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Do Socio-Economic Health Differences Persist in Nonagenarians?

Abstract

Objectives. Social inequality in health is well documented in younger adults and the younger-old, but data from the very old are scarce. We used a representative population sample to investigate socio-economic differences in health and functioning among nonagenarian men and women.

Methods. Data came from the Vitality 90+ Study. All individuals aged 90 and older in the city of Tampere, Finland, were included, irrespective of health or dwelling place. Data were collected from 1,283 participants whose age range ran from 90 to 107 years. Education and former main occupation were used as indicators of socio-economic status, and health was measured as functional ability, comorbidity and self-rated health. Data were analyzed in a cross-sectional design by using cross tabulation, ordered regression model with marginal effects and binary logistic regression model.

Results. Manual workers had poorer functional ability and health than upper non-manuals and the low-educated poorer than the high-educated. Most analyses showed a graded association between the lower socio-economic status and a poorer health outcome. On each level of the socio-economic hierarchy, men had better functional status than women.

Discussion. We found socio-economic differences in functional ability, comorbidity and self-rated health in nonagenarians. Our findings suggest that social disparity in health and functioning exists in very old age.

Introduction

Earlier studies have well documented the association of socio-economic status with morbidity and mortality in younger and middle-aged people. The special characteristic of these differences is that they do not exist only between the highest and the lowest group but typically show a gradient across the socio-economic hierarchy (Huijts, Eikemo, & Skalická, 2010; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997; Townsend & Davidson, 1982). Similarly, studies including home-dwelling individuals in the age range of 60 to 85 have demonstrated a heavier burden of diseases (CVD, arthritis, depression and the total number of diseases), and a higher disability among those with low education, poor financial assets or low occupational status (Chandola, Ferrie, Sacker, & Marmot, 2007; Laitalainen, Helakorpi, Martelin, & Uutela, 2010; Ramsay, Whincup, Morris, Lennon, & Wannamethee, 2008; Rostad, Deeg, & Schei, 2009; Rueda, Artazcoz, & Navarro, 2008; Schöllgen, Huxhold, & Tesch-Römer, 2010; Sulander, Rahkonen, Nummela, & Uutela, 2009), and a consistent association between poor self-rated health and low occupational status or lack of means (McFadden et al., 2008; McMunn, Nazroo, & Breeze, 2009). Among people aged 80 years or older, poor self-rated health and functional limitations have been associated with low socio-economic status (Arber & Cooper, 1999; Huisman, Kunst, & Mackenbach, 2003; Rostad et al., 2009).

In many countries, people aged 90 and older are the fastest growing age group. Yet it is not clear whether the socio-economic health differences exist among this oldest-old population (90+), where both the burden of disease and the level of mortality are high. We are not aware of any studies focusing on these differences in nonagenarians, but a couple of studies have information on mortality. In a European study which included 11 populations, relative differences in mortality between the low- versus the middle- and high-educated groups persisted at the age of 90+ although being weaker than in younger age groups (Huisman et al., 2004). In a nation-wide study in Finland, occupational differences remained at the age of 80, but disappeared by the age of 95+ (Martelin,

1996). In 90-year-old Danes, however, education was not associated with mortality (Nybo et al., 2003).

Different hypotheses have been put forward about the changes in socio-economic health inequalities that come with age, regarding increase, decrease, or stability. The hypothesis suggesting increasing differences refers to the cumulative advantage in resources throughout life which produces an increasing gap between the affluent and the underprivileged (Ross & Wu, 1996). Decreasing health disparity could be a result of the weakening effects of working conditions after retirement (House et al., 1994); inevitable biological frailty, especially in very old age (Herd, 2006); mortality selection, meaning that those in higher-risk categories have deceased at earlier ages with only the robust individuals remaining alive; and a ceiling effect, referring to a high risk of morbidity among both exposed and unexposed groups (Dupre, 2007; Kaplan, Haan, & Wallace, 1999). Schöllgen et al. (2010), based on their findings among 40-85-year-old Germans, suggest that health differences continue in the same magnitude until old age because socio-economic status influences life chances at an old as well as at young age. There is also some evidence that health disparity may peak in late middle age and then decrease along with ageing (Beckett, 2000). However the findings may differ for relative versus absolute differences. In cross-European analyses (Huisman et al., 2003; Mackenbach, 2006) both absolute and relative inequalities mostly declined from the age range between 60 and 69 years up to the age of 80+. In the Whitehall Study (Marmot & Shipley, 1996), the relative differences in mortality were smaller but the absolute differences larger at the ages of 70 to 79 compared with those aged 40 to 64. In Canada, using the Gini coefficient and adjusting for socio-economic status-associated earlier mortality selection, Prus (2007) found increasing inequality in mortality from the ages of 15-29 to the ages of 80+.

