

Chronic Backpain Among Adolescents in Denmark: Socioeconomic Inequality and Trends 1991-2018

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Abstract

Chronic backpain among adolescents is important because the prevalence and the burden of disability is high. Chronic backpain tracks into adulthood and is associated with several health problems. The objective was to study trends in the prevalence of chronic backpain among adolescents 1991-2018, to examine the association with socioeconomic status (SES) and whether this association changed over time. The study used data from eight comparable cross-sectional school-surveys of nationally representative samples of 11-15-year-olds in 1991, 1994, 1998, 2002, 2006, 2010, 2014 and 2018, the Danish arm of the international Health Behaviour in School-aged Children (HBSC) study. The participation rate was 88.0%, n=29,952. Chronic backpain was defined as self-reported backpain daily or several days a week during the last six months. The prevalence of chronic backpain was 11.1%, significantly increasing from 8.9% in 1991 to 11.7% in 2018. The OR for chronic backpain was 1.20 (1.10-1.31) in middle and 1.56 (1.41-1.73) in low compared to high OSC. Sensitivity analyses with two other cut-points for backpain frequency showed similar associations. *Conclusion:* Chronic backpain is common among adolescents and the prevalence increased from 1991 to 2018. The prevalence was highest in lower SES families. We recommend increased efforts to prevent chronic backpain.

Introduction

Frequent backpain is common among adolescents. A study of 15-year-olds in 45 European countries and Canada showed that 16% reported backpain more than once a week, varying from 29% among girls in Italy to 7% among girls and boys in Azerbaijan [1]. It is an important public health problem because the prevalence is high, and it causes a high disability burden and use of healthcare services [2]. Further, frequent backpain tracks into adulthood [3–7] and is associated with many other health problems such as headache [4–8], mental health problems, psychological problems, and poor well-being [3, 8, 11, 13–15]. Some of the known risk factors for frequent backpain in adolescence are female gender [4, 16–17], higher age [16, 18–19], physical inactivity [17, 20], poor fitness [4], low desk height at school or poor sitting posture [17, 20], and daily smoking [4, 12].

It is less clear whether frequent backpain among adolescents are associated with socioeconomic status (SES), i.e. more common in socially disadvantaged families. Some studies report that this is not the case [14], other studies show higher prevalence among adolescents from lower SES families [22–23], and still other studies report unclear patterns of association between low backpain and SES [19, 24–25].

It is also not clear whether the prevalence of frequent backpain is stable or changing over time. Trends in symptom prevalence seem to differ by country [26]. A study from Finland has shown a steady increase in the prevalence of concomitant neck and low-back pain among adolescents from 1991 to 2010 [27]. A study from Switzerland [28] found increasing prevalence of backpain 1998–2006, but generally, little is known about time trends in backpain among adolescents. If there is a socioeconomic inequality in the prevalence of frequent backpain, this inequality may also change over time, but little is known about this

issue. Our study focused on chronic backpain defined as self-reported backpain daily or several days a week during at least six months.

The aim of this study was to address these issues: 1) to study trends in the prevalence of chronic backpain among adolescents from 1991 to 2018, 2) to examine the association between SES and chronic backpain and 3) to examine if possible socioeconomic inequality changes over time. We expected an increasing prevalence of chronic backpain because the prevalence of other unspecific pain (headache, abdominal pain) has been increasing in this period [29–30]. We expected elevated prevalence of chronic backpain in lower SES families because many correlates of backpain (physical inactivity, daily smoking, mental health problems, overweight) are more common among adolescents in lower SES families [31–34]. Finally, we expected increasing socioeconomic inequality over time because socioeconomic inequality in health tend to mirror income inequality [35–38] and the income inequality in Denmark has increased significantly during the past three decades [39–40].

Materials And Methods

Study design and study population: Health Behaviour in School-aged Children (HBSC) is an international study which aims to examine adolescents' health and health behaviours in their social setting [1]. The HBSC study includes a series of cross-sectional school-surveys of nationally representative samples of three age groups, 11-, 13- and 15-year-olds, carried out every fourth year in currently 50 countries in Europe and North America. The studies are comparable since they adhere to a standard protocol for sampling, measurement, and data collection [1].

Our study used data from eight comparable, cross-sectional, periodical surveys in Denmark in 1991, 1994, 1998, 2002, 2006, 2010, 2014 and 2018. We collected data from random samples of schools, a new sample in each survey, drawn from complete lists of public and private schools. In each school we invited all students in the fifth, seventh and ninth grade (corresponding to the age groups 11, 13 and 15) to participate and complete the internationally standardized HBSC questionnaire in the classroom [41]. The participation rate across all eight surveys was 88.0%, n=35,320. This study included students with complete information about sex, age, prevalence of backpain and the family's SES, n=29,952 (Table 1).

