Social inequality in onset of mobility limitations in midlife: a longitudinal study in Denmark

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Abstract The aim of this longitudinal study was to investigate if social inequality in onset of mobility limitations is present in early midlife, and to examine whether common determinants of disability account for social status differences in onset of mobility limitations in midlife. 3,586 40- and 50-year-old Danish men and women enrolled in The Danish Longitudinal Study on Work, Unemployment and Health constituted the study population. Data were collected by mailed questionnaires in 2000 and 2006. Limitations in running 100 m and in climbing two flights of stairs represented two aspects of mobility limitations. Occupational social class was applied as a measure of socioeconomic position. Among individuals reporting no limitations in 2000 social gradients in onset of mobility limitations emerged in 2006. Having a low social class at age 40 and 50 respectively was associated with higher onset of mobility limitations 6 years later, and this association was overall only partly explained by common determinants of disability: smoking, alcohol consumption, physical activity, body mass index, and chronic diseases. These results indicate that the development of mobility

limitations might begin earlier in lower compared to higher social strata, and that social status differences in mobility limitations might emerge already in the forties.

Keywords Social inequality · Mobility limitations · Midlife · Health behaviors · Chronic diseases

Introduction

Despite a low level of income inequality (OECD. Growing Unequal? Income Distribution and Poverty in OECD Countries 2008) and a generous welfare system, social inequality in health, with a disadvantage of individuals in a low socioeconomic position, is seen in Denmark, e.g., in life expectancy and health expectancy (Bronnum-Hansen and Baadsgaard 2008), in self-rated health (Sacker et al. 2010) and in functional limitations among older people (Avlund et al. 2004; Nilsson et al. 2010b).

Many studies from other countries have also identified social inequalities in the prevalence of functional limitations among older adults (Grundy and Glaser 2000; House et al. 1994; Koster et al. 2005, 2006; Lantz et al. 2001; Martikainen et al. 1999; Murrell and Meeks 2002; Robert and House 1996; Sainio et al. 2007; von dem Knesebeck 2005; Zimmer and House 2003). The reasons for these inequalities are not fully understood, but studies suggest that common risk factors for functional limitations, such as behavioral factors (smoking, alcohol consumption, physical inactivity), overweight or obesity and chronic diseases may be part of the explanation (Koster et al. 2006; Lantz et al. 2001; Sainio et al. 2007) and targets for prevention of subsequent disability.

Functional limitations are particularly prevalent among older adults and are predictive of mortality, nursing home

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admission, healthcare utilization, and later stages in the disablement process such as disabilities in basic activities of daily living (Guralnik and Ferrucci 2003; Verbrugge and Jette 1994). Assessing the level of functional limitations in a population is a good way of capturing individuals who are at risk of disability and in whom prevention might be effective (Guralnik and Ferrucci 2003). Early onset of functional decline is a heavy social and economic burden to the individual, as well as to the family and the society who are the primary providers of support (Holmes et al. 2009).

Functional limitations are not only an issue of old age, as some cross-sectional studies have found that mobility limitations are prevalent at 10–20% already among individuals aged 50–64, with limitations in mobility tasks such as walking about 400 m, climbing stairs, and standing for about 20 min (Gardener et al. 2006; Iezzoni et al. 2001; Melzer et al. 2005; Sainio et al. 2006). Longitudinal studies concerning onset of new cases of mobility limitations in this age-group are scarce, yet onset of mobility limitations among adults aged 51–61, who reported no limitations at baseline, have been seen in 6% after 2 years follow-up (Clark et al. 1998).

Cross-sectional and longitudinal studies have suggested that social inequalities in mobility limitations are also present even in midlife, at around the age of 50 years (Adamson et al. 2003; Clark et al. 1998; Grundy and Glaser 2000; House et al. 1990, 1994, 2005; Koster et al. 2006; Lantz et al. 2001; Melchior et al. 2006; Osler et al. 2009; Sainio et al. 2007). It has also been suggested that social inequality might not widen much further beyond early old age, and that these inequalities may be established prior to early old age (House et al. 1990, 1994, 2005; Koster et al. 2006). The sickest individuals in midlife, who are most likely to suffer from limitations as well as to die prior to old age, are generally from the lower socioeconomic strata (House et al. 1990). Due to this selective mortality the prevalence of functional limitations in low socioeconomic strata might not differ much between midlife- and old-aged populations, and social inequality might thus not widen with increasing age (House et al. 1990). Yet social inequalities in functional limitations might also be caused by diverse socioeconomic differences in risk factors of mobility limitations throughout adult life (House et al. 1990). These potential explanations suggest that the origins of social inequalities in functional limitations arise prior to onset of older age, in an earlier stage of the life course.

There is still a lack of knowledge concerning the disability process in middle-aged populations that often progress to more severe disability later in life, including the extent to which there are social inequalities in the onset of mobility limitations. Based on secondary findings of a social gradient in onset of mobility limitations in a population of adults aged 40 and 50 years (Nilsson et al. 2010a),

the authors aimed at elaborating this important topic in the same dataset by applying two measures of mobility; one measure capturing the ability to climb two flights of stairs, which has been widely used in other studies, and a more physically demanding task capturing the ability to run 100 m, which might detect even earlier signs of mobility decline in a population in early midlife. This study population allows the study of a social gradient in onset of mobility limitations in an age-group somewhat younger than assessed in other studies on this topic.

The aim of this study was to investigate if there is social inequality in onset of mobility limitations in midlife in a representative sample of economically active 40- and 50-year-old men and women. Another aim was to examine the extent to which common determinants of disability, including health behaviors and chronic medical conditions account for social status differences in onset of mobility limitations in midlife.

Methods

Study sample

Data for this study were available from the Danish Longitudinal Study on Work, Unemployment and Health. This study has been described in detail elsewhere (Christensen et al. 2004). The study was approved by the Committees on Biomedical Research Ethics of the Capital Region of Denmark. A random sample of Danish men and women aged 40 and 50 years in 1999 constituted the study population ($N = 11,082$). This sample was drawn from the Amternes og Kommunernes Forskningsinstitut Longitudinal Register at Statistics Denmark (Institute of Local Government Studies in Denmark), which comprises information on a 10% sample of Danes aged 15 years or older. Baseline data were collected by postal questionnaire in 2000 ($N = 7,588$, response rate 69%). Follow-up data were collected by postal questionnaire in 2006 on surviving participants and participants who had not emigrated or refused to participate in scientific studies ($N = 4,893$, response rate 65%). Individuals who answered and returned the questionnaire in 2000 as well as in 2006 and had full records on all study variables, including occupational social class ($N = 3,586$) constituted our study population (Fig. 1).

