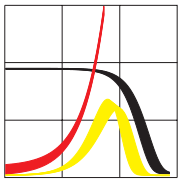

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The Impact of Health Behaviors and Life Quality on Gender Differences in Mortality

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1. INTRODUCTION

Women on average live longer than men – this has been known since more than two centuries, and at least since the mid eighteenth century when Struyck (1740) and Deparcieux (1746) constructed the first life tables separated by sex. Male excess mortality was confirmed when the construction of official population statistics began in all Western societies and holds until today, as can be observed in Sweden from 1751 onwards (Tabutin 1978). The question to which extent biological respective non-biological factors are responsible for this phenomenon is almost as old as the knowledge that there is a female survival advantage. The first explanations were of purely biological kind (e.g., Casper 1835), later they turned increasingly non-biological as male excess mortality continued to climb during the 20th century. In Germany, for instance, the differences in life expectancy at birth changed from a relatively constant female survival advantage of three years before World War II to the present level of more than six years (Luy 2004b). In most of the other industrialized countries the gender gap in mortality began to widen after World War I (Stolnitz 1956), particularly in the United States and in England and Wales (Wiehl 1938). This development coincided with an increase among men in mortality due to cardiovascular disease, cancer and accidents, and with the fall in maternal mortality and in the causes of death related to pregnancy among women (Lopez 1983). Recent mortality data seem to indicate a change in this diverging trend. In most industrialized countries, the gender-specific mortality gap has been slowly narrowing since the beginning of the 1980s (Buettner 1995; Trovato and Lalu 1996, 2001; Newman and Brach 2001; Luy 2002a, 2004b). Controversy surrounds expected future trends in mortality. Some demographers assume in their forecasts that male excess mortality will increase again (Carter and Lee 1992), whilst others predict a further closing of the gap (Bell et al. 1992; Birg 2000).

The question of whether mortality differences between women and men will maintain, decrease or increase is an important one. For instance, the future sex ratio of the older population especially is mainly affected by developments in female and male mortality. Thus, future mortality trends determine the future proportion of women and men staying married later in life, with consequential effects on survivor pensions, health insurances, demands for nursing care, among many others. Policy makers and insurance companies are depending on demographic forecasts in order to asses future conditions. However, to define the assumptions for reliable projections, first, a deeper knowledge of the causes of male excess mortality is required. A simple sex separation projection on the basis of past developments is insufficient since mortality differences are generally caused by a complex pattern of different factors that change their impact as the environment changes in terms of economic, political, and societal conditions, medical progress, but also with individual health behaviors and life styles affecting survival conditions on the macro level.

Recent studies indicate that the female survival advantage can be attributed in the most to behavioral and environmental factors whereas the impact of purely biological factors seems to be limited to one to two years in life expectancy at birth (Pressat 1973; Wingard 1982; Ram 1993; Luy 2002b, 2003). However, the quantitative contribution of the different behavioral factors to mortality differences between women and men is subject to controversy. This is partly due to the fact that research on the influence of health behavior on mortality differences suffered from the lack of suitable survey data. Thus, in most studies, only the impact of a few behavioral or environmental factors could be directly controlled in analyzing male excess mortality. In this paper, we will concentrate on the links between different non-biological factors, using longitudinal micro level data from Germany especially designed for studies on health and mortality. Usually, health related behaviors, such as smoking, nutrition, or alcohol consumption, are analyzed separately and in isolation of environmental factors to describe the causes of male excess mortality. Since this kind of analysis automatically excludes important connections between the different factors, our focus lies in the development of a lifestyle approach that reflects the interplay between certain health behaviors, living conditions, and social backgrounds working as intermediating platforms between micro level actions and macro level effects. Note that the described trends in rising as well as in decreasing male excess mortality also coincided with a considerable change in gender roles in the societies. Ultimately, a more specific gender view can help in understanding how the social status level, and then lifestyles, influence mortality differences between men and women.

In the first part of the paper, we will review the current knowledge about the factors influencing gender-specific mortality differences. We concentrate on non-biological factors that are

the subject of our analysis and clarify the theoretical background of our study. Following a description of data and research methods, we present the outcomes of our analysis and discuss the results so far gained.

2. THEORETICAL BACKGROUND OF THE STUDY

2.1. Biological versus non-biological factors

The amount of research contributing to find and describe the causes behind mortality differences between women and men abounds in plentitude (lengthy reviews can be found in Nathanson 1984; Wingard 1984; Waldron 1985; Lang et al. 1994; Carey and Lopreato 1995; Luy 2002a). As mentioned above, the hypothesis advanced to explain male excess mortality can be divided into two basic categories: the biological approach (focusing on biological and genetic factors, thus factors largely beyond human control) and the non-biological approach (focusing on behavioral and environmental factors, thus factors directly or indirectly influenced by human action).

According to the biological approach, women are less prone to disease for anatomic and physiological reasons (e.g. Lopez 1983; Waldron 1983a, 1985; Nathanson 1984). The female survival advantage is assumed to be a consequence of the additional X chromosome (Smith and Warner 1989; Skuse et al. 1997; Puck and Willard 1998; Kraemer 2000; Christensen et al. 2000, 2001) and of endogenous female hormones (Winkelstein et al. 1958; London et al. 1961; Kannel et al. 1976; Grodstein et al. 1997; Horiuchi 1997; Klotz and Stauffer 2003), which are held to protect women especially against ischemic heart disease. Male excess mortality exists in most animal species (Hamilton 1948; Comfort 1979; Smith 1989; Carey and Judge 2000), and among humans higher male mortality rates hold among children (Aaby 1998), even among infants, and in the prenatal period. Here, the higher rates cannot be caused by gender-specific behavioral differences (Wingard 1982; Lopez 1983; Dinkel 1984; Waldron 1985; Hazzard 1986). Thus, the existence of at least a biological basis for the female survival advantage is undoubted (Hayflick 1982).

