Living Arrangements and Marital Status of Older Adults Associated with Mortality Risk

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Introduction

The present study uses a multi-faceted approach to analyse the association between the mortality risks and living arrangements of older people. First, it considers not only broad living arrangement types - living with a partner, living with others, living alone and living in a collective household – but also the combination of these with marital status and some more specific situations of co-residence for which significant differences in mortality risk might be expected. Secondly, by analysing the whole of the Belgian population over 65, it allows us to assess the differences in mortality risks between specific living arrangements and between men and women in age groups up to the oldest ages, in private and collective households. Thirdly, the analysis uses a rich and reliable database that includes data from the administrative population registration system (*Registre National*) linked at the individual level with census data, the type of data available only in very few countries (Poulain and Herm 2013). Finally, the association between mortality risk and living arrangements is assessed controlling for individual health status such as might have a strong impact both on living arrangements and mortality risks, but which has been included in relatively few analyses on mortality differences by living arrangement (*e.g.* Davis *et al.* 1997).

Background

Mortality risks associated with marital status and living arrangements

Social support, companionship, and the availability of care are major factors affecting health (Uchino 2009) and mortality in old age. Being married is generally considered one of the most important of these factors, as a spouse is usually the closest person. Yet the legal status of being married does not necessarily reflect the *de facto* situation and is not sufficient to assess the availability of support from any co-resident person. In particular, the legal marital status does not necessarily indicate whether a person is actually living alone, with others or in a collective household. In assessing the effects of potential co-residential support on mortality risks, we need to look beyond the role of legal marital status and investigate living arrangements more directly.

Historically, mortality differentials associated with living arrangements have not been studied as extensively as has the relationship between legal marital status and mortality. The latter association has been investigated repeatedly since the 19th century, when the benefits of being married for health and mortality outcomes were detected by Farr ((1858), see also Robards *et al.* 2012) and the protective effect of marriage (in relation to suicides) was further confirmed by Durkheim ([1897], 1951). Since then many mortality studies have confirmed that an association exists between being married and experiencing lower mortality risk (Gove 1973; Hu and Goldman 1990; Ben-Shlomo *et al.* 1993; Drefahl 2012). Summarising the results of 53 independent studies around the world focusing on marriage and mortality, the meta-analysis of Manzoli *et al.* (2007) confirmed the lower mortality risk of married individuals. Nevertheless Rendall *et al.* (2011) found little evidence of mortality differences between the never-married, the divorced/separated, and the widowed, and suggested that marital status is important only as much as it distinguishes the currently married from all others.

The literature on the relationship between marital statuses with longevity gives the impression that marital status is often considered as a proxy for living arrangements. However, living arrangements as a reflection of whom a person is living with, *de facto,* requires information confirming a common place of residence, a constraint often difficult to meet due to data limitations. Helsing, Szklo and Comstock (1981) were among the first researchers that compared the effect of living alone and living with someone on mortality, but not of older people. Davis *et al.* (1992, 1997) assessed whether living arrangements affect survival in older age, and showed that those living alone are at greater risk than those living with a spouse or with others. In the last decade, demographic research has benefitted from the availability of large data sets extracted from centralised population registers linked with census-based data on household and individual characteristics (Poulain and Herm 2013). These possibilities have stimulated the investigation of relationships between actual living arrangements and mortality risks (*e.g.* Joutsenniemi *et al.* 2006). Identifying a wide variety of mortality differences between persons living with a spouse, with a cohabiting persons, with someone other than a partner or living alone, Koskinen *et al.* (2007) suggested that living arrangements, or co-residence status, may be as, if not more, important than legal marital status in explaining variations in mortality risk for older people. Living with a spouse is protective against the risk of dying but that protection could also be received from any co-resident adult who can also provide companionship, support or care (Anson 1989). Nonetheless, the mortality rates of married men and women are found to be lower than their cohabiting counterparts (Liu and Reczek 2012). These findings suggest that there are independent (but possibly interacting) effects of formal marital status and of living arrangements on survival, as confirmed by the study on the Swiss population aged up to 90 years and above (Staehelin *et al.* (2012).

Due mainly to data limitations, few researchers have compared the mortality risk in private and collective living arrangements. Recent work has demonstrated the higher mortality risk for older persons living in nursing homes (Grundy 2011; Herm, Poulain and Anson 2014; Martikainen *et al.* 2014) as well as the low mortality risk for members of religious communities. This last has often been attributed to the better diet and more regular life style of these communities (Luy 2003; Luy, Flandorfer and Di Giulio 2013), but there may also be an effect of the particular form of community organisation as well as an impact of selection.

Controlling health

When assessing the relationship between living arrangements and mortality risks, and in particular when comparing private and collective arrangements, it is critical that health be included as a control covariate in the explanatory model. Only then can we be sure that the observed variations in mortality risk by living arrangements are not proxies for variations in health status. Health status has been found to be an important intermediate variable when assessing mortality risks by marital status (Grundy and Tomassini 2010; Goldman, Korenman and Weinstein 1995; Lillard and Panins 1996; Zunzunegui, Beland and Otero 2001) as marital status is an important preventative condition. The deterioration in health status, whether actual or anticipated, is often the main reason for a change in living arrangement, such as joining children or entering an institution (Bōrsch-Supan *et al.*, 1996; Klein 1996; Nihtilä and Martikainen 2008), so that we may expect mortality in these living arrangements to be higher. By the same token, we expect to find that health is an important intermediary condition in the mortality risks of the institutionalised, because the transition mechanism makes this is population selected for ill health.

