

REGULAR ARTICLE

Danish children born to parents with lower levels of education are more likely to become overweight

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Keywords

Childhood obesity, Maternal education, Paternal education, Scandinavia, Socio-economic status

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Received

Submitted 11 december 2013; revised 7 April 2014;

accepted 16 June 2014.

DOI:10.1111/apa.12722

ABSTRACT**Aim:** Little is known about whether the socio-economic status of parents is linked to their children becoming overweight. This study examined the association between parents' educational level and overweight Danish children in a nationally representative sample.**Methods:** Body mass index was calculated for a random sample of 512 children aged from four to 14 from the Danish National Survey of Diet and Physical Activity 2005–2008. Their parents provided weight and height data during an interview, together with details of their own educational level. Children were classified as overweight/obese in accordance with the International Obesity Task Force. Frequency estimates of prevalence and logistic regression models were used to correlate childhood overweight/obesity with the mothers' and fathers' educational levels as the main outcome measures.**Results:** Danish mothers tended to be more highly educated than fathers and their educational level was inversely associated with their child being overweight, especially if it was a boy. However, the highest educational level of the parents was the only significant educational variable, suggesting that education was associated with overweight children irrespective of the gender of the parent.**Conclusion:** Public health initiatives should target parents with low educational levels to prevent, and reduce, social inequality in overweight children.**INTRODUCTION**

The number of children who are overweight and obese has increased at an alarming rate in recent decades, although statistics may show a levelling off after the year 2000 (1,2). Overweight and obesity should be prevented in early childhood, because excess body fat at this age is associated with the development of psychosocial problems such as low self-esteem later on (3). Children with weight problems also face an increased risk of premature mortality and chronic diseases, such as type 2 diabetes and coronary heart disease (4,5). Overweight and obesity in childhood also tends to persist into adulthood (6,7).

An inverse social gradient in childhood overweight and obesity has been found in most studies in western developed countries (8). In 2006, a Nordic Plan of Action was launched to reduce childhood obesity and to use targeted action to reach groups at risk and combat social inequality in health (9). However, little is known about the impact of the socio-economic status (SES) of the mother and the father on the prevalence of overweight in children. The aim of this study was to examine the association between the

educational levels of mothers and fathers and overweight Danish children in a nationally representative sample of four- to 14-year-olds.

METHODS**Study population and measures**

This study was a secondary analysis of recently published trend data on childhood overweight and obesity in Denmark (10). The study population comprised a random sample of 594 four- to 14-year-old children (response rate 77.7%), drawn from the Danish Civil Registration System

Abbreviations

BMI, Body mass index; CI, Confidence interval; DANSDA, The Danish National Survey of Diet and Physical Activity 2005–2008.

Key notes

- Little is known about links between parents' socio-economic status and paediatric weight problems, and our research examined associations between parental education levels and overweight Danish children.
- Our study of 512 children aged four to 14 years suggested that low parental education was associated with overweight children.
- These findings suggest that public health initiatives should target parents with low educational levels to tackle social inequality in overweight children.

(11), who took part in the Danish National Survey of Diet and Physical Activity 2005–2008 (DANSDA). We excluded people who did not speak Danish, boarding school students, disabled people, nursing home residents and people whose meals were prepared outside their homes. Participants received an invitation letter and study information and were then contacted by a trained, experienced interviewer by telephone. Verbal informed consent was obtained from a parent of each child before they participated.

The DANSDA is a nationwide, representative cross-sectional survey that carries out research on the association between diet, physical activity and health, including being overweight. It is conducted in accordance with the guidelines laid down in the Declaration of Helsinki and is approved by the Danish Data Protection Agency. The Danish National Committee on Health Research Ethics has decided that, according to Danish Law, our study does not require approval.

Data on the children's weight and height, and on the educational levels of the mother and the father, were derived from face-to-face interviews. Previous studies have shown education to be the strongest and most consistent dimension of SES associated with childhood overweight in western developed countries (8). Parental education was therefore chosen as an indicator of the children's SES. The educational variable included a combination of standard school education and further education. In Denmark, children have 9 years of compulsory education in primary and lower secondary school, with an optional tenth year. They can then go on to study vocational programmes that are aimed at direct entry to the labour market or further academic studies, including upper secondary education, with a university bachelor degree taking at least five more years. The educational level of the interviewed parent and his or her current spouse or live-in partner were categorised into three groups: low educational level of up to 13 years, medium educational level of 13–14 years and high education level of 15 or more years. Parental education was defined on the basis of well-established, standard questions used in other Danish population-based studies (12) and was classified in accordance with the standard used by Statistics Denmark. Highest parental educational level was defined as the highest educational level attained by either the mother or the father. Body mass index (BMI) was calculated from the parent-reported weight and height of the child, and children were categorised as being overweight if they exceeded the BMI cut-off points for overweight or obesity according to the International Obesity Task Force age-specific and gender-specific child BMI cut-off points (13).