On the other side, the advocates of the non-biological approach argue that society and culture influence men to lead lifestyles that are increasingly detrimental to health and life (in terms of smoking habits, alcohol consumption, diet, exercise, reckless driving, and so on), that men are subjected to greater health risks at work, that environmental factors lead to survival disadvantages for men, and that men are generally more exposed and susceptible to different kinds of social and psychological stress than their female counterparts. Probably the largest contribu-

tion to increasing male excess mortality is made by nicotine consumption (Retherford 1975; Nathanson 1984; Waldron 1985; Pampel and Zimmer 1989; Rogers et al. 2000), as expressed by higher male mortality caused by lung cancer and heart failure (Waldron 1976, 1986; United Nations Secretariat 1988). This phenomenon has been documented in many studies (e.g., Hammond 1966; Preston 1970; Burbank 1972; Johnson 1977; Holden 1983; Miller and Gerstein 1983; Rogers and Powell-Griner 1991; Hummer et al. 1998; Nilsson et al. 2001; Payne 2001). Furthermore, smoking also appears to play a considerable role in the currently observed slow narrowing of the sex-specific mortality gap since the share of female smokers increased considerably in the last decades (Waldron 1993; Lopez et al. 1994; Nathanson 1995; Trovato and Lalu 1998; Pampel 2002, 2003). A survival advantage among women may additionally be conferred by the tendency for women to consult a doctor earlier and more often than men, both in the case of noticing symptoms of illness and for health care needs related to child-bearing (Hazzard 1986). This gives rise to the possibility to recognize serious diseases in time to treat them successfully (Lang et al. 1994). However, the contribution of this factor to the mortality differences between women and men is discussed controversially (Dinkel 1984; Verbrugge 1985; Johansson 1991).

Social stress is seen as another basic causal factor of increasing male excess mortality, above all in connection with ischemic heart disease (Waldron 1995). In this context, Jenkins introduced the term "Type A behavior", which is characterized by intensive striving for achievement, competitiveness, the tendency to be easily provoked, impatience, time urgency, abruptness of gesture and speech, over-commitment to vocation or profession, and excesses of drive and hostility (Jenkins 1976: 1034). In Western societies, Type A behavior is found more frequently among men since it is strongly linked with professional life and social status (Waldron 1978, 1985; Hayes and Feinleib 1980; Nathanson 1984). Because lifestyles generally differ with the level of social status, sex differences in mortality may also be affected by the fact that men and women are not equally distributed within the social classes (see, e.g., Davidson and Townsend 1982; Marmot et al. 1984; Schepers and Wagner 1989; Lahelma and Valkonen 1990; Johansson 1991; Klein 1993; Valkonen 1993; Vallin 1995; Helmert et al. 1997; McDonough et al. 1999; Rogers et al. 2000; Anson 2003). Nathanson and Lopez (1987) hypothesized that the extent of male excess mortality is almost exclusively determined by the harmful lifestyles of men of low socio-economic status. This hypothesis was confirmed by the finding that the gender gap in mortality remained almost constant among the cloistered population, caused by the fact that monks (with lifestyles and environmental risk factors more similar to men of higher rather than lower social class) show almost identical gains in survival during the 20th century as nuns and women of the general population (see Luy in this volume). Also, Wingard et al. (1983) found that sex differences in mortality are larger at lower than at higher levels of social class. Finally, another factor probably connected

with lifestyles and living conditions is that the mortality of both sexes is differentiated by marital status, with stronger effects for men, resulting in a smaller male disadvantage among the married than among the unmarried population (Carter and Glick 1976; Nathanson 1984; Gärtner 1990; Rogers 1995a; Martikainen and Valkonen 1996).

Most of the arguments under the non-biological approach combine behavioral and societal factors. Beside this group of arguments, there are also explanations exclusively based on environmental factors that exert a different influence on male and female mortality and call for a more gender-oriented research design. Preston (1976) pointed out that economic modernization has improved the status of women more than that of men, and thus has led to a greater reduction in mortality among women. Similarly, Ram (1993) identified the societal position of women and the degree of modernization of society as the decisive causes for the extent that male excess mortality has taken. This hypothesis gains support from a study by Luy (2004a), who found that during the last three centuries in times of female and male excess mortality, the mortality of monks belonging to former mendicant orders was constantly closer to the mortality level of the female population than to the mortality level of the general male population (thus regardless whether female mortality was higher or lower than male mortality). Furthermore, some evidence exists that the characteristics of welfare state regimes may have a differentiated impact on health by sex. For example, in Britain, Finland, and Japan – representing 'liberal', 'Nordic', and 'conservative' welfare state regimes – they produce broadly similar patterns of socioeconomic health differences among men. However, different patterns of labor-force participation and welfare provision may be associated with different patterns of socioeconomic differences in health for employed women (Martikainen et al, 2004).

2.2. The interplay between biological and non-biological factors and the health lifestyle approach

It has been proven impossible to explain the observed trends in mortality differences between women and men by relying solely on one of the two groups of approaches (Verbrugge 1989; Johansson 1991; Rogers 1995b; Waldron 2000). Several authors thus have aimed to determine the relative contributions of biological, behavioral, and environmental factors to mortality between men and women (Pressat 1973; Wingard 1982, 1984; Lopez 1983; Waldron 1983a, 1983b; Stillion 1985; Holden 1987; Pampel and Zimmer 1989; Gage 1994; Lang et al. 1994). Some studies have been conducted on groups of individuals among whom men and women are comparable in one or several patterns that are relevant to mortality, showing a lower male excess mortality than that found in the general population (Hammond 1966; Philips et al. 1980; Berkel

and de Waard 1983; Luy 2002b, 2003; see also Luy in this volume). The biggest difficulty in estimating the impact of biological and non-biological factors is the analytical separation of the two categories of possible causes. First, there are several routes through which biological factors may not only be responsible for a basic female survival advantage but also indirectly contribute to (increasing) male excess mortality in interaction with behavioral and environmental factors. Smoking, an unhealthy diet, excessive body weight in relation to height, the lack of exercise, and stress are thought to operate primarily by raising mortality from coronary heart disease. That female hormones protect women against this kind of disease provides a clear example of how biological differences between the sexes play an important mediating role between non-biological factors and ultimate mortality (see Retherford 1975).

Another possible interplay between biological and non-biological factors is found in the hypothesis presented regarding sex-differentiated long-term effects of war on mortality. Horiuchi (1983) assumes that the impact of World War II on increasing male excess mortality operates through the poor nutritional status of the population in the postwar years. As a result of sex-specific anatomic characteristics (a greater female ability to store energy in the form of body fat), the nutritional deficit affected mainly adolescent men at the end of the war by causing increased susceptibility to cardiovascular disease later in life. Additionally, Haudidier (1995) assumes that wars caused psychological shocks among persons of child age during the wars, which affected later mortality more so among the male population as a consequence of the mixture of biological, psychological, and sociological factors. However, in populations directly involved in the two World Wars, the increasing mortality gap between women and men in the following decades might also be linked to the impact of the wars on the risk selection of men and women. The majority of male war victims was selected among the so-called "good risks" (healthy persons in good physical condition), whereas females who died during and immediately after the two World Wars were subject to nutrition, hygiene, and medical treatment conditions that were poor, and other stress factors that largely affected the "poor risks", persons who were physically weaker and less healthy (Dinkel 1984; Haudidier 1995).

