Author(s):	Enroth, Linda; Raitanen, Jani; Hervonen, Antti; Nosraty, Lily; Jylhä, Marja
Title:	Is socioeconomic status a predictor of mortality in nonagenarians? The vitality 90+ study
Year:	2014
Journal Title:	Age and Ageing
ISSN:	0002-0729
Discipline:	Public health care science, environmental and occupational health
School /Other Unit:	School of Health Sciences
Item Type:	Journal Article
Language:	en
DOI:	http://dx.doi.org/10.1093/ageing/afu092
URN:	URN:NBN:fi:uta-201408042027

IS SOCIOECONOMIC STATUS A PREDICTOR OF MORTALITY IN NONAGENARIANS? THE VITALITY 90+ STUDY.

ABSTRACT

Background

Socioeconomic inequalities in mortality are well-known in middle-aged and younger old adults, but the situation of the oldest old is less clear. The aim of this study was to investigate socioeconomic inequalities for all-cause, cardiovascular and dementia mortality among the people aged 90 or older.

Methods

The data source was a mailed survey in the Vitality 90+ Study (N = 1276) in 2010. The whole cohort of people 90 years or over irrespective of health status or dwelling place in a geographical area was invited to participate. The participation rate was 79%. Socioeconomic status was measured by occupation and education, and health status by functioning and comorbidity. All-cause and cause-specific mortality was followed for three years. The Cox regression, with hazard ratios (HR) and 95% confidence intervals (CI), was applied.

Results

The all-cause and dementia mortality differed by occupational class. Upper non-manuals had lower all-cause mortality than lower non-manuals (HR 1.61 95% CI 1.11-2.32), skilled manual workers (HR 1.56 CI 1.09-2.25), unskilled manual workers (HR 1.88 CI 1.20-2.94), housewives (HR 1.77 CI 1.15-2.71) and those with unknown occupation (HR 2.33 CI 1.41-3.85). Inequalities in all-cause mortality were largely explained by the differences in functioning. The situation was similar according to education but inequalities were not

statistically significant. Socioeconomic differences in cardiovascular mortality were not significant.

Conclusions

Socioeconomic inequalities persist in mortality for 90+-year-olds but their magnitude varies depending on the cause of death and the indicator of socioeconomic status. Mainly, mortality differences are explained by differences in functional status.

Key words: Inequality, Occupational class, Education, Functioning, older people

INTRODUCTION

A non-manual labour market position [1-3], high education [3-6] and high income [7, 8] are consistently associated with better health and lower mortality compared with those who are worse off. For middle-aged and young old, a social gradient has been found in mortality regardless of the social position indicator [1, 3, 9] applied. However, less is known of the most rapidly growing oldest segment of population, those aged 90 or older [10].

Only in a few studies, researchers have analysed mortality inequalities specifically in very old people. In a Finnish data, including all deaths from 1971 to 1990, mortality inequalities according to occupation and, for men, also according to education prevailed until the age group of 90-94 years although the differences were weaker and more inconsistent than for the younger age groups [11]. To our knowledge, this is the only study that demonstrated occupational mortality differences in very old people. Higher mortality for the low-educated in comparison to the mid-level- and high-educated 90+-year-olds was found in a study with 11 European populations [12], but not in a Danish survey study for 92- or 93-year-old born in 1905 [13]. Higher mortality in the lowest income decile compared with other groups was found in a register study for 90–99-year-olds in 1980–2002 [14]. Inequalities in cause-specific mortality or the role of health status in mortality inequalities in very old people are largely unknown.

In the Vitality 90+ Study, we have the opportunity to study socioeconomic mortality inequalities in a well-defined cohort of people aged 90 years or older. Information on socioeconomic status, functioning and comorbidity was linked with the dates and causes of death. Both all-cause mortality and mortality from dementia and cardiovascular disease were analysed.

