

European Journal of Public Health, Vol. 15, No. 6, 647–651

© The Author 2005. Published by Oxford University Press on behalf of the European Public Health Association. All rights reserved. doi:10.1093/eurpub/cki066 Advance Access published on August 10, 2005

# Effect of grandparent's and parent's socioeconomic position on mortality among Danish men born in 1953

Merete Osler, Anne-Marie Nybo Andersen, Rikke Lund, Bjørn Holstein\*

**Background:** The adverse effect on health of poor social circumstances might accumulate not only over the lifespan of the individual but also across generations. This study examines the effect of parent's and grandparent's socioeconomic position on all-cause mortality of their adult offspring. **Methods:** 2890 males born in the metropolitan area of Copenhagen, Denmark in 1953, whose mothers were interviewed for information on family social background in 1968, were followed from 1968 to 2002 for information on vital status by record linkage to the Civil Registration System. The data were analysed using Cox regression models. **Results:** All-cause mortality from age 15 to 49 years increased 25% [95% confidence interval (CI) 13–39%] for each number of parents or grandparents from working or unknown occupational social class. Offspring mortality decreased with the number of ancestors with a secondary school education hazard ratio [HR = 0.84 (95% CI 0.76–0.93)]. When the cumulative measures of ancestor's occupation and education were included in the same model, the estimates for the effect of occupational social class [HR = 1.19 (95% CI 1.06–1.34)] and education [HR = 0.91 (95% CI 0.80–1.03)] both attenuated. These relations only changed slightly when subject's own occupational class at age 22 years was taken into account. **Conclusion:** The adverse health effects of disadvantaged social circumstances accumulate not only over an individual's lifespan but also across generations. Cumulated occupational social class of ancestors seems to be an independent predictor of mortality in adult life after adjustment for subject's own social class at age 22 years.

**Keywords:** life course epidemiology, mortality, socioeconomic position

In the life course approach, time matters in regard to a better understanding of health and health inequalities. Thus, the particular point in time at which an exposure occurs (a critical or sensitive period), or the particular sequence in which exposures occur (exposure trajectory), or sheer intensity of exposure over time (accumulation), may be important in understanding later outcomes.<sup>1</sup> The positive or adverse effects of socioeconomic environment are hypothesised to be due to cumulative exposure over the life course, although some development stages may be more sensitive.<sup>2–4</sup> A few studies have examined the cumulative effect on mortality of socioeconomic circumstances acting across an individual lifespan.<sup>5–8</sup> A Scottish cohort study with data on social class in adulthood and retrospectively collected data on father's occupation, and own occupation at labour market entry and later in life found that those who remained in the less favoured circumstances throughout life experienced the highest mortality risks, suggesting that risk accumulates over the life course.<sup>5</sup> In a recent study we found that relations between parental social position and all-cause mortality in adult life followed a similar pattern for men born in 1953, as for their mothers and fathers.<sup>9</sup> Consequently, it is obvious to suggest that the adverse effect on health of poor social circumstances accumulate not only over the lifespan of the individual but also across generations. Further, intergenerational links, are suggested by research which has shown that anthropometric measures such as birth weight and height, which associate with poor social circumstances during gestation or childhood correlate closely across generations.<sup>2,10</sup> Further, smaller studies have related grandparent's and parent's

personalities, child-rearing practices and tobacco use to the toddler's anger.<sup>11</sup> However, to our knowledge the cumulative effect of adverse social circumstances on mortality has not been studied over more than two generations. In the present study, we analyse the contribution of parent's and grandparent's occupational social class and educational status to mortality risk from age 15 to 49 years in a cohort of Danish men born in 1953. Since parental and own social class are linked we also analysed the relations while taking subject's own occupational social class at age 22 years into account.