The impact of age and gender

Variation of the association between living arrangements and mortality risks by age was not considered in earlier studies, most probably because the data sources used in these studies did not allow detailed analysis at oldest ages. Recent studies using longitudinal data have indicated that the protective role of marriage still exists among older persons (Grundy and Tomassini 2010) but it decreases with age after age 65 (Rendall *et al.* 2011; Staehelin *et al.* 2012). The mortality gap between the widowed and the married has also been found to be greater at younger than at older ages (Martikainen and Valkonen 1996). With increasing age, widowhood may be considered as a more normative life event, and living alone when widowed may be therefore less harmful, in terms of health and mortality consequences, than at younger ages (Seeman *et al.* 1987).

An early study found living arrangements to have a weak impact on survival among men, but no effect among women (Davis *et al.* 1992). Other studies have confirmed that living with a spouse gives men a relative advantage (Goldman, Korenman and Weinstein 1995; Staehelin *et al*. 2012). In fact, any partnership, either with a spouse or cohabiting partner, is favourable for men but not necessarily for women, and the advantage of living with a partner decreases with age for both genders (Liu and Reczek 2012).

Age difference between spouses also appears to influence mortality risks, particularly in old age: a large age difference between spouses, with men older than women, has been shown to be a factor associated with male longevity (Fox, Bulusu and Kinlen 1979; Foster, Klinger-Vartabedian and Wispé 1984; Klinger-Vartabedian and Wispé 1989; Drefahl 2010). For women, by contrast, a similar situation, of living with an older husband, has been found to be detrimental but less so (Fox, Bulusu, and Kinlen 1979; Drefahl 2010). Being married to a younger wife postpones widowhood for men and prolongs the favourable status of living with spouse. As a large share of men are married to a woman who is about the same age or

younger, this may offer a partial explanation for the lower mortality risk of married men in old age, while women pay a price for living with older and presumably less healthy husbands.

Research question and hypothesis

This study addresses the association between living arrangements and the mortality risk of older men and women by considering a detailed typology of living arrangements that considers marital status and other demographic characteristics describing individuals living in both private and collective households. The total Belgian population aged 65 years and above is included in the analysis, and the mortality risks are assessed in a strictly comparative way for each living arrangement, both private and collective. The outcomes are controlled for health, as some types of living arrangements might be more characteristic of less healthy people than others. The general question of this analysis is whether, and to what extent, such an extended typology of living arrangements better explains mortality differences than marital status alone (H1). In other words, we assume that there are two separate factors at work in generating the mortality risk: on the one hand, the physical, material and inter-personal (spiritual) support that co-residence provides for the wellbeing of an older person and, on the other hand a direct, but independent, impact of the normative (legal) status of being married. We thus expect the mortality risk within a given living arrangement to vary by legal marital status, with married couples having a lower mortality risk than co-residing (cohabiting) couples who are not legally married; also, when living alone, we expect the never-married to have a lower mortality risk than the widowed and the divorced.

Secondly we assume that the association of living arrangements with mortality risks varies by age and is gender-specific (H2). Several factors linked to selection and behavioural effects may operate to diminish the gender gap in mortality at old age. Living with a spouse, which is generally favourable, and more so for men than for women, becomes less favourable at older

ages and earlier for women than for men. Mutual support between spouses becomes unbalanced when health deteriorates; when one of the spouses, more often the husband, becomes unhealthy and needs more care, the healthier spouse has to make a greater contribution, and this will affect negatively his or her health. Living alone is associated with relatively higher mortality, especially among younger men, whereas it might become more favourable at older ages indicating that a person is able to live independently and is relatively healthier, a situation that for men could result from a selection in favour of those coping better with living alone.

The third set of hypotheses (H3) points to some other specific distinctions in living arrangements that affect the risk of mortality. More concretely, we hypothesise that:

i. The relative age of the spouses is associated with their mortality risks in old age differently for men and for women (H3a). Following the literature, we assume that men have an advantage when living with a younger wife, whereas for women we expect an age gap, in either direction, to increase mortality risks compared to those with a spouse of about the same age (Drefahl 2010).

ii. For those living with partner the specific relationship between co-residents might also affect the mortality risks (H3b): living with a cohabiting partner, even if not equally protective as living with a spouse, still gives potentiality a similar support whereas living with child(ren) or with other persons, but not a partner, indicates the absence of resources for living independently and often a worse health status, both associated higher mortality risk.

iii. The timing of widowhood affects the mortality risk of widowed persons when living alone (H3c). We expect persons who have recently been widowed to face a higher mortality risk than those who lost their spouse long time ago (and have thus survived the immediate bereavement crisis).

iv. Finally we assume that the mortality risks of never-married older adults in different types of living arrangements vary largely, with a higher risk in nursing homes compared to those living in religious communities or living alone (H3d).