Measurements: Backpain was measured by one item in the HBSC Symptom Check List (HBSC-SCL) [42-44]: "In the last 6 months, how often have you had backpain?" We dichotomized the responses into chronic ("about every day" and "more than once a week") vs. episodic ("about every week", "about every month", and "rarely or never"). The HBSC-SCL is reliable assessed by consistent response patterns and valid assessed by qualitative interviews [42-44]. This measurement was similar in all eight surveys.

SES was measured by family occupational social class (OSC). The students answered six questions about their parents' occupation: "Does your father/mother have a job?", "If no, why does he/she not have a job?", "If yes, please say in what place he/she works (for example: hospital, bank, restaurant)" and "Please write down exactly what job he/she does there (for example: teacher, bus driver)". The research group coded the answers into OSC from I (high) to V (low). We added OSC VI for economically inactive

parents who receive unemployment benefits, disability pension or other kinds of transfer income, similarly based on students' responses. The questions about occupation were identical across surveys and so was the coding procedure [45]. Most students (87.6%) provided enough information for the coding of OSC. Several studies showed that 11-15-year-old schoolchildren can report their parents' occupation with a high agreement with parents' own information [46-49] and Pfortner et al. [50] showed that OSC is an appropriate variable for studies of social inequality in adolescents' health. Each student was categorized by the highest-ranking parent into three levels of OSC: High (I-II, e.g. professionals and managerial positions), middle (III-IV, e.g. technical and administrative staff, skilled workers), and low (V, unskilled workers and VI, economically inactive).

Statistical procedures: We calculated age-standardized prevalence proportions of chronic backpain with 95% confidence intervals. The analyses included chi²-test for homogeneity and Cochran-Armitage test for trends over time. Initial analyses found similar patterns among boys and girls, so the final analyses combined boys and girls and standardized for sex. The analyses of social inequality of chronic backpain included two approaches: 1) Prevalence difference between low and high OSC as an indicator of absolute social inequality and 2) logistic regression analyses to examine the relative social inequality. The logistic regression analyses included OSC, sex, age group and survey year in mutually adjusted models and a final model with inclusion of an interaction term (survey year * OSC) to assess potential interaction between survey year and OSC. The analyses accounted for the applied cluster sampling by means of multilevel modelling (PROC GLIMMIX in SAS). Sensitivity analyses included analyses with two other cut-points of backpain frequency, 1) daily backpain ("about every day") vs. less often and 2) weekly backpain ("about every day", "more than once a week", "about every week") vs. less often.

Results

Prevalence and time trends: In the entire study population, all survey years combined, the sex- and age standardized prevalence of chronic backpain was 11.1% (95% CI: 10.7-11.4%) (Table 1). The prevalence of chronic backpain fluctuated across survey years with an increasing trend, $p < 0.0001$. The lowest level was in 1994 (9.2%) and the highest in 2014 (13.0%) (Table 1). The OR (95% CI) for chronic backpain was 1.24 (1.15-1.34) among girls vs. boys, and it was 1.42 (1.29-1.55) and 1.87 (1.70-2.05) among 13- and 15-year-olds vs. 11-year-olds (Table 2).

Prevalence by socioeconomic groups: The prevalence of chronic backpain was 9.6% (9.0-10.2%), 11.0% (10.5-11.5%) and 13.4% (12.6-14.3%) in high, middle, and low OSC across all survey years, $p < 0.0001$ (Table 1). The prevalence of chronic backpain among 4,393 students without information about OSC was between middle and low OSC (12.4%, not shown in table, not included in the analyses). The above-mentioned increasing tendency from 1991 to 2018 appeared in all OSC groups, $p_{\text{high}} < 0.0001$, $p_{\text{middle}} = 0.0003$ and $p_{\text{low}} = 0.0203$ (Fig 1).

Absolute socioeconomic inequality: The prevalence difference in chronic backpain between low and high OSC was 3.8% in the entire study population. The prevalence difference was statistically significant in

1991, 1994, 1998, 2002, 2006, 2010 (p-values <0.05) but not in 2014 and 2018 (Table 1). It fluctuated across years without any consistent increasing or decreasing pattern; it was highest in 1991 (7.2%) and lowest in 2018 (2.7%).

Relative socioeconomic inequality: Table 2 shows the results of the logistic regression analyses. The OR for chronic backpain was significantly higher in the three latest surveys (2010, 2014 and 2018) than in 1991. The OR (95% CI) for chronic backpain was 1.20 (1.10-1.31) in middle and 1.56 (1.41-1.73) in low compared to high OSC. There was no significant statistical interaction between survey year and OSC (p=0.0767) which indicates that the relative inequality in chronic backpain did not change significantly over survey years.

Sensitivity analyses: Using the alternative cut-points, the prevalence of daily backpain was 5.3% (5.0-5.5%) and the prevalence of weekly backpain was 20.2% (19.8-20.7%) (not shown in table). The logistic regression analyses with these alternative cut-points showed that the direction of the associations was similar, for instance the OR for backpain increased significantly with decreasing OSC regardless of cut-point (Table 2).

