

## **Centenarians' Marital History and Living Arrangements:**

### **Pathways to Extreme Longevity**

Centenarians are examples of healthy aging (Engberg, Oksuzyan, Jeune, Vaupel & Christensen, 2009). From a multidisciplinary perspective, the analysis of their demographic trajectories contributes to our understanding of how men and women attain such extreme longevity (Franceschi et al., 2000). The present study analyzed the marital history and living arrangements (hereafter LA) of centenarians with the aim of identifying which trajectories are associated with reaching an advanced age. Numerous studies have investigated the so-called protective effect of marriage and some of these studies included older adults. However, only a limited number of these studies investigated whether these findings apply to very old age. The few studies that extended their investigation beyond age 80 identified major gender-specific changes in the association of marriage and mortality (reference blinded for review; Staehelin, Schindler, Spoerri & Zemp Stutz, 2012). To our knowledge no study has yet paid special attention to centenarians in order to confirm the results identified for younger age groups. Therefore, this study provides a novel contribution to the existing literature. Studies of centenarians are typically based on cross-sectional surveys conducted at or around the age of 100 years. However investigating trajectories of centenarians requires a longitudinal approach that includes individual data covering decades before a person reaches centenarian status (Ailshire, Beltrán-Sánchez & Crimmins, 2014). Our data are based on administratively registered demographic events gathered for each centenarian starting when they were 60 years old. As such this study addresses a large and representative group of centenarians whose demographic characteristics are identified by means of longitudinal data that were drawn from population registers. Using such a data set avoids the usual weaknesses of centenarian'

surveys, such as the numerous non-responses, proxy answers or memory errors (Rodgers & Herzog, 1992).

Living arrangements (e.g. whether a person lives alone, with a spouse, with others but without a spouse, or in a collective household) are influenced by the person's marital history (Taeuber & Rosenwaike, 1992; Grundy & Murphy, 2006). LA and marital status are characterized by a variety of types of family linkages and co-residence, which influence the availability of companionship, social and psychological support, and informal care (Grundy & Murphy, 2006). Accordingly, LA and marital status are major components of an older person's social environment (Kovar & Stone, 1992). Many researchers have investigated whether marital status and mortality are related (Manzoli, Villari, Pirone, & Boccia, 2007; Rendall, Weden, Favreault & Waldron, 2011), and most studies indicate that being married is associated with lower mortality (Hu & Goldman, 1990; Martikainen, Martelin, Nihtila, Majamaa & Koskinen, 2005; Rendall et al., 2011; Zhu & Gu, 2010). The association between LA and mortality risk is less frequently discussed in the literature. A number of differences in adult mortality associated with LA have been identified (Koskinen, Joutsenniemi, Martelin & Martikainen, 2007). It has also been clearly demonstrated that both marital status and LA are important predictors of mortality among people aged 45 years and older (Staehelin et al., 2012). The protective effect of being married, especially for men, has also been confirmed for older people (Goldman, Korenman & Weinstein, 1995; Rendall et al., 2011). Nevertheless, the association between LA and a longer life span needs a more in-depth investigation, as LA may become critical for well-being and managing everyday life at older ages. In particular, the spouse as a companion, psychological supporter and primary caregiver could contribute to protecting against premature mortality at older ages (Antonucci & Ajrouch, 2007). However, the group of older people is aggregated in most studies and the results reflect adults aged 65-80 and do not take those who are older than 80 years into account, due to the reduced number

of oldest old people. In fact, these two age groups are quite different, as health problems increase with age and most adults above 80 years of age become dependent. For the age group over age 80, the harmful effect of living alone is reversed and might become protective (Stahelin et al., 2012). Moreover, the association between LA and mortality risk at the oldest ages is dependent on age and gender. For women, living alone already appears to be favorable during their 70s, whereas for men this crossover occurs in their 80s (reference blinded for review). At older ages, living with one's spouse might entail additional responsibility leading to stress for the caregiving spouse. Caregiver stress can have a negative effect on a spouse's well-being (Navaie-Waliser, Spriggs & Feldman, 2002) reducing the advantage of being married, a situation that mainly concerns women, because they are more likely to be the primary caregiver. Moreover, men seem less able to cope with new situations when they no longer have a partner with whom to share life (Lee & De Maris, 2007). Widowers are more likely to remarry than widows, who are more inclined to live alone (Smith, Zich & Duncan, 1991; Davidson, 2002). The finding that women are less likely to remarry can partly be explained by the fact that older women also have fewer opportunities to find a partner due to the gender imbalance in the older population. These findings help explain why being married in advanced age could be more beneficial for men than for women (Friedman & Martin, 2011), and that, in general, the association between LA and mortality risk changes at older ages and varies by gender. Thus, focusing the analysis on centenarians provides an opportunity to better understand how mortality risk is associated with LA and marital status during the later phases of the life span. Another original aspect of this study is that it considers individual LA trajectories from age 60 to 100, and not only LA at a given age, or LA transitions. Specific marital history and LA trajectory (i.e., the successive LA of a given person) might be associated with a longer life span. Beneficial trajectories might, however, be different for men and women. Studying the marital history and LA trajectories of centenarians

is an innovative feature of our contribution that can confirm whether the association between LA and mortality risk is valid for the oldest ages or whether changes occur that would be relevant for policy development.