Data and methods

Data sources

The data were taken from the Belgian population registration system (*Registre National*) and linked individually to the 2001 Belgian census data, providing a unique opportunity to combine data on survival by detailed individual living arrangements, together with information on subjective health perceptions, disability and limitations on daily activities. The present analysis covers all residents of Belgium who were enumerated in the census on the 21 October 2001, and who were still alive and aged 65 years or older on 1 January 2002. This gave a total of 1.74 million persons, of whom 1.03 million were women and 0.71 million men. Of these, 85,298 persons died during the year 2002, to give a general mortality risk of 49 per 1000.

From the population registration system we derived the following variables: sex, date of birth, legal marital status, information on spouse including date of birth and date of death, and household characteristics as of 1 January 2002. Individual living arrangements were determined on the basis of household composition, the individual's relationship with other members of the household and legal marital status. These variables are recorded in the Belgian population register as part of the administrative procedures and the data for each individual include the family link with the household reference person. The legal marital status, as well as the relationship with other persons in the household, is that recorded at baseline on 1 January 2002; the changes of status over the 2002 calendar year are not considered. Based on this information the relationships with other persons in the household

are reconstructed for each individual in order to identify co-residence with spouse, partner, children or others. Where necessary, certain assumptions were made concerning the relationship between persons in the same household. Thus, following the statistical rule adopted by Statistics Belgium, cohabiting non-married partners were identified on the basis of age difference (no more than 15 years), opposite sex and no family link between these two persons.

The information on health is derived from a set of questions in the 2001 census on the health and disability status of each individual. These four census questions: self-rated health status, disability status and, for the disabled, the limitation of daily activities and to what extent the person was bedridden, were combined in order to create a health index that is a continuous variable ranging from 0 (very poor self-perceived health, strongly hampered in their daily life and permanently bedridden) to 100 (no disability and in very good self-perceived health). The construction of this health index is described in our previous work (Herm, Poulain and Anson 2014). The median value of the index is 44.3 with first and third quartiles 28.5 and 83.4 respectively.

An extended typology of living arrangements

Using the information from the population registration system as on 1 January 2002 we constructed the following typology: *Persons having private living arrangements* were categorised as living with a spouse, the husband older than the wife (with or without other persons in the household); living with a spouse, the husband younger than the wife (with or without other persons in the household); cohabiting with partner but not formally married; living with one or more children only; living with person(s) other than spouse, partner or child; living alone, never–married; living alone, widowed at least five years ago; living alone, widowed less than five years ago; l iving alone, divorced or married, but separated. *Persons*

having collective living arrangements were categorised as living in a nursing home, never-married; living in a nursing home, ever-married (including all current legal marital statuses); living in a convent or other religious community; living in other institutional residences (*e.g.* psychiatric institutions).

Data analysis

In the first step of the analysis we computed age specific mortality rates and the average health index for each living arrangement by sex and five-year age groups. To control the age structure of the population, which varies between living arrangements, we constructed an age-standardised mortality rate and an age-standardised health index of men and women in each living arrangement.

We ran several binary logistic regression models with survival or death (survival = 0 and died = 1) as the outcome at the end of year 2002 introducing age, sex and living arrangements as independent covariates, with health status as a control variable. Under the assumption that the mortality risk increases exponentially, as in the Gompertz law, we introduced age, centred at 80 years, for easier interpretation, as a continuous variable in the models. Considering that the exponential increase of the mortality risk by age may not be identical for all living arrangements (H2), we added an interaction between living arrangement and age. The interaction between sex and living arrangements allows us to assess if the relationship between living arrangements and mortality risk differs significantly between men and women. The first model included only age and sex as sole covariates (Model 1). To compare the associations with marital status and with living arrangements, we ran separately a model with marital status (Model 2), and a model with broad categories of living arrangement (Model 3) (living with partner - legally married or not -, living with others, living alone and living in a collective household), including their interaction with age and with sex. We ran two other

models with the extended typology combining the broad categories of living arrangement with marital status as well with other specific characteristics as listed above in the typology of living arrangements. We also ran separate models, by sex, to allow for the different effects of health on mortality for men and women. For comparative purposes two models are presented without considering health (Model 4A for men and Model 4B for women) and two including health (Model 5A for men and Model 5B for women). Controlling the impact of health in each living arrangements allows us to assess the direct association between living arrangements and mortality risks.

Results

Descriptive findings

As expected, the probability of dying during the year 2002 increased with age, almost doubling in every five-year age group, and the male mortality risk is about twice as high as the female risk, an excess mortality that decreases relatively with age (Table 1). For any given age group the risk of dying varies substantively between living arrangements and these variations differ by gender. Generally the mortality risk for those who live with a spouse is lower than average. However, in older ages mortality risks for persons living alone become closer to those living with a spouse and are even lower in very old ages. For women this occurs earlier (from age 80 years) than for men (from age 85 years). Cohabiting with a partner is associated with a higher mortality risk than living with a spouse, and the difference between these two groups is greater for women than for men. For men in the oldest ages cohabiting with a partner is associated with a mortality risk that is similar to that for those living with spouse, a situation not observed for women. Women in all ages living with other persons who are neither a spouse nor a cohabiting partner, or with one or more children, have a higher risk of dying than those living alone, while for men this situation is valid only for those older than

80 years of age. The most extreme situations emerge for those living in collective living arrangements, with the highest mortality risk being for those living in nursing homes, compared to all other living arrangements, and the lowest risk for those living in religious communities.