Discussion

Main findings: Our study confirms what other studies have shown, that the prevalence of chronic backpain among adolescents is high. Our finding of an average point prevalence of 11.1% having chronic backpain is slightly lower than the meta-analytic investigation by Calvo-Muñoz et al. [18] which found a mean point prevalence from ten studies of 12.0%. The mean period prevalence at 12 months from 13 studies was 33.6% [18]. In general, estimates of the prevalence of backpain in adolescence varies considerably across studies and countries [1, 18-19]. Our finding of an increasing prevalence during the later decades corresponds with studies from Finland and Switzerland [27-28]. In general, trends in symptom prevalence - including backpain - seem to differ by country [26, 51].

Our finding of a higher prevalence of chronic backpain among adolescents from lower SES families corresponds with findings from studies among adolescents in Denmark [23], in the Nordic countries [8] and in a study, which included data from 37 countries in Europe and North America [22]. Other studies have found unclear associations between SES and backpain in adolescence [14, 19, 24-25]. Finally, our expectation of an increasing social inequality in backpain over time was not confirmed since both the absolute and the relative social inequality was relatively stable during the 37-year observation period.

The study does not contribute to the explanation of the social inequality in chronic backpain. One possible explanation is higher frequency of physical inactivity among students from low SES families [31]. We refrained from including physical inactivity in the analyses because of the cross-sectional study design where it is impossible to detect whether physical inactivity is a determinant of or consequence of backpain. The social inequality in chronic backpain could also be explained by higher frequency of other risk factors in low SES families, e.g. overweight, poor fitness, and poor access to training facilities.

Methodological issues: The analyses build upon data from eight nationally representative and comparable studies with a high participation rate among students enrolled in the participating schools (88.0%). Still, there is a risk of selection bias because it is likely that there is an over-representation of students with health problems such as backpain among the absent and non-participating students. Therefore, we assess that the study may under-estimate the prevalence of chronic backpain. Validity studies of the applied measurements of OSC and backpain suggest that the data are valid [42-50], but the measurement of backpain may be too crude. The measurement focuses on frequency but does not include pain intensity or pain location. Some researchers recommend to separate data on neck pain, middle backpain and low-back pain as they should be regarded as specific entities [51-52].

Implications: From a research point of view it is important to unravel the processes which result in higher prevalence of chronic backpain among adolescents from low SES families. Reducing socioeconomic inequalities in childhood and adolescent health, including chronic pain, is an important public health priority because of its multiple long-term adverse health consequences [53]. One way to gain insight is to study how health inequalities have changed over time. We also recommend continued monitoring of the prevalence of chronic backpain, preferably by studies which provide separate data about pain from different parts of the spine.

From a public health point of view, we recommend increased focus on this health problem: It is common and tracks into adulthood [1, 3-7, 9-15] and is self-limiting [54]. According to MacDonald et al. [54] most causes of backpain in adolescence are musculoskeletal and benign in their clinical course. Nevertheless, when more than 10% of adolescents suffer from chronic backpain, it is worth taking seriously. It is important to implement preventive efforts such as sufficient physical activity, leisure-time activities with a balanced and not too high physical impact, restriction of sitting-time, non-smoking, appropriate sitting posture, optimal desk height at school, and improvement of school backpack habits. Finally, physicians should recognize the importance of a proper history, physical examination, and general knowledge of the lumbar spine and pelvic anatomy relevant to the child in their evaluation with this presenting symptom [54].

Abbreviations

HBSC, Health Behaviour in School-aged Children study

HBSC-SCL, HBSC Symptom Check List

SES, Socioeconomic Status

OSC, Occupational Social Class

OR (95% CI), Odds Ratio (95% Confidence Interval)

Declarations

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Data availability: Available on reasonable request to the Principal Investigator, Dr. Katrine Rich Madsen (krma@sdu.dk).

Code availability: Available on reasonable request to the Principal Investigator, Dr. Katrine Rich Madsen (krma@sdu.dk).

Authorship: All authors have contributed substantially to the conception and design of the paper and to the interpretation of data. BEH, MTD, KRM and TPP collected the data. BEH and MTD performed the analyses. BEH wrote the first draft of the manuscript. All authors contributed to the writing of the manuscript and a critical revision of the intellectual content. All authors have approved the final version of the manuscript and are accountable for all aspects of the work.

Ethics approval: There is no formal agency for approval of questionnaire-based surveys in Denmark. The study complied with national standards for data protection. The Danish Data Protection Authority granted acceptance for the 2014 survey (Case No. 2013-54-0576). From 2018 the study has been notified by the Research & Innovation Organization at University of Southern Denmark (Case No. 10 622).

Consent to participate: We obtained approval from the school board (parents' representatives), the headmaster, and the students' council in each participating school. The participants received oral and written information that participation was voluntary, and that data were treated confidentially.

Consent for publication: Not applicable.

