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Social Inequality and Overweight in German Primary School Children: A Cross-Sectional Analysis

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ABSTRACT

Objective: Overweight and obesity lead to adverse health outcomes and track from childhood into adulthood. There is growing evidence that social disparities in overweight already exist in childhood. This study examines associations between weight status in childhood, parental cultural background and socioeconomic status (SES).

Methods: Height and weight were measured in 1646 primary school children (7.1 ± 0.6 years, 50.1% male), of which 489 (29.8%) had a migration background. Body mass index (BMI) was calculated and weight status was determined based on national and international percentile curves. Migration status and SES were obtained through a parental questionnaire. Logistic regression was used to estimate odds of overweight, adjusted for age, gender and parental BMI.

Results: Prevalence of overweight including obesity was 18.5%. It was higher among children with migration background (26.5% p<0.001). Children whose parents emigrated from Turkey exhibited the highest overweight prevalence (34.8%, p<0.001). Children with migration background had an 81.9% higher risk of being overweight (p<0.001) while children from families with low income had a 114.9% higher risk of being overweight (p<0.001). The combination of both revealed no significant effect, showing that the two factors are independently related to childhood overweight.

Conclusion: Migration background and low family income are substantial independent risk factors for childhood overweight. Public health policies need to consider the social gradient in health as well as intracultural differences which are present already in childhood in order to be effective and to avoid further health inequalities.

Key Words: Childhood; Parents; Obesity; Overweight; Adiposity; Social gradient; Socio-economic status; Social background

INTRODUCTION

Inactivity and unfavorable lifestyle trends lead to adverse systemic and mental health outcomes worldwide and in all social strata. A growing number of young people is physically inactive and frequently as a consequence suffering from overweight and obesity [1,2]. High body weight very often tracks from childhood into adulthood [3]. Current prevalence of childhood overweight and obesity is substantial in many countries, but large variations between and within countries exist. In general, prevalence is higher in developed countries [4].

In 2016, over 340 million children and adolescents worldwide were overweight or obese [5]. Since 1975, the prevalence of overweight and obesity has risen from four to over 18% in 2016 and is continuously increasing in most countries [5]. The obesity prevalence among children has always been lower compared to adults, but the growth rate is higher. Childhood obesity is associated with several non-communicable diseases such as cardio-vascular diseases, certain forms of cancer and type 2 diabetes mellitus, inflammation, and is a significant early threat for adult morbidity and mortality [2,6].

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For children as for adults, migration to western countries increases the risk of overweight and obesity [7]. Variations in overweight prevalence between migrant and non-migrant populations may be due to epi-genetic predisposition as well as environmental and behavioral factors. Immigrants often have been exposed to specific experiences, which can be passed to their offspring, starting from infancy and even intrauterine life [8]. However, not only the process of migration, but also settlement in the new home country involves risks in terms of lifestyle related diseases. Traditional nutrition habits are abandoned while westernized patterns such as high contain of salt, sugar and fat are adopted [9]. Especially migrants coming from poorer to wealthier countries show elevated obesity prevalence rates due to these environmental and behavioral changes [10]. A longer period of stay is thus associated with higher prevalence rates of overweight and obesity (Waters et al., 2008). In addition, societies of developing countries often have a cultural preference for higher bodyweight as sign of wealth [11].

In 2020, 26.7% of the total population in Germany had a migration background [12]. This percentage is rising every year. A large representative study in Germany has shown that children with a two sided migrant background are generally at higher risk of becoming obese than those with a one sided or no migrant background [13]. Another high risk factor for overweight and obesity for children in industrialized countries is a low socioeconomic status (SES) [14,15].

In a study of 997 first graders in Germany, children with a low SES and migration background were more likely to show unfavorable health behavior patterns, higher BMI scores and poorer motor skills [16]. Differences in SES do not seem to be able to explain those inequalities sufficiently [15].

