ORIGINAL ARTICLE

Major differences in prevalence of overweight according to nationality in preschool children living in Germany: determinants and public health implications

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Aims: To investigate the prevalence of overweight according to nationality in preschool children living in Germany, and to establish the determinants responsible for differences in body mass index.
Methods: The study was performed within the context of the 2001/2002 obligatory health examination before school entry in the city of Aachen, Germany. Of 2020 eligible children 1979 children were recruited (participation rate: 98%). Children's height and weight were measured using a standardised protocol. The parents completed a standardised questionnaire on sociodemographic factors and possible determinants of nutritional status. Being overweight was defined according to age and sex specific reference values for German children as well as according to international reference values.
Results: The study population included 452 (22.9%) children with other than German nationality. Among these children the prevalence of overweight was twice as high than among German children (14.8% *v* 7.2%). Prevalence of most known risk factors for overweight, such as low physical activity, high consumption of soft drinks, and frequent visits to fast-food restaurants was higher in the children with other nationalities than in the German children. Multivariate analyses revealed that most of the difference in prevalence of obesity by nationality is explained by known risk factors of overweight, especially education of mother and watching TV.
Conclusions: The apparent ethnic differences could be explained by two non-ethnic but socioeconomic factors. In preventing overweight in children, there is the need to identify and deal with high risk environments rather than high risk ethnic groups.

Obesity is considered to be the most prevalent nutritional disease in developed countries, and it is widely acknowledged that obesity has emerged as an epidemic.[1] The incidence and prevalence of obesity in children and adolescents are increasing in many countries around the world[2] including countries in Europe.[3] German preschool children have gained a higher body mass index (BMI) during the last 30 years according to a recent study conducted in the city of Aachen, which also revealed that increasing BMI affected children in the upper weight range more than those in the lower range.[4] It is known that obesity in children persists into adulthood[5 6] and increases the risk of obesity related morbidity later in life.[7 8]

Regarding obesity, there seems to be great variation by ethnic groups both between and within populations. In the United States, where obesity is particularly common, a large variation in childhood obesity by ethnic groups has been shown,[9] with rates generally highest for Hispanic and Native-American children and for African-American girls.[10] Estimates of the prevalence of overweight of children in European countries suggest that prevalence is higher among the southern countries of Europe.[11] However, pertinent data comparing prevalences of overweight according to ethnic groups within European countries, including Germany, are scarce.

Several factors have been discussed that may be contributing to different obesity prevalence rates in ethnic groups. They include environmental factors such as high caloric food supply and a rapid change from an active to a sedentary lifestyle and socioeconomic factors. The role of the latter appears to vary across countries with different development levels. In developing countries children with higher socioeconomic status are more likely to be obese, whereas in developed countries socioeconomic status is inversely related to obesity.[12] Other contributing factors are race, which remains an independent risk factor after controlling for differences in socioeconomic status,[13] physical activity levels which vary by ethnicity,[14] dietary patterns,[15] and factors related to the home environment such as television watching during meals.[16]

Within the last decade, many European countries have faced high rates of immigration, particularly of young families, and there is now a large diversity of national groups among children living in many European countries. Recent epidemiological studies on childhood obesity in Europe have not included comparisons between children of different nationalities living in the same country. However, with regard to adequate and effective prevention programmes it is necessary to identify the risk factors and to adapt measures as much as possible. The aim of this study was to investigate the prevalence of overweight of German children and children of other nationalities living in Germany, and to establish the determinants responsible for possible differences in BMI.

METHODS

Study design and study population

All children born between 1 July 1995 and 30 June 1996, who attended the 2001/2002 obligatory health examination before school entry in the city of Aachen, Germany, and who were accompanied by a parent with sufficient knowledge of German, were enrolled in this cross-sectional study. The study was conducted in cooperation with the Aachen Public Health Service between December 2001 and July 2002 after approval by the Ethics Board of the University of Aachen.

