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ORIGINAL ARTICLE

Does socioeconomic status in adolescence predict low back pain in adulthood? A repeated cross-sectional study of 4,771 Danish adolescents

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Abstract Social and economic disadvantage is associated with general poor physical health. This relationship has been recognised for centuries, but it is unknown whether socioeconomic factors have a specific influence on low back pain (LBP). Furthermore, it is unknown how social and economic disadvantages in youth affect adult health. Therefore, the specific objectives of this study are to explore (1) the cross-sectional association between socioeconomic status (SES) and LBP in adolescence and (2) the longitudinal association between SES in adolescence and LBP in early adulthood. A database containing LBP data from 4,771 twins was merged with their parents' social and economic data, available from Statistics Denmark. Low back pain data ['any low back pain' and 'persistent low back pain (more than 30 days)'] were collected in 1994, when the subjects were 12–18 years of age, and collected again eight years later. Socioeconomic data of the parents (education, income, social class and long-term illness, all for both mother and father) were collected in 1994. Logistic regression analyses were used to estimate the associations between each parameter of parental SES in adolescence and LBP at baseline as well as at follow-up. Finally, the influence of a variable combining the different socioeconomic parameters was established. All estimates were controlled for smoking, alcohol consumption and body mass index at baseline. In the logistic regression models, only three of the 32 estimates were statistically significant. When merging the socioeconomic variables into a combined score, the results indicated that a good social background had a protective effect against the persistent LBP, while there was no association with any LBP. However, the statistical significance of this effect was unclear. We found no or very weak indications of possible relationships between social factors in adolescence and LBP at baseline and at follow-up.

Keywords Low back pain · Adolescence · Socioeconomic status · Social factors · Parents

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Background

Social and economic disadvantage is associated with poorer physical health [1]. This relationship has been recognised for centuries [2]. Several authors have demonstrated considerable socioeconomic components in the aetiology of various health problems and a number of

reviews have concluded that socioeconomic status (SES) has a profound influence on health [3–5]. Despite the ample evidence of associations between SES and health, relations to a specific disease, not investigated specifically, cannot be taken for granted. Specifically for back pain, there is conflicting evidence with regard to a possible association to SES in both adulthood [6–9] and childhood/adolescence [10–12].

With regard to the influence of SES in adolescence on adult health, there are several studies demonstrating associations between low SES in childhood and poor adult health, amongst others cardiovascular health [13–15], dental health [15], self-rated health [16] and mental health [17]. We are not aware of any longitudinal studies investigating the specific association between SES in childhood or adolescence and adult back pain.

In this field of research, there is a lack of consensus about measuring social and economic disadvantage and the validity of these variables is often questionable. SES is an aggregate concept based on one's level of resources or prestige in relation to that of others. In research concerning health, the most commonly used indicators of SES are based on educational attainment, occupational prestige and income. These indicators are interrelated, but may influence health through disparate pathways [18] and may also affect various domains of health in different ways. Therefore, it should be attempted to examine how the multiple levels of SES interrelate and affect health. There are, however, several problems related to this. Self-reported income is prone to missing or distorted responses, and occupational measures are changeable, and furthermore cannot be used for individuals who are retired, unemployed or not working for other reasons. Education is more reliable as people are usually both willing and able to report their educational level accurately and it rarely changes much after the late twenties.

The present study aims to overcome some of the above-mentioned shortcomings by estimating disease-specific associations and utilising detailed high-quality socioeconomic data in a longitudinal design from childhood into adulthood. In Denmark, a valid objective data about income, occupation, education and social class can be obtained through Statistics Denmark (www.dst.dk). All person-data are recorded with a personal identification number from the Danish Civil Registration system, which allows for linkage between different databases, both at individual and family level. We will link these data to back pain data collected by questionnaires in a large cohort of Danish adolescent twins who were re-evaluated as adults. The specific objectives are to explore (1) the cross-sectional association between SES and low back pain (LBP) in adolescence and (2) the prospective association between SES in adolescence and LBP in early adulthood.