< Insert Table 1 about here >

The age-standardised mortality rates and health index for the Belgian population aged 65 and over displayed in Figures 1 and 2 allows direct comparison of these indicators when age is controlled. These figures demonstrate that both the mortality risk and the health index vary by living arrangements, and that they are largely correlated, confirming that health and living arrangements are inter-related and the need to control for health status when assessing differential mortality risks.

< Insert Figure 1 about here >

< Insert Figure 2 about here >

Multivariate analysis

The multivariate analysis shows, as expected, that age and sex are important predictors for differences in mortality risks in older population (Table 2). In Model 1, with only age and sex included, the mortality risk increases by 12.9 per cent for every additional year of age with a level that is 71.2 per cent higher for men compared to women.

< Insert Table 2 about here >

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Model 2, which distinguishes four marital statuses: married; single; widowed and divorced, and legally married but separated, and includes interaction of marital status with age and with sex (interactions not shown) presents little improvement in the goodness-of-fit compared to the model where only age and sex are included. Nonetheless, the odds ratios confirm, as expected, that legally married persons face much lower mortality risks than others, and that there is only a limited change in older ages. Among other statuses, the risk for a never married older person is somewhat lower compared to the widowed and divorced or married but separated, with the latter groups showing the same level of mortality risk.

Model 3, which includes broad groups of living arrangements – living with a partner (legally married or not), living with others, living alone and living in a collective household – fits better with the observed data than the model in which the predictor variable was legal marital status (Model 2). The reduction in the likelihood ratio (LR) for Model 3, compared to Model 1 with only age and sex is 9,100 whereas it was only 1,200 for Model 2 with marital status. Technically, Models 2 and 3 cannot be compared as they are not nested – variables appear in each which do not appear in the other. Nonetheless, Model 3 clearly has the better fit (lower deviance with the same number of variables and degrees of freedom) and is, implicitly, closer to a super-model which includes all variables from both models (this model is not evaluated due to collinearity of the variables). We thus conclude that the differences of mortality risks between living arrangement categories are larger than those between marital statuses. The older persons living alone have an odds ratio of dying relatively close to that of individuals living with a partner, the latter having the lowest mortality risk. People living with others than a partner have a higher risk (OR = 1.424), and the highest risk is observed among persons in collective living arrangements (OR = 3.519).

Model 4 includes the extended typology of living arrangements, and has a slightly better fit than the model with broad living arrangements (Model 3), with each of the detailed living

arrangements differing significantly from the reference group. Among those who live with a partner, being married is associated with a lower risk of dying than cohabiting without being married. Both men and women living with a spouse have the lowest risk when the husband is older than the wife. Among those who live with others there is an advantage for individuals who live with child(ren). For all categories of persons living alone, the odds ratios are relatively low and similar but still result in a higher mortality risk compared to that observed in the reference group (being married husband older than wife). Among all private and collective living arrangements, the older persons who live in a nursing home have the highest risk of dying, with the ever-married showing higher odds ratios than the never-married. By contrast, the odds ratio is lowest for the members of religious communities.

Controlling health status

When comparing models with and without health separately for men (Model 4A and Model 5A respectively) and for women (Model 4B and Model 5B respectively) (Table 3), the effect of health is evident. The fit of the models that control health are better; the values of the pseudo-R^2 increase from 0.102 and 0.166 to 0.159 and 0.210 for men and women respectively. The Wald statistics for living arrangements remain significant (2,036 for men and 4,255 for women, with 12 df). In models including health the odds ratios are lower than in models without health in most living arrangements except for those living alone. The decrease is particularly large for those in nursing homes.

< Insert Table 3 about here >

Discussion and conclusion

This investigation suggests that living arrangements, a concept that includes the co-residence status, the relationship with other co-resident persons, their current legal marital status and

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some other demographic characteristics, better explain the variation of mortality risk in old age than does the legal marital status alone. The association between living arrangements and mortality risks in old age has seldom been analysed using a large dataset that includes all older people covering an age range up to the oldest old. Furthermore, most previous studies have not been able to control for health when assessing the relationship between living arrangements and mortality risk. Our study fills this gap by linking demographic data from the administrative register and data on health from the census. We also compared mortality in private and collective living arrangements, which only a few studies have done, mostly due to the selective coverage of the data sources. These elements make the data used in this study exceptional and the investigation innovative, and bring a valuable contribution to the existing literature on the association between living arrangements and the mortality risk of older adults.