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References

1. Inchley J, Currie D, Budisavljevic S, Torsheim T, Jåstad A, Cosma A, Kelly K, Arnarsson AM (eds) (2020) Spotlight on adolescent health and well-being: Findings from the 2017/18 Health Behaviour in School-aged Children (HBSC) Survey in Europe and Canada. International report. Volume 2. Key data. World Health Organization, Copenhagen
2. Kamper SJ, Yamato TP, Williams CM. The Prevalence (2016) Risk Factors, Prognosis and Treatment for Back Pain in Children and Adolescents: An Overview of Systematic Reviews. Best Pract Res Clin Rheumatol 30:1021–1036. doi:10.1016/j.berh.2017.04.003
3. Batley S, Aartun E, Boyle E, Hartvigsen J, Stern PJ, Hestbaek L (2019) The Association Between Psychological and Social Factors and Spinal Pain in Adolescents. Eur J Pediatr 178:275–286.

doi:10.1007/s00431-018-3291-y

4. Harreby M, Nygaard B, Jessen T, Larsen E, Storr-Paulsen A, Lindahl A, Fisker I, Laegaard E (1999) Risk factors for low back pain in a cohort of 1389 Danish school children: an epidemiologic study. *Eur Spine J* 8:444–450. doi:10.1007/s005860050203
5. Hestbaek L, Leboeuf-Yde C, Kyvik KO, Manniche C (2006) Study design: Prospective study with 8-year follow-up. The Course of Low Back Pain From Adolescence to Adulthood: Eight-Year Follow-Up of 9600 Twins. *Spine (Phila Pa 1976)* 31:468–472. doi:10.1097/01.brs.0000199958.04073.d9
6. Jones GT, Macfarlane GJ (2005) Epidemiology of low back pain in children and adolescents. *Arch Dis Child* 90:312–316. doi:10.1136/adc.2004.056812
7. Kjaer P, Wedderkopp N, Korsholm L, Leboeuf-Yde C (2011) Prevalence and Tracking of Back Pain From Childhood to Adolescence. *BMC Musculoskelet Disord* 12:98. doi:10.1186/1471-2474-12-98
8. Grøholt E-K, Stigum H, Nordhagen R, Köhler L (2003) Recurrent Pain in Children, Socio-Economic Factors and Accumulation in Families. *Eur J Epidemiol* 18:965–975. doi:10.1023/a:1025889912964
9. Vivekanantham A, Edwin C, Pincus T, Matharu M, Parsons H, Underwood M (2019) The Association Between Headache and Low Back Pain: A Systematic Review. *J Headache Pain* 20:82. doi:10.1186/s10194-019-1031-y
10. Swain MS, Henschke N, Kamper SJ, Gobina I, Ottová-Jordan V, Maher CG (2014) An International Survey of Pain in Adolescents. *BMC Public Health* 14:447. doi:10.1186/1471-2458-14-447
11. Gustafsson M-L, Laaksonen C, Aromaa M, Löyttyniemi E, Salanterä S (2018) The Prevalence of Neck-Shoulder Pain, Back Pain and Psychological Symptoms in Association With Daytime Sleepiness - A Prospective Follow-Up Study of School Children Aged 10 to 15. *Scand J Pain* 18:389–397. doi:10.1515/sjpain-2017-0166
12. Kamper SJ, Michaleff ZA, Campbell P, Dunn KM, Yamato TP, Hodder RK, Wiggers J, Williams CM (2019) Back Pain, Mental Health and Substance Use Are Associated in Adolescents. *J Public Health (Oxf)* 41:487–493. doi:10.1093/pubmed/fdy129
13. Rees CS, Smith AJ, O'Sullivan PB, Kendall GE, Straker LM (2011) Back and Neck Pain Are Related to Mental Health Problems in Adolescence. *BMC Public Health* 11:382. doi:10.1186/1471-2458-11-382
14. Sjölie AN (2002) Psychosocial Correlates of Low-Back Pain in Adolescents. *Eur Spine J* 11:582–588. doi:10.1007/s00586-002-0412-z
15. Stallknecht SE, Strandberg-Larsen K, Hestbaek L, Andersen A-MN (2017) Spinal Pain and Co-Occurrence With Stress and General Well-Being Among Young Adolescents: A Study Within the Danish National Birth Cohort. *Eur J Pediatr* 176:807–814. doi:10.1007/s00431-017-2915-y
16. Fabricant PD, Heath MR, Schachne JM, Doyle SM, Green DW, Widmann RF (2020) The Epidemiology of Back Pain in American Children and Adolescents. *Spine (Phila Pa 1976)* 45:1135–1142. doi:10.1097/BRS.0000000000003461
17. Noll M, Candotti CT, da Rosa BN, Loss JF (2016) Back Pain Prevalence and Associated Factors in Children and Adolescents: An Epidemiological Population Study. *Rev Saude Publica* 50:31. doi:10.1590/S1518-8787.2016050006175