These examples make clear that it is impossible to standardize for behavioral and biological factors since women and men usually are subject to differing environmental influences (Waldron 1983b). Consequently, probably no analysis will ever be able to quantify the impact of all factors contributing to male excess mortality in order to provide a complete picture. These limitations have to be kept in mind when analyzing the impact of different health behaviors on mortality differences between women and men. Thus, we aim to develop a concept allowing for the interaction between behavioral and environmental factors. Our starting point is Dasgupta's (1990) micro-level approach of relative welfare as a decisive determinant of macro-level longevity.

This concept is based on the hypothesis that relative welfare involves the interplay of "positive rights" (or "positive freedoms") and "negative rights" (or "negative freedoms"). Positive rights are defined as the extent to which the individual members of any population are free to make fundamental decisions about their long-term welfare (or the welfare of their dependants) because they control the material resources necessary to support extended longevity, for instance, through education, work, and health care. Negative rights are defined as the extent to which individuals are free to dispose of whatever resources they happen to control on a day-to-day basis, in order to satisfy their short run needs, and/or pursue various forms of pleasure. In setting this relative welfare approach within a cultural framework raised on biological foundations, Johansson (1991) developed a complex theory to explain the historical development of male excess mortality. According to him, it is the interaction of culturally constructed positive and negative rights and behavior patterns with a time and place specific disease environment that transforms human choices into sex-specific patterns of exposure and resistance. This has direct consequences for health and mortality and thus determines the extent as well as the direction of sex mortality differences.[1] If this hypothesis holds, men and women should develop different health life styles, or, given the existence of different lifestyles with different impacts on health and mortality, the two sexes should be unequally distributed in these lifestyle groups. Accordingly, individual behaviors should be summarized to define certain life-style groups with specific health-relevant characteristics. At the end, this may contribute to a deeper understanding of the complex patterns of behavioral, environmental, and also indirectly of the biological factors that determine male excess mortality.

Lifestyles as explanatory variable were already used in order to explain the mortality gap between women and men in Russia, where male excess mortality is the highest in the world with a current difference of 13 years in life expectancy at birth. Building on Weber's (1978) distinction between life chances and life choices and Bourdieu's (1984) notion of *habitus*[2], Cockerham (e.g. 1999, 2005) has developed a sociological explanation for the mortality crisis of Russian people – the healthy lifestyles theory. As reported in Abbott et al. (2006), he argues that health behaviors

[1] The exposure patterns involve the degree to which individuals come into contact on a regular basis with microorganisms, parasites, toxins, radiation, carcinogens, or trauma-related risks, all causing "disease" and premature mortality; resistance levels include the inborn and the acquired capacity of individuals to utilize biological or social resources to limit (or reverse) the biological damage caused by all forms of exposure. Resistance involves factors that are genetic (like the relative efficiency of the immune system), learned (like eating habits and exercise patterns) and socially driven (in terms of the home and hospital care that individuals receive when they are recognized as being "sick") (Johansson 1991: 138).

[2] Bourdieu defines *habitus* as "systems of durable, transposable dispositions, structured structures predisposed to operate as structuring structures, that is, as principles which generate and organize practices and representations that can be objectively adapted to their outcomes without presupposing a conscious aiming at ends or an express mastery of the operations necessary in order to attain them". In other words (Cockerham et al., 1997) "knowledge of social structures and conditions produces enduring orientations toward action that are more or less routine, and when these orientations are acted upon they tend to reproduce the structures from which they are derived".

are culturally shared practices formed by socialization and experience and shaped by material circumstances. Not only do resources and structural factors (life chances) mitigate against Russians and Ukrainians adopting healthy lifestyles, but so do culturally embedded practices (drinking, smoking, poor diet, and lack of recreational exercise) more typical for men than for women, as well as a passive orientation to health developed under communism and encouraged by the belief that health depends on the health-care system rather than on individual behavior. The resultant *habitus*, it is argued, has produced a relatively enduring disposition for Russian and Ukrainian men to lead unhealthy life styles, and this in a situation where there are limited opportunities for the individuals to do otherwise (see, e.g. Cockerham, 1999; Cockerham et al., 2005). The qualitative study by Abbott et al. (2006) has found slightly different results, with Russians having a more responsible attitude towards their own health. Nonetheless, the Russian circumstances (a broadening gap in life expectancy between the two sexes due to an unprecedented mortality crisis among men) have challenged the bio-medical definitions and pushed researchers to realize the importance of understanding health – and as a result of this, mortality -as a complex multidimensional social phenomena (Blaxter, 1990; Bury, 2000), with lay understandings of health needing to be contextualized in people's lived experiences (Blair, 1993). Lay understandings influence not only the ways in which people interpret their experience of health and illness but also the ways in which they act to promote their own health and that of their families (Blaxter and Paterson, 1982; Cornwell, 1984; Graham, 1984).

3. DATA

The German Life Expectancy Survey (LES) is used to examine the impact of individual health behavior and life quality on mortality differences between women and men. The LES is a panel survey that to date consists of two waves of interviews. It is based on the National Health Survey, which was a major element of the "German Heart Circulation Study". The first National Health Survey was carried out between 1984 and 1986. In the following years, there followed more surveys on this group of topics, including the New Federal States for the first time in 1991/92. All of these surveys were cross-sectional in nature, each based on a new representative random sample and including medical examinations in some cases. In 1998, the Federal Institute for Population Research (BiB) carried out a follow-up survey of the individuals interviewed in an earlier survey. For West Germany, the basis used was the survey of 1984/86, since the number of respondents was the largest and, due to the relatively long time interval, it was also possible to gain sufficient information regarding the already deceased. For East Germany, the 1991/92 sur-

vey was used as the basis for the second interview. In the second wave of the survey, the initial questionnaires, which already contain information about education, employment, physical activity, nutrition, smoking behavior, health, and morbidity, use of public health services, former life course, future perspectives, as well as several indicators for quality of life (reported satisfaction with different aspects of daily life) were slightly modified because of the specific research questions of the BiB. Purely medical details were removed and replaced by more detailed questions on general living conditions (like the availability of shopping centers, medical doctors, churches, restaurants, green space, etc.) and family situations.

