 2017. The first ASCOM wave includes individual information about demographics, work situation, family background, life satisfaction and life burden of the order members, and a variety of health indicators about their physiological and psychological constitution. The particular health questions and batteries in the survey were selected to allow direct comparisons to health surveys from the general population, most importantly to the Survey of Health, Ageing and Retirement in Europe (SHARE) and the German Socio-Economic Panel (SOEP).

During the HEMOX project (see chapter 1 of this volume) we decided to extend the number of health surveys from the general population to allow a more comprehensive comparison to our ASCOM data. In this way, we wanted to reduce a possible bias caused by different sampling or data collection procedures. A further reason for the extension of health surveys was to apply the full range of health indicators included in ASCOM wave I. The individual health surveys from the general population include only some of these indicators. The application of several different health surveys increases the number of health indicators we can use to compare the health status of order members and the general population. Therefore, we looked for all available health surveys in Germany and Austria which are representative for the general populations and contain respondents aged 50 or older. We did not restrict this search to surveys which cover the ASCOM collection period 2012 for being able to include as many health indicators as possible to our analyses. Under the assumption that health at the aggregate level changes only slowly, we also considered surveys which were initially conducted in 2004. At the end, we found 13 surveys for the general populations of Germany and Austria which fulfilled our criteria: seven from Germany, two from Austria, and four which contain respondents from both countries (see Table 1).

TABLE 1: OVERVIEW OF THE INCLUDED SURVEYS BY COUNTRY, NUMBER OF HEALTH INDICATORS, AGES USED FOR THE ANALYSIS AND DISTRIBUTION BY SEX

Surveys	Country	Health Ind.	Age Range	Females	Males	Both
ASCOM 2012	DE & AT	28	50+	615	535	1150
ALLBUS 2012	DE	4	50+	843	870	1713
ALLBUS ISSP 2012	DE	4	50+	408	430	838
ATHIS 2006	AT	19	50+	3889	2878	6767
ATHIS 2014	AT	6	50+	3924	3132	7056
DEAS 2008	DE	17	50 - 85	2313	2487	4800
DEGS 2008-11	DE	22	50 - 79	2287	2075	4362
ESS 2010/12	DE & AT	2	50+	1276	1155	2431
EU-SILC 2012	DE & AT	3	50+	14178	12779	26957
GEDA 2012	DE	17	50+	5682	4902	10584
GGG 2005	DE	2	50 - 79	2200	2056	4256
SHARE 2004	DE & AT	21	50+	2458	2019	4477
SHARE 2012	DE & AT	17	50+	3752	2924	6676
SOEP 2012	DE	11	50+	5818	5206	11024
Total				49643	43448	93091

Source: authors' own compilation. Note: DE = Germany, AT = Austria.

The first German survey is the German General Social Survey (ALLBUS) for the year 2012 (Wasmer et al. 2014). The ALLBUS is a cross-sectional survey and is conducted by the Leibniz Institute for the Social Sciences (GESIS) in western Germany every two years since 1980. After German unification, the survey was also conducted in eastern Germany. Although the survey is focused on political and social attitudes, norms, social changes, etc., the ALLBUS contains also the question about the self-perceived health status. After age restriction to ages 50 and older, the survey includes individual information of 1,713 persons (49.2% females, 50.8% males).

Since the ALLBUS project is part of the International Social Survey Program (ISSP), the survey further includes an ISSP sub-survey (ALLBUS ISSP). This sub-survey is based on a standardized questionnaire for 40 countries and contains additionally information about chronic diseases, obesity and hospitalization. For our analysis, we used only the German sample of the ALLBUS ISSP with 838 individuals aged 50 or older (48.7% females, 51.3% males).

The third survey for Germany is the German Ageing Survey (DEAS) conducted by the German Centre of Gerontology. This survey is a representative cross-sectional as well as longitudinal survey of the German population aged 40 to 85 years (Mahne/Engstler 2010). The first wave was conducted in 1996. We used the third wave of 2008 and the corresponding additional cross-sectional random sample. The DEAS contains information about work condition, pension transition, socioeconomic & living conditions, social network, norms & attitudes and a variety of health indicators, indicators of health behavior and care dependency of 4,800 individuals at ages 50 to 85 (48.2% females, 51.8% males).



A German study focusing in particular on health is the German Health Interview and Examination Survey for Adults (DEGS) conducted by the Robert Koch Institute (Dahm et al. 2015; Scheidt-Nave et al. 2012). The survey provides a representative compilation of the health condition and corresponding risk factors of women and men aged 18-79 and belongs to the health-monitoring program of the German population. The special feature of the survey is the additional CAPI interview by physicians in addition to the basic and food frequency questionnaires. For the purpose of our analysis, we can use the information of 4,362 persons at ages 50 to 79 (52.4% females, 47.6% males).

Another health survey within the German health-monitoring program conducted by the Robert Koch Institute is the “German Health Update” (GEDA), a representative cross-sectional survey for the German residential population aged 18 and older (Robert-Koch-Institut 2014). The GEDA was initiated in 2009 and is repeated every second year with a new random sample. Based on computer assisted telephone interviews, a variety of health and socioeconomic indicators are collected. Several GEDA questions are comparable to the German Life Expectancy Survey (LES) which was planned originally for our comparison with the order members because of its variety of health indicators (Gärtner 2000). However, GEDA provides more recent information compared to the LES which was conducted in 1984/86 and 1998. We used the GEDA survey of 2012 with 10,584 individuals aged 50 and older (53.7% females, 46.3% males).

We also used information from the Generations & Gender Survey (GGS). The GGS is a longitudinal survey and part of the Generations & Gender Programme. Albeit the GGS was initiated primarily for studies on fertility, nuptiality and family relations, it includes also information about self-perceived health status and chronic diseases. For our analysis, we used the first German wave conducted in 2005 with respondents at ages 18 to 79 years (Ruckdeschel et al. 2006). After excluding respondents younger than age 50, we could include 4,256 individuals to our analyses (51.7% females, 48.3% males). The first Austrian GGS wave of 2008/09 could not be included because the age of respondents ranged only from 18 to 49 years (Neuwirth 2015).

The seventh survey only related to the German population is the Socio-Economic Panel (SOEP), an annual longitudinal survey initiated in 1984 in western Germany. In 1990, the SOEP was extended to eastern Germany. Although SOEP is mainly focusing on the economic situation of persons and households, occupational biographies and employment status, it also includes a health section with some indicators about the health status, health behaviors and care dependency of the respondents. We used the SOEP data for the year 2012, wave BC (Schupp 2009; Schupp et al. 2012) of all non-institutionalized respondents with completed interviews and with a German head of the household. For all selected persons, we accomplished a backward merge to the wave BB in 2011 which includes additional information about the lifetime prevalence of specific diseases. The final merged SOEP data contains 11,024 respondents at ages 50 and older (52.8% females, 47.2% males).

For the Austrian population we had access to two recent health-monitoring surveys, namely the Austrian Health Survey (ATHIS) for the years 2006/07 and 2014. ATHIS is a representative cross-sectional health survey for the population aged 15 and older (Klimont et al. 2007, 2015). It includes a variety of health indicators, information about health behavior and care dependency as well as demographic and socioeconomic indicators of the respondents. After restriction to ages 50 and older, we could use information of 6,767 respondents of the 2006/07 survey (57.5% females, 42.5% males) and of 7,056 respondents of the 2014 survey (55.6% females, 44.4% males).

Surveys including health information for Germany and Austria together are the European Social Survey (ESS), the European Union Statistics on Income and Living Conditions (EU-SILC) and the Survey of Health, Ageing and Retirement in Europe



(SHARE). All these surveys allow a single country-specific analysis of health and other indicators. The ESS is a representative cross-sectional survey for individuals aged 15 and older, conducted for several European countries every two years with start in 2002 (Schnaudt et al. 2014). The main focus of the ESS lies on “European populations’ moral, religious, social, economic and political attitudes and behaviours” (Schnaudt et al. 2014, p.487), but the survey contains also the questions about self-perceived health and limitations due to the health condition. For our analysis, we used the sixth round for Germany in 2012 and the fifth round for Austria in 2010, including data for 2,431 persons aged 50 and older for both countries together (52.5% females, 47.5% males).

The EU-SILC comprises is a cross-sectional survey (with a specific longitudinal component) about the current status and changes in income distribution and social inclusion among 27 European countries (Arora et al. 2015). The respondents are at least 16 years old and do not live in institutions or collective households. The first round was conducted in 2003 as a follow-up of the European Community Household Panel. Beside socioeconomic indicators, the EU-SILC contains the three health questions of the so-called “Minimum European Health Module” (MEHM) about self-perceived general health, activity limitation and chronic health problems. For our analysis, we used the cross-sectional data for Austria and Germany of the year 2012, including almost 27,000 persons aged 50 and older (52.6% females / 47.4% males).

Finally, we used data from the first and fourth wave of the SHARE survey. This longitudinal dataset includes individual information of individuals aged 50 and older for 18 European countries and Israel (Börsch-Supan et al. 2013). The first wave was conducted in the years 2004/05 and the fourth wave in 2010/2011. SHARE provides a variety of variables about the status and changes in physical and mental health, economic and non-economic conditions, life satisfaction and well-being. Several questions of SHARE were directly used in the ASCOM survey to make SHARE the central data source for our comparison of monastic and general populations. Therefore, we used only the Austrian and German SHARE samples. A special feature of the Austrian sample is the high proportion of refreshers in the fourth wave resulting from sampling problems during the first wave of SHARE. The German sample also includes refreshers which were added in the second wave 2006/07. By using cross-sectional design weights, we can recalibrate the information from the fourth SHARE wave for our analysis. The final case numbers for our analysis were 4,477 individuals from Austria and Germany from the first wave (54.9% females, 45.1% males) and 6,676 individuals from the fourth wave (56.2% females, 43.8% males). Both waves were analyzed as individual cross-sectional datasets.

After the selection of available surveys, we carried out a harmonization procedure to bring all health questions and variables into a uniform format with our ASCOM data, including checks of the wording of the questions, the answer categories, and the time horizon in the questions which refer to particular reporting periods. At the end, we arrived at 28 different health indicators for our analysis (see Table 2), including:

- The Minimum European Health Module (MEHM) with the three questions about self-perceived health, activity limitations and chronic health problems,
- Lifetime prevalence of 15 different diseases such as hypertension and arthritis,
- Obesity indicated by a BMI of higher than 30,
- Limitations in general activities of daily living (ADL) and in instrumental activities of daily living (IADL) as well as limitations in physical mobility,

- 
- The 36 Item Short Form Survey (SF-36) with single indicators like vital health, mental health and bodily pain as well as sum indicators for the physical and psychological constitution, and
 - Overnight stay in a hospital within the last year.

Some important features of the available health indicators must be noted. Although both ATHIS surveys contain questions about limitations in daily activities, these questions were asked only to persons aged 65 or older. Further, lifetime prevalence of different diseases is missing in the ATHIS 2014 as a result of a change in the questionnaire. The questions in ATHIS 2006 about diseases refer to the whole life span, while in ATHIS 2014 the time horizon was restricted to the last 12 months. The missing information about self-perceived health in the fourth wave of SHARE is due to different answer categories in the used American variant, including excellent, very good, good, fair, and bad. These categories cannot be transformed into the answer categories very good, good, fair, bad and very bad which are usually applied in German surveys.

All health indicators were dichotomized for the analyses. A good self-perceived health status summarizes very good and good health. Activity limitation caused by health problems covers strong and minor limitations. Prevalence of disease relates to ever diagnosed occurrence of specific diseases regardless the age at which these were experienced. ADL limitations are identified as problems or limitations in bathing, clothing, eating and walking through a room. We defined ADL limitation if at least one of these problems was experienced. The same definition applies to IADL limitations and mobility. IADL limitation refers to problems in phoning, taking medical drugs or performing general daily activities. Mobility restrictions are characterized on the basis of lifting or carrying weights over 5 kilos, climbing one or several flights of stairs or stooping, kneeling, and crouching. The SF-36 indicators were dichotomized by the underlying scores (*Bullinger 2000; Ware/Sherbourne 1992*). If the scores are lower than 50, we categorized them as negative health outcome like impairments in vital or mental health status.

TABLE 2: ANALYZED HEALTH INDICATORS FROM THE SURVEYS INCLUDED IN THIS STUDY

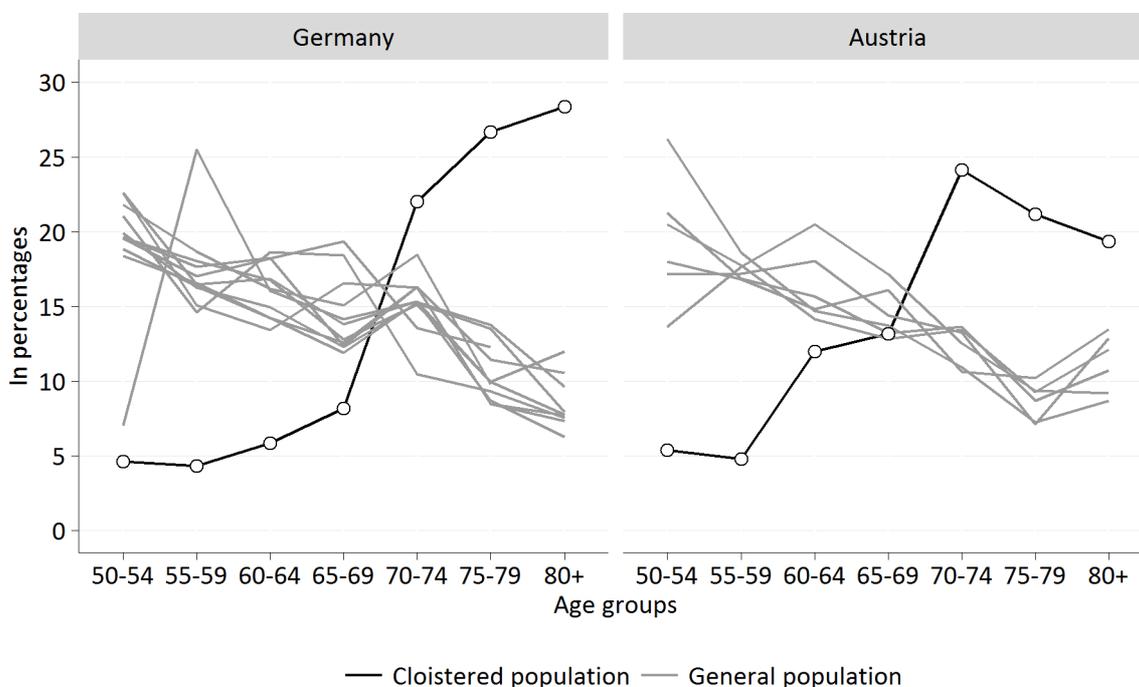
Health Indicator		ASCOM	ALBUS	ALBUS-ISSP	ATHIS 2006	ATHIS 2014	DEAS	DEGS	ESS	EU-SILC	GEDA	GGS	SHARE 2004/05	SHARE 2011/12	SOEP
MEHM	Self-perceived health status														
	Chronic diseases														
	Limitations due to health status														
Lifetime prevalence	Hypertension														
	High cholesterol level														
	Asthma														
	Diabetes														
	Chronic lung diseases														
	Arthritis														
	Osteoporosis														
	Cardiovascular diseases														
	Stroke														
	Malignant cancer														
	Parkinson disease														
	Depression														
	Cataract														
	Hip fracture														
Diseases of digestive system															
Obese (BMI > 30)															
Limitation	ADL														
	IADL														
	Mobility limitation														
SF-36	Vital health status														
	Mental health status														
	Bodily pain														
	Physical constitution														
	Psychological constitution														
Hospitalization															

Source: authors own compilation.

METHODS

We compared our ASCOM survey individually with each available survey from the general population separated for Germany and Austria to indicate health differences between the cloistered and general population. An important control factor within those comparisons was the different age structures of the populations. Figure 1 illustrates the age structure of each survey of the general population (grey lines) and of the ASCOM data (black line with white circles) separated for Germany and Austria. The graphs reveal the significant differences in the age composition of the samples, with the age structure of the monastic population being characterized by a lower proportion of individuals below age 65 and higher proportions of persons at older ages.⁵

FIGURE 1: AGE STRUCTURE OF THE ASCOM SAMPLE OF ORDER MEMBERS AND OF THE SINGLE SURVEYS OF THE GENERAL POPULATIONS OF GERMANY AND AUSTRIA



Source: authors own calculations.

We adjusted for the differences in the age structure by indirect age standardization with the standard population and standard counts referring to the general population in the particular survey. Moreover, we applied population—and if available cross-sectional—weights to adjust for an over- or under-sampling in the surveys from the general population. Consequently, the standard age structure differs between the order member-general population comparisons depending on the survey of the general population to take the specific underlying age structure into account. As a result, we have eleven single comparisons for Germany and six for Austria. In each of these comparisons, we quantified differences in health outcomes between the

⁵ The single grey line which starts with a low proportion at ages 50-54 in Germany refers to the fourth wave of SHARE. Because of the longitudinal setting of the SHARE survey and the low number of refreshers, the proportion is significantly underestimating the real population age structure.

monastic and general population by odds ratios. To test whether health differences are statistically significant, we estimated confidence intervals for the odds ratios by applying the hypergeometric exact method. Consequently, for a single health indicator we got several odds ratios resulting from the comparisons between the ASCOM data with the single health surveys of the general population.

To summarize all these single results to a comprehensive picture, we merged all survey estimations in each country by applying a weighted average of the odds ratios. The weights take into account the total number of respondents in each survey (separated by sex or type of population). The same weights were used to estimate the average standard deviations for each health indicator. This enabled us to adjust the confidence intervals. Consequently, we arrived at two summarized health comparisons separated by sex, one for Germany and one for Austria. Finally, we further averaged the country-specific results by using the population weights for ages 50 and older for Germany and Austria, derived from the Human Mortality Database.⁶

The analysis of the gender gap in health between order members and the general population followed the same analytical strategy. For the ASCOM survey and each survey from the general population we estimated the gender gap in all available health indicators. To control for the different age structures, we applied again an indirect age standardization, with standards being the total number, i.e. both sexes together, of respondents and counts from the survey of the general population. Thus, females and males from the general and the monastic population were standardized. As a consequence, we received estimations for the gender gap in health for all available health surveys from the general population and the same number of estimations for our ASCOM data. Since the standard population is always changing with different surveys from the general population, we had to re-estimate the gender gap in health among order members. After the single estimations, we merged the results for Germany and Austria separately by applying weighted averages as described above. Finally, we summarized the German and Austrian results by using population weights. All analyses were carried out with the statistical software R.

RESULTS

The health of female and male order members in comparison to women and men of the general population

The survey- and population-weighted mean odds ratios resulting from the comparison of the ASCOM data with the surveys from the general population are presented in Figure 2. Odds ratios higher than one indicate a worse health status (i.e., higher proportion of bad health outcome) among the monastic population while odds ratios below one reflect a better health status of order members compared to the general population. The dots represent point estimates and the horizontal lines the corresponding 95% confidence intervals. White dots indicate statistically significant differences between order members and the general population, whereas statistically not significant differences are displayed with black dots. The left panel of Figure 2 shows the results for females and the right panel those for males. Regarding the three MEHM indicators about self-perceived health, chronic diseases and activity limitation due to recent health problems we find no statistically significant differences between monastic and general population among females. A similar pattern with smaller differences for self-perceived health and activity limitations but somewhat larger differences for the prevalence of chronic diseases can be found for males, with the latter being even statistically significant.

⁶ The Human Mortality Database is online available at <https://www.mortality.org/>.



It is striking, however, that order members show disadvantages in basically all other analyzed diseases and conditions, in particular regarding lifetime experiences, albeit not all of them are statistically significant. Female order members are statistically significantly more likely to have experienced asthma, diabetes, chronic lung diseases, arthritis, osteoporosis, cardiovascular diseases, cancer, cataract and diseases of the digestive system. The number of statistically significantly higher proportions of ever occurred diseases is lower among male order members. These include diabetes, arthritis, cancer, depression, cataract and diseases of digestive system. Obesity defined by a BMI of higher than 30 reveals no differences between order members and the general population. Regarding limitation in daily activities and mobility, i.e. having experienced at least 1 kind of ADL, IADL and mobility limitation, the order members of both sexes show significant disadvantages compared to the women and men of the general population. Among the SF-36 indicators we find a statistically significant disadvantage of order members regarding vital and mental health. Even the summarized SF-36 indicators for the physiological and psychological constitution show statistically significant disadvantages for order members. Only for bodily pain we find no significant difference to the general population with the odds ratios for both females and males being even below one. Finally, male order members are significantly more likely to have spent at least one night in hospital compared to men of the general population during the last 12 months. The corresponding data for women indicates no difference between order members and general population.

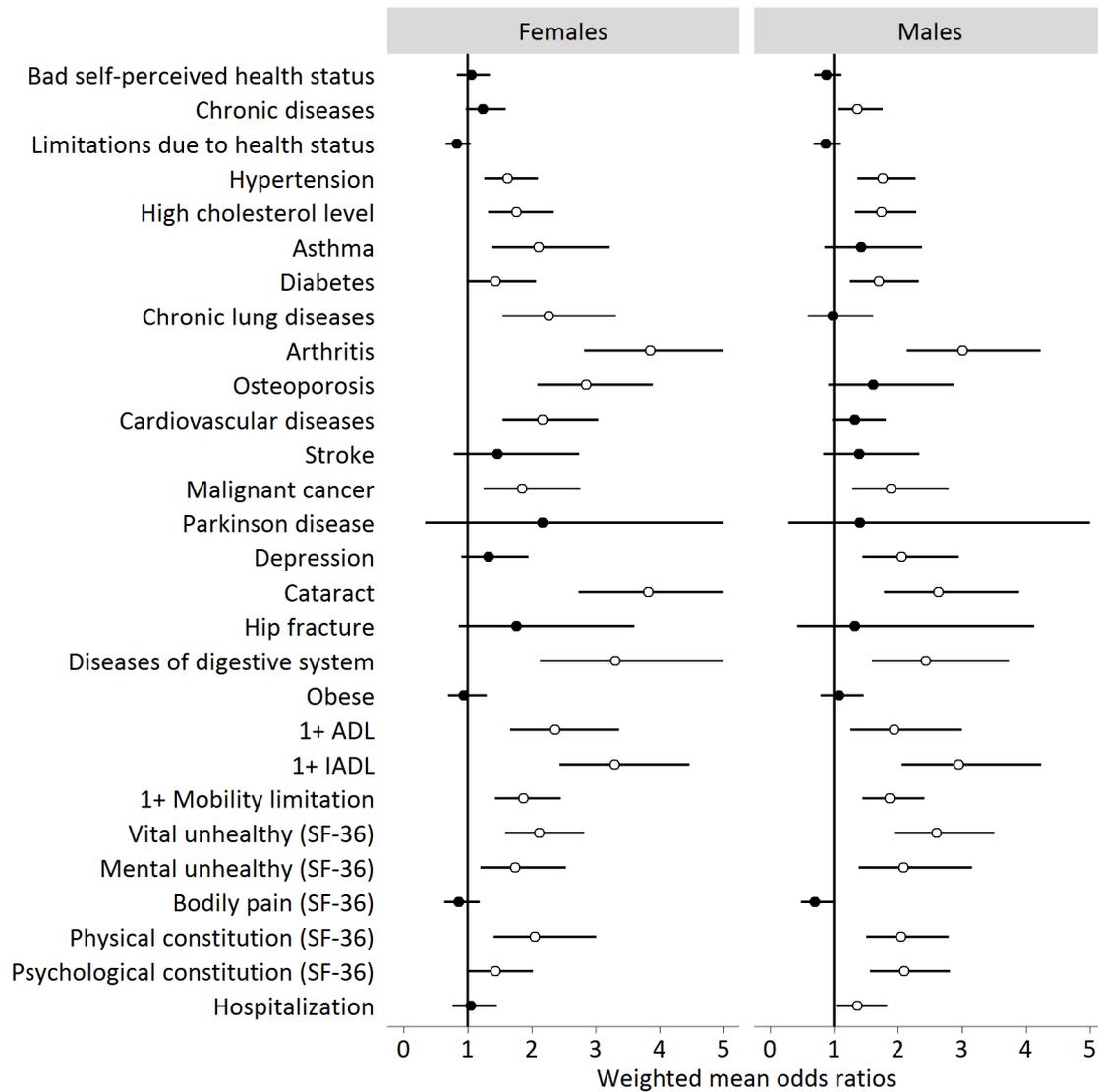
To sum up the results of the first analysis, order members experienced either an equal or higher likelihood of health impairments compared to the general population according to all analyzed indicators. Note, however, that these figures were only controlled for age and sex. To test whether the results are sensitive to other major characteristics of order life and the ASCOM survey, we carried out an identical analysis on the basis of differently selected sub-samples of the general population and adjustments of the ASCOM data. First, given that order life is characterized by living in a community, we restricted the comparison samples of the general population to only those individuals who are living with other persons in a household (i.e., we excluded all respondents who live alone, regardless of marital status).⁷ The ASCOM sample and data remained unchanged. The results of this analytic variant are very similar to those presented above and are thus not shown here. Only two effects among females are worth mentioning. The likelihood of diabetes remains higher for order members, but the difference loses its statistical significance because of the reduced case numbers in the samples of the general population. On the other hand, the disadvantage of female order members regarding the SF-36 indicator for the psychological constitution increased distinctly compared to the previous analysis. All other health indicators reflect the same odds ratio structure as those presented in Figure 2.

In the second additional analysis we took into account the specific characteristic of the ASCOM data to include much higher proportions of missing cases in specific question batteries. For example, the questions about the experience of specific diseases within lifetime or within the last six months were displayed in the self-administered questionnaire in form of a comprehensive table. While filling the questionnaire, several order members indicated only those diseases which they have experienced, while they left the boxes for other diseases blank instead of indicating that they did not experience them. This applies similarly to the question batteries for ADL, IADL and mobility limitations. For sensitivity check, we imputed the missing information in these batteries with the most favorable health outcome if at least one item of a battery was filled. This imputation was only carried

⁷ Note, however, that institutionalized persons living in nursing homes or similar institutions are generally excluded in health surveys of the general population, whereas they are included in the ASCOM data without possibility to identify them.

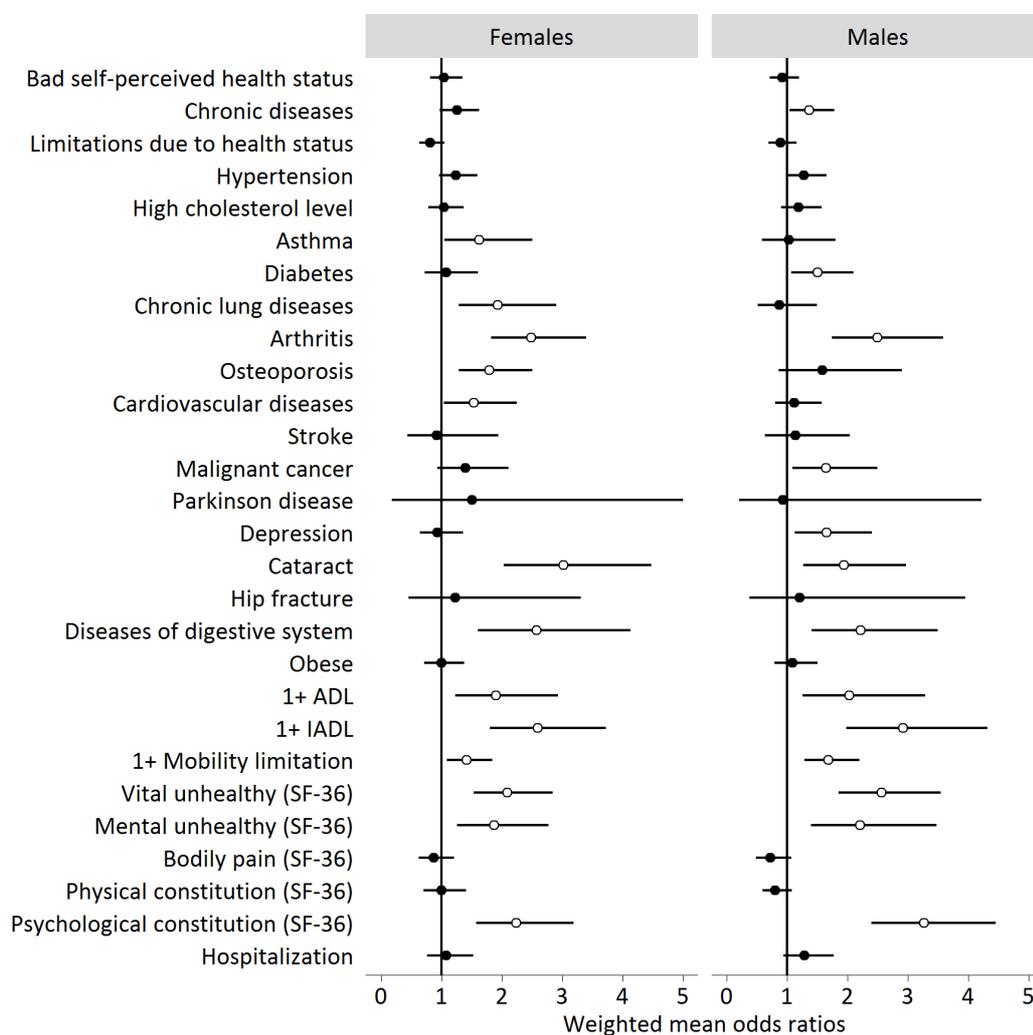
out for the monastic population. As a result, the number of observations for each health indicator increases among order members, while the number of bad health outcomes remain unchanged. Thus, the proportions of bad health among order members decreases with this imputation procedure. For the general population, we restricted the samples again to those individuals who live together with other people in the household as described for the first additional analysis.