METHODS

Study population

The data came from the 2010 mailed survey in the Vitality 90+ Study [15]. All people aged 90 years or older in the city of Tampere, Finland, irrespective of health status or dwelling place, were invited to participate. Names, addresses and places of residence were derived from the Tampere City Population Register. Questionnaires were mailed to 1686 people but 72 died before receiving it and 6 had moved out of Tampere. Total population came down to 1608 of which 1276 individuals participated, producing a response rate of 79%. The Ethics Committee of the City of Tampere approved the study and the participants gave their informed consents.

Socioeconomic status

The mailed survey included a question concerning participants' former longest held occupation. Occupational status was categorised into four hierarchical groups: upper non-manuals, lower non-manuals, skilled manual workers and unskilled manual workers according to the Occupational and Industrial Classification of Statistics Finland (1976) [16]. Workers in agriculture, fishery and forestry as well as farmers (N = 39) were categorised as skilled manual workers. The self-employed were categorized either as upper non-manuals or as lower non-manuals depending on their job description. Women who had not participated in the labour market and those who had worked as an assisting family member for an agricultural entrepreneur were categorised as housewives. Those who did not answer this particular question but had other information available were encoded as having unknown occupation.

Education was categorised into three hierarchic groups: low (primary, maximum 6 years), mid-level (lower secondary, vocational education, folk high schools, 7−9 years) and high

(upper secondary, college-level training, university education, at least 9 years). In addition, a fourth group was formed of participants whose education was unknown.

Covariates

The participants were asked whether they were able to perform the following five activities: dressing and undressing, getting in and out of bed, moving indoors, walking 400 meters and using stairs (1) without difficulty, (2) with difficulty, (3) if someone helps, or (4) not at all. Alternatives 1 and 2 were encoded as independent and 3 and 4 as dependent in the respective activity. In the analyses, the variable ranged from independent in 5 activities to independent in 0 activities.

Comorbidity was studied by asking the participants if a physician had told them that they had cardiovascular disease (CVD), diabetes, stroke, hip fracture or dementia (included Alzheimer's disease, other dementias and a decline in cognition). The comorbidity variable ranged from no to 5 chronic conditions.

Mortality

The dates and causes of death were drawn from the Finnish Causes of Death Register and linked with the survey data by using the Personal Identity Codes. In the all-cause mortality analyses, the follow-up period was from 23/2/2010 to 31/1/2013 ~ 36 months. For cause-specific mortality, data were available from 23/2/2010 to 19/11/2012 ~ 33 months. The underlying causes of death were categorised by using the International Classification of Diseases, 10th Revision. The two most common causes of death were CVDs (I00-I99) and a combined category for Alzheimer's disease (G30) and other dementias (F01-03), below: dementia. Of CVDs, more than half (56%) were ischemic heart diseases and 24% were cerebral blood circulation diseases. In the dementia category, 66% of the deaths were caused by Alzheimer's disease and 34% by other dementias.

Statistical analyses

It has been suggested that magnitude of inequalities in mortality may be different whether studied in absolute or relative setting [12]. We studied age-controlled predicted probabilities for absolute all-cause mortality after 36 months follow-up drawn from logistic regression analysis with a command adjust in STATA statistics. Mean follow-up times for all-cause, dementia and CVD mortality by socioeconomic status came from Kaplan-Meier survival analysis. For relative inequalities in mortality, Cox proportional hazard model and the extended Cox model were applied with SPSS statistical software. First, we analysed mortality in the age- and sex-adjusted model. As our earlier analyses [17] have shown socioeconomic differences in functioning and morbidity in nonagenarians, we investigated whether the possible inequalities in all-cause mortality are explained by these health indicators. We added comorbidity and functioning into the analysis, first separately, and finally all covariates together. Functioning was added as time-dependent covariate and we used the extended Cox model with the time-covariate interaction term. The extended model was used because, tested with Schoenfeld residuals, the assumption for proportional hazards did not hold for functioning. In cause-specific analyses, the particular cause of death was encoded as 1 and all the other causes of death, including those that were censored, were encoded as 0. As the sample sizes were rather small, no covariates were included in these analyses.