Statistical analysis

We calculated the prevalence estimates of the mother's educational level, the father's educational level, the highest parental educational level and the childhood overweight/obesity levels for each of the educational groups. The descriptive data were supplemented by logistic regression analysis. Multivariate adjustment for potential confounding factors was carried out in the regression analyses to take

account of differences in the distribution of the mother's BMI, the father's BMI, household income and family status in the educational groups. These factors have a social gradient (12) and have previously been reported to affect the risk of childhood overweight (7,8,14,15). Prevalence estimates of overweight and their 95% confidence interval (CI) were calculated from the regression estimates through the inverse logistic transformation. The probability of overweight models used education (mother, father and highest level), gender (boys or girls), age (four to six, 7–10 and 11–14 years), and interactions between these, as explanatory variables. P-values below 0.05 were considered to be statistically significant.

RESULTS

We included 512 of the 594 children in the analyses, as they had a complete set of data for BMI and parental education. The numbers of boys (253) and girls (259) were roughly equal. The 82 children we excluded comprised: 38 with missing values for weight and/or height, 40 whose parents, or their partners, were still students, as they had not finished their final level of education, and four with parents with the same, or missing, gender.

Characteristics of the study population of children and their parents are shown in Tables 1 and 2. Gender distribution was equal among the children; the mean age was 9.2 (SD 3.0) years; and 16.8% of the children could be categorised as overweight or obese (Table 1). The mean age of the parents was 40.2 (SD 5.6) years, just under two-thirds (65.7%) were in the 35–44 age group (Table 2), and 45.9% were overweight or obese. Of the 512 children, 428 were living with the interviewed parent and his or her current partner and 84 were living with single parents (Table 2). Household income was at least 296,000 Danish kroner for 40.1% of the couples or single parents.

Overall, the Danish mothers had higher educational levels than the fathers ($p = 0.003$). The mother's educational level, but not the father's, was inversely associated with overweight/obesity in all children and in boys (Table 3). The prevalence of overweight was significantly

Table 1 Characteristics of the study sample of children ($n = 512$), DANSDA 2005–2008

	All	Boys	Girls
Age (years; mean (SD))	9.2 (3.0)	9.0 (2.9)	9.4 (3.0)
Age group (n (%))			
4–6 years	125 (24.4)	61 (24.1)	64 (24.7)
7–10 years	193 (37.7)	108 (42.7)	85 (32.8)
11–14 years	194 (37.9)	84 (33.2)	110 (42.5)
BMI (kg/m^2 ; mean (SD))	17.3 (3.0)	17.3 (2.9)	17.4 (3.1)
Weight status (n (%))			
Overweight	70 (13.7)	40 (15.8)	30 (11.6)
Obese	16 (3.1)	6 (2.4)	10 (3.9)

Table 2 Characteristics of the parents of the study sample of children (n = 936), DANSDA 2005–2008

	All	Mother	Father
Age (years; mean (SD))	40.2 (5.6)	39.2 (5.2)	41.4 (5.9)
Age group (n (%))			
23–34 years	126 (13.5)	86 (17.4)	40 (9.0)
35–44 years	615 (65.7)	328 (66.5)	287 (64.8)
45–54 years	180 (19.2)	76 (15.4)	104 (23.5)
55–66 years	15 (1.6)	3 (0.6)	12 (2.7)
Parental education* (n (%))			
Low (≤ 13 years)	188 (36.7)	225 (45.4)	252 (56.8)
Medium (13–14 years)	43 (8.4)	52 (10.5)	25 (5.6)
High (≥ 15 years)	281 (54.9)	219 (44.2)	167 (37.6)
BMI (kg/m ² ; mean (SD)) (n = 912)	25.1 (4.0)	24.4 (4.4)	25.9 (3.3)
Weight status (n = 912 (n (%)))			
Overweight (BMI 25.0–29.9)	318 (34.9)	133 (27.7)	185 (42.8)
Obese (BMI ≥ 30)	100 (11.0)	47 (9.8)	53 (12.3)
Household income [†] (n (%))			
Lowest quintile (<144 000 Danish kroner per year)	65 (13.2)	–	–
Next lowest quintile (144 000–223 999 Danish kroner per year)	95 (19.3)	–	–
Intermediate quintile (224 000–295 999 Danish kroner per year)	134 (27.3)	–	–
Next highest quintile (296 000–389 999 Danish kroner per year)	121 (24.6)	–	–
Highest quintile (>390 000 per year Danish kroner)	76 (15.5)	–	–
Family status [‡] (n (%))			
Couples with one child <15 years	79 (15.4)	–	–
Couple with two children <15 years	215 (42.0)	–	–
Couple with at least three children <15 years	134 (26.2)	–	–
Single parent with one child <15 years	31 (6.1)	–	–
Single parent with two children <15 years	34 (6.6)	–	–
Single parent with at least three children <15 years	19 (3.7)	–	–

*Highest parental educational level of the mother and/or the father for all children (n = 512).