FIGURE 2: DIFFERENCES IN HEALTH OUTCOMES BETWEEN ORDER MEMBERS AND THE GENERAL POPULATION MEASURED BY WEIGHTED MEAN ODDS RATIOS



Note: odds ratios higher than one indicate a higher likelihood of bad health status among the order members. Black dots indicate no statistically significant differences ($p \geq 0.05$) between the monastic and the general population.
Source: authors' own calculations.

FIGURE 3: DIFFERENCES IN HEALTH OUTCOMES BETWEEN ORDER MEMBERS AND THE GENERAL POPULATION MEASURED BY WEIGHTED MEAN ODDS RATIOS RERUWITH IMPUTED DATA FOR THE MONASTIC POPULATION



Note: odds ratios higher than one indicate a higher likelihood of bad health status among the order members. Black dots indicate no statistically significant differences ($p \geq 0.05$) between the monastic and the general population.
 Source: authors' own calculations.

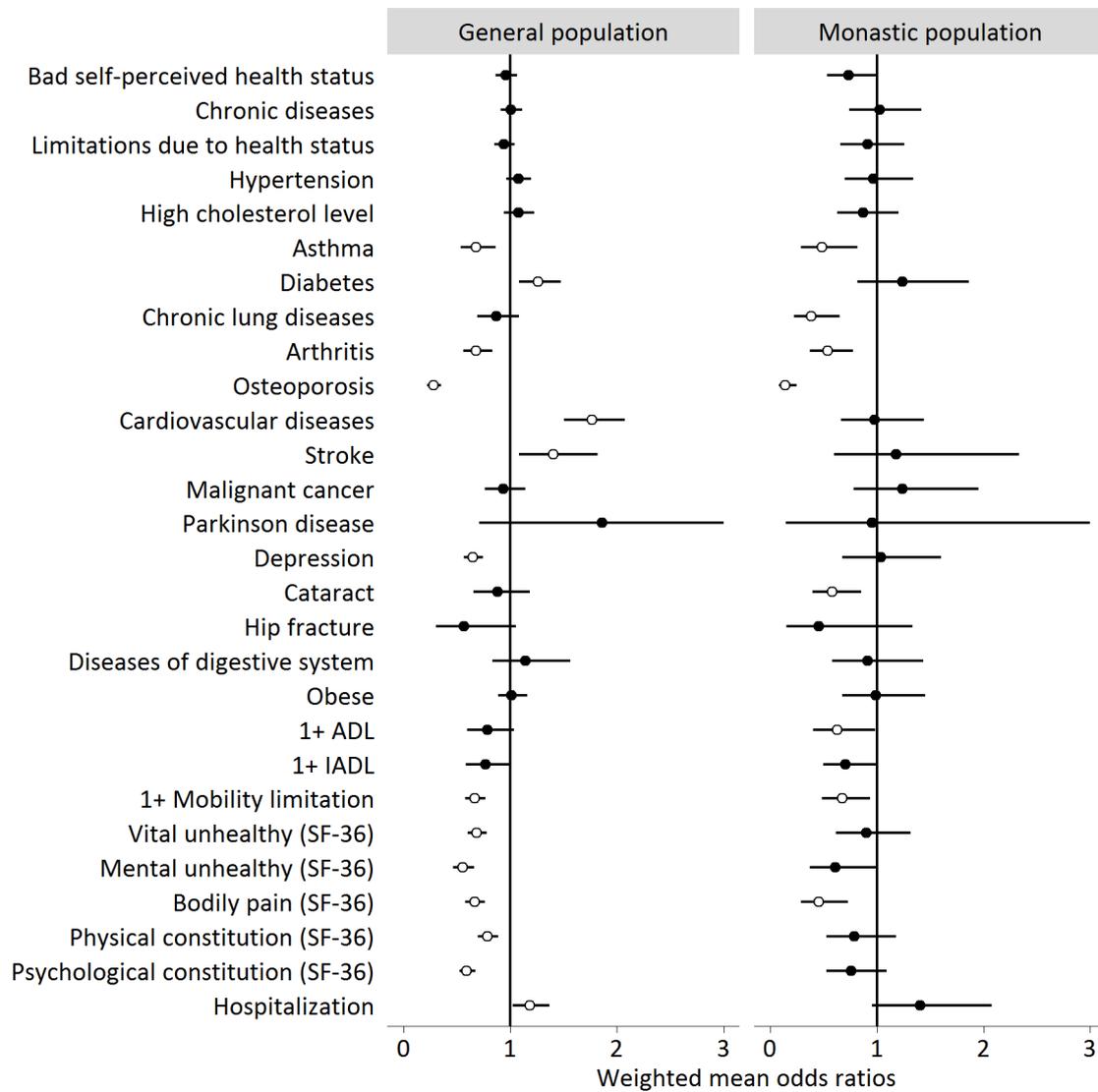
Figure 3 shows the results of this second additional analysis. The effect of the reduction of the general population samples is only marginal because only few respondents aged 50 or older indicated to live alone. Thus, changes in the odds ratios compared the results presented in Figure 2 can only be expected for the prevalence of specific diseases, ADL, IADL, mobility functioning and the SF-36 where missing data in the ASCOM survey was imputed. As to be expected, the odds ratio scales reduced because of the reduced prevalence rates among order member. However, the results provide a still high number of statistically significant health disadvantages among order members. Indicators which lost the statistical significant of the difference between monastic and general population include the prevalence of hypertension and high cholesterol level as well as the physical constitution based on SF-36. The higher diabetes prevalence among female order members of the initial analysis disappeared completely.

THE GENDER GAP IN HEALTH IN THE MONASTIC AND THE GENERAL POPULATION

In the previous section we analyzed the health of female and male order members in comparison to women and men of the general population for several different indicators of actual and past health conditions. In this section, we analyze the gender difference in the monastic population in comparison to the general population for the same set of health indicators. Our previous studies revealed that the gender gap in life expectancy is significantly smaller in the monastic population, mainly resulting from the low mortality of male order members (Luy 2002, 2003, 2009a, 2009b, 2011). Therefore, the interesting question is whether also gender differences in health are smaller among order members compared to their worldly counterparts.

Figure 4 presents the odds ratios for the gender differences in health for the two populations, calculated as male-female ratios of the prevalence values. Thus, odds ratios higher than one indicate a greater chance for men to experience impairment in a particular health outcome compared to women. The left panel shows the results for the general population and the right panel for the monastic population. As in Figures 2 and 3, white dots represent statistically significant differences, whereas black dots indicate no statistically significant difference between the sexes. Among the three MEHM indicators we find a similar pattern of gender differences in the monastic and the general population. Women show small disadvantages in self-perceived overall health and activity limitations, whereas there are no gender differences in the prevalence of chronic diseases. Note, however, that even the gender differences in self-perceived health and chronic diseases are not statistically significant, neither among order members nor in the general population. The lifetime prevalence of specific diseases reveals statistically significantly higher likelihoods for females in the general population to have experienced asthma, arthritis, osteoporosis and depression. Males show a significantly higher prevalence of diabetes, cardiovascular disease and stroke. Interestingly, monastic life seems to have a preventive effect for men in particular for these conditions which do not show statistically significant gender differences among order members. On the other hand, we did not find similar preventive effects for female order members except for depression. Beside this single observation, female order members show similar health disadvantages like women the general population plus additional higher likelihoods for chronic lung diseases and cataract.

FIGURE 4: GENDER DIFFERENCES IN HEALTH OUTCOMES IN THE GENERAL AND THE MONASTIC POPULATION MEASURED BY WEIGHTED MEAN ODDS RATIOS



Note: odds ratios higher than one indicate a higher likelihood of bad health status for men. Black dots indicate no statistically significant differences ($p \geq 0.05$) between men and women.

Source: authors' own calculations.

Limitations in ADL, IADL and mobility are more likely among females compared to males both in the monastic and in the general population. However, these gender differences are only statistically significant in ADL among order members and in mobility limitations among both populations. The female health disadvantage in the general population becomes very apparent among the SF-36 indicators. In all analyzed SF-36 dimensions, women show statistically significantly higher likelihoods of health impairments. While female order members show similar disadvantages for all these SF-36 health indicators, the only significant gender difference can be found for bodily pain. Finally, hospitalization shows higher likelihoods for men among order members and in the general population, being statistically significant only for the latter.

Equivalently to the previous separated analysis for women and men, we performed additional analyses of gender differences in health. First, we restricted the examination to respondents of the general population samples who do not live alone in the household, and in the second step, we used in addition the imputed ASCOM data as described in the previous section. Repeating the analysis with the selected samples of the general population had only marginal effects on the gender gap in health. Although the odds ratios changed slightly, the findings of the initial analysis persist without any changes in the statistical significance. However, the use of imputed ASCOM data led to the general tendency of more disadvantages for male order members. This shift of health disadvantages in the direction of men was mainly due to a reduction of health disadvantages among female order members. Nonetheless, the changes were only of minor in extent and therefore the results are not presented in detail here. Only the gender differences in the lifetime prevalence of asthma, arthritis and cataract as well as in limitations in ADL and mobility lost the statistical significance. All other results remain unchanged.

SUMMARY AND CONCLUSIONS

The aim of this study was to examine whether the particular environment of religious communities does not only lead to longer life and a smaller gender gap in life expectancy compared to the general population, but also to better health and reduced gender differences in health conditions. With regard to the first we found—against the initial intuitive expectation of better health—that order members show disadvantages in basically all analyzed diseases and conditions, in particular regarding lifetime experiences, albeit not all of them are statistically significant. This indicates that the higher life expectancy of order members is associated with more health problems as stated by the expansion of morbidity hypothesis, rather than with better health as suggested by the compression of morbidity hypothesis. Broader health indicators, such as those of the MEHM, showed no or only very small differences between monastic and general population, providing support for the dynamic equilibrium hypothesis. Thus, the relationship between health and mortality seems to depend strongly on the health indicator as described similarly in other studies (Christensen et al. 2009). Regarding the gender gap we found more health disadvantages for women than for men in both populations, supporting again the expansion of morbidity hypothesis as women have a higher life expectancy than men. In line with the smaller gender gap in life expectancy among order members, we found also smaller gender differences in health in the monastic population. The results indicate that this reduction of the gender gap results primarily from positive health effects of order life among men relative to women, who show no or only a smaller protective effect of monastic life. This seems to be in line with the findings of our previous studies on the life expectancy of order members. Also in this respect, men profit stronger from order life than women.

In sum, our results tend to indicate that longer life is associated with more health problems, in particular regarding the life time experiences of specific diseases, chronic illnesses and activities of daily living and mobility. Note, however, that these results might be biased by specific characteristics of the ASCOM data. Although we performed an age standardization on the basis of age groups shown in Figure 1, it is likely that order members are still older in each of these age groups, in particular in the last open age interval including persons aged 80 and older. Therefore, we must assume that the comparisons between monastic and general population are still biased by the higher ages of order members as health problems are typically increasing with age. Unfortunately, the size of the age groups could not be reduced further because of case numbers and restrictions in the age groups included the data for the general population. Thus, we reduced the effect of different age structures in this study to the most possible extent. The second important issue concerns institutionalized persons living in nursing homes or similar institutions. These are generally excluded in health surveys of the general population, whereas they are included in the ASCOM data without the possibility to identify them. Given that these individuals usually suffer more health problems than people who

live in private homes, it is likely that the worse health condition found among the monastic population is also—at least partly—due to the inclusion of institutionalized order members. However, it is not possible to assess to what extent the presented results are affected by the effects of higher ages and the inclusion of institutionalized individuals in the ASCOM sample of order members.

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3.2 THE CROSS-SECTIONAL ASSOCIATION BETWEEN HEALTH AND MORTALITY: INSIGHTS FROM THE CLOISTER STUDY

MARC LUY

ABSTRACT

The association between health and mortality usually refers to the longitudinal perspective, in which they are directly related: individuals in good health have a higher probability to be alive ten years later compared to individuals in poor health. In the cross-sectional perspective, however, health and mortality are treated as rather independent variables which are combined to a “Healthy Life Years” indicator: with information about mortality we construct a survival function (life table) to derive the total number of life years (life expectancy), and the information about health is then used to separate these life years into those spent in good and those spent in poor health. In this paper we hypothesize that the direct association between health and mortality known from the longitudinal perspective exists equivalently in the cross-sectional context, i.e., with the same relations and directions of their relationship. We refer to this hypothesis as “CroHaM hypothesis”, with CroHaM being the abbreviation for “cross-sectional association between health and mortality”. The paper describes the theoretical background of the CroHaM hypothesis, how it is related to the central research question of the HEMOX project, and how we tested it in the quasi-experimental setting of the Cloister Study.

INTRODUCTION

Differentials in health and mortality are a matter of great concern. Since more than a century, researchers try to identify the causes of such differentials in order to reduce or, ideally, eliminate them. In most cases, however, these efforts were not successful and many of these differentials still exist or became even larger. The HEMOX project dealt in particular with one of such differentials: the differences between women and men. Women have a higher life expectancy (LE) than men but they are often reported to be also the sex with the higher number of life years spent in poor health. This observation is referred to with terms like “gender and health paradox” (Rieker and Bird 2005), “morbidity paradox” (Gorman and Ghazal Read 2006), “morbidity-mortality paradox” (Kulminski et al. 2008), “paradox of ‘weak but strong women’ and ‘tough but weak men’” (del Mar García-Calvente et al. 2012), “male-female health-mortality paradox” (di Lego, Lazarevič and Luy 2019) or “male-female health-survival paradox” (Lindahl-Jacobsen et al. 2013; Oksuzyan et al. 2008; Oksuzyan et al. 2009; Van Oyen et al. 2013). Despite the efforts of many demographers, epidemiologists, socio-medical scientists and others, still very little is understood about the reasons for this paradox or its mechanisms, as concluded, e.g., by Austad (2006) and Grundy (2006).

The literature on this gender paradox is dominated by two explanations. The first states that—because of a combination of biological and social factors—women and men differ in the kinds and severity of diseases. Consequently, this hypothesis argues that women suffer from a greater number of conditions than men, but female disabilities tend to be less lethal. The second explanation sees the reason for excess female morbidity derived from survey data in different reporting behavior of women and men, the so-called “different item functioning”. According to this hypothesis, health differences between women and men

appear biased in surveys and are not reflecting the objective differences between the sexes. More details about these explanations can be found, e.g., in Payne (2006).

In the HEMOX project we focused on a third, so far widely ignored explanation. We introduced the “longevity hypothesis” which states the existence of a direct association between longevity and live years spent in poor health. Consequently, we hypothesized that women show higher morbidity rates than men not because they are female, but because they are the sex with higher LE (Luy and Minagawa 2014). This explanation is directed in particular to gender differences in less severe health domains, i.e. those health domains which are not strongly associated with the risk of dying. Thus, the longevity hypothesis is closely related to the above mentioned differences between women and men in kinds and severity of diseases.

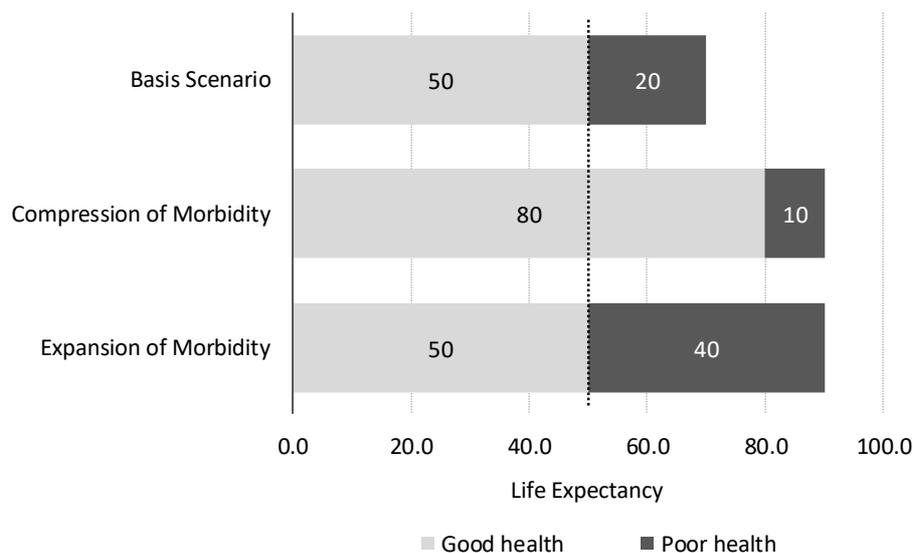
Usually, comparisons of total and healthy LE and the analyses of differentials are based on cross-sectional data; i.e., LE and the number of life years spent in good respective poor health are estimated with cross-sectional data to get an image of current health conditions. At a first glance, however, the longevity hypothesis describes a longitudinal phenomenon. In the next section, we explain how the asserted direct association between health and mortality can affect also cross-sectional differences between populations and population subgroups. We refer to this extension of the longevity hypothesis as “CroHaM hypothesis”, with CroHaM being the abbreviation for “cross-sectional association between health and mortality”. Then, we outline how we test the CroHaM hypothesis in the quasi-experimental setting of the Cloister Study. After presenting the results of our empiric analysis, we summarize and discuss the main theoretical aspects and empiric findings of this work, and we make suggestions for further tests of the CroHaM hypothesis.

CROSS-SECTIONAL ASSOCIATION BETWEEN HEALTH AND MORTALITY: THE “CROHAM HYPOTHESIS”

The association between health and mortality is naturally related to the longitudinal perspective and becomes relevant, e.g., in the “compression versus expansion of morbidity” debate. This debate concerns the question whether the life years gained by increasing LE are spent primarily in good health (i.e., compression of morbidity) or in poor health (i.e., expansion of morbidity). Figure 1 illustrates these two opposing approaches. The basis scenario shows a total LE of 70.0 years (total length of the bar) of which 50.0 years are spent in good health (light shaded part of the bar) and 20.0 years are spent in poor health (dark shaded part of the bar). The two bars below show the distribution of life years spent in good and poor health at a moment later in time, when total LE increased to 90.0 years. In the optimistic “compression of morbidity” scenario, all life years gained are spent in good health. In addition, the number of life years spent in poor health are reduced (“compressed”) to 10.0 years, resulting in an increase in the total number of life years spent in good health from 50.0 to 80.0. By contrast, in the pessimistic “expansion of morbidity” scenario, the number of life years spent in good health did not increase and all life years gained are spent exclusively in poor health.⁸

⁸ Note that these examples reflect only the extreme variants of the compression and expansion of morbidity scenarios. Several variants between these two are described in the literature as well, e.g., the scenarios of “health expansion” which does not reduce the number of life years spent in poor health but adds only life years spent in good health, or the “dynamic equilibrium” scenario which keeps the proportions of life years spent in good and poor health constant as given in the basis scenario. More details about the different variants of health changes within the process of changing LE can be found, e.g., in Crimmins and Beltrán-Sánchez (2011).

FIGURE 1: THEORETICAL MODELS OF COMPRESSION AND EXPANSION OF MORBIDITY



Source: author's own

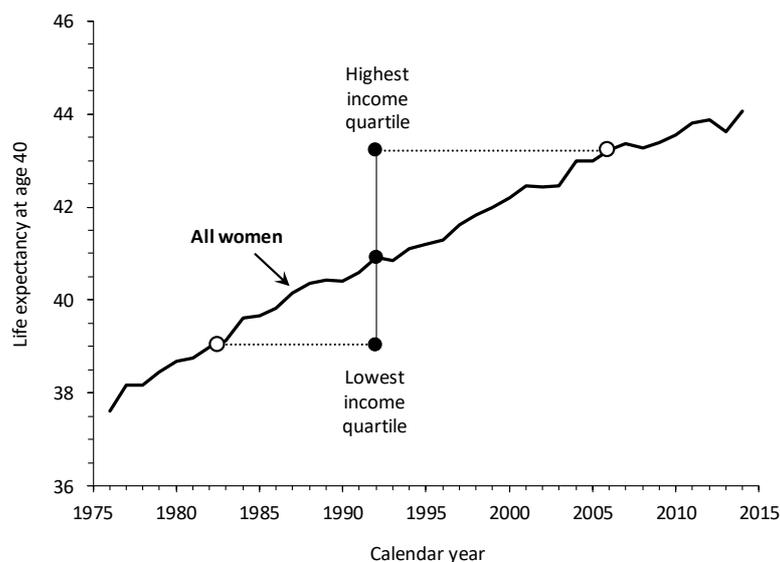
Empirical evidence suggests that both effects exist, depending on how health is defined: we find compression of morbidity, e.g., regarding disabilities and limitations, and expansion of morbidity regarding chronic illnesses (Christensen et al. 2009). More generally one could say that the occurrence of compression and expansion effects is linked to the considered health domain's association with mortality: we find compression effects among those health domains which are more severe and thus stronger linked to mortality, whereas we find expansion effects among those health domains which are less severe and thus only weakly (or not) associated with mortality. This link between compression and expansion effects on the one hand side and the health-mortality-relationship on the other appears to be plausible. The increase in LE is a consequence of reduced mortality which results from—besides reductions in incidence and fatality of specific diseases—a postponement in the onset of these diseases, i.e., a reduction in prevalence. Moreover, the likelihood of suffering longstanding illnesses increases with age, and therefore their prevalence increases with increasing LE (Crimmins, Hayward and Saito 1994). In line with this reasoning, analyses of the dynamics of disability revealed that the higher prevalence of disabling conditions among older women reflects their longer survival with disablement rather than differences in incidence (Crimmins, Kim and Hagedorn 2002; Manton, Corder and Stallard 1993).

The central idea of the CroHaM hypothesis is that these longitudinal health domain-specific associations between health and mortality exist equivalently in the cross-sectional context, affecting differences in the number of life years spent in good health between populations and subpopulations with different levels of LE. In other words, the CroHaM hypothesis transfers the described longitudinal health domain-specific expansion and compression effects to the cross-sectional context. The theoretical basis behind this transfer is Link and Phelan's "Theory of Fundamental Social Causes" (Link and Phelan 1995) which was developed to explain the enduring differences in health and longevity by socioeconomic status (SES). It states, in a nutshell, that SES embodies an array of flexibly usable resources that protect health no matter what mechanisms linking SES to health are relevant at any given time. These resources include money, knowledge, prestige, power and beneficial connections, and they operate at both individual and contextual level. On the individual level they are conceptualized as "cause of causes", and

on the contextual level they provide so-called “add-ons”. Consequently, the theory states, whenever gains are made in the ability to control disease, those who are advantaged with respect to the flexible resources will, on average, benefit more from these gains (further details about the Fundamental Cause Theory can be found in Link and Phelan 2010; Link 2008; Link and Phelan 1996; Phelan et al. 2004; Phelan, Link and Tehranifar 2010).

Although not explicitly stated by Link and Phelan, one can interpret their theory in the way that those who dispose more of the flexible resources are, in a sense, ahead in time compared to those who do not. This time perspective provides an explanation for the differences in LE by SES in both, the longitudinal and the cross-sectional context. We refer to this aspect of the Fundamental Cause Theory as “cross-sectional time effect”, implying that cross-sectional differences are an image of longitudinal developments. Figure 2 shows such a longitudinal development, i.e. the trend in period LE at age 40 of women in West Germany from 1975 to 2015 (bold solid line). The graph reveals the already mentioned (more or less) steady increase in LE, in this case from 37.3 years in 1975 to 43.7 years in 2015 (i.e., an average increase of 1.6 years per decade or almost 2 months per year). The graph shows also the cross-sectional differences in LE at age 40 between the population subgroups of lowest and highest income quartile in 1992, illustrated with big black dots: western German women of the lowest income quartile had a LE at age 40 of 39.0 years, and those of the highest income quartile had a LE of 43.2 years (Luy et al. 2015). When we relate this difference of 4.2 years to the longitudinal context we can see that it corresponds to almost 25 years of increases in LE. Women belonging to the lowest income quartile in 1992 had the same level of LE which all western German women reached already in 1982 (39.0 years), and women of the highest income quartile in 1992 had already the LE which was reached by the total female population in 2006 (43.2 years). In other words: compared to the LE of the total population, women of the lowest income quartile lagged 10 years behind, whereas women of the highest income quartile were 14 years ahead in time (illustrated by the big white dots in Figure 2).

FIGURE 2: LONGITUDINAL CHANGES IN LIFE EXPECTANCY AND CROSS-SECTIONAL DIFFERENCES BY INCOME LEVEL, WEST GERMANY, WOMEN, 1975-2015



Notes: All women: own calculations with data from the Statistical Office of Germany; income quartile: Luy et al. (2015)
Source: author's own

The idea of a cross-sectional time effect implies that varying LE levels of different populations prevailing at the same time root—at least to a large extent—in the same mechanisms as varying levels of LE of the same population prevailing at different times. Consequently, we can assume that the above described health domain-specific compression and expansion effects observed in the longitudinal context (e.g., between 1982 and 2006) exist equivalently in the cross-sectional context when we compare the life years spent in good health between populations or subpopulations (e.g., between women of the lowest and highest income quartile in 1992). Note that this hypothesis concerns not only differences between particular SES groups but likewise all kinds of differentials in life years spent in good health, because findings from previous research suggests that SES plays a central role in most of them (Bucciardini et al. 2019; Marmot 2005). Most importantly in the context of the HEMOX project, this applies also to gender differences in health and mortality (Vallin 1995).

EMPIRICAL TEST OF THE CROHAM HYPOTHESIS

An empirical test of the CroHaM hypothesis must fulfil two prerequisites:

1. populations or subpopulations with different levels of LE, and
2. health domains with differently strong associations to mortality.

Regarding the first issue, we compare female and male Catholic order members with their counterparts of the general population. Our previous studies revealed that order members live longer than worldly women and men (Luy 2002, 2003). What makes this quasi-experimental setting interesting for testing the CroHaM hypothesis is that the extent of these differences in LE differs between women and men: the advantage of monks against worldly men is larger than the advantage of nuns against worldly women. Consequently, if the effects stated in the CroHaM exist (i.e., the “CroHaM effects”), they should be stronger in the comparison between monks and men of the general population than in the comparison between nuns and worldly women.

This leads to the second prerequisite, health domains with differently strong associations to mortality. We chose the three domains of the “Minimum European Health” (MEHM) which are available for both the order members and the general population. The MEHM domains are:

1. self-perceived health (assessed by the survey question “How is your health in general?” with the answer categories very good/good/satisfactory/not so good/poor),
2. global activity limitation (GALI; “For at least the past 6 months, to what were you limited in activities people usually do due to health problems?”, strongly limited/limited/not limited), and
3. chronic health problems (“Do you have any longstanding illness or health problem?”, yes/no).

In a first step, we analyzed the mortality risks related to the three MEHM health domains to test whether the second prerequisite of the CroHaM test is fulfilled (Section 3.1). Then, we present the results of the empirical test of the CroHaM hypothesis in Section 3.2.