For relative mortality differences, combined results for men and women are given, as the interaction term between sex and occupation and education, respectively, was not significant. However, we also conducted all-cause mortality analyses separately for both sexes and found no major differences. Cause-specific mortality was analysed for men and women together to retain statistical power. Mortality risks in socioeconomic statuses were reported with hazard ratios and their 95% confidence intervals.

RESULTS

The median age of participants was 92 years, out of 1276 respondents 81% where women and 37% lived in institutions. In the study, 59% of the participants answered the questionnaire by themselves, 24% received help in filling out the questionnaire and 18% of the answers were given by proxy (family, friends, home helpers or staff in the institutions).

All-cause mortality

The study population was categorised as upper non-manuals (7%), lower non-manuals (35%), skilled manual workers (38%) and unskilled manual workers (7%). Besides these hierarchic categories, housewives (10%) and those whose occupation was unknown (4%) were included in the analyses (Table 1). After a 36-month follow-up, overall mortality was 49% for men and women. In the social hierarchy, age-controlled absolute all-cause mortality was lowest for upper non-manuals (37%) and highest for unskilled manual workers (56%). Mortality for housewives was 51% and for those with unknown occupation 62%.

Education was categorised as high-educated (13%), mid-level-educated (29%), low-educated (54%) and unknown-educated (4%). In the social strata, mortality was lowest for the high-educated (44%) and highest for the low-educated (50%); for the unknown education group, it was 65%. For men, occupational and educational differences followed the social hierarchy, for women, there were some exceptions. However, differences were not statistically significant.

In a model adjusted for age and sex (Table 2), mortality was higher for all the other occupational groups when compared with upper non-manuals (lower non-manuals HR 1.61, 95% CI 1.11-2.32; skilled manual workers 1.56, 1.09-2.25; unskilled manual workers 1.88, 1.20-2.94; housewives 1.77, 1.15-2.71; and unknown occupation 2.33, 1.41-3.85). When comorbidity was added to the model, it reduced mortality differences, but hazards remained

significantly higher for the other groups compared with the reference group. When age- and sex-adjusted analysis was controlled for functioning, differences in hierarchical occupations were no more significant. The final model, with both, comorbidity and functioning, decreased only marginally hazard ratios if compared with the model that included solely functioning. According to education, the rate of death was lowest for the high-educated, but only those with unknown education differed significantly from this group. After adjustments for comorbidity and functioning, the difference attenuated, but still remained significant.

Cause-specific mortality

We studied cause-specific mortality from CVDs and from dementia. During the 33-month follow-up, of 581 deceased, 191 (33%) owed the underlying cause of death to dementia and 263 (45%) died of CVDs.

Controlled for age and sex (Table 3), dementia mortality was significantly higher in all the other occupational groups when compared with upper non-manuals (lower non-manuals HR 2.58, 95% CI 1.11-6.01; skilled manual workers 2.42, 1.04-5.60; unskilled manual workers 2.95, 1.13-7.70; housewives 2.77, 1.10-7.00; and unknown occupation 5.16, 1.91-13.91). According to education, mortality from dementia seemed to be higher for the mid-level- and low-educated than for the high-educated, but only those with unknown education differed significantly.

Hazards of dying from CVDs were 30 to 91% higher for other groups than for the upper non-manuals, but only housewives differed significantly from the reference group (HR 1.91, 95% CI 1.03-3.54). According to education, the hazards of dying from CVDs were 9-25% higher for other groups than for the high-educated, but differences were not significant.

DISCUSSION

In this population-based study on 90+-year-olds, absolute inequalities in all-cause mortality after a 36-month follow-up were not significant but showed a trend by social status. In analysis of relative differences, all-cause mortality was significantly lower for upper non-manuals than for other groups, and, in the social hierarchy, mortality was highest for unskilled manuals. Inequality was mainly explained by the differences in functioning. The high-educated seemed to have lower mortality than the low- and mid-level-educated, but these differences were not significant. In a cause-specific analysis, inequalities by occupation were found in dementia mortality. The hazards of dying from CVDs were 30 to 91% higher for lower occupational positions than for upper non-manuals, but showed significantly higher mortality only for housewives, and no differences were found according to education

To our knowledge, only one earlier study has demonstrated occupational mortality inequalities in very old age. Consistent with the current study, Martelin [11] reported lower mortality for upper non-manuals in the five-year age group for 90-94-year-olds in a comprehensive nationwide data. The CLESA study, however, using harmonised data from five European countries and Israel, showed no mortality differences according to occupation for 75+-year-olds [18].