Non-responders of the 2000 questionnaire were more likely to be male or to have a low socioeconomic position compared to responders, whereas non-responders and responders had equal numbers of contacts with general practitioner. Non-responders of the 2006 questionnaire were also more likely to be male, to have a low socioeconomic position, to be immigrants from Third World

Fig. 1 Flowchart of the study-population

Countries or the Balkans, and in the group of 50-year-olds at baseline to have higher number of contacts with general practitioners, compared to responders. The individuals excluded due to missing values on covariates were more likely to be female, to have a lower social class, and to have a weekly alcohol consumption deviating from recommendations compared to the study participants, yet they did not significantly differ from the study participants on any other covariates.

Measures

Mobility limitations were assessed in 2000 and 2006 by a modified version of the Rosow–Breslau functional status measure (Rosow and Breslau 1966), evaluating whether the study participant felt limited, because of health problems, when running 100 m and climbing two flights of stairs (two floors above ground floor) respectively (response code: yes very limited/yes somewhat limited/no not limited at all). In

the present analyses, the individuals reporting no limitations constituted the reference group, and individuals reporting feeling somewhat or very limited constituted the group of cases experiencing mobility limitations.

In order to study if social class affected onset of new cases of mobility limitations in 2006, we started from a population reporting no limitations at baseline in 2000 in the relevant measures of mobility. At baseline 16% of the 1,760 40-year-olds reported limitations in running 100 m and 9% reported limitations in climbing two flights of stairs. Among the 1,826 50-year-olds 27% reported limitations in running 100 m and 13% reported limitations in climbing two flights of stairs at baseline. For analyses with onset of limitations in running 100 m as the outcome measure, we therefore started from the 1,484 40-year-olds and the 1,342 50-year-olds without limitations in running 100 m in 2000. For analyses with onset of limitations in climbing two flights of stairs as the outcome measure, we started from the 1,621 40-year-olds and the 1,585 50-year-olds without limitations in climbing stairs in 2000 (Fig. 1).

Socioeconomic position in 2000 was measured by occupational social class, and thus limits our study population to economically active individuals (e.g., having part-time or full-time employment). This measure was formed by coding the occupation of the study participants into social class I–V according to the standards of the Danish National Institute of Social Research, which resembles the British Registrar General’s Classification I–V (Christensen et al. 2004). Social class I: top managers in big organizations and companies (more than 50 employees), top level civil servants, jobs requiring >4 years of university or similar training; Social class II: other managers (11–50 employees), medium level civil servants, jobs requiring 3–4 years of further education; Social class III: lower level white collar workers within administrative jobs (1–10 employees), jobs requiring medium level of theoretical vocational training for specialized job functions; Social class IV: skilled manual workers; Social class V: unskilled or semi-skilled workers.

Analyses were stratified by age and gender. The following baseline variables were entered as potential explanatory factors for any social inequality in onset of mobility limitations: health behaviors (smoking status, alcohol consumption and physical activity), body mass index and number of chronic conditions.

Smoking status was assessed by the question “Do you smoke?” (response code: yes, every day; yes, but not every day; no, I stopped smoking within the past half year; no, I stopped smoking earlier; no, I have never smoked). This variable was categorized into smokers, former smokers, and never smokers.

Alcohol consumption was assessed by questions regarding consumption during weekdays and weekends

respectively and comprised a count of units of alcohol based on bottles of regular beer, bottles of strong beer, glasses of red or white wine, glasses of fortified wine, and drinks of liquor. The count was divided into 4 categories: 0 unit, 1–14/21 units (based on the recommendations of the Danish National Board of Health of a maximum of 14 units for women and 21 units for men per week), 15/22–35 units, 36+ units. 1–14/21 units was the reference category.

Physical activity was assessed by the question: “How many hours a week are you physically active? Please include sports, physical training, gardening, walking, and bicycle trips including transportation between work and home” (response code: none, about half an hour per week, about an hour per week, about 2–3 h per week, about 4–6 h per week, 7 h per week or more). Based on the recommendations for adults from the Danish National Board of Health of at least half an hour of moderate physical activity every day of the week and at least 20–30 min of vigorous physical activity twice a week, this measure was divided into three categories: 1 h or less per week, 2–6 h per week, and 7 h or more, with the latter group as the reference category.

Body mass index (BMI) [weight (kg)/height (m²)] was estimated based on responses to questions regarding height and weight, and divided into the following groups: <18.5, 18.5–<25, 25–<30, 30+, with 18.5–<25 constituting the reference category of individuals with normal weight.

Number of chronic diseases was evaluated by the question: “Did a medical doctor ever tell you that you have/have had one or more of the following diseases?—myocardial infarction, angina pectoris, or other heart disease/asthma or bronchitis/stroke or cerebral hemorrhage/depression or other mental illness/eczema or other skin disease/diabetes or other metabolic disease/arthritis or other diseases in back, muscles or joints/other chronic disease, please specify” (response code: no, yes, do not know). We used a dichotomized measure, 0–1 versus 2 or more chronic diseases diagnosed.

Statistical analyses

We tested for statistical interaction between social class and gender and age, respectively. Even though none of the statistical interaction terms were significant, all analyses were performed stratified by gender and by age-group, in order to try to identify any gender differences and to identify how early in midlife social inequality in mobility limitations might occur.

χ^2 tests were performed to study 1) the distribution of the potential explanatory variables measured at baseline by social class (Table 1), (2) the ability to run 100 m and ability to climb two flights of stairs at follow-up among those with no limitations in the respective measures at baseline (Table 2) (PROC FREQ SAS version 9).

A series of logistic regression analyses were performed with each mobility outcome in each age- and gender-group, all adjusted for health behaviors, BMI and chronic conditions in four consecutive models (Tables 3, 4, 5). In all analyses individuals in social class I constituted the reference group (odds ratio = OR = 1.00, PROC LOGISTIC SAS version 9).

As a further study of a social gradient in mobility limitations the Wald-test for trend was performed in all stratified analysis.

Results

In total, among the 40/50-year-olds without running limitations at baseline 17/25% had onset of running limitations at 6-year follow-up, and among the 40/50-year-olds without limitations in climbing two flights of stairs at baseline 11/15% had onset of limitations in climbing stairs at 6-year follow-up (data not shown). Overall, among the 40-year-olds without running limitations at baseline 16/18% of men/women had onset of running limitations at follow-up, and among the 40-year-olds without limitations in climbing stairs at baseline 11% of both men and women had onset of limitations in climbing stairs at follow-up. Among the 50-year-olds, 24/28% of men/women without running limitations at baseline had onset of running limitations at follow-up, and 14/16% of men/women without limitations in climbing stairs at baseline had onset of limitations in climbing stairs at follow-up. In both the age-groups, there were significant gender differences in social class with more men than women in higher social classes (data not shown).