MORTALITY RISKS OF THE MEHM HEALTH DOMAINS

We examined the health-mortality relationship of the three MEHM health domains with data of the German Life Expectancy Survey (LES). The LES is a panel that consists of two waves of interviews, restricted to individuals with German citizenship, and it is based on the German National Health Survey. The first wave was carried out between 1984 and 1986 and included a representative random sample of the total West German population. In 1998, the German Federal Institute for Population Research (Bundesinstitut für Bevölkerungsforschung—BiB) carried out a follow-up survey among the individuals interviewed in the 1984/86 National Health Survey. In this second survey, the initial questionnaires were slightly modified—e.g. purely medical details were removed and replaced by questions on general living conditions and family situations—and the number of respondents was restricted to those born between 1914 and 1952. The LES contains demographic indicators as well as information about economic and social status, social networks, health behaviors, life attitudes and a variety of health indicators (more details can be found in Gärtner 2001). Most importantly for this analysis, also the survival status of non-respondents was collected with the second survey.

The western German LES sample includes a total of 4,139 women and 4,335 men. Of those, 285 women (6.9%) and 613 men (14.1%) died between the two survey waves. For 998 women (24.1%) and 885 men (20.4%) the survival status in 1998 is unknown. Tests of the quality of the LES mortality data revealed that the reflected survival of the LES sample between 1984 and 1998 is representative for the mortality of the western German population, regardless of whether individuals with unknown survival status in 1998 are included or not (Luy and Di Giulio 2005; Salzmann and Bohk 2008). As suggested by Luy and Di Giulio (2005) we excluded the individuals with unknown survival status from the analysis. This selection of the LES sample leads to mortality levels and patterns close to those of the total German population (see Luy et al. 2015).

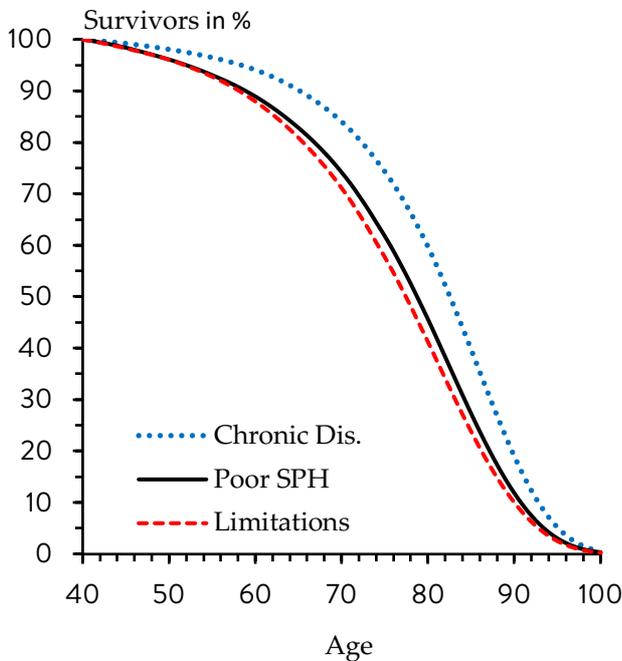
The question on self-perceived health was included in the LES as described above (question 47 in LES wave 1). For GALI we used question 48 of LES wave 1 which is not identical to the MEHM question but very similar, being: “Apart from short illnesses: does your health condition limit you in fulfilling everyday tasks, e.g. in household, job or education?” with the answer categories “not at all”, “a little”, and “substantially”.⁹ A simple question on chronic diseases as in the MEHM was not included in the LES questionnaire. We approximated the MEHM question on chronic illnesses by defining the presence of chronic health problems as the current prevalence of at least one long-standing illness out of a list of 35 diseases (question 59 of LES wave 1; the list of these 35 diseases in German can be found in Appendix 1).

We identified for each individual of the LES the presence of health problems according to the MEHM domains at the time of first interview (i.e. presence of chronic diseases, not so good or poor SPH, and substantial limitation in daily activities of life). In addition, we calculated for each individual the exact ages at beginning and end of observation with the corresponding survival time from the date of first interview and the date of second interview respective date of death. The survival times by age were then used to estimate survival functions from age 40 with the “Longitudinal Survival Method” (Luy et al. 2015) for the three subgroups of individuals with health problems according to the MEHM health domains.

⁹ The exact German wording of the question is: “Von kurzen Erkrankungen einmal angesehen: Behindert Sie Ihr Gesundheitszustand bei der Erfüllung alltäglicher Aufgaben, z.B. Haushalt, Beruf oder Ausbildung?” with the answer categories “Überhaupt nicht”, “Ein wenig”, and “Erheblich”.

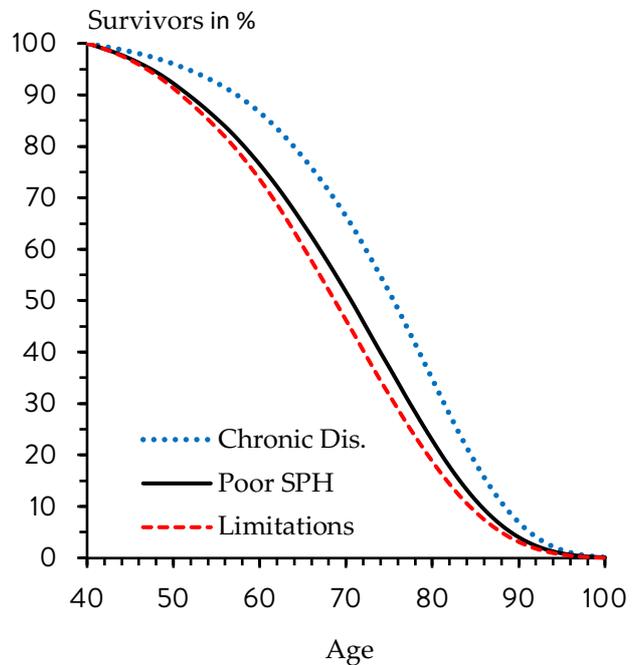
FIGURE 3: SURVIVAL FROM AGE 40 OF INDIVIDUALS WITH CHRONIC DISEASES, POOR SELF-PERCEIVED HEALTH (SPH) AND SUBSTANTIAL ACTIVITY LIMITATIONS, SEPARATED BY SEX

(A) WOMEN



Life expectancy at age 40
 Chronic Dis.: 40.5 years
 Poor SPH: 36.7 years
 Limitations: 35.6 years

(B) MEN



Life expectancy at age 40
 Chronic Dis.: 34.0 years
 Poor SPH: 29.7 years
 Limitations: 28.3 years

Source: own calculations with data from the German Life Expectancy Survey; Note: survival functions were estimated with the Longitudinal Survival Method (Luy et al. 2015); observation time for mortality follow-up: 1984-1998.

Figure 3 shows the three survival functions for individuals who suffer chronic diseases, poor SPH (summarizing “not so good” and “poor” SPH) and activity limitations, respectively, with the corresponding values for LE, separately for women and men. It becomes apparent that chronic diseases had the weakest link to mortality (dotted lines). The corresponding survival probabilities were distinctly higher than those for poor SPH and activity limitations. The two latter showed only minor differences between them, with individuals suffering poor SPH having had slightly higher survival probabilities than individuals with activity limitations. This holds equivalently for both, women and men. Among women, LE at age 40 of individuals with chronic diseases was 3.8 years higher than those of individuals with poor SPH and 3.9 years higher than those of individuals with activity limitation. Among men, the corresponding differences were 4.3 and 5.7 years, respectively. Note that the samples underlying the estimated probabilities of dying are to some extent overlapping because some individuals belong to two or all three subgroups. Nonetheless, the postulated differences in mortality exist with a distinctly lower mortality for chronic diseases than for poor SPH and activity limitations.

DIFFERENCES IN HEALTHY LIFE YEARS BETWEEN ORDER MEMBERS AND THE GENERAL POPULATION

We tested the CroHaM hypothesis on the basis of life years spent in good health, the so-called “Healthy Life Years” (HLY). “Good health” was defined by good or very good SPH, no global activity limitation, and no chronic health problems, respectively. In line with the CroHaM hypothesis, we expected that direction and extent of differences in HLY between order members and the general population would depend upon the domain of health considered. Based on the findings presented in Section 3.1, we expected to find the largest effects in favor of order members when HLY were estimated for life years without activity limitation (i.e., the MEHM health domain with the strongest association to mortality), somewhat reduced but still positive effects for order members when HLY were estimated for life years in good or very good SPH, and the smallest effects or even disadvantages for order members when HLY were estimated for life years without chronic illness (i.e., the MEHM health domain with the weakest association to mortality). Furthermore, we hypothesized that differences between the monastic and general population would be larger among men than among women, coinciding with the larger differences in LE among monastic versus general population men relative to women. According to the CroHaM hypothesis, this expectation applies in both directions, i.e. HLY on basis of health domains with an advantage of order members (consequently with larger advantages for monks compared to nuns) and health domains with an disadvantage of order members (consequently with larger disadvantages for monks).

We estimated HLY at age 50 with the “Sullivan method” which requires life tables and the age-specific prevalence of a specific health state (Sullivan 1971). Health data for Catholic order members stem from the first wave of the Health Survey of the German-Austrian “Cloister Study” (sub-project ASCOM). The survey is based on a self-administered questionnaire and includes Catholic order members aged 50 years and older. The survey was conducted between July and December 2012. In total, 1,158 order members (622 nuns and 536 monks) of 16 different orders from Germany and Austria – with a few members living in Switzerland and Italy – participated to the first survey wave, including 142 religious communities and 69 brothers and sisters who live on their own. The response rate was 68.8% (nuns 76.8%, monks 63.4%). Further information about the survey and details about the data can be found in Wiedemann et al. (2014). For the general populations of Germany and Austria we used data from the EU-SILC 2012 survey, restricted to ages 50 and above (data merged for the two countries, $n = 9,169$).¹⁰ Both surveys, ASCOM and EU-SILC, include the MEHM with identical wording of questions and answer categories as described in the introduction of this section.

Life tables for Catholic order members were derived from data of the continuously extended nuns’ and monks’ mortality data base of the Cloister Study collected from order archives, including the life dates of 18,105 order members from German and Austrian religious communities (sub-project COMMS). The use of mortality data from COMMS was necessary because the number of deaths in the ASCOM sample was not sufficient to estimate life tables at the time of this study. The communities participating in COMMS and ASCOM are not identical, but they overlap because some communities participate to both sub-projects of the Cloister Study. Moreover, the ASCOM sub-sample of participants is to some extent health selected and shows

¹⁰ Online available at <http://www.eurohex.eu>.

lower mortality compared to the total population of the communities participating to the ASCOM study (see Appendix 2).¹¹ Therefore, we adjusted the COMMS life tables by Cox regression parameters derived from comparisons between the mortality of the COMMS sample and the mortality of ASCOM participants, and between the mortality of ASCOM participants and the total ASCOM sample, referring to deaths of ASCOM participants between waves 1 and 2 (more details can be found in Appendix 3). Life tables of the general populations of Germany and Austria were calculated with data of the Human Mortality Database (HMD).¹² We merged the absolute numbers of person years and deaths by age for Germany and Austria to derive age-specific death rates for both populations combined. All estimates of this study were based on period life tables for the calendar years 1998-2009. The underlying rates for mortality and prevalence were calculated for the age groups 50-54, 55-59, ..., 85+.¹³

We analyzed the differences in HLY between order members and women and men of the general population with three alternative measurements. The first is the simple difference in the absolute number of life years spent in good health. Given that LE among female and male order members is on average higher than among their counterparts of the general population, the difference in LE should lead to a higher absolute number of years spent in a specific health state among nuns and monks, even if order members and the general population have identical age-specific health prevalence. To test the CroHaM hypothesis free of this “longevity effect”, we estimated also indicators for HLY which control for or eliminate the effect of different absolute numbers of life years. The most simple and intuitive approach is the proportion of life years spent in good health, i.e. HLY divided by LE. In addition, we decomposed the differences in HLY between order members and the general population into the effects caused by differences in health (“health effect”) and mortality (“mortality effect”) with the method developed by Nusselder and Looman (2004). The estimated health effect reflects the difference in the total number of life years spent in good health net of the effect caused by differences the total number of life years, i.e. net of the “longevity effect”. Thus, both approaches account for the differences in length of life and offer a more comprehensive picture of differences between order members and the general population in health and mortality.

Figure 4 shows the proportion of people in good health by age group for both order members and the general populations of Germany and Austria and for each of the three health domains. Across all health domains, the proportion of people in good health was generally lower in older age groups. Among order members there were noteworthy deviations in the oldest age group (85+). Specifically, the proportion of monastic women with no activity limitations and the proportion of both monastic women and men with no chronic health problems was higher amongst the 85+ age group relative to 80-84 year olds.

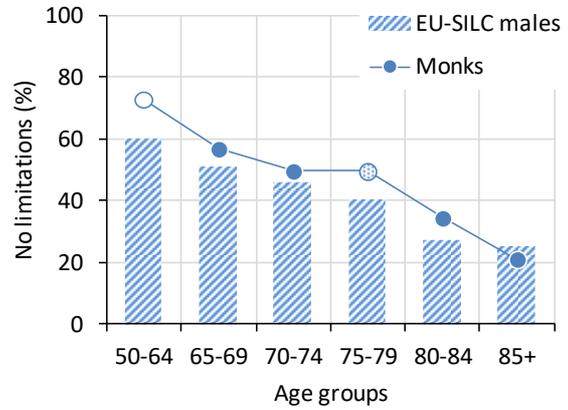
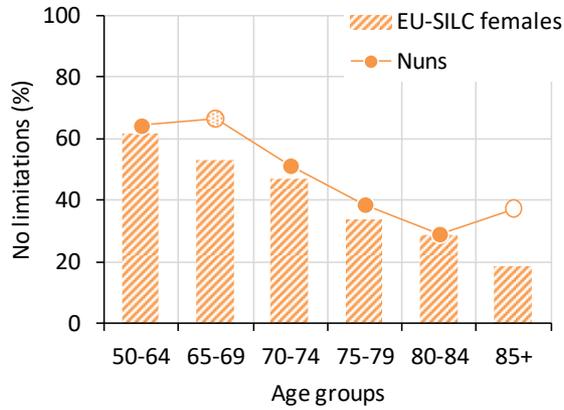
¹¹ Appendix 2 shows that mortality of ASCOM participants was significantly lower than mortality of COMMS participants. However, once non-participants were included in the analyses, the differences between the (full) ASCOM sample and the COMMS sample were not statistically significant.

¹² Online available at <http://www.mortality.org>. Data downloaded on 27 May 2015.

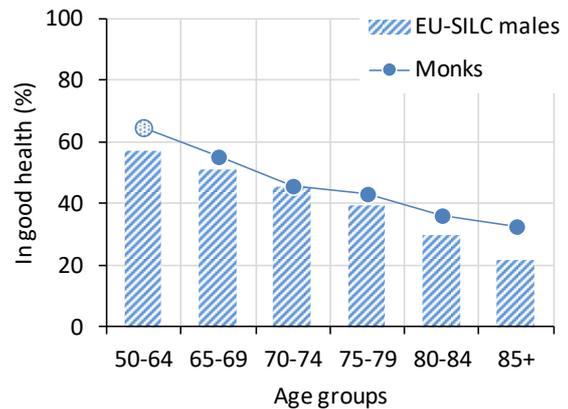
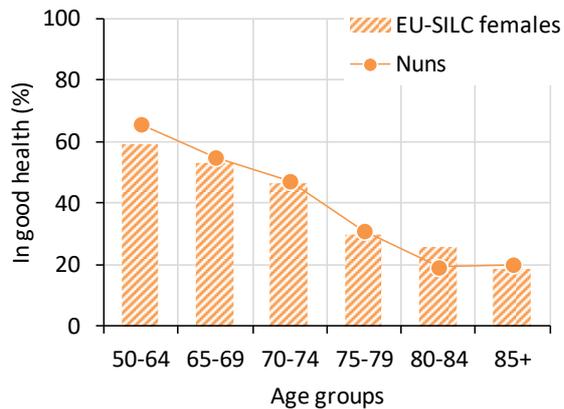
¹³ We performed the analyses also with different life tables for the general population by combining the data for Germany and Austria according to the proportions of German and Austrian order members in the ASCOM sample and by averaging LE for Germany and Austria (i.e., weighting both countries by 50:50). Likewise, we tested different variants to combine mortality from the COMMS sub-sample with the health data from the ASCOM sub-sample for order members, including the use of unadjusted and unweighted COMMS life tables and COMMS life tables weighted by the proportions of ASCOM participants from German and Austrian communities. Moreover, we varied the analyses by using the different last open age intervals of life 80+, 85+, 90+ and 95+, using the cross-sectional average length of life (CAL) instead of conventional LE, and using different observation periods (1995-2009, 1998-2009, 2000-2009) for both, order members and general population. Albeit the LE values differ between all these variants, the results were affected only to a minor degree and led to the same conclusions as those presented in this paper. (The different estimation variants affected mainly the order members because of the low case numbers. Some variants led to larger and others to smaller differences in LE between order members and general population, with corresponding effects on the differences in HLY, in particular regarding the gender-specific effects. Nonetheless, the order of the extent of differences in HLY between order members and general population by definition of health remained the same in all variants.)

FIGURE 4: AGE-SPECIFIC PREVALENCE OF DIFFERENT HEALTH CONDITIONS AMONG ORDER MEMBERS AND THE TOTAL POPULATION, GERMANY AND AUSTRIA, 2012

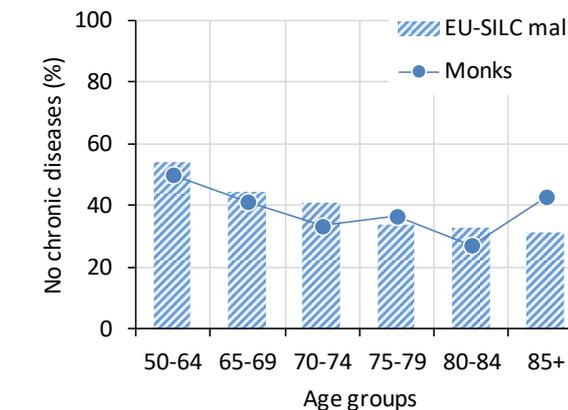
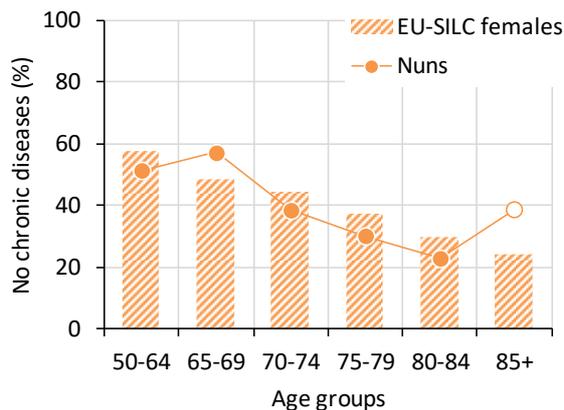
(A) GLOBAL ACTIVITY LIMITATION



(B) GENERAL PERCEIVED HEALTH



(C) CHRONIC HEALTH PROBLEMS



Source: own calculations with data of the Cloister Study and EU-SILC 2012; Note: white circles indicate statistically significant differences with $p < 0.05$, dotted circles with $p < 0.1$.

The estimates for LE at age 50 and HLY for each dimension of health at age 50 of order members and the general population are summarized in Table 1. Figure 5(a) shows the differences in HLY at age 50 between nuns and women of the general population, illustrated in bar plots with—from left to right—differences in life years without activity limitations in light shading, life years in good and very good SPH in medium shading, and life years without chronic illness in dark shading. The results are presented in three panels for the alternative measurements of differences in HLY: differences in the absolute number of life years shown in three bars on the left hand side, differences in the net health effect (in years) in the three bars in the middle, and differences in the proportion of life years spent in good health in the three bars on the right hand side. The dashed line in the left panel reflects the difference in the total number of life years (LE) between nuns and women of the general population.

TABLE 1: LIFE EXPECTANCY (LE) AT AGE 50 AND HEALTHY LIFE YEARS (HLY) AT AGE 50 BASED ON LIFE YEARS SPENT WITHOUT GLOBAL ACTIVITY LIMITATION, IN GOOD GENERAL HEALTH, AND WITHOUT CHRONIC HEALTH PROBLEMS, CATHOLIC ORDER MEMBERS AND TOTAL POPULATION BY GENDER, GERMANY AND AUSTRIA, 2012

	Total life years (LE)	Life years without limitation	Years in good general health	Life years without chronic illness
Female order members				
Absolute life years	34.6	18.9	17.3	15.8
Proportion of life years	---	54.8	50.1	45.6
Total population women				
Absolute life years	33.2	16.0	15.4	15.5
Proportion of life years	---	48.3	46.5	46.6
Male order members				
Absolute life years	30.7	18.0	16.8	13.1
Proportion of life years	---	58.5	54.9	42.7
Total population men				
Absolute life years	28.5	14.4	13.9	13.1
Proportion of life years	---	50.5	48.8	45.9

Source: own calculations with data of the Cloister Study, EU-SILC 2012, COMMS and HMD; Note: decimals of proportions are based on exact values for LE and HLY, the values in this table may be affected by rounding.

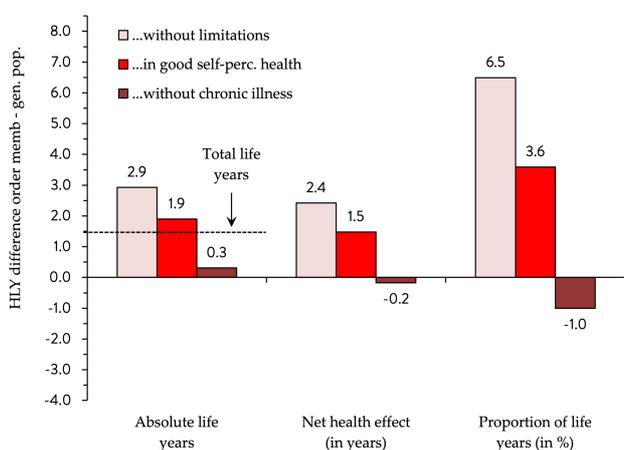
According to the used life tables, nuns had a 1.4 years higher LE at age 50 than women of the general population. Nuns had also a higher absolute number of life years spent in good health. The largest advantage of nuns was found when HLY were estimated on the basis of life years without activity limitation (+2.9 years), followed by their advantage in life years spent in good SPH (+1.9 years). In both cases, the advantage of nuns in HLY was larger than the advantage in total LE. Nuns had also a higher number of life years spent without chronic illness, albeit this advantage was smaller (+0.3 years) than the difference in the total number of life years (+1.4 years).

The corresponding results for HLY measures free of the longevity effect showed the same basic pattern of differences between nuns and women of the general population. Nuns had an advantage when HLY were defined as life years without activity limitation or life years spent in good SPH. The net health effect provided slightly smaller advantages of nuns compared to the

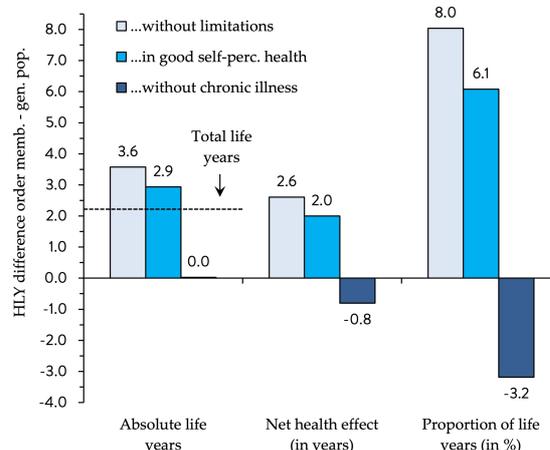
differences in the total number of life years, but even when the longevity effect was excluded the nuns' advantage in HLY was larger than their advantage in total LE (+2.4 years for life years without activity limitation and +1.5 years for life years spent in good SPH). These results were confirmed when HLY were defined as proportion of life years spent in good health (+6.5 percentage points for HLY based on life years without activity limitation, and +3.6 percentage points for HLY based on life years in good SPH). The major difference of the results for the net health effects and for proportions of life years spent in good health compared to those for the total number of HLY was that the nuns' small advantage in life years without chronic illness turned into a small disadvantage. The nuns' number of life years without chronic illness net of the mortality effect were 0.2 years (net health effect) respective one percentage point (proportion of HLY) lower than those of women of the general population.

FIGURE 5: DIFFERENCE IN HEALTHY LIFE YEARS (HLY) AT AGE 50 BETWEEN ORDER MEMBERS AND THE GENERAL POPULATION FOR DIFFERENT DOMAINS OF HEALTH AND DIFFERENT INDICATORS OF HLY

(A) WOMEN



(B) MEN



Source: author's own; Note: estimates are based on health data for the year 2012 and period life tables for the calendar years 1998-2009 (for details see text).

Figure 5(b) for men shows the same patterns of differences in HLY between order members and the general population as those described for women. Yet, all differences in HLY were larger in line with the monks' larger surplus in total LE (+2.2 years). The advantage of monks in life years spent without activity limitation compared to men of the general population was 3.6 absolute life years, 2.6 years net of the mortality effect, and 8.0 percentage points in the proportion of life years spent in good health. The corresponding differences in life years spent in good SPH were 2.9 years, 2.0 years and 6.1 percentage points, respectively. Regarding life years spent without chronic illness, we found basically no differences between monks and men of the general population in the total number of life years (+0.03 years), and a disadvantage of monks in the net health effect (-0.8 years) and in differences in the proportion of life years spent in good health (-3.2 percentage points).

SUMMARY AND CONCLUSIONS

The aim of this paper was to introduce the CroHaM hypothesis, with CroHaM being the abbreviation for “cross-sectional association between health and mortality”. The association between health and mortality is usually connected to the longitudinal perspective, most intensively investigated in the context of the “compression versus expansion of morbidity” debate. In the cross-sectional perspective, however, health and mortality are treated as rather independent variables which are combined to a “Healthy Life Years” indicator (HLY). With information about mortality, we construct a survival function to derive the total number of life years, i.e., life expectancy (LE), and the information about health is then used to separate these life years into those spent in good and in poor health. The central idea of the CroHaM hypothesis is that the well-established “health domain-specific” associations between health and mortality—which lead to compression effects for health impairments that are more closely related to mortality (such as functional limitations and disabilities), but to expansion effects for health problems that are less closely related to mortality (such as chronic diseases)—hold equivalently in the cross-sectional context regarding differences between populations and subpopulations with different levels of mortality. These “CroHaM effects” might be an important factor for better understanding still unexplained phenomena such as the “gender paradox” in health. Moreover, the CroHaM hypothesis might be the causal basis of Luy and Minagawa’s “longevity hypothesis”, stating that women spent less years in good health than men not in *spite of living longer*, but *because they live longer* (Luy and Minagawa 2014).

The relevance of the CroHaM hypothesis is not restricted to the gender paradox in health, however. If the hypothesized cross-sectional relationship between health and mortality existed, the CroHaM effects would affect all comparisons of populations with different levels of LE. Therefore, we tested the CroHaM hypothesis not directly in the context of the gender paradox but by analyzing the association between differences in LE and differences in HLY in a quasi-experimental setting separately for women and men. Namely, we used the proportion of older people in “good health” according to different health indicators (i.e., the MEHM indicators global activity limitations, self-perceived health and chronic conditions) to calculate HLY for a sample of female and male Catholic order members in Germany and Austria and their counterparts in the general population. Catholic order members are a specific sub-population with higher LE relative to the general population. By comparing HLY of Catholic order members and their counterparts in the general population, we tested whether a difference in average LE between two populations living under the same historical conditions (e.g., major world events, economic conditions, medical standards) is related to differences in life years spent in good health across different domains of health which are differently associated to mortality.

What made this quasi-experiment particularly interesting is the fact the order members’ advantage in LE is larger among men than among women. Consequently, we expected that the CroHaM effects were stronger in differences between monks and men of the general population compared to differences between nuns and women of the general population. This expectation was valid for both directions of the health-mortality relationship: health domains with stronger associations to mortality on the one hand side (i.e., health domains for which higher LE should lead—in line with the “compression effect”—to more HLY) and health domains with weaker associations to mortality on the other (i.e., health domains for which higher LE should lead—in line with the “expansion effect”—to fewer HLY).

