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Changes in the household structure of the Finnish elderly by age, sex and educational attainment in 1987–2035



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ABSTRACT

While the growth of the elderly population is both inevitable and predictable, the experience of old age is changing rapidly. Changes in living arrangements and family forms as well as cohorts' changing experiences of socioeconomic environments over the life-course will shape the experience of old age and have a substantial impact on the well-being, health and care needs of the elderly population. According to the latest population projections by Statistics Finland, the number of older Finns (65 and older) and old-age dependency ratio are likely to increase particularly rapidly in the next 20 years or so. However, little is known about the future prospects of living arrangements of older Finns. We use an 11% longitudinal sample of Finns aged 40 years and older drawn from population registration data to evaluate changes in living arrangements of 65+ Finnish men and women from 1987 to 2011 and project living arrangements to 2035 by educational level. We estimate proportions in various living arrangements and calculate multistate life table estimates of years lived in particular states. Projections are based on dynamic transition probability forecasts in LIPRO with constant and variable rates.

We show that living alone at older ages is currently more common among women than men: about 40% and 60% of women aged 65–79 and 80+ respectively, and about 20–30% of corresponding men live alone. These proportions are likely to start to decline slowly among women but increase among men under 80. Other living arrangements are becoming increasingly rare. Because of major changes in the access to further education the number of basic educated older people is declining rapidly. Educational differences in living arrangements are small among women, but among men living with a partner has been more common among the higher educated, although this advantage is decreasing. Of the remaining life expectancy at age 65 in 1987 women could expect to live about 40% with a partner; with the proportion increasing slightly to 2011 and 2035. Among men, these proportions were much higher in 1987 in all educational groups, but have declined slowly among the basic and secondary educated and quite markedly among the tertiary educated. Conversely, the much longer life expectancy of living alone among women as compared to men has narrowed somewhat.

Overall, we know that the future elderly population will be better educated than ever before and is more likely to live with a spouse or partner. Future living arrangement distributions of older people are strongly determined, in particular, by past household behavior and, to a lesser extent, future changes in mortality. If life expectancy differences between men and women continue to converge in the long run, the proportion of remaining years of life spent living with a partner will increase among women and living alone will increase among men. However, it remains to be seen whether the better educated and partnered future elderly will benefit from the same social, functioning, health and mortality advantages as the well-educated elderly and partnered of today. In the past 25 years, some of these differences have remained surprisingly persistent; for example, despite large distributional changes in these characteristics, the strong health benefits of education and living with a spouse remain. Thus, if the past is a guide for the future, we may expect to see a better functioning elderly population as a consequence of these demographic changes.

TIIVISTELMÄ

Aikaisempi tutkimus on osoittanut yhtäältä koulutustason ja toisaalta asumismuodon – sen, asuuko yksin, puolison tai muiden henkilöiden kanssa – olevan yhteydessä ikäihmisten hyvinvointiin, terveyteen, toimintakykyyn ja kuolleisuuteen. Asuntokunta- ja koulutusrakenteen muutoksilla saattaa siten olla merkittävä vaikutus ikääntyvän väestön hoivantarpeeseen ja hyvinvointiin. Tämän tutkimuksen tarkoituksena on kuvailla yli 65-vuotiaiden suomalaisten asuntokuntarakenteessa tapahtuneita muutoksia vuodesta 1987 vuoteen 2011 ja ennustaa asuntokuntarakennetta vuoteen 2035 iän, sukupuolen ja koulutuksen mukaan. Tutkimuksessa käytettiin hyväksi Tilastokeskuksen työssäkäyntitilaston pitkäaikaisaineistosta poimittua 11 prosentin otosta 40-vuotiaista ja sitä vanhemmista suomalaisista. Tutkimustulokset esitetään yli 65-vuotiaiden asuntokuntajakaumina sekä periodielinajanodotteina erilaisissa asuntokunnissa sukupuolen ja koulutuksen mukaan. Ennusteet perustuvat eri asuntokuntatyyppien välisiin siirtymätodennäköisyyksiin ja kuoleman todennäköisyyksiin. Ennusteet laskeaan toisaalta olettamalla, että viimeisimmät havaitut (2011–2012) todennäköisyydet pysyvät muuttumattomina koko ennustejakson ajan, ja toisaalta ottamalla huomioon todennäköisyyksissä tapahtuneet muutostrendit.

Nykyään noin 40 % 65–79-vuotiaista naisista asuu yksin ja yli 80-vuotiaista naisista jo 60 %. Vastaavan ikäisistä miehistä noin 20–30 % asuu yksin. Ennusteen mukaan yksin asuvien naisten osuus pienenee hieman vuoteen 2035 mennessä ja miehillä yksin asuminen hieman yleistyy. Koulutusekspansion myötä yli 65-vuotiaan väestön koulutustaso paranee nopeasti vuoteen 2035 mennessä. Koulutuserot asumismuodoissa ovat naisilla melko pieniä. Miehillä puolison kanssa asuminen on yleisintä korkeasti koulutetuilla, mutta koulutuserot näyttäisivät kapenevan tulevaisuudessa. Vuonna 1987 puolison kanssa asuttujen vuosien osuus 65-vuotiaiden naisten elinajanodotteesta oli 40 prosenttia. Osuus kasvoi hieman vuoteen 2011 mennessä, ja kasvun ennustetaan jatkuvan vuoteen 2035 asti. Miehillä puolison kanssa vietettyjen vuosien osuudet olivat vuonna 1987 selvästi suurempia kaikissa koulutusryhmissä mutta pienivät ajan myötä hieman perus- ja keskiasteen koulutuksen saaneilla ja selvästi korkeasti koulutetuilla. Vastaavasti naisten ja miesten ero yksin asumisen odotteessa kapeni vuodesta 1987 vuoteen 2011, ja tämän kehityksen ennustetaan jatkuvan.