18. Calvo-Muñoz I, Gómez-Conesa A, Sánchez-Meca J. Prevalence of low back pain in children and adolescents: a meta-analysis. *BMC Pediatrics* 2013; 13, Article number: 14. doi: 10.1186/1471-2431-13-14
19. King S, Chambers CT, Huguet A, MacNevin RC, McGrath PJ, Parker L, MacDonald AJ (2011) The Epidemiology of Chronic Pain in Children and Adolescents Revisited: A Systematic Review. *Pain* 152:2729–2738. doi:10.1016/j.pain.2011.07.016
20. Skoffer B, Foldspang A (2008) Physical Activity and Low-Back Pain in Schoolchildren. *Eur Spine J* 17:373–379. doi:10.1007/s00586-007-0583-8
21. Trevelyan FC, Legg SJ (2011) Risk Factors Associated With Back Pain in New Zealand School Children. *Ergonomics* 54:257–262. doi:10.1080/00140139.2010.547608
22. Holstein BE, Currie C, Boyce W, Damsgaard MT, Gobina I, Kökönyei G, Hetland J, de Looze M, Richter M, Due P (2009) Socio-economic inequality in multiple health complaints among adolescents: international comparative study in 37 countries. *Int J Public Health* 54(Suppl 2):260–270. doi:10.1007/s00038-009-5418-4
23. Joergensen AC, Hestbaek L, Andersen PK, Andersen A-MN (2019) Epidemiology of Spinal Pain in Children: A Study Within the Danish National Birth Cohort. *Eur J Pediatr* 178:695–706. doi:10.1007/s00431-019-03326-7
24. Hestbaek L, Korsholm L, Leboeuf-Yde C, Kyvik KO (2008) Does Socioeconomic Status in Adolescence Predict Low Back Pain in Adulthood? A Repeated Cross-Sectional Study of 4,771 Danish Adolescents. *Eur Spine J* 17:1727–1734. doi:10.1007/s00586-008-0796-5
25. 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* 25:216–220. doi:10.1067/mmt.2002.123172
26. Potrebny T, Wiium N, Lundegård MM-I (2017) Temporal Trends in Adolescents' Self-Reported Psychosomatic Health Complaints From 1980–2016: A Systematic Review and Meta-Analysis. *PLoS One* 12:e0188374. doi:10.1371/journal.pone.0188374
27. Ståhl MK, El-Metwally AAS, Rimpelä AH (2014) Time Trends in Single Versus Concomitant Neck and Back Pain in Finnish Adolescents: Results From National Cross-Sectional Surveys From 1991 to 2011. *BMC Musculoskelet Disord* 15:296. doi:10.1186/1471-2474-15-296
28. Dey M, Jorm AJ, Mackinnon AJ (2015) Cross-sectional Time Trends in Psychological and Somatic Health Complaints Among Adolescents: A Structural Equation Modelling Analysis of 'Health Behaviour in School-aged Children' Data from Switzerland. *Soc Psychiatry Psychiatr Epidemiol* 50:1189–1198. doi:10.1007/s00127-015-1040-3
29. Holstein BE, Andersen A, Denbæk AM, Johansen A, Michelsen SI, Due P (2018) Short communication: Persistent social inequality in frequent headache among Danish adolescents from 1991 to 2014. *Eur J Pain* 22:935–940. doi:10.1002/ejp.1179
30. Holstein BE, Damsgaard MT, Ammitzbøll J, Madsen KR, Pedersen TP, Rasmussen M (2020) Recurrent abdominal pain among adolescents: Trends and social inequality 1991–2018. *Scand J Pain* 21:95–