Table 1 shows the distribution of potential explanatory factors assessed at baseline by social class for men and women aged 40 and 50 years. Among 40-year-old men, there was a statistically significant association between social class and all factors except chronic conditions. On the whole, poor health behaviors were more frequent in lower social classes. An exception to this was that the highest level of physical activity (+7 h per week) and the more extreme categories of alcohol consumption (no alcohol or more than 36 units per week) were more frequent in lower social classes. These tendencies were in the same direction for 50-year-old men, yet there was no statistically significant association between social class and alcohol consumption or BMI.

Among 40-year-old women, there was a statistically significant association between social class and all factors except BMI. Generally speaking poor health behaviors and several chronic conditions were more frequent in lower social classes. The tendencies were in the same direction for 50-year-old women yet there was no statistically

Table 1 Distribution of health behaviors, BMI and chronic conditions by social class, stratified by gender and age-group

	40-year-olds						50-year-olds					
	Social class						Social class					
	I (%)	II (%)	III (%)	IV (%)	V (%)	<i>p</i> value (χ^2 test)	I (%)	II (%)	III (%)	IV (%)	V (%)	<i>p</i> value (χ^2 test)
Men												
Smoking												
Smoker	21 (20)	32 (21)	69 (33)	56 (31)	56 (40)	0.0016	41 (26)	74 (34)	85 (35)	83 (44)	67 (46)	0.0078
Previous smoker	26 (25)	44 (30)	41 (20)	34 (19)	34 (25)		54 (35)	73 (33)	77 (32)	60 (32)	43 (30)	
Never smoker	58 (55)	72 (49)	98 (47)	92 (50)	48 (35)		60 (39)	71 (33)	79 (33)	45 (24)	35 (24)	
Weekly alcohol units												
0	7 (7)	13 (9)	10 (5)	19 (10)	19 (14)	0.0009	6 (4)	7 (3)	18 (7)	9 (5)	15 (10)	0.1438
1–14/21	75 (71)	111 (75)	154 (74)	130 (71)	75 (54)		106 (68)	145 (67)	162 (67)	129 (68)	88 (61)	
15/22–36	19 (18)	19 (13)	26 (12)	21 (12)	24 (17)		32 (21)	40 (18)	38 (16)	35 (19)	23 (16)	
36+	4 (4)	5 (3)	18 (9)	12 (7)	20 (15)		11 (7)	26 (12)	23 (10)	15 (8)	19 (13)	
Physical activity, hours per week												
<1	17 (16)	21 (14)	32 (15)	28 (15)	16 (12)	0.0534	30 (19)	24 (11)	30 (12)	11 (6)	13 (9)	0.0002
2–6	68 (65)	89 (60)	110 (53)	87 (48)	72 (52)		86 (56)	131 (60)	115 (48)	101 (54)	71 (49)	
7+	20 (19)	38 (26)	66 (32)	67 (37)	50 (36)		39 (25)	63 (29)	96 (40)	76 (40)	61 (42)	
BMI												
<18.5	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.0054	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.2894
18.5–<25	67 (64)	79 (53)	99 (48)	83 (46)	54 (39)		69 (45)	87 (40)	85 (35)	83 (44)	49 (34)	
25–<30	31 (29)	60 (41)	87 (42)	82 (45)	62 (45)		73 (47)	105 (48)	121 (50)	83 (44)	73 (50)	
30+	7 (7)	9 (6)	22 (10)	17 (9)	22 (16)		13 (8)	26 (12)	35 (15)	22 (12)	23 (16)	
Chronic conditions												
0–1	95 (90)	132 (89)	180 (87)	170 (93)	117 (85)	0.1098	136 (88)	173 (79)	198 (82)	146 (78)	124 (86)	0.0870
2+	10 (10)	16 (11)	28 (13)	12 (7)	21 (15)		19 (12)	45 (21)	43 (18)	42 (22)	21 (14)	
Women												
Smoking												
Smoker	18 (23)	56 (29)	89 (29)	104 (40)	66 (46)	0.0003	14 (25)	43 (24)	95 (30)	70 (33)	52 (45)	0.0132
Previous smoker	15 (19)	53 (28)	80 (26)	62 (24)	35 (25)		16 (29)	60 (33)	77 (25)	57 (26)	27 (24)	
Never smoker	45 (58)	81 (43)	137 (45)	96 (36)	42 (29)		25 (46)	77 (43)	142 (45)	88 (41)	36 (31)	
Weekly alcohol units												
0	7 (9)	21 (11)	40 (13)	43 (17)	39 (27)	0.0009	1 (2)	14 (8)	38 (12)	27 (13)	25 (22)	0.0346
1–14/21	53 (68)	124 (65)	219 (72)	171 (65)	79 (55)		40 (73)	116 (65)	188 (60)	134 (62)	68 (59)	
15/22–36	17 (22)	42 (22)	44 (14)	45 (17)	20 (14)		12 (22)	44 (24)	79 (25)	47 (22)	21 (18)	
36+	1 (1)	3 (2)	3 (1)	3 (1)	5 (4)		2 (3)	6 (3)	9 (3)	7 (3)	1 (1)	

Table 1 continued

40-year-olds						50-year-olds						
Social class						Social class						
I (%)	II (%)	III (%)	IV (%)	V (%)	p value (χ^2 test)	I (%)	II (%)	III (%)	IV (%)	V (%)	p value (χ^2 test)	
Physical activity, hours per week												
<1	10 (13)	33 (17)	42 (14)	40 (15)	18 (13)	0.0036	7 (13)	16 (9)	30 (9)	29 (13)	21 (18)	0.1957
2-6	54 (69)	114 (60)	209 (68)	146 (56)	76 (53)		36 (65)	123 (68)	200 (64)	131 (61)	62 (54)	
7+	14 (18)	43 (23)	55 (18)	76 (29)	49 (34)		12 (22)	41 (23)	84 (27)	55 (26)	32 (28)	
BMI												
<18.5	5 (6)	2 (1)	10 (3)	8 (3)	4 (3)	0.3780	2 (4)	4 (2)	7 (2)	3 (1)	4 (3)	0.3853
18.5-<25	59 (76)	141 (74)	218 (71)	174 (66)	97 (68)		39 (71)	110 (61)	196 (63)	124 (58)	60 (52)	
25-<30	9 (12)	34 (18)	59 (20)	55 (21)	31 (21)		10 (18)	52 (29)	86 (27)	68 (32)	34 (30)	
30+	5 (6)	13 (7)	19 (6)	25 (10)	11 (8)		4 (7)	14 (8)	25 (8)	20 (9)	17 (15)	
Chronic conditions												
0-1	69 (88)	160 (84)	273 (89)	213 (81)	109 (76)	0.0041	44 (80)	140 (78)	262 (83)	169 (79)	85 (74)	0.2267
2+	9 (12)	30 (16)	33 (11)	49 (19)	34 (24)		11 (20)	40 (22)	52 (17)	46 (21)	30 (26)	

significant association between social class and physical activity and chronic conditions. Also among women the highest level of physical activity and the more extreme categories of alcohol consumption were more frequently seen in the lower social classes.