Ikääntyvä väestö on korkeammin koulutettua kuin aikaisemmin ja asuu aiempaa useammin puolison kanssa. Ikääntyvän väestön asuntokuntarakennetta määrittävät erityisesti perheellistymishistoriat ja jossain määrin myös tuleva kuolleisuuskehitys. Jos miesten ja naisten elinajanodotteiden ero jatkaa kapenemistaan, naiset voivat odottaa elävänsä yhä suuremman osan jäljellä olevasta elinajastaan puolison kanssa samaan aikaan kun miehillä yksin asuminen lisääntyy. On kuitenkin epävarmaa, voivatko tulevaisuuden korkeasti koulutetut ja puolison kanssa asuvat ikäihmiset odottaa hyötyvänsä samoista sosioekonomisista ja terveyteen liittyvistä eduista kuin tämän päivän ikäihmiset. Viimeisen 25 vuoden aikana koulutukseen ja asumismuotoon liittyvät terveydelliset ja toimintakykyyn liittyvät erot ovat kuitenkin olleet hämmästyttävän pysyviä. Jos menneisyyttä voidaan pitää ohjenuorana tulevalle, voimme odottaa tulevan ikääntyvän väestön olevan näiden väestöllisten muutosten seurauksena entistä terveempää ja toimintakykyisempää.

1 INTRODUCTION

While the growth of the elderly population is both inevitable and predictable, the experience of old age is changing rapidly. Changes in living arrangements and family forms as well as cohorts' changing experiences of socioeconomic environments over the life-course will shape the experience of old age and have a substantial impact on the well-being, health and care needs of the elderly population. For example, increasing proportion living with a partner and higher educated may provide major cost savings to the individual and the society as a whole. According to the latest population projections by Statistics Finland, the number of older Finns and old-age (65 and older) dependency ratio are likely to increase particularly rapidly in the next 20 years or so (Official Statistics of Finland 2015). However, little is known about the future prospects of living arrangements of older Finns.

Household characteristics have a significant impact on the availability of and access to social support and integration, informal care and social control, and they are associated with health and long-term care use. In particular, before the onset of severe disability towards the end of life, intensive elderly care needs are mostly met by informal care, most of which is provided by co-resident spouses or partners, if available. In addition, living arrangements have significant implications for the financial well-being of elderly citizens. Bereavement and living alone are among the most significant predictors of financial difficulties in old age. Also educational differences in health and well-being are well established findings, and these effects continue through adulthood and old age. Thus, understanding past trends and future changes in the living arrangement and educational composition of the older populations is of increasing scientific and policy importance.

In the past three decades, living alone among the 65+ has increased dramatically in developed countries (Dobriansky et al. 2007). Household projections indicate that by 2030–2040 the overall number of households will increase while the average household size will decrease (e.g. OECD 2011; Christiansen and Keilman 2013). A comparative study of nine European countries on marital status suggests that as the populations of Europe are rapidly ageing the proportion of women living as married will increase considerably (Kalogirou and Murphy 2006). Past trends in living arrangements are poorly understood and household projections of future living arrangements of the elderly – particularly at old-old ages when health problems and long-term care needs are most pressing – are not available for most European countries. Largely this is because of lack of reliable longitudinal data on nationally representative samples on elderly living arrangements.

The present study aims to fill these gaps in the knowledge by evaluating changes in the living arrangements of Finnish men and women aged 65 years and older for a 50-year period. More specifically, we aim to: (1) evaluate past changes in living arrangements by sex and age from 1987 to the present day, (2) project living arrangements to 2035 using dynamic transition probability based forecasting methods and (3) to assess educational differences in past trends and future prospects of living arrangements.

These analyses are based on Statistics Finland population registration data on annual living arrangement transitions broken down by age, sex and education, with large sample size, no self-report bias and practically no loss to follow-up. The results will be presented as proportions of different living arrangements for the period 1987-2035 and life table estimates of years lived in different states.

2 DATA AND METHODS

2.1 Data

We used a linked register-based 11% random sample of the population permanently residing in Finland at the end of any of the years between 1987 and 2011, obtained from the Statistics Finland longitudinal population data file. Because of data protection regulations, Statistics Finland does not provide individual-level data records for the whole population. Statistics Finland used unique personal identification codes to link information from administrative registers regarding official domicile, age and marital status, educational attainment and vital status. Analyses of past trends and projections were for persons aged 65 years or more. However, in order to have information on the population characteristics of people that age to 65+ over the projection period 2012–2035 we extracted information from all those aged 40+ in 2011.

Measurement of household structure and education was at the end of each year 1987–2011. The unit of analysis we used for defining living arrangements was the household. We defined living arrangements in the following way: (1) living with a spouse or a cohabiting partner (with or without other family members), (2) living alone, (3) living in other kinds of private households (e.g., with children or other adults), (4) living in non-private households (e.g. institutions). Cohabitors were defined by Statistics Finland as persons living in the same dwelling, aged 18 or over, of different sex, not being siblings and with an age difference not exceeding 15 years. Same sex couples were not identified.

Educational categories were based on the highest completed educational degree or certificate, which were coded into three categories: (1) basic education lasting 9 years or less, (2) secondary education lasting 10–12 years, and (3) tertiary education lasting 13+ years. We use educational attainment as the basic measure of socioeconomic status because it is consistently measured for all persons. Furthermore, since educational qualifications are almost exclusively obtained before the age of 40-years, it is also relatively safe to project the educational distribution of the 65+ population for the next 25-years, under the assumption that no further educational qualifications are obtained at advanced ages.