102. doi: 10.1515/sjpain-2020-0062
31. Johnsen NF, Toftager M, Melkevik O, Holstein BE, Rasmussen M (2017) Trends in social inequality in physical inactivity among adolescents 1991–2004. *SSM Population Health* 3:534–538. doi:10.1016/j.ssmph.2017.04.003
32. Due P, Damsgaard MT, Madsen KR, Nielsen L, Rayce SB, Holstein BE (2019) Increasing prevalence of emotional symptoms in higher socioeconomic strata. Trend study among Danish schoolchildren 1991–2014. *Scand J Public Health* 47:690–694. doi:10.1177/1403494817752520
33. Holstein BE, Andersen A, Damsgaard MT, Due P, Bast LS, Rasmussen M (2020) Trends in social inequality in daily smoking among 15-year-old Danes 1991–2014. *Scand J Public Health* 48:667–673. doi:10.1177/1403494819848284
34. Rasmussen M, Damsgaard MT, Morgen CS, Kierkegaard L, Toftager M, Rosenwein SV, Krølner RF, Due P, Holstein BE (2020) Trends in social inequality in overweight and obesity among adolescents in Denmark 1998–2018. *Int J Public Health* 65:607–616. doi:10.1007/s00038-020-01342-1
35. Elgar FJ, Pförtner TK, Moor I, De Clercq B, Stevens GW, Currie C (2015) Socioeconomic inequalities in adolescent health 2002–2010: a time-series analysis of 34 countries participating in the Health Behaviour in School-aged Children study. *Lancet* 385:2088–2095. doi:10.1016/S0140-6736(14)61460-4
36. Levin KA, Torsheim T, Vollebergh W, Richter M, Davies CA, Schnohr CW, Due P, Currie C (2011) National income and income inequality, family affluence and life satisfaction among 13 year old boys and girls: A multilevel study in 35 countries. *Soc Indicators Res* 104:179–194. doi:10.1007/s11205-010-9747-8
37. Rathmann K, Ottova V, Hurrelmann K, de Loose M, Levin K, Molcho M, Elgar F, Gabhainn SN, van Dijk JP, Richter M (2015) Macro-level determinants of young people's subjective health and health inequalities: a multilevel analysis in 27 welfare states. *Maturitas* 80:414–420. doi:10.1016/j.maturitas.2015.01.008
38. Torsheim T, Currie C, Boyce W, Samdal O (2006) Country material distribution and adolescents' perceived health: multilevel study of adolescents in 27 countries. *J Epidemiol Community Health* 60:156–161. doi:10.1136/jech.2005.037655
39. Jutz R (2015) The role of income inequality and social policies on income-related health inequalities in Europe. *Int J Equity Health* 14:117. doi:10.1186/s12939-015-0247-y
40. Tóth I. Time series and cross country variation of income inequalities in Europe on the medium run: are inequality structures converging in the past three decades? GINI Policy Papers 3, AIAS, Amsterdam Institute for Advanced Labour Studies, 2013
41. Roberts C, Freeman J, Samdal O, Schnohr CW, de Looze ME, Gabhainn SN, Iannotti R, Rasmussen M (2009) The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions. *Int J Public Health* 54(Suppl 2):140–150. doi:10.1007/s00038-009-5405-9
42. Haugland S, Wold B (2001) Subjective health complaints in adolescence - reliability and validity of survey methods. *J Adolesc* 24:611–624

43. Haugland S, Wold B, Stevenson J, Aarø LE, Woynarowska B (2001) Subjective health complaints in adolescence. A cross-national comparison of prevalence and dimensionality. *Eur J Public Health* 11:4–10
44. Ravens-Sieberer U, Erhart M, Torsheim T, Hetland J, Freeman J, Danielson M, Thomas C (2008) An international scoring system for self-reported health complaints in adolescents. *Eur J Public Health* 18:294–299. doi:10.1093/eurpub/ckn001
45. Christensen U, Krølner R, Nilsson CJ, Lyngbye PW, Hougaard C, Nygaard E, Thielen K, Holstein BE, Avlund K, Lund R (2014) Addressing social inequality in aging by the Danish occupational social class measurement. *J Aging Health* 26:106–127. doi:10.1177/0898264314522894
46. Lien N, Friedstad C, Klepp K-I (2001) Adolescents' proxy reports of parents' socioeconomic status: how valid are they. *J Epidemiol Community Health* 55:731–737
47. Pu C, Huang N, Chou YJ (2011) Do agreements between adolescent and parent reports on family socioeconomic status vary with household financial stress? *BMC Med Res Methodol* 11:50. doi:10.1186/1471-2288-11-50
48. Pueyo M-J, Serra-Sutton V, Alonso J, Starfield B, Rajmil L (2007) Self-reported social class in adolescents: validity and relationship with gradients in self-reported health. *BMC Health Services Res* 7:151. doi:10.1186/1472-6963-7-151
49. West P, Sweeting H, Speed E (2001) We Really Do Know What You Do: A Comparison of Reports From 11 Year Olds and Their Parents in Respect of Parental Economic Activity and Occupation. *Sociol* 35:539–559
50. Pförtner T-K, Günther S, Levin KA, Torsheim T, Richter M (2015) The use of parental occupation in adolescent health surveys. An application of ISCO-based measures of occupational status. *J Epidemiol Community Health* 69:177–184. doi:10.1136/jech-2014-204529
51. Jeffries LJ, Milanese SF, Grimmer-Somers KA (2007) Epidemiology of Adolescent Spinal Pain: A Systematic Overview of the Research Literature. *Spine (Phila Pa 1976)* 32:2630–2637. doi:10.1097/BRS.0b013e318158d70b
52. Wedderkopp N, Leboeuf-Yde C, Andersen LB, Froberg K, Hansen HS (2001) Back Pain Reporting Pattern in a Danish Population-Based Sample of Children and Adolescents. *Spine (Phila Pa 1976)* 26:1879–1883. doi:10.1097/00007632-200109010-00012
53. Due P, Krølner R, Rasmussen M, Andersen A, Damsgaard MT, Graham H, Holstein BE (2011) Pathways and mechanisms in adolescence contribute to adult health inequalities. *Scand J Public Health* 39(Suppl 6):62–78. doi:10.1177/1403494810395989
54. MacDonald J, Stuart E, Rodenberg R (2017) Musculoskeletal Low Back Pain in School-aged Children: A Review. *JAMA Pediatr* 171:280–287. doi:10.1001/jamapediatrics.2016.3334