Educational inequalities were found by Huisman and colleagues [12] in all 11 studied European populations for younger than 90 years old; and, when all the populations were combined, even in the aged 90 or over. In the CLESA study [18], higher education was associated with lower mortality only in Netherlands and in other survey studies with a focus on 90+-year-olds, education has not been associated with mortality [13, 19].

Very little is known about socioeconomic differences in cause-specific mortality in the oldest old. In our study, the differences by occupation were clear for dementia but not for cardiovascular causes. Many, but not all [20], studies have reported a higher incidence of Alzheimer's disease and other dementias for those in lower social positions [21-23]. In a Swedish study of 75+-year-olds, the incidence of Alzheimer's disease and other dementias was higher in low-educated but mortality from those diseases was not higher than in the general population [24].

Mortality from CVDs is related to a lower social position in middle-aged and young old adults [2, 25, 26] but there were no differences in a social hierarchy in our data. CVDs are the leading cause of death also in the oldest old. However, at very old age, death often results from aging-related frailty and multi-organ failure rather than a specific pathology in one organ system [27, 28]. In this age group, most death certificates are based on clinical examinations rather than autopsies, and it is likely that deaths without an evident specific cause are mainly recorded as being caused by CVDs. If CVDs as a cause of death constitute a biologically heterogeneous group, it is understandable that there are no clear socioeconomic differences.

In the study, functioning played a major role in explaining mortality differences whereas comorbidity was not as important. This finding supports the role of functioning as the most important and comprehensive health indicator in old age [13].

Outside the usual occupational hierarchy, groups of housewives and those with unknown occupation or education showed high mortality rates. The seemingly heterogeneous group of housewives included also women who assisted family members in agricultural work. In this group, mortality was comparable to that of manual workers. Similar to our study, a Norwegian health survey found higher all-cause and cardiovascular mortality for women who did not participate in the labour market [3]. Among those with unknown status, dementia

diagnosis, institutionalisation and proxy respondents were common, and to a large extent these factors explain both the missing information and the high mortality.

In many countries, women's labour market participation has traditionally been low, which complicates socioeconomic status classification for the oldest old [29]. In the Finnish context it has been common that women participate in the labour market at least for some years and in our data participation was as high as 84%. This enabled us to use a personal longest held occupation as a measure of socioeconomic status also for women.

Unfortunately, we did not have information on the social status at earlier ages of the entire birth cohorts but only for those who participated in the study; this prevented us from evaluating mortality selection. As our study only included 90+-year-olds, we could not directly compare the magnitude of inequalities with younger age groups. However, nationwide analyses imply that for middle-aged and younger old people, socioeconomic mortality differences are more prominent than in our study [26]. Relative differences may be smaller at older ages because of selective or high overall mortality [30]. However, in our study, significant differences were found in relative all-cause mortality but in spite of a clear social gradient, not in absolute mortality. From the public health perspective, relative differences imply that there are "avoidable deaths" even among the very old, and even at this age, remaining life expectancy would be higher without social inequality. In clinical terms, higher morbidity, disability and mortality is a special challenge for health and social services, and particular attention should be paid to old people in lower social classes.

The clear advantages of our study include population-based, reasonably large data, inclusion of both community-dwelling and institutionalised people, use of reliable and exhaustive mortality information from the Finnish Causes of Death Register, and a high response rate (79%). Availability of demographic and mortality data also allowed comparisons between the

participants and the non-response group (21% of the population, N 332). The hazard of dying was higher (HR 1.47; 95% CI 1.25-1.73) in those who did not respond, but the groups were similar with regard to age and sex distribution. Similar findings are reported by Ferrie and colleagues [31], and, in their study socioeconomic status did not interfere with the association between non-response and mortality.