2.2 Methods

Presentation of results

The results for both past trends and projections are provided in the following three ways. First, we present absolute numbers of persons by age, sex and period for selected characteristics of interest in the form of population pyramids (we truncate the presentation at 99 years as numbers and rates become erratic after that age). Second, we present age-adjusted proportions of people in different living arrangements according to two broad age-groups (65–79, 80+), sex, period and education. Third, we calculate remaining life expectancy at age 65 by living arrangement, age, sex and period from multi-state life tables using the observed or the projected transition probabilities as input. For more detail of these methods, see Preston et al. (2001).

Living arrangement projections 2012–2035

We use a multistate demographic model for these projections; the LIPRO Model of Van Imhoff and Keilman (1991), which starts with a base population and applies appropriate assumed future transition rates to this population.

Since we concentrate on projections up to 2035 of those aged 65 and over, we have included those aged 40 and over in 2011. We do not need to consider younger ages in detail, since they are not members of the cohorts of interest, although they may have small residual effects in that, for example, the possibility of a non-partnered person becoming partnered depends on the total number of potential partners of the opposite sex, or the death of a partnered person under age 40 may lead to a change of the living arrangements of the surviving partner who is over age 40. Such effects are likely to be small since our analyses are concerned with populations with average ages of about 80.

For projecting the future population aged 65 and over for the three educational level groups by household status, the base year data required are population numbers broken down by sex, single years of age, living arrangement and education. The second requirement for making projections is data on both internal transitions between household states and external transitions of mortality by household status as well as how these evolve. LIPRO estimates transitions (jump intensities) by household status, sex and age using 2011 populations as denominators and change in living arrangements (or death) measured in the population register 12 months later as numerators. We exclude the small number of cases for which no information was available at the second time point for reasons such as emigration.

We produce two sets of findings. The first is based on continuing the rates observed in the year 2011 to the end of 2035 (constant transition rates). This model shows the impact of demographic history due to changes in population structure as the baby boom generation moves into the 65+ group. The second set uses transition rates that continue the trends observed in the period leading to 2011, therefore also allowing for changes in household behavior and mortality (variable transition rates).

Statistical modelling procedures of transition rates

To obtain our second projection that allows rates to change in the future we need to obtain estimates of future transition rates. We use a flexible regression modelling approach to estimate the main trends and level in mortality and household change rates, which uses the available past data from 1987 to 2011 efficiently and treats all transitions consistently within a single framework. We fitted a series of Generalised Additive Models (GAMs) (Hastie and Tibsharani 1990) to each transition for those aged 40 and over for each sex and educational group. Therefore, the model is an extension of a standard GLM, but with the added flexibility of not pre-specifying the form of the dependence with age or time, and it has been used in a number of different areas in epidemiology (Schimek 2009).

The GAM Poisson regression model is:

$$\log(n_{at}/p_{at}) = s(a) + s(t) + e_{at}$$

where n_{at} is the number of events and p_{at} is the population at risk at age a in year t ; $s(a)$ and $s(t)$ are smooth non-parametric curves with no pre-specified form so that the data can ‘speak for themselves’, and e_{at} is a random error term. We fit the $\log(p_{at})$ term as an offset. The transition rates n_{at}/p_{at} can refer to either household transition rates or mortality rates. Separate models are fitted in each education group to each sex for mortality (separately for each of the four household states) and every household transition type in the period 1987 to 2011. Thus, a common framework for household change is employed. These derived rates minimize problems of the original data due to small numbers and some anomalies in occasional years, and therefore provide a better basis for forecasting. We do not use more complex models such as those containing interactions between age and time. There was no evidence that these would substantially alter the results and we have no clear theoretical model to expect a particular departure from constant values across all ages. For example, mortality has been extensively analyzed but there is no clear expectation that, for example, some age groups are likely to improve more rapidly than others. Finally, we are interested mainly in cross-sectional values at different time points, which tends to average out cohort differences. We estimate the annual rate of change of these rates by calculating the average value over the past five years, 2006 to 2011, and we assume that these current trends will persist for the next 25 years or so.

Note that we do not include any constraints in our models, such as those found in marital status projections where, for example, the total number of men who marry must equal number of women who do so in any time period. Since we are concerned with a subset of the population, those above age 40, such constraints do not exist. In addition, for example, a woman with lower education who died could leave her surviving highly educated partner living alone, but we do not have data on the stocks and flows for joint educational characteristics of all household members that will be necessary to include such linked events (Van Imhoff and Keilman 1991). We did, however, check the results to ensure that the results are as expected: for example, the numbers of men and women living as partners would be expected to move in the same general way although the numbers will not be equal since, on average, men tend to live with women slightly younger than themselves so that the numbers above an age such as 40 or 65 will not be equal.