Living arrangements better associate with mortality risks than legal marital status

The detailed typology of living arrangements used in this study is more closely associated with mortality differences among older people compared to the legal marital status that do not consider *de facto* co-residence status (H1). We found that survival among older adults was more strongly associated with co-residence status than with the legal marital status, which supports the results of Staehelin *et al.* (2012). Our finding is confirmed by the difference in the goodness-of-fit statistics for the respective models showing that the association of living arrangements with survival is higher than that of marital status (reduction in the likelihood ratio (LR) for model with marital status added was 1,200 and with living arrangements 9,100). Thus living arrangements, with whom a person lives in practice, reflect more directly the support an older person can expect from co-resident persons.

Health status is an important intermediate variable when assessing mortality risks. Average

health status varies with age and gender, but also between different types of private and collective living arrangements. Accordingly, the association of mortality risks with living arrangements is largely reduced when controlling for health, but still remains statistically significant and is stronger than with marital status.

As demonstrated in earlier studies we also found that the odds ratios of dying were higher in all unmarried statuses compared to the currently married. The advantage of being married was particularly true for men, as was also found by Goldman, Korenman and Weinstein (1995) and more recently confirmed by Staehelin *et al*. (2012) for the Swiss population. Nevertheless, we need to distinguish between marriage as a legal (and normative) arrangement, and the pragmatics of living with a life-partner. That the mortality risk varies only marginally between types of living arrangements without a partner is probably because the heterogeneity among them is hidden by mutually balancing variations. The most extreme situation in our analysis appeared in the mortality risk for those living in collective living arrangements, which is about three times higher compared to those living in private living arrangements. This result supports findings of other studies (Grundy 2011; Herm, Poulain and Anson 2014; Martikainen *et al*. 2014). Our analysis confirms that in the same living arrangements those who are single, married, widowed and divorced experience different mortality risks and such differences might be related to differences in the availability of support at older ages, and linked to differences in their marital and fertility history. It corroborates the inclusion of marital status within the detailed typology of living arrangements used here.

Age and sex influence to the association between mortality risks and living arrangements
The association of the mortality risk of older people with living arrangements varies with age and this variation is gender-specific (H2). A given living arrangement may be favourable or

unfavourable at certain ages compared to others and these variations by age can be gender-specific. Interaction coefficients (not shown) between age and living arrangements estimated in the models confirm this hypothesis. More specifically, the advantage of living with a spouse decreases with age, supporting findings presented by Liu and Reczek (2012), and is less salient for women than for men as also found by Blomgren *et al.* (2012) and Staehelin *et al.* (2012). The difference in mortality risks between cohabiting partners and those living with a spouse is also gender-specific. For men, the odds ratio for those living with a cohabiting partner is close to that for men living with a spouse, while for women there is a strong disadvantage associated with cohabitation. Moreover, for men, this living arrangement appears to be unfavourable at relatively younger ages but becomes favourable later in life whereas for women no change emerges. Overall, the results of our study do not contradict the findings by Koskinen *et al.* (2007), that, as a whole, for older people, mortality among cohabiting individuals, whatever their marital status (single, widowed or divorced), was higher than among married persons. However, when disaggregating this population by age, up to age 90 and over, a positive effect of living with a cohabiting partner becomes visible for men above age 85. This point calls for further in-depth investigations involving other covariates including psychological factors. The present study also confirms findings by Liu and Reczek (2012) that partnership, either with a spouse or a cohabiting partner, is favourable for men but not necessarily for women. In collective living arrangements, both never married men and women experience lower mortality risks compared to the ever-married. This finding should be interpreted bearing in mind the counterbalancing protective effect of being married with the negative effect of widowhood. These effects together result in the ever married entering later into nursing home and having a shorter stay, compared to the never-married – as confirmed by the recent findings of Martikainen *et al.* (2014).

Other characteristics of living arrangements associated with mortality risk

Some demographic characteristics related to the living arrangements add more variation to mortality risk in older age. The difference in age of spouses was associated with a small but statistically significant difference in mortality risk (H3a). Living as a married couple, with the husband older than the wife, was associated, for both men and women, with the lowest risk of dying of all living arrangements, whereas the mortality risk was slightly higher when the husband was younger than his wife. These results are consistent with those of Drefahl (2010) but noting that the spouses, married men and women, are pooled in two large groups only, men with an older and with a younger wife, and women with an older and with a younger husband. Hence, unlike Drefahl, our study suggests that the benefit from having an older husband is larger for women than is the benefit of having a younger wife for men. It could be because the health of an older husband could deteriorate before his wife's, who would then be the caregiver for her dependent husband, and the husband subsequently benefits from living with a younger wife. A woman having an older husband will most likely be widowed earlier, and thus will not contribute to lowering the mortality risk of married women. Thus, relatively younger and healthier women can more easily provide support and care for their husband so that an older husband would profit from that situation enabling them to preserve a reasonable level of health for longer survival as a couple. This point needs further investigation.