The interplay between cultural and socioeconomic factors remains unclear and it has to be further examined, whether migration background is a proxy for SES regarding weight status, or whether there is an independent effect. This cross-sectional study aims to investigate the interplay between cultural background, SES (i.e. educational background and income) and childhood overweight in order to better comprehend the potential for variation in future intervention strategies and to finally reduce health inequalities.

METHODS

The evaluation is designed as a cross-sectional investigation. Baseline data from the cluster randomized Baden-Württemberg primary school study were evaluated [17]. The study was approved by the ethics committee of Ulm University (Application No. 126/10) and is registered at the German Clinical Trials Register, German Institute of Medical Documentation and Information [DRKS-ID DRKS00000494].

Participants

A total of 1968 parents gave their written informed consent for their children to take part in the study. 1956 children, between six and nine years of age, visiting primary schools (1st and 2nd grade) in Baden-Württemberg, southwest Germany were examined. In the data processing, 310 children were excluded since information on country of origin was not available from both parents. Accordingly, 1646 schoolchildren (7.1 ± 0.6 years, 50.1% male), of which 489 have a migration background, are included in the statistical analysis. Questionnaire data were available from 1714 parents.

Data Collection

Children's weight status includes Body Mass Index (BMI), BMI percentiles and Waist to Height Ratio (WHtR). Examinations were performed according to the standardized procedures by trained examiners in small groups of children, separated by gender [18,19]. Measurement of body weight was performed using calibrated flat scales (Seca® 826, Hamburg, Germany) in minimal clothing. Height was measured barefoot with mobile stadiometers (Seca® 217, Hamburg, Germany). Waist circumference was measured halfway between the lower costal border and the iliac crest using a metal tape measure (Lufkin® W606PM, Lufkin Industries Inc., Texas, USA). Children's BMI was calculated (kg/m2). BMI percentiles (BMIPCT), based on German and international cut off criteria, were used to classify children into overweight or obese [20-22]. In addition, WHtR as a measure of central obesity (WHtR>0.5) was calculated.

Level of academic and professional education and monthly net income from both parents were assessed within the parental questionnaire. Family level of education was categorized according to the adjusted "Comparative Analyses of Social Mobility in Industrial Nations" (CASMIN) classification [23]. Levels were dichotomized into tertiary and elementary/intermediate level of education. Household monthly net income was assessed on a seven point scale and dichotomized into <1750 € and ≥ 1750 €.

Children were identified as having a migrant background if they wereborn abroad or at least one parent was born abroad [12]. A distinction between children with one and two sided migrant background was made. Further, three migrant groups were specified, based on geographical location: from Turkey, from Eastern Europe, and from other countries. Children not having a migration background were titled "native".

Analysis

Data evaluation was performed using IMB SPSS Statistics 22 (SPSS Inc., Chicago, IL, US). Significance level was set to $\alpha<0.05$. Socio-demographic characteristics of the sample were described, categorized into migrant and native children and further subdivided into parental origin (Germany, Turkey, Eastern Europe and other). Overweight and obesity prevalence, according to national and international cut-off points and World Health Organization [21,24]. WHtR and socioeconomic factors were reported. Pearson's Chi^2-Test and Mann Whitney U-Test were used to reveal group-differences. Binary logistic regression was employed to analyze strength and direction of associations between weight status, SES, cultural background and parental weight status.

Regressions were run separately for each explanatory variable and also block wise with forced entry, adjusted for age, gender and parental BMI. Results were presented as odds ratios (OR) with 95% confidence intervals (CI). Possible joint effects of cultural background and socioeconomic factors on childhood overweight were examined.