Several studies have found evidence that socio-economic health differences are wider among men than among women (Marmot et al., 1997). Men tend to have a more stratified occupational

structure, which is one factor in producing the gender difference, but larger health differences were observed for men when the indicator of the socio-economic status was education (Matthews, Manor, & Power, 1999). Only a few studies have focused on gender patterns in socio-economic health differences in old age. A European study in 80+-year-old people found that when all 11 countries were analyzed together, men had larger differences in poor self-rated health, cut down in daily activities and long-term disabilities than women (Huisman et al., 2003). In another study, (Rueda & Artazcoz, 2009) a socio-economic gradient by education in poor self-rated health and limiting long-standing illness was discovered both in men and women aged 65-85, but women had larger differences in limiting long-standing illness than men. Gender differences in health according to socio-economic status are largely unknown.

Most studies on socio-economic health differences in old age include only community-dwelling individuals. This may compromise study reliability among the oldest-old, as the number of people living in institutions is high, and those persons are likely to have more health problems than others. In the Vitality 90+ Study information on a whole cohort in the geographical area was available, irrespective of health and dwelling place. The advantage in comparison to previous research is that our sample of nonagenarians is relatively large. We use two indicators of socio-economic status, occupational class and educational level, to describe the relative position of the individuals in the social hierarchy. The purpose is not to compare two indicators but to give a more comprehensive and reliable picture of the association of health with socio-economic status. In our data, both indicators are available for both men and women.

To our knowledge, this is the first study that focuses on socio-economic inequality in health among people aged 90 and older. By using a representative population sample, we investigate (1) whether in nonagenarians, functional ability, comorbidity and self-rated health are associated with

occupational status and educational level, and (2) whether the health indicators on different levels of socio-economic status differ between the genders.

Methods

Study population

Data in this study came from the Vitality 90+ Study which is a multidisciplinary research project carried out among people aged 90+ in Tampere, Finland. This study uses cross-sectional data collected through a mailed survey in 2010. All individuals aged 90 years or over living in Tampere, irrespective of health status or dwelling place, were included. Names, addresses and places of residence of the target population (N=1686) were acquired from the Tampere City Population Register on 15 January, 2010. Questionnaires were mailed to 1,686 people but 74 died before receiving it and 6 moved to a different town. Thus, the basic population was 1,606 and 1,283 individuals participated which gave a response rate of 80%. Almost 59% of the participants answered independently and 24% chose the answers themselves but received help from someone else in filling out the questionnaire. For the remaining 18% (11% of men and 19% of women), the responses were provided by family members, relatives, friends, home helpers or the staff in institutions; these were categorized as proxy answers. Those whose answers were given by proxy had on average more diseases, poorer functional ability, were more likely to live in an institution and many of those belonged to the group ‘occupation unknown’. In women, proxy participants were also older and more often low-educated.

The study was approved by the Ethics Committee of the City of Tampere.

Variables

Socio-economic status

Indicators of socio-economic status were the longest held occupation during a person's working years and the level of education. Occupational status was encoded according to the Occupational and Industrial Classification by Statistics Finland (1976) and was analyzed in four hierarchical groups: upper non-manuals (7%), lower non-manuals (34%), skilled manual workers (37%) and unskilled manual workers (6%). Besides these four occupational categories, housewives (10%) and those whose occupation was unknown (6%) were analyzed as separate groups. Housewives included women who had not participated in the labor market and those who had worked as an assisting family member for an agricultural entrepreneur (n = 19). Workers in agriculture and forestry (n = 18) and farmers (n = 20) were categorized as skilled manual workers. The self-employed were categorized either as upper non-manuals (n = 8) or as lower non-manuals (n = 53) depending on their job description.

During the 1920s when the participants went to school, basic education consisted of six-grade primary schooling which was compulsory for all 7 to 13-year-old children. Secondary education included secondary school (high school) and vocational education. Graduation from upper secondary school, a prerequisite for university studies, was rare and less than 10 per cent of the age group completed such studies in 1920. (Statistics Finland, 2007). After primary school both non-academic general education and vocational education was also available in institutions for adult education, "folk high schools". In our study, education was classified into three hierarchic groups: low (primary or lower secondary school 64%), middle (vocational education and folk high schools 20%) and high (upper secondary school, college-level training and university education 13%). In addition, a fourth group was formed of participants whose education was unknown (4%).