Materials

Data sources

The Danish twin register is the most comprehensive population-based twin register in the world, spanning a period of more than 100 years. The twins of interest for this study were born between 1972 and 1982. They were identified through the Danish civil registration system and represent 95% of the twins and 1.6% of all children born during that period. In Denmark, the majority of adolescents at 18 years of age and above have left home. Therefore, the sample was reduced to include only persons under the age of 18 and living with their parent(s). Twins can be regarded representative of the general population, since they have been shown previously to have the same mortality rate [19] and the same prevalence of various diseases as the population at large, e.g. insulin-dependent diabetes [20], hand eczema [21], asthma [22], allergic rhinitis [22] and LBP [23]. The database is described in detail elsewhere [24]. Since the population can be regarded representative of the general population, the register provides a valuable population-based study cohort for various purposes. The fact that the study subjects are twins is of no interest in the present study. In 1994, when the participants were 12–22 years, comprehensive questionnaires were sent to those who had agreed previously to participate in future studies (96%). The questionnaires contained items relating to disease, health and health-related behaviour. Similar questionnaires were sent to the same population in 2002, when they were 20–30 years of age. The outcome variable of interest for this paper was the total number of days with LBP during the past year. The exact wording of the question was "How many days have you altogether had trouble with the lower part of your back during the past year?" The possibilities for answering were "0 days", "1–7 days", "8–30 days", "more than 30 days, but not daily" or "daily". Furthermore, the question: "Have you ever had trouble with the lower part of your back?" was used for validation purposes.

Validation

The questions regarding LBP were modelled on the Nordic Back Pain Questionnaire [25], which has been validated previously [26]. The reliability of LBP questions during the year 1994- to 2002-omnibus has previously been considered satisfactory through identification of logical errors [27, 28].

Table 1 Description of variables

Income (Euros)	0. <12,499
	1. 13,500–26,999
	2. 27,000–39,999
	3. 40,000–53,499
	4. 53,500–66,999
	5. 67,000–79,999
	6. >80,000
Education	1. Elementary school
	2. High school
	3. Skilled worker
	4. Bachelor level up to master level
	5. Master level or above
Social class	1. Non-skilled worker
	2. Skilled worker
	3. Low-level white-collar worker
	4. High-level white-collar worker
	5. Assistant manager
	6. Manager
	Unclassified if outside the labour force (unemployed, on disability pension, etc.)
Long-term illness	0. Receiving disability pension or sickness benefit for more than 30 days during 1994
	1. Not receiving disability pension or sickness benefit for more than 30 days during 1994

For the purpose of interpretation, all variables were categorised with higher values indicating higher SES

Variables

Dependent variables

- 'Persistent LBP' was defined LBP for more than 30 days during the previous year.
- 'Any LBP' was defined LBP for at least one day during the previous year.

Independent variables

All the independent variables were collected at baseline (1994). The proxy measures for SES were total income before tax, education, social class and income substitution benefits. Death of a parent might be an important variable, but this information was not available. The SES variables were measured at only one point in time (1994). Although people might change environment during life, we did not consider this to be a problem due to the size of our cohort and the age of the children (Danish people with children aged 12–18 are usually in a rather stable life phase).

The SES measures were registered from the Statistics Denmark for the adult male and the adult female in the household. These could be the biological parents, adoptive parents or one biological parent and his/hers partner. For clarity of the text, they were all called mother and father in the rest of the article. The SES variables were categorised as shown in Table 1. Lifestyle factors have been suspected previously for influencing health in a negative way. However, the interrelations between these lifestyle factors and SES are unclear and thus, lifestyle factors might be proxy measures for SES or vice versa. Therefore, the lifestyle factors available in the dataset at baseline were included in the analyses. These were tobacco smoking (yes/no), alcohol consumption (yes/no) and body mass index (continuous).

Methods

Representativeness

Responders and non-responders at follow-up were compared with regard to age, gender, socioeconomic factors and LBP status at baseline.

