Intake of sugar sweetened soft drinks among adolescents
Trends and social inequality in Denmark 2002-2018
Holstein, Bjørn E; Damsgaard, Mogens Trab; Due, Pernille; Krølner, Rikke Fredenslund; Pedersen, Trine Pagh; Rasmussen, Mette
Published in:
Nutrition and Health

DOI:
10.1177/0260106019900742

Publication date:
2020

Document version
Accepted manuscript

Citation for published version (APA):

Terms of use
This work is brought to you by the University of Southern Denmark through the SDU Research Portal. Unless otherwise specified it has been shared according to the terms for self-archiving. If no other license is stated, these terms apply:

• You may download this work for personal use only.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying this open access version

If you believe that this document breaches copyright please contact us providing details and we will investigate your claim. Please direct all enquiries to puresupport@bib.sdu.dk

Download date: 14. Jun. 2020
Intake of sugar sweetened soft drinks among adolescents: Trends and social inequality in Denmark 2002-2018

Authors: Bjørn E. Holstein, Mogens Trab Damsgaard, Pernille Due, Rikke Fredenslund Krølner, Trine Pagh Pedersen, Mette Rasmussen

Affiliation, all authors: University of Southern Denmark, National Institute of Public Health, Copenhagen

Short title: Trends in social inequality in soft drink intake

Corresponding author
Bjørn E. Holstein
University of Southern Denmark, National Institute of Public Health
Studiestræde 6, DK-1455 Copenhagen, Denmark
e-mail: bho@niph.dk

Word count: abstract 150; main text 2000. References: 20; Tables/Figures: 3
Abstract

**Background:** Intake of sugar sweetened soft drinks (SSSD) has decreased among adolescents, but trends in social inequality in SSSD intake are unknown.

**Aim:** to examine trends in social inequality in SSSD intake among adolescents in Denmark 2002-2018.

**Methods:** Five Health Behaviour in School-aged Children (HBSC) surveys with data on SSSD intake and parents’ occupational social class (OSC) from nationally representative samples of 11-, 13- and 15-year-olds, n=20,112.

**Results:** The overall prevalence of daily SSSD intake decreased from 10.1% in 2002 to 6.4% in 2018. The prevalence decreased in both high OSC (from 8% to 5%) and middle OSC (from 10% to 6%) but remained around 12% in low OSC. The odds ratio estimates of low compared to high OSC increased over the years around an overall OR of 2.01 (1.74-2.34).

**Conclusions:** Danish adolescents’ SSSD intake decreased 2002-2018 and was higher the lower the parents’ OSC. This social inequality increased 2002-2018.

**Key words:** Adolescents, HBSC, social inequality, socioeconomic status, sugar sweetened soft drinks, trend study
Introduction

Sugar sweetened soft drinks (SSSD) is an important source of energy intake among adolescents. High SSD intake is related to overweight and oral health problems (Hardy et al., 2018), clusters with other risk behaviours (Scully et al., 2017), and tracks from childhood to adulthood (Craigie et al., 2011).

Parents’ socioeconomic status is associated with adolescents’ SSD intake, but studies show conflicting findings. A study in 23 countries applied two indicators of socioeconomic status: occupational social class (OSC) and a family affluence scale (FAS). In most countries there was no association between FAS and SSD intake but SSD intake was lowest in high OSC families (Vereecken et al., 2005). A study in 42 countries showed a different pattern for Eastern and Western European countries: SSD intake was most prevalent in poor families in nine Eastern-European countries and most prevalent in affluent families in twenty Western-European countries (Inchley et al. 2016). A study from Lithuania showed highest intake of SSD in affluent families (Zaborskis et al., 2012) while studies from the Nordic countries (Fismen et al. 2016) and the Czech Republic (Voráčová et al., 2016) showed no association between FAS and SSD consumption. A study from Australia found the highest SSD consumption among adolescents in the most disadvantaged areas (Niven et al., 2014) and a study from the US found that children of parents with college or higher education consumed SSD less frequently (Han & Powell 2013).

Trend studies show decreasing SSD intake among adolescents in the last 10-20 years (Fismen et al., 2014; Fismen et al., 2016; Inchley et al., 2017; Zaborskis et al., 2012). Social inequality in SSD intake may change alongside this trend but little is known about this issue. A multi-country study using FAS as socioeconomic indicator shows that the relative social inequality in daily SSD intake increased among girls 2001-2014 but decreased among boys, although with considerable country variations (Inchley et al., 2017). Kant & Graubard (2013) found highest SSD intake among adolescents with affluent and highly educated parents in USA in the 1970s but SSD intake was not associated with parental income or education in later years, i.e. a diminishing social inequality in SSD intake.