In conclusion, this study aims to clarify the complex relationship between a prolonged life span and individual life trajectories resulting from various changes of LA and marital status, with special emphasis on gender differences. Therefore, the present study analyzed centenarians' trajectories to test the following hypotheses:

First, we hypothesized that the proportion of male and female centenarians at age 100 differs by marital status and LA, and that centenarians in these different groups experienced different marital histories and LA trajectories to reach extreme age (H1). Why do we assert that these trajectories differ for male and female centenarians? Previous research has shown that each LA is associated with a specific mortality risk and that this relationship might vary for men and women (reference blinded for review). Therefore, we assume that reaching the age of 100 years could be associated with a relatively longer duration spent in a LA that is more favorable for survival. As these associations are gender-specific, they could result in different LA trajectories for men and women up to age 100.

Second, we assume that some aspects of the marital history and LA trajectory of centenarians as observed starting about age 60 differ from those of their counterparts in the same cohort who died before reaching the age of 100 (H2). Comparing the traits of centenarians with those of the whole population is very unusual due to data limitations, as comprehensive register-based data were not available until 1991. Since 1991, aggregated census data allow us to compare the median age at widowhood, age at entry into an institution, and the age difference between spouses. The probability of becoming a centenarian can now be estimated at each past census point separately for each marital status and LA as observed at

different census dates. Such comparisons will allow us to identify the demographic traits of people who become centenarians.

### **Data and methods**

We followed a large group of centenarians (born between the years 1893-1903) from 60 to 100 years of age, highlighting their most prevalent marital history and LA trajectories. We made use of longitudinal data extracted from the Belgian Population Register (*Registre National*), an electronic centralized database that covers the past 40 years of the centenarians' life span (reference blinded for review). The Belgian population register has operated since 1988, and is a reliable source of demographic statistics.

Retrospective demographic data on 3,002 Belgian centenarians born during the years 1893-1903 were extracted. Individual historical data were obtained directly from the database by entering the name, surname and complete date of birth of each centenarian. Due to spelling errors in the first or last name or errors in the date of birth, some personal files were not useable (13.6% and 5.6% of male and female centenarians, respectively). More precisely, data were obtained for 729 of 844 identified male centenarians (86.4 percent). Fifty percent of the female centenarians were selected randomly, and we located individual data for 2,273 of a total of 4,818 women (47.2 percent). The centralized national population register includes information on every demographic event that occurred in the person's life: marriage, divorce, widowhood, change of residence and change of household, including entry into and exit from an institution. The dates of the last marriage and widowhood before 1991 were also recorded; therefore, marital status at age 60 is known. Information indicating with whom a given person was living as well as his or her family relationship with the household person of reference were also included. That information allows the LA of the person to be identified. The accuracy of the data included in the database is generally good, even though the administrative registration differed slightly from the actual LA situation. The information

collected for a given centenarian in the database includes comprehensive historical data that made it possible to portray the marital history and LA trajectory of that centenarian starting at age 60.

The marital history of centenarians was constructed on the basis of the legal marital status recorded in the population registration system. The term “ever-married” is used in this analysis for any person who was legally married at least once regardless of whether the individual was living with his or her spouse at the time of the observation, or not (due to widowhood, divorce or separation.) The LA trajectory of each centenarian was constructed on the basis of four LA: living alone, living with spouse (with or without others), living with others in a private household (in most cases with one of their children but not with their spouse), and living in a collective household (mostly residential care facilities or religious communities). The centenarians whose LA at the age of 60 was the most prevalent was selected for a more detailed investigation: ever-married persons living with spouse at the age of 60 (84 percent of ever-married centenarians at the age of 60), ever-married persons living alone at the age of 60 (14 percent of that group), and never-married persons living alone at the age of 60 (73 percent of never-married centenarians at age 60).

In order to identify possible differences in demographic traits between centenarians and the total population of the same generations, the marital status and LA were retrieved from the 1961, 1970, 1981 and 1991 censuses from data included in their individual file extracted from the population register. The corresponding data of the entire population was obtained from aggregated census data. The marital status and LA of centenarians was compared with the total number of persons of the same generations with the same marital status or LA that were enumerated in the respective census. This made it possible to compute the proportion of people enumerated for each census who would become centenarians, and this represents the probability of becoming a centenarian based on marital status and LA as

observed at different censuses. Centenarians who immigrated from abroad after the age of 60 were excluded from the sample, assuming that the impact of international migration could be disregarded.

## Results

### Marital History and LA Trajectory of Male and Female Centenarians (H1)

Most centenarians were married at least once; in relative terms, there were more ever-married men (93.4 percent) than women (88.3 percent). At their 100<sup>th</sup> birthday, 87 men and 11 women were still married, but not all of them were living with their spouses. At 60 years of age, 377 women (18.8 percent of those who had been married) were widows, whereas only 28 men (4.1 percent) were widowers. Sixty percent of widowers but only 26 percent of widows remarried after 60 years of age. The timing of the marital history also differs by gender (Table 1). Men were older at widowhood and remarriage. On average, male centenarians were widowed more than ten years later than women. They also remarried ten years later, and still remarried in their 80s and 90s. Only 6.6 percent of male centenarians were never married; the proportion is almost twice as much for women (11.7 percent). These results include members of religious communities (9 men and 53 women); but even when excluding members of religious communities, the difference remains significant (5.5 compared to 9.5 percent).

