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Do childhood and adult socioeconomic circumstances influence health and physical function in middle-age?★

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Abstract

This study examines the joint and separate contribution of social class in early and adult life to differences in health and physical function in middle-aged men. We use data from the Metropolit project which includes men born in 1953 in Copenhagen and a study of middle-aged Danish twins (MADT). In total 6292 Metropolit participants in a follow-up survey on health in 2004 were included in the study together with 2198 male twins of which 1294 were part of a male twin pair ($N = 647$ pairs). Logistic regression was used to investigate the association between social class in early and adult life, respectively and health in midlife, measured as limitations in running 100 m, poor dental status, poor self-rated health, and fatigue. In both datasets, men with low childhood or adult social class had a higher risk of being unable to run 100 m, having poor dental status, having poor self-rated health and fatigue than men from the highest social classes. When childhood and adult social class were mutually adjusted, the estimates for both measures were attenuated. Adjustment for living without a partner, body mass index (BMI) and smoking in midlife, which were also related to the four outcomes, had marginal effects on the estimates for childhood social class, but attenuated the effect of adult social class somewhat. Among male twin pairs discordant on adult social class, the twin in the lowest class seemed to be unable to run 100 m, rate own health poorer and being fatigued more often than the high class co-twin, while there seemed to be no twin pair difference in dental status. This suggests that the associations of adult social class with functional limitations, poor self-rated health and fatigue may partly be due to causal effects related to adult social class exposures, while social class differences in dental status might be consistent with an effect of factors mainly operating early in life.

Keywords

Social class; Twins; Physical limitations; Dental status; Self-rated health (SRH); Denmark; Children, Socioeconomic status (SES)

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One of the most consistent epidemiological findings is the inverse relation between socioeconomic position (SEP) and health, a relationship which appears consistent across various health measures, e.g. mortality, self-rated health and chronic conditions (Black, Morris, Smith, Townsend, & Whitehead, 1988; Marmot & Davey Smith, 1997). Most attention has been paid to the importance of adult SEP on health. However, several studies have emphasized the importance of childhood social circumstances for adult mortality (Ben-Shlomo & Kuh, 2002; Galobarades, Smith, & Lynch, 2006; Davey Smith, Hart, Blane, & Hole, 1998; Davey Smith, Blane, & Bartley, 1994) and most recently also for general health and measures of midlife physical function, which have been suggested to reflect ageing processes and chronic conditions accumulated over the life course (Adams, White, Pearce, & Parker, 2004; Ben-Shlomo & Kuh, 2002; Guralnik, Butterworth, Wadsworth, & Kuh, 2006; Kuh et al., 2006).

The theories linking early and later life socioeconomic conditions with adult health have broadly concentrated on social causation and selection (Fig. 1). "Causation" here refers to the hypotheses that regard the observed health divides as results of different living conditions and behavior in social layers that lead to different health outcomes, while selection hypotheses suggest that health state in some way determines SEP rather than the other way around (Black, Morris, Smith, Townsend, & Whitehead, 1988; Blane, Davey Smith, & Bartley, 1993; Davey Smith, Blane, & Bartley, 1994; Lichtenstein, Harris, Pedersen, & McLearn, 1993; Marmot & Davey Smith, 1997; West, 1991). Selection can occur early in life if health status in childhood determines both health status and SEP in adulthood, and indirectly if common background factors such as social deprivation, height and education determine both social mobility and later health (Blane, Davey Smith & Bartley, 1993). Causation and selection mechanisms are interrelated and can operate both in early and late life. Thus, it is difficult to disentangle the individual contribution of childhood and adult socioeconomic conditions on health, and the extent that SEP in adulthood has an additional impact on adult health beyond the influence of one's childhood environment and genetic makeup remains an open question.

One way to examine the influence of childhood and adult SEP to differences in specific health outcomes in adulthood, is to use multivariable models, which include and mutually adjust both social variables. However, as Fig. 1 shows, some early life exposures, which are not captured by measures of childhood SEP contribute to the relation between adult social class and health. This makes it difficult to isolate the independent effect of adult SEP on health. Studies of twins provide an opportunity to isolate the effects of social standing later in life from the contribution of genetic, prenatal and rearing environmental influences (including social). Twins share not only either all (monozygotic) or on average half (dizygotic) of their genes but also nearly always their childhood environment. In twins discordant for adult SEP (different social mobility) it is, thus, possible to explore whether the association of SEP with health outcomes is consistent with causal factors in adulthood or early life factors. If an association of adult SEP and health outcomes reflects early life factors (whether social or constitutional), then we do not expect health outcome differences in twin pairs discordant on adult SEP because these twins are matched on early rearing environmental factors and genetic factors. Alternatively, a causal effect of adult SEP would be supported by the finding that twins discordant on adult SEP are also discordant on health.