All in all, the LES contains 10,020 individuals, i.e., 8,474 from West Germany (4,335 men and 4,139 women surveyed in the years 1984 to 1986) and 1,546 from East Germany (733 men and 813 women surveyed in the years 1991 and 1992). Unfortunately, 2,137 persons could not be traced or no longer be reached to conduct a second interview as a consequence of the long time interval between the two survey waves (especially for the West German sample). Of those recaptured, 1,081 died by the time of the follow-up survey in 1998 (957 of the Western and 124 of the Eastern German sample). Additionally, due to refusals, the number of people interviewed in the second wave decreased to 3,939 individuals from the West and 904 individuals from the East German sample. The 1998 sample thus must be expected to contain a health selected group of the first survey sample. This does not affect the present study, however. Since we are interested in mortality, information of the first survey only can be used. To cope with the other mentioned problems of the data, we chose a special sub-sample of the LES, based on the following characteristics:

1. Only the West-sample of the LES is used because (i) the different periods of the first survey prohibits a combination or comparison of the West and the East sample and (ii) the number of deaths in the East-sample is insufficient regarding the planned analysis of gender-specific lifestyle-groups. Thus, we have an observed time span of the individuals from the first survey in the years 1984/86 to the second survey in 1998 of up to 171.0 months for the individuals with the longest observation time.
2. We focused on the cohort of ages 60-69 at the time of first interview in 1984/1986 since in the last decades ages 60-75 form the most important age segment regarding overall mortality differences between women and men (Luy and Di Giulio, 2005).
3. We included only those individuals of whom the survival status at the time of the second interview in 1998 is known. This reduced the sample size by about 17.3% (almost two thirds of them are women).

These restrictions finally decreased the number of observed cases to 1,674 individuals. Of these, 402 died until the time of the second survey in 1998. Table 1 shows a division of these

numbers by sex. The used sub-sample of the LES reflects the true mortality of the West German population almost perfectly despite the expected selection effects and thus builds a reliable base for the event-history analysis intended (for a more detailed description see Luy and Di Giulio, 2005).

- about here Table 1 -

4. RESEARCH STRATEGY AND METHODS OF ANALYSIS

The main goal of this paper is to group people according to their health lifestyles and to assess the extent to which a "lifestyle group" approach adds to the understanding of sex mortality differences at older ages. We proceed in three steps: First, we summarize the health behaviors that we can implement from the LES data by means of a multiple correspondence analysis (MCA, see subsection a). The MCA produces results in form of new quantitative variables, which we will use in the next step. Second, we group individuals who show a similar health lifestyle by means of a cluster analysis (see subsection b) applied to the results previously found with MCA Next, we will use the lifestyle groups to study the different survival of men and women, using a Cox regression model (see subsection c).

a) Multiple Correspondence Analysis

The Multiple Correspondence Analysis (MCA) is a statistical factorial technique developed primarily in France by Jean-Paul Benzecri in the early 1960's and 1970's (Benzecri, 1973). It is commonly used to analyze large frequency tables, with the primary purpose to produce a simplified (low-dimensional) representation of the information. The basic features of MCA are the symmetric nature (no variable plays an explicative role), the descriptive and explorative (not explanatory) power, and its applicability to categorical variables. The results provide information that is similar in nature to those produced by factor analysis techniques, and they allow to explore the structure of categorical variables included in the data. The analysis produces a set of new quantitative variables, each of one account for the explanation of a part of the total variability of the sample along the different dimensions studied. It is possible to visualize graphically the results of MCA. For example, on the first factorial plan, represented by the two first axes (the two first components), the categories that are closer to the axes and more distant from the center of the factorial plan will be specially important to define the meaning of that component. For further information, see Greenacre (1984). We will use a slightly modified version of MCA, designed

specifically so that missing values of the variables do not concur in the definition of the main components (Benali and Escofier, 1987).

b) Cluster Analysis

The cluster analysis divides the data into groups (clusters) by means of a defined criterion in a way that similar objects belong to the same cluster, and dissimilar objects belong to different clusters. The resulting data partition improves the understanding of the data and reveals its internal structure. A cluster analysis can be used to classify variables, individuals, or variables and individuals at the same time. For the purpose of our analysis, we are interested in classifying individuals. Most of the cluster analysis methods use a structure of techniques consisting of: (i) a proximity or similarity measure between couples of objects: this measure is used to quantify the degree of similarity or diversity between the couples in the unities of the studied data set; (ii) a measure of homogeneity between groups: it indicates the degree of similarity between the unities belonging to a subset of the data studied; (iii) an algorithm used to individuate the best partition in the data. We use a hierarchical algorithm that group objects on the basis of the Ward proximity measure. For more information, see Lebart et al. (1995).

c) Cox Regression Model

Finally, we use the lifestyle groups in a Cox regression, controlling for sex, living arrangements, and resources. A semi-parametric Cox regression is a proportional risk model that does not require any precise hypothesis about the dependency of the risk to experience the event from time. The most interesting consequence of its mathematical construction is that the covariates can push up or down the baseline risk function with the same amount on all durations, while the baseline function can be left unspecified. Results will be presented by means of the odds ratio. For further details, see Blossfeld and Rohwer (1995).

5. RESULTS

5.1 Health behaviors

The LES permits us to evaluate almost every risk factor in the health behaviors highlighted in the literature review in the previous sections. The variables were carefully chosen to measure health behavior and living condition at old age and their effect on sex mortality differences (see paragraph 2). We included smoking habit, consumption of high proof spirit (based on

the frequency and quantity of consumption), physical exercise, vegetables and fruit intake (based on frequency but not on quantities), together with other risk factors, such as having a psychological Type A behavior (for the detailed definition see Luy and Di Giulio 2005) and having (had) a stressful job. Moreover, we used a small measure of social support, based on the number of people ready to help in case of need. We did not include any objective measure of health status, apart from the body mass index (based on the self-declaration of the individuals studied). We did, however, use some subjective measures of health status and of health related attitudes, such as the intensity at which the respondents look after their own health, and the extent to which they believe they can influence their health status. Other important variables consist in resources on the basis of which people take decisions (education level, equivalence income), and living arrangements at the time of interview, as an indicator of the environment in which the health behavior decisions have developed. The basic statistics are found in Table 2. In our sample of the 60-69 year old cohort at the time of first interview, women on average smoke less often than men do, they consume alcohol less regularly, eat vegetables and fruit more often (and as a possible consequence are more often of normal weight compared to men who are more often overweight), but there are no differences as far as mild physical activity is concerned. Women are found less often than men in the stressful job categories and tend to display slightly less Type A behavior. Women and men enjoy almost similar levels of resources (education level and income class): Women are only slightly less educated than their male counterparts and they have only slightly fewer financial resources (at the household level). Half of the men declare that they take care of their own health 'much or very much' against 44% of the women,[3] and an almost share of both sexes (67% of men and 65% of women) thinks they can exert a large influence on their health status. The result, already found in the literature, is that women declare more often that they have a 'medium' health status (53%) rather than a good or very good one (24%), while men are more optimistic (almost 28% say that they have a good and very good health status, 47% declare to have a medium health status), but men die earlier (41% of the men died in the following 14 years against 24% of women). Lastly, the living arrangements of men and women, i.e. the environment that affects the development of health related behavior, largely differ: most people still live with a partner, although men tend to do so more often than women. About 31% of women live alone; this compares to 6% of men. Interestingly for the following analysis is that a certain part of the population lives with other household members (apart from the possible partner), and

[3] Luy (2005) has shown that the answer "living according to a health-conscious lifestyle" is connected with an increased mortality risk. This is probably due to the fact that the self-reported health-consciousness is often caused by interventions of medical doctors as a consequence of severe health problems. Thus, a self-reported health-conscious lifestyle is not necessarily connected with healthy individuals.

this applies to 32% of men and 22.5% of women. It is perhaps for this reason that more men than women declare they have more than three people to ask for help should they need to do so.