#### Table 1 about here

At the time of their 60<sup>th</sup> birthday, a large proportion of ever-married future centenarians were still living with their spouse (Table 2). This proportion was particularly high among male centenarians (95.4 percent compared with less than 79.6 percent for women). The majority of those who were not married at 60 years of age lived alone (72.9 percent of women and 76.0 percent of men). As shown in Table 2, at 100 years of age, very

few ever-married centenarians still lived with their spouse, and almost all of them were men. Approximately one quarter of the centenarians of both genders lived alone and another quarter lived with others, but the largest proportion were living in care facilities. Of all centenarians, 941 ever-married women and 134 never-married women were in care facilities (47.1 percent of ever-married and 49.1 percent of never-married). For men, these corresponding numbers are 233 and 15, respectively (34.3 percent of ever-married and 30.0 percent of never-married). Although changes in the LA trajectory after 100 years of age is not the subject of this analysis, it is worth mentioning that 211 women and 56 men entered care facilities after age 100; a total of 304 male centenarians (42.2 percent) and 1286 female centenarians (57.9 percent) finished their life in a long-term care facility. In general, three features emerge with regard to gender differences: (i) in relative as well as absolute numbers, more male than female centenarians were still living with their spouse when they became centenarians; (ii) relatively more women (47.3 percent) than men (34.0 percent) in the observed population were living in care facilities at the age of 100; (iii) relatively more male centenarians, both never-married and ever-married, were living alone as compared to female centenarians. This is remarkable and the difference is statistically significant: 29.1 percent of men compared to 24.4 percent of women ( $p$ -value < 0.001).

### **Table 2 about here**

To better understand the relationship between LA trajectory and extreme longevity we selected the three groups of centenarians who had the most prevalent LA at the age of 60, and we followed their LA trajectories to age 100: centenarians living with their spouse at the age of 60, ever-married centenarians living alone at 60 years of age, and centenarians never-married and living alone at 60 years of age (Table 3). The LA trajectories of the three groups starting at 60 years of age differ between men and women. Among those who were not married and lived alone at 60, most women (60.8 percent) ended their LA trajectory in a care

facility, whereas only 36.8 percent of the men had the same experience. Similarly, more women (48.0 percent) than men (34.0 percent) who were living with their spouse at 60 years of age celebrated their 100<sup>th</sup> birthday in a care facility. Among those who had been married but were living alone at the age of 60, the proportion of men and women who were living in a care facility at the age of 100 was more similar and not statistically different (46.3 percent of women and 42.9 percent of men). Among women, those in the latter group were the least likely to be in a care facility at 100 years of age. The LA trajectories allowed us to identify centenarians who lived alone during any period of their life. Relatively more ever-married and never-married men compared to women who were living alone at the age of 60 lived continuously alone from the age of 60 to the age of 100 years (27.3 percent for men and 23.7 percent for women). Conversely, among the larger group of those living with their spouse at the age of 60, more women than men experienced episodes of living alone (80.7 percent and 64.0 percent, respectively). The proportion of never-married living with others or in a care facility also differs by gender (50.0 percent for men and 41.7 percent for women), whereas for the ever-married, that difference was smaller and not statistically significant (39.9 and 38.6 percent, respectively).

### **Table 3 about here**

Gender differences were also assessed for the mean duration of time spent by male and female centenarians in each LA between the age of 60 and 100. The durations of time in a specific LA differed by gender. A difference between the never-married and ever-married (Table 4) was also observed. Ever-married male centenarians spent twice as much time living with their spouse between the ages of 60 and 100 than female centenarians. As expected, the average duration of time centenarians lived alone was longer for the never-married than the ever-married, but it is interesting to note that ever-married women spent twice as much time alone when compared to their male counterparts. We obtained similar differences concerning

the length of time spent in a care facility: longer for the never-married compared with the ever-married, and also for women compared to men.

Previous findings for the total population have shown that the mortality risk associated with a given LA increases differently by age and gender (blinded for review). Crossovers effects between those living alone or with other persons in a private household (including those living with their spouse) were identified at age 73 for men and at age 85 for women. Therefore, we divided the 40-year period from age 60 to 100 into three sub-periods and calculated the proportion of time spent in different LA for each sub-period (Table 4).

Men lived with their spouse for a longer period of time during the first two sub-periods of older age, whereas women did so only during the first sub-period. During the second sub-period women were more likely to live alone for the majority of the time. During the third sub-period the difference between men and women was still significant: women spent a longer time in care facilities and men lived for a relatively longer time with others than did women.

**Table 4 about here**

### **Comparing Male and Female Centenarians with the Whole Population (H2)**

We compared the marital status in 1961 for the 3,002 centenarians born between 1893 and 1903, based on individual register-based data, with the distribution by marital status including the entire population of the same birth cohorts of Belgium, as enumerated in the 1961 census when participants were about 60 years of age (between 58 and 68 years of age). Among centenarians, about 6.9 percent of all men and 11.9 percent of all women were never-married in 1961, whereas the percentage for the same birth cohorts of the whole population was larger for men (7.1 percent) and smaller for women (9.8 percent); only the difference for women was statistically significant.

With regard to the age difference between spouses, 80 percent of male centenarians were older than their wife compared to 72 percent of the entire population enumerated in 1961. For female centenarians, 68 percent were younger than their husband compared to 58 percent of the entire population. The mean age differences between male centenarians and their wife (4.60 years) and between female centenarians and their husband (1.95 years) were significantly larger when compared to the total population (2.45 and 1.15 years, respectively). The age difference between spouses is significantly larger in the case of remarriage. Female centenarians who married only once were on average 1.8 years younger than their husband, but those who remarried were only 0.9 years younger. For male centenarians the age difference is larger in the case of remarriage: an average of 12.0 years older compared to 3.4 years for those in the first marriage.