[†]Household income of couples or singles with at least one child (n = 491). 7,45 Danish kroner = 1 euro.

[‡]Family status for couples or singles with at least one child (n = 512).

higher in all children, particularly boys, if their mothers had a low (21.3% (95% CI 16.0; 26.7) than high (12.3% (95% CI 8.0; 16.7) educational level. The descriptive results were confirmed by the logistic regression analysis, disregarding the highest parental educational level, which showed that the mother's educational level showed a significant effect

($p = 0.001$), but not the father's educational level ($p = 0.81$). However, when the model was extended to the highest parental educational level, only the highest parental educational level ($p = 0.001$), gender of the child ($p = 0.001$), mother's BMI ($p < 0.0001$) and the number of children living with couples ($p = 0.001$) were significant. This suggests that the highest parental educational level was more strongly associated with childhood overweight than the mother's educational level. The logistic regression analysis found that the prevalence of overweight in the boys of parents with a low educational level (25.0% (95% CI 15.5; 35.8)) was three times higher than the combined medium and high education level group (8.4% (95% CI 5.3; 12.1, not tabulated)). When we adjusted for family status, the prevalence estimates for all educational groups in girls were statistically indistinguishable from the medium/high group in boys. Mother's BMI and the number of children living with couples were positively associated with childhood overweight, with the highest prevalence of overweight among the daughters of couples with at least three children. However, no relationship was found between the father's BMI and household income (data not shown). Adding children living with single parents did not change the results significantly ($p = 0.92$).

DISCUSSION

When we disregarded highest parental educational level in the preliminary regression analysis, we found social inequality in childhood overweight when the mothers' educational level was used, but not when the fathers' educational level was used. These results are in line with other studies (15–17), which suggest that the mother's socio-cultural capital plays an important role in influencing their children's lifestyle and health behaviour (18). However, the observed gender difference in the present study was explained by the children's mothers having a higher overall level of education than the children's fathers. When all the variables were analysed together, highest parental educational level was the only significant educational variable in the model. The importance of parental education for childhood overweight was highlighted by a systematic review by Shrewsbury and Wardle (8). They reported that 15 of the 20 studies from western developed countries reported an inverse relationship between parental education and childhood overweight, four studies reported a mixed association and one study reported no association (8). However, in a recent study, Moschonis et al. (19) found that family income was more strongly associated with childhood overweight than parental education in primary school children in Greece.

In the present study, the mother's BMI was found to be positively related to childhood overweight, which is in agreement with other studies (7,14–16). However, our finding that the highest prevalence of overweight occurred in the daughters of couples with at least three children differs from what has previously been reported in families with single children (20). Although multivariate adjustments

Table 3 Percentage (95% CI) of overweight/obesity for mothers', fathers' and highest parental educational level (highest level) for all children (n = 512), boys (n = 255) and girls (n = 259), DANSDA 2005–2008

	Mother						Father						Highest level*							
	All [†]		Boys [†]		Girls [†]		All [†]		Boys [†]		Girls [†]		All [†]		Boys [†]		Girls [†]			
	n	95% CI	n	95% CI	n	95% CI	n	95% CI	n	95% CI	n	95% CI	n	95% CI	n	95% CI	n	95% CI		
Low (<=13 year)	225	21.3 ^a (16.0;26.7)	109	25.7 ^a (17.4;33.9)	172	17.2 (10.3;24.1)	116	18.7 (13.8;23.5)	252	20.3 (13.3;27.3)	128	16.9 ^a (10.3;23.6)	124	23.9 ^a (17.8;30.1)	188	30.0 ^a (20.5;39.5)	90	18.4 (10.7;26.1)	98	18.4 (10.7;26.1)
Medium (13–14 year)	52	13.5 ^{a,b} (4.1;22.8)	23	8.7 ^{a,b} (0.0;20.5)	17.2	17.2 (3.2;31.2)	29	8.0 (0.0;18.9)	25	14.3 (0.0;33.3)	14	0 ^b (0.0;0.0)	11	11.6 ^{a,b} (1.9;21.3)	43	10.5 ^{a,b} (0.0;24.7)	19	12.5 (0.0;26.0)	24	12.5 (0.0;26.0)
High (>=15 year)	219	12.3 ^b (8.0;16.7)	109	11.0 ^b (5.1;16.9)	13.6	13.6 (7.2;20.1)	110	14.4 (9.0;19.7)	167	14.0 (6.6;21.3)	86	14.8 ^a (7.0;22.6)	81	12.8 ^b (8.9;16.7)	281	11.8 ^b (6.5;17.1)	144	13.9 (8.1;19.7)	137	13.9 (8.1;19.7)