Table 2 shows the distribution by social class of the two mobility outcomes among those who reported no limitations at baseline in the respective mobility measures, stratified by gender and age-group. Overall, for men as well as women and in both age-groups, there was a statistically significant association between social class and onset of limitations in running and climbing stairs, with a higher frequency of mobility limitations in the lower social classes. An exception to this pattern was the equal distribution by social class of onset of limitations in running among 50-year-old women.

Among the 40-year-olds women in most social classes reported more limitations in running compared to men, whereas there was no clear gender difference in onset of limitations in climbing stairs. Among the 50-year-olds, equal numbers of women in the five social classes reported onset of limitations in running, whereas among men this number was only seen in the two lower social classes. Especially in social class V 50-year-old women reported more limitations in climbing stairs compared to men.

Results from the longitudinal analyses regarding onset of mobility limitations are presented in Tables 3 and 4. Among the 40-year-olds, there was a tendency among both genders to a social gradient in onset of limitations in running, with higher odds of onset of limitations in running in lower social classes. Among both genders only social class V had marginally significantly higher odds compared to social class I when health behaviors, BMI and chronic conditions were included (model 4, Table 3).

Among both genders in the 40-year-old category there were social gradients in onset of limitations in climbing stairs, which was however most pronounced among men, where the odds for social class IV and V were significantly increased, compared to social class I even when the potential explanatory factors were included.

Among 50-year-old men, there was a social gradient in onset of limitations in running, which remained significant when the potential explanatory factors were included in the model (model 4, Table 4). Among 50-year-old women, there was no social gradient in onset of limitations in running.

Among both genders in the 50-year-old age-group, there were social gradients in onset of limitations in climbing stairs, particularly among women. Even though only social class IV among men and social class V among women had significantly increased odds compared to social class I, the gradients were apparent even when health behaviors, BMI and chronic conditions were included in the model.

Table 2 Onset of mobility limitations (somewhat/very limited) at follow-up by age-group and social class, men and women, respectively, for those who reported no limitations at baseline

	40-year-olds						50-year-olds					
	Social class						Social class					
	I (%)	II (%)	III (%)	IV (%)	V (%)	<i>p</i> value (χ^2 test)	I (%)	II (%)	III (%)	IV (%)	V (%)	<i>p</i> value (χ^2 test)
Limitations in running 100 m, 2006 ^a												
Men	7	16	17	16	22	0.0922	13	25	22	30	28	0.0096
Women	11	20	13	20	28	0.0095	28	27	26	29	31	0.9289
Limitations in climbing two flights of stairs, 2006 ^b												
Men	4	9	10	13	19	0.0067	8	13	12	22	16	0.0039
Women	4	9	9	14	15	0.0444	6	11	14	18	32	<0.0001

Percentages indicate % of men/women with limitations in a given social class

^a Men: *N* = 677 (age 40) and *N* = 727 (age 50) not limited at baseline. Women: *N* = 807 (age 40) and *N* = 615 (age 50) not limited at baseline

^b *N* = 727 (age 40) and *N* = 833 (age 50) not limited at baseline. Women: *N* = 894 (age 40) and *N* = 752 (age 50) not limited at baseline

A summary of main findings from Tables 3 and 4 can be found in Table 5.

Based on the relatively small gender differences in the associations between social class and onset of mobility limitations, analyses were also performed without stratifying by gender, but adjusting analyses for gender. These analyses revealed even stronger social gradients in onset of mobility limitations (data not shown).

Discussion

The aim of this study was to investigate if social inequality in onset of mobility limitations is present in midlife, and to examine whether common determinants of disability account for social status differences in onset of mobility limitations in midlife.

In our study population of 40- and 50-year-old Danish men and women in employment, there were clear tendencies to social gradients in onset of mobility limitations in running 100 m and climbing two flights of stairs; in general, the lower the social class the higher the odds of experiencing onset of mobility limitations after six years. These results indicate that the development of mobility limitations begin earlier in the lower social strata and social status differences in mobility limitations might emerge already in the forties. Indeed, generally the tendencies to social gradients in onset of mobility limitations appeared stronger among the 40-year-olds.

This study extends the finding from previous studies on social inequality in mobility limitations prior to old age (Adamson et al. 2003; Clark et al. 1998; Grundy and Glaser 2000; House et al. 1990, 1994, 2005; Koster et al. 2006; Lantz et al. 2001; Melchior et al. 2006; Osler et al. 2009; Sainio et al. 2007), as, to our knowledge, no previous study has investigated social inequality in onset of mobility

limitations as early as in the mid-forties in a longitudinal setting. Social inequality in functional limitations at age 40 and younger has previously been reported, yet in cross-sectional studies (House et al. 1990; Melchior et al. 2006). To our knowledge, longitudinal studies of social inequality in functional limitations have been performed in age-groups no younger than 51–55 years at baseline. These studies found that low educational level (Clark et al. 1998; Grundy and Glaser 2000) and low net worth (Clark et al. 1998) increased the likelihood of reporting functional limitations at 2- (Clark et al. 1998) and 5-year follow-up (Grundy and Glaser 2000), respectively.

Common determinants of disability among older people (health behaviors, BMI and chronic conditions (Koster et al. 2006; Lantz et al. 2001; Sainio et al. 2007)) appeared to account for some of the social status differences in onset of mobility limitations in this study.

Disability and mobility limitations are likely to be predicted by some degree of pathology and impairments in the human organism (Verbrugge and Jette 1994), wherefore indicators of disease or perhaps especially risk factors for disease are highly relevant to be included as potential explanatory factors in studies on determinants for mobility limitations in midlife. Poor health behaviors and a high BMI are well-known risk factors for diseases of high prevalence in midlife (cardiovascular diseases, hypertension, diabetes, chronic obstructive pulmonary disease), which are likely to become chronic and entail onset of limitations in mobility in midlife. The potential explanatory factors chosen for this study were also selected based on the evidence from previous studies showing strong associations between these factors and performance-based as well as self-reported measures of mobility and functional disability (Kuh et al. 2005; LaCroix et al. 1993; Stuck et al. 1999), in addition to being socially unequally distributed (Koster et al. 2006).