The age distribution at widowhood also shows that there is a different pattern among centenarians in comparison to the whole population. The median age of male centenarians at widowhood was 86.0 years compared to 71.8 years for female centenarians. Data on age at widowhood collected for the Belgian female population in the 1981 census revealed that the median age of widowhood for women of the same birth cohort was close to that of female centenarians (71.2 years). Similar data for men were not available because the census question only pertained to women. The median ages at widowhood for the whole Belgian male and female population observed from 1991 to 2009 were 75.5 and 72.7 years, respectively.

During the same time period, centenarians entered long term care facilities relatively late when compared to the whole population (at age 95.5 and 81.1 years, respectively for men, and at age 93.6 and 83.0 years, respectively for women).

For additional comparison of centenarians with the generations born between 1893-1903, the marital status and LA of each centenarian were identified at the time of the

successive 1961, 1970, 1981 and 1991 censuses as recorded in the population register. For each sub-group of people with a marital status or LA enumerated in these censuses, the probability of becoming a centenarian (i.e., the probability of survival from the census date up to the 100<sup>th</sup> birthday) was estimated by comparing the number of centenarians with the corresponding number of persons in the same birth cohort enumerated in the census. For example, the probability of married persons enumerated in the 1961 census living to age 100 was obtained by dividing the number of centenarians who were married in 1961 by the total number of married persons in the same birth cohorts enumerated in the 1961 census.

The age pattern of these probabilities by marital status is similar for men and women but, as expected, the probability for women of all ages and marital status groups is remarkably higher than that of males (Table 5). Single and married persons, both men and women, had a significantly higher probability of becoming centenarians than the widowed and divorced individuals. There was a slight, non-significant advantage for married men compared to single men, and for single women compared with married women.

**Table 5 about here**

With regard to LA, there was no significant difference in the probability of becoming a centenarian between ever-married men and women living with their spouse and living alone at the time of each census (Table 6). Those ever-married men and women who were living with others (not with their spouse or in a care facility) showed a significantly lower probability of becoming centenarians compared to those living with their spouse or alone (all  $p$ -values  $< 0.01$ ). A comparison of the ever-married living with others group to those living in a care facility indicates that living with others is always more favorable for survival to age 100 (all  $p$ -values  $< 0.001$ ).

The probability of becoming a centenarian is higher for never-married men and for women living alone in their 70s compared to those living with others at this age ( $p$ -value  $<$

0.001). At older ages the figures do not exhibit a clear pattern and no significant difference appears. Compared to living in a care facility, never-married men and women living with others have a higher probability of becoming a centenarian, but this situation is reversed for men in the oldest age groups ( $p$ -value  $< 0.001$ ).

Never-married men and women living in a care facility in their 90s at the time of the 1991 census had a higher probability of living to the age of 100 than did the ever-married group ( $p$ -value  $< 0.001$ ). This LA was the most favorable for never-married men at this age, whereas for ever-married men and women, living in a care facility was the least favorable. Among all never-married men and women, those who lived in religious communities at the time of each census had the highest probability of becoming centenarians ( $p$ -value  $< 0.001$ ), and the advantage was greater for men than for women.

**Table 6 about here**

### **Discussion**

The primary results of this study suggest that the proportion of male and female centenarians differs by LA, and that differences already existed when these individuals were in their 60s. Furthermore, male and female centenarians who were married and lived with their spouse at age 60 experienced significantly different marital history and LA trajectories from age 60 to 100 years (H1). Being married and living with one's spouse is favorable for survival, especially for men — a result that agrees with long-established findings on people aged 65 and over (Goldman et al., 1995; Rendall et al., 2011). The present investigation shows that the positive association between survival and living with one's spouse diminishes with age, whereas living alone at the oldest ages becomes more favorable, especially for women. Living with one's spouse at the oldest ages does not provide the same level of protection as it does at younger ages. This may be explained by the decline of the caregiver's own health as the needs of his or her spouse increase. Caregiving could also have negative

consequences for the health and economic condition of the spouse who is the primary caregiver, especially for older women (Berg & Woods, 2009). Analysis of the LA trajectories of centenarians suggests that for women living alone longer is associated with a higher probability of reaching age 100, whereas for men, living with their spouse as long as possible might be beneficial, which confirms previous findings (reference blinded for review; Staehelin et al., 2012). From age 60 to 100, male centenarians lived twice as long with their wife as female centenarians did with their husband. Yet at age 100, the proportion of men living alone is larger than that of women, a situation that is not observed at younger ages. This paradox can be explained by the fact that men started living alone later than women, whereas women are more likely to enter a care facility before the age of 100. When the life span from age 60 to 100 is divided into three equal periods, in each of these periods, both male and female centenarians lived proportionally more years in LA characterized by a reduced mortality risk.

Although a comparison with the whole population was possible only for certain aspects of marital history and LA trajectory, the analysis demonstrated that some significant differences emerged confirming our second hypothesis. Male centenarians were widowed later in life compared with the entire population, whereas no difference was found for female centenarians. This might be attributable to a wider age gap between male centenarians and their wife as compared with that of men who died at a younger age. Moreover, the large majority of older widowers remarried and did so with a woman who was often more than ten years younger than they were, a tendency that appears in other populations as well (Livington, 2014). These findings may indicate that men are often not able to live by themselves, whereas women seem to have few problems to manage on their own (Klinenberg, 2013). Furthermore, men may be more upset by the experience of widowhood when compared to women, although the negative impact tends to decrease with age (Lusyne, Page & Lievens, 2001; van

Grootheest, Beekman, Broese van Groenou & Deeg, 1999). The association between LA and mortality risk is strengthened by the wide age gap between spouses, which is connected to our finding that male centenarians tend to be widowed very late. The age difference between spouses has been identified by several authors as a factor that is associated with longevity (Foster, Klinger-Vartabedian & Wispe, 1984; Fox, Bulusu & Kinlen, 1979; Klinger-Vartabedian & Wispe, 1989). However, this effect varies by gender: having a younger spouse seems to be beneficial for men but could be a disadvantage for women (Drefahl, 2010). The larger age difference between centenarians and their spouse confirms a positive impact, and might be partially responsible for men's exceptional survival. Finally, living in a religious community appears to be the best LA for survival to the age of 100 for both men and women, with a larger advantage for men. This is attributed to a healthier and more regular life style among members of religious communities (Luy, 2003).