A potential problem is caused by including people with dementia in a study based on self-reports. "Dementia" in our study included also people with cognitive decline without a clinical diagnosis, and those with an early stage of dementia. Our own analyses [32, 33] and those of others [34] suggest that these people are able to provide information sufficiently reliable on their health status. For more than a third of the people with dementia, the answers were received by proxy, a relative or most often from a nurse in an institution where clinical conditions are well registered. Therefore, it is not plausible that this would jeopardize the reliability of the study.

Although the study focused on one geographical area only, it represents 90+-year-olds at a national level in respect to sex distribution (18-21% men), and the relative proportion of those aged 90 or over in the population (0.6%). It included both urban and rural areas. However, in generalizing results, specific attention should be paid to women's high labour market participation and to the fact that we had limited information on the real status of the housewives.

In conclusion, our study showed significant hierarchic socioeconomic differences in all-cause and dementia mortality in a population sample aged 90 and older. The differences were largely explained by differences in health, measured as functional status and comorbidity. The findings demonstrate that even in the very old population that has been exposed to social selection throughout the life span and that experiences very high basic mortality, a social

position persists as a major determinant on the length of remaining life.

ACKNOWLEDGMENTS

The Gerontology Research Center is a joint effort between the Universities of Tampere and Jyväskylä. The authors wish to thank municipal and private home care and elderly care units in Tampere for their help in the data collection.

CONFLICT OF INTEREST

None declared.

FUNDING

This work was supported by the Juho Vainio Foundation and the Finnish Cultural Foundation, Pirkanmaa Regional Fund. Competitive Research Funding of the Expert Responsibility Area of Tampere University Hospital, (grant number 9M025) to Marja Jylhä.

TABLES

Table 1. Population by occupational and educational status at baseline (N) and mortality after a 36-month follow-up (%, CI).

	At baseline			Mortality after 36 months					
	All	Women	Men	All		Women		Men	
	N	N	N	N	%, CI	N	%, CI	N	%, CI
	1276	1036	240	627		510		117	
Occupation									
Upper non-manuals	92	48	44	34	37 (28-48)	17	36 (24-51)	17	37 (24-52)
Lower non-manuals	441	364	77	211	49 (44-54)	177	50 (45-55)	34	45 (34-57)
Skilled manual workers	487	384	103	241	49 (44-53)	187	48 (43-53)	54	52 (43-62)
Unskilled manual workers	83	72	11	47	56 (45-66)	38	52 (40-63)	9	82 (49-96)
Housewives	124	124		65	51 (42-60)	65	51 (42-60)		
Unknown occupation	49	44	5	29	62 (48-75)	26	62 (47-75)	3	66 (24-92)
Education									
High	162	113	49	68	44 (36-51)	47	44 (35-54)	21	41 (28-55)
Mid-level	373	293	80	179	49 (44-55)	142	50 (44-56)	37	47 (37-59)
Low	694	591	103	349	50 (46-53)	296	49 (45-53)	53	52 (42-61)
Unknown education	47	39	8	31	65 (50-77)	25	63 (46-77)	6	75 (37-94)

Age-adjusted predicted probabilities from logistic regression analysis and 95% confidence intervals (CI).

Table 2. All-cause mortality in a 36-month follow-up separately by occupational and educational status and mean survival times (maximum 1073 days).