RESULTS

Of the 1646 children included in the analysis, 489 (29,7%) had at least one parent, who was born abroad in one of 62 countries represented. 50.1% of the children were male and the majority were 5, 6 or 7 years of age (99.1%), the mean age of the sample was 7.1 (± 0.6) years. 76.8% of the mothers and 76.5% of the fathers were born in Germany. From those parents who were born abroad, most came from Eastern Europe (51.3% and 47.1%, respectively) or Turkey (22.3% and 26.6%, respectively). In 23.3% of the families, one of the parents spoke another language than German to the child. There was no family in which none of the parents was able to speak German. Descriptive characteristics of the study population are shown in **Table 1**.

Table 1: Descriptive characteristics of the study population

	Missing values	Migrant (n=489)	Native (n=1157)	Total (N=1646)
Age, years [m (SD)] *		7.13 (0.66)	7.04 (0.61)	7.06 (0.63)
Gender, male n (%)		237 (48.5)	587 (50.9)	825 (50.1)
BMI, kg/m² [m (SD)] **	47	16.34 (2.39)	15.75 (1.87)	15.94 (2.07)
BMIPCT [m (SD)] **	47	53.20 (28.53)	46.13 (26.47)	48.37 (27.33)
BMI z-score [m (SD)]**	47	0.32 (1.21)	0.06 (1.02)	0.14 (1.08)
WHtR>0.5, n (%)**	51	54 (11.0)	62 (5.4)	116 (7.0)
Family net income <1 750€, n (%)**	207	101 (23.3)	83 (8.3)	184 (12.8)
Family education medium/ low, n (%)**	81	345 (76.2)	703 (63.4)	1048 (67.1)
Single parent, n (%)*	26	58 (12.1)	87 (7.6)	145 (9.0)

m (SD) mean (standard deviation), BMI body mass index, BMIPCT BMI percentiles, WHtR Waist-to-Height Ratio *Significant difference between the groups (p<0.05), **Highly significant difference between the groups (p<0.01)

The overall sample prevalence of overweight including obesity was 18.5% and 5.0% for obesity alone (according to WHO reference values) as shown in **Table 2** [9]. For children with migration background, the prevalence was 26.7% and 7.9%, respectively. No gender differences either for overweight including obesity or obesity alone could be detected. The mean BMI z-score (WHO) was 0.14 (± 1.08).

Table 2: Prevalence of overweight (and obesity) defined by German and international cut-off points

Gender	Origin	Total	German reference values		WOF reference values		WHO reference values	
		n	n	%	n	%	n	%
Girls	Native	567	44 (9)	8.1 (1.6)	64 (9)	11.7 (1.6)	82 (13)	14.8 (2.3)
	Migrant	250	26 (16)	10.8 (6.6)	49 (15)	20.3 (6.2)	69 (19)	26.7 (7.9)
	One-sided	110	10 (6)	9.4 (5.7)	17 (5)	16 (4.7)	27 (7)	25.5 (6.6)
	Two-sided	140	15 (10)	11.3 (5.7)	31 (10)	23.3 (7.5)	38 (12)	28.6 (9.0)
Boys	Native	587	40 (19)	7.0 (3.3)	50 (15)	9.1 (2.6)	89 (30)	15.6 (5.3)
	Migrant	233	31 (12)	13.4 (5.2)	34 (11)	14.7 (4.8)	66 (18)	27.4 (7.8)
	One-sided	95	15 (4)	16.1 (4.3)	16 (4)	17.2 (4.3)	21 (7)	22.6 (7.5)
	Two-sided	138	15 (7)	11.1 (5.2)	17 (6)	12.6 (4.4)	36 (10)	26.7 (7.4)
Total	Native	1154	84 (28)	7.5 (2.5)	118 (24)	10.5 (2.1)	171 (43)	15.2 (3.8)
	Migrant	516	57 (28)	12.1 (5.9)	83 (26)	17.6 (5.5)	125 (37)	26.5 (7.8)
	One-sided	205	25 (10)	12.6 (5.0)	33 (9)	16.6 (4.5)	48 (14)	24.1 (7.0)
	Two-sided	278	30 (17)	11.2 (6.3)	48 (16)	17.9 (6.0)	74 (22)	27.6 (8.2)