Tables

Table 1 Study population and prevalence of chronic backpain * by year of data collection

	Year of data collection								
	1991	1994	1998	2002	2006	2010	2014	2018	Total
Participation rate ^a	90.2%	89.5%	89.9%	89.3%	88.8%	86.3%	85.7%	84.8%	88.0%
N	1,860	4,046	5,205	4,824	6,269	4,922	4,534	3,660	35,320
Included in the study ^b	1,647	3,546	4,671	4,256	4,975	4,117	3,787	2,953	29,952
Study population									
... by sex									
% boys	49.8	49.2	49.6	48.1	48.4	49.1	47.9	48.4	48.7
% girls	50.2	50.9	50.4	51.9	51.6	50.9	52.1	51.6	51.3
... by age group									
% 11-year-olds	29.9	30.7	33.3	35.3	36.3	35.1	28.4	39.0	33.8
% 13-year-olds	34.7	34.3	35.5	33.3	35.9	34.7	36.4	34.4	35.0
% 15-year-olds	35.4	35.0	31.1	31.4	27.7	30.2	35.2	26.6	31.2
... by OSC^c									
% high	28.2	33.2	28.1	24.9	27.8	38.9	42.4	43.1	33.0
% middle	51.8	48.5	49.8	54.4	49.7	42.3	41.5	44.6	47.8
% low	20.0	18.3	22.1	20.8	22.6	18.8	16.1	12.3	19.3
Prevalence (%) of chronic backpain^{d, e}									
... 95% CI	3.4-5.3	3.1-4.3	4.1-5.3	4.4-5.7	5.2-6.6	5.3-6.7	5.6-7.1	4.5-6.1	5.0-5.5
Prevalence (%) of chronic backpain^{d, e}									
... in high OSC ^{c, d, e}	7.0	7.8	8.4	8.9	9.1	9.4	12.4	11.7	9.6
... 95% CI	4.7-9.4	6.2-9.3	6.9-9.9	7.2-10.6	7.6-10.7	7.9-10.8	10.8-14.1	9.9-13.4	9.0-10.2
... in middle OSC ^{c, d, e}	8.9	9.3	11.4	9.8	11.5	12.7	12.8	11.7	11.0
... 95% CI	7.0-10.8	8.9-10.7	10.1-12.7	8.6-11.0	10.3-12.8	11.2-14.3	11.1-14.4	10.0-13.4	10.5-11.5

... in low OSC ^c	14.4	11.4	11.6	13.8	13.9	14.9	15.2	14.6	13.4
^{d,e}	10.6-	9.9-	9.7-	11.5-	11.9-	12.4-	12.3-	11.0-	12.6-
... 95% CI	18.2	13.9	13.6	16.1	15.9	17.4	18.0	18.3	14.3
Prevalence difference (high-low OSC)^c	7.4 ^f	3.6 ^f	3.2 ^f	4.9 ^f	4.8 ^f	5.5 ^f	2.8	2.9	3.8 ^f

* Self-reported backpain daily or several days a week during the last six months.

^a Number of participants in the data file as percentage of schoolchildren enrolled in the participating classes.

^b Participants with full information on sex, age group, occupational social class and backpain.

^c OSC = Occupational Social Class.

^d Sex- and age-standardized prevalence.

^e The trend from 1991 to 2018 was increasing; the increase was statistically significant assessed by Cochran-Armitage test, $p < 0.05$

^f The prevalence difference was statistically significant, $p < 0.05$.

Table 2 Mutually adjusted OR (95% CI) for chronic backpain ^a

Independent variable	Category	Main analysis: OR (95% CI) for chronic backpain	Sensitivity analyses with other cut-points	
			OR (95% CI) for daily backpain	OR (95% CI) for weekly backpain
Sex	Boys (ref.)	1	1	1
	Girls	1.24 (1.15-1.34)	1.45 (1.31-1.61)	1.10 (1.04-1.16)
Age group	11-year-olds (ref.)	1	1	1
	13-year-olds	1.42 (1.29-1.55)	1.36 (1.19-1.55)	1.46 (1.36-1.57)
	15-year-olds	1.87 (1.70-2.05)	1.58 (1.39-1.80)	2.02 (1.88-2.17)
Year	1991 (ref.)	1	1	1
	1994	0.97 (0.80-1.19)	0.85 (0.63-1.13)	1.06 (0.92-1.24)
	1998	1.13 (0.93-1.36)	1.07 (0.81-1.40)	1.16 (1.00-1.34)
	2002	1.10 (0.91-1.33)	1.16 (0.88-1.52)	1.07 (0.92-1.23)
	2006	1.19 (0.99-1.44)	1.32 (1.02-1.72)	1.05 (0.91-1.21)
	2010	1.30 (1.08-1.58)	1.43 (1.09-1.87)	1.15 (0.99-1.33)
	2014	1.47 (1.22-1.78)	1.55 (1.19-2.03)	1.30 (1.13-1.51)
	2018	1.35 (1.11-1.65)	1.28 (0.96-1.71)	1.30 (1.11-1.51)
Occupational social class	High (ref.)	1	1	1
	Middle	1.20 (1.10-1.31)	1.29 (1.14-1.46)	1.12 (1.05-1.20)
	Low	1.56 (1.41-1.73)	1.81 (1.57-2.09)	1.42 (1.31-1.54)