There are different paths to becoming a centenarian (Perls, 2006), and marital history and LA trajectory are important factors associated with a longer life and becoming a centenarian. LA trajectories of male and female centenarians seemed to be favorably associated with extreme survival. The well-known gender difference in survival is the strongest factor explaining the gender differences in LA trajectory and marital history as well as in LA status at the age of 100. The proportion of female centenarians is much larger than that of males. However, it is possible that if men follow specific LA trajectories this could contribute to reducing the gender gap in longevity.

The use of a large, original and representative dataset that is based on an administrative population register provides a new perspective on the analysis of the association between marital history, LA trajectory and survival to the age of 100. The primary contribution made by our study is that studying centenarians significantly extends the age range for examining the relationship between survival, marital history and LA trajectory.

Limitations that are traditionally linked to the use of register-based data exist, especially the absence of information on the health status and the health trajectory of centenarians and their spouse. It is obvious that health status is an important factor in selecting LA (Börsch-Supan, McFadden & Schnabel, 1996). Nevertheless, the association between LA, health and well-being of older people is complex, with underlying factors that are not easy to disentangle (Friedman & Martin, 2011). Analyzing the impact of these factors and their possible associations was not within the scope of this study. Data from public records also lack information about the children who do not live in the same household as their parents. Yet, it is known that children, both co-resident and any other child living in close proximity may provide care to their parents, thereby having an effect on their well-being.

The LA determines the availability of a spouse or co-resident child (or children) as potential informal caregivers, which in turn affects the need for formal care and the socio-economic living conditions of the oldest olds. All these factors are strongly influenced by social policies. The evidence emerging from this study could contribute significantly to discussions about the future needs of older adults within the context of population aging, with special attention to gender. The need for formal care and availability of beds in care facilities is gender-specific, and the relevant policies should meet the different needs of older men and women. In addition, it is evident that effective support for very old adults cannot be achieved without considering the variation of LA during the later part of the life span, when the need for care becomes inevitable. Accordingly, more in-depth analysis of the characteristics and behaviors of those over the age of 80 is needed. Centenarians are forerunners and examples of healthy aging, and analysis of their trajectories could be instrumental in developing policies on long-term and alternative forms of care that would satisfy the needs of the growing proportion of older people.

## References

- Ailshire, J. A., Beltrán-Sánchez, H., & Crimmins E. M. (2014). Becoming centenarians: Disease and functioning trajectories of older U.S. Adults as they survive to 100. *Journal of Gerontology, Series A: Biological Sciences and Medical Sciences*, 70(2), 193-201. doi: 10.1093/gerona/glu124
- Antonucci T. C., & Ajrouch K. J. (2007) Social resources. In H. Mollenkopf & A. Walker (Eds.), *Quality of life in old age*. Social Indicators Research Series, 31 (pp. 49-64). Dordrecht: Springer. doi: 10.1007/978-1-4020-5682-6\_4
- Berg, J. A., & Woods, N. F. (2009). Global women's health: A spotlight on caregiving. *Women's Health, Nursing Clinics of North America*, 44(3), 375-384. doi: 10.1016/j.cnur.2009.06.003
- Börsch-Supan, A., McFadden, D., & Schnabel, R. (1996). Living arrangement, health and wealth effects. In D. Wise (Ed.), *Advances in the economics of aging* (pp. 193-218). Chicago: University of Chicago Press.
- Davidson, K. (2002). Gender differences in new partnership choices and constraints for older widows and widowers. *Ageing International*, 27(4), 43-60. doi:10.1007/s12126-002-1014-0
- Drefahl, S. (2010). How does the age gap between partners affect their survival? *Demography*, 47(2), 313-326. doi: 10.1353/dem.0.0106
- Engberg, H., Oksuzyan, A., Jeune, B., Vaupel, J. W., & Christensen K. (2009). Centenarians – a useful model for healthy aging? A 29-year follow-up of hospitalization among 40 000 Danes born in 1905. *Aging Cell*, 8(3), 270-276. doi: 10.1111/j.1474-9726.2009.00474.x
- Foster, D., Klinger-Vartabedian, L., & Wispe, L. (1984). Male longevity and age differences between spouses. *Journal of Gerontology*, 39(1), 117-120. doi: 10.1093/geronj/39.1.117