- about here Table 2 -

5.2 In search of a lifestyle categorization

As we can easily imagine, people make choices on the basis of their resources, not simply to display a certain behavior or not, but to conduct their life and choose their health life style according to a consistent set of preferences. To define health lifestyle, we will refer to the classical definition adopted by Thomas Abel: "Health lifestyles comprise patterns of health related behavior, values, and attitudes, adapted by groups of individuals in response to their social, cultural and economic environments" (Abel, 1991). Using the LES data in our analysis, we cover most of the definition; in fact, we can include not only measures of health related behavior but also attitudes and psychological traits (life choices). Moreover, we can control for the level of resources that an individual has and the household situation in which the individual is embedded (life chances). The hypothesis is that, given a certain level of resources, women are more willing and able than men to invest in their health, and that this will have an impact on sex mortality differences. The focus on health lifestyles instead of single health behaviors helps in gaining a deeper understanding of sex differences in mortality in two ways: First, we can locate men and women with more or less healthy lifestyles, and second, we can see if the lifestyles conducted as a whole have an impact on sex differentials in mortality.

As suggested by several authors (Mayer et al., 2000; Abel, 1991; Burke et al., 1997; Hagoel, 2002), people can be grouped according to their health behaviors and attitudes by means of a cluster analysis. We proceeded in doing this using two steps: First, we performed an MCA on the health behavior and attitude indicators commented on in the previous subsection. Next, we grouped people by means of a hierarchical clustering on the basis of the new quantitative variables found in the previous step. We included in the MCA the following indicators as mortality risk factors: smoking, alcohol intake, the frequency of vegetable and fruit intake, physical exercise, the body mass index, stress at work, Type A personality, and, finally, social support. As indicators for the health status and attitudes on health, we used the variables on current health status, the expected possibility of influencing the health status, and survival after 14 years.

A graph depicting the first two components is presented in Figure 1. Here it can be seen that the modalities characterizing a behavior that is more healthy, for example taking care of one's own health, eating vegetables and fruits, engaging in physical activity, are all grouped to-

gether, and the same applies to the variables that indicate poor health care. On the right part of the graph, we find people who are more active as far as work and social behavior is concerned, individuals who are less active in these activities are on the left. All in all, there seems to be a consistent picture of possible health behaviors. The new quantitative variables defined by MCA will be used in the next step, the cluster analysis, to group people who behave similarly according to their (health) behaviors in order to define lifestyle groups for the 60-69 year old.

- about here Figure 1 -

The hierarchical cluster analysis[4] reveals the existence of four lifestyle groups, which we named as follows according to the characteristics they display:

1) The "active bon-vivants" (45.5% of the sample): These are characterized by being engaged in work or retired not long ago, by being smokers (past or present) and overweight, on each count on average more often than others, although they have a vegetable and fruit intake that is above average; they drink alcohol (moderately or heavily) and can count on more intensive social support than average.

2) The "interventionists" (34.4% of the sample): They do neither smoke nor drink alcohol, they have a normal body mass index, are mostly inactive, eat vegetables and fruit, all of this again more often than others, do not have a Type A personality, and take intensive care of their health; unfortunately, they cannot count on high social support.

3) The "nihilists" (14.4% of the sample): These are individuals who are obese more often than average and do not take care of their health; they believe that they cannot influence their health status, they are not engaged in sports, and in general have a poorer health status than average.

4) The "past workaholics" (5.7% of the sample): They form only a small fraction of the sample and are fully characterized by having been in a stressful past job. Moreover, the share of non-drinkers is considerably higher than in the total sample.

- about here Table 3 -

A detailed description of the characteristics of the groups can be found in Table 3, where the percentage of the most relevant characteristic is reported and compared for each group with the average percentage in the sample as a whole. Women and men differ as to the lifestyles

[4] The cluster analysis was performed on the first ten components (the new quantitative variables) individuated by the MCA analysis.

groups, as Tab. 4 shows. The "active bon vivants" group includes more men than women; the opposite is true for the "interventionist" category. Following the hypothesis suggested by Johansson (1991), this result could reflect that women aim to invest in their health "resources" for the future, while men tend to use them to enjoy the present.

- about here Table 4 -

5.3 Lifestyles, living arrangements, and sex differences in mortality

The interesting findings about male and female differences in health lifestyles will be analyzed by means of a Cox regression model to see whether or not they make a contribution towards explaining (controlling) at least a small part of the mortality differences between the two sexes. The main control variable is sex, to which we add all the variables about resources and living arrangements. We did not include these variables in the lifestyles cluster analysis because they represent a different explanatory level (life chances against life choices, Abel 1991); they are important nevertheless to control for the basic resources (and therefore freedom) one has in choosing health behaviors. Moreover, note that we are not interested in explaining mortality in general, but rather to see the effect of the model covariates on the basic control variable, sex. The results are shown in Table 5, Models 1-4.

- about here Table 5 -

Model 1 includes no control variables other than sex and age. Here, men have almost double the risk of dying earlier than women. When we control for individual resources (education) and for living arrangements, to be male has a disadvantage on survival still, compared to being a female, and the disadvantage is even higher than before (Model 2). In Model 3, which includes all relevant health behaviors, we see that although the difference between the two sexes has decreased, it is still highly significant. In this model, health status, taking care of one's health, physical activity, as well as smoking and drinking habits are the most important factors to influence mortality, but none of them taken separately explain or control the survival differences between the two sexes.

Placing together individuals with similar behaviors and attitudes, we expect that lifestyle groups explain differences between the two sexes at least as much as the different health behaviors taken separately, but in a more comprehensive way. In fact, we can imagine that people usu-

ally make consistent choices about their health behaviors. Model 4, which has fewer statistical parameters than Model 3, highlights the difference between the lifestyles groups. Of the four health lifestyle groups, the interventionists show the lowest mortality. Model 4 has the same if not a higher controlling power for sex differences in mortality as compared to Model 3. Thus, we can conclude, therefore, that still unobserved factors including the biological components play an important role in sex mortality differences that cannot be controlled for, neither by single behavior nor by lifestyles groups.