^a Multivariate multilevel logistic regression analyses using SAS PROC GLIMMIX to account for the cluster sampling.

Estimates in italics are significantly higher than 1.0

Figures

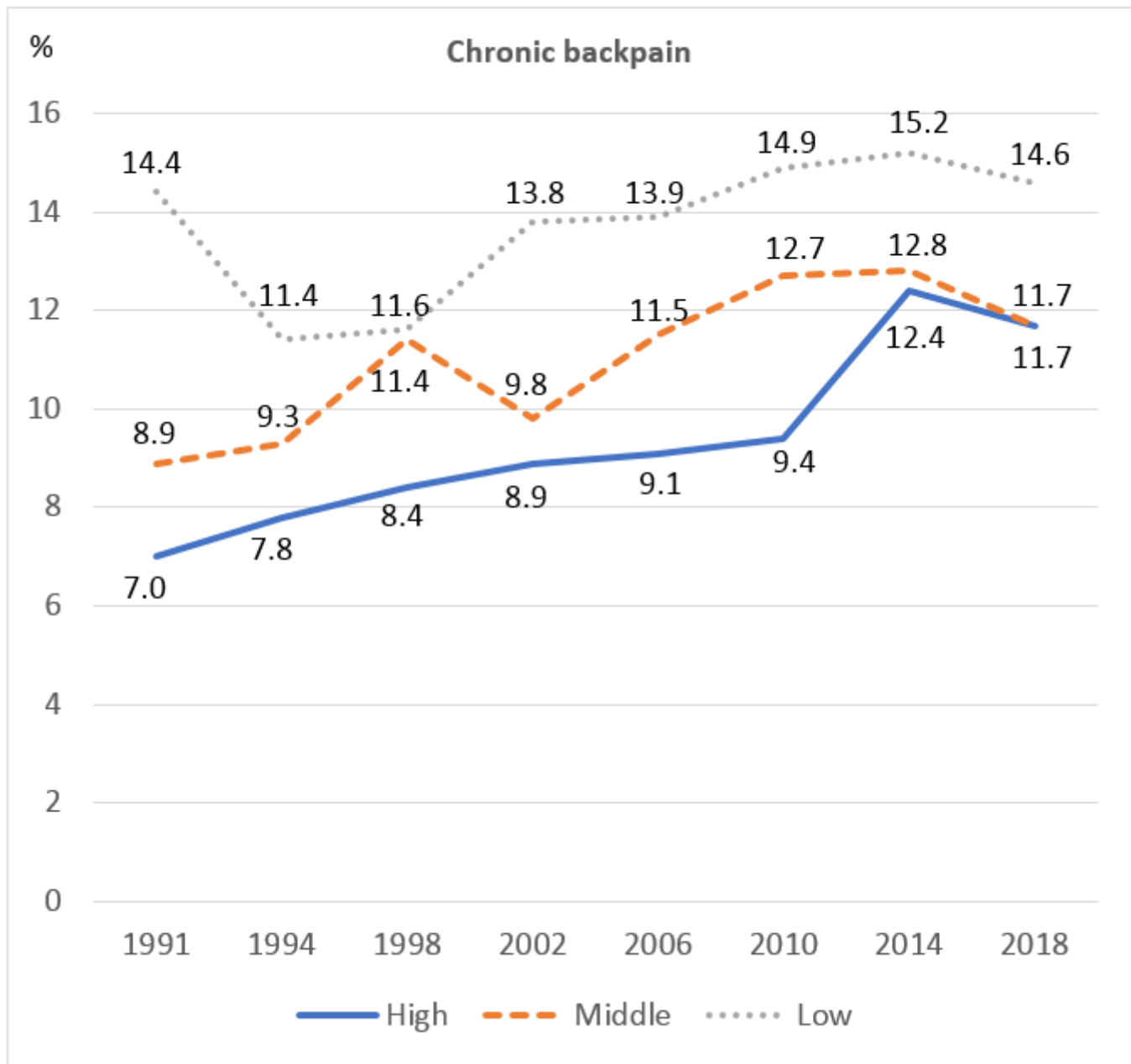


Figure 1

Sex- and age-standardized prevalence of chronic backpain by year and occupational social class