	Adjusted for age and sex		Age, sex and comorbidity		Age, sex and functioning		Age, sex, comorbidity and functioning		Mean survival time	
	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	Mean in days	95% CI
Occupation										
Upper non-manuals	1		1		1		1		935	(883-987)
Lower non-manuals	1.61*	(1.11-2.32)	1.55*	(1.07-2.26)	1.43	(0.99-2.09)	1.42	(0.97-2.08)	802	(769-835)
Skilled manual workers	1.56*	(1.09-2.25)	1.46*	(1.01-2.11)	1.33	(0.92-1.93)	1.31	(0.90-1.92)	806	(776-836)
Unskilled manual workers	1.88**	(1.20-2.94)	1.65*	(1.05-2.60)	1.55	(0.98-2.45)	1.45	(0.91-2.31)	782	(706-857)
Housewives	1.77**	(1.15-2.71)	1.63*	(1.06-2.52)	1.59*	(1.03-2.46)	1.55	(1.00-2.41)	778	(715-840)
Unknown occupation	2.33***	(1.41-3.85)	1.90*	(1.13-3.18)	1.56	(0.92-2.64)	1.48	(0.87-2.51)	743	(636-849)
Age	1.11***	(1.08-1.14)	1.10***	(1.07-1.13)	1.06***	(1.04-1.09)	1.07***	(1.04-1.10)		
Sex										
Male	1		1		1		1			
Female	0.88	(0.72-1.09)	0.83	(0.68-1.03)	0.72**	(0.57-0.89)	0.71**	(0.57-0.89)		
Comorbidity[a]			1.42***	(1.31-1.55)			1.24***	(1.13-1.36)		
Functioning[b]					1.52***	(1.40-1.66)	1.47***	(1.35-1.61)		
Functioning*time					1.00**	(1.00-1.00)	1.00**	(1.00-1.00)		
Education										
High	1		1		1		1		875	(828-922)
Mid-level	1.23	(0.93-1.63)	1.17	(0.88-1.54)	1.26	(0.95-1.68)	1.21	(0.91-1.61)	812	(778-847)
Low	1.24	(0.96-1.62)	1.18	(0.90-1.53)	1.14	(0.87-1.49)	1.12	(0.85-1.46)	799	(773-825)
Unknown education	1.98**	(1.29-3.03)	1.87**	(1.21-2.89)	1.58*	(1.01-2.48)	1.62*	(1.03-2.54)	654	(540-768)

Age	1.10***	(1.07-1.13)	1.10***	(1.07-1.13)	1.06***	(1.03-1.09)	1.06***	(1.04-1.09)
Sex								
Male	1		1		1		1	
Female	0.94	(0.77-1.15)	0.89	(0.72-1.09)	0.76*	(0.62-0.94)	0.76*	(0.61-0.94)
Comorbidity[a]			1.43***	(1.32-1.56)			1.25***	(1.14-1.36)
Functioning[b]					1.52***	(1.40-1.66)	1.47***	(1.35-1.60)
Functioning*time					1.00**	(1.00-1.00)	1.00**	(1.00-1.00)

Cox hazard ratios (HR) and their 95% confidence intervals (CI), statistical significances at
* P-value < 0.05, ** P-value <0.01, *** P-value < 0.001.
[a]Comorbidity = CVD, diabetes, dementia, stroke, hip fracture.
[b]Functioning = independence in getting in and out of the bed, dressing and undressing, moving indoors, walking 400 m, using stairs.
Mean survival time with 95% confidence intervals from Kaplan-Meier analysis.

Table 3. Association of occupation and education with a 33-month cardiovascular and dementia mortality and mean survival times (maximum 1000 days).

	Cause of death dementias				Cause of death CVDs			
	HR	95% CI	Mean in days	95% CI	HR	95% CI	Mean in days	95% CI
Occupation								
Upper non-manuals	1		976	(954-998)	1		921	(878-964)
Lower non-manuals	2.58*	(1.11-6.01)	912	(891-934)	1.36	(0.79-2.35)	889	(865-913)
Skilled manual workers	2.42*	(1.04-5.60)	914	(894-934)	1.36	(0.80-2.33)	884	(861-907)
Unskilled manual workers	2.95*	(1.13-7.70)	895	(841-949)	1.57	(0.80-3.08)	862	(802-922)
Housewives	2.77*	(1.10-7.00)	894	(850-938)	1.91*	(1.03-3.54)	855	(806-903)
Unknown occupation	5.16**	(1.91-13.91)	850	(765-936)	1.30	(0.55-3.06)	898	(823-973)
Age	1.17***	(1.12-1.22)			1.09***	(1.04-1.13)		
Sex								
Male	1				1			
Female	1.13	(0.75-1.72)			0.93	(0.67-1.30)		
Education								
High	1		944	(916-970)	1		912	(878-947)
Mid-level	1.06	(0.61-1.84)	934	(913-955)	1.25	(0.83-1.90)	882	(856-907)
Low	1.42	(0.86-2.35)	903	(885-921)	1.09	(0.73-1.61)	881	(862-901)
Unknown education	3.23**	(1.62-6.45)	770	(668-871)	1.11	(0.51-2.42)	869	(780-957)
Age	1.15***	(1.10-1.21)			1.09***	(1.05-1.14)		
Sex								
Male	1				1			
Female	1.25	(0.83-1.88)			1.02	(0.74-1.41)		

