Associations of behavioural, psychosocial and socioeconomic factors with over- and underweight among German adolescents

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Summary

Objectives: The prevalence of overweight and obesity has dramatically increased in western societies. This paper examines behavioural, psychosocial and socioeconomic factors associated with overweight and underweight among adolescents in Germany.

Methods: Data from the German part of the 2001/02 Health Behaviour in School-aged Children (HBSC) survey, composed of 5,650 respondents aged 11 to 17 years were analysed. Body mass index (BMI) was calculated based on self-reported weight and height. The overweight category was defined as BMI within or above the 90th percentile of specific BMI values for gender and age in the German national sample. The underweight category was defined as BMI within or below the 10th percentile of this sample. A multinomial logistic regression model was used to investigate the association between behavioural, psychosocial and socioeconomic factors and BMI categories.

Results: 9.5 % of the boys and 5.4 % of the girls were classified as overweight. The prevalence of underweight was 12.6 % among boys and 19.1 % among girls. Several factors were associated with over- and/or underweight in the bivariate analysis, showing different patterns for gender and BMI categories. In the multivariable model only low family affluence, high sedentary behaviour, and being bullied (for girls only) remained positively associated with being overweight. Being underweight was negatively associated with higher age and low parental occupation; it differed also by region.

Conclusion: Despite several variables being associated with overweight and underweight in bivariate models, only three factors remained associated with overweight in multivariable analysis. Other considered variables did not have independent associations with the outcome, but still could be included in respective causal pathways. Our results suggest that preventive strategies focussing on students of low socio-economic status and the avoidance of sedentary behaviours could help to address issues of overweight and obesity.

The general increase in the prevalence of overweight and obesity among children and adolescents has become a key threat for public health in industrialised countries[1,2]. Current research shows that overweight in childhood and adolescence is associated with several individual and social determinants: physical inactivity[3–8], consumption of sweets and soft drinks[9], lack of parental support, stress associated with unsatisfactory outcomes in school and/or being bullied[6,10,11], and low socio-economic status[12–15]. So far, many studies dealing with correlates of overweight in children have focused on single or very limited numbers of associations. In addition, studies frequently compare overweight children with all others, discounting possible differences between normal weight and underweight children. The aims of this study were 1) to assess what behavioural, psychosocial and socioeconomic factors are associated with weight problems before and after mutual adjustment of the factors, and 2) to analyse whether the associations differ by gender or age.

Methods

Sample

Data were obtained from the German part of the 2001/02
Health Behaviour in School-aged Children (HBSC) study, a
multinational study that was conducted in collaboration with
the World Health Organization[16,17]. The total sample included
5,650 students (49.3 % boys, 50.7 % girls) aged 11–17 years
(mean 13.5 years; SD 1.71). Data were collected by means
of a standardised questionnaire. Teachers administered the
questionnaires in the classroom. Students were included in
the study if they volunteered to participate and if their parents
had also signed an informed consent. Further details of the
German HBSC study can be found elsewhere[18].

Body-Mass Index

Body-Mass-Index (BMI) was calculated from self-reported
weight and height (kg/m²). The age- and gender-specific BMI
cut-off points for the German population were used to define
subjects as underweight (≤10th percentile), normal weight
and overweight (≥90th percentile)[19]. While most variables
had a very low proportion of missing responses, 7–8 % of the
weight and/or height responses were missing; these responses
were included in a separate category for the analysis of miss-
ing values.

Behavioural, psychosocial and socioeconomic factors

The following variables were analysed (categories are indi-
cated in parentheses).
Socioeconomic factors: family structure (living with both
parents, single parent family, step-family, and other); parental
occupation (high, middle and low status of the head of the
household); family affluence was measured with a four item
scale[20,21]: number of vacations during the past year, family car
ownership, number of computers in the household, and wheth-
er children had their own bedroom (high, middle and low).

Psychosocial factors: Parental support was measured with
four items: "How easy is it for you to talk to the following peo-
ple about things that really bother you?" a) father, b) mother,
c) stepfather, d) stepmother" (Students who reported that it
was "difficult" or "very difficult" to talk to any of the named
persons were classified as having low support); classmate sup-
port was measured with a three item scale: "The students in
my class(es) enjoy being together", "Most of the students in
my class(es) are kind and helpful", "Other students accept me
as I am" (high, low); school adjustment was assessed with a
composite of three items "How do you feel about school at
present?", "In your opinion, what does your teacher(s) think
about your school performance compared to your class-

mates?", and "How pressured do you feel by the schoolwork
you have to do? (high, low); number of friends of the same and
the opposite sex (more than two friends, two or less).