There was a clear association between occupational status and education. Among unskilled manual workers, 90% of men and 85% of women were low-educated and among upper non-manuals 84% of men and 66% of women were high-educated. On the other hand, among the low-educated 67% of

men were manual workers and 67% of women were manual workers or housewives. Among the high-educated almost 98% of men were non-manuals and 94% of women were non-manuals or housewives.

Health measures

Health was measured according to three indicators: functional ability, comorbidity and self-rated health. Functional ability was studied by asking the participants whether they were able to get in and out of the bed, dress and undress, move indoors, walk 400 meters and use stairs (1) without difficulty, (2) with difficulty, (3) if someone helped, or (4) not at all; the alternatives (1) and (2) were categorized as independent and (3) and (4) dependent in each respective activity. Chronic conditions were revealed by asking the question, "Has your physician mentioned that you have some of the following conditions: cardiovascular disease (CVD), diabetes, dementia or memory problems, depression, osteoarthritis or hip fracture?" Self-rated health was assessed by asking, "How would you evaluate your present health: (1) very good, (2) fairly good, (3) average, (4) fairly poor, or (5) poor?" For self-rated health, only self-reports were included in the analyses while other health indicators also included proxy answers.

Statistical analyses

Cross tabulation, ordered regression and binary logistic regression models were applied to analyze variation in health according to socio-economic status. For the cross tabulation analyses, dichotomized measures were created. Functional ability was categorized as good functioning (independent in all five activities) versus poor functioning (dependent in at least one activity). Comorbidity was categorized as 0-1 versus 2-6 chronic conditions and self-rated health was categorized as poor (fairly poor and poor health) and good or average (very good, fairly good and average health).

Absolute health differences by occupation and education were tested with Pearson's chi-squared test, and if the conditions were not met, Fisher's exact test was used. Dichotomized variables were also used in binary logistic regression analyses to investigate gender differences in health along the social strata. The reference groups in the analyses were men on each socio-economic level. Odds ratios (ORs) and their 95% confidence intervals (CIs) were reported.

Ordered regression analyses were performed to examine socio-economic health differences separately for men and women. This method allowed the utilization of all the variation in the measures: six groups were considered in functional ability (independent in all activities, dependent in 1, dependent in 2, dependent in 3, dependent in 4 and dependent in 5), five in comorbidity (no chronic conditions, 1 condition, 2 conditions, 3 conditions and 4-6 conditions) and five in self-rated health (very good, fairly good, average, fairly poor and poor). Probit link function was used in comorbidity and self-rated health analyses according to the normally distributed health outcomes and complementary log-log link in functional ability analyses because the distribution was heavily skewed towards good functioning. The parallel lines assumption was tested and in three cases the assumption was not reached (for middle-educated, education unknown and occupation unknown women in functional ability). However, those groups were included in the analyses but irregularity was taken into account in STATA with hetero option for the ordinal generalized linear model (Williams, 2009). Coefficients and their 95% confidence intervals were reported. We also computed Average Marginal Effects (AMEs) after the ordered regression analyses. Marginal effects were computed for each case, and the effects were then averaged. For categorical variables with more than two possible values, the marginal effects show the difference in the predicted probabilities for cases in one category relative to the reference category. Data were analyzed by using IBM SPSS statistics 20.0 and STATA for windows version 12.1.

Results

The data consisted of 1,283 participants with 81% women and 19% men (Table 1). More than 60% of the participants lived in the community in ordinary housing. Men belonged to the high or middle-educated group more often than women and men also outnumbered women in the upper non-manual occupation group. In functional ability, participants had more difficulty in walking 400 meters and using stairs than in other activities. The three most common chronic conditions were CVD, arthritis and dementia. Only 10% of the participants were free of diseases and one out of three had more than two diseases. The self-rated health outcome followed the shape of the normal distribution for both genders. Women were more often dependent in all the activities than men, and they had a higher prevalence in all chronic conditions except for CVD and diabetes.