## Materials and Methods

According to official statistics, 12 270 boys were born within the metropolitan area of Copenhagen during 1953. These persons formed the population of the Danish longitudinal study (Project Metropolit) which has been described in detail elsewhere.<sup>12</sup> Briefly, 11 376 of this population, who were alive and living in Denmark in 1968 were registered when the Civil Registration System (CRS) was established. In 1965, data on perinatal conditions from birth registers and certificates were linked to each study participant. During the same year, cohort members were administered a questionnaire by their class teachers. The survey included tests of cognition and enquiries regarding social and leisure time activities. A total of 7877 (62.2%) of this study population participated in a school survey. In 1968 a random one in four sample of this birth cohort was drawn. In addition, the highest scoring 10% and the lowest scoring 10% on the cognition test were included in this sample. Trained research staff visited families of study participants for interviews with the mother/carer. A total of 82% of the invited mothers/carers were interviewed and provided information on their mother's and her husband's educational attainment, occupation, the level of social interaction within the family, and mother's educational aspirations for the child. These data were available for 2890 (25.3%) of the cohort members.

\* Department of Social Medicine, Institute of Public Health, University of Copenhagen, Denmark

**Correspondence:** Prof. Merete Osler, Department of Social Medicine, Institute of Public Health, University of Copenhagen, Blegdamsvej 3, 2200 N, Denmark, tel: +45 3532 7997, fax: +45 3535 1181, e-mail: m.osler@pubhealth.ku.dk

**Table 1** The distribution of social class and educational status (in %) for parents and grandparents of 2890 men born in Copenhagen in 1953

	Father	Mother	Paternal grandfather	Paternal grandmother	Maternal grandfather	Maternal grandmother
<b>Social class</b>						
High/middle class	53.7	28.6	51.0		53.9	
Housewife	–	50.3	–		–	
Working class	34.2	19.7	37.5		43.6	
Unknown	12.2	0.4	11.5		2.5	
<b>Education</b>						
Secondary	37.8	42.4	10.0	6.7	12.2	9.9
Basic	55.1	57.3	74.2	78.5	81.1	85.7
Unknown	8.2	0.2	16.0	15.8	6.2	4.3

**Table 2** Hazard ratios for all-cause mortality in 2890 men born in 1953 followed from 1968–2002 in relation to parent's and grandfather's social class

	Total/dead	Crude hazard ratio (95% CI)	Adjusted <sup>a</sup> hazard ratio (95% CI)
<b>Father's social class</b>			
High/middle class	1552/93	1	1
Working class	987/91	1.53 (1.12–2.01)	1.30 (0.94–1.77)
Unknown	351/40	1.94 (1.26–2.65)	1.60 (0.94–2.70)
<b>Paternal grandfather's social class</b>			
High/middle class	1474/93	1	1
Working class	1085/94	1.39 (1.10–1.96)	1.26 (0.92–1.69)
Unknown	333/37	1.81 (1.29–2.97)	1.27 (0.74–2.17)
<b>Mother's social class</b>			
High/middle class	828/54	1	1
Housewife	1455/102	1.08 (0.75–1.46)	1.13 (0.80–1.58)
Working class	569/67	1.75 (1.12–2.30)	1.57 (1.08–2.28)
Unknown	11/1	1.45 (0.25–10.6)	1.21 (0.16–8.78)
<b>Maternal grandfather's social class</b>			
High/middle class	1558/113	1	1
Working class	1261/102	1.10 (0.86–1.47)	0.94 (0.71–1.24)
Unknown	71/9	1.79 (0.83–3.46)	1.50 (0.76–3.01)

a: Model including the social class measures in the column

### Follow up

In the spring of 2002 study members and their parents were traced in the Danish CRS, which provided information on vital status from April 1968 to January 2002 and date of death if not alive.

### Measures of socioeconomic position

From the family interview in 1968 we used the information from the mother about her own, her father's, and husband's and his father's current or latest occupational social class. This information was coded by the interviewers into 23 strata: non-urban self-employed (four strata); urban self-employed (six strata);

white collar workers (five strata); blue collar workers (five strata); pensioners; students and unknown. For mothers there was an additional category for housewives. The preliminary data analyses showed that the mortality risk estimates for self-employed and white-collar workers were very similar and consequently they were combined, leaving three categories (high/middle, which includes self-employed and salaried employed; working class, which includes skilled and unskilled workers; unknown, which also includes the small groups of pensioners and students). The risk estimates for working and unknown classes were in the same direction and we repeated the analyses with the two groups combined and the number of working class/unknown ancestors was counted in a cumulative measure