In a first step, we analyzed the mortality of individuals who stated health problems according to the MEHM domains over 14 years with data of the German Life Expectancy Survey (LES). We found the highest mortality among individuals who stated to suffer substantive health-related limitations in daily activities of living and among those who rated their health as poor or



very poor. The lowest mortality was prevalent for individuals suffering chronic illnesses. In a second step, we compared the HLY of nuns and monks with their counterparts of the general population for the three MEHM health domains. The results provided strong support for the CroHaM hypothesis. All three measurements for differences in HLY between Catholic order members and the general population showed the same basic pattern: order members had the largest advantages when HLY were estimated on the basis of life years spent without activity limitation, followed by advantages in life years spent in good SPH, and they were smallest (or even negative) for life years spent without chronic illness. Thus, the extent of order members' advantages in HLY was positively associated with the health domains' association to mortality: the stronger this association, the bigger the advantage (and vice versa). Also in line with the CroHaM hypothesis, all these results were stronger among men, indicating the effect of the higher LE surplus of monks against the general population.

We carried out a series of analyses with alternative approaches for estimating LE and HLY for order members and the general population to test whether the results are sensitive to these estimation issues. It turned out that all analytic variants arrived at similar results which led to the same conclusions. Nonetheless, further tests of the CroHaM hypothesis should be carried out to evaluate its general relevance in the analysis of HLY. Although our analyses of Catholic order members characteristics within the HEMOX project suggested that nuns and monks are not systematically different from their counterparts of the general population (see chapters 2.1 and 2.2 of this report), they might be considered too selective to provide insights of general value. Therefore, future research should test the hypothesis on the basis of other sub-populations with different levels of LE.

To conclude, the results presented in this paper indicate that the postulated CroHaM effect exists and affects the absolute and relative number of HLY of sub-populations or populations with different levels of LE in the cross-sectional context. These insights might help to better understand unexpected differences in HLY as it is the case, e.g., with the gender paradox in health. Once the CroHaM effect is confirmed in other empirical tests, it should be controlled for in the analyses of differences in HLY to reduce the risk of misleading interpretations.

ACKNOWLEDGEMENTS

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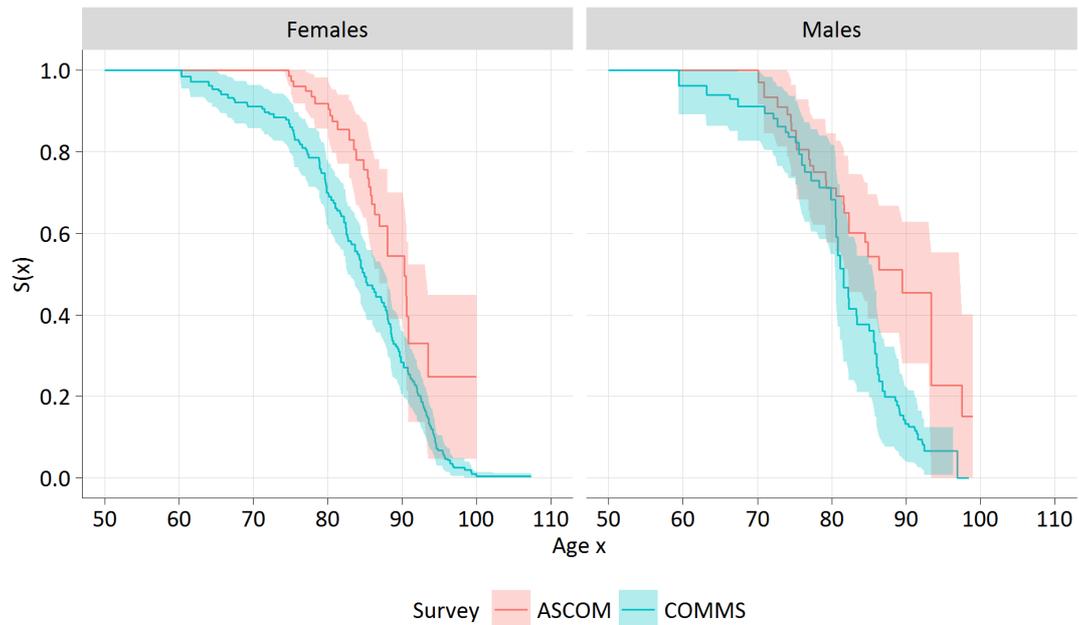
APPENDIX 1: LIST OF 35 LONGSTANDING ILLNESSES FROM QUESTION 59 OF LES WAVE 1 (IN GERMAN)¹⁴

- Durchblutungsstörungen am Herzen, Angina pectoris
- Herzinfarkt
- Herzschwäche (Herzinsuffizienz, „Herzasthma“)
- Durchblutungsstörungen am Gehirn
- Zuckerkrankheit, Diabetes
- Schlaganfall
- Krampfadern, Thrombose, Venenentzündung
- Durchblutungsstörungen in den Beinen (außer Krampfadern)
- Bluthochdruck, Hypertonie
- Starkes Übergewicht, Fettsucht
- Gicht, Harnsäureerhöhung
- Erhöhtes Cholesterin, erhöhte Blutfette
- Zu niedriger Blutdruck
- Gelenkrheumatismus, chronische Gelenkentzündung, Arthritis, Arthrose
- Hexenschuss, Ischias
- Bandscheibenschaden
- Lungenasthma, Bronchialasthma
- Lungentuberkulose
- Chronische Bronchitis, d.h. Husten mit morgendlichem Auswurf an den meisten Tagen, mindestens 3 Monate lang
- Leberentzündung, akute oder chronische Hepatitis, Fettleber
- Leberverhärtung, Leberzirrhose
- Gallenblasenentzündung oder Gallensteine
- Magen-, Zwölffingerdarmgeschwür, Ulcus
- Magenschleimhautentzündung
- Kropf, andere Schilddrüsenkrankheit
- Entzündung oder Steine der Blase, der Niere, der Harnwege
- Verdauungsbeschwerden, Verstopfung
- Heuschnupfen
- Andere Allergien
- Körperbehinderungen der oberen Gliedmaßen oder Schulter (z.B. Lähmungen, Fehlen von Gliedmaßen oder Teilen, Fehlbildungen, Gelenkversteifungen)
- Körperbehinderungen der unteren Gliedmaßen oder Hüfte (z.B. Lähmungen, Fehlen von Gliedmaßen oder Teilen, Fehlbildungen, Gelenkversteifungen)
- Körperbehinderungen der Wirbelsäule (z.B. Verkrümmungen, Versteifungen oder Fehlbildungen, nicht Muskelverspannungen)
- Krebskrankheiten
- Sonstige Krankheiten oder Behinderungen, die länger als drei Monate gedauert haben
- Für Männer: Vergrößerte Vorsteherdrüse, Prostata

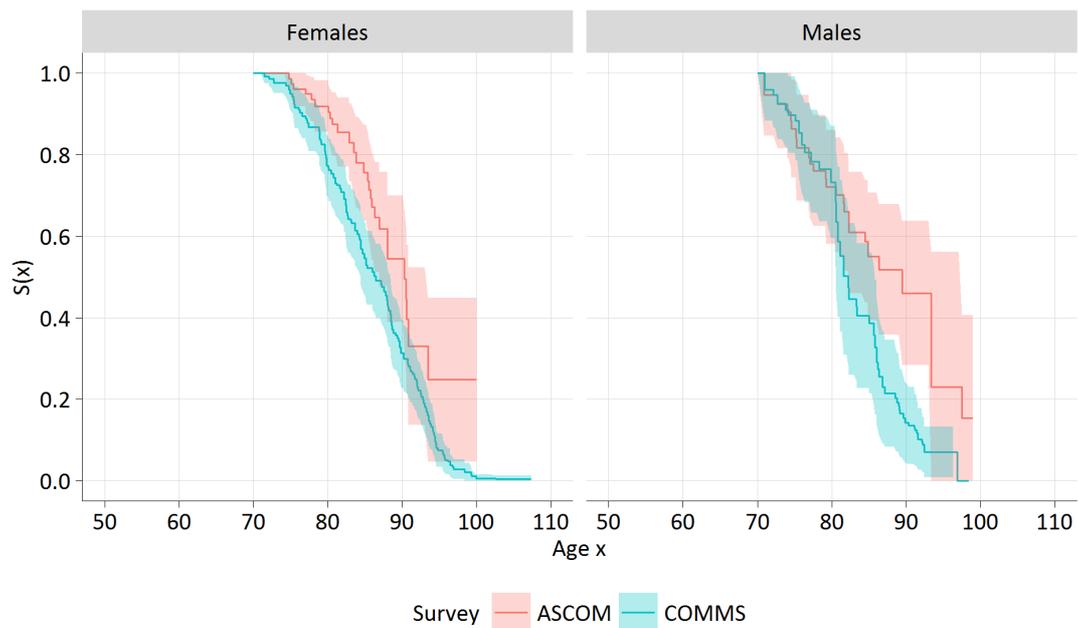
¹⁴ Exact German wording of the question: „Haben oder hatten Sie jemals eine dieser Krankheiten?“

APPENDIX 2: KAPLAN MEIER SURVIVAL FUNCTION FOR THE COMMS SAMPLE OF THE CLOISTER STUDY IN COMPARISON TO THE ASCOM SUB-SAMPLE OF SURVEY PARTICIPANTS AND TO THE FULL ASCOM SAMPLE

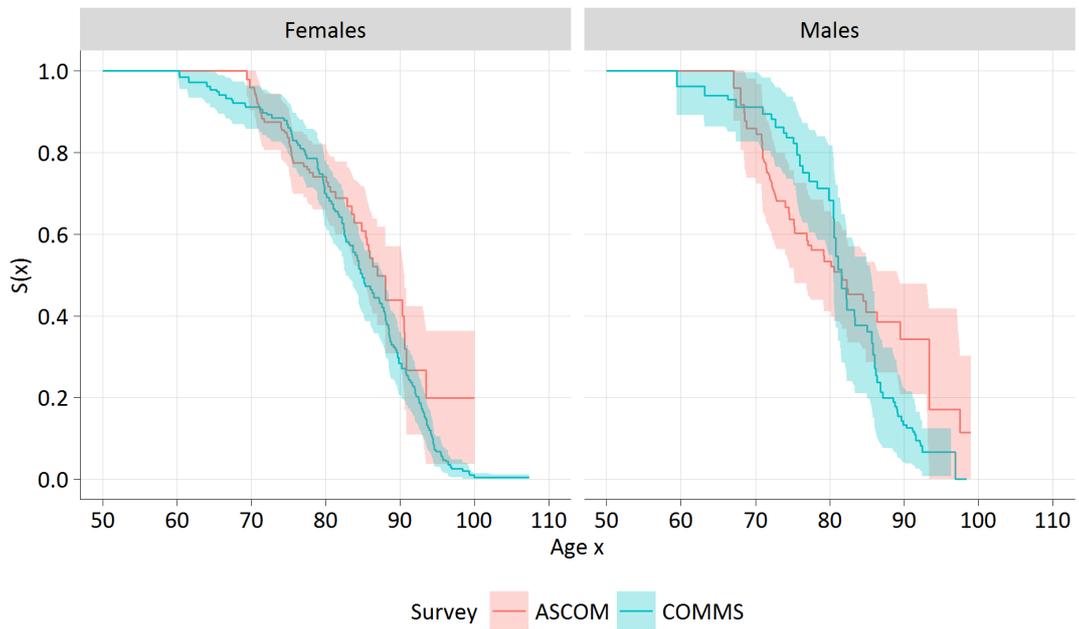
(A) SURVIVAL TIME BY AGE (FROM AGE 50), ASCOM PARTICIPANTS ONLY



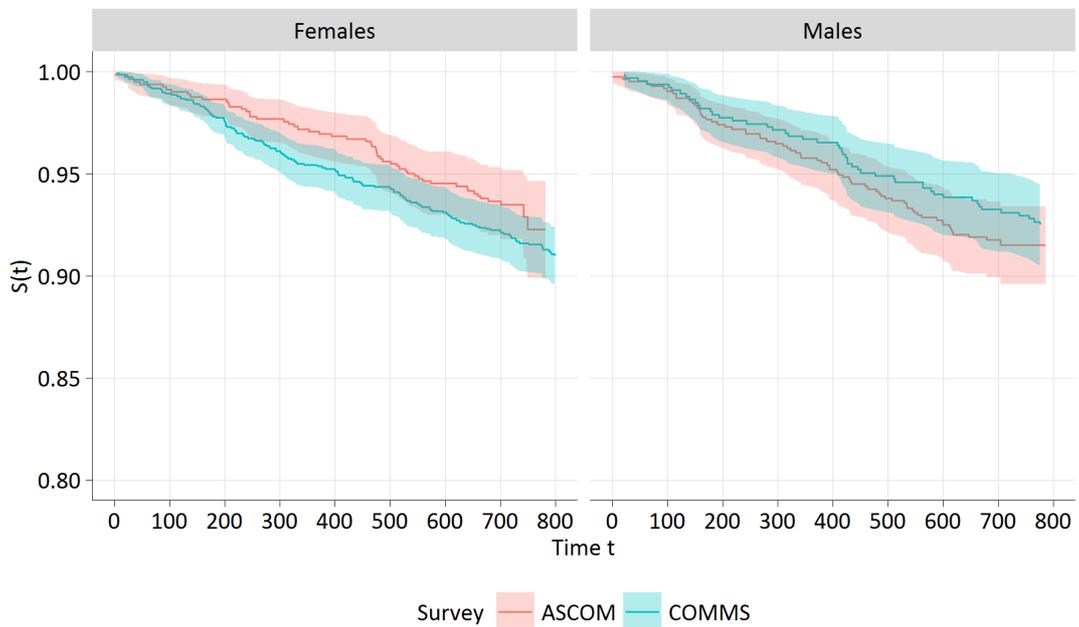
(B) SURVIVAL TIME BY AGE (FROM AGE 70), ASCOM PARTICIPANTS ONLY



(C) SURVIVAL TIME BY AGE (FROM AGE 50), FULL ASCOM SAMPLE (AGE OF NON-PARTICIPANTS IMPUTED)

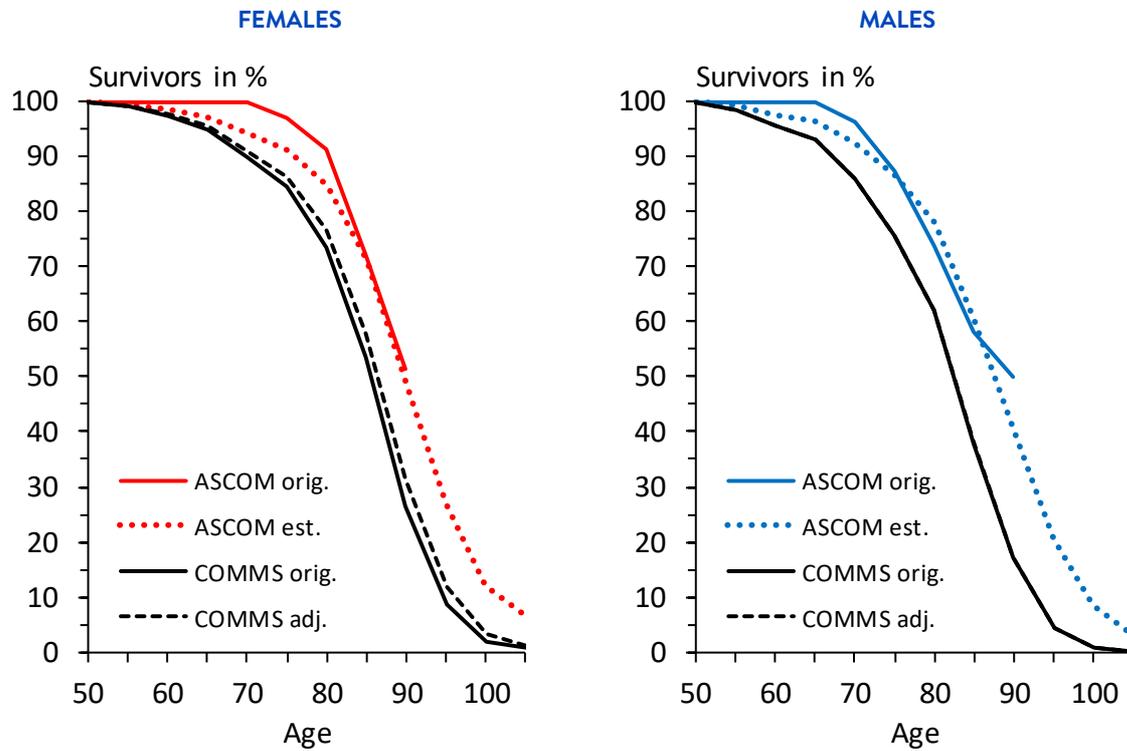


(D) SURVIVAL TIME IN DAYS, FULL ASCOM SAMPLE



Notes: the imputation of ages of ASCOM non-participants was necessary because ages are known only for participants; imputation was based on information of ASCOM participants about sex, country and community and information about survival status of non-participants at the time of survey wave 2.

APPENDIX 3: SURVIVAL FUNCTIONS FOR ASCOM PARTICIPANTS AND THE COMMS SAMPLE OF THE CLOISTER STUDY, ESTIMATED SURVIVAL FOR ASCOM PARTICIPANTS ON THE BASIS OF THE COMMS AND ASCOM-ADJUSTED SURVIVAL OF THE COMMS LIFE TABLE



Notes: "ASCOM orig." refers to the mortality of the participants of the ASCOM survey and "COMMS orig." refers to the mortality of the total COMMS sample. "ASCOM est." is the estimated survival of ASCOM participants derived from the "COMMS orig." survival function, adjusted by Cox regression controlled for age. "COMMS adj." results from adjustment of the "ASCOM est." survival function by Cox regression on the basis of mortality differences between ASCOM participants and the total ASCOM sample (see below). The "COMMS adj." survival function was used as life table for the estimation of healthy life years for Catholic order members.

**COX REGRESSION FOR COMPARISON OF MORTALITY OF ASCOM PARTICIPANTS [1] AND THE FULL COMMS SAMPLE [2]
(BASIS OF "ASCOM EST." SURVIVAL FUNCTION)**

Variable	Females Exp(b)	S.E.	z	p	Males Exp(b)	S.E.	z	p
[1]	1.00	-	-	-	1.00	-	-	
[2]	1.85	0.220	2.80	0.0051	1.93	0.251	2.62	0.0088
Age	1.13	0.008	14.71	0.0000	1.14	0.013	9.90	0.0000

**COX REGRESSION FOR COMPARISON OF MORTALITY OF ASCOM PARTICIPANTS [1] AND FULL ASCOM SAMPLE [3]
(BASIS OF "COMMS ADJ." SURVIVAL FUNCTION)**

Variable	Females Exp(b)	S.E.	z	p	Males Exp(b)	S.E.	z	p
[1]	1.00	-	-	-	1.00	-	-	-
[3]	0.62	0.243	-1.97	0.0490	0.52	0.240	-1.97	0.0066

3.3 THE BIOLOGICAL COMPONENT IN SEX DIFFERENCES IN VARIOUS FACETS OF HEALTH

INTRODUCTION

Compared to men, women on average live several years longer than men in Western countries (Glei & Horiuchi, 2007; Luy & Minagawa, 2014). For instance, in 2017 the life expectancy at birth in Germany was 83.3 years for women and 78.6 years for men. In Austria, the corresponding numbers were 83.9 and 79.3 years (Human Mortality Database, 2019).

The major part the sex gap in mortality is ascribed to an accumulated influence of non-biological factors, e.g. behavioral, environmental, psychosocial or socioeconomic factors, across the life course. Accordingly, these theoretically could be modified to some extent. Contrasting, biological factors are inherent and cannot be altered per se. There are few studies, in which the influence of biological factor has been assessed quantitatively (for an overview see Luy 2016, p. 26f.). Estimates suggest, that about 25% to 30% of the observed sex difference in mortality or about one to two years of life expectancy at birth are due to intrinsic differences such as hormones, genes, anatomy, etc. between women and men (Luy, 2016).

As health at some point translates into mortality, the motivation for this paper is to detect indications for a biological component of sex differences in health and, if any, whether an inherent advantage would analogous to mortality favor women or rather men. The challenge in order to isolate the impact of biological factors on sex differences in health is to account for non-biological confounding factors. A number of risk factors has been identified to impact on sex differences in health and mortality (Luy, 2002; Oksuzyan, Juel, Vaupel, & Christensen, 2008; Rogers, Everett, Onge, & Krueger, 2010; Waldron, 2000). However, due to the characteristics of monastic life it is accounted for sex differences in many non-biological confounding factors potentially relevant to health. For instance, the monastic population is less diverse than the general population with regard to acquired risks related to lifestyles, daily routines, socioeconomic characteristics, physical environments, access to health care, housing etc. (Luy, 2003, 2016). In addition, order members are homogenous considering marital status and religion. Since they are usually part of a community and fulfil assigned tasks (Luy, Flandorfer, & Di Giulio, 2015), perhaps it can be argued that also some psychosocial factors are more similar for them than in the general population (e.g. support or social networks). Another advantage is that among order members the sex difference in life expectancy is much lower than in the general population. This is important, because the length of life itself has been identified as a contributing factor to sex differences in health (Luy & Minagawa, 2014). Since due to the study design it is controlled for major sex-specific variations in a number health risk factors, persistent health differences between male and female order members would point towards being determined biologically at least to some extent. Numerous indicators will be considered to take into account the multifacetedness of health.

DATA AND METHODS

The first wave of the health survey conducted in the context of the Aging Study of Catholic Order Members (ASCOM) in 2012 is used. It includes the records of 1,158 Catholic order members (622 female and 536 male individuals) aged 50+ years from Germany and Austria. The survey is based on a self-administered questionnaire that focuses on different facets of physical and mental health and health-relevant factors measured by means of single items as well as established survey modules (e.g., SF-36). Further information about the survey and data can be found elsewhere (Wiedemann, Marcher, Wegner-Siegmundt, Di Giulio, & Luy, 2014).

Sex differences in health risk factors and health outcomes were evaluated by means of Chi²-tests, Fisher's Exact tests, and odds ratio tests. Direct age standardization was applied, for which male order members were chosen as the standard population. For quantitative health indicators parametric or non-parametric tests (t-tests, Welch-tests, and U-tests) were applied. Within the multivariate analyses (a series of multiple logistic regression models respective multivariate linear regression models) the role of sex as a predictor of poor health was tested.

Education of the respondents was classified using to the International Standard Classification of Education (ISCED). Two categories, high (ISCED 5-6) and low/medium (ISCED 1-4) are distinguished. Smoking was dichotomized (never vs. ever), as was physical activity (active vs. inactive), annual preventive examination (yes vs. no), alcohol consumption (5+ times per week vs. less), fluid intake (1+ liter per day vs. less), type of drinks (mainly unsweetened vs. others), nutrition (primarily meat vs. other), and living arrangement (community vs. living alone).

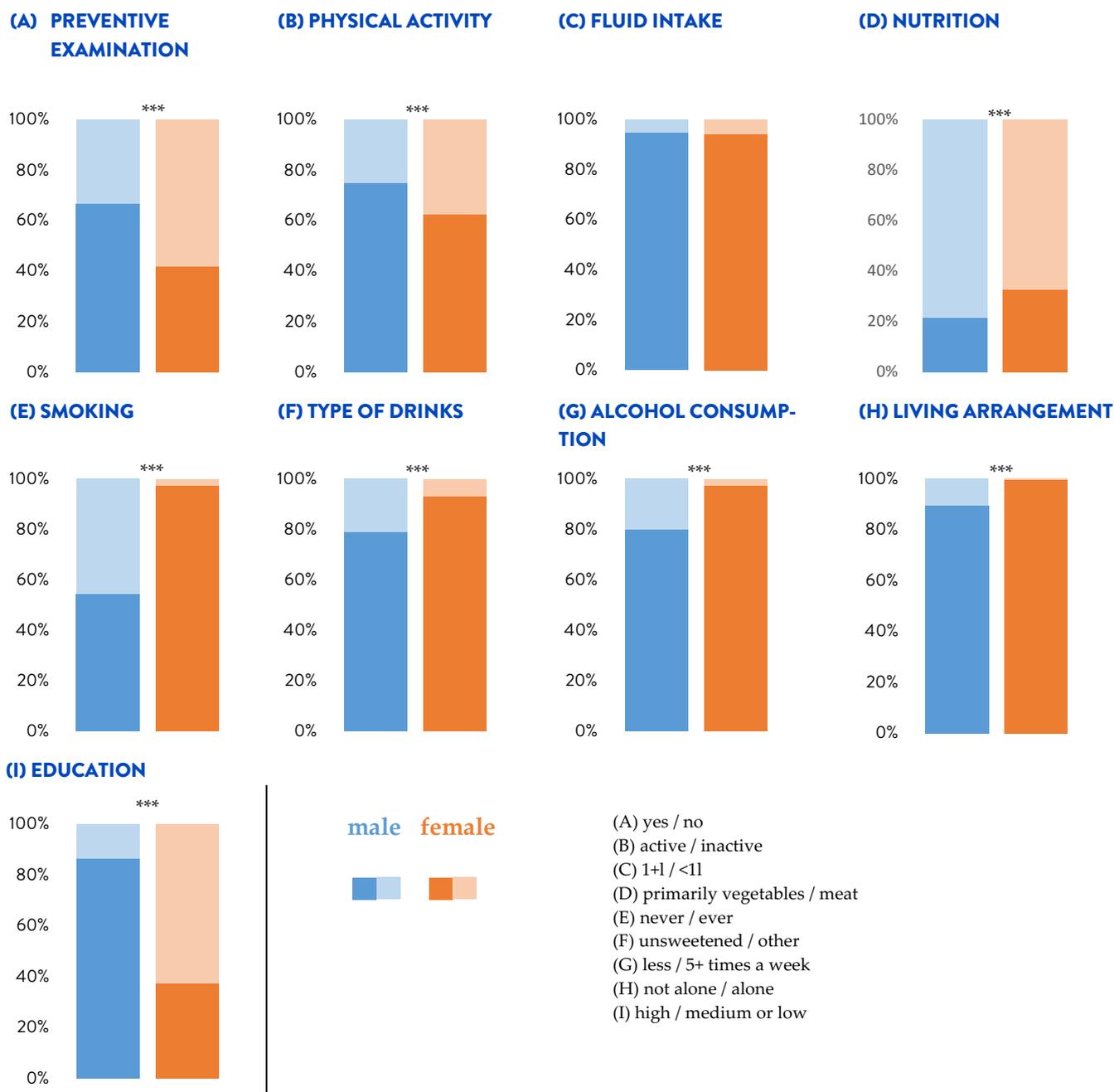
General health was assessed by means of the Minimum European Health Module (MEHM). It encompasses information about self-perceived health, global activity limitations (GALI), and the presence of a chronic disease. For these three items response categories were dichotomized into very good/good vs. fair/bad/very bad, limited vs. not limited, and yes vs. no. To understand limitations in physical functioning, activities of daily living (ADL), instrumental activities of daily living (IADL) and mobility were analyzed. Five ADL (e.g. bathing, eating etc.), three IADL (e.g. make phone calls) and nine items on mobility (e.g. walk several blocks, bending over, lifting arms) were considered. The response categories were collapsed into "limited" when at least in one out of the five / three / nine items was reported and "not limited". The survey also contains information whether the respondent has ever been diagnosed with any of 18 diseases. Two of them were cataract and diseases of gall, liver or kidney. Additionally, five new variables were calculated using information on different single items: cancer, cardiometabolic condition (high blood pressure or cholesterol, diabetes, heart disease, or stroke), stomach / colon diseases, and musculoskeletal diseases (rheumatism, (osteo-)arthritis, osteoporosis, or femoral neck fracture). General physical or mental health and wellbeing were calculated with the German version of the SF-36 v.1 (Morfeld, Kirchberger, & Bullinger, 2011). A specific scoring algorithm led to two aggregate indicators, the physical component summary (PCS) and mental component summary (MCS). Scale scores range from 0 to 100 with higher scores indicating better health. The PCS and MCS were norm based ensuring comparability, whereas the data stems from a representative sample of the German population in 1994 (Morfeld et al., 2011).

RESULTS

SEX DIFFERENCES IN THE PREVALENCE OF HEALTH RISK FACTORS

Figure 1 displays the prevalence of health risk factors for male and female order members. In most factors, the majority of the individuals (>50%) reports rather advantageous characteristics.

FIGURE 1: AGE-ADJUSTED PERCENTAGE DISTRIBUTIONS OF SELECTED HEALTH RISK FACTORS BY SEX



Reference = men; * p<0.05; ** p<0.01; *** p<0.001 Numbers are based on valid cases (% missing in each variable <10%, exceptions are alcohol consumption with 11% and 27% missing cases for men respectively women).

