

**Short communication**

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## **Short communication: Persistent socioeconomic inequality in frequent headache among Danish adolescents from 1991 to 2014**

**Running head:** Socioeconomic inequality in headache among adolescents

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**Conflicts of interest:** None

**Significance (What does this study add?)** The prevalence of frequent headache among adolescents increases with decreasing socioeconomic status. This socioeconomic inequality has been persistent among adolescents in Denmark from 1991 to 2014. Clinicians should be aware of this social inequality.

## Abstract

**Background:** The association between socioeconomic status and headache among adolescents is an understudied issue and no study has examined whether such an association changes over time. The aim was to examine trends in socioeconomic inequality in frequent headache among 11-15-year-olds in Denmark from 1991 to 2014, using occupational social class as indicator of socioeconomic status.

**Methods:** The study applies data from the Danish part of the international Health Behaviour in School-aged Children (HBSC) study. HBSC includes nationally representative samples of 11-, 13- and 15-year-olds. This study combines data from seven data survey years from 1991 to 2014, participation rate 88.6%, n=31,102. We report absolute inequality as percent difference in frequent headache between high and low occupational social class and relative inequality as odds ratio for frequent headache by occupational social class.

**Results:** In the entire study population, 10.4% reported frequent headache. There was a significant increase in frequent headache from 8.0% in 1991 to 12.9% in 2014, test for trend,  $p < 0.0001$ . This increasing trend was significant in all occupational social classes. The prevalence of frequent headache was significantly higher in low than high occupational social class, OR=1.50 (95% CI: 1.34-1.67). This socioeconomic inequality in frequent headache was persistent from 1991 to 2014.

**Conclusion:** There was a significant and persistent socioeconomic inequality, i.e. increasing prevalence of frequent headache with decreasing occupational social class. The association between socioeconomic position and headache did not significantly change over time, i.e. the statistical interaction between occupational social class and survey year was insignificant.

## Introduction

Headache is one of the most common symptoms among adolescents (Gobina et al., 2015; Inchley et al., 2016; Straube et al., 2013; Walter, 2014; Zwart et al., 2004) and an important threat to quality of life.

Headache among adolescents is associated with a range of stressing experiences such as anxiety, depression, behavioural problems (Blaauw et al., 2014; Milde-Busch et al., 2010), poor psychological functioning (Kröner-Herwig & Gassmann, 2012; Powers et al., 2006), sleep disturbances (Gilman et al., 2007), psychological distress (Stensland et al., 2013), physical complaints (Straube et al., 2013), exposure to interpersonal violence (Stensland et al., 2014), exposure to bullying (Due et al., 2005; Gini et al., 2014) and perceived teacher unfairness (Lenzi et al., 2012). Headache is also associated with risk behaviours such as smoking, alcohol use, and physical inactivity (Milde-Busch et al., 2010; Straube et al., 2013; Walter, 2014).

A few studies have shown increasing prevalence of headache with decreasing socioeconomic status (SES) (Holstein et al., 2009; Lenzi et al., 2013). The mechanisms behind this association are not known but high level of stress and risk behaviour in lower socioeconomic strata may contribute to a higher level of headache. Explanations of health inequalities often focus on economic determinants. De Clercq et al. (2017) propose use of more meaningful social and cultural indicators to understand health inequalities. Occupational social class (OSC) may be a more appropriate indicator of SES because it reflects cultural aspects of family life which may be associated with headache.

Until now, no study has examined changes in socioeconomic inequality in frequent headache over time. This paper examines trends in socioeconomic inequality in frequent headache among 11-15-year-olds in Denmark from 1991 to 2014, using OSC as indicator of SES. Income inequality measured by the Gini coefficient has been increasing in Denmark in this time period, from 0.25 in 1991 to 0.30 in 2010 (Tóth 2013). Since there is an association between income inequality and health inequality (Jutz, 2015) we expect increasing socioeconomic inequality in the prevalence of frequent headache.