In summary, social inequality in SSD intake varies by study, country and indicator of socioeconomic status and it is unclear whether the social inequality changes over time. The aim of this study was to examine trends in social inequality in SSD intake among adolescents in Denmark from 2002 to 2018.
Methods

Design and study population: The paper applied Danish data from the international Health Behaviour in School-aged Children (HBSC) study (Inchley et al. 2016). The study design was repeated and comparable cross-sectional surveys of nationally representative samples of 11-, 13-, and 15-year-olds every fourth year. The last five surveys 2002-2018 used identical measurements of SSSD intake and OSC.

Data collection and measurements: In each survey, we collected data from students in a new random sample of schools drawn from a complete list of private and public schools. The student level response rate across all five surveys was 87.2%, n=24,209 (Table 1). The students answered the internationally standardized HBSC questionnaire in the classroom. SSSD intake was measured by a food frequency item: “How many days a week do you drink sugar sweetened soft drinks?” (never; less than once a week; once a week; 2-4 days a week; 5-6 days a week; once a day every day; every day more than once). A Belgian study reported that this measure was reliable assessed by test-retest agreement and valid assessed by comparison with a seven-day food diary (Vereecken & Maes 2003). We dichotomized the responses into daily (“once a day every day” + “every day more than once”) vs. less often.

The students provided information about their father’s and mother’s occupation. The research group coded this information in accordance with the Danish Occupational Social Class measurement based on two job characteristics: 1) educational requirements and 2) control over capital or people. The categories range from high (I) to low (V) OSC and social class VI for parents who receive unemployment benefits or other kinds of transfer income. Each participant was categorized by the highest-ranking parent into 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) OSC.

Statistical analyses: Participants with missing information about SSSD intake and OSC were excluded, final n=20,112 (Table 1). We calculated sex- and age standardized prevalences with exact 95% confidence limits and applied chi²-test for homogeneity and Cochran-Armitage test for trends over time. The analyses included two measures of social inequality: 1) prevalence difference in daily SSSD intake between low and high OSC as a measure of absolute social inequality; 2) odds ratio (OR) for daily SSSD as a measure of relative social inequality. The logistic regression analyses applied multilevel modeling to account for the cluster sampling, included sex, age group and survey year as control variables and a final test for statistical interaction between OSC and survey year. We used SAS 9.4 for statistical analyses.
Sensitivity analyses: We performed sensitivity analyses with SSSD intake 2+ days per week vs. less to study the importance of cut-point. Further, we applied a different indicator of socioeconomic status - the Family Affluence Scale (FAS) (Currie et al. 2008) – to study the association between socioeconomic status and SSSD. FAS summarizes data on four kinds of consumer goods: family cars, child having own bedroom, and number of computers and family vacations, range 0-7 points categorized as low (0-3 points), medium (4-5 points) and high FAS (6-7 points).

Ethical issues: There is no formal agency for approval of questionnaire-based 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 data file does not comprise data about the identity of the individual participants. The study complies with national standards for data protection. The Danish Data Protection Authority has granted acceptance (Case No. 2013-54-0576).

Results

The study population was a nationally representative sample of 11-, 13- and 15-year-old students. The proportion of students from high OSC increased and the proportion from low OSC decreased over time.

Absolute measures: In the entire study population, the sex and age standardized prevalence of daily SSSD intake was 8.0% (Table 1). The prevalence decreased from 10.1% in 2002 to 6.4% in 2018 (p<0.0001). The overall sex and age standardized prevalence was 5.7% in high, 8.1% in middle and 12.3% in low OSC (p<0.001). The difference between high and low OSC was statistically significant in all survey years as demonstrated by the exact confidence limits (Table 1). The prevalence was 10.6% among 3,544 participants without data on OSC (data not shown). Figure 1 shows a decreasing intake in high (p<0.0001) and middle OSC (p<0.0001) but not in low OSC (p=0.6451). The absolute social inequality (prevalence difference between low and high OSC) increased from 4.7% in 2002 to 8.5% in 2018.