The usefulness of the lifestyle approach can be seen more clearly when taking another perspective in that we can observe much more easily than with separate health behaviors whether or not sex differences in mortality persist in each lifestyle group. The results are shown in Table 6, where the basic Cox regression model has been calculated for each lifestyle group separately. Interestingly, age is an important covariate in the interventionist group, but sex is no longer statistically significant (the same holds for resources and living arrangements). It seems that when engaging in a lifestyle that is healthy overall, this fact is more important to the survival of women and men than the biological component of sex differences. These results should be taken with precaution, however, given the low number of men in the interventionist group.

- about here Table 6 -

Naturally, the living arrangements of old people largely determine their resource environment and therefore their way of living; we thus, and finally, want to find out whether a particular living arrangement lowers mortality differences between men and women. It does so for the group of people living with a partner and with another member of the household, and for the very small group of people living without a partner but with another household member, both form the group "couple with other members or no couple with other members" in Model 4b (see Table 5, Models 4a-c for more information). Figure 2 shows the Kaplan Meier survival functions for the defined living arrangement groups. It becomes clear, that among the group of people who live with (or without) a partner and with other household members (in Figure 2 named "C/NC+Other") especially men show a lower mortality as compared to the survival conditions of the total sample. Among women the C/NC+Other group also shows the best survival conditions, but the differences to the other living arrangement groups are less marked as compared to the situation among men. Consequently, the effects among men are responsible for the missing sex mortality differences in this living arrangement group.

What could be the factors that provide an explanation for this result? Unfortunately, we are unable to identify what kind of other members there are in the family. As expected, people

living neither alone nor in a simple couple-relationship have on average more children than others (2.51 children, against 1.73 for people living in a simple couple-relationship and 1.39 for people living alone). They benefit, at least theoretically, from a more intense flux of human relationships, which sometimes provides access to more updated information, from which men seem to benefit more than women. This living arrangement group is, in fact, the only one where men declare to be (slightly) happier than women on all of the surveyed aspects, and where men who are happy or very happy with their free time outnumber women significantly (74.4% against 62.2%). The impression is that in this group men have an enjoyment of life that is higher than average, whereas women show the same patterns as the women in the other groups. A further discussion of this finding can be found in the article of Luy in this volume.

- about here Figure 2 -

6. CONCLUSIONS

In this paper, particular attention has been devoted to theoretically justify and empirically develop a special dimension of behavior that is called health lifestyle in order to arrive at a deeper understanding of sex differences in mortality at old ages. This goal was achieved in successive steps: First, we selected the health behaviors thought to influence mortality in general and that may play a role in explaining sex mortality differences at old ages. Then we obtained a synthesis of them by means of a multivariate statistical analysis, and on the basis of the results we statistically clustered individuals. West German men and women aged 60 to 69 at first interview and followed up for 14 years score differently across the lifestyles group: More women than men are engaged in a healthy lifestyle (interventionists), more men than women behave in a different and more unhealthy way (active bon vivants or "nihilists). This result confirms, at least in part, the view suggested by Johansson (1991) on the difference in the decision of individuals on how to use their resources: Men seem to enjoy the present more so than women, whereas the latter tend to invest into the future.

Although the results of the Cox regression on mortality confirm the strong impact of lifestyles on mortality in general, the effect on sex differences is present but weak, and comparable with the result we gain when we include the complete series of health behaviors. Interestingly, we can use lifestyle categorization to answer with ease the question of whether or not sex differences in mortality remain significant inside each category of health lifestyle separately.

In some groups of individuals, survival no longer seems to display a distinct male and female pattern. This applies to the interventionists, a select group of people who take intensive care of their health, and to people who live with (or without) a partner and with other household

members. The reasons for this result may be different for the two cases. In the first case, men who are classified as interventionists are a highly selective group compared to women: only 11% of men fall into this category against nearly 60% of women. However, our result indicates that biology does not play the major role in determining sex differences in mortality at older ages, and that a lot can be achieved with a healthy lifestyle overall. In the second case, the result points to the fact that the same chances of survival between the two sexes may depend also on the amount of daily social and family contacts that possibly provide access to updated information about modern behaviors. As to the living arrangements mentioned above, men seem to be slightly happier than women, above all about the free time they have at their disposal. Women in the same situation possibly are more engaged in daily household activities and have less energy because they spend a large amount of their energy on other members of the household, and overall are less happy than men on average. Whatever the driving factors behind this finding might be, they influence especially men, since it is the low male mortality in this living arrangement group that is responsible for the vanished mortality differences between the sexes. All in all, these first findings of this study should encourage the future research to invest energies both in considering a meaningful definition of healthy lifestyles and in adopting a comprehensive gender approach in studying mortality differences between the two sexes.

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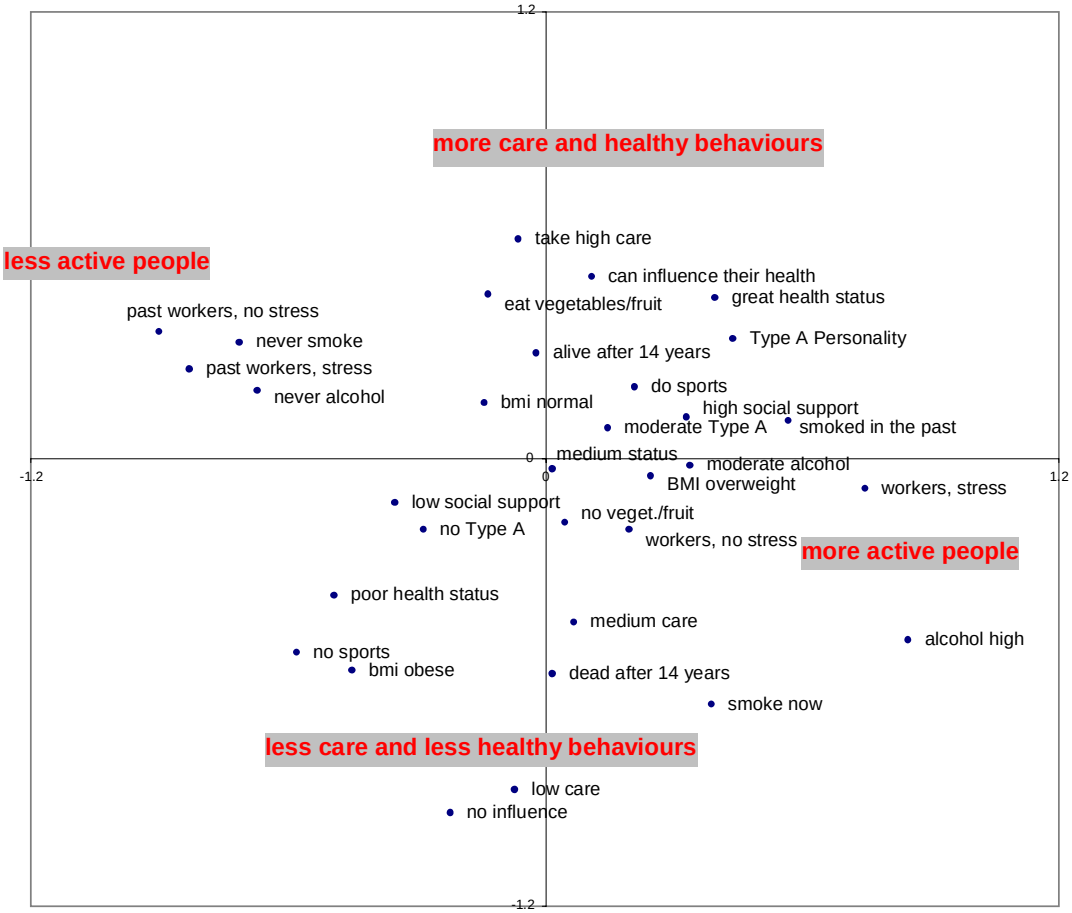
7. FIGURES AND TABLES