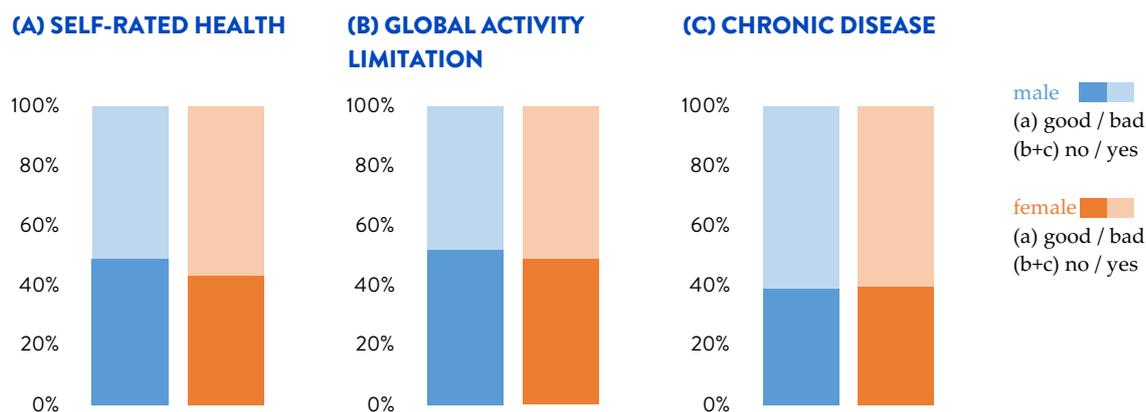
Source: author's own.

Women have better nutritional habits and less severe health damaging behaviors (e.g. heavy drinking and smoking). On the other hand, male order members do significantly more sports, and are more likely to have higher education and to regularly utilize preventive health care. Particularly distinct sex differences in prevalence are visible in preventive examinations (40% of women vs. two thirds of men had one in the last year), smoking (a high share of persons who has never smoked among female order members) and education (about 90% of male and less than 40% of female order members have high education). The odds ratio tests (results not shown here) confirm the presented sex differences.

SEX DIFFERENCES IN HEALTH

No striking sex differences in health appear with respect to the three items of the MEHM (Figure 2). Men report slightly more often good self-perceived health than women do (49% vs. 43%; $p<0.1$) and are more likely not to have any activity limitations (52% vs. 49%). The prevalence of a chronic disease is almost equal for both sexes (about 60%). Additional analyses with the help of odds ratio tests could not detect any significant sex differences ($p<0.05$) in the items of the MEHM, even stratified by education.

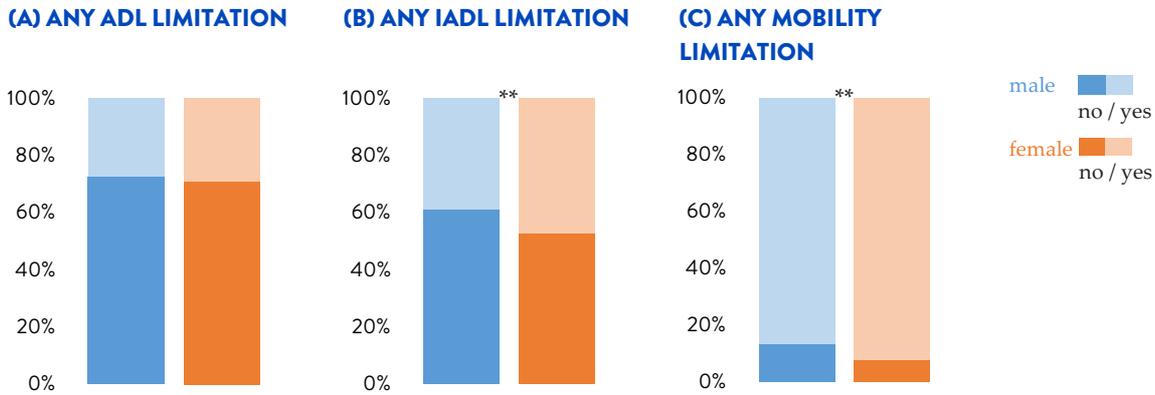
FIGURE 2: AGE-ADJUSTED PERCENTAGE DISTRIBUTIONS FOR THE ITEMS OF THE MEHM BY SEX



* $p<0.05$; ** $p<0.01$; *** $p<0.001$
 based on valid cases (% missing in each variable <10%)
 Source: author's own.

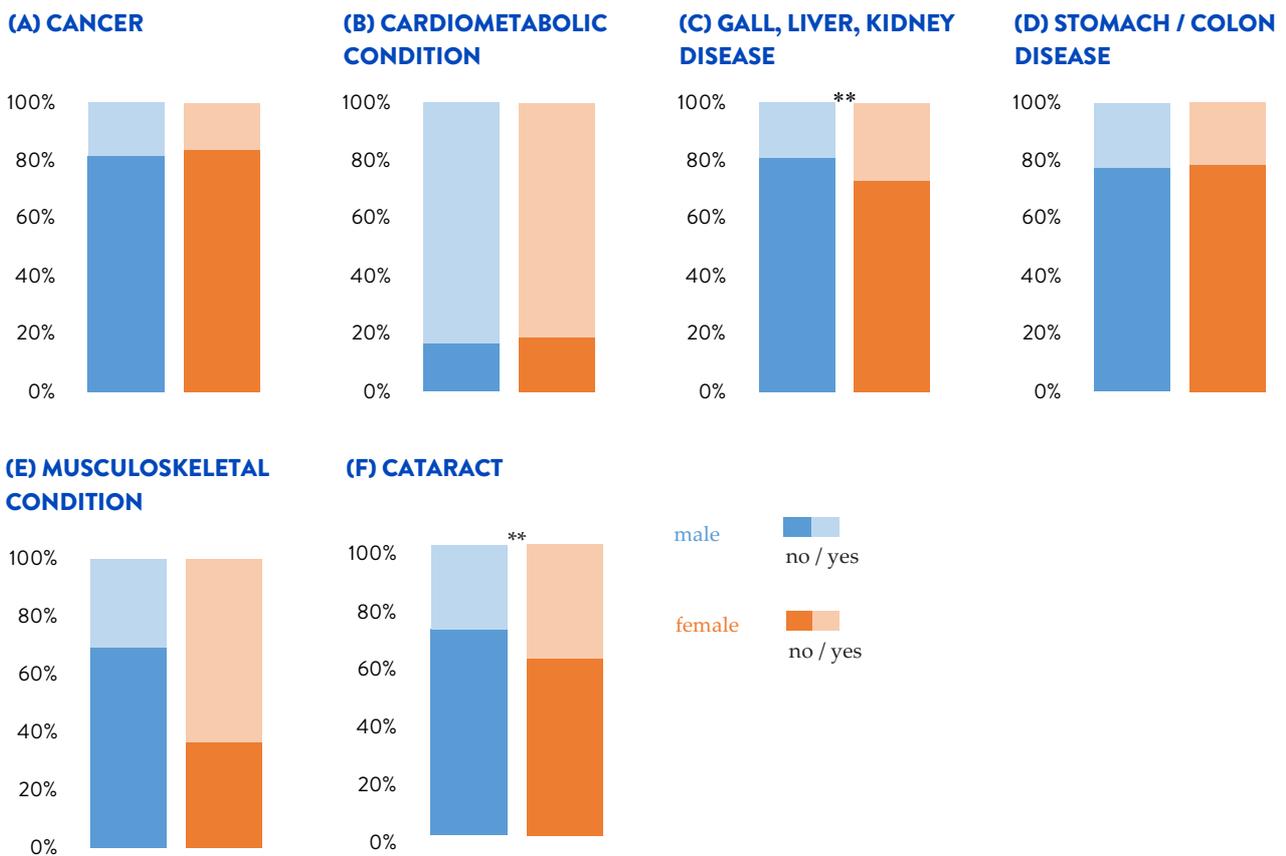
Figure 3(A-C) provides an overview about limitations in different indicators of physical functioning. About the same proportion of male and female order members have a limitation in at least one ADL (28% vs. 29%) and significant sex differences in limitations in IADL in favor of men exist (39% vs. 47%). A high proportion of male and female respondents (87% vs. 92%; $p<0.01$) report a limitation with regard to mobility. Again, odds ratio tests were conducted for the evaluation of sex differences in the total sample as well as by educational attainment. The odds of a limitation in any IADL or mobility are 44% respectively 88% higher for female than for male order members ($p<0.01$). Results suggest some influence of the education variable, as for instance the significantly elevated odds for a limitation in mobility appears only among the highly educated individuals.

FIGURE 3: AGE-ADJUSTED PERCENTAGE DISTRIBUTIONS FOR PHYSICAL FUNCTIONING



* p<0.05; ** p<0.01; *** p<0.001
 based on valid cases (% missing in each variable <10%, exceptions are limitations in any ADL and IADL for women (<15%))
 Source: author's own.

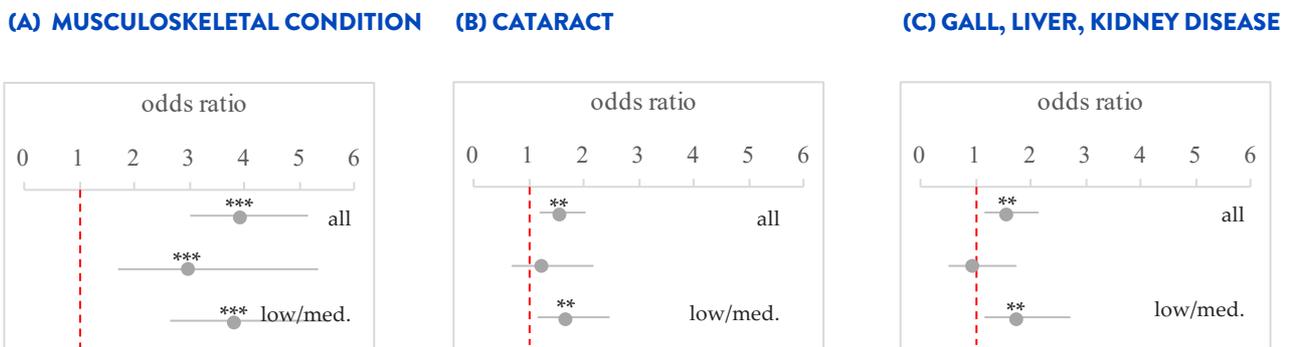
FIGURE 4: AGE-ADJUSTED PERCENTAGE DISTRIBUTIONS OF SELECTED DISEASES BY SEX



* p<0.05; ** p<0.01; *** p<0.001
 based on valid cases (% missing in each variable for men <15%; % missing in each variable for women ranging from 9% in cardiometabolic conditions up to 28% in cancer or gall, liver, kidney disease)
 Source: author's own.

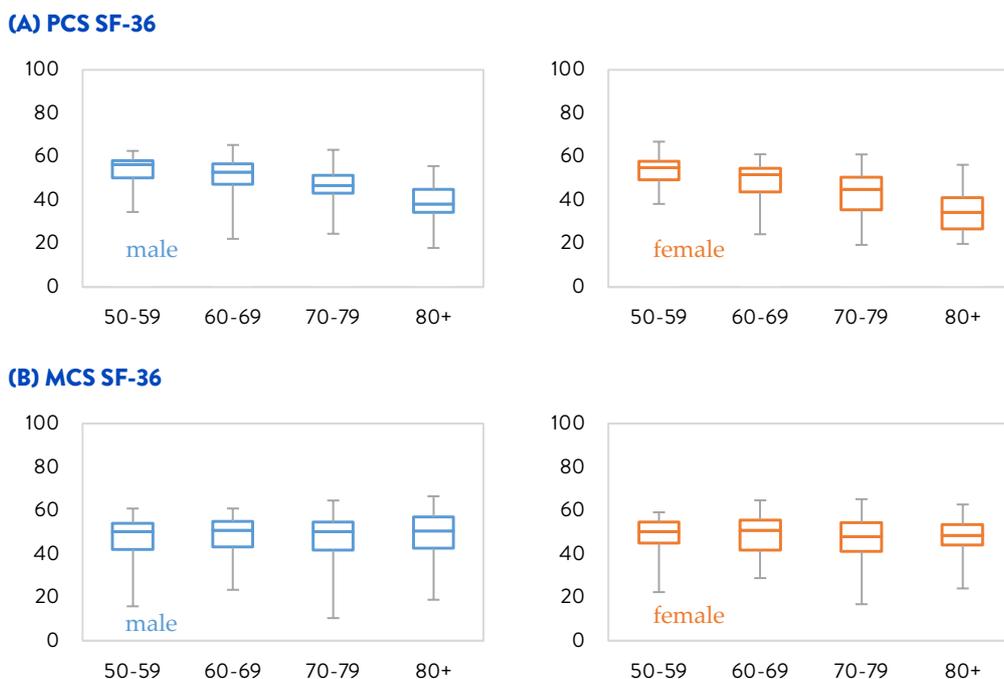
Figure 4 (A-F) provides an overview on the sex differences in six diseases in the sample of Catholic order members. Common are deficits in cardiometabolic health, which are present in four out of five respondents. For three diseases a significant sex differences could be detected. It is particularly pronounced for diseases of the skeletal system, whereas significantly less men compared to women (30% vs. 63%, $p < 0,001$) have ever been diagnosed with. The results of the odds ratio tests are in line with these results, e.g. significant sex differences in gall, liver and kidney diseases as well as cataract, although there are some education-specific variations (Figure 5B, 5C). Notably, women are more likely to experience a musculoskeletal condition and the association of sex and this disease also is highly significant in both education groups (Figure 5A).

FIGURE 5: AGE-ADJUSTED ODDS RATIO FOR SELECTED CHRONIC DISEASES BY EDUCATION



reference = men; * $p < 0,05$; ** $p < 0,01$; *** $p < 0,001$
 Source: author's own.

FIGURE 6: BOXPLOTS FOR SF-36 AND SF-12 PCS AND MCS SCORES BY 10-YEAR AGE GROUPS AND SEX



Numbers are based on valid cases (% missing range from 20%-22% (men vs. women) in the age group 50-59 year up 59%-80% in the age group 80+);
 Source: author's own.



With regard to the SF-36, physical health (PCS scores) deteriorates as age increases. For mental health, the mean scale scores (not shown here) respectively median scores are more or less similar across all age groups (Figure 6). No distinct sex differences in health with regard to the SF-36 PCS and MCS exist when comparing the mean scale scores in the age groups, also not stratified by education (results not shown here).

REVELATION OF INHERENT SEX DIFFERENCES: THE RELATIONSHIP OF SEX AND HEALTH NET OF RISK FACTORS

Adjusted solely for age, sex is a significant predictor for only five of the analyzed health variables: IADL limitations, mobility limitations, musculoskeletal conditions, cataract and the SF-36 PCS sum scale. This low number may be surprising at first glance, but actually supports the anticipated similarity of adult lives in order members. With respect to all of these five indicators, being a women increases the chance for bad health (Table 1 and Table 2).

Women are more likely to report problems in physical functioning. The odds for experiencing a mobility limitation or IADL limitations are 2.2 respectively 1.5 significantly greater for women than for men ($p < 0.001$). The relationship between sex and IADL limitations does not persist after controlling for lifestyle factors. Adding these variables to the models also attenuates the association of sex and mobility limitations ($OR = 2.0$, $p < 0.05$). Additional adjustment for education further decreases the OR and results in elevated odds for mobility limitations in women compared to men, but they are marginally insignificant ($OR = 1.8$, $p = 0.103$). Women have statistically worse physical health ($b = 2.24$, $p = 0.004$) measured by the SF-36 PCS scores than men. Controlling for living arrangement and behavioral characteristics, the coefficient for sex remains significant though the magnitude of the association between sex and the SF-36 PCS score is lower. However, it becomes insignificant when education is added to the model. Results suggests that likewise to physical functioning, sex differences in this indicator of physical health mainly can be explained by differences in acquired risks and education in order members. Women are more likely to have a disease of the skeletal system and to report cataract than men. These two associations remain significant after the introduction of covariates into the models. According to the final model, women have almost 4.0 times the odds of having a skeletal-related disease as men ($p < 0.001$) and 2.2 times the odds of cataract ($p < 0.01$).

To conclude, the initial significant associations between sex and mobility limitations, IADL limitations, and physical health measured by the SF-36 PCS scale attenuated when covariates were added to the models. For the other health indicators studied in this paper (ADL limitations, MCS SF-36, other diseases) no significant association with sex was found. There is a relationship between sex and cataract respectively musculoskeletal conditions, which even persists after multiple adjustment for potential confounders. These robust results suggest that sex differences in health are at least partially due to differences in factors related to the human body.

TABLE 1: ODDS RATIOS FROM MULTIVARIABLE LOGISTIC REGRESSION ANALYSES FOR THE SIGNIFICANT ASSOCIATIONS OF SEX AND HEALTH

		Model 1				Model 2				Model 3			
		OR	s.e.	p	Sig.	OR	s.e.	p	Sig.	OR	s.e.	p	Sig.
Musculo-skeletal condition	n=747 ^a												
	age	1.07	0.01	0.000	***	1.07	0.01	0.000	***	1.07	0.01	0.000	***
	women	3.90	0.16	0.000	***	4.21	0.21	0.000	***	9.92	0.22	0.000	***
Cataract	n=751 ^a												
	age	1.14	0.01	0.000	***	1.15	0.01	0.000	***	1.15	0.01	0.000	***
	women	1.75	0.18	0.001	**	2.37	0.23	0.000	***	2.21	0.25	0.001	**
Any mobility limitation	n=815 ^a												
	age	1.13	0.01	0.000	***	1.13	0.01	0.000	***	1.13	0.01	0.000	***
	women	2.18	0.27	0.004	**	2.01	0.32	0.027	*	1.76	0.34	0.103	
any IADL limitation	n=794 ^a												
	age	1.10	0.01	0.000	***	1.10	0.01	0.000	***	1.10	0.01	0.000	***
	women	1.53	0.16	0.000	**	1.27	0.20	0.228		1.10	0.44	0.661	

* p<0.05; ** p<0.01; *** p<0.001; further notes under Table 2.
Source: author's own.

TABLE 2: PARAMETER ESTIMATES FROM MULTIPLE LINEAR REGRESSION ANALYSES FOR THE SIGNIFICANT ASSOCIATIONS OF SEX AND HEALTH

		Model 1				Model 2				Model 3			
		b	s.e.	p	Sig.	b	s.e.	p	Sig.	b	s.e.	p	Sig.
PCS-36	n= 486 ^a												
	intercept	18.5	2.79	0.000	***	20.3	2.83	0.000		20.5	2.83	0.000	
	age	0.5	0.04	0.000	***	0.5	0.04	0.000	***	0.5	0.04	0.000	***
	women	2.2	0,77	0.004	**	2.0	0.94	0.038	*	1.3	1.05	0.225	

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

^a Due to the method, cases in which at least one variable was missing were excluded.

^b The value of this variable was reversed on the scale of 0-100 so that analogous to the other health indicators, a positive coefficient of the independent variable reflects an increment in poor health.

Table 1 and 2: Covariates were added stepwise. Model 1 adjusted for age, model 2 additionally adjusted for health risk factors, and in model 3 it was additionally adjusted for education.

Source: author's own.

DISCUSSION

To sum up, the combination of two different methodological approaches, by looking at a specific study population and by applying statistical techniques, was used to minimize the effects of other factors than biological ones leading to sex-specific differences in health. Descriptive results showed some differences in the prevalence in a number of lifestyle factors among male and female order members and suggested an influence of education, underlining the requirement of multivariate analyses. The identified persistent differences in health after adjustment for multiple potential intervening factors are in favor of men. Results suggest that inherent sex differences lead to worse health in women with regard to musculoskeletal conditions and cataract. At a first glance, this contradicts their mortality advantage. Nevertheless, results coincide with the so-called gender paradox in health, i.e., women live longer than men, but they are equally or less healthy with respect to several outcomes (Alberts et al., 2014; Luy & Minagawa, 2014; Newman & Brach, 2001; Oksuzyan et al., 2008; Wingard, 1984). One strand of explanation focuses

on types and severity of illness and diseases and suggests that the gender paradox theoretically can arise from women indeed having more health conditions, but less severe respectively less lethal ones than men do (Case & Paxson, 2005; Crimmins, Kim, & Sole-Auro, 2011; Kingston et al., 2014; Luy & Minagawa, 2014; Verbrugge, 1982). This may also apply in this study, since compared to other indicators, cataract and diseases of the skeletal system can be assumed to be comparatively weakly linked to mortality as they do not count to the leading causes of death (Naghavi et al., 2017). Another interesting aspect is that biological factors contribute to a longer life of women compared to men, but on the other hand to a health advantage of men – at least a small one with regard to cataract and musculoskeletal conditions. This pattern coincides with the one in the overall gender paradox. Thus, a hypothesis can be that a part of the overall gender paradox may actually result from biological differences between women and men.

Beside non-biological factors (e.g. behavior, environment), different biological factors such as physiological, anatomic, and hormonal differences between women and men, can potentially contribute in explaining the findings of a female health disadvantage in diseases of the eye and skeletal system. In general, various ocular diseases are more common among women and one of them is cataract (Wagner, Fink, & Zadnik, 2008). As a biological influential factor the role of female sex hormones has been mentioned (Wagner et al., 2008). Overall, autoimmune diseases are more common in women (e.g. rheumatoid arthritis), in particular those with high incidences (Ngo, Steyn, & McCombe, 2014). Especially sex hormones and their impact on immune reactivity seem to play an important role, but in general, sex differences in these diseases are assumed to be influenced by an interplay of biological (e.g. hormones, genetic, and epigenetic factors) as well as behavioral and environmental factors (Ortona et al., 2016). Regarding osteoarthritis, in particular in the knee and hand, women are at greater risk reflected in higher prevalences as well as incidences (Srikanth et al., 2005). Potential biology-related explanations involve physiologic components such as biomechanical factors (e.g. muscle function) or sex hormones (Boyan et al., 2013; Srikanth et al., 2005). In addition, osteoporosis is more prevalent among women and connected to that is a greater risk of fractures. Since usually this is found in postmenopausal women, the influence of sex hormones is possible. Further explanations of the greater incidence of fractures apart from bone mineral density are bone size, geometry, and strength (Cawthon, 2011).

One limitation of this study is the relatively high proportion of missing information in some variables and it also differs by sex occasionally. However, at least for the diseases of the skeletal system for which the association with sex is highly significant in the multivariate models, it seems unlikely that this limitation would change the results distinctly. Another limitation is that a complete exclusion of potential non-biological confounders cannot be claimed, although they were isolated carefully. Apart from that, it should be noted that analyses are based on self-reported information with potential errors such as different reporting behavior across sexes (Molina, 2016). Another point is the grouping of the diseases. Firstly, although thematically related items were classified together, the groups are generic. Secondly, certain groups contain information on different disease types. For instance, musculoskeletal conditions encompass degenerative as well as autoimmune diseases for which biological factors may be not equally important.

CONCLUSION

Sex differences in cataract and musculoskeletal conditions seem to root at least to some extent in factors related to the human body. These identified health differences originating from biological differences between women and men favor the latter. For the numerous other health conditions studied, there was no indication that either sex is more prone to any of them due to biological factors. The overall contribution of inherent differences among women and men seems to be rather small with respect

to sex differences in health, which underlines the importance of other factors. Thus, an implicit consequence of this finding with regard to observed sex differences in health in the general population is that they might primarily result from variation in health risk factors and thus are susceptible to human influence and provide the possibility for interventions.

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3.4 A FRAILTY INDEX TO EXPLORE AGEING IN THE MONASTIC POPULATION

PAOLA DI GIULIO

INTRODUCTION

With respect to health and survival, chronological age is a central element. However, individuals of the same chronological age display a great variety in relation to their health status (Mitnitski, Mogilner et al. 2001). During the aging process, elderly people have an increasing risk to develop chronic diseases, what ultimately impacts also their mortality risks. However, among the elderly some individuals show a higher number of deficits and limitations than others and, in other words, are *frailer* than others without having life threatening illness.

In this chapter we examine the individual differences in the aging process in a monastic population using the concept of frailty. The frailty scheme moves away from organ- and disease-based approaches toward a health-based, integrative one (Bergman, Ferrucci et al. 2007). Hence, rather than on illnesses, it focuses on the process of accumulation of deficits which, while age related, do not always achieve disease status and are not usually known as risks for diminished life expectancy.

As we compare the frailty variability among subgroups with different characteristics, we will observe that a given degree of fitness at almost 90 years of age may actually represent frailty at about 70 years of age (Mitnitski, Graham et al. 2002), and that the biological age of individuals (defined on their fitness/frailty) does not always match their chronological one.

By using data of the first wave of the health survey of our Ageing Study of Catholic Order Members (ASCOM, see Wiedemann et al 2014 for details), we first show the pattern of increase of frailty in older ages. Afterwards, we give an overview of the variability of frailty in the monastic population by comparing a group of individuals with the same chronological age but with different characteristics that might impact their fitness.

THE FRAILTY INDEX

We compute the frailty index as a combination of fitness and deficit characteristics that cover well-being aspects. We follow the suggestion of Sourial, Wolfson et al. (2010) and we compute it as a combination of the values of seven different indicators, where each indicator is a binary variable specifying if the person is considered frail or not frail in each dimension (Sourial, Wolfson et al. 2010, Sourial, Bergman et al. 2012; see Table 1). The dimensions taken into account are nutrition, physical activity, mobility, strength, energy, cognition, and mood (Sourial, Wolfson et al. 2010). The index is then added across all indicators and illustrates the average relative number of deficits by age. In place of emphasizing the precise nature of the deficits, it is interesting to note that the frailty index gives importance to the relative number of deficits accumulated as an individual age (Mitnitski, Graham et al. 2002).

A plot of the frailty index by 5 years age groups and gender is shown in Figure 1. The index increases by age and is consistently higher for women than for men from age 60-64. Moreover, as anticipated by the literature, the index remain lower than 0.5 until very old ages, indicating that the average person presents not more than 3 or 4 deficits out of a total of 7.

The frailty index as depicted in Figure 1 can also be used as a model. Its values by age and gender can be interpolated into smooth lines (named PolyM and PolyF in the graph, respectively, for men and women). Along these lines, if we observe a given value of the frailty index, e.g. 0.25 (1/4 of all frailty items are present), we can identify at what age it is typical to experience that level of frailty. In the presented example, this would happen at age 70-74 for women, but almost 10 years later, at age 80-84, for men. This observation guides us in the description of the variability of the frailty index in the monastic population.

TABLE 1: CONSTRUCTION OF THE FRAILTY INDEX FOR CATHOLIC ORDER MEMBERS

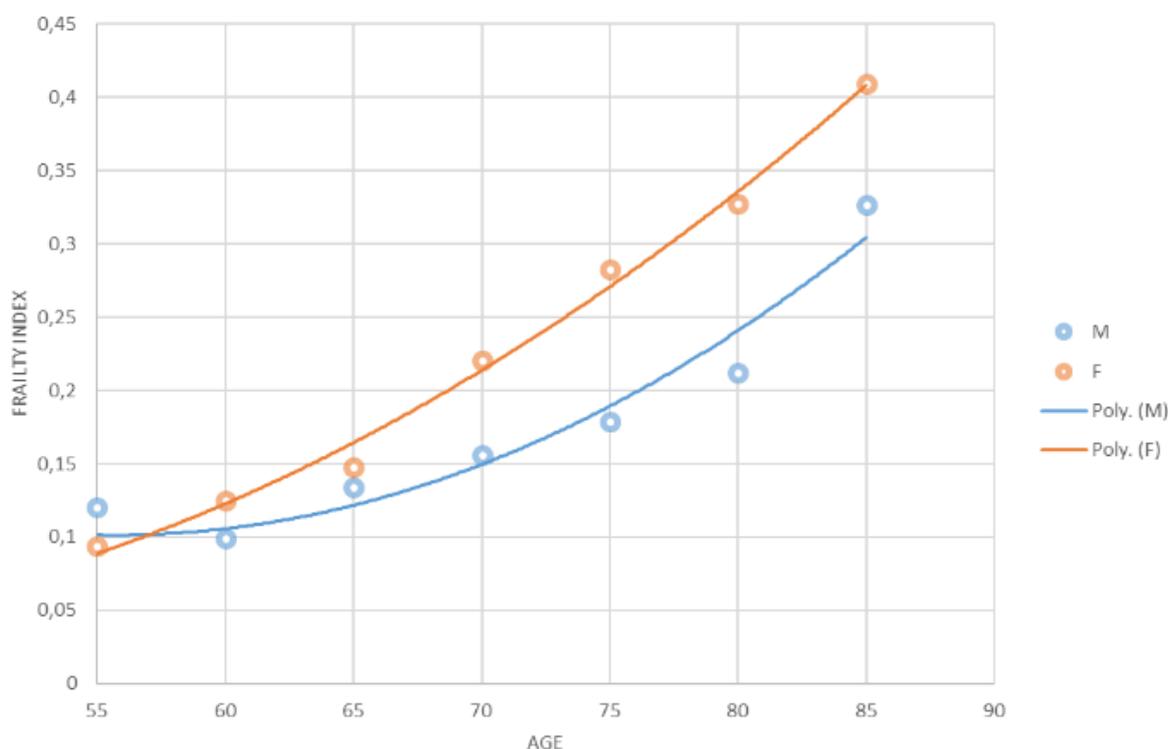
Dimension	Frail if...	Not frail if...	% frail at age 70-74	
			Men	Women
Nutrition BMI (body mass index)	<22	>=22	3	14
Physical activity How often do you do gymnastic, fitness, sport or long walks?	Never or almost never	At least once per month	25	43
Mobility How limited are you because of your health status in: climbing a flight of stairs	Severely limited	Not severely or not limited at all	4	7
Vitality How often did you feel full of energy?*	Sometimes/rarely/never	Often/most of the times/always	20	20
Strength How limited are you because of your health status in: lifting or carrying a weight of more than 5 Kg?	Severely limited	Not severely or not limited at all	14	19
Cognition How often do you have difficulties in remembering things?	Very often/often	Sometimes/ rarely/ never	21	24
Mood During the past 4 weeks, have you had difficulties with your work or other regular daily activities as a result of any emotional problems?*	Yes	No	19	22

* This variable is a combination of 4 indicators: to feel "full of pep", "full of energy", "not worn out" and "not tired"

**This variable is a combination of 3 indicators: "cut down the amount of time you spent on work or other activities", "accomplished less than you would like", "didn't do work or other activities as carefully as usual".