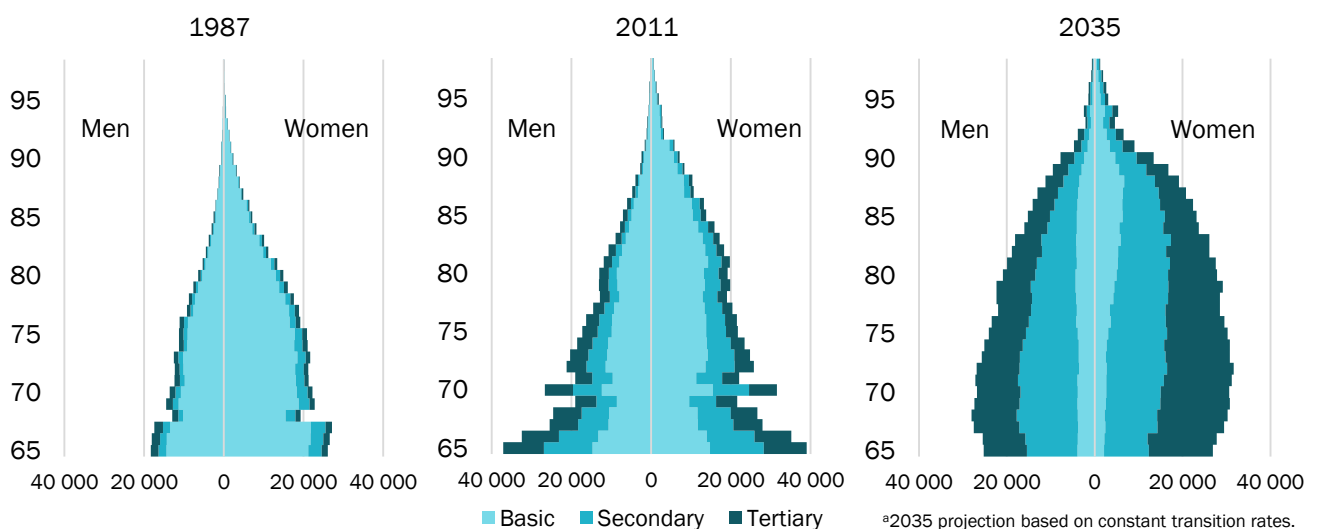
3 RESULTS

3.1 Past trends and future prospects of population structure by education

The number of 65–79 year olds and particularly the 80+ group has increased rapidly and will continue to increase rapidly in the next 25 years or so (Figure 1). The large baby-boom cohorts, born after 1945, have just entered the 65+ population and will increasingly contribute – together with rapidly declining mortality – to the large increase in the 80+ population after 2025.

The rapid expansion of the educational system in the immediate post-war period is increasingly observed in the educational distribution of the population aged 65 years and over. Based on constant rates, our projections show a very strong decline in the number of Finns with basic education only. The ageing of more recent and better educated birth cohorts will first be seen in the educational qualifications of those aged 65–79 and by 2035 also among the 80+. At the end of the projection period, only a small minority of Finns will have basic education only.

Figure 1. Population (N) by sex, age and education for years 1987, 2011 and projected for 2035^a.



3.2 Past trends in living arrangements

At ages 65–79 years, about 75% of men live with a spouse (Figure 2, Figure 3, p. 11). This proportion decreased slightly from 1987 to 2011. At the same time, living alone has increased slightly while other living arrangements have declined. Changes have been much more marked among women: the proportion of those living with a partner has increased from about 35% to 55%, while living alone has declined slowly and living in other households has declined rapidly. The low levels of women living with a partner in 1987 reflects the severe shortage of men in those age groups due to wartime losses and sex-selective emigration.

Figure 2. Population (N) by sex, age and living arrangement for years 1987, 2011 and projected for 2035^a.