Figure 1. MCA results on health behavior and attitudes, age 60-69 (West Germany, 1984/86)



Source: Own calculations, based on LES data.

Figure 2. Kaplan Meier Survival Functions for the defined living arrangement groups

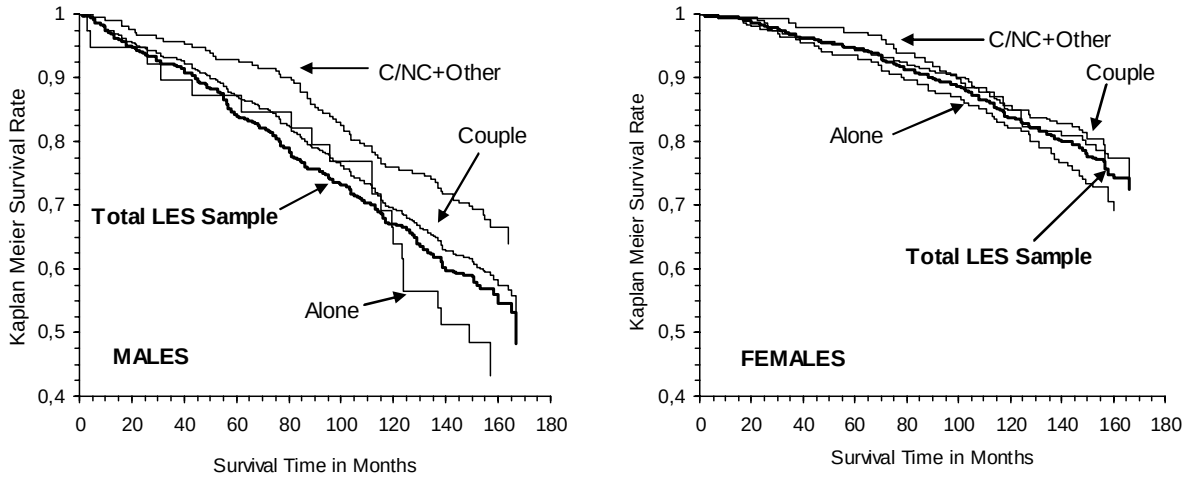


Table 1. Number of individuals, deaths, and survival time in months for the analyzed cohorts of the LES West-sample by age at first interview in the years 1984-1986 and estimated survival time for the West German population, based on official population statistics

	Individuals	Deaths	Survival Time	95% Confidence Interval	West German Population
Females, ages 60-69	673	162	151.50	148.27 - 154.73	149.26
Males, ages 60-69	680	280	135.43	131.63 - 139.23	134.04

Notes:
Survival time limited to 171.0 months observation time of the LES.
Pseudo-cohorts for West German population for the years 1985 to 1998 (168.0 months), see Luy and Di Giulio (2005).

Table 2. Selected health behavior, by respondent's age and sex, (West Germany, 1984/86).

	Age Group 60-69	
	Males	Females
"Type A" behavior		
Low	45.9	51.5
Moderate	28.3	28.1
High	25.8	20.4
Total	100.0	100.0
Cases	667	658
Health-conscious behavior		
Much or very much	49.9	44.3
Moderate	40.2	45.5
Bad or very bad	9.9	10.3
Total	100.0	100.0
Cases	677	671
Expected own influence on health		
Much or very much	67.0	65.1
Moderate, few, or nothing	33.0	34.9
Total	100.0	100.0
Cases	676	670
Current health status		
Good or very good	27.7	24.1
Medium	47.0	52.9
Bad or very bad	25.2	23.0
Total	100.0	100.0
Cases	674	671
Body Mass Index		
Normal, BMI < 25	40.5	53.0
Overweight, BMI 25 - 30	50.4	37.7
Obese, BMI > 30	9.1	9.3
Total	100.0	100.0
Cases	659	642

(continues)

Table 2 (continued) . Selected health behavior, by respondent's age and sex, (West Germany, 1984/86).

	Age Group 60-69	
	Males	Females
Job situation		
Worked never or long ago, no stress	6.0	45.7
Worked long ago, stressful	3.2	8.3
Working/recently stopped working, no stress	51.0	35.2
Working/recently stopped working, stressful	39.8	10.7
Total	100.0	100.0
Cases	679	661
Vegetable and fruit intake		
Not regularly	77.2	64.8
Almost daily	22.8	35.2
Total	100.0	100.0
Cases	676	665
High consumption of spirits		
Never	27.9	52.9
Moderately	51.6	40.3
Often	20.5	6.8
Total	100.0	100.0
Cases	663	643
Engaged in sports		
Not regularly	27.3	27.2
Regularly	72.7	72.8
Total	100.0	100.0
Cases	664	658
Living arrangements		
Couple living together	62.4	46.6
Couple living together + others	28.5	14.1
Living without partner but with others	3.3	8.4
Living alone	5.8	30.8
Total	100.0	100.0
Cases	670	652
Education		
Low level	71.9	76.4
Medium level	13.7	18.4
High level	14.4	5.2
Total	100.0	100.0
Cases	679	670

(continues)

Table 2 (continued) . Selected health behavior, by respondent's age and sex, (West Germany, 1984/86).