Missing values

Owing to the inclusion of eight independent variables on the parents in some of the models, the issue of missing data had to be dealt with to avoid a seriously reduced dataset. For this purpose, if the value of one variable was missing for one of the parents, this value was imputed on the basis of the value of the other variables for the same parent (conditional mean imputation). If one parent was completely missing, the missing values were imputed based on the values of the present parent to allow single-parent families as well as families with both parents in the models. Since the parents' data were register-based, the missing data were missing due to administrative procedures rather than the individual's ability/will to respond. Therefore, imputation of missing values was unlikely to bias the results.

Correlation between dependent variables

All the independent variables were tested for correlation to avoid problems with colinearity.

Associations between independent and dependent variables

The associations between all the SES variables and the outcome variables were estimated through bivariate

logistic regression analyses. Multiple logistics regression analyses were then performed for all the outcome variables in a model including all the SES variables. This was repeated including the three lifestyle factors. In the regression analyses, the explanatory variables were treated as continuous variables except long-term illness, which was dichotome (all as reported in Table 1). Thus, the odds ratios represented the decrease or increase in odds for each increase in category. All estimates were reported as odds ratios with 95% confidence intervals.

Creating one combined, disease-specific, weighted score for socioeconomic status

Part of the aim was to evaluate the combined influence of the SES variables on LBP. To achieve this, two procedures were performed. The first step was to capture the influence of the SES variables on each outcome variable via a combined SES score. For each outcome variable, a multiple logistic regression analysis was performed including all the SES and lifestyle variables. The regression coefficient for each variable was divided by the sum of all the coefficients to estimate the proportional importance of each variable. The combined SES score was then estimated by the sum of all the regression coefficients multiplied with their proportional value. Then, the combined SES score was entered into a logistic regression model with the lifestyle factors for each outcome variable. The effect estimates have been reported, but no inference results given from this model. Because the combined score was constructed from the values belonging to this dataset, the inference results would be overoptimistic. The second step was to evaluate the significance of the entire set of SES variables. For this purpose, we performed a likelihood ratio test between the model containing all the SES variables as well as the lifestyle variables and the model with only the lifestyle variables. Then, we calculated the significance of the difference of the estimates with and without the SES variables in the model.

All analyses were done using STATA 8.0 statistical software package. A significance level of 5% was used throughout the analyses.

Results

Description of cohort

In 1994, the overall response rate was 84% of which 98% answered the LBP questions, resulting in 9,569 participants, 4,854 of these being under the age of 18. Eighty-three of these had left home and were excluded leaving 4,771 individuals for the cross-sectional analyses. Of these, 68% answered the question regarding number of days with LBP in 2002, leaving 3,245 individuals for longitudinal analyses.

In 1994, the mean age of this part of the cohort was 14.58 years (SD = 1.69, range 12–17) and the male/female ratio was 50/50. The distribution of the independent variables in relation to LBP is shown in Table 2.

All baseline register-data about SES were missing from 698 fathers (single mother families) and from 94 mothers (single father families). In addition, there were some missing answers to individual items for administrative reasons. The number of answers for each item is shown in Table 2.

Representativeness

As seen in Table 2, there was a similar age-distribution amongst responders at baseline and follow-up but a higher proportion of females at follow-up. Furthermore, the parents of the responders at follow-up were of higher social class, had a higher income, were better educated and received less income compensation benefits, all with a small, but statistically significant, difference in favour of the parents to the responders. At follow-up, there was an over-representation of individuals with any LBP in 1994 ($p = 0.007$), whereas the distribution of persistent LBP in 1994 was similar amongst responders and non-responders.

Correlation between dependent variables

All two-by-two combinations of the SES variables were tested for correlation and found to have a correlation coefficient below 0.80, and thus perfect colinearity was not an issue. Therefore, all the variables were included in the multivariate analyses.