ranging from 0 to 4. The mother was also asked in detail about her and her husband's as well as her and his parent's school education. For each family member this information was reported in nine categories (ranging from seven years of basic school education to high school exam), which were combined into two: (i) basic school education (7 years) and (ii) secondary [ $>7$  years (middle or high school examination)]. The highest educated group increased in size from grandparent's to parent's generation (table 1). Consequently, we subdivided parent's secondary educational attainment into two groups: middle (8–10 years) and high [ $>10$  years (high school)]. However, the risk estimates for these two groups were very close and on this basis the same categorisation was used for all ancestor's school education. We calculated a cumulative educational measure which counted the numbers of parents and grandparents with a secondary education (range 0–6). From a linkage with the CRS in 1975 we had information on subject's own occupation. These data were missing for 36% of the cohort members because many were still undergraduates at age 22 years, but were included in the analyses as unknown.

### Statistical methods

Associations between socioeconomic position variables (occupation and education) and mortality for cohort members were analysed using Cox's proportional hazards regression models. Age was used as the underlying time scale and entry time was age in 1968. Age in 1975 was used in the analyses when subject's own social class was included. Follow up ended at the age of death, migration or January 2002 whichever came first. We tested the proportional hazard assumption in two different ways: the standard graphical check based on the log of the cumulative hazard and through a formal test of proportionality based on Schoenfeld residuals.<sup>13</sup> Based on basic rules for multiplicative models we calculated the combined risks (HR) for all 16 different combinations of parents and grandparents occupational social class. Thus, when a given family member belonged to high/middle class the risk was set to 1 (reference), while if the family member was from the working class the risk estimate for this category was used. Statistical analyses were performed using STATA version 7.

## Results

Table 1 shows that 40% of the parents and 10% of the grandparents had a secondary education. The distribution of the social class measure was relatively stable across generations with more than half of the fathers and grandfathers in high/middle class. All 2890 cohort members were followed up regarding vital status and, of these, 224 cohort members had died between 1968 and 2002, 14 of whom died before 1975. Table 2 shows unadjusted and adjusted HRs according to father's, mother's and grandfather's occupational social class. Men born in 1953 with fathers, mothers or paternal grandfathers from working/unknown class in 1968 had higher mortality in adult life compared to those with fathers, mothers or paternal grandparents from high/middle social class, respectively. Maternal grandfather's social class was not significantly associated with offspring mortality. All estimates attenuated when mutually adjusted. Table 3 gives the risk estimates for each parent's and grandparent's educational status. Men with parents or paternal grandparents with a secondary school education had lower mortality compared to those men with parents or paternal grandparents with a basic education. However, none of the estimates for grandparents reached significance when all the educational measures were included in the model.

When the risk was calculated for each social class trajectory on the basis of the adjusted occupational social class measure for each family member (table 2) we found that men whose father,

**Table 3** Hazard ratios for all-cause mortality in 2890 men born in 1953 followed from 1968 to 2002 in relation to parent's and grandparent's school education

	Total/dead	Crude hazard ratio (95% CI)	Adjusted <sup>a</sup> hazard ratio (95% CI)
<b>Father's education</b>			
Secondary	1093/62	0.65 (0.49–0.89)	0.79 (0.55–1.12)
Basic	1591/135	1	1
Unknown	236/27	1.37 (0.92–2.06)	1.10 (0.60–2.02)
<b>Paternal grandfather's education</b>			
Secondary	288/9	0.40 (0.21–0.79)	0.51 (0.22–1.14)
Basic	2143/167	1	1
Unknown	464/48	1.35 (0.98–1.86)	0.62 (0.26–1.46)
<b>Paternal grandmother's education</b>			
Secondary	195/6	0.40 (0.18–0.91)	0.74 (0.29–1.89)
Basic	2268/168	1	1
Unknown	457/50	1.50 (1.09–2.00)	2.00 (0.88–4.52)
<b>Mother's education</b>			
Secondary	1226/79	0.74 (0.56–0.97)	0.86 (0.62–1.20)
Basic	1657/145	1	1
Unknown	7/0	–	–
<b>Maternal grandfather's education</b>			
Secondary	354/18	0.62 (0.38–1.02)	0.73 (0.40–1.33)
Basic	2345/185	1	1
Unknown	181/21	1.54 (0.98–2.42)	1.30 (0.66–2.54)
<b>Maternal grandmother's education</b>			
Secondary	288/20	0.92 (0.58–1.47)	1.58 (0.89–2.79)
Basic	2477/190	1	1
Unknown	125/14	1.52 (0.88–2.17)	1.19 (0.53–2.68)