Behavioural factors: smoking (less than once a week, at least
once a week); physical activity in the past week and in a typical
week (2–7 days a week, 0–1.5 days a week)[22]; sedentary be-
haviour: composite score of three items of hours spent watch-
ing television, using a computer, doing homework (low, high);
consumption of fruits/vegetables and sweets/soft drinks in a
typical week (low, high); having breakfast at home on school
days (not every day, every day)[23,24]; weight control behaviour
(yes, no) being bullied at school in the past two months (rare-
ly/never, more than two times a month).

Statistical Analysis

When no explicit rules for calculating scores from multiple
variables with similar content existed, Categorical Principal
Components Analysis (CATPCA) was used to build a com-
posite index. CATPCA is a non-parametric version of factor
analysis suitable for analysis of categorical (ordinal) vari-
ables[25–27]. The obtained scores were dichotomised at median
or into tertiles. When missing values exceeded the level of
10 %, they were included in the analysis as a separate cat-
egory. Bivariate analyses were performed separately for boys
and girls and for the subgroup with missing values for weight
or height. Thereafter, all independent variables were included
in a multinomial logistic regression model together with in-
teractions between them and gender or grade. Backward se-
lection was performed to obtain a reduced model, including
only terms significant at $p < 0.05$.

Results

Prevalence of overweight and underweight and patterns
of missing information on BMI

A lower proportion of girls (5.4 %) compared to boys (9.5 %)
were classified as overweight (≥90th percentile) and 19.1 %
of the girls and 12.6 % of the boys were classified as under-
weight (≤10th percentile). The proportion of missing BMI
information was slightly higher in girls than in boys and for
children in lower grades; it also differed strongly across re-
gions (Table 1).

Factors associated with over- and underweight in bivariate
analysis

Several of the analysed covariates were significantly ($p < 0.05$)
associated with weight categories, but the pattern differed by
gender and for underweight/overweight (Table 1). Low paren-

Table 1. Percentages of children with overweight, underweight or missing BMI information for different characteristics (separate analyses for both genders for weight categories, normal weight is not presented but is composite to 100 %, for missing BMI composite to 100 % is non-missing).

	Boys N = 2,433				Girls N = 2,445				Total sample	
	Under-weight	p-value*	Over-weight	p-value*	Under-weight	p-value*	Over-weight	p-value*	Missing BMI	p-value#
Total	**12.6**		**9.5**		**19.1**		**5.4**		**13.7**	
Grade		<0.05				<0.05				<0.05
5 (11-year olds)	15.8		8.2		22.2		5.3		18.7	
7 (13-year olds)	13.4		10.6		20.3		5.8		11.5	
9 (15-year olds)	8.0		9.8		14.8		5.0		9.8	
Region/Municipality						<0.05				<0.05
Berlin (B)	13.7		11.4		16.4		5.3		5.8	
Hesse (HE)	11.6		6.7		20.4		5.8		17.1	
Northrhine-Westphalia (NRW)	13.4		9.9		20.7		5.3		15.8	
Saxony (SA)	9.4		9.7		12.6		4.9		4.0	
Socioeconomic factors										
Family structure								<0.05		
both parents	12.3		9.2		18.8		4.7		14.0	
Single parent	11.1		11.5		18.0		8.6		12.8	
step family	15.1		10.5		22.8		5.1		11.8	
Other	20.0		5.0		20.8		8.3		8.3	
Parental occupation+		<0.05		<0.05				<0.05		<0.05
High	16.1		6.2		21.9		4.8		9.8	
Middle	11.8		8.0		19.6		4.3		13.4	
Low	10.8		11.8		16.9		6.9		13.8	
Family affluence+				<0.05				<0.05		
High	13.6		6.8		21.6		2.6		12.1	
Middle	13.3		9.8		18.7		6.0		14.2	
Low	9.7		13.1		16.7		7.6		14.7	
Psychosocial factors										
Parental support+										
High	12.6		10.0		19.0		4.8		14.2	
Low	12.4		8.3		18.7		5.9		12.5	
Missing	15.4		17.3		19.7		4.7		28.8	
Class mate support+		<0.05								
High	14.1		9.0		19.9		5.2		14.0	
Low	11.2		9.7		17.9		5.6		13.3	
School adjustment+		<0.05				<0.05				
High	14.2		9.0		20.4		4.9		14.0	
Low	10.3		10.0		17.1		6.0		13.1	
Friends of same sex								<0.05		
More than two	10.8		9.2		19.4		5.0		13.4	
Two or less	12.7		11.5		14.0		9.5		15.6	
Missing	14.3		17.9		26.5		4.1		19.8	
Friends of other sex		<0.05				<0.05				<0.05
More than two	13.9		9.4		18.1		5.9		11.8	
Two or less	10.1		9.6		19.0		4.7		14.4	
Missing	17.5		8.4		25.2		5.0		20.3	

Table 1 continued.