Table 3 40-year-olds, longitudinal analyses

	N/cases with outcome	OR (95% CI) Model 1 ^a	OR (95% CI) Model 2 ^b	OR (95% CI) Model 3 ^c	OR (95% CI) Model 4 ^d
Ability to run 100 m					
Men (<i>N</i> = 677)					
Social class → somewhat/very limited run 100 m					
Social class I	95/7	1.00	1.00	1.00	1.00
Social class II	133/21	2.36 (0.96–5.80)	2.40 (0.97–5.94)	2.31 (0.92–5.76)	2.32 (0.93–5.81)
Social class III	180/30	2.51 (1.06–5.96)	2.26 (0.94–5.52)	2.06 (0.85–4.99)	2.08 (0.85–5.05)
Social class IV	158/26	2.48 (1.03–5.95)	2.30 (0.94–5.60)	2.07 (0.84–5.10)	2.11 (0.86–5.22)
Social class V	111/24	3.47 (1.42–8.47)	2.98 (1.20–7.41)	2.54 (1.01–6.40)	2.48 (0.98–6.30)
Trend test, <i>p</i> value		0.0148	0.0557	0.1469	0.1619
Women (<i>N</i> = 807)					
Social class → somewhat/very limited run 100 m					
Social class I	70/8	1.00	1.00	1.00	1.00
Social class II	160/32	1.94 (0.84–4.45)	1.88 (0.81–4.35)	1.86 (0.80–4.34)	1.81 (0.77–4.24)
Social class III	262/35	1.20 (0.53–2.71)	1.13 (0.49–2.57)	1.10 (0.48–2.54)	1.11 (0.48–2.56)
Social class IV	210/42	1.94 (0.86–4.36)	1.72 (0.76–3.90)	1.63 (0.71–3.72)	1.56 (0.68–3.86)
Social class V	105/29	2.96 (1.26–6.93)	2.42 (1.01–5.76)	2.36 (0.98–5.67)	2.29 (0.95–5.53)
Trend test, <i>p</i> value		0.0157	0.0877	0.1177	0.1462
Ability to climb two flights of stairs					
Men (<i>N</i> = 727)					
Social class → Somewhat/very limited climb stairs					
Social class I	100/4	1.00	1.00	1.00	1.00
Social class II	142/13	2.42 (0.77–7.65)	2.45 (0.77–7.82)	2.44 (0.76–7.80)	2.45 (0.76–7.86)
Social class III	194/19	2.61 (0.86–7.88)	2.47 (0.81–7.55)	2.31 (0.75–7.10)	2.30 (0.75–7.08)
Social class IV	170/22	3.57 (1.19–10.67)	3.39 (1.12–10.28)	3.24 (1.06–9.92)	3.31 (1.08–10.15)
Social class V	121/23	5.63 (1.88–16.90)	4.97 (1.63–15.18)	4.54 (1.47–14.00)	4.45 (1.44–13.75)
Trend test, <i>p</i> value		0.0004	0.0018	0.0040	0.0044
Women (<i>N</i> = 894)					
Social class → Somewhat/very limited climb stairs					
Social class I	74/3	1.00	1.00	1.00	1.00
Social class II	180/16	2.31 (0.65–8.17)	2.16 (0.61–7.70)	2.03 (0.56–7.33)	1.95 (0.54–7.05)
Social class III	284/26	2.39 (0.70–8.11)	2.33 (0.68–7.98)	2.33 (0.67–8.07)	2.31 (0.67–8.01)
Social class IV	238/33	3.81 (1.13–12.81)	3.33 (0.98–11.28)	3.05 (0.89–10.48)	2.84 (0.83–9.79)
Social class V	118/18	4.26 (1.21–15.01)	3.46 (0.97–12.37)	3.27 (0.90–11.85)	3.05 (0.84–11.08)
Trend test, <i>p</i> value		0.0032	0.0191	0.0288	0.0458

Social class (2000) and limitations in running/climbing two flights of stairs (2006). Respondents were unlimited in mobility at baseline

OR Odds ratio, CI confidence interval

^a Model 1: social class 2000 → mobility 2006

^b Model 2: social class 2000 + health behaviors → mobility 2006

^c Model 3: social class 2000 + health behaviors + BMI → mobility 2006

^d Model 4: social class 2000 + health behaviors + BMI + chronic diseases → mobility 2006

On the whole, health behaviors, BMI and chronic conditions were not consistently socially unequally distributed in this study, yet the tendencies were in the expected direction, indicating a higher level of risk factors for poor health in lower social classes. A peculiar finding was that no alcohol consumption at all or consuming more than 36 units of alcohol per week, as well as being physically

active more than 7 h per week were factors most frequently seen in the lowest social classes. The high frequency of having no weekly alcohol consumption at all in the lowest social classes has been found in previous studies on working populations (Marmot 1997). It has been suggested that individuals with an exceptionally high intake of alcohol may be underrepresented in studies on populations

Table 4 50-year-olds, longitudinal analyses

	N/cases with outcome	OR (95% CI) Model 1 ^a	OR (95% CI) Model 2 ^b	OR (95% CI) Model 3 ^c	OR (95% CI) Model 4 ^d
Ability to run 100 m					
Men (<i>N</i> = 727)					
Social class → somewhat/very limited run 100 m					
Social class I	126/16	1.00	1.00	1.00	1.00
Social class II	175/43	2.24 (1.20–4.19)	2.34 (1.23–4.44)	2.26 (1.18–4.32)	2.25 (1.17–4.31)
Social class III	185/41	1.96 (1.04–3.67)	2.01 (1.06–3.81)	1.86 (0.97–3.57)	1.86 (0.97–3.57)
Social class IV	135/41	3.00 (1.58–5.69)	3.09 (1.60–5.99)	3.03 (1.55–5.91)	3.00 (1.54–5.87)
Social class V	106/30	2.71 (1.38–5.32)	2.49 (1.25–4.98)	2.31 (1.14–4.66)	2.35 (1.16–4.74)
Trend test, <i>p</i> value		0.0027	0.0089	0.0163	0.0148
Women (<i>N</i> = 615)					
Social class → somewhat/very limited run 100 m					
Social class I	46/13	1.00	1.00	1.00	1.00
Social class II	126/34	0.94 (0.44–1.99)	0.93 (0.43–1.97)	0.94 (0.43–2.04)	0.96 (0.44–2.09)
Social class III	234/61	0.90 (0.44–1.81)	0.84 (0.41–1.72)	0.88 (0.43–1.83)	0.94 (0.45–1.95)
Social class IV	145/42	1.04 (0.50–2.16)	0.97 (0.46–2.04)	0.95 (0.44–2.04)	0.98 (0.45–2.11)
Social class V	64/20	1.15 (0.50–2.65)	1.00 (0.43–2.35)	0.88 (0.37–2.11)	0.94 (0.39–2.26)
Trend test, <i>p</i> value		0.5675	0.8502	0.8717	0.9591
Ability to climb two flights of stairs					
Men (<i>N</i> = 833)					
Social class → somewhat/very limited climb stairs					
Social class I	146/11	1.00	1.00	1.00	1.00
Social class II	196/26	1.88 (0.90–3.94)	1.98 (0.93–4.21)	1.89 (0.88–4.05)	1.84 (0.85–3.94)
Social class III	209/26	1.74 (0.83–3.65)	1.78 (0.84–3.78)	1.63 (0.76–3.49)	1.60 (0.74–3.42)
Social class IV	160/36	3.56 (1.74–7.30)	3.62 (1.72–7.61)	3.58 (1.69–7.55)	3.51 (1.66–7.44)
Social class V	122/20	2.41 (1.10–5.25)	2.25 (1.01–5.02)	2.02 (0.90–4.53)	2.04 (0.90–4.58)
Trend test, <i>p</i> value		0.0026	0.0080	0.0149	0.0130
Women (<i>N</i> = 752)					
Social class → somewhat/very limited climb stairs					
Social class I	53/3	1.00	1.00	1.00	1.00
Social class II	161/18	2.10 (0.59–7.43)	2.10 (0.59–7.52)	2.06 (0.57–7.43)	2.03 (0.56–7.32)
Social class III	273/39	2.78 (0.83–9.35)	2.57 (0.75–8.76)	2.53 (0.74–8.70)	2.71 (0.79–9.34)
Social class IV	174/31	3.61 (1.06–12.34)	3.27 (0.95–11.33)	3.18 (0.91–11.09)	3.26 (0.93–11.40)
Social class V	91/29	7.80 (2.24–27.09)	6.24 (1.76–22.16)	5.64 (1.58–20.19)	5.88 (1.64–21.10)
Trend test, <i>p</i> value		<0.0001	0.0002	0.0005	0.0003