- Fox, J., Bulusu, L., & Kinlen, L. L. (1979). Mortality and age differences in marriage. *Journal of Biosocial Science*, *11*(2), 117-131. doi: 10.1017/S0021932000012177
- Franceschi, C., Motta, L., Valensin, S., Rapisarda, R., Franzone, A., Berardelli, M., Motta M., . . . The Italian Multicenter Study on Centenarians (IMUSCE) (2000). Do men and women follow different trajectories to reach extreme longevity? *Aging Clin. Exp. Res.* *12*(2), 77-84. doi:10.1007/BF03339894
- Friedman, H. S., & Martin, L. R. (2011). *The Longevity Project. Surprising discoveries for health and long life from the landmark eight-decade study*. Hay House.
- Goldman, N., Korenman, S., & Weinstein, R. (1995). Marital status and health among the elderly. *Social Science & Medicine*, *40*(12), 1717-1730. doi: 10.1016/0277-9536(94)00281-W
- Grundy, E., & Murphy, M. (2006). Marital status and family support for the oldest-old in Great Britain. In J.- M Robine, E. M. Crimmins, S. Horiuchi, & Z. Yi (Eds.), *Human longevity, individual life duration, and the growth of the oldest-old population*. (pp. 415-436). Springer. doi: 10.1007/978-1-4020-4848-7\_19
- Hu, Y. R., & Goldman, N. (1990). Mortality differentials by marital status: An international comparison. *Demography* *27*(2), 233-250. doi: 10.2307/2061451
- Klinenberg, E. (2013). *Going Solo: The Extraordinary Rise and Surprising Appeal of Living Alone*. New York: The Penguin Books.
- Klinger-Vartabedian, L., & Wispe, L. (1989). Age Difference in Marriage and Female Longevity. *Journal of Marriage and the Family*, *51*(1), 195-202. doi: 10.2307/352380
- Koskinen, S., Joutsenniemi, K., Martelin, T., & Martikainen, P. (2007). Mortality differences according to living arrangements. *International Journal of Epidemiology*, *36*(6), 1255-1264. doi:10.1093/ije/dym212

- Kovar, M. G., & Stone, R. I. (1992). The social environment of the very old. In Suzman R. M., Willis, D. P., & Manton, K. G. (Eds.), *The oldest old* (pp. 303- 320). New York, Oxford: Oxford University Press,
- Lee, G. R., & De Maris, A. (2007). Widowhood, Gender, and Depression: A Longitudinal Analysis. *Research on Aging*, 29(1), 56-72. doi: 10.1177/0164027506294098
- Livington, G. (2014). *Tying the knot again? Chances are, there's a bigger age gap than the first time around*. Pew Research Center, December 4, 2014. Retrieved from [www.pewresearch.org/fact-tank/2014/12/04/tying-the-knot-again-chances-are-theres-a-bigger-age-gap-than-the-first-time-around/](http://www.pewresearch.org/fact-tank/2014/12/04/tying-the-knot-again-chances-are-theres-a-bigger-age-gap-than-the-first-time-around/)
- Lusyne, P., Page, H. & Lievens, J. (2001). Mortality following conjugal bereavement, Belgium 1991-96: The unexpected effect of education. *Population Studies*, 55(3), 281-289. doi: 10.1080/00324720127701
- Luy, M. (2003). Causes of Male Excess Mortality: Insights from Cloistered Populations. *Population and Development Review*, 29 (4), 647-676. doi: /10.1111/j.1728-4457.2003.00647.x
- Manzoli, L., Villari, P., Pirone, G. M., & Boccia, A. (2007). Marital status and mortality in the elderly: a systematic review and meta-analysis. *Social Science and Medicine*, 64(1), 77–94. doi:10.1016/j.socscimed.2006.08.031
- Martikainen, P., Martelin, T., Nihtila, E., Majamaa, K., & Koskinen, S. (2005). Differences in mortality by marital status in Finland from 1976 to 2000: Analyses of changes in marital-status distributions, socio-demographic and household composition, and cause of death. *Population Studies*, 59(1), 99-115. doi:10.1080/0032472052000332737
- Navaie-Waliser, M., Spriggs, A., & Feldman P. H. (2002). Informal caregiving: differential experiences by gender. *Medical Care*, 40(12), 1249-1259. doi: 10.1097/00005650-200212000-00012

- Perls, T. T. (2006). The different paths to 100. *The American Journal of Clinical Nutrition*, 83(2), 484S–7S.
- Rendall, M. S., Weden, M. M., Favreault, M. M., & Waldron, H. (2011). The protective effect of marriage for survival: a review and update. *Demography*, 48(2), 481-506. doi: 10.1007/s13524-011-0032-5
- Rodgers, W. L., & Herzog, A. R. (1992). Collecting data about the oldest old: problems and procedures. In Suzman R. M., Willis, D. P., & Manton, K. G. (Eds.), *The oldest old* (pp. 135-156). New York, Oxford: Oxford University Press,.
- Smith K. R., Zick C. D., & Duncan G. J. (1991). Remarriage Patterns Among Recent Widows and Widowers. *Demography*, 28(3), 361-374. doi: 10.2307/2061462
- Stahelin, K., Schindler, C., Spoerri, A., Zemp Stutz, E., for Swiss National Cohort Study Group (2012). Marital status, living arrangement and mortality: does the association vary by gender? *Journal of Epidemiology & Community Health*, 66(7). e22. doi: 10.1136/jech.2010.128397
- Taeuber, C. M., & Rosenwaike I. (1992). A demographic portrait of America's oldest old. In R. M. Suzman, D. P. Willis & K. G. Manton (Eds.), *The oldest old* (pp. 17-49). New York, Oxford: Oxford University Press.
- van Grootheest, D. S., Beekman, A. T. F., Broese van Groenou M. I., & Deeg, D. J. H. (1999). Sex differences in depression after widowhood. Do men suffer more? *Soc Psychiatry Psychiatr Epidemiol*, 34(7), 391-398. doi: 10.1007/s001270050160
- Zhu, H., & Gu, D. (2010). The protective effect of marriage on health and survival: Does it persist at oldest-old ages? *Journal of Population Ageing*, 3(3), 161-182. doi: 10.1007/s12062-011-9034-8