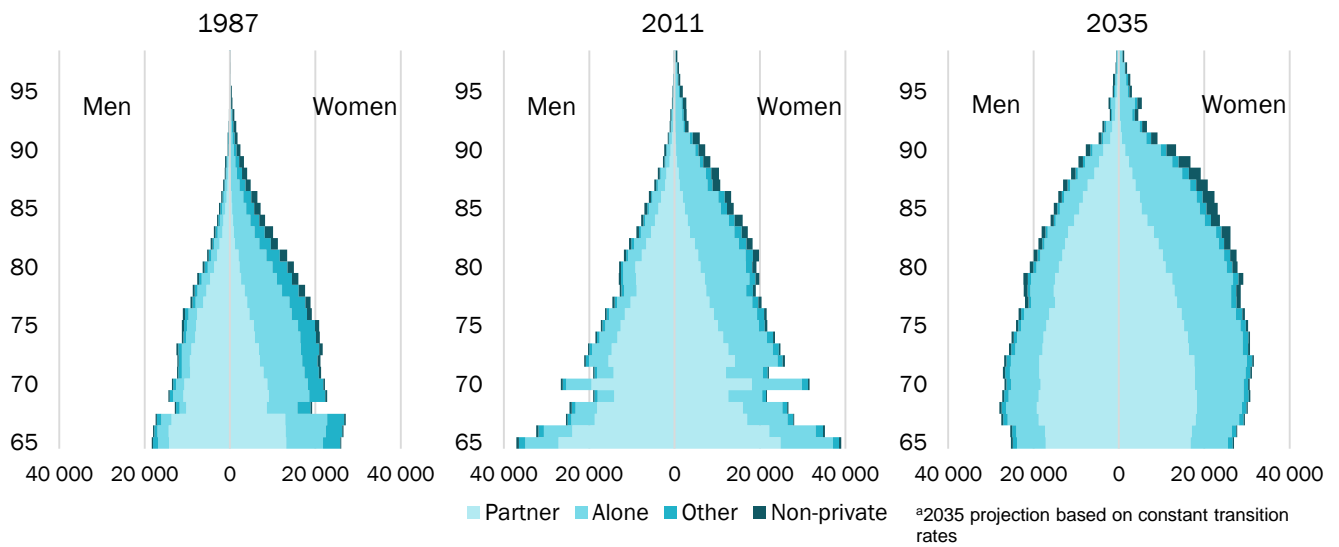
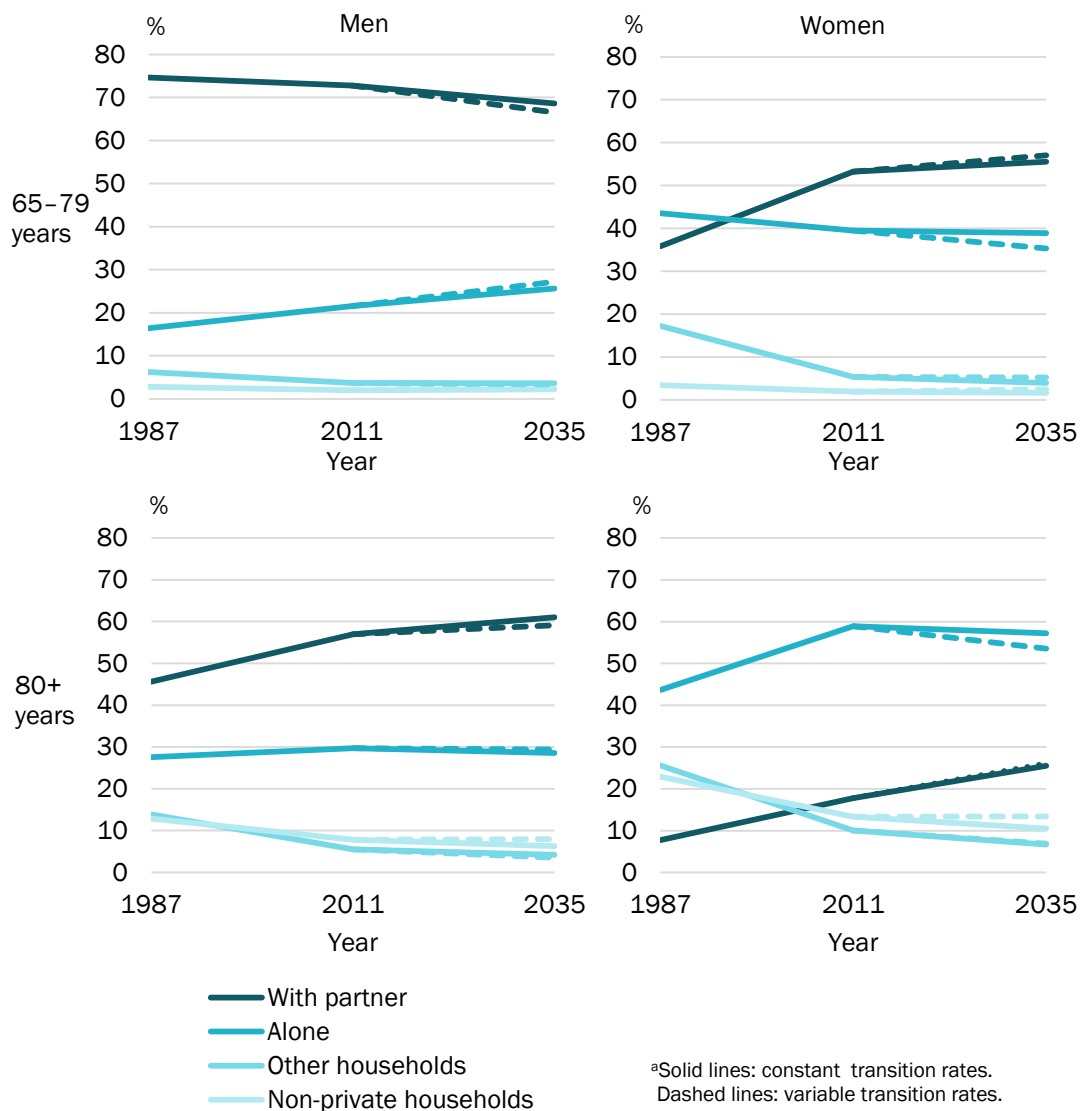


Figure 3. Change in age-adjusted proportion (%) of different living arrangements by sex and age^a.



Among men aged 80+, living with a partner increased, with about 60% living with a partner in 2011. Among women aged 80+, living with a partner and living alone have both increased. However, among women living alone is the most common living arrangement at about 60%. The proportion of women living with a partner doubled to about 18%, while the proportion living as un-partnered in other household types (mainly with adult children) or on non-private households halved.

These changes have been relatively similar across educational groups among both men and women (Figure 4, p. 13). However, both better educated men and better educated women were about 10% points more likely to live with a spouse than corresponding basic educated men and women in the period 1987 to 2011.