Social class (2000) and limitations in running/climbing two flights of stairs (2006). Respondents were unlimited in mobility at baseline

OR Odds ratio, CI confidence interval

^a Model 1: social class 2000 → mobility 2006

^b Model 2: social class 2000 + health behaviors → mobility 2006

^c Model 3: social class 2000 + health behaviors+BMI → mobility 2006

^d Model 4: social class 2000 + health behaviors + BMI + chronic diseases → mobility 2006

in employment, and the exclusion of these individuals might contribute to the pattern observed, which deviates somewhat from the expectation of higher alcohol consumption in lower compared to higher social classes (Marmot 1997). Another explanation could be that individuals in lower social classes decline from alcohol

consumption due to financial difficulties (Marmot 1997). As regards the peculiar pattern of high physical activity in the lowest social classes, some of the more physically demanding work experienced by individuals in lower social classes might have been counted in as physical activity.

Table 5 Summary of findings from Tables 3 and 4

	40-year-olds		50-year-olds	
	OR (95% CI) Crude model ^a	OR (95% CI) Final model ^b	OR (95% CI) Crude model ^a	OR (95% CI) Final model ^b
Onset of limitations in running 100 m				
Men				
Social class I	1.00	1.00	1.00	1.00
Social class II	2.36 (0.96–5.80)	2.32 (0.93–5.81)	2.24 (1.20–4.19)	2.25 (1.17–4.31)
Social class III	2.51 (1.06–5.96)	2.08 (0.85–5.05)	1.96 (1.04–3.67)	1.86 (0.97–3.57)
Social class IV	2.48 (1.03–5.95)	2.11 (0.86–5.22)	3.00 (1.58–5.69)	3.00 (1.54–5.87)
Social class V	3.47 (1.42–8.47)	2.48 (0.98–6.30)	2.71 (1.38–5.32)	2.35 (1.16–4.74)
Trend test, <i>p</i> value	0.0148	0.1619	0.0027	0.0148
Women				
Social class I	1.00	1.00	1.00	1.00
Social class II	1.94 (0.84–4.45)	1.81 (0.77–4.24)	0.94 (0.44–1.99)	0.96 (0.44–2.09)
Social class III	1.20 (0.53–2.71)	1.11 (0.48–2.56)	0.90 (0.44–1.81)	0.94 (0.45–1.95)
Social class IV	1.94 (0.86–4.36)	1.56 (0.68–3.86)	1.04 (0.50–2.16)	0.98 (0.45–2.11)
Social class V	2.96 (1.26–6.93)	2.29 (0.95–5.53)	1.15 (0.50–2.65)	0.94 (0.39–2.26)
Trend test, <i>p</i> value	0.0157	0.1462	0.5675	0.9591
Onset of limitations in climbing two flights of stairs				
Men				
Social class I	1.00	1.00	1.00	1.00
Social class II	2.42 (0.77–7.65)	2.45 (0.76–7.86)	1.88 (0.90–3.94)	1.84 (0.85–3.94)
Social class III	2.61 (0.86–7.88)	2.30 (0.75–7.08)	1.74 (0.83–3.65)	1.60 (0.74–3.42)
Social class IV	3.57 (1.19–10.67)	3.31 (1.08–10.15)	3.56 (1.74–7.30)	3.51 (1.66–7.44)
Social class V	5.63 (1.88–16.90)	4.45 (1.44–13.75)	2.41 (1.10–5.25)	2.04 (0.90–4.58)
Trend test, <i>p</i> value	0.0004	0.0044	0.0026	0.0130
Women				
Social class I	1.00	1.00	1.00	1.00
Social class II	2.31 (0.65–8.17)	1.95 (0.54–7.05)	2.10 (0.59–7.43)	2.03 (0.56–7.32)
Social class III	2.39 (0.70–8.11)	2.31 (0.67–8.01)	2.78 (0.83–9.35)	2.71 (0.79–9.34)
Social class IV	3.81 (1.13–12.81)	2.84 (0.83–9.79)	3.61 (1.06–12.34)	3.26 (0.93–11.40)
Social class V	4.26 (1.21–15.01)	3.05 (0.84–11.08)	7.80 (2.24–27.09)	5.88 (1.64–21.10)
Trend test, <i>p</i> value	0.0032	0.0458	<0.0001	0.0003

OR (95% CI) for onset of mobility limitations in 2006 by social class for men and women with no limitations at baseline, stratified by age-group. Crude (unadjusted) and final (fully adjusted) models

^a Corresponding to Model 1 in Tables 3 and 4: social class 2000 → mobility 2006

^b Corresponding to Model 4 in Tables 3 and 4: social class 2000 + health behaviors + BMI + chronic diseases → mobility 2006

These common determinants of disability have also previously been identified as factors explaining some of the association between socio-economic position and functional limitations cross-sectionally as well as longitudinally, yet only among adults in their fifties or older (Clark et al. 1998; Sainio et al. 2007). This study adds to these previous findings by showing that health behaviors, BMI and chronic conditions altogether do explain some of the association between social class and onset of mobility limitations already in midlife. However, the tendency to a social gradient remained in fully adjusted analyses. Overall it appears that poor health behaviors and a high BMI

explain social class differences in onset of mobility limitations to a greater extent than number of chronic conditions. Previous studies have shown a tendency in lower social classes to an under-reporting of certain chronic conditions (Mackenbach et al. 1996). Individuals in upper social classes are more likely to have been diagnosed and treated for any given disease, and might thus tend to report a higher number of chronic conditions. Furthermore some of the diseases diagnosed and treated in upper social classes might be less severe and less disabling, compared to the diseases reported in lower social classes. This will thus tend to diminish any negative effect of low socioeconomic

position on risk of disease. Therefore, the measure of self-reported chronic conditions applied in this study might not appear to play a large role accounting for social class differences in onset of mobility limitations.