Native both parents born in Germany, Migrant one-sided one parent born abroad, Migrant two-sided both parents born abroad, WOF World Obesity Federation, WHO World Health Organization

Parental BMI

Children's overweight was positively associated with parental BMI (p<0.001). With a mother being overweight or obese, children had a 42.7% higher risk of being overweight or obese (CI 1.247-1.633, p<0.001). Almost the same was true for the fathers (OR 1.436, CI 1.232-1.673, p<0.001). Having one overweight or obese parent in general increased the odds by 82.8% (CI 1.257-2.651, p<0.01). Being a child of two overweight or obese parents increased the chance of being overweight by 269.5% (CI 2.471-5.528, p<0.001). Therefore, analyses were adjusted not only for age and gender, but also for parental BMI.

Socioeconomic Position

Overweight including obesity was negatively associated with parental education and family income (**Table 3**). Children of parents with low or medium education were 55.3% more likely to be overweight or obese compared to the reference population (CI 1.113-2.167, p=0.01). Children of families with a net income <1750 € had 96.2% higher odds of being overweight (CI 1.316-2.924, p=0.001) compared to children from families with a higher income.

Parental Origin

Children whose parents emigrated from Turkey exhibited the highest overweight prevalence (34.8%, p < 0.001). Children of mothers born in Turkey carried the highest risk being almost twice as likely to be overweight or obese compared to children with native parents (OR 1.916, CI 1.316-2.789, p=0.001). In ad-

dition, a father born in Turkey elevated the odds (OR 1.749, CI 1.235-2.477, p<0.01). No significant differences were found across the other groups of origin as shown in Table 4.

Table 3: Final binary logistic regression model

	b	95% CI for Odds Ratio		
		Lower	Odds	Upper
Migration background	0.598 [0.284, 0.936]	1.323	1.819	2.502
Low family income	0.765 [0.341, 1.191]	1.422	2.149	3.247
Constant	-7.438 [-9.444, -5.261]		Total	Total

R^2= .54 (Hosmer-Lemeshow) .08 (Cox & Snell) .13 (Nagelkerke).

Table 4: **Prevalence and risk estimates for overweight (including obesity)**

	n	%	OR	95% CI	p value
Maternal country of origin					
Germany	1261	78.5	Reference	1.316, 2.789	0.001
Turkey	77	4.8	1.916	0.686, 1.283	0.689
Eastern Europe	181	11.3	0.938	0.628, 1.385	0.731
Othera	88	5.5	0.933		
Paternal country of origin					
Germany	1243	77.3	Reference	1.235, 2.477	0.002
Turkey	99	6.2	1.749	0.759, 1.404	0.841
Eastern Europe	175	10.9	1.032	0.663, 1.461	0.939
Othera	90	5.6	0.985		
Family education					
High	514	32.8	Reference		
medium/low	1051	67.2	1.553	1.113, 2.167	0.010
Family net income					
≥ 1750 €	1255	12.8	Reference	1.316, 2.924	0.001
<1750 €	184	87.2	1.962		
Single Parent					
No	1474	91.0	Reference	1.051, 1.566	0.014
Yes	146	9.0	1.962		
Maternal BMI					
Normal weightb	1043	68.2	Reference		
Overweightc	486	31.8	1.427	1.247, 1.633	<0.001
Obese	151	9.9	1.447	1.194, 1.753	<0.001
Paternal BMI					
Normal weightb	886	61.0	Reference	1.232, 1.673	<0.001
Overweightc	566	39.0	1.436	1.392, 1.945	<0.001
Obese	204	14.0	1.645		

[a] Other nationalities include Southern Europe, Asia, and others b Normal weight including underweight, c Overweight including obese, Regressions were run separately for each explanatory variable.