Living with child(ren) only or living with other persons is associated for both men and women with significantly higher mortality risks compared to living with a spouse or a cohabiting partner, but also compared to those living alone (H3b). This supports the research of Davis *et al.* (1997) who found that older people who live with persons other than a spouse have an enhanced mortality risk. Yet, our results add that living only with child(ren) is associated with better survival than living with other persons, suggesting that dependent parents rely on their children to take care of them. The relative mortality risk for the ever-

married in nursing home is higher compared with those living with a child or with other persons. Previous studies have shown that, when living alone is no longer possible, men prefer going to live with a child whereas women prefer entering a nursing home (Guilbault, Dal and Poulain 2007). Such an observation could explain why the mortality risk of those living with others is relatively lower for men compared to women.

Widowers living alone have an excess mortality compared to widows in the same situation, regardless of the duration of widowhood. Men and women who were widowed within the last five years and lived alone faced higher mortality risks than those who were long time widow(er)s. These results, in line with those of Lusyne, Page and Lievens (2001), suggest that women possess a greater ability than men to cope with the shock of widowhood at least at relatively younger ages and that such differences disappear over time, probably as a result of the stronger selection among men due to mortality.

Comparing the mortality risks of never-married older adults in different types of living arrangements (H3d), considerably higher mortality risks were observed in nursing homes compared to those living alone or living in religious communities. Those living in a religious community have lower mortality risks, and this is especially true for men, as already shown by Luy (2003) and Luy, Flandorfer and Di Giulio (2013). The gender gap in mortality risks of the never married appears to be greater among older adults living alone compared to those living in nursing homes or in a religious community. To the best of our knowledge, this result has not been reported previously, and might be the result of a higher selection among men living alone compared to women.

Limitations and future work

As with most investigations, this one, too, is limited by available data. The time frame for this study was dictated by the availability of data on health, used to control the results. This

information was available only as recorded at the census date in October 2001 and no follow-up information on possible deterioration of health was available after that time. Data for identifying living arrangements were taken from the population register as of 1st January 2002. Yet new events occurring during the year 2002, particularly widowhood, may have led to changes in living arrangements and modified the risk of dying. For simplification, the changes in living arrangements during the year 2002 were not included in this analysis as a relatively short time period of one year reduces the possibility of any bias these effects may have on our study.

A previous study has discussed whether the population register can provide reliable information on current living arrangements (Poulain and Herm 2013). For the population aged 65 and over, this has only a limited impact on the reliability of the data, except for those who enter a nursing home, whose change of residence may be registered with a delay or not registered at all if they die soon after entering the nursing home.

In the current analysis the association between living arrangements and mortality were not controlled for variation in socio-economic variables such as wealth or education, because the coverage and the reliability of data describing the socio-economic status of the oldest persons were not satisfactory. Similarly, psychological factors such as loneliness, confidence and life satisfaction that influence wellbeing in old age and are related to co-residence as well as affecting mortality risks differentially by living arrangements were available neither in the population register nor in the census. The lack of these explanatory variables makes this study rather descriptive. Yet, it raises new aspects of the variation of mortality risks in old age that need to be addressed in specific surveys aiming to replicate our findings and to explain them in a larger explanatory framework.

Policy implications

The findings of this investigation provide valuable information for the development of an evidence-based policy designed to meet the needs of care and to support wellbeing in old age. Our results have important implications for the direction of policy for older people by indicating very clearly that, except at very old ages, it is preferable for older people to remain at home where possible. Whether living with a spouse or a partner, living with others or living alone, a network of support services should enable older people to maintain as normal a life as possible in their familiar surroundings. Even at the highest ages, under conditions where collective living arrangements may be expected to favour survival, there is still an advantage for those who stay in private living arrangements. From a prospective viewpoint, within the development of the Second Demographic Transition, the number of older persons not living with a spouse is expected to increase, a trend that could negatively affect the overall level of mortality in old age and even limit the on-going improvement of healthy ageing and longevity. Although current marital status and living arrangements were found to be important covariates associated with health and mortality risks, future research should consider the life course approach and investigate the transitions between different living arrangements, including both marital and non-marital living arrangements. To assess the future impact of living arrangements on mortality risks the changes in the composition of population by living arrangements and trends in mortality risk within each living arrangement should be analysed.

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TABLE 1. *Age specific mortality rates at age 65 and above by sex and living arrangement and age group (2002).*