a: Model including the measures of education in the column

mother and paternal grandfather or whose father, mother and both grandfathers were from working or unknown occupational class had the highest mortality risks [ $HR = (1.30 \times 1.26 \times 1.57 \times 1.00) = 2.57$  and  $HR = (1.30 \times 1.26 \times 1.57 \times 0.94) = 2.41$ , respectively] compared to those whose parents and grandfathers all were high/middle class ( $1 \times 1 \times 1 \times 1 = 1$ ). The proportion of parents experiencing social mobility was relatively small. Thus, for 237 (8.2%) and 318 (11.0%) of study members, one or both parents had experienced downward or upward mobility, respectively. These groups showed risk estimates that were higher than men with parents and grandparents with stable high social positions and lower than those in stable low classes. On this basis it seemed reasonable to calculate a cumulative social class measure which showed a linear increase in mortality risk with number of working/unknown class parents and grandfathers [ $HR = 1.25$  (95% CI 1.13–1.39)] (table 4). The number of ancestors with a secondary school education was inversely associated with offspring mortality [ $HR = 0.84$  (95% CI 0.76–0.93)]. When both cumulative measures were included in the same model, in order to explore their independent effect on mortality, the effect of education attenuated markedly and became insignificant [ $HR = 0.91$  (95% CI 0.80–1.03)], while the estimate for the cumulative occupational social class retained significance

**Table 4** Hazard ratios for all-cause mortality in 2890 men born in 1953 followed from 1968 to 2002 in relation to cumulative measures counting numbers of parents and grandfathers with working/unknown occupational social class (cumulative occupation) and number of parents and grandparents with basic or unknown educational status (cumulative education)

	Total/dead	Crude hazard ratio (95% CI)	Adjusted <sup>a</sup> hazard ratio (95% CI)
<i>Cumulative occupational social class</i>			
0 parents/grandfathers from working/unknown class	716/29	1	1
1 parent/grandfather from working/unknown class	642/50	1.89 (1.19–2.99)	1.72 (1.07–2.76)
2 parents/grandfathers from working/unknown class	761/68	2.22 (1.44–3.43)	1.98 (1.24–3.16)
3 parents/grandfathers from working/unknown class	555/53	2.36 (1.50–3.72)	2.07 (1.25–3.41)
All parents/grandfathers from working/unknown class	216/24	2.79 (1.62–4.80)	2.38 (1.32–4.30)
<i>P</i> -value: test for trend		<0.001	0.02
Per parents/grandfathers from working/unknown class		1.25 (1.13–1.39)	1.20 (1.06–1.34)
<i>Cumulative education</i>			
0 parents/grandparents with a secondary school education	1321/123	1	1
1 parent/grandparents with a secondary school education	616/44	0.77 (0.54–1.08)	0.83 (0.59–1.19)
2 parent/grandparents with a secondary school education	504/35	0.75 (0.51–1.09)	0.92 (0.62–1.37)
3 parent/grandparents with a secondary school education	176/11	0.67 (0.36–1.25)	0.92 (0.48–1.75)
4 parent/grandparents with a secondary school education	135/9	0.72 (0.36–1.42)	1.09 (0.53–2.25)
5–6 parent/grandparents with a secondary school education	138/2	0.15 (0.03–0.62)	0.26 (0.06–1.11)
<i>P</i> -value: test for trend		0.09	0.62
Per parents/grandfathers from secondary school education		0.84 (0.76–0.93)	0.91 (0.80–1.03)

a: The measures are mutually adjusted (the two categorical versions in same model and the two continuous versions in same model)

[HR = 1.19 (95% CI 1.06–1.34)]. Subject's own occupational social class at age 22 years showed the expected relation with mortality among the 2870 cohort members who were alive and living in Denmark in 1975 (table 5). When this variable was added to a model together with the two cumulative measures, the estimates for subject's own and the cumulative occupational class attenuated slightly. We also included cohort member's occupational social class to the cumulative measure (now ranging from 0–5) and this measure was also positively related with mortality [HR = 1.19 (95% CI 1.06–1.28)].