## Methods

**Design and study population:** The study applies data from the Danish part of the international research project Health Behaviour in School-aged Children (HBSC) (Inchley et al. 2016, Roberts et al., 2009). The study design is repeated cross-sectional surveys of nationally representative samples of school children in three age groups, 11-, 13-, and 15-year-old. The study only includes school children. We included data from

seven surveys in 1991, 1994, 1998, 2002, 2006, 2010 and 2014. The sampling procedure was similar in all surveys. Inclusion criteria: All students in the fifth, seventh, and ninth grade in random samples of schools, drawn from complete lists of private and public schools. Exclusion criteria: Special schools for students with learning disabilities, students not in school and school drop-outs. The participation rate was 88.6%, n=31,660. After exclusion of 558 participants with missing information the final n was 31,102 (87.0%).

**Data collection and measurements:** All data are self-reported by the participating students. There are no data from parents, school staff, or register-linkage in the data file. The participants answered the internationally standardized HBSC questionnaire (Roberts et al., 2009) in the classroom. Headache was measured in the same way in all surveys by the question: "In the last 6 months, how often have you had headache?" We dichotomized the responses into frequent ("about every day" and "more than once a week") vs. non-frequent ("about every week", "about every month", and "rarely or never"). Two studies (Haugland & Wold, 2001; Haugland et al., 2001) suggest that this measure is reliable assessed by adequate intraclass correlation coefficients and consistent response patterns and also valid assessed by qualitative interviews.

OSC was measured by the students' response to these questions: "Does your father/mother has 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 (Christensen et al. 2014). Most students (87.6%) provided sufficient information for the coding of OSC. Several studies show that schoolchildren in these age categories are able to report their parents' occupation with a fair validity (Ensminger et al., 2000; Lien et al., 2001; Pu et al., 2011; Pueyo et al., 2007; West et al., 2001) compared with parents' own information.

Each participant was categorized by the highest-ranking parent into four levels of OSC: High (I-II, e.g. professionals and managerial positions), middle (III-IV, e.g. technical and administrative staff, skilled workers), low (V, unskilled workers and VI, economically inactive), and unclassifiable. This four-level categorization facilitates the communication of findings and does not hide important information about specific OSC categories.

**Statistical analyses:** We applied the Cochran-Armitage test to analyze trends over time. The analyses of socioeconomic inequality included two measures: 1) Absolute inequality, i.e. percent difference of frequent headache between high (I-II) and low (V-VI) OSC, leaving out middle OSC and unclassifiable; 2) relative inequality measured by odds ratio (OR) for frequent headache with high (I-II) OSC as reference. The logistic regression analyses included sex, age group and survey year as control variables and a final test for statistical interaction between survey year and OSC. We also tested whether the OSC distribution was stable across the seven survey years.

**Ethical issues:** There is no formal agency for approval of questionnaire surveys in Denmark. We asked the school board (parents' representatives), the headmaster, and the students' council in each of the participating schools to approve the study. The participants received oral and written information that participation was voluntary and anonymous. The study complies with national standards for data protection. From 2014 the Danish Data Protection Authority has requested notification of such studies and has granted acceptance (case No. 2013-54-0576).

## Results

Table 1 shows the OSC distribution. In the entire study population, the proportion of participants in high, medium, low and unclassifiable OSC was 27.8%, 42.1%, 17.7% and 12.4%. In the entire study population, 3,242 of 31,102 (10.4%) schoolchildren reported frequent headache, increasing from approximately 8% in the beginning of the 1990s to 12.9% in 2014 (test for trend,  $p < 0.0001$ ). Most of this increase took place from 2010 to 2014. The increasing trend was significant in high, middle, low and unclassifiable OSC ( $p$ -values:  $< 0.0001$ ,  $< 0.0001$ , 0.0005, and 0.0203). The percent difference between high and low OSC in each of the seven surveys was 5.3, 5.0, 0.9, 4.6, 5.1, 5.3 and 4.7 (Figure 1). These data suggest that the absolute inequality in frequent headache was persistent.