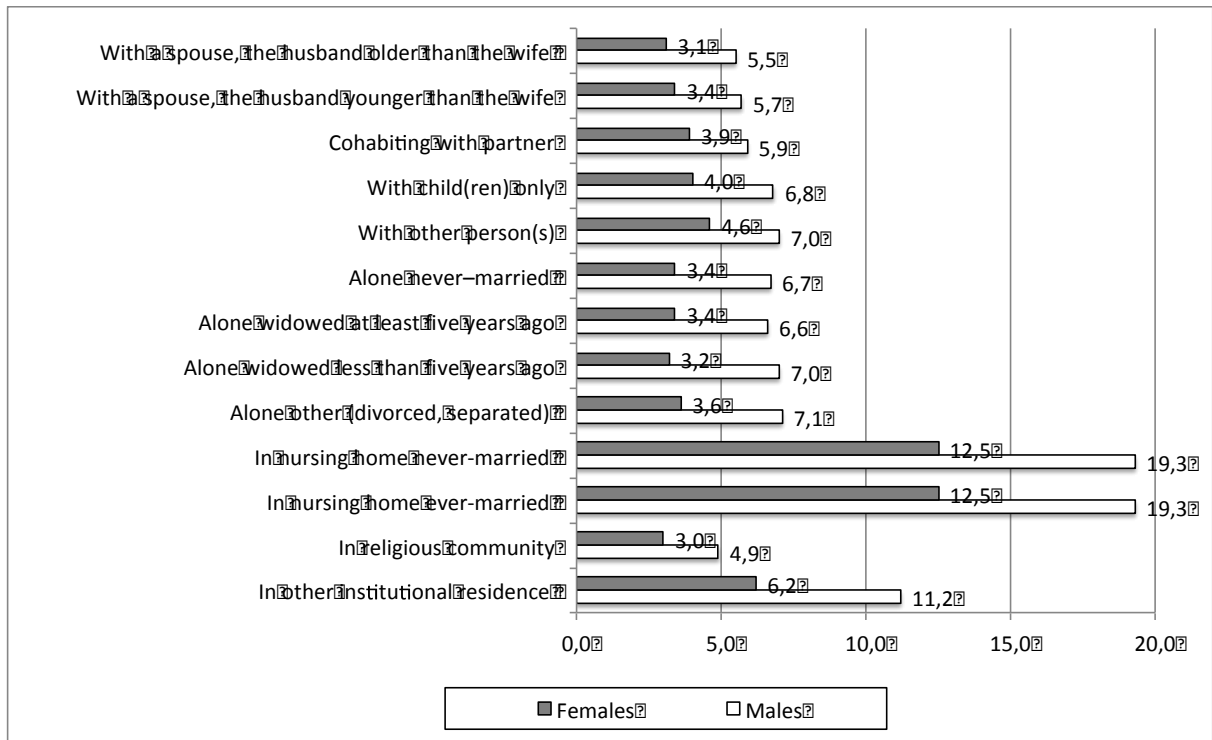| Living arrangement	Men						Women					
	Age-groups						Age-groups					
	65-69	70-74	75-79	80-84	85-89	90+	65-69	70-74	75-79	80-84	85-89	90+
With a spouse, the husband older than the wife	1.92	3.19	5.45	8.94	14.54	23.23	0.89	1.54	2.71	5.11	9.60	16.99
With a spouse, the husband younger than the wife	2.14	3.42	5.97	8.48	15.76	20.75	0.94	1.54	2.92	5.34	11.25	18.30
Cohabiting with partner	2.52	3.95	5.80	9.83	15.18	16.00	1.29	2.03	2.95	6.18	12.34	21.96
With child(ren) only	3.09	4.35	6.58	10.81	15.94	26.85	1.40	2.10	3.62	5.93	11.58	20.97
With other person(s)	2.54	4.18	6.78	10.75	19.69	27.53	1.48	2.04	4.23	7.48	14.18	22.98
Alone never–married	3.10	4.58	7.16	9.99	14.89	20.79	1.28	1.81	3.03	5.39	9.48	16.23
Alone widowed at least five years ago	3.43	4.47	6.66	9.71	14.31	22.80	1.20	1.81	3.03	4.99	9.20	17.74
Alone widowed less than five years ago	3.40	5.07	7.31	9.79	14.70	23.37	1.13	1.80	2.96	5.09	8.71	15.88
Alone other (divorced, separated)	3.43	4.55	7.92	10.03	17.35	21.72	1.35	1.87	3.17	5.92	9.73	17.26
In nursing home never-married	8.22	11.81	18.09	18.15	28.81	38.25	4.33	6.26	9.42	13.07	19.18	26.66
In nursing home ever-married	15.90	19.75	24.91	25.70	30.31	38.39	10.17	11.55	13.85	17.34	21.34	29.11
In religious community	0.94	2.07	3.96	7.39	17.37	32.26	0.63	1.41	2.44	4.94	9.74	18.77
In other institutional residence	5.21	9.16	10.78	16.39	24.43	34.78	3.13	3.27	6.06	10.16	15.56	22.44
All living arrangements	2.30	3.69	6.29	9.92	16.76	26.76	1.10	1.84	3.46	6.48	12.56	22.55