Table 1

*Age at Events in the Marital History of Ever-married Centenarians (in percent)*

Age group	Female (N = 2000)			Male (N = 679)		
	First marriage	Widowhood	Remarriage	First marriage	Widowhood	Remarriage
-20	7.0	0.0	0.0	1.2	0.0	0.0
20-29	75.7	0.3	6.8	66.2	0.2	1.4
30-39	13.1	2.3	15.8	25.1	0.5	17.1
40-49	3.0	5.7	27.4	4.6	0.8	10.0
50-59	1.0	10.9	24.0	2.6	3.2	11.4
60-69	0.3	23.3	24.0	0.2	9.8	22.9
70-79	0.0	32.2	1.4	0.0	23.5	18.6
80-89	0.0	19.6	0.7	0.2	31.7	12.9
90-99	0.0	5.5	0.0	0.0	28.5	5.7
100+	0.0	0.3	0.0	0.0	1.8	0.0
	100.0	100.0	100.0	100.0	100.0	100.0
Mean age + SD (in years)	25.8 (±12.5)	70.2 (± 26.5)	49.4 (± 23.9)	28.7 (±14.5)	81.9 (± 24.0)	61.4 (± 36.5)

Table 2

*Living Arrangements (LA) at age 60 and 100 of Centenarians who were Ever-married and Never-married at age 60*

	Women	Men	Total	% of women	% of men
<b>LA of ever-married at age 60</b>					
Living with spouse	1,592	648	2,240	79.6	95.4
Living alone	350	28	378	17.5	4.1
Living with others (excluding spouse)	58	3	61	2.9	0.4
<b>Total ever-married at age 60</b>	<b>2,000</b>	<b>679</b>	<b>2,679</b>	<b>100.0</b>	<b>100.0</b>
<b>LA of never-married at age 60</b>					
Living alone	199	38	237	72.9	76.0
Living with others	21	3	24	7.7	6.0
Living in religious community	53	9	62	19.4	18.0
<b>Total never-married at age 60</b>	<b>273</b>	<b>50</b>	<b>323</b>	<b>100.0</b>	<b>100.0</b>
<b>LA at age 100 of ever-married at age 60</b>					
Living with spouse	3	39	42	0.2	5.7
Living alone	506	199	705	25.3	29.3
Living with others (excluding spouse)	550	208	758	27.5	30.6
Living in care facility	941	233	1174	47.1	34.3
<b>Total ever-married at age 60</b>	<b>2,000</b>	<b>679</b>	<b>2,679</b>	<b>100.0</b>	<b>100.0</b>
<b>LA at age 100 of never-married at age 60</b>					
Living alone	48	13	61	17.6	26.0
Living with others	38	13	51	13.9	26.0
Living in care facility	134	15	149	49.1	30.0
Living in religious community	53	9	62	19.4	18.0
<b>Total never-married at age 60</b>	<b>273</b>	<b>50</b>	<b>323</b>	<b>100.0</b>	<b>100.0</b>
<b>TOTAL</b>	<b>2,273</b>	<b>729</b>	<b>3,002</b>		

Table 3

*Living Arrangement Trajectories of Living with Spouse or Alone at the age of 60*

Living arrangement trajectory	Women	Men	Women	Men
from age 60 to 100	(absolute number)	(absolute number)	(percentage)	(percentage)
<b>Living with spouse at age 60</b>				
With spouse	3	39	0.2	6.0
With spouse – alone	411	191	25.8	29.5
With spouse – with others	173	120	10.9	18.5
With spouse – nursing home	83	49	5.2	7.6
With spouse – alone – with others	241	78	15.1	12.0
With spouse – alone – care facility	491	113	30.8	17.4
With spouse – others – care facility	49	25	3.1	3.9
With spouse – alone – others – care facility	141	33	8.9	5.1
<b>Total living with spouse at age 60</b>	<b>1,592</b>	<b>648</b>	<b>100.0</b>	<b>100.0</b>
<b>Ever-married living alone at age 60</b>				
Alone	87	8	24.9	28.6
Alone – with others	101	8	28.9	28.6
Alone – care facility	117	6	33.4	21.4
Alone – others – care facility	45	6	12.9	21.4
<b>Total ever-married living alone at age 60</b>	<b>350</b>	<b>28</b>	<b>100.0</b>	<b>100.0</b>
<b>Never-married living alone at age 60</b>				
Alone	43	10	21.6	26.3
Alone – with others	35	14	17.6	36.8
Alone – care facility	77	8	38.7	21.1
Alone – others – care facility	44	6	22.1	15.8
<b>Total never-married living alone at age 60</b>	<b>199</b>	<b>38</b>	<b>100.0</b>	<b>100.0</b>

**Table 4**

*Average Number of Years Lived in each Living Arrangements (LA) from the age of 60 to 100 by Marital Status and Proportion of Time Lived in each LA by Selected Age Group*

	With spouse	Alone	With others	In care facility	Total number of years
<b>Average number of years lived in each LA</b>					
<b>ALL MEN</b>	<b>21.7</b>	<b>10.6</b>	<b>5.9</b>	<b>1.9</b>	<b>40.0</b>
never-married men	-	21.8	13.9	4.3	40.0
ever-married men	23.2	9.8	5.3	1.7	40.0
<b>ALL WOMEN</b>	<b>10.5</b>	<b>18.7</b>	<b>7.3</b>	<b>3.5</b>	<b>40.0</b>
never-married women	-	24.5	9.4	6.1	40.0
ever-married women	11.9	17.9	7.0	3.2	40.0
<b>Proportion of time lived in each LA (percent)</b>					
<b>MEN</b>					
from age 60 to 72	<b>83.5</b>	14.4	1.9	0.2	100.0
from age 73 to 84	<b>61.1</b>	24.2	13.7	1.0	100.0
from age 85 to 99	25.6	<b>35.8</b>	26.4	12.2	100.0
<b>WOMEN</b>					
from age 60 to 72	<b>56.8</b>	32.8	10.1	0.3	100.0
from age 73 to 84	24.1	<b>50.5</b>	23.6	1.8	100.0
from age 85 to 99	3.8	<b>44.9</b>	29.1	22.2	100.0