The prevalence of frequent headache in high, middle, low and unclassifiable OSC was 8.6%, 10.3%, 12.6% and 11.9% ( $\chi^2$ -test,  $p$ -value  $< 0.0001$ ). The difference in frequent headache between high and low OSC was statistically significant in all survey years ( $\chi^2$ -test, all  $p$ -values  $< 0.01$ ) except in 1998.

Table 2 shows the relative inequality, i.e. OR (95% CI) for frequent headache by OSC. In the entire dataset there was a significant increase in OR (95% CI) by decreasing OSC. The estimates did not change substantially when adjusted for survey year. The OR for frequent headache was significantly higher in low than high OSC in all survey years except 1998. Assessed by the magnitude of the OR estimates, there was

no systematic increasing or decreasing trend in the relative inequality in frequent headache. Although Figure 1 shows slightly different trends for high, medium and low OSC the statistical interaction between OSC and survey year did not reach statistical significance,  $p=0.4991$ .

## **Discussion**

**Findings:** There are three main findings: First that the prevalence of frequent headache among adolescents increased from 1991 to 2014. Second, that the prevalence of frequent headache increased with decreasing OSC. Third, that this social inequality did not change significantly over the 23-year observation period, i.e. there was no statistical interaction between OSC and survey year.

The finding of an increasing prevalence of headache among schoolchildren corresponds to the review by Straube et al. (2013) which compiled information from eight studies from various countries. The observation of an increasing prevalence of headache with decreasing OSC corresponds with the studies by Holstein et al. (2009) and Lenzi et al. (2012). These two studies measured SES by family affluence, defined by four indicators (car ownership, own bedroom, number of computers in the family, number of family vacations last year). They applied the same international dataset although with different cut-off points for low, middle and low family affluence. Our study shows that the association between family affluence and headache and the association between OSC and headache are similar.

During the observation period 1991-2014 there was an increasing trend for some risk factors for frequent headache (emotional symptoms, poor life satisfaction, loneliness, and perceived school pressure). On the other hand, there was a decreasing trend for other risk factors (smoking, alcohol use, physical inactivity, and exposure to bullying) (Rasmussen et al. 2015). The higher prevalence of frequent headache in the lower OSC group may be related to a higher prevalence in this group of most of the above-mentioned risk factors for frequent headache (Rasmussen et al. 2015).

**Methodological issues:** It is strength of this study that we applied a standard protocol for sampling, data collection, and measurement across all survey years. In this way, the seven cross-sectional studies are comparable. The high participation rate is probably related to the school-based data collection and the fact that the study was anonymous. Studies about the validity of the independent variable OSC suggest that this measurement has acceptable validity (Ensminger et al., 2000; Lien et al., 2001; Pu et al. 2011; Pueyo et al., 2007; West et al., 2001). The validity of the measurement of headache is not sufficiently documented

although two studies report that the HBSC measure of symptoms is valid and reliable (Haugland & Wold, 2001; Haugland et al., 2001).

A limitation of the study is the crude measure of headache frequency which provides no information about type and intensity of headache. Several other studies of headache among adolescents apply similar crude measures (Gobina et al., 2015; Lenzi et al., 2012; Walther, 2014). Another potential limitation is that the OSC distribution changed over time, mostly because the upper middle classes increased in size. Finally, although the study includes more than 30,000 students, this may still be insufficient for the detection of a statistical interaction between OSC and survey year.

**Implications:** We propose further studies to explore and understand the association between SES and headache in adolescents. Further, we propose similar studies from other countries to assess whether the findings are generalizable to other countries. Information about trends in socioeconomic inequality in headache is a way to evaluate efforts to reduce such inequalities in adolescent health.

**Author contributions:** All authors made a substantial contribution to the conception and design of the study. BH and PD were responsible for the data collection. BH performed the analyses and drafted the first version of the manuscript. All authors contributed to a critical discussion of the results and a critical revision of the manuscript. All authors approved the final version of the manuscript.