Associations between dependent and independent variables

Bivariate analyses of the associations between the SES variables and all the outcome variables showed no statistically significant associations for ‘any LBP’, but three statistically significant associations were found for persistent LBP in 1994: father’s social class (odds ratio 0.87; 95% confidence interval 0.77–0.98), father’s education (0.86; 0.74–1.00) and mother’s long-term illness (0.53; 0.31–0.92). For persistent LBP in 2002, four of the associations to SES were statistically significant: mother’s social class (0.88; 0.80–0.98), father’s social class (0.89; 0.81–0.97), mother’s education (0.90; 0.82–0.99) and father’s long-term illness (0.56; 0.33–0.96).

When including all the SES variables in the model, only two of the above associations remained statistically

Table 2 Description of study sample

Variables and item responses[a]	Any LBP 1994 $n = 1{,}154$ (25%)	Persistent LBP 1994 $n = 145$ (3%)	All in 1994 $n = 4{,}771$	Any LBP 2002 $n = 1{,}391$ (43%)	Persistent LBP 2002 $n = 286$ (9%)	All in 2002 $n = 3{,}245$
Female gender $n = 4771$	59%	66%	50%	60%	64%	56%
Age in 1994 (mean ± SD) $n = 4771$	15.5 ± 1.5	15.8 ± 1.3	14.6 ± 1.7	14.7 ± 1.7	14.5 ± 1.6	14.6 ± 1.7
Mother's income ≥2 $n = 4{,}677$	41%	42%	38%	42%	36%	39%
Father's income ≥2 $n = 4{,}073$	82%	80%	81%	85%	83%	83%
Mother's social class ≥4 $n = 4{,}677$	40%	37%	37%	38%	33%	39%
Father's social class ≥4 $n = 3{,}979$	48%	37%	46%	46%	39%	48%
Mother's education ≥3 $n = 4{,}609$	65%	61%	63%	65%	61%	65%
Father's education ≥3 $n = 4{,}009$	74%	68%	73%	75%	75%	75%
Long-term illness, mother $n = 4{,}677$	7%	11%	6%	5%	7%	6%
Long-term illness, father $n = 4{,}073$	5%	7%	5%	5%	7%	4%
Smoking ≥1 cig./day in 1994 $n = 4{,}627$	14%	14%	7%	8%	8%	7%
Alcohol ≥1 unit/month in 1994, $n = 4{,}053$	64%	71%	42%	47%	39%	43%
BMI in 1994 (mean ± SD) $n = 4{,}655$	19.88 ± 2.55	19.93 ± 2.40	19.20 ± 2.74	19.47 ± 2.81	19.27 ± 2.84	19.23 ± 2.81

The percentages represent the proportion of the LBP-group whose parents have the given characteristics unless otherwise stated in the first column

[a] The generally lower number of responses from fathers is due to an overweight of single mothers. There were 698 single mothers and only 94 single fathers

significant: between persistent LBP in 1994 and mother's long-term illness (0.48; 0.23–0.99) and between persistent LBP in 2002 and father's long-term illness (0.49; 0.28–0.87). By adding the lifestyle variables to the model as well, the first association lost its significance, whereas the association between persistent LBP in 2002 and father's long-term illness remained statistically significant (0.41; 0.23–0.76). In this full model, also the associations between father's education and persistent LBP in 1994 and between father's long-term illness and any LBP in 2002 were found to be statistically significant (0.76; 0.62–0.93 and 0.55; 0.33–0.91, respectively). The bivariate regression estimates and the fully adjusted estimates have been shown in Table 3.

Only three of the 32 fully adjusted estimates in Table 3 were statistically significant. However, the estimates were slightly stronger (smaller odds ratios—stronger negative associations) for persistent LBP than for any LBP, especially for the estimates at follow-up.