In this study we used data from a population-based cohort and a twin sample of middle-aged men to investigate the joint and separate contribution of childhood and adult SEP (measured as social class) to differences in health in midlife. The associations were investigated by examining four different health outcomes: two outcomes which reflect physical limitations (limitations in running 100 m and dental status), a measure of general health status (self-rated health) and a measure of early frailty (fatigue). These outcomes are likely to represent health indicators for which susceptibility is different, depending on constitution (genetic makeup) and exposures over the life course. Physical limitations reflect the consequences of disease and

impairments on daily activities (Guralnik & Ferrucci, 2003; Verbrugge & Jette, 1994) and predict adverse health effects (Avlund, 2004). Dental status is affected by oral as well as general diseases over the life course (Österberg, Mellström, & Sundh, 1990) and is strongly related to mortality (Abnet et al., 2005; Holm-Pedersen, Schultz-Larsen, Christiansen, & Avlund, 2008; Thompson et al., 2004). Self-rated health is a general health measure, which encompasses all kinds of health problems and is strongly related to mortality (Idler & Benyamini, 1997). It also reflects current psychological distress (Sing-Manoux et al., 2006). Fatigue in daily activities is strongly related to functional decline and mortality (Avlund, 2004; Watt et al., 2000; Vestergaard et al., 2009) and may be regarded as an early indicator of frailty (Avlund, Rantanen, & Schroll, 2007).

For each outcome we addressed the following questions:

1. Are childhood and adult social class associated, both jointly and separately, with health outcomes in Danish middle-aged men?
2. Does the health of the twin of the highest adult social class differ from that of the lower class twin, in pairs of twins, who are matched on genes and rearing environment (childhood social class) but discordant on adult social class?

Material and methods

Study populations

The Metropolit cohort—The Metropolit cohort is comprised of the 11,532 men born in 1953 in the Copenhagen Metropolitan area who were living in Denmark in 1968 (Osler, Lund, Kriegbaum, Christensen, & Nybo Andersen, 2006). Data from birth certificates, including information on father's occupational status at time of delivery were manually collected on all members of the original study population in 1965. As part of the conscription procedure, all Danish men undergo physical and mental examinations when they are about 18 years old. In 2004, we collected data on height, weight, cognitive function and educational status from the conscript registers for 11,108 of the 11,494 cohort members who were alive and living in Denmark in 1971. In 2004 cohort members were followed up in a mailed questionnaire survey. A total of 9507 men with available addresses in Denmark were sent a questionnaire in September 2004 and of them 6292 (66.2%) responded.

Middle-aged Danish twins (the MADT study)—The MADT sample was ascertained through the Danish Twin Registry and the Danish Central Person Registry. This sampling framework targeted 240 twins from 120 intact twin pairs for each birth year from 1931 through 1952. They were randomly selected from all available twin pairs from each of these birth years (Gaist et al., 1999). Of the 5280 individual twins in the sampling framework, 90 died prior to the time the survey was undertaken and a total of 4314 (83%) of the 5190 surviving twins participated in a personal interview and a health examination with tests of cognitive and physical functioning in late 1998 or early 1999. Of these 4314 individuals there were 2198 males and 2116 females. They represented 1266 same-sex twin pairs, 618 opposite-sex DZ pairs and 546 whose twin was non-respondent. In the present analyses we used information on the 2198 male twins from 647 ($n = 1294$) intact twin pairs (51.8% monozygotic (MZ) and 48.2% dizygotic (DZ)), the 618 males from opposite-sex DZ pairs and 286 males with a non-respondent co-twin.

Measures

Health outcomes—In the Metropolit cohort *physical limitations* were measured by the item "Does your health limit you in running 100 m", which was dichotomized as yes limits a lot or little vs. not at all. In the MADT subjects had been asked how far they were able to run without

resting. This question was dichotomized as <100 m vs. 100 m or more. In both surveys *self-reported dental status* was based on response to the item “How many of your own teeth do you have”, which was dichotomized as less than 10 teeth vs. 10 or more teeth. *Self-rated health* was based on responses to a single item (“How do you consider your health in general?”), which was dichotomized as excellent/good/fair vs. poor/very poor. In the Metropolit *fatigue* was assessed by the question. “How much of the time during the past 4 weeks did you feel worn out.” In the present study, responses to this question were divided into two groups: yes (all, most, a good bit or some of the time) vs. no (a little or none of the time). Members of the MADT had been asked whether they had less energy than they used to have. This question was categorized as yes (most or some times) vs. no.