The potential explanatory factors for a social gradient in onset of mobility limitations may not be the same in different age-groups in adult life (Koster et al. 2006); that is, findings on explanatory factors for a social gradient in onset of mobility limitations identified among older adults may not necessarily be replicated in midlife. However, we did find that health behaviors, BMI and chronic conditions accounted for more of the social gradient among those aged 40 years at baseline compared to those aged 50 years. In addition, biomedical factors such as hypertension or high serum level of inflammatory markers have been shown to explain a substantial part of the social inequality in mobility limitations (Koster et al. 2005). Whether these factors might explain the social gradient in mobility limitations in midlife is an interesting issue for future studies.

It is plausible that additional factors may explain more of the social gradient, such as psychosocial factors (e.g. social relations, self-efficacy), work-related factors and stress (House et al. 1994; Koster et al. 2006; Martikainen et al. 1999; Sainio et al. 2007), as well as access to and use of medical care in due time (Krasnik et al. 1997). In a middle-aged population of individuals in the labor market working conditions may indeed be an important factor for the development of mobility limitations as well as of social class differences. Post-hoc analyses including measures of physical exposures in the working environment and psychosocial work environment into the model revealed that a high level of negative exposures in the physical working environment (e.g., noise, poor indoor climate, heavy lifting) did explain a part of the association between low social class and higher odds of onset of mobility limitations, however, it did not affect the overall social gradient. A poor psychosocial work environment did not affect the association between social class and onset of mobility limitations.

A peculiar finding in most of the logistic regression models was a tendency that social class II had higher odds of onset of limitations compared to social class III. This could be due to particular detrimental working conditions in social class II, but the inclusion of physical and psychosocial working conditions into the models did not affect this pattern. Additional post-hoc analyses revealed that social class II had higher exposure to working at high pace, having to work extra hours, not always being able to complete all tasks, low level of help and support from colleagues or the supervisor, compared to social class III. These stressors might impose a higher health- and disability-risk for those in social class II. However, these stressors were not associated with mobility limitations in

this study. We therefore have no explanation for these findings. The confidence intervals for social class II and III are widely overlapping, and we cannot conclude if social class II and III differs significantly, and the *p* values for the social gradients might better describe the overall tendencies.

Among older adults gender is another common determinant of disability, as older women are more likely to experience mobility limitations than men in the same age-group (Arber and Cooper 1999). We found only very small and insignificant gender differences in onset of mobility limitations in our population of adults in midlife, however, they were in the expected direction, and by and large the social gradients in onset of mobility limitations did not differ between men and women. Generally it is debated whether gender differences exist in the association between socioeconomic position and health (Lantz et al. 2001; Matthews et al. 1999; Zajacova and Hummer 2009), and this will probably depend on several characteristics in the populations studied, e.g., culture, working environment, proportion of women in the work force.

Measuring functional ability and mobility is not simple. Physical capacity, the physical environment and the social roles and factors surrounding the individual all have an effect on the functional level. It is thus a challenge to capture function without the influence of these surrounding factors (Haas 2008; Verbrugge and Jette 1994). It has however been established that measures of functional limitations such as mobility limitations, which comes prior to disability in the disablement process, are more likely to be free of the influence of environmental factors that affect disability (Guralnik and Ferrucci 2003; Verbrugge and Jette 1994). Functional limitations are mere physical tasks, capturing, e.g., the ability to walk, the ability to climb stairs, and gait speed, whereas measures of disability often applied in old age capture the interaction between the physical capability of the individual and surrounding environmental factors, e.g., instrumental activities of daily living (e.g. ability to household management), activities of daily living (e.g., personal hygiene) and attending hobbies (Guralnik and Ferrucci 2003). It may not be relevant to apply measures of disability in a population of adults in their forties and fifties, as these are expected to be fully independent in these basic activities. It may not be possible to show sufficient variation in function using these common measures of disability, neither in middle-aged persons nor in persons in early old age (Guralnik and Ferrucci 2003). Therefore, we based this study on measures of functional limitations, i.e., on two questions on mobility, reflecting basic and more demanding mobility.

In this study, data were available on two measures of mobility: the ability to run 100 m and to climb two flights of stairs. The ability to climb stairs has been used in many

previous studies as a measure of mobility/lower extremity function, and is included in the Rosow Breslau measure of function (Adamson et al. 2003; Clark et al. 1998; Koster et al. 2005; Rosow and Breslau 1966; Sainio et al. 2006, 2007). However, it is more demanding to be able to run 100 m than to perform many other measures of mobility. It has indeed been argued that this measure might rather be a measure of endurance or athletic capacity (Sainio et al. 2007). We chose to include the measure of ability to run 100 m, expecting that this measure might capture even earlier emerging mobility limitations than the measure of stair climbing-ability. It is obvious from our results that running 100 m is experienced as a more demanding task than climbing two flights of stairs, as, as expected, the prevalence at baseline and the incidence of new cases during the follow-up period were higher for running than for climbing stairs for both age-groups.

According to Haley et al. (2002) climbing one flight of stairs is a basic lower extremity function, yet climbing three flights of stairs, running to catch the bus or running one-half mile (about 800 m) are defined as advanced lower extremity functions. Such advanced lower extremity functions reflect physical activities, where the execution requires a high level of physical capacity and endurance (Haley et al. 2002). Therefore, climbing two flights of stairs and running 100 m might cover different degrees of lower extremity function or mobility (Haley et al. 2002). We therefore chose not to make a composite measure of mobility, but kept the two measures separate. Post-hoc analyses revealed that 95% of individuals with limitations in climbing stairs at baseline also had limitations in running, whereas only 48% of individuals with limitations in running also had limitations in climbing stairs. This indicates that limitations in the more demanding task of running may be experienced prior to limitations in climbing stairs. Thus, the two mobility measures might represent different aspects of mobility limitations, probably different points on a continuum ranging from limitations in physically demanding tasks (such as running), via mobility tasks encountered in everyday life (such as climbing stairs), to more severe disability in old age.

Our reference categories of individuals experiencing no limitations at all in the respective mobility measures and the category of cases experiencing to be somewhat or very limited may result in a quite rigid distinction, yet we wanted to detect whether any limitations were present, not paying regard to the severity of limitations. In a study by Koster et al. (2005) looking at social inequality in onset of mobility limitations in an initially nondisabled population of older adults, mobility limitations were required to be present at two consecutive assessments (every half year) in order to capture individuals with more chronic and severe limitations, and to reliably capture a clinically relevant

change in functional ability (Koster et al. 2005). This was not an option in our study with only two waves of data, yet we do see it as strength, that we did have prospective data enabling us to study onset of limitations among those with no limitations at baseline.