Relative measures: In the entire study population, the OR (95% CI) for daily SSSD intake was lower among girls than boys, OR=0.48 (0.43-0.54) and increased with age, OR=1.60 (1.39-1.83) among 13-year-olds and OR=2.10 (1.83-2.41) among 15-year-olds compared to 11-year-olds. The OR (95% CI) for daily intake was 1.36 (1.20-1.55) in middle and 2.01 (1.74-2.34) in low OSC. These estimates changed only slightly when adjusted for sex, age group and survey year and were significant in all survey years (Table 2). The analyses suggest increasing relative social inequality in daily intake 2002-2018. This was supported by inclusion of an interaction product (year * OSC) in the statistical modelling which was statistically significant, p=0.0226.
**Sensitivity analyses:** Analyses with SSSD intake at least two days per week, confirmed the main observations: Decreasing intake from 2002 to 2018, significantly higher intake among boys than girls, increasing intake with age and higher intake in low OSC families (data not shown). Analyses with FAS showed a daily SSSD intake of 6.5% in high, 8.8% in medium and 11.8% in low FAS families (p<0.0001). The sex-, age- and survey year adjusted OR (95% CI) for daily intake of SSSD was 1.27 (1.13-1.43) in medium and 1.62 (1.33-1.96) in low compared to high FAS families (data not shown).

**Discussion**

There were three main findings: First, the prevalence of daily SSSD intake decreased from 2002 to 2018. This finding corresponds with studies from Europe and USA (Han et al., 2013; Fismen et al., 2016; Inchley et al., 2017). Our study does not include data suitable for explaining this trend.

Second, SSSD intake was most frequent in lower socioeconomic groups. This finding was robust to choice of cut-point and choice of socioeconomic indicator. The finding of higher SSSD intake in low socioeconomic status corresponds with some studies from Europe (Vereecken et al., 2005), Australia (Niven et al., 2014) and USA (Han & Powell, 2013) but contradicts other studies (Fismen et al., 2016; Voráčová et al., 2016; Zaborskis et al., 2012). The finding corresponds with the more general observation of healthier lifestyles in high socioeconomic status groups. Choice of socioeconomic indicator may explain some of the diverging findings in the literature. According to Fismen et al. (2012) and de Clerq et al. (2016), economic capital and cultural capital are differently associated with adolescents’ food choice. OSC is related to cultural capital, i.e. the accumulated cultural knowledge that confers social status and power, while FAS is closer related to economic capital.

Third, the absolute and relative social inequality in SSSD intake increased 2002-2018. This finding contradicts a US-study which applied family income and education (Kant & Graubard, 2013). We lack data to explain the increasing social inequality, but it may reflect the general experience that higher socioeconomic strata adopt new healthier habits faster than lower socioeconomic strata.

**Methodological issues:** It is an advantage that the study includes data from five comparable surveys among nationally representative samples of adolescents. Although the overall student level response rate was high, there is a risk of selection bias. The prevalence of daily SSSD intake was high among students with missing data about OSC; the study may therefore underestimate the prevalence of daily intake. The use of FAS as socioeconomic background factor may not be appropriate. The affluence value of the single
components of the measure, like computers, may change considerable over time. It is possible that the family’s possession of consumer goods appears after the establishment of children’s eating- and drinking patterns in which case FAS is not an independent variable for studies of social inequality in SSSD intake. OSC is closely linked to parents’ educational attainment which probably comes before the establishment of the children’s eating- and drinking patterns.

**Implications for research:** Food habits in adolescence track into adulthood (Craigie et al., 2011) which may be one of the pathways explaining social inequalities in health behaviour, health and body weight in adulthood (Due et al., 2011; Kant & Graubard, 2013). It is therefore important to monitor social inequalities in health behaviours among adolescents.

We propose studies which dig deeper into the measurement issue, i.e. whether different aspects of socioeconomic status (affluence, education, OSC) are differently associated with SSSB intake among adolescents. We need studies on why the social inequality in SSSD intake varies by country (Vereecken et al., 2005; Inchley et al., 2017) and studies of differential effects of SSSD marketing efforts.

**Implications for policy and practice:** School-based health education is a feasible way to control SSSD intake (Avery et al., 2016; Van de Gaar et al., 2014), in particular efforts which include environmental factors such as restricted access to soft drinks and easy access to drinking water. Less is known about how to reduce social inequality in SSSD intake. A possible strategy is to target mediators of the association between socioeconomic status and SSSD intake such as parents’ subjective norm, parenting practices, parental modelling, parental attitude and availability of SSSD at home and school (Van de Gaar et al., 2017).
Acknowledgements: The Principal Investigator for the Danish HBSC studies was Pernille Due until 2010 and Mette Rasmussen from 2010.