	Boys N = 2,433				Girls N = 2,445				Total sample	
	Under-weight	p-value*	Over-weight	p-value*	Under-weight	p-value*	Over-weight	p-value*	Missing BMI	p-value#
Behavioural factors										
Smoking										
Less than once a week	13.1		9.4		19.6		5.5		14.3	
At least once a week	9.5		10.1		16.1		4.7		10.3	
Physical activity								<0.05		
2–7 days per week	12.8		9.3		19.1		5.1		12.8	
0–1.5 days per week	13.5		11.8		18.6		8.1		16.2	
Sedentary behaviour+						<0.05		<0.05		
Low	12.6		8.5		20.4		4.2		13.9	
High	12.7		10.4		16.1		7.8		13.0	
Consumption of fruits/ vegetables+										
Low	11.9		10.2		19.1		5.5		14.6	
High	13.2		8.4		19.1		5.2		12.4	
Consumption of sweets/soft drinks+		<0.05				<0.05				
Low	10.8		10.3		17.4		5.6		14.9	
High	14.5		8.3		22.3		5.0		11.6	
Having breakfast every school day						<0.05		<0.05		
Not every day	12.0		11.2		16.2		7.2*		14.6	
Every day	12.5		8.9		20.7		4.3		12.9	
Weight control behaviour		<0.05		<0.05		<0.05		<0.05		
No	13.1		7.4		21.4		3.9		13.2	
Yes	4.7		32.2		8.5		12.5		16.0	
Being bullied				<0.05				<0.05		
Rarely / never	12.7		9.0		19.0		4.5		13.1	
more than 2 times a month	12.1		13.2		19.5		16.6		16.8	

+ see method section for scale definition
* chi-square test within gender (remaining weight categories recoded into a joint category); effect not significant when no p-values are given
# chi-square test comparing respondents with missing and non-missing values

tal occupational status, low family affluence, weight control behaviour, and having been bullied at least once a week were more frequently associated with being overweight in both genders. Having a single parent family, two or more friends of same sex, high levels of sedentary behaviour, having breakfast irregularly and low physical activity were more frequent only in overweight girls. In contrast, having a high number of friends of the opposite sex, a low level of adjustment to school, younger age, and dieting behaviour were all associated with the underweight category in both genders. High occupational status of the parents and high levels of classmate support were associated with being underweight in boys but not in girls. On the other hand, low sedentary behaviour and regularly having breakfast were frequently reported only in girls who were underweight.

Factors associated with over- and underweight in multivariable regression

In a multiple regression analysis we found a significant positive association between overweight and sedentary behaviour and a negative association between family affluence and overweight (Table 2). Dieting was used to control for the possible modification of food consumption in overweight pupils; this removed the negative association between consumption of sweets/soft drinks and being overweight. There was no interaction between any of the assessed risk factors and age or gender, apart from the interaction between being bullied and gender. Girls who were bullied at school had an odds ratio of more than 10 (calculated from the odds ratios for girls bullied at school versus not bullied boys (4.5) and girls not bullied at

Table 2. Factors associated with overweight and/or underweight among 11- to 17-year old German students in multiple multinomial regression (odds ratios and 95 % confidence interval).

Variable	Overweight	Underweight	Missing BMI
Sedentary behaviour			
High vs. low	1.37 (1.06–1.77)	0.92 (0.76–1.10)	1.20 (1.00–1.45)
Consumption of sweets/soft drinks			
High vs. low	0.87 (0.68–1.12)	1.51 (1.27–1.80)	0.81 (0.67–0.98)
Parental occupation			
low vs. middle	0.89 (0.62–1.28)	0.78 (0.63–0.97)	1.21 (0.93–1.56)
low vs. high	1.21 (0.85–1.74)	0.72 (0.57–0.92)	1.31 (0.99–1.73)
Family affluence			
Middle vs. low	0.80 (0.60–1.06)	1.25 (0.99–1.57)	1.02 (0.81–1.28)
high vs. low	0.53 (0.38–0.75)	1.24 (0.97–1.58)	0.90 (0.70–1.15)
Dieting			
yes vs. no	3.82 (2.90–5.03)	0.39 (0.28–0.56)	1.16 (0.91–1.49)
Grade			
7 vs. 5	1.15 (0.85–1.57)	0.85 (0.70–1.04)	0.56 (0.45–0.69)
9 vs. 5	1.15 (0.84–1.57)	0.51 (0.41–0.63)	0.42 (0.34–0.53)
Regions			
Saxony vs. Hesse	0.98 (0.64–1.52)	0.60 (0.43–0.84)	0.18 (0.11–0.29)
Berlin vs. Hesse	1.07 (0.68–1.70)	0.97 (0.69–1.36)	0.30 (0.19–0.47)
Northrhine-Westphalia vs. Hesse	1.08 (0.78–1.50)	1.12 (0.90–1.40)	0.93 (0.76–1.15)
Interaction between gender and being bullied			
Girls			
Being bullied	4.50 (3.39–5.61)	1.24 (0.19–2.29)	1.87 (0.88–2.87)
Not bullied	0.43 (0.32–0.57)	1.77 (1.48–2.13)	1.26 (1.04–1.53)
Boys			
Being bullied	1.27 (0.82–1.96)	1.28 (0.69–2.37)	1.14 (0.76–1.72)
Not bullied (reference)	1	1	1