Creating one combined, disease-specific, weighted score for socioeconomic status

When collapsing the SES variables into a combined score through the two steps described in the "Methods" section, we obtained an approximation of the total influence of the SES factors investigated. The results of the multiple logistic regression analyses indicated that a good social background has a protective effect against persistent LBP, while there was no association with any LBP. However, using this method, the strength of the association could not be determined, since the combined SES variable was based upon other variables with four different units. Thus, it could be estimated whether there was an influence on LBP or not, but the individual values obtained could not be rationally interpreted. When testing the statistical significance of the total influence of the SES variables by comparing the models with and without these variables, none of the differences were

Table 3 Odds ratios with 95% confidence intervals for reporting LBP at baseline in relation to parents' individual socioeconomic variables at baseline (statistically significant findings in *bold*)

	Any LBP 1994		Persistent LBP 1994	
	Unadjusted	Adjusted[a-]	Unadjusted	Adjusted[a]
Mother's income	1.06 (0.98–1.14)	0.97 (0.85–1.11)	1.06 (0.88–1.28)	1.05 (0.77–1.42)
Father's income	1.03 (0.98–1.09)	0.98 (0.90–1.07)	0.97 (0.85–1.11)	1.02 (0.84–1.23)
Mother's social class	1.05 (1.00–1.12)	1.08 (0.97–1.21)	1.04 (0.85–1.12)	1.04 (0.84–1.28)
Father's social class	1.03 (0.98–1.08)	1.06 (0.98–1.16)	0.87 (0.77–0.98)	1.00(0.82–1.22)
Mother's education	1.04(0.99–1.10)	1.01(0.91–1.13)	0.96 (0.84–1.09)	1.03 (0.83–1.27)
Father's education	1.02 (0.96–1.08)	0.94 (0.84–1.04)	0.86 (0.74–1.00)	**0.76 (0.62–0.93)**
Long-term illness, mother	0.77 (0.59–1.01)	0.82 (0.50–1.33)	**0.53 (0.31–0.92)**	0.63 (0.27–1.47)
Long-term illness, father	1.02 (0.73–1.42)	1.29 (0.73–2.28)	0.64 (0.32–1.29)	0.75 (0.31–1.83)
	Any LBP 2002		Persistent LBP 2002	
	Unadjusted	Adjusted[a]	Unadjusted	Adjusted[a]
Mother's income	1.03 (0.95–1.11)	0.98 (0.87–1.11)	089 (0.77–1.03)	0.99 (0.80–1.23)
Father's income	1.00 (0.95–1.06)	1.03 (0.95–1.12)	0.93 (0.84–1.03)	0.99 (0.87–1.13)
Mother's social class	1.00 (0.94–1.06)	0.97 (0.88–1.08)	**0.88 (0.80–0.98)**	0.87 (0.72–1.05)
Father's social class	0.97 (0.92–1.02)	1.01(0.94–1.10)	**0.89 (0.81–0.97)**	0.91 (0.78–1.06)
Mother's education	0.99 (0.94–1.04)	1.00 (0.91–1.10)	**0.90 (0.82–0.99)**	1.03 (0.86–1.25)
Father's education	0.96 (0.90–1.03)	0.99 (0.90–1.09)	0.93 (0.84–1.04)	1.15 (0.96–1.38)
Long-term illness, mother	1.22 (0.89–1.67)	1.65 (0.96–2.82)	0.79 (0.48–1.29)	1.05 (0.48–2.31)
Long-term illness, father	0.55 (0.60–1.24)	**0.55 (0.33–0.91)**	**0.56 (0.33–0.96)**	**0.41 (0.23–0.76)**

[a] All SES variables as well as smoking, alcohol consumption and body mass index in 1994 included in the model

found to be statistically significant. Results are shown in Table 4.

Discussion

Altogether, only three of the adjusted estimates for the association between the eight independent and the four dependent variables were statistically significant. This might be due to chance, considering the 5% significance level. However, when creating one combined variable for all the SES variables, a good socioeconomic background seemed to protect against persistent LBP, but not against a more general definition of LBP. It should be noted, that the difference between the association to persistent and non-persistent LBP was larger than the difference shown in this study, since persistent LBP was included with non-persistent in the general LBP variable. This possible protective effect seemed to be more significant at follow-up. This could be due to a possible latency period for the appearance of LBP or it might be due to the later occupation of the children. SES tends to be stable across generations of family members [4, 17]; thus, children growing up in the higher social classes are more likely to get an academic education and thereby a less physically demanding job as adults. Hence, a higher prevalence of persistent LBP in children from less favourable socioeconomic environments might be partly due to heavy work in adulthood rather than a direct association to socioeconomic status in childhood.