[Table 1 about here]

We first studied absolute differences in poor functional ability, CVD, diabetes, arthritis, hip fracture, depression, dementia, comorbidity, and poor self-rated health by occupation and education (Table 2). In contrast to other measures, proxy answers were excluded for self-rated health. Therefore, the population in these analyses was smaller and healthier than for the other indicators of health and functioning. Between the occupational groups, there were significant differences in the prevalence of poor functional ability, arthritis and dementia among women and in depression among men. In the occupational hierarchy from upper non-manuals to unskilled manual workers, the prevalence was lowest in the upper non-manual group for all conditions other than arthritis and hip fracture in women and depression and hip fracture in men; and, with one exception (poor self-rated health in men), it was highest among unskilled manual workers or those whose occupation was unknown. Poor functional ability, comorbidity and dementia in both genders and also depression in women showed a gradient of increasing prevalence with lower occupational status.

According to education, women had statistically significant differences in poor functional ability, CVD and dementia, and men in comorbidity. A gradient of an increasing prevalence of poor functioning, comorbidity, dementia and poor self-rated health was seen in men from the low- to the high-educated; in women, the gradient of the hip fracture showed lower prevalence in low- and middle-educated groups.

[Table 2 about here]

Relative health differences by occupation were analyzed with the age-adjusted ordered regression model (Table 3). We compared participants in other occupational groups with upper non-manuals and other educational groups with those having high education. The findings mainly followed a similar pattern to the absolute differences; the probability of most conditions was lowest in the highest group and increased gradually to the lowest in the hierarchy. The position of housewives and those with an unknown occupation or education varied. Skilled manual workers, unskilled manual workers and housewives had poorer functional ability than the upper non-manuals. In addition, in women, self-rated health was significantly poorer in skilled (borderline) and unskilled manual workers and housewives, and in men, comorbidity was higher among unskilled manual workers than among the upper non-manuals.

Marginal effects (provided in the supplementary data) were calculated for all health categories (6 categories in functional ability, 5 in comorbidity and 5 in self-rated health). For the most part, they repeated the findings of the earlier analyses, showing decreasing probability of good health outcomes and increasing probability of poor health outcomes with lower socio-economic status. In women, unskilled manual workers were 23% less likely to be independent and 12% more likely to be dependent in 5 activities compared with upper non-manuals. In all functional ability categories, except where dependent in 1 activity, both skilled and unskilled manual workers differed significantly from upper non-manuals. Unskilled manual worker women were 5% less likely to be

free of chronic conditions. Both skilled and unskilled manual worker women were statistically less likely to report very good or fairly good self-rated health, and more likely to report it as fairly poor. For functioning and self-rated health, a regular gradient was found from upper non-manuals to unskilled manual workers on every level of the respective health outcome. In most categories, housewives showed poorer outcomes than upper non-manuals. With men, skilled manual workers were 24% less likely to be independent and approximately 7% more likely to be dependent in 1 or 2 activities than upper non-manuals. The likelihood of independence decreased and the likelihood of poorer functioning increased with lower occupational class. Unskilled manual workers had a lower probability of having no or only one chronic condition and a higher probability of having 3 conditions than upper non-manuals.

Relative health differences according to education in women showed that compared with the high-educated, the middle-educated were less likely to be dependent in all five activities, and both the middle- and low-educated were less likely to report good and more likely to report poor self-rated health. In comorbidity no significant differences were found. In men, the low-educated had a 22% lower likelihood of being independent and a 5 to 7% higher likelihood of being dependent in 1, 2 or all 5 activities, respectively. In comorbidity, the low-educated men showed a poorer outcome throughout the comorbidity scale, and the middle-educated were also less often free from chronic conditions than the high-educated. In self-rated health, the likelihood of fairly good and fairly poor self-rated health in low-educated differed significantly from the high-educated. For both genders, most marginal effects showed a gradient of poorer outcome with lower education.

The situation of those with an unknown occupation and an unknown education level varied, but whenever they differed statistically from the reference group, they showed poorer outcomes. In women, the likelihood of dependence in all 5 activities was clearly higher in these groups than in any other socio-economic category.

[Table 3 about here]

To see whether the findings observed were also true for the oldest part of our sample, we conducted binary logistic regression analyses to examine the associations of occupation and education with health and functioning in the subgroup of those aged 95+ (n = 272, 86% women and 14% men). In women, unskilled manual workers suffered statistically more often from poor functional ability than upper non-manuals. Otherwise, differences were not statistically significant, however, the number of men in this age group was very low.

Finally, to demonstrate the joint effects of gender and socio-economic status, we examined the association between gender and health outcomes within the hierarchical socio-economic groups, with the age-adjusted binary logistic regression analyses (Table 4). Women showed significantly poorer functioning than men in all occupation and education groups except in that of unskilled manual workers. Women also had higher odds of comorbidity on each level of socio-economic status but statistical significance was found only in lower non-manuals by occupation and in high-educated by education. For poor self-rated health, no significant gender differences were found.