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**Table 1** Study population by sex, age group, occupational social class (OSC), survey year and prevalence of frequent headache

	Survey year							Total
	1991	1994	1998	2002	2006	2010	2014	
Number of participation schools	19	45	55	68	80	73	48	388
Number of participating classes	112	234	302	297	354	302	248	1849
Student response rate <sup>a</sup>	90.2%	90.9%	89.9%	89.3%	88.8%	86.3%	85.8%	88.6%
n	1860	4046	5205	4824	6269	4922	4538	31,664
Included in this study <sup>b</sup>	1827	3962	5107	4776	6184	4867	4379	31,102
Pct. Boys	50.0	49.6	49.7	48.7	49.2	50.1	48.6	49.4
Pct. Girls	50.0	50.4	50.3	51.3	50.8	49.9	51.4	50.6
Pct. 11-year-olds	31.3	31.4	33.7	36.3	37.5	37.0	31.4	34.6
Pct. 13-year-olds	35.0	34.8	35.7	33.6	35.5	33.7	35.2	34.8
Pct. 15-year-olds	33.7	33.9	30.6	30.1	27.0	29.3	33.5	30.6
Distribution by OSC								
Pct. high	26.0	31.2	25.8	22.1	22.3	32.9	37.3	27.8
Pct. middle	47.2	44.2	46.0	48.6	40.1	35.9	36.3	42.1
Pct. low	18.0	16.8	20.9	18.7	18.4	16.2	14.1	17.7
Pct. unclassifiable	8.8	8.8	7.4	10.6	19.3	15.0	12.3	12.4
Pct. with frequent headache ...								
- in high OSC	6.5	6.3	8.8	8.4	8.3	8.1	11.8	8.3
- in middle OSC	8.6	7.5	10.0	10.8	10.5	11.2	12.4	10.3
- in low OSC	11.9	11.3	9.7	13.0	13.4	13.3	16.5	12.6
- in unclassifiable OSC	5.6	9.7	12.8	13.4	11.0	13.4	13.3	11.9
- in the entire study population	8.4	8.0	9.8	11.0	10.6	10.9	12.9	10.4

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

b: Cases with full information on sex, age group, occupational social class and frequency of headache.

**Table 2** OR (95% CI) for frequent headache by occupational social class, adjusted for sex and age group

Survey year	Occupational social class			
	High (ref.)	Middle	Low	Unclassifiable
All years (n=31,102)				
- model 1 <sup>a</sup>	1	<b>1.19 (1.08-1.30)</b>	<b>1.50 (1.34-1.67)</b>	<b>1.48 (1.31-1.68)</b>
- model 2 <sup>a</sup>	1	<b>1.21 (1.10-1.33)</b>	<b>1.53 (1.37-1.71)</b>	<b>1.48 (1.30-1.67)</b>
1991 (n=1827)	1	1.38 (0.89-2.15)	<b>1.97 (1.20-3.25)</b>	0.86 (0.40-1.86)
1994 (n=3962)	1	1.18 (0.88-1.59)	<b>1.82 (1.30-2.55)</b>	<b>1.61 (1.05-2.47)</b>
1998 (n=5107)	1	1.16 (0.91-1.46)	1.09 (0.82-1.45)	<b>1.52 (1.06-2.18)</b>
2002 (n=4776)	1	1.27 (0.98-1.63)	<b>1.58 (1.18-2.12)</b>	<b>1.69 (1.20-2.37)</b>
2006 (n=6184)	1	<b>1.28 (1.01-1.61)</b>	<b>1.69 (1.30-2.18)</b>	<b>1.41 (1.08-1.84)</b>
2010 (n=4867)	1	<b>1.42 (1.12-1.80)</b>	<b>1.74 (1.32-2.29)</b>	<b>1.91 (1.44-2.53)</b>
2014 (n=4379)	1	1.00 (0.81-1.24)	<b>1.41 (1.09-1.84)</b>	1.20 (0.89-1.61)

<sup>a</sup> Model 1 adjusted for sex and age group, model 2 adjusted for sex, age group and survey year

Estimates in bold are statistically significant

Figure 1. Per cent with at least weekly headache by parents' occupational social class and year