Age- and sex-adjusted Cox proportional hazard ratios (HR) and their 95% confidence intervals (CI), statistical significances at * P-value < 0.05, ** P-value <0.01, *** P-value < 0.001.
Mean survival time with 95% confidence intervals from Kaplan-Meier analysis

References

1. McFadden E, Luben R, Wareham N, Bingham S, Khaw K. Occupational social class, educational level, smoking and body mass index, and cause-specific mortality in men and women: A prospective study in the European prospective investigation of cancer and nutrition in Norfolk (EPIC-Norfolk) cohort. Eur J Epidemiol 2008; 23: 511-22.

2. Stringhini S, Sabia S, Shipley M et al. Association of socioeconomic position with health behaviors and mortality. JAMA 2010; 303: 1159-66.

3. Rostad B, Schei B, Lund Nilsen TI. Social inequalities in mortality in older women cannot be explained by biological and health behavioural factors -- results from a Norwegian health survey (the HUNT study). Scand J Public Health 2009; 37: 401-8.

4. Mackenbach JP, Stirbu I, Roskam AJ et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med 2008; 358: 2468-81.

5. Montez JK, Hayward MD, Brown DC, Hummer RA. Why is the educational gradient of mortality steeper for men? J Gerontol B Psychol Sci Soc Sci 2009; 64: 625-34.

6. Zajacova A. Education, gender, and mortality: Does schooling have the same effect on mortality for men and women in the US? Soc Sci Med 2006; 63: 2176-90.

7. Laaksonen M, Tarkiainen L, Martikainen P. Housing wealth and mortality: A register linkage study of the Finnish population. Soc Sci Med 2009; 69: 754-60.

8. Lantz PM, Golberstein E, House JS, Morenoff J. Socioeconomic and behavioral risk factors for mortality in a national 19-year prospective study of U.S. adults. Soc Sci Med 2010; 70: 1558-66.

9. Connolly S, O'Reilly D, Rosato M. House value as an indicator of cumulative wealth is strongly related to morbidity and mortality risk in older people: A census-based cross-sectional and longitudinal study. Int J Epidemiol 2010; 39: 383-91.

10. Huisman M, Read S, Towriss CA, Deeg DJH, Grundy E. Socioeconomic inequalities in mortality rates in old age in the world health organization Europe region. Epidemiol Rev 2013; 35: 84-97.

11. Martelin T. Socio-demographic differentials in mortality at older ages in Finland. In: Caselli G, Lopez AD, editors. Health and Mortality among Elderly Populations. Oxford: Clarendon Press; 1996; p. 112-34.

12. Huisman M, Kunst AE, Andersen O et al. Socioeconomic inequalities in mortality among elderly people in 11 European populations. J Epidemiol Community Health 2004; 58: 468-75.

13. Nybo H, Petersen HC, Gaist D et al. Predictors of mortality in 2,249 Nonagenarians—The Danish 1905-cohort survey. J Am Geriatr Soc. 2003; 51: 1365.

14. Hoffmann R. Illness, not age, is the leveler of social mortality differences in old age. J Gerontol B Psychol Sci Soc Sci 2011; 66B: 374-9.

