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

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Research Article

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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 Pförtner 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<0.0001, p<0.0001 and p=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-Muños 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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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 | % girls |
|------------|--------|--------|
| 95% CI     | 49.8   | 50.2   |
|            | 49.2   | 50.9   |
|            | 49.6   | 50.4   |
|            | 48.1   | 51.9   |
|            | 48.4   | 51.6   |
|            | 49.1   | 50.9   |
|            | 47.9   | 52.1   |
|            | 48.4   | 51.6   |
|            | 48.7   | 51.3   |

... by age group

| % 11-year-olds | % 13-year-olds | % 15-year-olds |
|----------------|----------------|----------------|
| 95% CI         |                |                |
| 29.9           | 34.7           | 35.4           |
| 30.7           | 34.3           | 35.0           |
| 33.3           | 35.5           | 31.1           |
| 35.3           | 33.3           | 31.4           |
| 36.3           | 35.9           | 27.7           |
| 35.1           | 34.7           | 30.2           |
| 28.4           | 36.4           | 35.2           |
| 39.0           | 34.4           | 26.6           |
| 33.8           | 35.0           | 31.2           |

... by OSC c

| % high | % middle | % low |
|--------|----------|-------|
| 95% CI |          |       |
| 51.8   | 20.0     | 20.0  |
| 48.5   | 18.3     | 49.2  |
| 49.8   | 22.1     | 50.2  |
| 54.4   | 18.8     | 50.9  |
| 49.7   | 16.1     | 51.9  |
| 42.3   | 12.3     | 51.3  |
| 41.5   |          |       |
| 44.6   |          |       |
| 47.8   |          |       |

Prevalence (%) of chronic backpain d, e

| Prevalence (%) of chronic backpain d, e | 4.4 | 3.7 | 4.7 | 5.1 | 5.9 | 6.0 | 6.4 | 5.3 | 5.3 |
|----------------------------------------|----|----|----|----|----|----|----|----|----|
| ... 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 | 4.5-5.0 | 5.0-5.5 |

Prevalence (%) of chronic backpain d, e

| Prevalence (%) of chronic backpain 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 |

Prevalence (%) of chronic backpain d, e

| Prevalence (%) of chronic backpain d, e | 8.9 | 9.3 | 11.4 | 9.8 | 11.5 | 12.7 | 12.8 | 11.7 | 11.0 |
|----------------------------------------|----|----|------|----|------|------|------|------|------|
| ... 95% CI                              | 8.9-10.8 | 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 high OSC c,d,e                     |     |     |      |     |      |      |      |      |      |
| ... 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                  |     |     |      |     |      |      |      |      |      |
| ... 95% CI                              | 8.9-10.8 | 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 \(c, d, e\)

\[
\begin{array}{ccccccccccc}
\text{... 95\% CI} & 14.4 & 11.4 & 11.6 & 13.8 & 13.9 & 14.9 & 15.2 & 14.6 & 13.4 \\
10.6- & 9.9- & 9.7- & 11.5- & 11.9- & 12.4- & 12.3- & 11.0- & 12.6- \\
18.2 & 13.9 & 13.6 & 16.1 & 15.9 & 17.4 & 18.0 & 18.3 & 14.3 \\
\end{array}
\]

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)                               |                                                                          | 1.07 (0.92-1.23)                |
|                      | 2006                              | 1.19 (0.99-1.44)                               | 1.16 (0.88-1.52)                                                        | 1.05 (0.91-1.21)                |
|                      | 2010                              | 1.30 (1.08-1.58)                               | 1.32 (1.02-1.72)                                                        | 1.15 (0.99-1.33)                |
|                      | 2014                              | 1.47 (1.22-1.78)                               | 1.30 (1.13-1.51)                                                        |                                  |
|                      | 2018                              | 1.35 (1.11-1.65)                               | 1.43 (1.09-1.87)                                                        | 1.30 (1.11-1.51)                |
|                      |                                   |                                                |                                                                          | 1.55 (1.19-2.03)                |
|                      |                                   |                                                |                                                                          | 1.28 (0.96-1.71)                |
| 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