The analyses were performed on individuals reporting no baseline limitations in running and climbing stairs, respectively. This entails that participants may have baseline limitations in climbing stairs in analyses of the effect of social class on onset of limitations in running, and likewise in analyses of onset of limitations in climbing stairs. When we repeated the analyses in the 2,808 individuals who had limitations in neither running nor climbing stairs, it did not change the estimates and social gradients observed, but entailed a large reduction in the size of the study population. We therefore chose to present the analyses with different baseline populations for each mobility outcome.

In a middle-aged cohort, the chance of recovery from mobility limitations is high. This is likely to be caused by mobility limitations in this age-group being due to temporary health-related problems. Among those who had mobility limitations at baseline, between 25 and 40% of men as well as women recovered at follow-up. Recovery was seen more often among those aged 40 at baseline, and more often in the ability to climb stairs than to run. If social inequality exists in the likelihood of reporting temporary problems, this could affect the results of this study. The wording of the questions regarding mobility limitations does not ensure that temporary problems such as injuries and infections are not the causes of mobility limitations, which in those cases may be only transient. In post-hoc analyses measures of tiredness in the 4 weeks prior to answering the follow-up questionnaire, and pain in neck, back or other joints at the time of the follow-up questionnaire, were included in order to account for possible temporary conditions at the time of assessment of the mobility outcome measures. The inclusion of these variables only changed the estimates to a minor degree and did not change the overall direction and significance of the estimates. Unfortunately, there was no possibility to look more into this issue with the data present. However, since well over half of the study participant reporting baseline-limitations also reported limitations at 6-year follow-up, we do believe that the main part of onset of mobility limitations in our study population was not transient.

It is a weakness of our study that we have no objective measure of mobility, as self-reported measures of mobility reflect the individuals opinion of his/her mobility, and the individuals attitude toward the mobility task in question, besides reflecting the actual mobility of the individual (Salen et al. 1994). Furthermore, many individuals in this age group might not be aware of their ability to run 100 m

as this is not necessarily a task performed very often, if at all. Nevertheless, self-reported mobility limitations including the ability to climb stairs have been shown to be a valid measure in the identification of individuals in increased risk of further mobility limitations (Fried et al. 2000; Manty et al. 2007) and disability (Guralnik and Ferrucci 2003), yet this has to the authors' knowledge not been shown regarding the measure on ability to run 100 m. However, previous studies using similar measures including ability to run and climb stairs have argued that such measures are suitable due to their association with general lower extremity function, which is a predictor of functional disability (Malmberg et al. 2002; Sainio et al. 2006). Measures of self-rated mobility, including climbing stairs and running, have been shown to be well correlated with the individuals' rating of the mobility performance right after the execution of the performance (Pearson's $r = 0.69$) among healthy adults and patients with varying degrees of neck/shoulder/low-back pain, arthritis or multiple sclerosis (Salen et al. 1994), whereas Sainio et al. (2006) found clear disagreement between self-reported and test-based information on stair-climbing, yet not so pronounced among individuals in midlife.

A strength of this study is that the study population comprised a representative sample of the adult Danish population in employment. The study findings can thus be generalized, and guide potential interventions in this area, to the employed part of the adult Danish population, which does make up the majority of the population in this age group. However, those who are employed at age 50 might to an even larger degree than those employed at age 40 constitute a segment of the general population enjoying better health, compared to those outside the labor market, thus hampering generalizability to the total population. This might be particularly true among women, as supplementary analyses revealed that the share of unemployed individuals at age 40 compared to at age 50 increased more among women than among men, indicating that women to a higher degree than men might leave the labor market prior to normal retirement age. This could also be part of the explanation for us not finding the common gender patterns in mobility limitations, with women reporting more limitations compared to men (Arber and Cooper 1999). If women with mobility limitations in midlife are more likely to leave the labor market compared to men with the same level of limitations, this would reduce any gender differences in mobility limitations in the population in employment.

The findings are not representative of the total Danish population, as economically inactive individuals are not included in analyses (e.g., housewives, retired individuals, individuals who receive welfare payments). These individuals are highly likely to be economically inactive at

baseline due to disability and including them would not allow us to distinguish a potential causal relation between social class and mobility from reverse causation due to health selection into a given social class. The exclusion of these individuals, the longitudinal design and starting from an initially non-mobility-limited population makes the study of causal relations between social class and onset of mobility limitations more accessible.

The study population was restricted at several points, by excluding (1) individuals who reported limitations at baseline, (2) by non-response to the questionnaires, and by (3) excluding individuals with missing values on the analysed variables. At all three restriction points, we found that the excluded individuals generally had a lower social class and reported more mobility limitations. This might underestimate our findings. Individuals who were lost to follow-up generally reported more mobility limitations at baseline, suggesting that individuals lost to follow-up might have a higher risk of onset of mobility limitations. Analyses including those lost to follow-up as cases with mobility limitations generally showed clearer social gradients compared to the figures presented in Table 5, indicating that our findings might be slight underestimates of the true social gradient.

Apart from what has been mentioned already our study has some other limitations. Only baseline values of the potential explanatory factors were studied. Therefore, the association between social class at baseline and the potential explanatory factors might result from reverse causation, yet this might only be plausible regarding chronic diseases. It seems unlikely that health behaviors could determine the positioning in occupational social classes, whereas chronic conditions might hinder the execution of certain occupations. It has been argued that a change in explanatory factors in the follow-up period might better explain socioeconomic differences in onset of new limitations, compared to only having baseline measures (Haas 2008; Stringhini et al. 2010).

Another limitation is that we only applied one measure of socioeconomic position: social class based on occupation. Other measures of socioeconomic position may render other results. As summarized by House et al. (2005) education might play a larger role in onset of limitations than income, whereas income might be a more important predictor of the progression of the limitations. This might be explained by education being completed early in life and thereby being able to affect onset of new health problems through opportunities for health promotion, while income provides resources that might rather be used to ameliorate or adapt to a given health problem (House et al. 2005).

In conclusion our findings were that there is a tendency to a social gradient in onset of mobility limitations among Danish adults in midlife. Having a low social class at age

40 and 50, respectively, predicted onset of mobility limitations 6 years later, even after adjustment for common determinants of disability among older people: smoking, alcohol consumption, physical activity, BMI and chronic diseases.

Despite the low level of income inequality in Denmark, a social gradient in predictors of functional limitations is present even in midlife. As the percentage of older people in Denmark will increase in the years to come (Christensen et al. 2009), it is even more important that these people survive for more years without functional limitations. Paying attention to the functional capacity of adults already in midlife, particularly among those who are socioeconomically disadvantaged, may be essential in order to maximize the number of individuals living independently in old age.

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Conflict of interest None.

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