Socioeconomic position—In both studies we measured childhood and adult social class using a validated classification tool developed by the Danish Institute for Social Research on the basis of self-reported information on type of employment, vocational education and number of subordinates (Enevoldsen, Michelsen, Friis-Hasche, & Kamper-Jørgensen, 1980). The participants were classified into five social classes with I as the highest. Adult social class was based on the social class of the participants themselves, while childhood social class was determined on basis of the breadwinner of the participants’ rearing families. Social class I includes university graduates, those who are self-employed with more than 20 employees and salaried employees with more than 50 subordinates. Social class II consists of self-employed with six to 20 subordinates, salaried employees with 11–50 subordinates, and those having a medium long theoretic education such as school teachers and nurses. Social class III consists of self-employed with a maximum of five employees, and salaried employees with one to 10 subordinates or with specialist work. Social class IV includes salaried employees, and lower level and skilled manual workers. Social class V consists of unskilled manual workers. The initial data analyses showed that the distribution of most of the health outcomes differed only slightly among the two highest classes (I + II). These classes were consequently merged to comprise a single high social class (H) group. Similarly, because health outcome differences between members of the two lower social classes (IV + V) were minimal, these two groups were combined to form a low social class (L) group. We also classified twin pairs with respect to their adult social class as concordant high (HH, $n = 117$ pairs), concordant middle (MM, $n = 65$ pairs) concordant low (LL, $n = 159$ pairs), discordant HL ($n = 76$ pairs) discordant HM ($n = 110$ pairs) and discordant ML ($n = 112$ pairs) based on whether each twin was in the top three vs. bottom or middle of the three social class groups. In eight pairs social class were unknown for one of the twins.

Assessment of covariables—The following potential confounding or mediating variables were included in the multivariable analyses: Current *body mass index* ($BMI = (weight/height^2)$) calculated on basis on self-reported height and weight; *current smoking* (dichotomized as yes vs. no) and *cohabitation status* (dichotomized as 1. married or living with a partner vs. 2. divorced, separated, widowed, never married and living without a partner).

Statistical analyses

Analyses were undertaken at both the individual level (first research question, reported in Tables 2 and 3) and in the twin sample also within twin’s pairs (second research question, reported in Fig. 2). In the individual analyses we used logistic regression to investigate the association of social class in adult and early life with each of the four health outcomes (limitations in running 100 m, poor dental status, poor self-rated health, and fatigue). For each outcome, we applied a multivariable model to examine the joint and separate associations with childhood and adult social class. An attenuation of any association with childhood social class would lend support for a mediating effect of adult social class. In a second model we also accounted for the influence of other potential mediating or confounding variables (living

without a partner, BMI and smoking). In the co-twin analyses, we estimated whether the prevalence of each outcome differed in twin pairs concordant or discordant on adult social class. We used conditional logistic regression to test whether any differences in twin pairs discordant on adult social class were significant, and we compared the odds of outcome in the high class twin with middle or low class co-twin. There is dependence within twin pairs due to the correlation of many traits. To account for this dependency within twin pairs, we used a robust estimator of variance, which relaxes the independence assumption and only requires that the observations are independent across pairs. All analyses were performed in STATA version 8.

Results

Table 1 shows the prevalence of each health outcome and the distribution of social class and the other covariables in the two studies. In the Metropolit study 28.2% were limited in running 100 m, 2.9% had poor dental status, while 10.5% rated their health as poor and 13.8% often experienced fatigue. Among men from MADT with similar age (49–53 years) the equivalent prevalences were 13.9%, 3.4%, 4.0% and 18.1%, respectively (All tests of difference between the two studies had p -values <0.01).

Table 2 shows the unadjusted associations of childhood and adult social class, respectively and covariables with each outcome in the two studies. Both in the population-based Metropolit and the twin sample, men with low childhood or adult social class had elevated odds of being limited in running 100 m, having poor dental status, poor self-rated health and experiencing fatigue compared to men from the highest social class. Adult cohabitation status, BMI and smoking were also associated with the four health outcomes (Table 2). The analyses also supported a linear association across the social class categories, which allowed us to enter the two social variables as continuous measures in the model (Table 3). When childhood and adult social class were mutually adjusted, both variables seemed to have independent influence on the outcomes in the Metropolit study. In the MADT sample the association with childhood social class escaped statistical significance for dental status, poor self-rated health and fatigue, when adjusted for adult social class (Table 3). Adjustment for the other covariables hardly had any effect on the estimates for childhood social class, but attenuated the estimate of adult social class somewhat.