	Age Group 60-69	
	Males	Females
Smoking habits		
Never smoked	15.0	68.6
Smoked in the past	50.6	16.7
Currently smoking	34.4	14.7
Total	100.0	100.0
Cases	680	666
Support in case of emergency		
Less than 3 persons to ask	43.8	53.1
More than 3 persons to ask	56.2	46.9
Total	100.0	100.0
Cases	673	667
Survival status at time of 2nd survey		
Alive	58.8	75.9
Deceased	41.2	24.1
Total	100.0	100.0
Cases	680	673

Source: Own, based on LES data

Table 3: Characteristics of the lifestyles group defined by the Cluster Analysis, age 60-69 (West Germany, 1984/86)

ACTIVE BON VIVANT				
Group 1/4	% ot the sample	% in the group	% in the sample	
	45.45	42.1	25.2	retired not long ago, stressful job
		51.2	33.6	past smoker
		56.8	42.4	BMI overweight
		36.9	24.5	currently smoking
		53.3	42.8	working now or retired since not long, no stressfull job
		79.4	70.4	no vegetable/fruit intake
		19.5	13.3	heavy drinkers
		58.1	51.1	more than three people to ask for help
		39.2	32.7	dead after 14 years
		51.1	44.4	moderate drinkers
		76.9	71.1	engaged in physical activity
		27.6	22.6	Type A Personality
		70.9	65.7	cannot influence their health
		51.2	46.9	take good care of their health
		46.8	42.7	take moderate care of their health
INTERVENTIONIST				
Group 2/4	% ot the sample	% in the group	% in the sample	
	34.44	82.0	41.3	never smoke
		59.0	25.4	never worked or retired not long ago, no stressfull job
		82.2	67.3	alive after 14 years
		54.3	38.8	never drink alcohol
		59.2	44.9	normal BMI
		37.6	28.7	regular vegetable/fruit intake
		54.5	47.7	not Type A
		53.9	48.0	less than three people to ask for help
		52.2	46.9	take great care of their health
NIHILIST				
Group 3/4	% ot the sample	% in the group	% in the sample	
	14.41	55.9	10.1	do not take care of their health
		48.2	8.9	obese
		57.4	33.8	cannot influence their health
		40.0	26.6	do no regular sports
		45.6	32.7	dead after 14 years
		33.9	24.0	poor helath status
		52.8	42.8	working now, or retired not long ago, no stressfull job
PAST WORKAHOLICS				
Group 4/4	% ot the sample	% in the group	% in the sample	
	5.69	100.0	5.7	worked in the past, stressful job
		61.0	38.8	never drink alcohol

Source: Own, based on LES data

Table 4. Lifestyle groups by sex, West Germany 60-69 age (1984-86)

	Men	Women
Active bon-vivant	70.0	20.6
Interventionist	10.9	58.3
Nihilist	15.9	12.9
Past workaholics	3.2	8.2
Total	100.0	100.0
Total (abs.)	680	673

Source: our elaboration on LES data

Table 5. Results of Cox regression on mortality, by different health behaviors, lifestyles, and living arrangements; odds ratio, ages 60-69 (West Germany, 1984/86)

					by living arrangements		
	Model 1	Model 2	Model 3	Model 4	Model 4a	Model 4b	Model 4c
					Couple with no other members	Couple with other members or no couple with other members	Alone
Male (ref. Female)	1.931 ***	2.275 ***	1.720 ***	1.709 ***	2.033 ***	0.942	1.837 *
Age	1.087 ***	1.080 ***	1.080 ***	1.086 ***	1.074 **	1.097 *	1.091 *
Education (ref. Low)							
Medium		0.890	0.984	0.880	0.854	1.102	0.694
High		0.606 **	0.754	0.595 *	0.641	0.613	0.512
Living arrangement (ref. Living alone)							
Couple living together		0.828	0.881	0.798			
Couple living together and with other members		0.574 **	0.620 **	0.569 **			
Living without a partner but but others		1.044	1.009	1.042			
Unknown		1.445	1.321	1.534			
Lifestyle (ref. Interventionist)							
Active bon-vivant				2.051 ***	1.544 *	3.328 ***	2.531 ***
Nihilist				2.831 ***	2.089 **	5.512 ***	2.194 *
Past workaholic				2.186 ***	1.763	1.986	2.956 ***
Current health status (ref. Good or very good)							
Medium			1.408 **				
Bad or very bad			2.285 ***				
Health-conscious behavior (ref. Moderate)							
Much or very much			1.288 *				
Bad or very bad			1.255				
Expected own influence on health (ref. Medium, bad or very bad)			1.177				
BMI (ref. Normal)							
Overweight			1.030				
Obese			1.292				
Unknown			1.883 **				
Regular vegetable and fruit intake (ref. No)			1.218				
Engaged in sports (ref. Not regularly)							
Regularly			0.759 *				
Unknown			1.003				
Smoking habits (ref. Never smoked)							
Past smoker			1.562 **				
Currently smoking			2.112 ***				
Consumption of spirits (ref. Moderately)							
Never			1.197				
Regularly			1.348 *				
Unknown			1.422				
Type A Personality (ref. Strong)							
Moderate			0.986				
Low			0.870				
Job situation (ref. Working now, no stressfull job)							
Never worked or retired since>10 years, no stressfull job			0.842				
Retired since>10 years, stressfull job			1.087				
Working now or retired<10 years, stressfull job			0.904				
Support from more than 3 people if needed (ref. Less than 3)			0.830				
-2logl (without covariates)	6146.760	6146.760	6146.760	6146.760	3134.147	1157.896	818.901
-2logl (with covariates)	6074.547 ***	6048.968 ***	5934.852 ***	6002.722 ***	3066.224 ***	1119.253 ***	788.386 ***
Number of individuals	1353	1353	1353	1353	722	360	240

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

Source: Own, based on LES data

Table 6. Cox regression by lifestyle groups, odds ratio, 60-69 age (West Germany, 1984/86)

	Active bon-vivant	Interventionist	Nihilist
Male (ref. Female)	1.730 **	1.406	1.908 **
Age	1.046	1.210 ***	1.089 *
Education (ref. Low)			
Medium	0.841	0.865	1.249
High	0.633	0.460	0.625
Living arrangement (ref. Living alone)			
Couple living together	0.664	1.130	0.927
Couple living together with other members	0.442 **	0.688	-
Living without partners but with others	0.999	0.817	-
-2logl (without covariates)	2880.966	936.892	849.375
-2logl (with covariates)	2856.504 ***	905.679 ***	835.327 *
Number of individuals	604	451	191

* p<0.05; ** p<0.01; ***p<0.001
Source: Own, based on LES data