15. Jylhä M, Enroth L, Luukkaala T. Trends of functioning and health in nonagenarians− the Vitality 90+ Study. In: Robine JM, Jagger C, Crimmins E, editors. Annual Review of Gerontology and Geriatrics vol 33, "Healthy Longevity". Springer Publishing Company; 2013; p. 313-332.

16. Official Statistics Finland. Occupational and industrial classification. 1976.

17. Enroth L, Raitanen J, Hervonen A, Jylhä M. Do socioeconomic health differences persist in nonagenarians? J Gerontol B Psychol Sci Soc Sci 2013; 68: 837-47.

18. Noale M, Minicuci N, Bardage C et al. Predictors of mortality: An international comparison of socio-demographic and health characteristics from six longitudinal studies on aging: The CLESA project. Exp Gerontol 2005; 40: 89-99.

19. Formiga F, Ferrer A, Chivite D, Rubio-Rivas M, Cuerpo S, Pujol R. Predictors of long-term survival in nonagenarians: The NonaSantfeliu study. Age Ageing. 2011; 40: 111-6.

20. Chen J, Lin K, Chen Y. Risk factors for dementia. J Formosan Med Assoc 2009; 108: 754-64.

21. Evans DA, Hebert LE, Beckett LA et al. Education and other measures of socioeconomic status and risk of incident Alzheimer disease in a defined population of older persons. Arch Neurol 1997; 54: 1399-405.

22. Geerlings MI, Schmand B, Jonker C, Lindeboom J, Bouter LM. Education and incident Alzheimer's disease: A biased association due to selective attrition and use of a two-step diagnostic procedure? Int J Epidemiol 1999; 28: 492-7.

23. Sattler C, Toro P, Schönknecht P, Schröder J. Cognitive activity, education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimer's disease. Psychiatry Res 2012; 196: 90-5.

24. Qiu C, Bäckman L, Winblad B, Agüero-Torres H, Fratiglioni L. The influence of education on clinically diagnosed dementia incidence and mortality data from the Kungsholmen project. Arch Neurol 2001; 58: 2034-9.

25. Huisman M, Kunst AE, Bopp M et al. Educational inequalities in cause-specific mortality in middle-aged and older men and women in eight western European populations. Lancet 2005; 365: 493-500.

26. Elo IT, Martikainen P, Myrskylä M. Socioeconomic status across the life course and all-cause and cause-specific mortality in Finland. Soc Sci Med 2013. http://dx.doi.org/10.1016/j.socscimed.2013.11.037

27. Kohn RR. Cause of death in very old people. JAMA 1982; 247: 2793-7.

28. Gessert CE, Elliott BA, Haller IV. Dying of old age: An examination of death certificates of Minnesota centenarians. J Am Geriatr Soc 2002; 50: 1561–1565.

29. Guilley E, Bopp M, Faeh D, Paccaud F. Socioeconomic gradients in mortality in the oldest old: A review. Arch Gerontol Geriatr 2010; 51: e37-40.

30. Kaplan GA, Haan MN, Wallace RB. Understanding changing risk factor associations with increasing age in adults. Annu Rev Public Health 1999; 20: 89-108.

31. Ferrie JE, Kivimäki M, Singh-Manoux A et al. Non-response to baseline, non-response to follow-up and mortality in the Whitehall II cohort. Int J Epidemiol 2009; 38: 831-7.

32. Goebeler S, Jylhä M, Hervonen A. Self-reported medical history and self-rated health at age 90. Agreement with medical records. Aging Clin Exp Res 2007; 19: 213-219.

33. Jylhä M, Enroth L, Luukkaala T. Trends of functioning and health in nonagenarians: The Vitality 90+ Study. In Robine, JM, Crimmins E, Jagger C, (Eds) Annu Rev Gerontol Geriatr. New York: Springer Publishing Company, 2013; 33: 313-332.

34. Walker JD, Maxwell CJ, Hogan DB, Elby EM. Does Self-Rated Health Predict Survival in Older Persons with Cognitive Impairment? J Am Geriatr Soc 2004; 52: 1895-1900.