[Table 4 about here]

Discussion

Socio-economic status is widely understood as one of the main determinants of health and functional status in young, middle-aged and younger-old people, but data on the very old has been scarce. We used a representative population sample to analyze whether the position in the social hierarchy is associated with health at the age of 90 or above, and if this association shows the social gradient usually observed in younger age groups. Our findings suggest a clear absolute and relative advantage in health and functioning for higher socio-economic groups, and even a graded inverse association between health and socio-economic status for several indicators, particularly for functional ability. A notable exception was seen for hip fracture in women, which was most

frequent among upper non-manuals and showed a decreasing gradient towards lower education. Possibly, this is due to a higher survival after the hip fracture among upper social classes rather than a higher incidence (Roberts & Goldacre, 2003). In arthritis, differences between the social groups were very small among women. For self-rated health, only self-reports were included in the analyses. Those who were not able to answer the questionnaire by themselves were more likely to belong to lower socio-economic groups, which may lead to underestimation of socio-economic differences in self-rated health. In spite of that, self-rated health was significantly associated with occupation in both genders and also with education in women.

As we have no earlier information concerning this birth cohort, it is impossible to say how the socio-economic health differences have changed with increasing age. If we compare our results with earlier studies among the middle-aged and younger old, it seems that the magnitude in health differences in our study is somewhat weaker. In the 65+-year-old population in Finland, Rahkonen and Takala (1998) found more than a threefold difference in men between workers and white-collar workers in functional disability and in women the difference was twofold. In poor self-rated health differences between groups were twofold for both men and women. In a European study, the difference in poor self-rated health between the high- and low-educated Finns was approximately threefold for 25 to 69-year-old men and women (Kunst et al., 2005). Although no definite conclusions can be drawn, this seems to speak for decreasing, rather than increasing socio-economic differences towards very advanced age.

We employed two frequently used indicators, occupational class and educational level, to measure socio-economic status. These two together with the third common measure, income, capture different dimensions of social position, and are therefore not entirely interchangeable (McFadden, Luben, Wareham, Bingham, & Khaw, 2008). Still, when used as indicators of the relative position in social hierarchy, they have been found to produce basically similar results, although the

magnitude of differences varies depending on the measure (Macintyre, 1997; Minkler, Fuller-Thomson, & Guralnik, 2006). Also in our study, measures of occupation and education were highly correlated. Our main findings regarding relative health differences were highly similar whether we used occupation or education as the socio-economic indicator, even if the exact coefficients and significances varied. Differences in findings also arise from the fact that education was divided into three hierarchical categories (high, middle and low-educated) with emphasis on low-educated and occupational status was analyzed in four categories. The reason why poor self-rated health in men, for instance, differed significantly between the extreme ends according to education but not according to occupation may relate to the fact that nearly 70% of the low-educated were manual workers and the weight was greater for that group than for the divided categories of skilled manual workers and unskilled manual workers.

In addition to hierarchical socio-economic groups, we included in the analyses separate categories for housewives and those with an unknown occupation or education. The apparently heterogeneous groups seemed to have in general poorer health outcomes than the reference groups. In the 'education unknown' group, half and in the 'occupation unknown' group 40% of the answers were given by proxy. Participants in these groups had high levels of disability and comorbidity and, women with an unknown occupation, had a particularly high rate of dementia and institutionalization. It is likely that poor health and memory problems in addition to having the answers given by proxy are the main reasons why the occupation was not known for them, but they also are more likely to belong to lower than higher socio-economic groups.

We also demonstrated the differences in health and functioning between men and women respectively, on all hierarchic levels of occupation and education. Women showed significantly poorer functioning in all socio-economic groups except for that of unskilled manual workers, and also a higher comorbidity among lower non-manuals and the high-educated. This gender pattern

was highly regular although the differences did not always show statistical significance. Our findings suggest that the well-known female disadvantage in disability in old age (Murtagh & Hubert, 2004; Newman & Brach, 2001) probably should not be attributed to the lower socio-economic position of women, but is a result of mechanisms effective on each socio-economic level.