The ANOVA revealed no significant differences between one and two sided migration background concerning BMI, BMIPCT, z-score and WHtR. However, differences between no and one sided migration background (BMI p<0.01, BMIPCT p<0.05, z-score p<0.05, WHtR p<0.05) and between no and two sided migration background (BMI p<0.01, BMIPCT p<0.01, z-score p<0.01, WHtR p<0.05) were detected. Differentiating for parental country of origin, the group with Turkish parental origin differs from the native group in BMI, BMIPCT, z-score and WHtR, according to the Kruskall-Wallis Test (maternal origin: BMI p<0.001, BMIPCT p<0.001, z-score p<0.001, WHtR p<0.01; paternal origin: BMI p<0.001, BMIPCT p<0.001, z-score p<0.001, WHtR p<0.001).

The final analysis was adjusted for age, gender and parental BMI. The Pearson Chi2 test shows a strong association between childhood overweight (WHO) (p < 0.001) and maternal cultural background ($\chi2(3)=28.705$, p<0.001), using the four categories: Germany, Turkey, Eastern Europe and other. This is also true for central obesity (WHtR<0.5), but only in girls [maternal background: ($\chi2(3)=22.542$, p<0.001); paternal background: ($\chi2(3)=30.409$, p<0.001)].

In the final binary logistic regression model, having a migration background and a family net income below 1750€ showed to be relevant risk factors on childhood overweight (Table 4). Children with a migration background had an 81.9% higher risk of being overweight (CI 1.323-2.502, p<0.001) while children coming from a family with low income had a 114.9% higher risk (CI 1.422-3.247, p<0.001). The combination of both revealed no significant effect, showing that the two factors are independently related to childhood overweight.

DISCUSSION

The interplay between cultural and socioeconomic factors is still unclear in scientific literature. In the present cross-sectional study, anthropometrical, socio-economic and cultural factors were assessed in a large, statewide sample of families in southwest Germany. The results show a higher prevalence of overweight and obesity among children with migration background compared to children of German born parents. A similar finding was observed for children from low income families. These effects showed to be independent from each other.

In this sample, the overall prevalence of overweight including obesity was 18.5% and 5.0% for obesity alone. Prevalence in children with migration background was 26.7% and 7.9%, respectively. Another large study from Germany revealed similar observations with an overweight prevalence among migrant children of 12.7% compared to 6.9% among non-migrant children [25]. Numerous international studies also found a higher prevalence of overweight and obesity in migrants in general [21,26,27]. However, such comparisons are not necessarily practical since countries differ in their migration history and origin of immigrants. In addition, the definition of migration background is not uniform. Different reference values for childhood overweight and obesity make the evaluation even more difficult.

Parameters such as SES, duration of stay and immigrant generation are not assessed routinely. Therefore, the effect of migration on overweight was possibly underestimated in the present study, since children and adolescents from the first immigrant generation have been shown to have a lower prevalence of overweight (13.6%) than those from the second or third immigrant generation (22.6%) [28]. Findings reveal that not all groups of migrants are affected by overweight and obesity in a similar manner. In the present sample, children from parents born in Turkey had an elevated risk of being overweight or obese whereas children from parents born elsewhere did not differ significantly from the native reference group. In Germany and the Netherlands, children from parents originating from Turkey have been identified as a high risk group for childhood overweight [29]. In the Netherlands, children and adolescents aged 0-21 years from Turkish (n=2904) and Moroccan (n=2855) origin had a higher overweight prevalence compared to their Dutch counterparts (n=14500) [29]. The overweight prevalence in Turkish boys and girls was 23.4% and 30.2%, in Moroccans 15.8% and 24.5%, for Dutch adolescents in large cities 12.6% and 16.5%, and for other Dutch participants 8.7% and 11.3%, respectively. Also, in the Dutch ABCD cohort (n=3871), girls from mothers with Turkish and Moroccan origin were at a higher risk of early weight gain during infancy (0-3 years) already [30]. In Austria, anthropometric data of 1786 children aged six, 10, and 15 years were collected, showing that children from Turkey but especially from former Yugoslavia display an elevated weight status [31]. In order to determine whether this effect is genetic, cultural or a result of acculturation, comparable data on childhood overweight prevalence in Turkey would be useful. Unfortunately, there is no large scale nationwide study on prevalence of childhood obesity in Turkey available. Several local studies performed between 2001 and 2011 in different regions of Turkey have shown varying prevalence rates of (8.3%-22.4%) (1.6%-10.6%) for overweight (and obesity) in 2-18 year olds with a peak before puberty [32]. Obviously, those numbers cannot be compared to the present study outcome due to the huge variations in subject sampling.