Fig. 2 shows the prevalence of each outcome in twin pair classified with respect to their adult social class (described in section Statistical analyses). Based on the prevalence for the discordant pairs we calculated the odds of outcome across the three social classes. This showed, that within male twin pairs who had been reared together but were discordant on adult SES, each step decrease in social class was associated with a higher odds of being limited in running (OR = 1.13 (1.01–1.26)), while estimates for poor dental status (OR = 1.01 (0.87–1.01)), poor self-rated (OR = 1.23 (0.95–1.58)), and fatigue (OR = 1.06 (0.96–1.17)) did not reach significance. However, in models where the lowest class twin was compared with the highest class co-twin the twins in the lowest social class seemed to have poorer self-rated health (OR = 6.42 (0.84–299.5); p = 0.05) and a greater likelihood of fatigue (OR = 2.25 (0.93–5.63); p = 0.04) than the high class co-twin. The estimates for the differences within the twins in pairs discordant on adult social class pointed in a similar direction for limitations in running (OR = 1.80 (0.79–4.16); p = 0.12), and poor dental status (OR = 1.49 (0.48–4.90); p = 0.44). However, the number of twins in each combination of adult social class was small, and these estimates were imprecisely estimated. In order to increase the precision of the estimates we also collapsed the three discordant categories. In this analysis, the OR's comparing the low twin with the higher co-twin were OR = 1.41 (0.95–2.11); p = 0.07 for limitations in running, OR = 1.00 (0.60–1.67); p = 0.98 for poor dental status; OR = 1.91 (0.74–5.29); p = 0.12 for poor self-rated health and OR = 1.21 (0.78–1.90); p = 0.35 for fatigue. The co-twin analyses compare

twins who are matched on rearing environment and genes (half in DZ and all in MZ). Thus, it is not possible to examine the effect of childhood social class in this design.

Discussion

This study of the association of childhood and adult social class with indicators of physical limitations (limitations in running 100 m and dental status), general health (self-rated health) and early frailty (fatigue) among randomly sampled middle-aged men and male twins revealed that low social class in both childhood and adulthood were associated with having poorer health outcomes. When mutually adjusted childhood social class explained a minor part of the relation between adult social class and these health outcomes. This suggests that social differences in poor health in middle-age are due to factors operating both in adult- and to a certain degree in early life. However, adult social disadvantage does not seem to determine poor dental status when early life factors are taken into account.

Physical functioning has also been associated with both childhood and adult social class in birth cohorts from UK (Guralnik, Butterworth, Wadsworth, & Kuh, 2006; Kuh et al., 2006). In contrast to our finding, the effect of childhood social class on health outcomes in the studies from UK was entirely explained by adjustment for adult behavioral factors such as smoking and BMI. However, all the studies suggest that factors related to adult social class mediate the effect of childhood social class. In addition, our study showed that male twins discordant for adult social class seem to differ in prevalence of limitations in running, which suggests that social differences in this measure of physical functioning in adulthood are also due to factors operating later in adult life. The strong relationships of childhood and adult social class with poor dental status are in agreement with a few previous studies (Antoft, Rambusch, Antoft, & Christensen, 1999; Thompson et al., 2004). In a birth cohort from New Zealand, social class and oral health during childhood predicted oral health at age 26 (Thompson et al., 2004). In this study upward social mobility between age 6 and 26 years was also associated with a reduced risk of dental caries and tooth loss. This is in contrast with the findings in the present study where male twins discordant for adult social class (different social mobility) did not differ in prevalence of poor dental status. This suggests that the observation of an effect of adult social class on dental status in the individual level analyses (Tables 2 and 3) could be due to confounding from genetic factors or rearing environment (early selection mechanisms (Fig. 1)). In Denmark dental care is one of the few health benefits that are not free of charge. Consequently, we were surprised that in the co-twin design adult social class did not seem to have an independent effect on dental status. We cannot exclude the possibility of some effect of adult social class on dental health, however, as the twin-analyses had insufficient power to detect a modest difference. However, when the three discordant categories were collapsed in order to gain power, the effect estimate moved close towards unity.