Table 4 Odds ratios for reporting LBP at follow-up in relation to the combined SES variable at baseline, and *p* values for difference in estimates of a likelihood ratio test with and without SES variables in the model

	Association with the combined SES variable[a]	*p* values
Any LBP 1994	1.10	0.203
Persistent LBP 1994	0.41	0.298
Any LBP 2002	0.90	0.924
Persistent LBP 2002	0.40	0.063

[a] Adjusted for smoking, alcohol consumption and BMI

The analysis of non-responders indicated that more children from advantageous background with LBP at baseline answered the questionnaire. Since the results pointed towards a slight protective effect of a good social environment, this could have weakened our results, i.e. the real associations may be stronger than our estimates. However, because the differences between responders and non-responders were small, it was not likely that this skewness was of any large importance.

The confounding effect of the three measured lifestyle factors was surprisingly small. This was illustrated by a very small difference between the estimates from the models with lifestyle factors included and those without (data not shown, available on request). Thus, although SES

and lifestyle are connected, they seem to act independently if at all, on the development of LBP.

It was our hope that this study would reveal a few variables, which could be representative for the total SES, to be used in future studies as indicator variables rather than using a whole array of variables. However, adding or removing variables from the models, did not change the estimates to any noteworthy extent. Therefore, the various components, which combine to create the socioeconomic background of a child, all turned out to have some individual importance—as far as they have any importance at all. To estimate the importance of SES, several components probably need to be considered in combination. Unfortunately, this has rarely been done, often due to poor validity and/or availability of data. This might explain part of the inconsistency of the previous literature. Another explanation might be differences in outcome measures. Various subgroups of LBP might be influenced differently by SES. Since our cohort showed SES to be borderline associated with persistent LBP but not with the variable 'any LBP', any influence might act on the ability to recover rather than the susceptibility to disease.

Besides the large size of our cohort, this study had two major strengths: (1) The high quality and the objective nature of the socioeconomic data and (2) the prospective design, where the children were followed into adulthood. A possible weakness of this study was the non-specific nature of the LBP variable. Since LBP is multifaceted and multifactorial in nature, the influence of SES might vary between different types of LBP. Indeed, our results indicated that this could be the case, as the estimates were stronger for persistent than for general LBP.

Conclusion

Cross-sectionally, the only statistically significant finding is a negative association between father's education and 'persistent LBP' in 1994. Prospectively, father's long-term illness has a statistically significant, negative association with both 'any LBP' and 'persistent LBP'. All in all, we find no or very weak indications of possible relationships between LBP and social factors in adolescence.