Funding: This work was supported by the Nordea Foundation, Copenhagen (grant number 02-2011-0122). The Nordea Foundation had no role in the design, analysis or writing of this article.

Availability of data: Upon request and after application to the Principal Investigator, Dr. Mette Rasmussen (mera@sdu.dk).

Authors’ contribution: All authors contributed substantially to the formulation of research questions, the design of the study and to the data collection. RFK and BEH developed the protocol for coding of occupational social class. BH analysed the data and drafted the paper. All authors contributed to a critical review of analyses and manuscript, approved the final manuscript and can take public responsibility for the content.

Conflicting of interests: The Authors declare that there are no conflicts of interest.
References


Table 1 Study population by sex, age group, occupational social class (OSC), family affluence scale (FAS) and intake of sugar-sweetened soft drinks (SSSD) by survey year

<table>
<thead>
<tr>
<th>Survey year</th>
<th>2002</th>
<th>2006</th>
<th>2010</th>
<th>2014</th>
<th>2018</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invited schools</td>
<td>78</td>
<td>100</td>
<td>137</td>
<td>168</td>
<td>200</td>
<td>683</td>
</tr>
<tr>
<td>Participating schools</td>
<td>69</td>
<td>80</td>
<td>73</td>
<td>48</td>
<td>45</td>
<td>315</td>
</tr>
<tr>
<td>Student response rate</td>
<td>89.3%</td>
<td>88.8%</td>
<td>86.3%</td>
<td>85.7%</td>
<td>84.8%</td>
<td>87.2%</td>
</tr>
<tr>
<td>N included in the data file</td>
<td>4824</td>
<td>6269</td>
<td>4922</td>
<td>4534</td>
<td>3660</td>
<td>24,209</td>
</tr>
<tr>
<td>N included in this study</td>
<td>4195</td>
<td>5011</td>
<td>4102</td>
<td>3853</td>
<td>2951</td>
<td>20,112</td>
</tr>
<tr>
<td>Boys (%)</td>
<td>48.1</td>
<td>48.5</td>
<td>48.9</td>
<td>47.6</td>
<td>48.6</td>
<td>48.3</td>
</tr>
<tr>
<td>Girls (%)</td>
<td>51.9</td>
<td>51.5</td>
<td>51.2</td>
<td>52.4</td>
<td>51.4</td>
<td>51.7</td>
</tr>
<tr>
<td>11-year-olds (%)</td>
<td>35.2</td>
<td>36.2</td>
<td>35.7</td>
<td>29.6</td>
<td>38.7</td>
<td>35.0</td>
</tr>
<tr>
<td>13-year-olds (%)</td>
<td>33.2</td>
<td>36.1</td>
<td>34.3</td>
<td>35.8</td>
<td>34.6</td>
<td>34.8</td>
</tr>
<tr>
<td>15-year-olds (%)</td>
<td>31.6</td>
<td>27.7</td>
<td>30.1</td>
<td>34.6</td>
<td>26.7</td>
<td>30.2</td>
</tr>
<tr>
<td>High OSC (%)</td>
<td>24.7</td>
<td>27.6</td>
<td>38.7</td>
<td>42.4</td>
<td>43.2</td>
<td>34.4</td>
</tr>
<tr>
<td>Middle OSC (%)</td>
<td>54.5</td>
<td>49.5</td>
<td>42.2</td>
<td>41.5</td>
<td>44.6</td>
<td>46.8</td>
</tr>
<tr>
<td>Low OSC (%)</td>
<td>20.8</td>
<td>22.9</td>
<td>19.2</td>
<td>16.1</td>
<td>12.2</td>
<td>18.8</td>
</tr>
<tr>
<td>High FAS (%)</td>
<td>39.4</td>
<td>51.8</td>
<td>60.2</td>
<td>58.0</td>
<td>66.0</td>
<td>54.1</td>
</tr>
<tr>
<td>Middle FAS (%)</td>
<td>47.0</td>
<td>40.5</td>
<td>35.0</td>
<td>36.1</td>
<td>31.2</td>
<td>38.6</td>
</tr>
<tr>
<td>Low FAS (%)</td>
<td>13.6</td>
<td>7.7</td>
<td>4.8</td>
<td>5.9</td>
<td>2.9</td>
<td>7.3</td>
</tr>
<tr>
<td>Daily SSSD intake (%)</td>
<td>10.1</td>
<td>9.0</td>
<td>8.0</td>
<td>5.8</td>
<td>6.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Intake of SSSD 2+ days/week (%)</td>
<td>49.9</td>
<td>46.0</td>
<td>42.9</td>
<td>37.1</td>
<td>39.4</td>
<td>43.6</td>
</tr>
<tr>
<td>Daily SSSD intake in high OSC (%)</td>
<td>8.1</td>
<td>7.1</td>
<td>5.4</td>
<td>3.6</td>
<td>5.1</td>
<td>5.7</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(6.4-9.8)</td>
<td>(5.7-8.4)</td>
<td>(4.3-6.5)</td>
<td>(2.7-4.5)</td>
<td>(3.9-6.3)</td>
<td>(5.1-6.2)</td>
</tr>
<tr>
<td>Daily SSSD intake in middle OSC (%)</td>
<td>10.0</td>
<td>8.4</td>
<td>8.9</td>
<td>5.9</td>
<td>5.6</td>
<td>8.1</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(8.7-11.2)</td>
<td>(7.3-9.5)</td>
<td>(7.5-10.2)</td>
<td>(4.8-7.1)</td>
<td>(4.4-6.9)</td>
<td>(7.5-8.6)</td>
</tr>
<tr>
<td>Daily SSSD intake in low OSC (%)</td>
<td>12.8</td>
<td>12.6</td>
<td>11.6</td>
<td>11.0</td>
<td>13.6</td>
<td>12.3</td>
</tr>
<tr>
<td>(95% CI)</td>
<td>(10.6-15.0)</td>
<td>(10.7-14.6)</td>
<td>(8.3-13.8)</td>
<td>(8.5-13.4)</td>
<td>(10.1-17.1)</td>
<td>(11.2-13.3)</td>
</tr>
<tr>
<td>Prevalence difference in daily intake (high-low OSC)</td>
<td>4.7</td>
<td>5.5</td>
<td>6.2</td>
<td>7.4</td>
<td>8.5</td>
<td>6.6</td>
</tr>
</tbody>
</table>