The finding of a relationship of both childhood and adult social class with self-rated health in middle-age found in our individual level analyses, is in agreement with studies within other populations (Adams, White, Pearce, & Parker, 2004; Lundberg, 1993; Mensah & Hobcraft, 2008; Van de Mheen, Stronks, Looman, & Machenbach, 1998; Power, Matthews, & Manor, 1998). Previous studies have shown that illness in childhood explains a part of social class differences in self-rated health around age 30 years (van de Mheen, Stronks, Looman, & Mackenbach, 1998). Unfortunately, we had no information on participant's health during childhood, but in the co-twin control study, which allows us to adjust for all mediators or confounders linked to genetic factors or rearing environment — most likely including propensity to childhood disease — we continued to observe social class differences in poor self-rated health. These differences are consistent with a causal effect of current social class exposures, although selection effects related to poor health during the life course cannot be excluded (later selection mechanisms (Fig. 1)). In previous studies higher education, social

class and income have been associated with less fatigue (Avlund, Rantanen, & Schroll, 2007; Watt et al., 2000), but we are not aware of studies that have explored the effect of childhood experiences on this outcome.

In the present study we have included two independent study samples, which has the advantage that it allows us to make confirmatory analyses. This means that even though differences in social class and health between twins and singletons might potentially influence the generalizability of the findings based on the random sample of middle-aged Danish twins (MADT), the fact that effect estimates obtained in the two different study samples (Table 1) were fairly similar, suggests that this is not a serious concern. The twin design used in this study has some additional advantages as it enables us to control for both genetic and early environmental factors per design.

Some other methodological issues should be considered. First, the design was cross sectional. This hampers the examination of the causal pathways between childhood social class, adult social class and adult health. Our assumption is that childhood and adult social class affects adult health and not vice versa, but reverse causation in shape of direct and indirect selection processes cannot be excluded. However, in the Metropolit study we also had prospectively collected information on father's occupational class at the birth of participants and subject's own social class at age 18 and 48 years. When we repeated the analyses with these data it did not change the pattern of associations found in the present cross sectional design. Secondly, all measures were self-reported and measurement errors in our assessment of social class, health outcomes and covariables might be a potential concern. If errors in reporting were non-differential this would bias the results towards the null. However, it is possible that poor health somehow has influenced the reporting of a lower social class, which may cause bias and explain the found associations. Thirdly, selection problems may be an issue since the present study was based on those who responded to a health survey. In the Metropolit study non-participation in the health survey in 2004 was associated with having a single mother at birth and low childhood cognitive function (Osler, Kriebaum, Lund, Christensen, & Nybo Andersen, 2008a; Osler, Kriebaum, Holstein, Christensen, & Nybo Andersen, 2008b; Osler et al., 2008a). The incidence of hospitalizations for alcohol abuse, tobacco-related lung disease, and depression was also higher among non-responders. However, when analyzing the associations between information on early life factors and these health outcomes, which were available for all cohort members, it showed that the risk estimates did not differ significantly between responders and the entire cohort. Thus, non-response does not seem to bias the associations between childhood social class and adult health seriously. Finally, we need to emphasize the relatively small number of twin pairs, which affects the power of our data set to detect all differences for the least prevalent health outcomes such as poor dental status. On the other hand, this strengthens the findings on poor health and fatigue, although we cannot exclude the occurrence of change findings as a result of the multiple comparisons made.

In conclusion, the present study suggests that in Denmark the associations of adult social class with physical limitations, poor self-rated health and fatigue may partly be due to effects of exposures related to social circumstances during adult life, while social class differences in dental status are most consistent with early effects.

References

- Abnet CC, Qiao Y-L, Dawsey SM, Dong Z-W, Taylor PR, Mark SD. Tooth loss is associated with increase of total death and death from upper gastrointestinal cancer, heart disease and stroke in a Chinese population-based cohort. *Int J Epidemiol* 2005;34:467–474. [PubMed: 15659476]
- Adams J, White M, Pearce MS, Parker L. Life course measures of socioeconomic position and self reported health at age 50: prospective cohort study. *J Epidemiol Comm Health* 2004;8:1028–1029.