Several studies have discussed the suitability of one's personal occupational status and education as socio-economic indicators for women and older age groups (Bartley, Sacker, Firth, & Fitzpatrick, 1999; Huisman et al., 2004). Differences in years of schooling are smaller among nonagenarians than among middle-aged people (Grundy & Holt, 2001) which may hide the social differences. In most studies with older people, the participants retired a long time ago and all women have not participated in paid work outside the home. In Finland, the employment rate for women has been exceptionally high, and in 1950, when our study participants were from 20 to 35 years-old, altogether 57% of women aged 15 to 64 were employed outside the home (Statistics Finland, 1964). Additionally, the association between occupational status and mortality has been found to be similar irrespective of whether the woman's own occupation or that of the spouse is considered (Martikainen, 1995). In our study, we were able to use occupational status as an indicator of socio-economic status in four hierarchical categories for both men and women.

In a cross-sectional analysis, it is not possible to clarify causal relationships between socio-economic status and health. While it is obvious that poor health and disability can weaken possibilities for extensive education and increase the possibility of landing in less specialized occupations (Elovainio et al., 2011), there is a strong consensus among researchers that rather than health-based selection, the relation between socio-economic status and health throughout societies is one of social causation (Minkler et al., 2006; Chandola, Bartley, Sacker, Jenkinson, Marmot, 2003; Bartley & Plewis, 1997; Doornbos & Kromhout, 1990). For our participants, the educational choices and decisions about occupations are far in the past, and it is unlikely that the present chronic

conditions could have had a major influence on them. It is plausible to believe that the health differences in old age, as during younger ages, are determined by differences in "conditions in which people are born, grow, live, work and age" (Marmot, Allen, Bell, Bloomer, & Goldblatt, 2012), including social inequalities in access to and utilization of care. Life-long health disparities also lead to disparities in mortality. In the 1960s, 2.6% of men and 2.8% of women aged 40 to 44 years living in Tampere had passed the matriculation examination, an upper secondary school requirement for university studies, while in our data 20% of men and 11% of women had high education (Statistics Finland, a). In the 1970s in Tampere, out of those who were born between 1915 and 1920, 29% to 36% (depending on the classification) were non-manuals, but in our data 40% of women and 50% of men were non-manuals (Statistics Finland, b). Thus, it is likely that mortality selection has some influence on our results.

The major strength of this study is that a whole age cohort in a geographical area was included and the participation rate was high. Unlike with many other studies, our reasonably large data set consisted of people living in home-dwellings, service homes and institutions and no exclusion criteria was used, which means that the whole spectrum of health was represented. Two indicators of socio-economic status and several indicators of health were available. However, there are also important limitations. There were noticeably more women than men in the study sample although the participant-strength was relatively the same as in the basic population. The small sample sizes compromise the reliability of the results among men in the unskilled manual worker group and in groups with an unknown social status. Even though unskilled manual worker men had statistically poorer functional ability than the reference group, in the marginal effect analysis only one out of six categories reached statistical significance. Another limitation is the lack of information concerning the participants' cognitive level. The mailed survey was based on self-reports and a great proportion of the participants had dementia or memory problems. However, more than a third of the responses from those suffering from dementia were given by proxy. It has also been shown that the prognostic

validity of self-rated health is high in people with mild to moderate cognitive decline (Walker, Maxwell, Hogan, & Ebly, 2004). Therefore, it is not likely that this jeopardized the reliability of our findings. Furthermore, we cannot exclude the possibility that people of differing socio-economic status could use different criteria for assessing and reporting health status, a problem our study shares with all others based on self-reports.

On the basis of our findings in a representative population-based cohort, we conclude that the well-established socio-economic health disparity identified in younger old age groups persist in very old age. In spite of selective mortality during the life course and increasing heterogeneity in health in the oldest age groups, better education and higher occupational status are associated with health advantage even among nonagenarians. This implies that among the oldest-old, avoidable morbidity and disability also exists, even in a country that has a universal health and social care system. It is plausible that measures targeting social inequality at younger ages would also be effective in diminishing discrepancies in old age. However, with increasing numbers of very old people expected in the future (Statistics Finland, 2009; Statistics Finland, 2011) special attention should be paid to prevention and care of old people in lower socio-economic positions.

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Table 1. Characteristics of the study population. Number and percentage.