All the analyses were repeated in two sub-groups of the one in four sample, which did not include the 10% highest and 10% lowest scoring on the cognitive test, and the 2234 participants with complete information on all parent's and grandparent's education and occupation. A very similar pattern of associations was seen in both sub-groups (data not shown).

## Discussion

In this cohort of Danish men born in 1953 we found that all-cause mortality in young adulthood increased with number of working class parents and grandparents. This relation persisted after adjustment for subject's own social class at age 22 years. Our finding supports the hypothesis that the adverse health effect of disadvantaged social circumstances accumulate not only over the individual's lifespan but also across generations.

We had nearly complete follow-up for study participants and the study allows us to examine the same indicators of socio-economic position measured in two generations. There was an over-representation of subjects with low or high IQ in our study. However, analyses restricted to the random sample of the total cohort showed the same direction of associations as in the full sample. The data on cohort members' parents and grandparents occupation and education was based on mothers' report in 1968.

**Table 5** Hazard ratios for all-cause mortality in 2870 men born in 1953 followed from 1975–2002 in relation to own social class in 1975 and to cumulative measures counting numbers of parents and grandfathers with working/unknown occupational social class (cumulative occupation) and number of parents and grandparents with basic or unknown educational status (cumulative education)

	Crude hazard ratio (95% CI)	Adjusted <sup>a</sup> hazard ratio (95% CI)
<i>Cumulative occupational social class</i>		
Per parents/grandfathers from working/unknown class	1.27 (1.15–1.42)	1.21 (1.07–1.37)
<i>Cumulative education</i>		
Per parents/grandparents from secondary school education	0.84 (0.76–0.94)	0.96 (0.84–1.09)
<i>Own social class in 1975</i>		
High/middle class	1	1
Working class	2.00 (1.35–2.97)	1.67 (1.11–2.49)
Unknown	2.06 (1.39–3.04)	2.00 (1.18–2.98)

a: Model including the three social variables in the column

This information seems to be less complete for paternal grandparents since the numbers of unknown were higher. On the other hand, the risk estimates were comparable for mothers and fathers. Further, analyses on those with complete



information on all variables gave estimates in the same direction as the analyses presented here based on the whole sample, which included 656 subjects with one or more missing. The educational system in Denmark has changed over time and as a result the highest-educated group has increased in size from grandparents to parents. The fathers and mothers who belong to the highest-educated group were probably at a lesser relative advantage than were their well-educated parents. This might reduce the validity of the cumulative educational measure. We found that the cumulative estimate for education lost significance when cumulated occupational social class was included in the multivariate model. A recent study from a cohort born in 1946, in the UK, also found that HRs for mortality between the ages of 26 and 54 years for maternal and paternal education were smaller than the HRs associated with father's social class.<sup>8</sup> In sub-analyses we included information on study participant's own occupational social class at age 22 years, which, however, was missing for more than 30%. Thus, although this variable showed the expected relation with mortality, we cannot exclude that it did not sufficiently account for adult socioeconomic position. On the other hand, the association between parental social position and adult mortality has been shown in a number of studies, even after taking account of the offspring's own socioeconomic position in adult life.<sup>4,8</sup>

The present analyses focus on the potential cumulative effect on offspring mortality of the socioeconomic experience of the previous two generations. However, previous studies have suggested that intergenerational changes in social position upward or downward might also have an influence on health.<sup>6,8</sup> In the UK 1946 cohort, study members who experienced upward or downward social mobility had mortality rates between those with stable high or low social positions from childhood to early adulthood. In a case-control study from Stockholm<sup>14</sup> there was a graded response on myocardial infarction to accumulation of times as manual worker at three stages of the individual's life course. There was also some evidence for effects of sensitive periods and social mobility, but the authors address the problem of confounding between accumulation, sensitive periods and social mobility. Our study was too small to form distinct empirical categories for each hypothesis and it illustrates the empirical difficulties in separating sensitive periods, social mobility and accumulation. On the other hand, by looking at the social position of previous generations we find that the influence of sensitive periods might not be a problem.