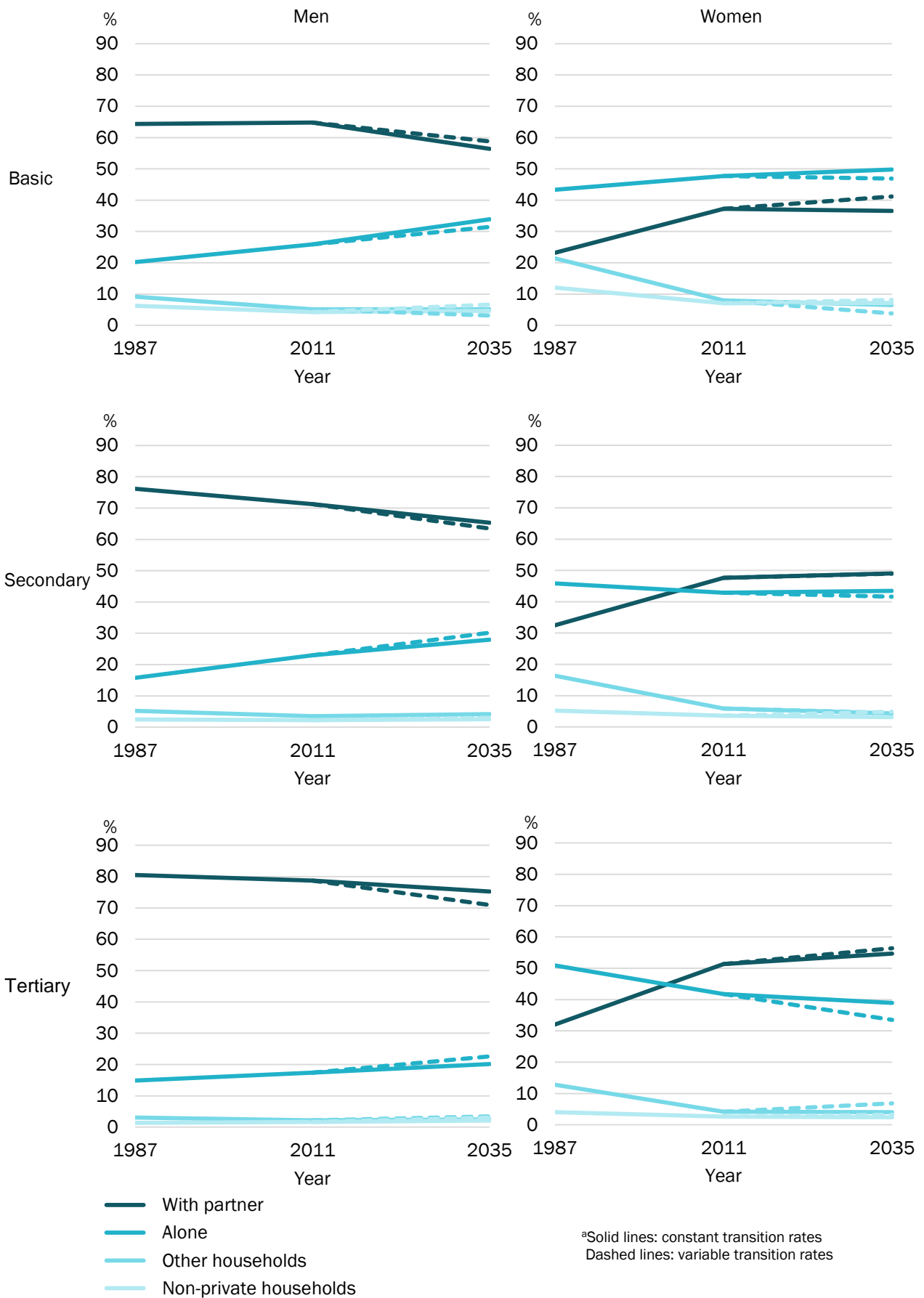
3.3 Constant rates projection of living arrangements

Our constant rates household projection is based on the last observed annual transition rates between the private household statuses, non-private households and mortality for the year 2011. The effects of migration are at these ages negligible, and migrants have been excluded. Constant rates projection does not allow demographic trends to continue into the future; for example, mortality decline and slowly converging sex differences in mortality would be expected to attenuate further declines in living alone. The future trends in household structure in the constant rates projection will thus be driven by the replacement of older birth cohorts with more recently born cohorts only.

The constant rates projection indicates that from the early 2010s onwards (Figure 3; solid line after 2011) the increasing proportion of women aged 65–79 years living with a partner will stabilise to about 55% in mid-2030s when about 40% will live alone. Among men, partnership proportions are expected to decline in this age-group, and proportions living alone will continue to increase moderately. For women aged 80+, the proportion living with a partner is still likely to increase and conversely the proportion living alone to decrease. For men aged 80+, however, the proportion living with a partner is expected to increase slightly and stabilize at about 60% and living alone at slightly below 30%.

As noted earlier, overall differences in living arrangements are relatively small with the better educated having somewhat higher proportions of those living with a partner. However, better educated men and women are expected to experience lesser declines or even increases in the proportion living with a partner until 2035 (Figure 4).

Figure 4. Change in age-adjusted proportion (%) of different living arrangements by sex and education^a.



^aSolid lines: constant transition rates
Dashed lines: variable transition rates

3.4 Variable rates projection of living arrangements

Our variable rates projection allows transition rates to change over the projection period and is based on extrapolation of past observed rates (for more detail see the methods section). For the purposes of this application, the most significant rates influencing the results are those related directly or indirectly to mortality; differential mortality rates will directly underlie differential exit from various living arrangements such as the death of partner will strongly influence transitions from living with a partner to living alone. Partnership breakdown rates and migration rates are of much lesser volume and thus of lesser significance.

The main results of the variable rate projections for 2012–2035 are presented as dashed lines in Figures 3 (by age and sex) and Figure 4 (by education and sex). As compared to the constant rate projection, the differences are relatively modest. The main difference between the two projections is that the variable rates projection will lead to larger declines in the proportion of older women living alone than the constant rate projection. The variable rate projection will also lead to smaller but opposite changes in the proportion of men living alone.

3.5 Life expectancy by living arrangement at age 65 and their changes

The transition rates between living arrangement categories and death define life expectancy in the various living arrangement states (see Table, p. 15). Overall, life expectancy at age 65 is higher among women than men, but this gap has narrowed from 1987 to 2011 and with the variable rates projection is expected to narrow further by 2035. This is mainly because the projected life expectancy increases among women are smaller than among men. We also observe systematic educational differences in life expectancy that are consistent with previous Finnish studies (Martikainen et al. 2013).

Of the remaining life expectancy at age 65 a woman could expect to live about 40% with a partner if she experienced 1987 rates, with this proportion increasing slightly for 2011 and 2035. Among men, these proportions were much higher with 1987 rates in all educational groups, but they have declined slowly among the basic and secondary educated and quite markedly among the tertiary educated. Proportions of life spent as partnered have been rising in all periods apart from men aged 65 to 79. The proportion of partnered women aged 80+ shows a threefold increase between 1987 and 2035, reflecting the impact both of more favourable sex ratio at age 65 and reduced mortality differentials from age 65 (results not shown here).

Conversely, the much longer life expectancy of living alone among women as compared to men has narrowed somewhat. Life expectancy in other living arrangements – e.g. living with children or in non-household arrangements – is of lesser magnitude, about 10% of total life expectancy at age 65 among men and slightly more among women in all educational groups, and continues its long-term decline.