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

b Number of participants with full data about intake of SSSD, OSC, sex, age group and survey year.

c Sex and age standardized prevalence levels. d Test for trend, p<0.0001. e Test for trend, p=0.6451
Table 2 OR (95% CI) for daily intake of sugar sweetened soft drinks by occupational social class.

<table>
<thead>
<tr>
<th></th>
<th>Occupational social class</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High (reference)</td>
<td>Middle</td>
<td>Low</td>
</tr>
<tr>
<td>Total (n=20,112)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- model 1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1</td>
<td><strong>1.36 (1.20-1.55)</strong></td>
<td><strong>2.01 (1.74-2.34)</strong></td>
</tr>
<tr>
<td>- model 2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1</td>
<td><strong>1.39 (1.22-1.59)</strong></td>
<td><strong>2.11 (1.82-2.46)</strong></td>
</tr>
<tr>
<td>2002 (n=4195)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1</td>
<td><strong>1.32 (1.00-1.74)</strong></td>
<td><strong>1.70 (1.24-2.34)</strong></td>
</tr>
<tr>
<td>2006 (n=5011)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1</td>
<td>1.21 (0.93-1.58)</td>
<td><strong>1.92 (1.43-2.56)</strong></td>
</tr>
<tr>
<td>2010 (n=4102)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1</td>
<td><strong>1.67 (1.26-2.22)</strong></td>
<td><strong>2.16 (1.55-2.99)</strong></td>
</tr>
<tr>
<td>2014 (n=3853)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1</td>
<td><strong>1.66 (1.18-2.33)</strong></td>
<td><strong>3.00 (2.06-4.38)</strong></td>
</tr>
<tr>
<td>2018 (n=2951)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1</td>
<td>1.08 (0.76-1.54)</td>
<td><strong>2.53 (1.68-3.82)</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup> Multivariate logistic regression analyses in multilevel models to account for the cluster sampling.

<sup>b</sup> Unadjusted, <sup>c</sup> adjusted for sex, age group and survey year, <sup>d</sup> adjusted for sex and age group.

Estimates in bold are statistically significant. Statistical interaction between year and OSC, p=0.0226.
Figure 1 Sex- and age standardized pct. with daily intake of sugar sweetened soft drinks by survey year and occupational social class (test for trend in high and middle OSC, p<0.0001, test for trend in low OSC, p=0.6451)