	Women N = 1041	Men N = 242	Total N = 1283
	n, %	n, %	n, %
Participants			
In person	836 (81)	213 (89)	1049 (82)
Via proxy	197 (19)	27 (11)	224 (18)
Institution + Service home > 24 h	399 (39)	76 (32)	475 (37)
Median age in years (range)	92 (90−107)	91.5 (90−99)	92 (90−107)
Socio-economic status			
Occupation			
Upper non-manual	48 (5)	43 (18)	91 (7)
Lower non-manual	359 (35)	78 (32)	437 (34)
Skilled manual	378 (36)	101 (42)	479 (37)
Unskilled manual	69 (7)	11 (5)	80 (6)
Housewives	122 (12)		122 (10)
Occupation unknown	65 (6)	9 (4)	74 (6)
Education			
High-educated	114 (11)	48 (20)	162 (13)
Middle-educated	181 (17)	73 (30)	254 (20)
Low-educated	704 (68)	113 (47)	817 (64)
Education unknown	42 (4)	8 (3)	50 (4)
Health indicators			
Functional ability			
Independent in			

Getting in and out of bed	837 (81)	217 (91)	1054 (83)
Dressing and undressing	765 (74)	205 (86)	970 (76)
Moving indoors	824 (81)	209 (89)	1033 (83)
Walking 400 m	479 (47)	160 (68)	639 (51)
Using stairs	471 (46)	165 (70)	636 (51)
Diseases			
CVD	551 (55)	138 (59)	689 (55)
Diabetes	116 (12)	34 (15)	150 (12)
Arthritis	474 (47)	73 (32)	547 (44)
Hip fracture	192 (19)	26 (11)	218 (18)
Dementia	422 (42)	80 (35)	502 (41)
Depression	211 (21)	30 (13)	241 (20)
Self-rated health			
Very good	23 (3)	9 (4)	32 (3)
Fairly good	185 (23)	44 (21)	229 (22)
Average	381 (46)	110 (53)	491 (48)
Fairly poor	172 (21)	39 (19)	211 (21)
Poor	59 (7)	6 (3)	65 (6)

Table 2. Prevalence of poor functional ability, chronic conditions, comorbidity and poor self-rated health by occupation and education. Percentages and relative differences.

	Poor functional ability		CVD		Diabetes		Arthritis		Hip fracture		Depression		Dementia		Comorbidity		Poor self-rated health	
	%	Rd	%	Rd	%	Rd	%	Rd	%	Rd	%	Rd	%	Rd	%	Rd	%	Rd
Women																		
Occupation																		
Upper non-manuals	50		52		2		53		30		16		30		55		18	
Lower non-manuals	58	8	55	3	10	8	43	-10	17	-13	20	4	38	8	59	4	24	6
Skilled manual workers	69	19	52	0	14	12	51	-2	19	-11	21	5	41	11	59	4	30	12
Unskilled manual workers	74	24	64	12	8	6	46	-7	28	-2	29	13	50	20	73	18	37	19
Housewives	68	18	52	0	13	11	57	4	21	-9	18	2	45	15	64	9	34	16
Occupation unknown	68	18	61	9	17	15	29	-24	16	-14	28	12	62	32	69	14	25	7
N	1003		1009		1004		1002		1000		1002		1007		949		822	
chi-square test, p-value	0.004		0.46		0.10		0.004		0.12		0.27		0.005		0.16		0.10	
Education																		

High-educated	55		52		6		48		25		18		38		60		18	
Middle-educated	53	-2	65	13	12	6	44	-4	20	-5	17	-1	31	-7	57	-3	30	12
Low-educated	68	13	53	1	12	6	48	0	19	-6	22	4	44	6	62	2	29	11
Education unknown	77	22	38	-14	22	16	42	-6	5	-20	27	9	68	20	65	5	32	14
N	1003		1009		1004		1002		1000		1002		1007		949		822	
chi-square test, p-value	<0.001		0.007		0.09		0.72		0.07		0.31		<0.001		0.61		0.13	
Men																		
Occupation																		
Upper non-manuals	24		54		10		34		5		19		24		33		10	
Lower non-manuals	41	17	60	6	13	3	26	-8	15	10	5	-14	35	9	43	10	27	17
Skilled manual workers	44	20	55	1	16	6	33	-1	10	5	11	-8	39	15	52	19	23	13
Unskilled manual workers	55	31	82	28	46	36	36	2	27	22	36	17	50	26	70	37	10	0
Occupation unknown	50	26	100	46	0	-10	50	16	14	9	38	19	14	-10	71	38	17	7
N	230		234		232		229		230		234		232		219		208	
chi-square test, p-value	0.15		0.07		0.07		0.64		0.17		0.005		0.29		0.10		0.26	
Education																		
High-educated	29		46		11		30		6		13		22		25		12	