Table. Life expectancy at age 65 in each living arrangement, by sex, education and year^a.

| | Year | With partner | Alone | Other households | Non-private households | Total | Change from previous period | % of life expectancy lived with partner |
|--------------|------|--------------|-------|------------------|------------------------|-------|-----------------------------|---|
| Men | | | | | | | | |
| Tertiary | 1987 | 12.2 | 2.1 | 0.9 | 0.7 | 15.9 | | 76.8 |
| | 2011 | 14.5 | 4.0 | 0.4 | 0.6 | 19.6 | 3.7 | 74.1 |
| | 2035 | 14.3 | 6.7 | 0.9 | 1.5 | 23.4 | 3.8 | 61.1 |
| Secondary | 1987 | 8.7 | 4.2 | 0.9 | 0.3 | 14.1 | | 62.0 |
| | 2011 | 11.5 | 4.5 | 0.9 | 0.7 | 17.6 | 3.5 | 65.3 |
| | 2035 | 12.6 | 6.5 | 0.9 | 1.3 | 21.3 | 3.7 | 59.1 |
| Basic | 1987 | 8.9 | 2.8 | 1.1 | 0.5 | 13.4 | | 66.9 |
| | 2011 | 9.7 | 5.2 | 0.8 | 0.8 | 16.5 | 3.1 | 59.0 |
| | 2035 | 11.7 | 4.6 | 0.4 | 1.2 | 17.9 | 1.4 | 65.3 |
| Women | | | | | | | | |
| Tertiary | 1987 | 8.5 | 8.3 | 1.3 | 1.4 | 19.5 | | 43.8 |
| | 2011 | 10.8 | 9.7 | 0.9 | 1.0 | 22.4 | 2.9 | 48.2 |
| | 2035 | 11.4 | 9.1 | 1.9 | 1.8 | 24.2 | 1.8 | 47.1 |
| Secondary | 1987 | 6.9 | 8.6 | 1.5 | 0.7 | 17.7 | | 38.9 |
| | 2011 | 9.5 | 9.9 | 1.1 | 1.1 | 21.6 | 3.9 | 43.9 |
| | 2035 | 10.0 | 10.0 | 1.2 | 2.3 | 23.5 | 2.0 | 42.3 |
| Basic | 1987 | 6.2 | 7.8 | 2.0 | 1.5 | 17.5 | | 35.3 |
| | 2011 | 8.2 | 9.5 | 1.3 | 1.4 | 20.4 | 2.9 | 40.4 |
| | 2035 | 10.9 | 8.4 | 0.7 | 1.9 | 21.9 | 1.5 | 50.0 |

^aProjections for 2035 based on variable transition rates.

4 DISCUSSION

4.1 Summary of the main findings

We evaluated changes in the living arrangements of Finnish men and women aged 65 years and more for a period of almost 50 years. The analysis consists of a detailed examination of past trends in living arrangements over a 25-year period from 1987 to 2011 and a subsequent projection to 2035. We show that living alone at older ages is more common among women than men: about 40% and 60% of women aged 65–79 and 80+, respectively, and about 20–30% of corresponding men live alone. These proportions are likely to start to decline slowly among women but increase among men under 80. Other living arrangements are becoming increasingly rare. Because of major changes in the access to further education in the cohorts

ageing to 65+, the number of basic educated older people is declining rapidly. Educational differences in living arrangements are small among women, whereas among men living with a partner has been more common among the higher educated, although this advantage is decreasing. Differences in the patterns of change in living arrangements across educational groups are small. Of the remaining life expectancy at age 65 in 1987 women could expect to live about 40% with a partner; with the proportion increasing slightly to 2011 and 2035. Among men, these proportions were much higher in 1987 in all educational groups, but have declined slowly among the basic and secondary educated and quite markedly among the tertiary educated. Conversely, the much longer life expectancy of living alone among women as compared to men has narrowed somewhat.

Living arrangement projections, usually referred to as household projections, are routinely produced by few countries and methodologies vary widely. Most household projections – themselves a small minority of population projections in general – typically provide little specific detail on elderly households and often focus on the overall number of households and their average size. Few projections are based on transition probability based models, and to our knowledge, there are no projections that are disaggregated by educational level. However, withstanding these differences in methodology and aims, certain similarities seem to emerge. For example, Australian projections show a similar trend as we do of declining proportion of women – particularly 80+ women – living alone, with constant or moderately increasing proportion among men. These future trends are likely to be particularly strong if past trends in living arrangement propensities continue to the mid-2030s (Australian Bureau of Statistics 2011). Similar sex specific findings are observed in Scotland (National Records of Scotland 2014) and Japan (National Institute of Population and Social Security Research 2013). More generally, the share of single persons households of all ages are expected increase (e.g. Alho and Keilman 2010; Christensen and Keilman 2013).

4.2 Methodological considerations

In general, short-term household projections for older people tend to be more reliable than those for the younger or for the total population (Alho and Keilman 2010; Christiansen and Keilman 2013). The most important reason for this is that there is no need to project fertility and partnership formation/dissolution that have little effect on the accuracy of projections among the older population. Furthermore, in a projection period of about 20–25 years, migration also has a relatively modest role to play as about 80% of migration occurs at ages below 40-years (and that Finland is still a society with relatively low net-migration).