Table 5

*Probability of Becoming a Centenarian by Marital Status at Successive Census Dates, Cohorts born 1893-1903 (Confidence Interval at 95% in Parentheses)*

Marital status at census	1961 (age 58-68)	1970 (age 67-77)	1981 (age 78-88)	1991 (age 88-98)
<b>MEN</b>				
Single	0.00183 (±0.00007)	0.00290 (±0.00011)	0.00822 (±0.00031)	0.05934 (±0.00221)
Married	0.00198 (±0.00002)	0.00311 (±0.00003)	0.00815 (±0.00011)	0.06176 (±0.00109)
Widowed	0.00126 (±0.00005)	0.00220 (±0.00006)	0.00746 (±0.00012)	0.05326 (±0.00064)
Divorced	0.00041 (±0.00007)	0.00060 (±0.00010)	0.00312 (±0.00042)	0.02323 (±0.00307)
<b>TOTAL</b>	<b>0.00188 (±0.00002)</b>	<b>0.00287 (±0.00003)</b>	<b>0.00781 (±0.00008)</b>	<b>0.05548 (±0.00053)</b>
<b>WOMEN</b>				
Single	0.01086 (±0.00068)	0.01409 (±0.00088)	0.02634 (±0.00165)	0.11302 (±0.00674)
Married	0.00972 (±0.00026)	0.01324 (±0.00042)	0.02471 (±0.00123)	0.11807 (±0.01209)
Widowed	0.00681 (±0.00032)	0.00963 (±0.00032)	0.02113 (±0.00055)	0.09299 (±0.00211)
Divorced	0.00802 (±0.00147)	0.00945 (±0.00173)	0.02063 (±0.00368)	0.08044 (±0.01390)
<b>TOTAL</b>	<b>0.00900 (±0.00019)</b>	<b>0.01149 (±0.00025)</b>	<b>0.02224 (±0.00048)</b>	<b>0.09557 (±0.00197)</b>

Table 6

*Probability of Becoming a Centenarian by Living Arrangements (LA) at Successive Census Dates, Cohorts born 1893-1903 (Confidence Interval at 95% in Parentheses)*

LA at census	1970 (age 67-77)	1981 (age 78-88)	1991 (age 88-98)
<b>Never-married men</b>	0.00290 (±0.00011)	0.00822 (±0.00031)	0.05934 (±0.00221)
living alone	0.00553 (±0.00026)	0.00668 (±0.00037)	0.05000 (±0.00315)
living with others	0.00095 (±0.00009)	0.00998 (±0.00068)	0.03720 (±0.00343)
living in collective household	0.00323 (±0.00028)	0.01088 (±0.00087)	0.09113 (±0.00482)
(in care facility)	0.00054 (±0.00014)	0.00427 (±0.00071)	0.08878 (±0.00583)
(in religious community)	0.01062 (±0.00096)	0.02110 (±0.00189)	0.10309 (±0.00885)
<b>Ever-married men</b>	0.00287 (±0.00003)	0.00778 (±0.00008)	0.05522 (±0.00055)
living with spouse	0.00311 (±0.00003)	0.00815 (±0.00011)	0.06176 (±0.00109)
living alone	0.00310 (±0.00009)	0.00741 (±0.00014)	0.06273 (±0.00096)
living with others (excluding spouse)	0.00094 (±0.00005)	0.00925 (±0.00027)	0.04956 (±0.00109)
living in collective household	0.00034 (±0.00009)	0.00174 (±0.00019)	0.02909 (±0.00114)
<b>Total men</b>	0.00287 (±0.00003)	0.00781 (±0.00008)	0.05548 (±0.00053)
<b>Never-married women</b>	0.01409 (±0.00017)	0.02634 (±0.00031)	0.11302 (±0.00128)
living alone	0.02519 (±0.00038)	0.02555 (±0.00044)	0.12154 (±0.00217)
living with others	0.00492 (±0.00015)	0.02503 (±0.00060)	0.10247 (±0.00285)
living in collective household	0.01363 (±0.00035)	0.02944 (±0.00068)	0.11027 (±0.00191)
(in care facility)	0.00292 (±0.00023)	0.02166 (±0.00099)	0.08860 (±0.00212)
(in religious community)	0.02217 (±0.00059)	0.03354 (±0.00089)	0.15447 (±0.00384)
<b>Ever-married women</b>	0.01122 (±0.00005)	0.02178 (±0.00009)	0.09364 (±0.00039)
living with spouse	0.01324 (±0.00008)	0.02471 (±0.00023)	0.11807 (±0.00230)
living alone	0.01350 (±0.00009)	0.02372 (±0.00013)	0.12390 (±0.00067)
living with others (excluding spouse)	0.00417 (±0.00007)	0.02076 (±0.00021)	0.07321 (±0.00065)
living in collective household	0.00025 (±0.00005)	0.00432 (±0.00015)	0.05767 (±0.00065)
<b>Total women</b>	0.01149 (±0.00005)	0.02224 (±0.00009)	0.09557 (±0.00038)