- Antoft P, Rambusch E, Antoft B, Christensen HW. Caries experience, dental health behaviour and social status-three comparative surveys among Danish military recruits in 1972, 1982 and 1993. *Comm Dental Health* 1999;16:80–84.
- Avlund K. Disability in old age. Longitudinal population-based studies of the disablement process. *Dan Med Bull* 2004;51:315–349. [PubMed: 16009060]
- Avlund K, Rantanen T, Schroll M. Factors underlying tiredness in older adults. *Aging Clin Exp Res* 2007;19:16–25. [PubMed: 17332717]
- Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol* 2002;31:285–293. [PubMed: 11980781]
- Black, D.; Morris, JN.; Smith, C.; Townsend, P.; Whitehead, M. Inequalities in health: the black report: The health divide. Penguin; London: 1988.
- Blane D, Smith G. Davey, Bartley M. Social selection: what does it contribute to social differences in health? *Sociol Health Illness* 1993;15:1–15.
- Smith, G. Davey; Blane, D.; Bartley, M. Explanations for socio-economic differentials in mortality. Evidence from Britain and elsewhere. *Eur J Pub Health* 1994;4:131–144.
- Smith, G. Davey; Hart, C.; Blane, D.; Hole, D. Adverse socioeconomic conditions in childhood and cause specific adult mortality: prospective observational study. *BMJ* 1998;316:1631–1635. [PubMed: 9603744]
- Enevoldsen B, Michelsen N, Friis-Hasche E, Kamper-Jørgensen F. Social classifications. *Ugeskr Læger* 1980;134:544–550.
- Gaist D, Bathum L, Jensen TK, McGue M, Vaupel JW, Christensen K. Strength and anthropometric measures in identical and fraternal twins: no evidence of masculinisation of females with male co-twin. *Epidemiol* 1999;11:340–343.
- Galobarades B, Smith GD, Lynch JW. Systematic review of the influence of childhood socioeconomic circumstances on risk for cardiovascular disease in adulthood. *Ann Epidemiol* 2006;16(2):91–104. [PubMed: 16257232]
- Guralnik JM, Butterworth S, Wadsworth MEJ, Kuh D. Childhood socioeconomic status predicts physical functioning a half century later. *J Gerontol* 2006;61A:694–701.
- Guralnik JM, Ferrucci L. Assessing the building blocks of function. Utilizing measures of functional limitation. *Am J Prev Med* 2003;25:112–121. [PubMed: 14552934]
- Holm-Pedersen P, Schultz-Larsen K, Christiansen N, Avlund K. Tooth loss and subsequent disability and mortality in old age. *J Am Geriatr Soc* 2008;56:429–435. [PubMed: 18194226]
- Idler E, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Behav* 1997;38:21–37.
- Kuh D, Hardy R, Butterworth S, Okell L, Richards H, Wadsworth M, Cooper C, Sayer AA. Developmental origins of midlife performance: evidence from a British Birth Cohort. *Am J Epidemiol* 2006;164:110–124. [PubMed: 16757569]
- Lichtenstein P, Harris P, Pedersen NL, McLearn GE. Socioeconomic status and physical health, how are they related? An empirical study on twins reared apart and twins reared together. *Soc Sci Med* 1993;36:441–450. [PubMed: 8434269]
- Lundberg O. The impact of childhood living conditions, loneliness and mortality in adulthood. *Soc Sci Med* 1993;36:1047–1052. [PubMed: 8475420]
- Marmot M, Smith G. Davey. Socio-economic differentials in health. The contribution of the Whitehall studies. *J Health Psychology* 1997;2:283–296.
- Mensah KF, Hobcraft J. Childhood deprivation health and development: associations with adult health in 1958 and 1970 British prospective birth cohort studies. *J Epidemiol Comm Health* 2008;62:599–606.
- Osler M, Kriegbaum M, Lund R, Christensen U, Andersen A. M. Nybo. Loss to follow-up did not bias associations between early life factors and adult depression. *J Clin Epidemiol* 2008a;61(9):958–963. [PubMed: 18495426]
- Osler M, Kriegbaum M, Christensen U, Holstein B, Andersen A. M. Nybo. Does loss to follow up in a cohort study bias associations between early life factors and lifestyle related health outcomes. *Ann Epidemiol* 2008b;18:422–424. [PubMed: 18329893]