Thus, the potential for projection error is probably most significant for mortality. Overall, our baseline life expectancies at age 65 are lower than the ones produced by Statistics Finland (1.0 years for women and 0.7 years for men). This is probably mainly because we exclude emigrants from our analyses. Our variable rates projection has extrapolated mortality rates for about 25 years to the future. The life expectancy increase that we obtain for men at age 65 for the year 2035 is broadly in line with the most recent population projection by Statistics Finland. However, for women life expectancy at age 65 is increasing slightly slower in our projec-

tion. Both projections show a convergence of life expectancy among men and women. This is in accordance with past trends in many high-income countries at these ages and with the latest population projection for the majority of EU countries by Eurostat (Eurostat 2014). However, the convergence of sex differences that we project is particularly strong. From a methodological point of view this may reflect: (1) Relative stagnation of mortality decline among women and particularly strong mortality decline among men in the period 2006–2011 which define the mortality trend in our projection. (2) The methodological choice of projecting educational groups separately and obtaining totals by aggregating over the education groups. This choice will put more emphasis on the mortality trends of the better educated population, which is rapidly increasing over time. In general, life expectancy projections may diverge significantly. For example, Eurostat projects slower mortality declines for Finland at these ages than Statistics Finland; a difference of about 1 year. Overall, one of the major forces that may be expected to continue to contribute to the strong trend of converging life expectancies is the ongoing decline of smoking-related mortality among men and increase or stability among women. (Pampel 2005; Preston and Wang 2006; Janssen and van Poppel 2015).

We have projected men and women separately and made no constraints to take into account that some of the processes we observe have repercussion at the couple level. For example, death of a married woman also leads to the widowhood of a married man. Explicitly allowing for this problem (the so called ‘two-sex’ problem) is typically extremely difficult in population projections and no standard procedure exists (Alho and Keilman 2010). In our particular, relatively short-term projection, the most likely inconsistency would be, for example, that the projected increase in the number of 80+ women living with a partner would not be consistent with a matching trend in the number of men living with a partner; this does not appear to be the case.

For a proper substantive interpretation of our findings, any measurement errors in living arrangements need to be considered. Overall, the reliability of Finnish register data on place of residence and living arrangements is considered to be high. Reliability surveys indicate that more than 98% of information on address is correct (Official Statistics of Finland 2010). Our measurement of non-marital cohabitation is derived from information on shared place of residence and does not take into account the perceptions of the subjects as to whether they are partners. However, register-based prevalence estimates of cohabitation in Finland have been found similar to those obtained from survey data with self-reported cohabitation (Aromaa and Koskinen 2004). Finally, our data on end of the year living arrangements is likely to underestimate those living in non-private households; at these ages, they consist of various types of long-term care arrangements (nursing homes, supported housing with 24-hour care or health care wards) This underestimation is probably due to the fact that those who have been residents in care institutions for a short time only still maintain their home addresses. Comparing the number of non-household individuals in our data to more accurate estimates available from the records of the facilities providing long-term care (maintained by the National Institute for Health and Welfare) indicates that in 2011 we underestimate the number of long-term care residents by about 13% with the underestimate being higher among women than men (SOTKANet 2016). The underestimation may also be larger for the partnered because their private households are more likely to be maintained by their partners.

It is important to bear in mind that at these ages the number of elderly in non-household living arrangements is also partly driven by policy decisions. Mainly because of high expected future costs, many ageing high income countries are making efforts to restrict the number of long-term institutional places available and helping continued home residence for as long as possible. To the extent that these policies are successful, we may be overestimating the proportion of elderly living in non-private households and underestimating the proportion in private households. The current estimates may be best viewed as indicating pressure on the institutional care-system, under the assumption that no further policy change will take place in the coming years.

4.3 Conclusion and policy implications

In the course of the latter part of the 20th century, Finland experienced major changes in household behaviour and education. At the beginning of our study period, in 1987, the 65+ population was born before the mid-1920s and by the end of our projection period, in 2035, before mid-1960s. In Finland cohort nuptiality increased for cohorts born from the 1900s onwards and peaked for the cohorts born in the 1930s and 1940s when about 9 out of 10 eventually married. In later birth cohorts, marriage was increasingly replaced by cohabitation. Union dissolution for marriage cohorts of the mid-1960s increased rapidly and approached 30% and is likely to be around 50% for those marrying in the 1980s (Pitkänen and Jalovaara 2007, 151–152). Similarly, educational opportunities increased rapidly since the end of the Second World War.

These patterns are also evident in our data as observed until 2011. Furthermore, these cohort changes also underlie our projections, which are consistent with the ageing of cohorts with evolving marriage rates and union dissolution rates as well as ever-higher educational qualifications. We carried out projections with transition rates fixed at their 2011 values and variable rates projections based on extrapolating past trends in transition rates into the future. These two sets of projections – regardless of the fact that our methodological choices yield rapidly converging sex differences in mortality in the variable rates projection – produce relatively similar living arrangement distributions over the projection period. As expected, the variable rates projection produces a somewhat more rapid future decline in the proportions living alone among ageing women than the fixed rate projection. The relative similarity in the outcomes of these different projections demonstrates that future living arrangement distributions are mainly driven by the replacement of older birth cohorts with more recently born cohorts; for example, the increasing proportion living with a partner at older ages is driven by the ageing of the cohorts with high nuptiality rates to ages 80+.

In summary, we know that the future elderly population will be better educated than ever before and is more likely to live with a spouse or partner. Future living arrangement distributions of older people are strongly determined, in particular, by past household behavior and, to a lesser extent, by future changes in mortality. Furthermore, if life expectancy differences between men and women continue to converge in the long run, the proportion of remaining years of life spent living with a partner will increase among women and life spent living alone

will increase among men. Raising education is simply a consequence of cohort replacement. However, it remains to be seen whether the better educated and partnered future elderly will benefit from the same social, functioning, health and mortality advantages as the well-educated and partnered elderly of today. Another possibility is that the benefits of education and partnership are devalued over time. In the past 25 years, some of these differences have remained surprisingly persistent; for example, despite large distributional changes in these characteristics, the strong health benefits of education and living with a spouse remain. Thus, if the past is a guide for the future, we may expect to see a better functioning elderly population as a consequence of these demographic changes.

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