References

1. Macleod J, Smith GD (2003) Psychosocial factors and public health: a suitable case for treatment? J Epidemiol Community Health 57:565–570
2. Smith GD, Carroll D, Rankin S, Rowan D (1992) Socioeconomic differentials in mortality: evidence from Glasgow graveyards. Br Med J 305:1554–1557
3. Adler NE, Boyce T, Chesney MA, Folkman S, Syme L (1993) Socioeconomic inequalities in health: no easy solution. JAMA 269:3140–3145
4. Lynch JW, Smith GD, Kaplan GA, House JS (2000) Income inequality and mortality: importance to health of individual income, psychosocial environment or material conditions. Br Med J 320:1200–1204
5. Williams DR, Collins C (1995) US socioeconomic and racial differences in health: patterns and explanations. Annu Rev Sociol 21:349–386
6. Larsen K, Leboeuf-Yde C (2006) Coping and backproblems: a prospective observational study of Danish military recruits. J Manipulative Physiol Ther 29:619–625
7. Leboeuf-Yde C, Larsen K, Ahlstrand I, Volinn E (2006) Coping and back problems: analysis of multiple data sources on an entire cross-sectional cohort of Swedish military recruits. BMC Musculoskeletal Disord 7:39
8. Leino-Arjas P, Kaila-Kangas L, Keskimäki I, Notkola V, Mutanen P (2002) Inpatient hospital care for lumbar disc disorders in Finland in relation to education, occupational class, income, and employment. Public Health 116:272–278
9. Papageorgiou AC, Macfarlane GJ, Thomas E, Croft PR, Jayson MI, Silman AJ (1997) Psychosocial factors in the workplace—do they predict new episodes of low back pain? Evidence from the South Manchester Back Pain Study. Spine 22:1137–1142
10. Khatun M, Ahlgren C, Hammarström A (2004) The influence of factors identified in adolescence and early adulthood on social class inequities of musculoskeletal disorders at age 30: a prospective population-based cohort study. Int J Epidemiol 33:1353–1360
11. Leboeuf-Yde C, Wedderkopp N, Andersen LB, Froberg K, Hansen HS (2002) Back pain reporting in children and adolescents: the impact of parents' educational level. J Manipulative Physiol Ther 25:212–220
12. Sjolie AN (2002) Psychosocial correlates of low-back pain in adolescents. Eur Spine J 11:582–588
13. Kristensen PL, Wedderkopp N, Moller NC, Andersen LB, Bai CN, Froberg K (2006) Tracking and prevalence of cardiovascular disease risk factors across socio-economic classes: a longitudinal substudy of the European Youth Heart Study. BMC Public Health 27:6–20
14. Lehman BJ, Taylor SE, Kiefe CI, Seeman TE (2005) Relation of childhood socioeconomic status and family environment to adult metabolic functioning in the CARDIA study. Psychosom Med 67:846–854
15. Poulton R, Caspi A, Milne BJ, Thomson WM, Taylor A, Sears MR, Moffitt TE (2002) Association between children's esperience of socioeconomic disadvantage and adult health: a life-course study. Lancet 360:1640–1645
16. Laaksonen M, Rahkonen O, Martikainen P, Lahelma E (2005) Socioeconomic position and self-rated health: the contribution of childhood circumstances, adult socioeconomic status, and material resources. Am J Public Health 95:1403–1409
17. Harper S, Lynch J, Hsu WL, Everson SA, Hillemeier MM, Raghunathan TE et al (2002) Life course socioeconomic conditions and adults psyhosocial functioning. Int J Epidemiol 31:395–403
18. Gallo LC, Matthews KA (2003) Understanding the association between socioeconomic status and physical health: do negative emotions play a role? Psychol Bull 129:10–51
19. Christensen K, Vaupel J, Holm NV et al (1995) Twin mortality after age 6: fetal origins hypothesis versus twin method. Br Med J 310:432–436
20. Kyvik KO, Green A, Beck-Nielsen H (1995) Concordance rates of insulin dependent diabetes melitus: a population based study of young Danish twins. Br Med J 311:913–917

21. Bryld LE, Agner T, Kyvik KO et al (2000) Hand eczema in twins: a questionnaire investigation. Br J Dermatol 142:298–305
22. Skadhauge LR (1999) Genetic and environmental influence on asthma. A population based study of Danish twins. Ph.D. thesis, University of Southern Denmark, Odense, Denmark
23. Hestbaek L (2003) The natural course of low back pain and early identification of high-risk populations. Ph.D. thesis, University of Southern Denmark, Odense, Denmark
24. Kyvik KO, Christensen K, Skytthe A et al (1996) The Danish Twin Register. Dan Med Bull 43:467–470
25. Kuorinka I, Jonsson B, Kilbom A et al (1987) Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 18:233–237
26. Biering-Soerensen F, Hilden J (1984) Reproducibility of the history of back trouble. Spine 9:280–286
27. Hestbaek L, Leboeuf-Yde C, Kyvik KO et al (2004) Comorbidity with low back pain. A cross-sectional population-based survey of 12–22 year olds. Spine 29:1483–1491
28. Hestbaek L, Leboeuf-Yde C, Kyvik KO, Manniche C (2006) The course of low back pain from adolescence to adulthood: eight-year follow-up of 9,600 twins. Spine 31:468–472