- Osler M, Lund R, Kriegbaum M, Christensen U, Andersen A, Nybo. Cohort profile: The Metropolit 1953 Danish male birth cohort. *Int J Epidemiol* 2006;35:541–546. [PubMed: 16377658]
- Österberg T, Mellström D, Sundh V. Dental health and functional ageing. A study of 70-year-old people. *Community Dent Oral Epidemiol* 1990;18:313–319. [PubMed: 2090384]
- Power C, Matthews S, Manor O. Inequalities in self-rated health, explanations from different stages in life. *Lancet* 1998;351:1009–1014. [PubMed: 9546506]
- Sing-Manoux A, Martikainen P, Ferrie J, Zins M, Marmot M, Goldberg M. What does self rated health measure? Results from the British Whitehall II and French Gazel cohort studies. *J Epidemiol Community Health* 2006;60:364–372. [PubMed: 16537356]
- Thompson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KMS. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. *Comm Dent Oral Epidemiol* 2004;32:345–353.
- Van de Mheen H, Stronks K, Looman CWN, Machenbach JP. Role of childhood health in the explanation of socioeconomic inequalities in early adult health. *J Epidemiol Comm Health* 1998;52:15–19.
- Verbrugge LM, Jette AM. The disablement process. *Soc Sci Med* 1994;38:1–14. [PubMed: 8146699]
- Vestergaard S, Nayfield S, Patel K, Eldadah B, Cesari M, Ferrucci L, Ceresini G, Guralnik J. Fatigue in a representative population of older Persons and its association with functional impairment, functional limitation and disability. *J Gerontol Med Sci* 2009;64:76–82.
- Watt T, Groenvold M, Bjorner JB, Noerholm V, Rasmussen N, Bech P. Fatigue in the Danish general population. Influence of sociodemographic factors and disease. *J Epidemiol Comm Health* 2000;54:827–833.
- West P. Rethinking the health selection explanation for health inequalities. *Soc Sci Med* 1991;32:373–384. [PubMed: 2024152]

Fig. 1.
Potential mechanisms linking childhood and adult socioeconomic position (SEP) with health.

Fig. 2.

Prevalence of four indicators of general health and physical function in middle-aged male twin pairs concordant or discordant on adult social class (H = high, M = medium, and L = low social class). H = high social class; M = middle social class; L = low social class. * $p < 0.05$. For the number of twins in each pairs see section Statistical analyses.

Table 1

Distribution (%) of indicators of general health and physical function, social class and related characteristics in the Metropolit and MADT cohort

Age	Metropolit cohort		Middle-aged twins (MADT-cohort)			
	51	46-48	49-53	54-58	59-63	64-69
	N = 6 292	N = 298	N = 516	N = 504	N = 490	N = 390
<i>Health indicators</i>						
Limited in running 100 m	28.2 *	12.6	13.9	23.9	34.6	44.3
Fewer than 10 teeth	2.9 *	3.4	5.0	12.7	17.0	28.2
Rate general health poor	10.5 *	4.0	4.1	6.2	5.5	5.4
Fatigued	13.8 *	12.9	18.1	17.3	23.2	21.3
Childhood social class						
High	22.2 *	20.6	17.2	14.9	16.7	17.8
Middle	23.5 *	17.1	40.4	41.6	35.8	40.0
Low	54.3 *	44.8	42.4	43.6	47.5	42.3
Own social class						
High	37.2 *	31.9	32.8	29.7	29.8	31.5
Middle	22.6 *	24.5	23.8	26.9	30.0	30.7
Low	40.2 *	44.0	43.1	43.1	40.2	37.7
% Living single	19.0 *	18.1	11.6	15.9	13.4	15.6
% Smoking	42.5 *	45.6	37.4	42.2	41.7	42.3
% BMI 30 or above	12.7 *	12.7	8.3	10.5	11.9	9.2

* $p < 0.01$ in chi-square test for difference between Metropolit and MADT (age 49-53).

Table 2

Age-adjusted Odds Ratios (OR and 95% CI) of social class and covariables with limitation in running 100 m, poor dental status, poor self-rated health and fatigue in middle-aged Danish men