Source: author's own.

FIGURE 1: FRAILITY INDEX, OBSERVED AND INTERPOLATED VALUES BY AGE AND GENDER FOR FEMALE AND MALE ORDER MEMBERS



Note: The observed values are interpolated with a second degree polynomial function, obtaining $R^2 = 0.995$ and 0.944 for women and men, respectively; Source: author's own.

RESULTS

For our analysis we select the group of respondents aged 70-74. This is quite a consistent group with a case number of 264 respondents. The observed frailty index in this age group is 0.156 for men and 0.221 for women. More in details, about 67% of men have a frailty lower than the average (and 44% declare to have none of the deficits considered) versus about 62% among women (with only 23% declaring having no deficits). This group of people is not homogeneous, however. Respondents could have higher or lower frailty than the average and this could be influenced by having higher or lower education, being more or less satisfied with life, or in general having better or worse subjective health. Lower frailty than expected (i.e., lower than average) indicates that a certain characteristic is associated with a slower aging process. On the contrary, a higher frailty than expected (i.e., higher than average) indicates a faster aging process.

In the following, we show the association between several characteristics and frailty, illustrating the number of life years *gained* (indicating a disadvantage) or *saved* (indicating an advantage) in the aging process, grouped in 5 years age classes. The frailty will be analyzed by education level, happiness, feeling younger than the own chronological age, belief in having influence on the own health, working activity, stress and three different subjective health indicators (general health, extent of activity limitations in everyday life, presence of chronic diseases). The results are presented in Figure 2 for men and in Figure 3 for women.

FRAILITY AND EDUCATION

Respondents aged 70-74 years with high education (at least completed gymnasium) show less frailty than respondents with lower education (less than gymnasium), especially among women. On average, men with higher education show the frailty of a approximately 5-year younger men with average frailty, women with higher education show the frailty of roughly 10-year younger average women. While low education is a disadvantage for men (about 5 years), it makes no difference for women.

FRAILITY AND HAPPINESS

Happiness is an indicator stating the satisfaction with life as a whole. Very happy women and men show an advantage of about 5 and 10 years, respectively, but only unhappy men show a strong disadvantage of about 15 years.

FRAILITY AND FEELING YOUNGER

In one of the survey questions, respondents were asked how old they feel (the so-called "subjective age"). We compared this value with their chronological age and computed the frailty for the resulting subgroups (divided into the subgroups feeling at least 2 years younger, feeling more or less the same age, feeling older). Only a few people declared to feel older. Interestingly, those declaring to feel more or less of the same chronological age presented a frailty typical of roughly 10 years older people. Only those feeling younger had an advantage of about 5 years.

FRAILITY AND HOURS WORKED

In the monastery it is not unusual to work until higher ages, mainly with occupations that are related to the own capabilities and shaped around the own health status. The number of hours worked is strictly related to some of the dimensions of the frailty. It is interesting to note that there is almost no individual belonging to the group of people not working. It is not a surprise that those who are able to work for more than 4 hours a day are the less frail ones.

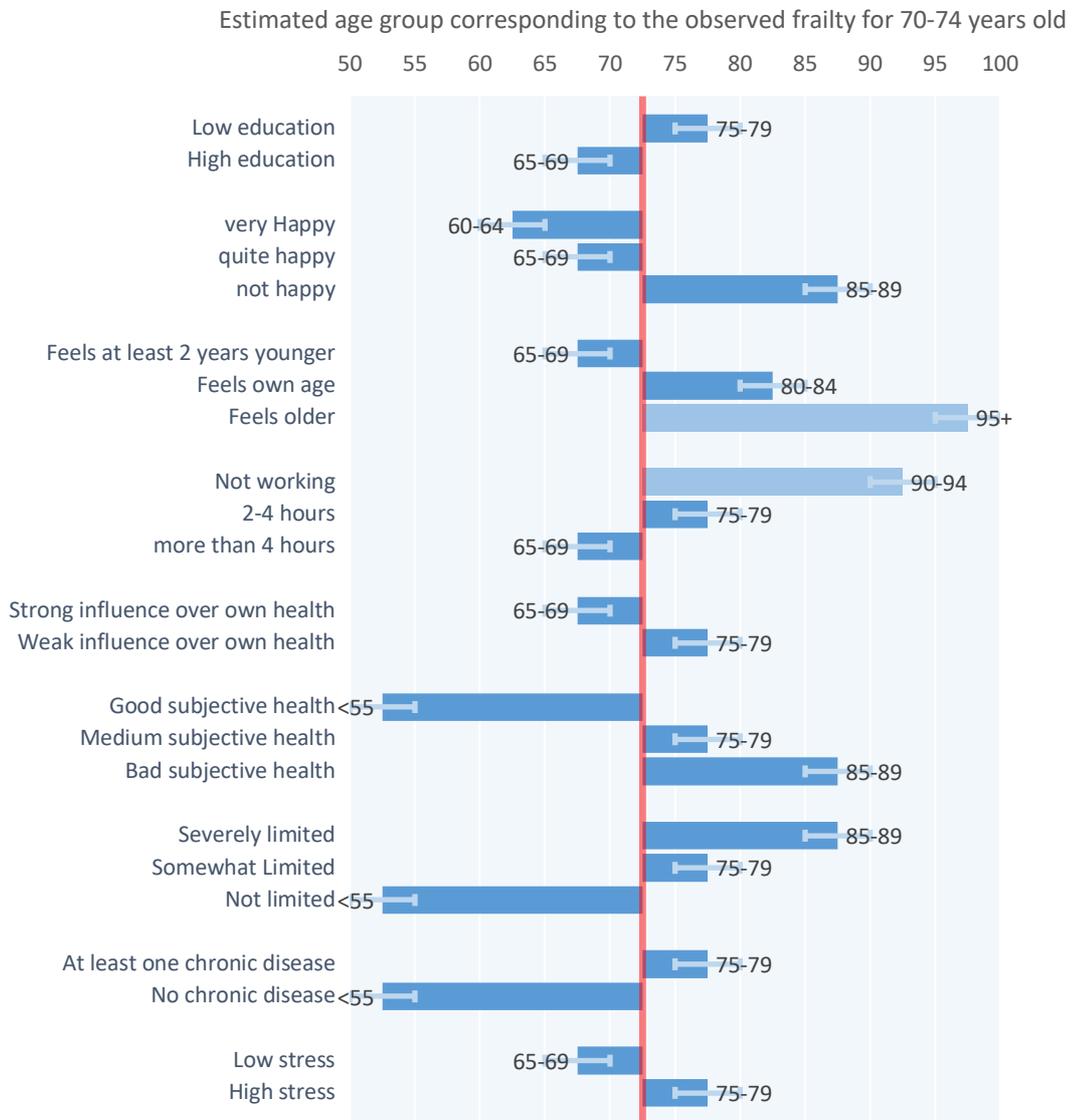
FRAILITY AND BELIEF IN INFLUENCE ON THE OWN HEALTH

Respondents were asked how much influence they think they have on the own health. Both men and women who answer they think they have a strong influence on the own health present a frailty level that is typical of individuals who are on average about 5 years younger. Men with a perceived weak influence on the own health have a frailty level of approximately 5-years older men.

FRAILITY AND GOOD SUBJECTIVE HEALTH, EXTENT OF ACTIVITY LIMITATIONS IN EVERYDAY LIFE, CHRONIC DISEASES

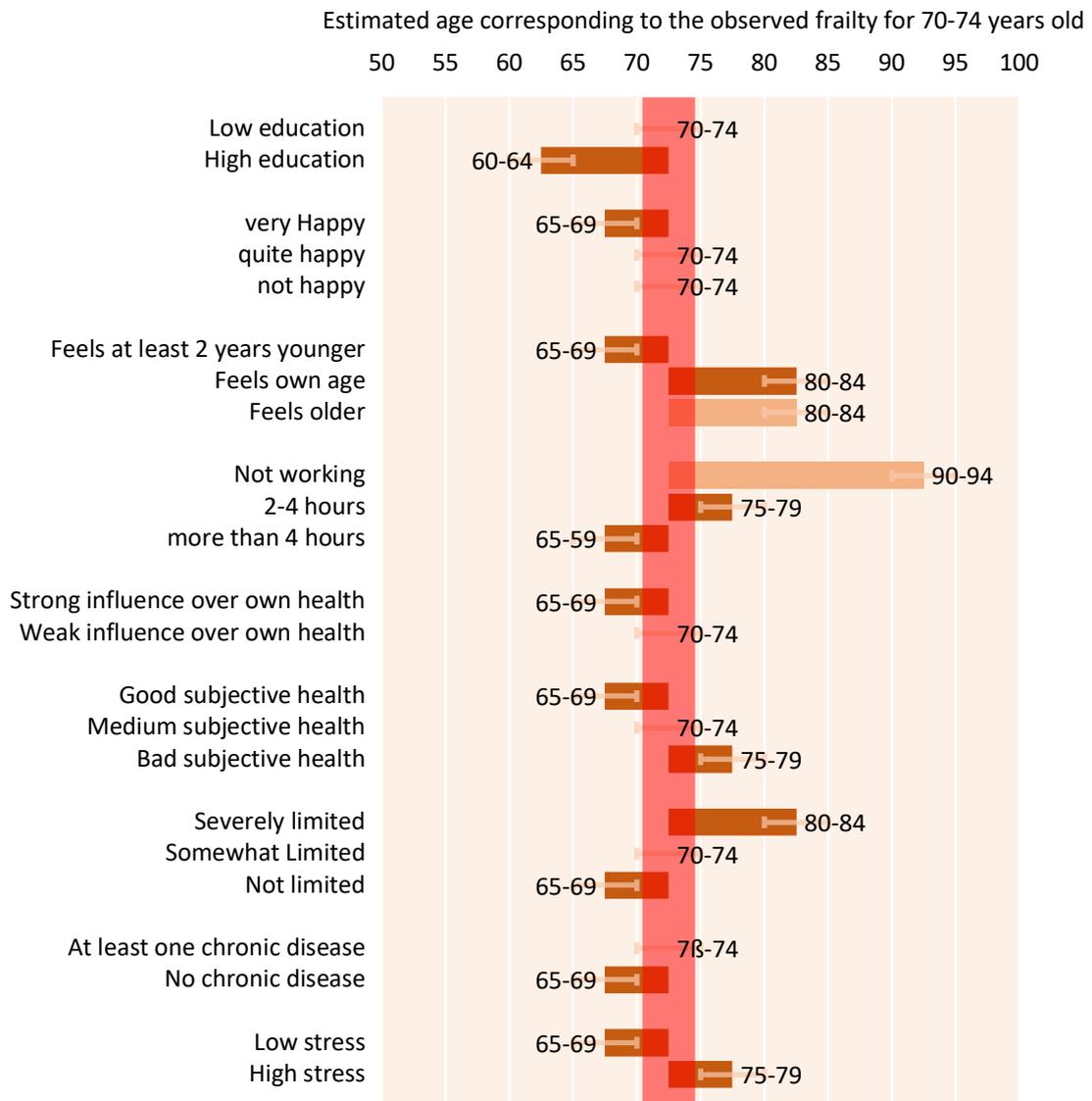
For the three health indicators there is a striking resemblance in the pattern of variation in the frailty among genders. For men the best health status among the three indicators (very good health, no limitations and no chronic diseases) is associated with a very low level of frailty, reflecting the frailty level of people that are on average at least 20 years younger. However, to be in bad or even medium health conditions is associated with a frailty level of people that are on average about 5-15 years older, depending on the health indicator used. For women, the benefit of enjoying extremely good health is smaller with an effect of

FIGURE 2: VARIATION OF THE FRAILTY INDEX BY SEVERAL CHARACTERISTICS OF THE INDIVIDUALS, MALE ORDER MEMBERS AGED 70-74



Note: values indicate the age class difference between an individual aged 70-74 with the average frailty level and individuals with the frailty level characteristics of the particular subgroup. In light color the subgroups with less than ten observations.
Source: author's own.

FIGURE 3: VARIATION OF THE FRAILTY INDEX BY SEVERAL CHARACTERISTICS OF THE INDIVIDUALS, FEMALE ORDER MEMBERS AGED 70-74



Note: values indicate the age class difference between an individual aged 70-74 with the average frailty level and individuals with the frailty level characteristics of the particular subgroup. In light color the subgroups with less than ten observations.

Source: author's own.



about 5 years. On the other hand, to be in very bad health conditions (severely limited or with bad subjective health) creates a disadvantage of roughly 5-10 years, but there is no difference with the average 70-74 years old women concerning the intermediate conditions (medium subjective health, somewhat limited).

FRAILITY AND STRESS

Stress is the only indicator where there is no difference in gender regarding its effect on frailty. Stress is computed as a combination of four items of the stress scale. Both men and women who experience low stress in the last 4 weeks have shifts in the frailty index to a value typical of about 5 years younger individuals, while experiencing higher stress shifts the frailty index in the opposite direction by the same quantity.

SUMMARY

The frailty index offers an interesting approach to analyze the aging process in the monastic population. Rather than focusing on illnesses and diseases, it highlights the relative prevalence of deficits that influence the everyday life without being directly life threatening. Moreover, it could be used as a tool to evaluate what conditions promote a more independent and autonomous life.

As expected, to be more educated, happier, more optimistic regarding the own health and the possibility to influence the own health, less stressed and more involved in work activities are all associated with lower frailty than the average individual. Own subjective health, in all its dimensions, is strictly interrelated with frailty. Nonetheless, the results are clearer for men and less clear cut for women. This could be related to the differences in the health reporting behavior between men and women, and deserves a more in-depth analysis.

In general, the variability of frailty is higher among men than among women. Women seem to undergo a more homogeneous aging process, while men appear to follow more differentiated distinctive paths. This possibly reflects the fact that the individual characteristics analyzed in this study are associated with a larger range of health and well-being related behaviors for men than for women, which ultimately impact on their frailty.

An open question is whether the frailty-related ageing trajectories observed in the monastic population are comparable to those of the general population, or whether they are a specific feature of the religious lifestyle. This will be the focus of a subsequent study.

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3.5 OVERALL LEVEL AND GENDER DIFFERENCES IN DEPRESSIVE SYMPTOMS AMONG OLDER CATHOLIC ORDER MEMBERS AND THEIR PEERS IN THE GENERAL POPULATION

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ABSTRACT

Objectives: I compare the depressive symptoms of older (50+) Catholic order members (i.e., monks and nuns) and their peers in the general population to gain insight into the extent to which (gender differences in) depressive symptoms in later life are related to modifiable social and lifestyle factors. Order life is characterized by less exposure to a number of risk factors and more exposure to a number of protective factors related to depressive symptoms. Relative to men and women in the general population, there are fewer differences between male and female order members with regards to a number of social factors thought to contribute to gender differences in depressive symptoms.

Method: Linear and logistic regression were used to compare mean level and prevalence of clinically-relevant depressive symptoms in a sample of order members aged 50+ years (N=515) with a sample of same aged, same nationality, same religion peers in the general population (N=875).

Results: The mean level and prevalence of clinically-relevant depressive symptoms were higher in the order population. Women had higher depressive symptoms in both populations. There was no indication that the magnitude of gender differences in the order population differed from the magnitude of gender differences in the general population.

Conclusion: Higher depressive symptoms amongst order members may be linked with the different developmental tasks (spiritual growth) of order versus secular life. The results provide further evidence that social factors alone do not explain gender differences in depressive symptoms.

Keywords: depression, depressive symptoms, old age, gender differences

INTRODUCTION

In the current study I compare the depressive symptoms of older (50+) Catholic order members (i.e., monks and nuns) and their peers in the general population in order to assess the extent to which (gender differences in) depressive symptoms in later life are related to social and lifestyle factors. Order life is characterized by a number of social and lifestyle factors thought to be protective against later life depressive symptoms. For instance, order members receive the same adequate material privileges independent of their ability to work and tend to live in stable groups throughout adulthood and into old age. Because “retirement” is based on health limitations as opposed to chronological age, older order members generally experience a gradual reduction in responsibilities (versus an abrupt exit from the workforce) and continue to contribute to the group for as long as possible (Luy, Flandorfer, & Di Giulio, 2015). Thus, relative to the general population, older Catholic order members are protected from many of the social risk factors for late-life depressive symptoms which include financial strain (Almeida et al., 2012), social disconnectedness (Cornwell & Waite, 2009), and major disruptions in social roles (Fiske, Wetherell, & Gatz, 2009). Order members’ frequent religious practice may be protective against depressive symptoms (Koenig, 2009). Older order members may also be protected from some of the physical health risk factors for depression due to their healthy lifestyle. Particularly relevant is that cardiovascular disease tends to co-occur with depression (Hare, Toukhsati, Johansson, & Jaarsma, 2014) and also tends to be lower amongst members of religious groups that encourage a healthy lifestyle (Christiansen et al., 2015).

Depressive symptoms tend to be higher among women (Hyde, Mezulis, & Abramson, 2008; Nolen-Hoeksema, 2001; Van de Velde, Bracke, & Levecque, 2010). Social, psychological, and biological factors are all thought to contribute to gender differences. Women in the general population are thought to experience certain stressors such as poverty and gender-specific demands of marriage, childcare and employment to a greater extent than men which may put them at a greater risk for depression (Hyde et al., 2008; Nolen-Hoeksema, 2001; Van de Velde et al., 2010). Men and women also tend to respond differently to stressors, resulting in gender-specific relationships between stressors and depressive symptoms. For instance, there is evidence that work problems (Kendler, Thornton, & Prescott, 2001), retirement, housekeeping and caretaking (Van de Velde et al., 2010) are more strongly associated with men’s depressive symptoms, while poverty is more highly related to women’s depressive symptoms (Van de Velde et al., 2010).

Relative to men and women in the general population, there are fewer differences between monks and nuns with regards to many of the social factors thought to contribute to gender differences in depressive symptoms. Specifically, nuns and monks have similar material living standards, occupations and family obligations (all are unmarried without children) and are similarly embedded in stable social networks (Luy, 2003). Analysis of the order population thus offers the unique opportunity for assessing whether there is a gender difference in depressive symptoms when many of the social and lifestyle differences between men and women in the general population are held relatively constant.

METHODS

SAMPLES

Data on order members were from the health survey of the German-Austrian Cloister Study (<https://cloisterstudy.eu/>). The German-Austrian Cloister Study is a longitudinal health study of German and Austrian order members aged 50+. The current study is based on data from the subsample of German participants because comparable data on depressive symptoms were available for the German but not the Austrian general population. Data on depressive symptoms were collected during the second wave of data collection in 2014. Participants were recruited by contacting the leadership of various orders (convenience sample). Of the 961 German order members originally contacted for participation in Wave 1, $N=515$ German order members aged 50+ completed the Wave 2 questionnaire (overall response rate: 53.6%).

Data on the general population were from a subsample of $N=875$ self-identified Catholic men and women 50+ who participated in the German Aging Study in 2011 (<http://www.dza.de/en/research/deas.html>). Order members and general population Catholics are likely to have been socialized with a similar worldview in early life (i.e., before order entry) based on their shared religion and national culture (Johnson, Hill, & Cohen, 2011).

The two samples were similar with respect to the proportion of women (order: 47.2% vs. general: 48.8% women, $\chi^2(1, N=1390)=.34, p=.56$) but differed with regards to age ($M_{Order}=75.51, SD_{Order}=8.92$ vs. $M_{GenPop}=66.43, SD_{GenPop}=9.70$ years, $F(1, 1388)=301.10, p<.001$), education (order: 4.7%, 41.5%, 53.7% vs. general: 11.2%, 65.4%, 23.4% low, medium and high education, $\chi^2(2, N=1383)=132.97, p<.001$), and number of siblings as an early life factor related to childhood mental disorders (Carballo et al., 2013) ($M_{Order}=4.00, SD_{Order}=2.57$ vs. $M_{GenPop}=2.03, SD_{GenPop}=1.80, F(1, 1356)=274.59, p<.001$).

DEPENDENT VARIABLE: DEPRESSIVE SYMPTOMS

Depressive symptoms were assessed with the German-version of the Center for Epidemiologic Studies Depression scale (Hautzinger, Bailer, Hofmeister, & Keller, 2012). Participants indicated the frequency with which they experienced 15 symptoms over the past week using a scale ranging from 0 (*seldom*) to 4 (*most of the time*). Scores across items were summed. Scores 18 and over were considered clinically-relevant (Lehr, Hillert, Schmitz, & Sosnowsky, 2008).

ANALYTIC STRATEGY

SPSS 22 was used to conduct all analyses. Missing data was low across all items in the general population sample ($\leq 1.0\%$). Missing data was low for the control items ($\leq 5.2\%$) and relatively high for several depression items in the order sample (8.2% to 23.3%; $>15\%$ for 6 of 15 items). Despite relatively high missingness at the item level, the vast majority of order members (88.9%) answered more than half of the depression items. To preserve power, I used the multiple imputation procedure separately for each sample to produce 40 datasets with missing imputed. All study variables plus an age by gender interaction term were included in the imputation model. Analyses were conducted on the imputed data sets. I report and interpret the pooled results which take into account the uncertainty of the parameter estimates due to missing data.

Linear and logistic regression analysis were used to analyze the relationships between the predictor variables and depressive symptoms (continuous) and clinically-relevant depressive symptoms (yes/no), respectively. I included order membership and

gender as the main variables of interest as well as age, education, and number of siblings as control variables based on differences between the two samples (see above) that may act as confounders. To investigate whether the magnitude of gender differences in depressive symptoms differed between the two populations, in a second model I additionally included a gender by order member interaction term. To check whether the differences between the order and general populations were consistent across genders, I also ran separate analyses for men and women.

RESULTS

The unadjusted mean depressive symptoms were 8.73 for order men, 10.50 for order women, 6.62 for general population Catholic men, and 7.53 for general population Catholic women. The unadjusted prevalence of clinically-relevant depressive symptoms was 8.2% for order men, 12.1% for order women, 4.5% for general population Catholic men and 6.8% for general population Catholic women.

Table 1 displays the results of the regression analyses. Order membership was positively associated with both mean and clinically-relevant depressive symptoms after controlling for gender and sample differences in age, education, and number of siblings. Female gender was associated with higher depressive symptoms but not clinically-relevant depressive symptoms. There was no indication that the magnitude of the gender differences varied across the two samples as indicated by the non-significant gender by order member interaction terms. The within-gender analyses confirmed that differences between the order and general samples were similar in magnitude and direction across both genders with regards to mean (men: $B_{\text{Order}}=1.13(0.53)$, $p=.03$, women: $B_{\text{Order}}=1.27(0.60)$, $p=.03$) and clinically-relevant depressive symptoms (men: $B_{\text{Order}}=0.26(0.46)$, $p=.57$, women: $B_{\text{Order}}=0.42(0.38)$, $p=.27$).

TABLE 1: RESULTS OF THE LINEAR AND LOGISTIC REGRESSION ANALYSIS OF THE RELATIONSHIP BETWEEN ORDER MEMBERSHIP, GENDER, AND DEPRESSIVE SYMPTOMS

Dependent variable:	Depressive symptoms		Clinically-relevant depressive symptoms (yes/no)	
	B(S.E.)	B(S.E.)	B(S.E.)	B(S.E.)
Intercept	5.83(1.17)**	5.96(1.19)**	-2.94(0.85)**	-2.93(0.88)**
Order member ^a	2.45(0.41)**	2.25(0.53)**	0.64(0.29)*	0.63(0.39)
Gender (female) ^a	0.79(0.33)*	0.66(0.39)†	0.35(0.24)	0.34(0.31)
Age	0.01(0.02)	0.01(0.02)	0.00(0.01)	0.00(0.01)
Low education ^a	1.36(0.58)*	1.41(0.58)*	0.61(0.35)†	0.61(0.35)†
High education ^a	-0.76(0.37)*	-0.68(0.39)†	-0.01(0.28)	-0.01(0.30)
Num. siblings	0.16(0.07)*	0.15(0.07)*	0.04(0.05)	0.04(0.05)
Gender x order member		0.41(0.70)		0.03(0.48)

Notes. ^aDummy variable. † $p \leq .10$; * $p \leq .05$; ** $p \leq .01$
Source: author's own.

DISCUSSION

Order members had higher depressive symptoms and a higher prevalence of clinically-relevant depressive symptoms in comparison with their same aged, same religion, same nationality peers in the general population. The result is surprising given that order life is characterized by less exposure to a number of risk factors and more exposure to a number of protective factors associated with depressive symptoms in the general population identified in the literature on late-life depression.

One potential explanation for the higher depressive symptoms amongst order members is that order members may be less concerned with optimizing their hedonic well-being than members of the general population (Hicks & King, 2008). Research based on qualitative interviews found that nuns experience depressive symptoms as a concomitant to spiritual growth (Dura-Vila, Dein, Littlewood, & Leavey, 2010). Thus, the higher depressive symptoms among order members may be due to the different developmental tasks (spiritual growth) of order versus secular life. The structure of order life may enable order members to invest more resources in *personality maturity* (i.e., self-, and world-insight, complex emotion-regulation, investment in the well-being of others) than typically observed in the general population at the “cost” of lower *personality adjustment* (i.e., the ability to achieve, maintain, or regain well-being) (Staudinger & Bowen, 2010; Staudinger & Kessler, 2009). Another reason why order members might have higher depressive symptoms may be because they typically have jobs with high psychosocial demands (e.g., offering emotional support to others). Human service professionals such as social workers are at greater risk for affective and stress related disorders (Wieclaw, 2006). Future research should explore reasons for differences in depressive symptoms between the order and general populations as well as explore whether depressive symptoms are related to other indicators of positive adult development (e.g., spiritual growth, personality maturity).

Consistent with previous research, the results of the current study indicated that women had higher depressive symptoms than men (Hyde et al., 2008; Nolen-Hoeksema, 2001; Van de Velde et al., 2010). Particularly noteworthy is that gender differences were of the same magnitude in both the order and general population samples despite the greater similarity between nuns and monks with regards to a number of social factors related to depression. The results are in line with previous findings that socioeconomic and family-related factors do not fully explain gender differences in depressive symptoms (Kendler et al., 2001; Van de Velde et al., 2010). The current results suggest that social factors alone do not explain gender differences in depressive symptoms. Biological factors such as genetic influence and hormones may play a significant role in explaining gender differences in depressive symptoms (Hyde et al., 2008).