In the present study, overweight including obesity was negatively associated with parental education and family income. Children of parents with low or medium education were more likely to be overweight or obese compared to the reference population. Children of families with a low income had an elevated risk of being overweight. These findings correspond with former scientific work [33] However, this can only be observed in developed countries. In developing countries the effect works inversely [14]. Even though Turkey has an industrializing economy, evidence suggests that obesity is more prevalent in children of higher SES in Turkey which contrasts to studies executed in Germany and other westernized countries [34].

Although this study has a large sample size, which increases the likelihood of having sufficient power to detect differences, some aspects should be considered when interpreting these findings. As every study, this study faces potential sources of bias. First, the parental questionnaire was only available in German, which could have led to a response bias and a misclassification of SES due to language deficits of some respondents. Consequently, there was no family in which none of the parents spoke German. Second, a non-response bias might have occurred due to avoidance of anthropometric measurements by overweight children and parents, which might have led to a reduction of effect estimates. Further, parental height and weight was based on self-report, which might have led to downward bias and misclassification of weight status. However, this type of bias is consistent across gender, age and ethnic groups [35,36] Another source of misclassification might have been the primary use of the “2007 WHO growth reference for school age children and adolescents” for classification of children’s weight status [9]. It is designed for children and adolescents aged 5-19 years but have not been widely used, which makes it difficult to compare prevalence rates on an international or even on a national basis. Nevertheless, it was possible to compare and analyze differences between subgroups of the sample. The WHtR, as a measure of central obesity, was objectively measured in this sample by trained stuff according to the ISAK-standards, which makes up a notable strength in data acquisition [20,32]. Parental data were analyzed from both mother and father. Moreover, it was not only differentiated for migrant or native, but also for origin country of each of the parents. Unfortunately, data about second or third immigrant generations was not obtained. Linear relationships between immigrant generation and weight status could not be detected. The CASMIN-index is a one-dimensional indicator of educational level. As parental education plays a particular role in the development of childhood overweight and obesity, decomposition of SES components (e.g. education, income, professional qualification) gives a more detailed picture than a multidimensional index. The three categories for non-native respondents (Turkey, Eastern Europe, other) or even dichotomization (migrant/non-migrant) partly failed to describe the diversity in migrant groups. However, the case numbers of 489 children with migration background with parents from 62 different countries did not offer another statistically sound option. Oversampling

of non-native children and parents could prevent this problem in future studies. However, the total sample size in this study (1946 children and their parents) is remarkable. Considering the large sample size and the high response rate, it can be assumed that the sample is representative for the state of Baden-Württemberg and southwest Germany.

CONCLUSION

Overweight and obesity are largely preventable conditions and at the same time difficult to cure. This study strengthens the perception that migration background and low family income are substantial risk factors for childhood overweight. Beyond that, it could be detected that migration background does not serve as a proxy for family income and vice versa, regarding childhood overweight risk. This offers a new perspective for future intervention designs and analyses as both factors can be addressed independently. For further studies, the inclusion of a greater variety of socioeconomic indicators is advised as well as nationwide, representative samples. Effective public health policies need to consider the social gradient in health as well as intra-cultural differences, which are present already in childhood in order to avoid further possible health inequalities.

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