How do the cumulative socioeconomic experiences of the previous generations affect the mortality of the adult offspring? The social position of the parents affects their resources for care of their offspring in very early life, which may influence growth and development and later health. It has also been suggested that children of families in favourable socioeconomic circumstances have what is, in effect, a supportive climate, which is enhanced if one or both parents have higher educational attainment or non-manual jobs, and still further by strong parental concern for their child's education and career.<sup>3</sup>

In conclusion, the adverse health effects of disadvantaged social circumstances accumulate not only over the individual's lifespan but also across generations.

## Acknowledgements

We thank all those who initiated and/or continued the study from 1965 to 1983: K. Svalastoga, E. Høgh, P. Wolf, T. Rishøj, G. Strande-Sørensen, E. Manniche, B. Holten, I.A. Weibull and

A. Ortmann for their thorough work on the project. This study was funded by the Danish Heart Association, the Lundbeck Foundation and the Danish Health Incurrence Funds.

## Key points

- All-cause mortality in young adult men increases with number of working class parents and grandparents.
- The relation between the cumulative measure of ancestor's occupation and offspring mortality only changes slightly when subject's own occupational class at age 22 years is adjusted for.
- For 8.2 and 11.0% of men born in 1953 one or both parents had experienced downward or upward social mobility, respectively. These groups showed risk estimates that were higher than men with parents and grandparents in stable high social positions and lower than those in stable low social positions.

## References

- 1 Ben Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol* 2002;31:285–93.
- 2 Kuh D, Power C, Blane D, Bartley M. Social pathways between childhood and adult health. In: Kuh D, Ben Shlomo Y, editors. A lifecourse approach to chronic disease epidemiology. Oxford: Oxford Medical Publications, 1997.
- 3 Wadsworth MEJ. Health inequalities in the life course perspective. *Soc Sci Med* 1997;44:859–69.
- 4 Galobardes B, Lynch JW, Davey Smith G. Childhood socioeconomic circumstances and cause-specific mortality in adulthood: systematic review and interpretation. *Epidemiol Rev* 2004;26:7–21.
- 5 Smith GD, Hart C, Blane D, Gills C, Hawthorne V. Lifetime socioeconomic position and mortality: prospective observational study. *Br Med J* 1997;314:547–52.
- 6 Pensola TH, Martikainen P. Cumulative social class and mortality from various causes of adult men. *J Epidemiol Comm Health* 2003;57:745–51.
- 7 Lynch JW, Kaplan GA, Cohen RD, et al. Childhood and adult socioeconomic status predictors of mortality in Finland. *Lancet* 1994;343:524–7.
- 8 Kuh D, Hardy R, Langenberg C, et al. Mortality in adults aged 26–54 years related to socioeconomic conditions in childhood and adulthood: postwar birth cohort study. *Br Med J* 2002;325:1076–80.
- 9 Osler M, Andersen AN, Batty GB, Holstein B. The relation between early life socio-economic position and all-cause mortality in two generations. A longitudinal study of Danish men born in 1953 and their parents. *J Epidemiol Comm Health* 2005;59:38–41.
- 10 Klebanoff MA, Schulsinger C, Mednick BR, Secher NJ. Preterm and small-for-gestational age birth across generations. *Am J Gynecol* 1997;176:521–6.
- 11 Brook J, Whiteman M, Brook DW. Transmission of risk factors across three generations. *Psychol Rep* 1999;85:227–41.
- 12 Osler M, Andersen AN, Lund R, et al. Revitalising the Metropolit 1953 Danish male birth cohort: Background, aims and design. *Paediatrics Perinatal Epidemiol* 2004;18:385–94.
- 13 Grambsch PM, Therneau TM. Proportional hazard tests and diagnostics based on weighted residuals. *Biometrika* 1994;81:515–26.
- 14 Hallqvist J, Lynch J, Bartley M, Lang T, Blane D. Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socioeconomic positions and myocardial infarction in the Stockholm Heart Epidemiology program. *Soc Sci Med* 2004;58:1555–62.

Received 1 June 2004, accepted 18 October 2004