The results of the current study should be interpreted with caution. There may be psychosocial traits and early life circumstances that influence both the probability of entering order life as well as the probability of experiencing depressive symptoms in later life. I attempted to control for potential selection of people with characteristics that predispose them to late-life depression into order life by (a) comparing order members with their same aged, same nationality, same religion peers in the general population as people likely socialized with a similar world view in early life (i.e., before order entry) and (b) by statistically controlling for the number of siblings in the family of origin. Differences between the two samples may be due to unmeasured differences in the willingness to disclose information about depressive symptoms and/or different data collection procedures (pencil-and-paper for the order sample, face-to-face interview for the general population sample). Finally, the analyses were based on data from a convenience sample of order members and an unweighted subsample of the German Aging Study participants. Hence, the data may not be representative of the two populations. To the best of my knowledge, there is no other published data on the depressive symptoms of older order members. The current results therefore offer an important first

insight into the depressive symptoms of older order members relative to their peers in the general population. All in all, the results suggest that lower exposure to the social and lifestyle factors associated with late-life depression is not sufficient for protecting older people from depressive symptoms and that gender differences in depressive symptoms stem from more than just social and lifestyle factors.

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3.6 EINFLUSS DER SOZIALEN QUALITÄT EINER GEMEINSCHAFT AUF DIE GESUNDHEIT IHRER MITGLIEDER – ERKENNTNISSE AUS DER KLOSTERSTUDIE

Eine Zusammenfassung des Aufsatzes „Community Social Characteristics And Health At Older Ages: Evidence From 156 Religious Communities“ von Catherine E. Bowen und Marc Luy, erschienen in der Zeitschrift *Journals Of Gerontology: Social Sciences*, 2018, Jg. 73, Nr. 8, S. 1429-1438, 29.08.2016)

ANGELA WIEDEMANN

Die Klosterstudie bietet für zahlreiche Forschungsfragen eine nahezu ideale – und häufig einzigartige – Grundlage, um neue Einblicke zu gewinnen oder bestehende Erkenntnisse zu überprüfen. Eine interessante hierzu gehörende Frage ist, inwieweit sich die „soziale Qualität“ einer Gemeinschaft auf die Gesundheit ihrer Mitglieder auswirkt. Mit sozialer Qualität werden Eigenschaften beschrieben wie Zusammenhalt, gegenseitiges Vertrauen, Zugehörigkeitsgefühl oder Häufigkeit und Ausmaß von Konflikten zwischen den Mitgliedern. Die bisher zu dieser Frage durchgeführten Studien deuten darauf hin, dass derartige Eigenschaften des Gemeinschaftslebens durchaus mit der individuellen Gesundheit in Zusammenhang stehen. Allerdings beziehen sich diese Studie vor allem auf das Familienleben, was die Aussagekraft der gewonnenen Ergebnisse deutlich eingrenzt. So ist es zum Beispiel in solchen Studien nur schwer möglich, kausale Effekte (also wie sich die soziale Qualität einer Gemeinschaft auf die Gesundheit der einzelnen Mitglieder auswirkt) zu trennen von Selektionseffekten (möglicherweise hat die Gesundheit einer Person selbst einen Einfluss darauf, einer Gemeinschaft mit bestimmter sozialer Qualität anzugehören).

Nach einer Analyse möglicher Verzerrungseffekte auf der individuellen und der Gemeinschaftsebene gelangte J. Michael Oakes in einem Aufsatz zu der Schlussfolgerung, dass der einzige Weg, tatsächlich kausale Effekte der sozialen Qualität der Gemeinschaft auf die Gesundheit der Mitglieder empirisch nachzuweisen darin bestünde, ein Experiment durchzuführen (bzw. zu simulieren), in dem ähnliche (homogene) Personen auf unterschiedlich charakterisierte (heterogene) Gemeinschaften verteilt würden.¹⁵ Nun ist die Durchführung eines derartigen Experiments natürlich aus vielen Gründen nicht möglich. Ordensgemeinschaften können jedoch als Annäherung an dieses theoretische Forschungsdesign angesehen werden. Im Vergleich zur weltlichen Gesamtbevölkerung sind katholische Ordensmitglieder eine sehr homogene Personengruppe bezüglich zahlreicher gesundheitsrelevanter individueller Lebensumstände, wie z.B. Berufstätigkeit, Ausmaß der berufsbedingten Gesundheitsgefährdung, Einkommen, Religionszugehörigkeit, Religiosität, Familienstand oder Wohnverhältnisse. Ebenso sind die sozioökonomischen Eigenschaften der Gemeinschaften vergleichbar, z.B. bezüglich materieller Lebensstandards oder dem Zugang zu medizinischer Versorgung. Nichtsdestotrotz kann sich die soziale Qualität zwischen den Ordensgemeinschaften unterscheiden, z.B. in Bezug auf zwischenmenschliche Konflikte und/oder das Ausmaß der Verbundenheit unter den Mitgliedern. Diese Ausgangssituation ermöglicht es, zumindest approximativ, den Einfluss der sozialen Qualität des Gemeinschaftslebens auf die Gesundheit der einzelnen Ordensmitglieder von den oben genannten Verzerrungsfaktoren zu isolieren.

¹⁵ Siehe Oakes, J. Michael (2013). „Commentary: identification, neighbourhoods and families.“ *International Journal of Epidemiology* 42(4): 1067-1069.

Durchgeführt wurde die Studie mit den Daten der ersten Erhebungswelle des ASCOM-Surveys, wobei nur die Ordensfrauen und -männer berücksichtigt wurden, die in einer Ordensgemeinschaft lebten (also zusammen mit mindestens einem weiteren Ordensmitglied, das sich ebenfalls an der Studie beteiligt hat).¹⁶ Diese Auswahl resultierte in einer Stichprobe von 1.041 Studienteilnehmern (59% Ordensfrauen) aus 156 verschiedenen Ordensgemeinschaften, deren Mitgliederzahl zwischen zwei und 77 variierte (mit einem Medianwert von 14). Auf dieser Grundlage wurde untersucht, ob sich ein Zusammenhang feststellen lässt zwischen Konflikten und Verbundenheit innerhalb der Gemeinschaften auf der einen Seite und der Gesundheit der Ordensmitglieder auf der anderen. Bei den Konflikten wurde zwischen *persönlichen Konflikten* (Unstimmigkeiten, Kontroversen und Streitigkeiten zwischen den Personen) und *Konflikten in der Gemeinschaft* (Ausmaß der Streitigkeiten unter den anderen Mitgliedern der Gemeinschaft) unterschieden. Ebenso wurde bei der Verbundenheit unterschieden zwischen empfundener *persönlicher Verbundenheit* der Ordensmitglieder (Intensität der gefühlten sozialen und emotionalen Verbundenheit mit anderen Mitgliedern) und *Verbundenheit in der Gemeinschaft* (Ausmaß der empfundenen Verbundenheit in der Gemeinschaft).

Für die Einschätzung der individuellen Gesundheit wurde die Frage verwendet „Wie würden Sie Ihren Gesundheitszustand im Allgemeinen beschreiben?“ mit einer Antwortskala von 1 (sehr gut) bis 5 (sehr schlecht). Verbundenheit wurde mit der aus elf Einzelfragen bestehenden „Rasch-Type Loneliness-Scale“ gemessen.¹⁷ Die Involvierung in persönliche Konflikte wurde über die Zustimmung zu der Aussage „Ich bekomme häufiger Streit mit meinen Mitschwestern bzw. Mitbrüdern“ erfasst, wobei die Studienteilnehmer zwischen fünf Antwortmöglichkeiten von 1 (Trifft sehr zu) bis 5 (Trifft nicht zu) entscheiden konnten. Als Kontrollvariablen wurden schließlich Alter, Geschlecht, Bildung und Mitgliederzahl der jeweiligen Gemeinschaft als potentielle Einflussfaktoren einbezogen. Die Besonderheit der Analyse war die Verwendung des *Group Actor-Partner Interdependence Models* (GAPIM),¹⁸ welches es ermöglicht, sowohl den Zusammenhang zwischen eigenen Konflikterfahrungen und eigener Verbundenheitsempfindung mit der eigenen Gesundheit zu untersuchen, als auch die entsprechende Wirkung von Konflikten zwischen anderen Mitgliedern der Gemeinschaft sowie deren Empfinden von Verbundenheit auf die eigene Gesundheit. Hierfür wurden für jeden Studienteilnehmer die durchschnittlichen Konflikterfahrungen (Konflikte in der Gemeinschaft) und Verbundenheitsempfindungen *aller anderen Gemeinschaftsmitglieder* (Verbundenheit in der Gemeinschaft) ermittelt, also jeweils ohne die eigenen Werte der Ordensfrauen und Ordensmänner, aus denen die Untersuchungsvariablen persönliche Konflikte und persönliche Verbundenheit bestimmt wurden.

Die Ergebnisse für die Einzelvariablen zeigen, dass jüngeres Alter, höherer Bildungsgrad, größeres persönliches Verbundenheitsempfinden und geringeres Ausmaß an Konflikten in der Gemeinschaft mit einer besseren Gesundheit der Studienteilnehmer einhergehen. Vertiefende Analysen von Interaktionseffekten zwischen den Untersuchungsvariablen deuten darauf hin, dass der Zusammenhang zwischen individueller Gesundheit der Studienteilnehmer mit persönlicher Verbundenheit und Gemeinschaftsverbundenheit (welche im Einzelmodell nicht signifikant war) vom Geschlecht der Studienteilnehmer, und der

¹⁶ Ausgeschlossen wurden demnach sowohl alleine lebende Ordensmitglieder als auch jene, für die keine Informationen über andere Mitglieder der Ordensgemeinschaft verfügbar waren.

¹⁷ Dabei handelt es sich um elf Aussagen mit jeweils vier Zustimmungsmöglichkeiten von 1 (Trifft sehr zu) bis 4 (Trifft nicht zu). Die Aussagen beinhalten sowohl die emotionale Dimension von Verbundenheit (z.B. „Ich fühle mich häufig im Stich gelassen“) als auch die soziale Dimension (z.B. „Ich kenne viele Leute, auf die ich mich echt verlassen kann“). Die Antwortwerte wurden über alle Aussagen gemittelt. Die im ASCOM-Survey verwendete Skala basiert auf: de Jong-Gierveld, Jenny; Kamphuis, Frans (1985). „The Development of a Rasch-Type Loneliness Scale.“ *Applied Psychological Measurement* 9(3): 289-299.

¹⁸ Siehe Garcia, Randi L.; Meagher, Benjamin R.; Kenny, David A. (2015). „Analyzing the effects of group members' characteristics: A guide to the group actor-partner interdependence model.“ *Group Processes & Intergroup Relations* 18(3): 315-328.

Zusammenhang zwischen individueller Gesundheit und Gemeinschaftskonflikten vom Alter der Studienteilnehmer abhängen:

- der Zusammenhang zwischen individueller Gesundheit und persönlich empfundener Verbundenheit war stärker für Männer als für Frauen,
- der Zusammenhang zwischen individueller Gesundheit und Gemeinschaftsverbundenheit war positiv für Frauen (also je größer die Verbundenheit in der Gemeinschaft, desto besser die Gesundheit der Studienteilnehmerinnen), aber negativ für Männer (hier gilt folglich, je größer die Verbundenheit in der Gemeinschaft, desto schlechter die Gesundheit der Studienteilnehmer), und
- der Zusammenhang zwischen individueller Gesundheit und Konflikten in der Gemeinschaft war stärker in höherem als in jüngerem Alter.

Insgesamt deuten die Resultate dieser Studie also darauf hin, dass die soziale Qualität der Gemeinschaft tatsächlich einen Einfluss auf die persönliche Gesundheit der Mitglieder hat. Sowohl das Ausmaß an Konflikten (bei mit dem Alter zunehmender Wirkung) als auch das der Verbundenheit in der Gemeinschaft (mit unterschiedlichen Effekten für Frauen und Männer) wirken sich signifikant auf die Gesundheit der Ordensleute aus. Dabei ist hervorzuheben, dass diese Effekte aufgrund der Anwendung des GAPIM-Modells *unabhängig sind sowohl von der eigenen Involvierung der Studienteilnehmer in Konflikte als auch ihrer eigenen Verbundenheitsempfindungen*. Interessanterweise zeigte sich bei den Ordensleuten keine gesundheitliche Auswirkung von eigenen Konflikten mit anderen Mitgliedern der Gemeinschaft, so wie dies aus anderen Studien bekannt ist. Es ist jedoch schwer zu beurteilen, inwieweit dies an dem unter Ordensleuten viel stärker ausgeprägten Einfluss der Religiosität auf das Zusammenleben liegen könnte, oder auch am Querschnittsdesign dieser Studie. In einer Längsschnittbetrachtung, in welcher der Einfluss von persönlichen Konflikten auf die Gesundheit im Zeitverlauf betrachtet werden könnte, wäre diesbezüglich ein anderes Ergebnis möglich. Die Daten aus den Follow up-Wellen der ASCOM-Studie werden helfen, diese Frage zu beantworten. Wichtig bleibt aber vor allem die Bestätigung der Ergebnisse früherer Studien aus der weltlichen Bevölkerung, dass die soziale Qualität des unmittelbaren Lebensumfelds eine wichtige Gesundheitsdeterminante darstellt. Dabei ist die soziale Qualität der gesamten Gemeinschaft bei den Frauen bedeutender als bei den Männern, während bei den Männern das persönliche Empfinden des Gemeinschaftslebens eine etwas wichtigere Rolle spielt. Diese Erkenntnisse sind auch für die gesamte Bevölkerung relevant, da viele Eigenschaften des Ordenslebens ein Pendant im weltlichen Familienleben finden.

3.7 DIRECT EFFECT OF EDUCATION ON MORTALITY: INSIGHTS FROM THE CLOISTER STUDY

MARC LUY, CHRISTIAN WEGNER-SIEGMUNDT AND PAOLA DI GIULIO

ABSTRACT

Education is the central element of a complex network that links many factors related to socioeconomic status (SES) with health and mortality. As a consequence of this complex interaction of different factors it is still unclear whether and to what extent education per se has a direct effect on individuals' survival chances, or whether education is rather a proxy for other characteristics of SES and their impact on longevity. We test this by analysing the association between education and mortality in a cohort of Catholic nuns and monks from western Germany in comparison to the corresponding general population. The study sample comprises 8,435 individuals who were born between 1914 and 1952 and alive in 1984. We analysed their survival until 1998 by Kaplan-Meier product limit estimation and we estimated the impact of education on mortality by Cox proportional hazard regression modelling. In the end, our study provides mixed evidence for the existence of a direct effect of education on mortality. Among female order members we found the same education gradient as among women of the general population. On the other hand, male order members with lower education show no statically significant mortality differences to monks with higher education. On the contrary, the odds ratios even point at a rather better survival. We discuss several different interpretations of these findings and demonstrate that the study provides strong support for the Nathanson/Lopez hypothesis (1987) that the extent of sex differences in mortality is primarily determined by the lifestyles and living conditions of men with low SES.

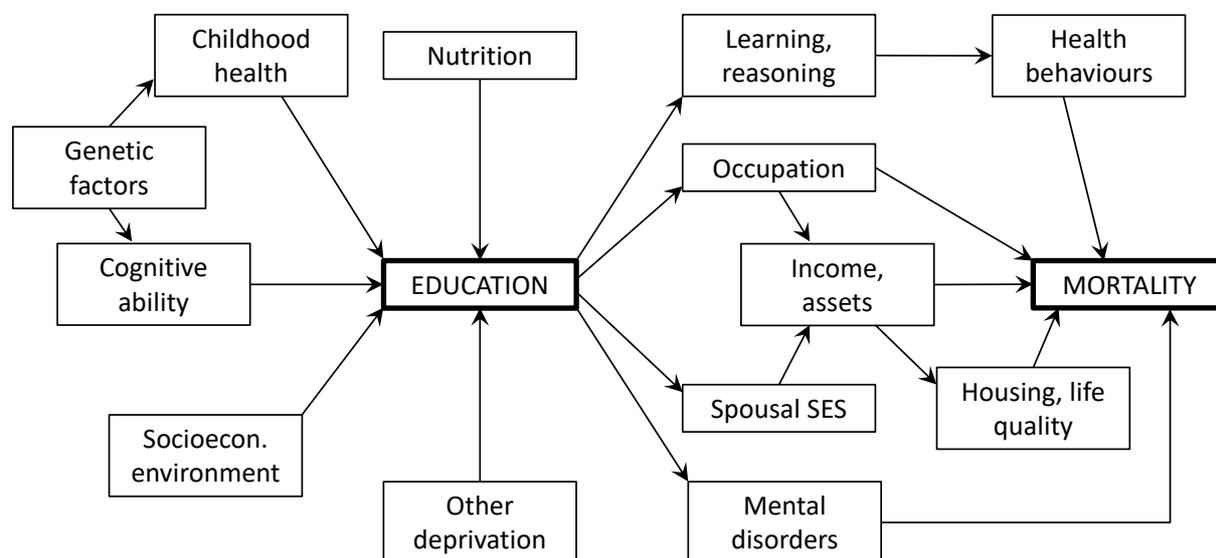
INTRODUCTION

It is a well-known phenomenon that the level of mortality differs with the level of education. Women and men with higher education have a lower mortality than their less educated counterparts at any adult age (Kitagawa and Hauser 1973). The largest differences can usually be found among the less educated individuals, but studies on members of academic societies indicate that this gradient in mortality extends into the most highly educated segments of the population (Winkler-Dworak 2008; Andreev et al. 2011). The relationship between education and mortality is so strong that education has been described as being "as close to a perfect predictor for life expectancy at age 5 as we can possibly aspire to" (Palloni and Pinto-Aguirre 2011: 125, referring to literacy as indicator for education). Several studies report that mortality differences by education are even widening in recent decades (e.g. Elo and Preston 1996; Shkolnikov et al. 2006; Meara et al. 2008; Klotz 2010). This is, however, probably a consequence of increasing selection effects among less educated individuals of the younger cohorts and not an indicator for increasing health inequalities within the societies (Deboosere et al. 2009; Luy et al. 2011). The education-specific mortality differences vary in their extent between countries (Kunst 1997; Corsini 2010), and in general they are larger among men than among women (Ross et al. 2012). Nevertheless, the education gradient in mortality is a universal phenomenon and therefore it is no surprise that this is one of the most intensively investigated subjects in epidemiologic and demographic research.

DIRECT EFFECT OF EDUCATION ON MORTALITY: BACKGROUND AND DEFINITION

Education is the central element of a complex network that links many factors related to socioeconomic status (SES) with health and mortality (see Figure 1). Access to education and educational attainment are influenced by a combination of several determinants, such as cognitive ability, genetic factors, childhood health, socio-economic environment before and after birth, nutrition and other deprivation (see e.g. overview in Haveman and Wolfe 1995). Also parental health has been shown to influence the educational success of their children (Boardman et al. 2012). Along the pathway to mortality, education is associated with many further factors related to health and survival (extensive overviews can be found in Mirowsky and Ross 2003 and Hummer and Lariscy 2011). In Figure 1 we simplify this complex network of factors to three major causation lines. The first connects education and mortality through learning and reasoning (including disease management) which influence and determine health behaviours such as smoking, alcohol consumption, nutrition and physical activity, but also illness and injury prevention (Cutler and Lleras-Muney 2010). The second causation line summarises the other typical elements of SES. Income and assets are in the centre of this pathway from education to mortality that is determined by occupation and/or spousal SES and connected to mortality either directly or indirectly through factors like housing conditions and the general quality of life, including the access to curative and preventive care (Krueger and Burgard 2011). Finally, there is some evidence that education is related to specific mental disorders independently of other mediating factors, which might have also an impact on mortality (Butler et al. 1996).

FIGURE 1: SIMPLIFIED MODEL OF INFLUENCES ON EDUCATION LEVEL AND POTENTIAL PATHWAYS LINKING EDUCATION WITH LATER MORTALITY



Source: authors' own model.

As a consequence of this complex interaction of different factors it is still unclear whether and to what extent education per se has a direct effect on individuals' survival chances or whether education is rather a proxy for other characteristics of SES and their impact on longevity. We define the "direct effect of education" as the influence of education and its determinants (above

all cognitive ability, but also other factors like nutrition and childhood health) on longevity through the path that links education and mortality via learning/reasoning (or in other words “knowledge”) and health behaviours (see Figure 1). Empirical evidence suggests that such a causal link does indeed exist although it is still unclear what basic mechanisms could be responsible to drive this relationship (e.g. Madsen et al. 2010). Most advocates of this direct-effect line consider the association between education and survival to be connected with cognitive functioning, which has been shown to influence mortality regardless of whether cognitive abilities are assessed in mid-adulthood (Pavlik et al. 2003; Deary and Der 2005) or in older ages (Kelman et al. 1994; Johansson and Zarit 1997; Bassuk et al. 2000; Neale et al. 2001). Some studies demonstrate that higher cognitive functioning leads to better health even when education is controlled for (Elias et al. 2004; Hartog and Oosterbeek 1998). Also Auld and Sidhu (2005) found that a large proportion of the association between schooling and health can be attributed to cognitive ability, however, with the relationship being stronger among less educated than among more highly educated individuals. Attempts to relate education and other characteristics of SES to biological ageing provided only mixed results (Adams and White 2004; Cherkas et al. 2006; Batty et al. 2009; Robertson et al. 2013).

When one considers education to be an outcome of intelligence—which can be criticised, however; see e.g. Neisser et al. (1996)—the strongest evidence for the existence of a direct effect of education on mortality is provided by several longitudinal studies that found an inverse relationship between IQ assessed in childhood or early adulthood and later all-cause mortality (O’Toole et al. 1988; Whalley and Deary 2001; Hart et al. 2003; Osler et al. 2003; Deary et al. 2004; Kuh et al. 2004; Hemmingsson et al. 2006; Batty et al. 2007; Batty et al. 2008b; Deary et al. 2008; Jokela et al. 2009; Lager et al. 2011). Indeed, this association is mainly attributed to the same pathway from education—as a consequence of childhood environmental conditions (which affect brain development and the integrity of the nervous system) and cognitive abilities—to mortality through health behaviours that we defined as the “direct effect of education on mortality” (see Whalley and Deary 2001; Gottfredson and Deary 2004; Whitley et al. 2010a; Whitley et al. 2010b). The emphasis on IQ is relevant in this context because it measures the psychometric intelligence (made up of a combination of efficient learning, reasoning, problem solving, abstract thinking) which enhances the ability to find solutions for changing and ambiguous problems as well as the capacity of patients to correctly follow treatments and prevent health risks (Goldman and Smith 2002). In fact, what seems most important for a direct effect on health is that more educated people are better capable of processing available information (Cutler and Lleras-Muney 2010). For example, Gottfredson and Deary (2004) showed that higher IQ in childhood was associated with a higher probability of quitting smoking as soon as the knowledge about risks of smoking was publicly available. Other studies instead focused on other types of intelligence, based on non-cognitive skills (also defined as socio-emotional skills). For example, Chiteji (2010) found that orientation towards the future and self-efficacy (this refers to the evaluation of one’s ability to be effective in performing tasks that are necessary for realising an outcome) are positively associated with healthy behaviours and negatively with unhealthy ones.

Despite the extensive research it remains an unanswered question whether the relationship between IQ or cognitive ability and mortality really exists independently of other SES characteristics in adulthood (see e.g. Whalley and Deary 2001; Batty et al. 2008a; Hemmingsson et al. 2009). Therefore, we are in search of further evidence for the existence of a direct effect of education on longevity. We do this by analysing the association between education and mortality in a cohort of Catholic nuns and monks from western Germany in comparison to the corresponding general population. This quasi-experimental setting allows us to examine the education–mortality relationship in a population of women and men where education does not cause any differences with regard to other typical SES characteristics such as income, assets, housing and partnership. Although order members pursue different occupations which do in part depend on their education level, it seems unlikely that these cause different risks for health and mortality (see Luy 2003). We expect that the described direct effect of education on mortality exists and thus we

hypothesise that education does have a significant impact on order members' mortality, albeit to a lower extent than in the total population where the education effect works in combination with the other factors related to SES. In fact, the investigation of the relationship between education and mortality among order members enables us to isolate the education–learning/reasoning–mortality path of the causation network shown in Figure 1, with the possibility of an existing independent education–mental disorders–mortality path being the only restriction.

Similar analyses of the “Nun Study” conducted in the US showed that educational attainment has a statistically significant impact on the health of Catholic sisters in terms of both cognitive functioning in old age (Butler et al. 1996) and mortality (Snowdon et al. 1989). Our investigation differs from the Nun Study in three respects: (i) the Nun Study included only women, whereas our “Cloister Study” includes order members of both sexes, (ii) the sample of the Nun Study was limited to the voluntary participants of the yearly medical and cognitive examinations, which might imply a health and education-biased sample of Catholic sisters, who additionally belonged only to one specific order (the “School Sisters of Notre Dame”), whereas our study includes all members who ever entered the participating religious communities belonging to different Catholic orders, and (iii) the US study analysed the sisters' mortality without comparing the effects to those inherent in the total population.

DATA AND METHODS

In order to investigate whether there is a direct effect of education on mortality we analysed differences in mortality by education among female and male Catholic order members and women and men of the western German general population. Education level was dichotomised into the two basic groups of low (defined as completed secondary or lower education) and high education (tertiary education). Data for the general population stem from the western sample of the German Life Expectancy Survey (Lebenserwartungssurvey/LES). The LES is a panel that consists of two waves of interviews, restricted to individuals with German citizenship and is based on the German National Health Survey. The first wave was carried out between 1984 and 1986 and included a representative random sample of the total West German population. In 1998, the German Federal Institute for Population Research (Bundesinstitut für Bevölkerungsforschung/BiB) carried out a follow up survey among the individuals interviewed in the 1984/86 National Health Survey. In this second survey, the initial questionnaires were slightly modified—e.g. purely medical details were removed and replaced by questions on general living conditions and family situations—and the number of respondents was restricted to those born between 1914 and 1952 (more details can be found in Gärtner 2001). The western German LES sample includes a total of 4,139 women and 4,335 men. Of those, 285 women (6.9%) and 613 men (14.1%) died between the two survey waves, with the dates of death registered. For 998 women (24.1%) and 885 men (20.4%) the survival status in 1998 was unknown. Tests of the quality of the LES mortality data revealed that the reflected survival of the LES sample is representative for the western German population, regardless of whether individuals with unknown survival status in 1998 are included or not (Luy and Di Giulio 2005; Salzmänn and Bohk 2008). As suggested by Luy and Di Giulio (2005) we excluded the 1,883 individuals with unknown survival status from the LES sample.

For the monastic population we use data from the German subsample of the “Cloister Study” which contains a total of 6,199 Catholic nuns and 5,781 Catholic monks from eleven religious communities located predominantly in Bavaria (southern area of western Germany). The nuns were born between 1804 and 1985 and the monks between 1588 and 1983. Both include individuals with German as well as other citizenships (information not available). The data were initially collected in the years 1997–1998 and include the complete life dates of each order member (i.e. dates of birth and entry as well as death or exit if applicable) and—as far as available—information about education and occupation as well as some other information about the

order member's life courses (such as family background or missionary activity). The main source for data collection was the so called "profession books" of the communities, in which each person ever entering is recorded with their life dates and functions inside the order. In 2006, the data were updated and extended by an additional western German monastery outside Bavaria (for more details see Luy 2003 and Luy 2009b or the regularly updated project homepage at <https://cloisterstudy.eu>).

For our analysis we merged the LES data with the data of the Cloister Study. Therefore, we selected only nuns and monks of the births cohorts 1914–1952 who were alive at the beginning of 1984 and had entered the order before 31 December 1986, so as to match the characteristics of the LES sample. This reduced the Cloister Study sample to 1,213 nuns and 671 monks. Since the data sources from the cloister archives did not contain consistently classified data on the order members' education we approximated the education level from the available information. Among male order members we used the order title (padre, cleric or brother) which was available for 664 of the selected monks. Padres (366 individuals) and clerics (1 case) have at least a high-school degree and thus belong to the high education group, whereas brothers (297 individuals) usually have a lower education level and could therefore be assigned to the low education group. Among female order members, information of the highest education level attained was available for 693 nuns of our study sample (57.1%), including 61 with high and 632 with low education level. As for the remaining 520 nuns, they were assigned an education level on the basis of their function inside the community. From the data for nuns of whom information on both education and occupation was available we inferred that most nuns with high education were working as school or university teachers. Moreover, these occupation groups include predominantly nuns with high education level (79.7% of school and 100.0% of university teachers). Thus, based on the information about their occupation we assigned 30 nuns with unknown education level to the high education group and 465 nuns with unknown education level to the low education group. For the remaining 25 nuns it was not possible to assign a level of education.