FIGURE 1. *Age-standardized mortality rates by sex and living arrangement (2002).*
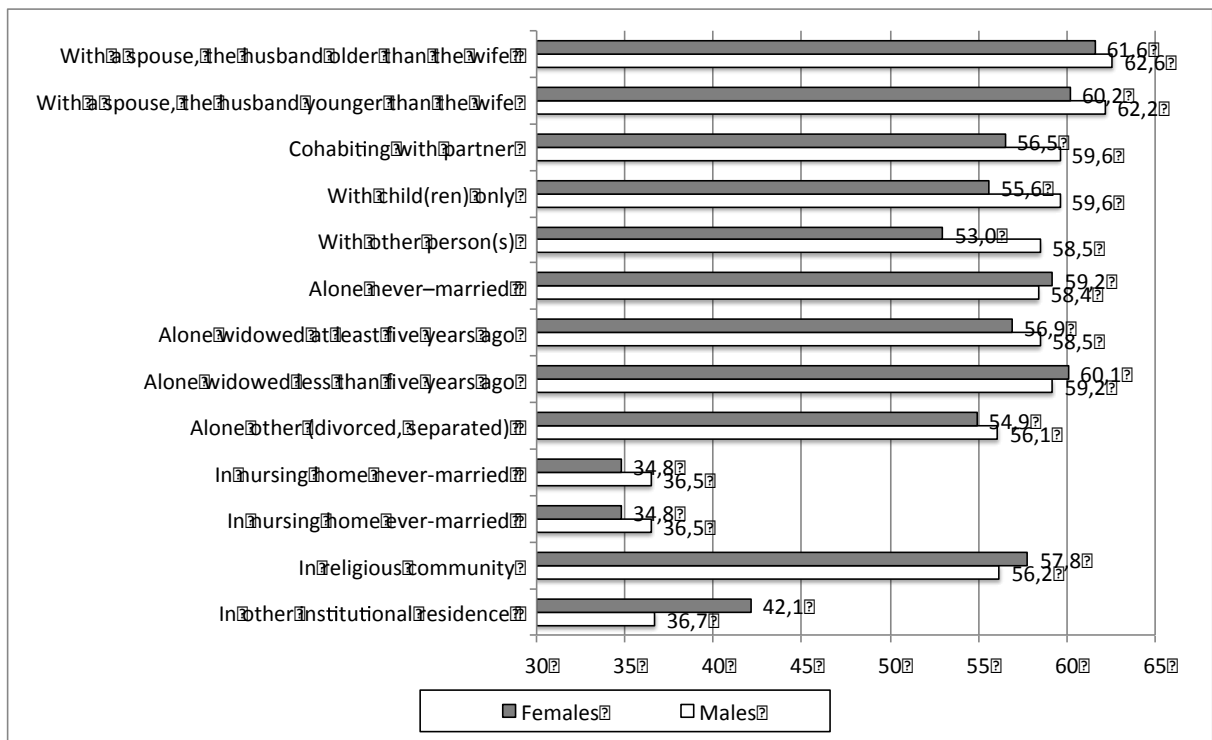
FIGURE 2. *Age-standardized health index by sex and living arrangement (2001 Census)*

TABLE 2. *Regression analysis: odd ratios to die, sex as covariate, health not controlled.*

	Model 1	Model 2	Model 3	Model 4	
Age	1.129***	1.125***	1.123***		1.122***
Sex :					
Female (reference)		1	1		1
Male	1.712***	1.926***	1.948***		1.987***
Marital status:					
Married (reference)		1			
Single		1.283***			
Widowed		1.338***			
Divorced or separated		1.335***			
Living arrangement:					
With partner (reference)			1	With a spouse, the husband older than the wife (reference)	1
				With a spouse, the husband younger than the wife	1.099***
				Cohabiting with partner	1.251***
With others			1.424***	Living with child only	1.354***
				Living with other person(s)	1.580***
Alone			1.083***	Alone never–married	1.134***
				Alone widowed at least five years ago	1.114***
				Alone widowed less than five years ago	1.067**
				Alone other (divorced, married but separated)	1.169***
In collective			3.519***	In nursing home never-married	3.152***
				In nursing home ever-married	4.632***
				In religious community	0.944
				In other institutional residence	2.187***
Constant	0.056	0.046	0.043		0.042
-2 log Likelihood (initial value =	611,845	610,645	602,745		601,101

681,155)					
Nagelkerke R2	0.121	0.123	0.136		0.139

*** p < .001
** p < .01
* p < .05

TABLE 3. *Regression analysis: odd ratios to die, men and women separately, with and without controlling health*

	Model 4a	Model 5a	Model 4b	Model 5b
Population	Men		Women	
Age	1.119***	1.102***	1.135***	1.112***
Health		0.979***		0.980***
Living arrangement (13):				
With a spouse, the husband older than the wife (reference)	1	1	1	1
With a spouse, the husband younger than the wife	1.058*	1.036	1.076**	1.064*
Cohabiting with partner	1.054	1.013	1.236***	1.185***
With child(ren) only	1.236***	1.236***	1.264***	1.248***
With other person(s)	1.272***	1.214***	1.468***	1.392***
Alone never–married	1.193***	1.165***	1.059	1.153***
Alone widowed at least five years ago	1.153***	1.186***	1.026	1.089***
Alone widowed less than five years ago	1.221***	1.263***	1.017	1.103***
Alone other (divorced, separated)	1.284***	1.159***	1.142***	1.076*
In nursing home never-married	2.908***	2.174***	2.939***	2.414***
In nursing home ever-married	4.147***	2.906***	4.276***	3.189***
In religious community	0.791*	0.713**	0.919	0.946
In other institutional residence	2.142	1.504***	2.051***	1.660***
Constant	0.082	0.222	0.044	0.107
-2 log Likelihood (initial value = 681,155)	277,894	263,159	322,836	308,197
Nagelkerke R²	0.102	0.159	0.166	0.210

*** $p < .001$
** $p < .01$
* $p < .05$