school versus boys not bullied at school (0.43)) for overweight compared with non-bullied girls, whereas the association was much weaker in boys. Being underweight was negatively associated with higher grades and higher parental occupation; it also differed across regions. Being bullied had no significant association with being underweight. Several other variables (included in Table 1, but omitted in Table 2) that showed significant bivariate relationships had no significant association with any of the weight categories in the multivariable model.

Discussion

Prevalence of overweight (for age and sex specific cut-off points) was lower than the nominal value of 10 % in the normative sample for German adolescents[19], whereas the prevalence of underweight was considerably higher, especially in girls. There was a substantial fraction of missing values for reported weight and height with differences across regions of Germany (the proportion of missing BMI was much larger in West German than in East German regions), which sug-

gests some cultural or organisational differences. The higher proportion of missing information was accompanied by a higher proportion of underweight, especially among girls. In the Welsh HBSC sample the prevalence of overweight would have been higher by about 5 % if measured data instead of self-reported were evaluated[28], but the analysis included only adolescents who reported BMI. The discrepancy between international comparisons in estimates of the prevalence of overweight in school-age children based on normative samples and HBSC datasets has been discussed in length by Lissau[29]. Our results suggest that additionally the potential impact of missing BMI information needs to be evaluated. The effects of missing responses and underreporting of weight and over-reporting of height may differ across countries and genders.

Our results support findings from previous studies which showed strong and consistent relationships between various measures of socioeconomic status and being overweight in adolescence[12–14,30–32]. Others found parental obesity as a risk factor[33], or social support and encouragement of physical activity as protective factors[34,35]. Both aspects are likely to be

related to parental socioeconomic status. Differential under-reporting of weight could play an additional role when social desirability is stronger in higher socioeconomic groups. Nevertheless, the finding that family affluence was still associated with overweight after adjusting for so many covariates in our analysis points to the high relevance of socioeconomic status for overweight among adolescents.

Sedentary behaviour was found to be associated with overweight in several longitudinal studies[5,11,36,37] and this association is supported by the evidence from intervention studies[38,39]. However, associations between sedentary behaviour and being overweight observed in cross-sectional studies may not have arisen from the causal effect of the sedentary behaviour itself, but rather, from an increase in sedentary behaviour due to being overweight[40].

Being bullied is seen more often as a consequence of overweight[6,10,11]; however, bullying can also aggravate weight problems through social isolation[6,41]. The strong difference of the association between being bullied and weight categories by gender found in our study could be caused by gender differences regarding perception of body weight[41]. After adjusting for other variables (including being bullied) we did not find any association between social support (from friends, parents or classmates) and being overweight.

Apart from family affluence, sedentary behaviour, and being bullied (in girls) none of the potential behavioural, psychosocial or socioeconomic factors proposed to affect weight problems were associated with a higher risk of overweight in our analysis. Consumption of sweets and soft drinks displayed an opposite relationship with overweight than the theoretically postulated one. Since consumption of sweets is traditionally strongly associated with overweight, it might be most exposed to social desirability bias. More factors were associated with

risk for overweight in bivariate analysis, but after controlling for other variables, the associations were no longer significant. The lack of independent association with the outcome can either mean that the bivariate association resulted from confounding or that there is an indirect association mediated by any of the variables included in the multivariable model.

Limitations

The results are not representative for Germany, since only four regions were selected for the study and within the regions only one third of the invited schools participated. A major limitation is that all variables were self-reported and thus exposed to different forms of bias. As stated by Elgar et al.[28], self-reported body weight and height are important measures in epidemiological research, but the possibility of differential reporting across weight categories, genders, ethnic groups, regions and countries should be ruled out prior to comparisons.

In conclusions, whereas cross-sectional studies cannot establish causal relationships, we aimed to identify associations, which persist in a cross-sectional study after adjusting for other variables. We investigated a wide range of variables potentially associated with weight, including age and gender, measures of parental socioeconomic status, measures of social support and social stress as well as several documented behavioural factors. Many of the factors were significantly associated with being overweight in the bivariate analysis. But in the multivariable analysis, only three factors were associated with being overweight: sedentary behaviour, being bullied and family affluence. These results suggest that preventive strategies which target overweight and obese students from lower socio-economic backgrounds may effectively tackle weight problems.

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