TABLE 1: DESCRIPTIVE CHARACTERISTICS OF THE STUDIED POPULATION SAMPLES

Sex	Population, sub-population	Cases	% of Pop.	Av. Age	% died
Female	General, high education	245	7.8	46.4	3.7
	General, low education	2,892	92.2	50.0	9.5
	Monastic, high education	91	7.7	48.5	5.5
	Monastic, low education	1,097	92.3	54.1	16.0
Male	General, high education	553	16.1	48.0	11.8
	General, low education	2,893	83.9	49.9	18.9
	Monastic, high education	367	55.3	51.6	19.1
	Monastic, low education	297	44.7	51.4	14.1

Data: LES and Cloister Study; Source: authors' own calculations

Finally, we restricted our analysis to individuals with information about the education level (99.9% of women and 99.9% of men of the general population, 99.0% of Catholic monks and 97.9% of Catholic nuns). Thus, the final dataset for our analyses contains 8,435 persons (22.0% Catholic order members), including 4,325 women (27.5 % Catholic nuns) and 4,110 men (16.2% Catholic monks). Further descriptive statistics of our study sample are summarised in Table 1. Survival was followed until the day of the second LES interview for the women and men of the general population and until the end of 1998 for the order



members. The maximum survival times were 182.6 months for order members and 175.8 months for the general population. We analysed the mortality of each population subgroup by a Kaplan-Meier product limit estimation and we estimated the impact of education on the survival of the cloistered and the general population by Cox proportional hazard regression modelling, separated by sex. Included covariates were population (general and monastic population), education (low and high education level as defined above) and age in 1984 (or at the time of first interview) summarised into the ten-year age groups 30–39, 40–49, 50–59 and 60–69. All analyses were carried out with the software package R, Version 2.15.2.

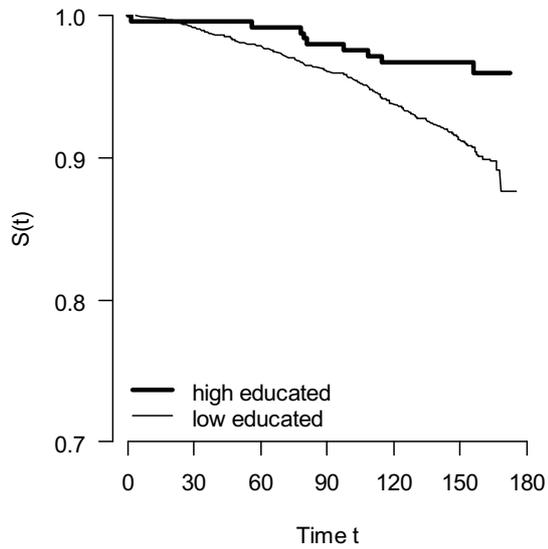
RESULTS

In a first step we produced Kaplan-Meier survival functions by education level for each studied subpopulation, i.e. women of the general population, men of the general population, female order members and male order members. The results for the complete populations—i.e. containing all individuals born between 1914 and 1952—are displayed in Figure 2. For women and men of the general population the survival functions confirm the well-known education gradient in mortality, with a distinctively better survival of individuals with higher education (Figures 2A and 2B). The survival advantage of the more highly educated persons is statistically significant for both sexes with the log rank being 0.0025 in women and 0.0001 in men. The survival functions for the female order members with high and low education displayed in Figure 2(C) show the same education gradient with a statistically significantly better survival of higher educated nuns (log rank = 0.0095). However, the survival functions for male order members do not show a clear difference in mortality for higher and lower education levels (Figure 2D). The survival functions are crossing over several times and the mean survival time (i.e. the area under the survivorship curves) is more or less identical in both education subgroups (log rank = 0.1089).

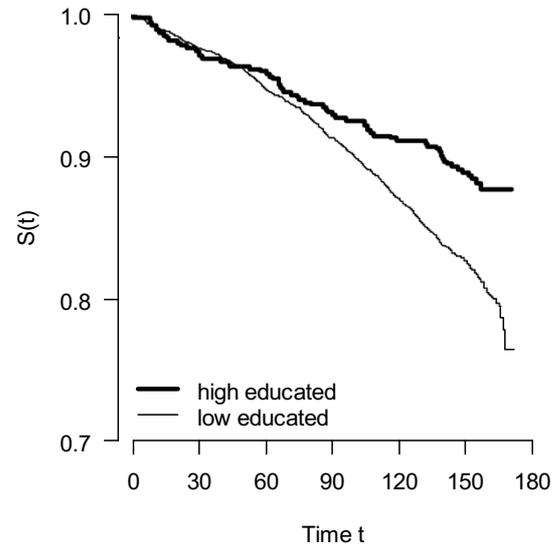
Table 2 summarises the results for the first Cox regression models on the impact of education on the survival of women which were carried out separately for the general and the monastic population. Model 1a for women of the general population and Model 1b for Catholic nuns include population as the only covariate. The models confirm the statistically significant higher mortality of women with low education for both subpopulations. The corresponding odds ratios—which reflect the relative mortality risk of less educated individuals compared to those with high education as reference category—are 2.68 ($p = 0.0036$) in women of the general population and 3.06 ($p = 0.0138$) in Catholic nuns. Models 2a for worldly women and 2b for female order members include age as an additional covariate to control for the effects of different age compositions of the analysed population sub-groups. Among the general population the relative risk for less educated women decreases to 2.14 and remains statistically significant at the 5% confidence level ($p = 0.0252$). For less educated nuns the odds ratio decreases to a similar level of 2.16, which is statistically significant only at the 10% confidence level ($p = 0.0898$), however.

FIGURE 2: KAPLAN-MEIER SURVIVAL FUNCTIONS BY EDUCATION LEVEL FOR WOMEN AND MEN OF THE GENERAL POPULATION AS WELL AS FEMALE AND MALE ORDER MEMBERS FROM 1984 TO 1998, BIRTH COHORTS 1914–1952

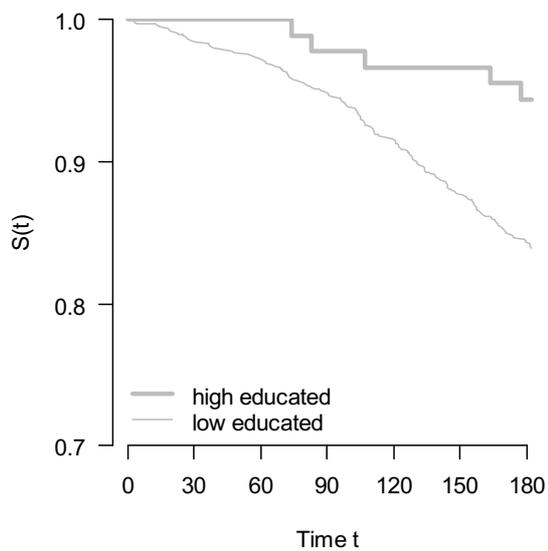
(A) GENERAL POPULATION, WOMEN



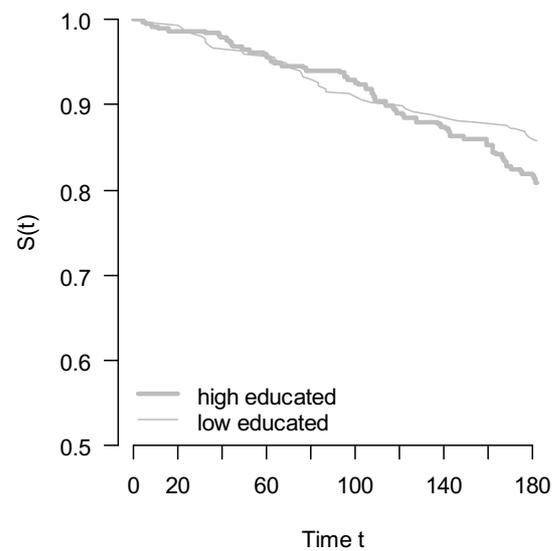
(B) GENERAL POPULATION, MEN



(C) FEMALE ORDER MEMBERS



(D) MALE ORDER MEMBERS



Note: Time t in months; Data: LES and Cloister Study; Source: authors' own calculations.

TABLE 2: COX REGRESSIONS ON THE IMPACT OF EDUCATION ON THE SURVIVAL OF WOMEN BETWEEN 1984 AND 1998, COHORTS 1914–1952, SEPARATE MODELS FOR THE GENERAL AND THE MONASTIC POPULATION

		Model 1a	Model 1b	Model 2a	Model 2b
		RR	RR	RR	RR
Population (Women)	General, high education	1.00		1.00	
	General, low education	2.68**		2.14*	
	Monastic, high education		1.00		1.00
	Monastic, low education		3.06*		2.16+
Age group	30-39			1.00	1.00
	40-49			1.45	1.39
	50-59			3.41***	4.18*
	60-69			10.76***	14.27***
R ²		0.00	0.01	0.07	0.12
Likelihood ratio test				219.1***	138.0***
df				3	3
N		3,137	1,188	3,137	1,188

Notes: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001;

Data: LES and Cloister Study; Source: authors' own calculations.

Also among men of the general population the results from the Kaplan-Meier survival functions are confirmed by the corresponding Cox regression analysis (Table 3). The mortality of general population men with low education is statistically significantly higher than the mortality of their more highly educated counterparts. This holds for both models, Model 1a without controlling for age with an odds ratio of 1.66 (p = 0.0001) and Model 2a which includes age as a control variable with an odds ratio of 1.53 (p = 0.0013). For monks the Cox regressions paint a completely different picture, as already indicated by the Kaplan-Meier analysis. In Model 1b without control for age, the Cox estimates for the whole survival time indicate that the risk of mortality of less educated order members is even lower than that of highly educated monks (odds ratio = 0.73), albeit not statistically significant (p = 0.1100). However, after controlling for age in Model 2b, the reduced risk of mortality of less educated monks becomes mildly statistically significant at the 10% confidence level (p = 0.0758) with the odds ratio being 0.71.

TABLE 3: COX REGRESSIONS ON THE IMPACT OF EDUCATION ON THE SURVIVAL OF MEN BETWEEN 1984 AND 1998, COHORTS 1914–1952, SEPARATE MODELS FOR THE GENERAL AND THE MONASTIC POPULATION

		Model 1a	Model 1b	Model 2a	Model 2b
		RR	RR	RR	RR
Population (Men)	General, high education	1.00		1.00	
	General, low education	1.66***		1.53**	
	Monastic, high education		1.00		1.00
	Monastic, low education		0.73		0.71+
Age group	30-39			1.00	1.00
	40-49			2.07***	0.56
	50-59			5.46***	2.37+
	60-69			12.39***	6.68***
R ²		0.01	0.00	0.11	0.13
Likelihood ratio test				398.5***	88.5***
df				3	3
N		3,446	664	3,446	664

Notes: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001;
Data: LES and Cloister Study; Source: authors' own calculations.

Finally, we ran Cox regressions for the combined LES–Cloister Study sample—separately for women and men and controlled for age—to assess these results by a direct comparison of education-specific mortality levels in the general and the monastic population (Table 4). In these analyses, the mortality of less educated worldly individuals as well as order members with high and low education, respectively, is expressed in relative terms to the mortality of highly educated individuals in the general population (reference category). Model 3 for women reveals that the typical education gradient in mortality can be observed similarly in both the general and the monastic population. Moreover, the mortality levels by education appear to be almost identical in both populations. While nuns with high education show no difference in mortality to highly educated women of the general population (odds ratio = 1.01, p = 0.9805), both population subgroups with low education exhibit a statistically significantly higher mortality than highly educated worldly women. The corresponding odds ratios are very similar, being 2.12 for less educated women from the general population (p = 0.0270) and 2.25 for less educated nuns (p = 0.0188). The results of this analysis are graphically displayed in Figure 3, where the estimated survival functions based on the Cox proportional hazard assumption for all four sub-populations are illustrated for the age group 50–59.

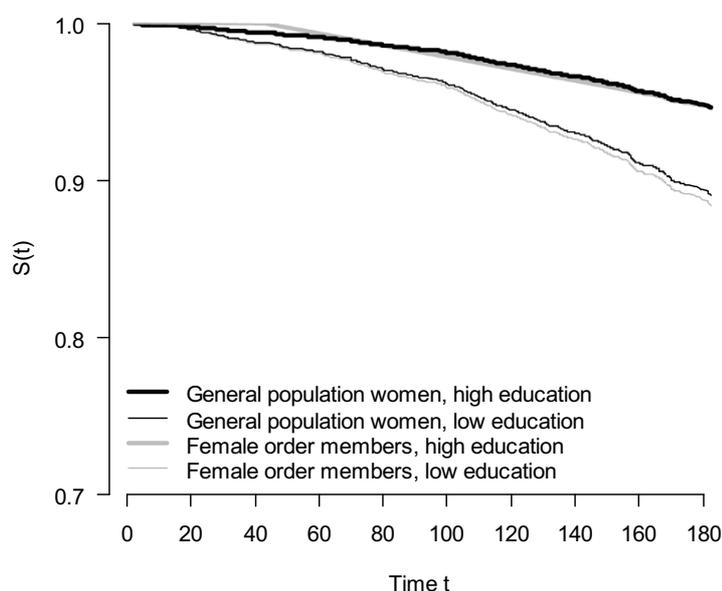
The corresponding results of the Cox regression for men are summarised in Model 4 (Table 4) and graphically illustrated in Figure 4. The mortality of worldly men with low education is statistically significantly higher than the mortality of their highly educated counterparts, the odds ratio being 1.53 (p = 0.0012). Similarly to what was observed in the female populations, the mortality of the highly educated male order members is more or less identical to the mortality of men with high education in the general population (odds ratio = 1.04, p = 0.8239). The decisive difference in the overall picture is caused by the less educated monks. Their mortality does not differ with any statistical significance from that of highly educated worldly men (p = 0.1378). Moreover, the odds ratio of 0.74 indicates that less educated monks have the lowest mortality of all male subpopulations (see also Figure 4).

TABLE 4: COX REGRESSIONS ON THE IMPACT OF EDUCATION ON THE SURVIVAL OF WOMEN AND MEN BETWEEN 1984 AND 1998, COHORTS 1914–1952, JOINT MODELS FOR THE GENERAL AND THE MONASTIC POPULATION

		Model 3 - Women		Model 4 - Men	
		RR	S.E.	RR	S.E.
Population	General, high education	1.00		1.00	
	General, low education	2.12*	0.3392	1.53**	0.1313
	Monastic, high education	1.01	0.5591	1.04	0.1777
	Monastic, low education	2.25*	0.3443	0.74	0.2034
Age group	30-39	1.00		1.00	
	40-49	1.38	0.2823	1.77**	0.2036
	50-59	3.48***	0.2614	4.90***	0.1911
	60-69	11.32***	0.2515	11.54***	0.1880
R ²		0.09		0.12	
Likelihood ratio test		355.7***		479.6***	
df		3		3	
N		4,325		4,110	

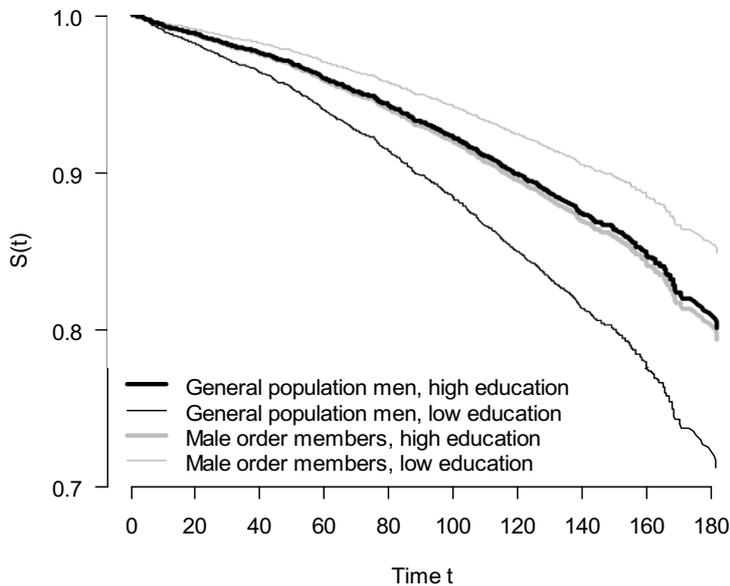
Notes: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
 Data: LES and Cloister Study, authors' own calculations

FIGURE 3: ESTIMATED SURVIVAL FUNCTIONS BY EDUCATION LEVEL FOR WOMEN OF THE GENERAL AND THE MONASTIC POPULATION, COX REGRESSION MODEL 4, ILLUSTRATED FOR AGE GROUP 50–59



Data: LES and Cloister Study, authors' own calculations

FIGURE 4: ESTIMATED SURVIVAL FUNCTIONS BY EDUCATION LEVEL FOR MEN OF THE GENERAL AND THE MONASTIC POPULATION, COX REGRESSION MODEL 4, ILLUSTRATED FOR AGE GROUP 50–59



Data: LES and Cloister Study, authors' own calculations

DISCUSSION

Studies of order members have a long scientific tradition in the research area of health and mortality where they provided already path-breaking knowledge for human medicine and demography. Specifically, they have helped to understand determinants and/or transmission factors of breast cancer (Ramazzini 1713), cervical cancer (Rigoni-Stern 1842), tuberculosis (Cornet 1890) and, most recently, Alzheimer's disease (Snowdon 2001). In the field of demography, the analysis of nuns' and monks' mortality led to the first sex-specific life tables and thus to the first clear empirical evidence that women live longer than men (Deparcieux 1746). Furthermore, nun studies provided important insights into the impact of biological factors for sex differences in life expectancy in pre-war years (Madigan 1957) and in post-war periods (Luy 2003) as well as for excess male mortality due to external causes of death (Luy 2009b). All these studies used the much more homogenous lifestyle of nuns and monks and their well-documented life histories as a central basis.

In this paper we used the special characteristics of order life to test the still open question of whether a direct effect of education on mortality exists. The study of Catholic nuns and monks has the great advantage that many factors related to the mortality differences by SES are automatically controlled for. Before interpreting the results it must be noted, however, that our comparison of people in the general population and order members is limited because of the difference in data types. The information for the nuns and monks stems from archive data for the complete population of the communities participating to the Cloister Study. By contrast, information for women and men of the western German general population originates from a sample of a longitudinal two-wave survey including not only attrition and cases with unknown survival status at the end of the observation

time. It has also been shown that participation in health surveys usually results in specifically composed samples, with participants being strongly selected towards better health and higher SES (see, e.g. Osler and Schroll 1992; Hoeymans et al. 1998; von Strauss et al. 1998; Boshuizen et al. 2006). Further limitations of our study are the—somewhat—different derivations of the studied individuals' education level, the censored survival times and the low numbers of deaths in some of the analysed population groups. However, the investigation is based on longitudinal survival experiences which has clear advantages compared to the more commonly conducted analysis of cross-sectional period data. Moreover, the long observed survival time (approximately 14 years) is appropriate for a longitudinal analysis of mortality differences although we cannot exclude that the differentials change between the end of the observation and the extinction of our study samples.

In the end, our study provides mixed evidence for the existence of a direct effect of education on mortality. Therefore, we have to reject our basic hypothesis that education has a significant impact on order members' mortality but to a lower extent than in the general population. Among female order members we found the same education gradient as among women of the general population. Thus, our results confirm the previous investigations of the US Nun Study which found equivalent directed survival differences by education among Catholic nuns (Snowdon et al. 1989), indicating a direct relation between education and mortality. On the other hand, male order members with lower education show no statically significant mortality differences to monks with higher education. On the contrary, the odds ratios even point at a rather better survival. Note, however, that the results provided by the presented Cox regressions are strongly influenced by the proportional hazards assumption which translates the overall mortality differences into constant inequalities over the entire observed survival time. Therefore, the relative education-specific mortality risk among Catholic monks estimated in the Cox models reflects predominantly the differences at the end of the survival time. The Kaplan-Meier survivorship functions in Figure 2(D)—which, by contrast, reflect the actual survival of the study samples—show that the survival differences between less and highly educated monks are in fact not proportional. Instead, the survivorship curves cross over several times, indicating that no real survival differences exist between the two education groups.

We also found that the survival of order members with high education is almost identical to the survival of their worldly counterparts. It seems therefore that highly educated women and men of both the general and the monastic population are similar with regard to the risk factors for mortality. This similarity includes not only factors related to the risk of dying but also those with protective characteristics as part of the learning and reasoning–health behaviour path that has been described in the introduction (see also Figure 1). In other words, it seems that among highly educated individuals the life in religious communities does not provide any protection against potential mortality risks to which women and men of the worldly society are exposed to. Hence, the decisive survival differences with regard to our research question occur among order members with low education. While nuns with low education show survival rates very similar to less educated women of the general population, monks with low education show considerably better survival than their worldly counterparts. In additional Cox regressions on the differences between monastic and general populations inside the education groups of our study (and controlled for age as performed in the analyses presented in the results section of this paper) we found that the less educated monks are indeed the only subgroup of order members whose mortality differs statistically significantly from the counterparts of the general populations. The odds ratios with the corresponding general population group as reference category are 0.48 for less educated monks ($p < 0.0001$), 1.07 for highly educated monks ($p = 0.6981$), 1.07 for less educated nuns ($p = 0.5290$) and 0.82 for highly educated nuns ($p = 0.7541$).



To assess the findings of our investigations we do not only have to take into account the differences in education-specific mortality risks between female and male order members, but also the differences in relation to their worldly counterparts as well as the differences between the sexes in general. There are three different interpretations that would be in accordance with the results of this study:

1. A direct effect of education on mortality exists for both sexes, but specific factors overlay this effect among less educated monks;
2. A direct effect of education on mortality exists neither for men nor for women, but less educated nuns are exposed to mortality risks related to education similarly to the women and men of the general population;
3. A direct effect of education on mortality exists among women but not among men.

If the first explanation were true, the question is why less educated monks do not show disadvantaged survival conditions compared to their more highly educated counterparts, just as the other three low-education groups do, i.e. less educated women and men of the general population as well as nuns with low education level. One difference between the female and male religious communities is the proportion of members with high education level. While among nuns this proportion is 7.7% and thus very similar to the women of the general population (7.8%), more than half of the monks have a high education level (55.3%), compared to 16.1% in the male general population (see Table 1). Thus, it might be that less educated monks profit from the high education level of the majority of their community, either indirectly because important health-related factors of community life are determined by the highly educated members or directly through adaption of health behaviours and strategies to manage or avoid health threats. Moreover, it is true that specific occupations with severe health threats, such as working with poisoning materials etc. which are typically done by less educated men in the general population are not performed by order members. This could also explain why the protective effect of monastic life can be found predominantly among men with lower education.

If the second explanation were true, we have to understand what adverse risk factors less educated nuns might be exposed to that monks with low education are not. It is in general an unexpected finding that nuns do not profit at all from monastic life in terms of life years. Given the fact that smoking was and still is prohibited in female orders (see Luy 2003) this observation is even more surprising. Thus, among women the protective effects of order life seem to be outbalanced by other risk factors for mortality. Based on an analysis of causes of death in a sample of the Cloister Study, Luy (2009a) assumes that these adverse health risks of nuns are caused by a higher stress load related to occupation and childlessness. In fact, compared to the women of the general population, nuns' lives are not only characterised by quasi full employment, but most of them—and in particular those with lower education—work in extremely stressful occupations such as kindergarten teachers or nurses. Although the adverse effects of childlessness (see e.g. Green et al. 1988; Friedlander 1996; Doblhammer 2000; Hurt et al. 2006) can be expected to affect nuns of all education levels similarly, it might be that less educated nuns are even more affected by the negative consequences of job-related stress, above all in comparison to worldly women. This could also explain why the education effect on mortality cannot be found in male order members among whom the occupation rate—and probably also the average stress load—is more similar to the general population. Moreover, some studies have shown that women are more susceptible than men to the negative health consequences of stress related to occupation (Frankenhaeuser et al. 1989; Spielberger and Reheiser 1994).

Ultimately, there is a third line of reasoning which is based on the hypothesis that the mechanisms of the relationship between education and mortality are different in women and men. In more detail, this explanation builds upon the mediating role of illnesses and corresponding causes of death in the cause–effect chain that connects education with mortality. Studies on sex differences in health and mortality reveal that women and men differ with regard to the types of illnesses they have and their relation to mortality. Many findings indicate that women suffer from more chronic conditions than men do, whereas many of those conditions with a male excess are the more immediate causes of death, like coronary heart disease and cerebrovascular disease (e.g. Verbrugge 1985; Dunnell et al. Bunting 1999; Spiers et al. 2003; Case and Paxson 2005; Grundy 2006). Furthermore, men are affected more frequently than women by problems closely related to the risk of dying, like alcoholism linked to cirrhosis of the liver and, in younger adult ages, injuries linked to accidents and homicide (Verbrugge and Wingard 1987; Rieker and Bird 2000). These differences between the sexes could not only lead to different mortality levels but also to different causation patterns for the relationship between education and mortality. This might make specific factors more important for women than for men and vice versa. For instance, psychiatric diseases belong to the illnesses which occur more often in women than in men. It is therefore possible that these diseases are causing education-specific mortality differences through the pathway education–mental disorders–mortality among women as illustrated in Figure 1, while at the same time this direct effect of education on mortality is insignificant or offset by other factors related to SES among men. Note that different effects on women’s and men’s mortality have been reported also for other socioeconomic characteristics, e.g. for unemployment (Garcy and Vågerö 2012).

At this stage of our research we cannot determine which of the three explanations is true. Although we began this study with a simple and promising research design we have to conclude that we cannot answer the basic research question of whether a direct effect of education on mortality exists. If we had focused on only one sex we would have possibly come up with a clear conclusion. Thus, this study demonstrates how important it is to collect comprehensive data to investigate causal mechanisms in mortality differentials and how difficult it is to gain thoroughly reliable evidence.

However, as a side effect, this study provides interesting and important insights with regard to some previous findings of the Cloister Study on the overall life expectancy of Catholic order members. In an analysis of trends in period life expectancy no differences could be found between nuns and women of the general population since the 1960s, but large differences between the male populations – with monks showing an advantage of up to four years in life expectancy at young adult ages (Luy 2003). As a consequence, the sex gap in life expectancy is reduced to about one year among Catholic order members. Until now it is still unclear what drives this huge difference to the general population. The longitudinal survival analysis for the years 1984 to 1998 presented in this paper reveals that the similarity of mortality conditions between women of the general population and Catholic nuns does not only apply to the overall populations but also to the subgroups of women with high and low education level. Moreover, the present study indicates that the higher life expectancy of monks compared to men of the general population is not a consequence of a general survival advantage of male order members. Obviously, it is predominantly the men with low education who profit from living in a religious community. It seems therefore that they are the main cause for the overall high life expectancy of Catholic monks and consequently for the small sex gap in life expectancy among order members. Moreover, with this finding our study provides strong support for the hypothesis that the extent of sex differences in mortality is primarily determined by the lifestyles and living conditions of men with low SES as outlined by Nathanson and Lopez (1987) and further supported by Luy and Gast (2014).

Not only in light of the latter conclusion we must hardly add that further research is necessary to understand the causes of the different effects of education on mortality among female and male order members. This would be important not only to gain better insights into the still unknown mechanisms behind the relationship between education and mortality. It would also be a big step forward to a deeper understanding of the general network of mortality-relevant factors related to SES and probably also to the drivers of differences in overall mortality between specific populations or population subgroups. Finally, it is important to note that all our interpretations are based on the assumption that Catholic order members are representative for all women and men. Obviously, a sex-specific selectivity of order members would have significant consequences on the results and, above all, on the conclusions to be drawn from this study. With the exceptions of chapters 2.1 and 2.2 of this report, this question has never been investigated directly. There is only some evidence regarding female order members from a study by Timio et al. (1999) who tested some medical conditions and health behaviours which might cause biases when comparing monastic and general populations. They reported that the nuns and the worldly women of their study were similar in most of these conditions. Evidence for men is missing, however. The explorations of a potential selection effect among order members presented in chapters 2.1 and 2.2 of this volume did likewise not find any strong indication for a significant bias. Nonetheless, all these findings are not conclusive and it is clear that if such a selection exists it would be necessary to know its precise nature and how the health–mortality relationship is affected. Taking this knowledge into account would still provide important insights into the mechanism of the relationship between health and mortality and also into the causes of the investigated effects of education on mortality. Thus, many questions related to the mortality experiences of order members are still unanswered and call for intensified follow up research to draw the right conclusions from this interesting and promising quasi-experiment.

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