	Limited in running 100 m		Poor dental status		Poor self-rated health		Fatigue	
	Metropolit	MADT	Metropolit	MADT	Metropolit	MADT	Metropolit	MADT
Childhood social class								
High	1	1	1	1	1	1	1	1
Middle	1.22 (1.07–1.47)	1.47 (1.08–2.02)	2.59 (1.24–5.31)	1.64 (1.08–2.47)	1.58 (1.18–2.11)	1.75 (0.89–3.44)	1.25 (0.97–1.63)	1.05 (0.76–1.46)
Low	1.57 (1.34–1.83)	1.89 (1.38–2.57)	4.93 (2.59–9.44)	1.97 (1.67–2.51)	1.96 (1.52–2.52)	2.05 (1.06–3.95)	1.81 (1.46–2.88)	1.32 (0.96–1.52)
Adult social class								
High	1	1	1	1	1	1	1	1
Middle	1.77 (1.50–2.08)	1.62 (1.27–2.15)	4.86 (2.17–10.0)	2.10 (1.41–3.14)	1.79 (1.38–2.32)	0.88 (0.50–1.56)	1.52 (1.22–1.91)	1.54 (1.14–2.09)
Low	2.97 (2.24–3.70)	2.62 (2.03–3.39)	14.44 (7.33–28.46)	3.74 (2.61–5.37)	3.16 (2.55–3.91)	1.71 (1.08–2.71)	2.39 (2.99–2.88)	1.98 (1.51–2.60)
Living single	1.97 (1.72–2.26)	2.03 (1.56–2.65)	4.77 (3.53–6.45)	1.64 (1.19–2.27)	2.39 (2.43–3.44)	4.56 (3.06–6.76)	2.12 (1.80–2.51)	1.96 (1.38–2.23)
BMI								
-19.9	2.39 (1.29–4.42)	1.21 (0.54–1.47)	5.66 (2.44–13.11)	2.51 (1.14–5.50)	4.87 (2.58–9.19)	2.26 (0.76–6.67)	3.20 (1.61–6.35)	1.26 (0.50–2.74)
20–24.9	1	1	1	1	1	1	1	1
25–29.9	1.44 (1.27–1.69)	1.18 (0.94–1.47)	0.68 (0.48–0.96)	0.95 (0.72–1.26)	1.01 (0.84–1.23)	0.81 (0.52–1.24)	1.09 (0.92–1.30)	0.79 (0.63–1.01)
30–	4.44 (3.73–5.29)	3.04 (2.20–4.30)	1.00 (0.63–1.58)	1.81 (1.22–2.68)	2.11 (1.68–2.67)	1.71 (0.97–2.98)	2.03 (1.63–2.53)	1.25 (0.88–1.77)
Smoking	2.34 (2.09–2.62)	1.43 (1.19–1.72)	6.42 (4.39–9.40)	2.64 (2.03–3.42)	2.21 (1.88–2.61)	2.33 (1.71–3.76)	1.67 (1.44–1.94)	1.71 (1.38–2.23)

Estimates in bold: $p < 0.05$ in Wald-test.

Table 3

Crude and adjusted Odds Ratios (OR and 95% CI) for the relation of childhood and adult social class with limitation in running 100 m, poor dental status, poor self-rated health and fatigue in middle-aged Danish men

	Metropolit cohort			MADT		
	Crude	Childhood and adult social class mutually adjusted	Multiple adjustment ^{***}	Age adjusted	Childhood and adult social class mutually adjusted	Multiple adjustment ^{***}
<i>Limited in running 100 m</i>						
Childhood social class [*]	1.12 (1.08–1.16)	1.03 (1.00–1.08)	1.01 (0.97–1.05)	1.16 (1.08–1.25)	1.08 (1.00–1.17)	1.09 (1.00–1.17)
Adult social class [*]	1.66 (1.56–1.78)	1.61 (1.49–1.73)	1.42 (1.31–1.59)	1.27 (1.19–1.35)	1.24 (1.16–1.36)	1.20 (1.12–1.38)
<i>Poor dental status</i>						
Childhood social class [*]	1.43 (1.27–1.66)	1.25 (1.08–1.43)	1.25 (1.07–1.45)	1.10 (1.01–1.20)	1.06 (0.98–1.10)	1.00 (0.91–1.10)
Adult social class [*]	3.34 (2.70–4.66)	3.06 (2.24–4.09)	2.53 (1.85–3.46)	1.38 (1.26–1.30)	1.37 (0.96–1.30)	1.33 (1.21–1.46)
<i>Poor self-rated health</i>						
Childhood social class [*]	1.17 (1.10–1.23)	1.07 (1.01–1.15)	1.06 (0.99–1.14)	1.16 (1.01–1.33)	1.12 (0.96–1.28)	1.11 (0.92–1.29)
Adult social class [*]	1.77 (1.40–1.97)	1.66 (1.48–1.86)	1.41 (1.25–1.59)	1.16 (1.03–1.31)	1.12 (1.00–1.28)	1.05 (0.92–1.10)
<i>Fatigue</i>						
Childhood social class [*]	1.16 (1.10–1.23)	1.10 (1.04–1.17)	1.09 (1.02–1.15)	1.08 (1.01–1.16)	1.03 (0.95–1.12)	1.04 (0.96–1.12)
Adult social class [*]	1.55 (1.41–1.70)	1.47 (1.32–1.62)	1.31 (1.18–1.46)	1.18 (1.10–1.20)	1.18 (1.09–1.23)	1.13 (1.06–1.22)

Estimates in bold: $p < 0.05$ in Wald-test.

^{*} Per unit (high, middle, low) decrease in social class in a logistic regression model.

^{***} Childhood social class, adult social class, cohabitation status, smoking and BMI in model.