Middle-educated	36	7	68	22	15	5	28	-2	9	3	9	-4	35	13	49	24	22	10
Low-educated	48	19	57	11	15	4	35	5	15	9	16	3	40	18	54	29	25	13
Education unknown	29	0	83	37	33	15	43	8	17	11	14	1	33	11	67	42	20	8
N	230		234		232		229		230		234		232		219		208	
chi-square test, p-value	0.12		0.06		0.53		0.68		0.36		0.56		0.20		0.008		0.30	

Table 3. Association of functional ability, comorbidity and self-rated health with occupation and education. Age-adjusted coefficients and their 95% CIs from the ordered regression model. Higher coefficient indicates worse health. *Notes*: CI = confidence interval; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

	Women			Men		
Occupation Reference: upper non-manuals	Coefficient		95% CI	Coefficient		95% CI
Functional ability						
Lower non-manuals	0.303		-0.13 to 0.74	0.694		-0.02 to 1.41
Skilled manual workers	0.499	*	0.07 to 0.93	0.784	*	0.09 to 1.48
Unskilled manual workers	0.704	**	0.20 to 1.20	1.02	*	0.01 to 2.04
Housewives	0.557	*	0.09 to 1.02			
Unknown occupation	0.712		-0.12 to 1.54	0.932		-0.23 to 2.10
Comorbidity						
Lower non-manuals	0.027		-0.30 to 0.36	-0.039		-0.45 to 0.37
Skilled manual workers	0.128		-0.20 to 0.46	0.111		-0.29 to 0.51
Unskilled manual workers	0.338		-0.06 to 0.74	0.998	**	0.25 to 1.74
Housewives	0.166		-0.20 to 0.53			
Unknown occupation	0.302		-0.11 to 0.72	0.567		-0.27 to 1.41
Self-rated health						
Lower non-manuals	0.115		-0.24 to 0.47	0.280		-0.14 to 0.70
Skilled manual workers	0.349	*	-0.00 to 0.70	0.318		-0.09 to 0.73
Unskilled manual workers	0.456	*	0.02 to 0.90	0.312		-0.44 to 1.06
Housewives	0.454	*	0.06 to 0.85			
Unknown occupation	0.177		-0.31 to 0.66	0.515		-0.42 to 1.45
Education Reference: high-educated	Coefficient		95% CI	Coefficient		95% CI
Functional ability						
Middle-educated	-0.062		-0.37 to 0.24	0.419		-0.25 to 1.10
Low-educated	0.245		-0.02 to 0.51	0.721	*	0.11 to 1.33
Unknown education	0.956	*	0.00 to 1.91	-0.084		-1.58 to 1.41
Comorbidity						
Middle-educated	0.015		-0.24 to 0.27	0.403		-0.01 to 0.82
Low-educated	0.128		-0.09 to 0.35	0.500	**	0.12 to 0.88
Unknown education	0.19		-0.22 to 0.59	0.816		-0.07 to 1.71
Self-rated health						
Middle-educated	0.357	**	0.08 to 0.63	0.246		-0.17 to 0.66
Low-educated	0.391	***	0.15 to 0.63	0.439	*	0.05 to 0.83
Unknown education	0.403		-0.12 to 0.93	0.596		-0.41 to 1.60

Table 4. Association of poor functional ability, comorbidity and poor self-rated health with gender by the level of occupation and education. Age-adjusted ORs and 95% CIs. Reference category is men on each socio-economic level.

	Poor functional ability		Comorbidity		Poor self-rated health	
	OR	95% CIs	OR	95% CIs	OR	95% CIs
Occupation						
Upper non-manuals	3.19*	1.28 to 7.98	2.36	0.96 to 5.83	1.86	0.50 to 6.93
Lower non-manuals	1.89*	1.13 to 3.16	1.87*	1.12 to 3.15	0.86	0.48 to 1.55
Skilled manual workers	2.68***	1.67 to 4.31	1.35	0.85 to 2.15	1.42	0.80 to 2.50
Unskilled manual workers	2.39	0.57 to 10.00	1.10	0.25 to 4.87	5.10	0.59 to 43.97
Education						
High-educated	3.46**	1.59 to 7.53	4.28***	1.93 to 9.47	1.66	0.56 to 4.91
Middle-educated	1.81*	1.01 to 3.23	1.42	0.80 to 2.54	1.55	0.79 to 3.08
Low-educated	2.28***	1.50 to 3.48	1.36	0.89 to 2.06	1.18	0.72 to 1.94

Notes: OR = odds ratio, CI = confidence interval; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$