*Highest parental educational level of the mother and/or the father.

[†]Percentage of overweight/obesity in both boys and girls with unlike superscript letters (a,b) differed significantly (p < 0.05) between parental educational groups (student's t-test).

were made for key factors, such as the mother's BMI, the father's BMI, household income and family status, we cannot rule out that other possible confounding factors, such as smoking during pregnancy (21), may limit the interpretation of our results.

Overall, our results indicate that parental education is independently associated with childhood overweight, as suggested by Shrewsbury and Wardle (8). This may be due to education influencing knowledge and beliefs and impacting on healthy lifestyles (8). To the authors' knowledge, the present study is the first to report that the parents' education was associated with childhood overweight irrespective of the gender of the parent in a nationally representative sample. Women in Scandinavia and in several European Union countries have higher educational levels than men (22), and European trend data suggest that this gender difference will grow in the future.

A clear social gradient in childhood overweight was only found in boys, which indicates that parental education has more impact on health behaviour in boys than in girls. We cannot explain why the educational level of the parents in this study seems to influence the weight development of boys more than girls. The gender difference could be due to a less favourable development in physical activity among boys than girls (10), and perhaps parents with a higher education level have been more successful at preventing overweight in their children (23). This may explain why boys of parents with low educational levels seem to be the group that has been most affected by the obesity epidemic. This is supported by newly published data from DANSDA that shows that social inequality in overweight is increasing among Danish boys, but not among girls (10).

Our data also support the idea that parents with low educational levels may be less concerned about their child's excess weight as a health problem and less able to react to it than parents with high educational levels (17,24). One Danish study has shown that parents with low socio-economic status (SES) believed that the child was obese due to factors not related to eating and, or, exercise (25). This may explain why efforts towards healthy eating and exercise are not seen as so important in low SES families as in high SES families. Recently reported data from DANSDA 2005–2008 confirm the existence of a social gradient in diet and exercise that may promote excess weight gain among the children of parents with low educational levels, especially boys (26).

The school setting makes it possible to reach all school-aged children of families with diverse SES. Furthermore, preschool health examinations in Denmark include height and weight measurements, together with data on the parents' SES, making it possible to link parental education to childhood overweight. School health examinations provide a unique opportunity to track childhood overweight across SES in young school-aged children and target prevention programmes at families with low levels of education and overweight children.

One strength of the present study is the fact that the data comes from a representative sample, covering a wide age

range of children and all regions of Denmark. Very few recent studies have reported data on parental education and childhood overweight in such a nationally representative sample (14,27). The high response rate (77.7%) adds support to this representativeness. The study sample was representative of the child population in Denmark by gender and age when compared with census data. However, we cannot exclude the possibility of systematic differences in overweight between participants and nonparticipants, because the children of parents with a low educational level were underrepresented. Limitations of the study were the small sample size, which could lead to a loss of statistical power, and the use of parent-reported weight and height, which may have resulted in biased estimates of the true prevalence of overweight (28). We do not know how the parents in the present study obtained the reported weight and height of their children; so, these measurements may be imprecise. Finally, the cross-sectional study design does not allow us to establish a causal relationship between parental education and childhood overweight.

CONCLUSION

Education seems to have an impact on childhood overweight irrespective of the gender of the parent. Data on parental education are essential in population-based studies in western developed countries when exploring determinants for childhood overweight. In general, women in countries like Denmark have higher educational levels than men. As a result, the mother appears to play the key parental role in combatting social inequality in children's health. To reduce social inequality in childhood overweight, public health initiatives should target parents with low educational levels.

ACKNOWLEDGEMENTS

The authors wish to thank Data Warehouse Manager Karsten Kørup and Data Scanning Manager Hanne-Jette Hinsch, for contributing to the data processing, and all the children and parents who took part in the Danish National Survey of Diet and Physical Activity.

COMPETING INTERESTS

The authors declare no conflict of interest.

FUNDING

This research received no specific grant from any funding agency in the public, commercial or nonprofit sectors.

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