Data collection

The children's anthropometric data, including height and weight, were measured according to a standardised protocol as part of the routine examination conducted at the prospective primary school of the children. Body weight in underwear was measured to the nearest 0.1 kg and height to the nearest 1 cm using a digital scale (Seca column scale 910 with telescopic measuring rod, Hamburg, Germany). Body mass index (BMI) was calculated as weight (kg)/height (m^2). The age and sex specific BMI percentile ranks were calculated by a German internet based reference program (www.mybmi.de), which is based on pooled data from 17 epidemiological studies in Germany, including anthropometric data of 17 147 boys and 17 275 girls in the age range 0–18 years.[17] A BMI ⩾ the 90th centile was defined as being overweight. Additionally, prevalence of overweight was estimated according to the age and sex specific cut-off points derived from international data as recommended by the Childhood Obesity Working Group of the International Obesity Task Force.[18] These cut-off points (boys: 17.5, 17.6, 17.7, and 17.9 kg/m^2; girls: 17.2, 17.3, 17.5, and 17.8 kg/m^2 for ages <5.75 years, 5.75 to <6.25 years, 6.25 to <6.75 years, and ⩾6.75 years, respectively) are linked to the widely accepted cut-off point for overweight of a BMI ⩾25 kg/m^2.

During the examination the parents were asked to complete a standardised 42 item questionnaire, which included questions on sociodemographic factors as well as on several suggested determinants of nutritional status. The screening questionnaire was presented in German; however, one of our research assistants was always available at the survey location and was able to explain unclear items to the parents.

Statistical analysis

We first described the study participants with respect to basic sociodemographic factors. The children were categorised in German children and children with other nationalities according to the nationality of their mothers in order to take the cultural background of the mother into account, who is the person with the closest contact to the child in most cases. The nationality of the mother was strongly linked to the country where the mother has predominantly lived before age 18: more than 90% of German mothers, but less than 20% of mothers with other nationality had predominantly grown up in Germany. Hence, although no clear definition of ethnicity of the children (which is rather difficult for European countries) was available in this study, nationality as defined here should closely reflect the ethnic background in most cases. Next, the prevalence of overweight as well as eating habits and various suggested risk factors for overweight were described according to nationality.

Furthermore, we used multiple logistic regression analyses to assess to what extent differences in prevalence of overweight (dependent variable) by nationality are explained by the following known or suggested risk factors or protective factors: mother's and father's school education classified according to the German school system (<9 years, 9 years, 10–12 years, 13 years), watching TV on weekdays (<2 hours/day, ⩾2 hours/day), watching TV on weekends (<2 hours/day, ⩾2 hours/day), doing sports or playing outside (⩽1×/week, >1×/week), consumption of sweets (⩽1×/week, >1×/week), consumption of savoury snacks (⩽1×/week, >1×/week), consumption of soft drinks (⩽1×/week, >1×/week), visiting fast-food restaurants (⩽1×/week, >1×/week), BMI of mother (<25 kg/m^2, ⩾25–<30 kg/m^2, ⩾30 kg/m^2), and BMI of father (<25 kg/m^2, ⩾25–<30 kg/m^2, ⩾30 kg/m^2). These variables were added one by one to the regression model, and changes in odds ratios (ORs) for nationality by inclusion of these covariates were recorded. The covariates were entered into the model in the order of their impact on the OR—that is, the variable which changed the OR for nationality the most was entered first, and this algorithm was repeated until none of the remaining covariates changed the OR by more than 5%. Finally, a fully adjusted model was calculated in which all mentioned risk factors were considered. All analyses were carried out with the SAS statistical software package version 8.2.

Table 1 Sociodemographic characteristics of the study population (n = 1974)

Characteristics	n	%
Gender		
Boys	1008	51.1
Girls	966	48.9
Age		
5 years	417	21.1
6 years	1557	78.9
Nationality		
German	1522	77.1
Other	452	22.9
Turkish	146	32.3
Southern Europe*	33	7.3
Central Europe†	33	7.3
Eastern Europe‡	99	21.9
Other countries	141	31.2

*Southern Europe = Greece, Italy, Portugal, Spain.
†Central Europe = Austria, Belgium, Denmark, France, Great Britain, Netherlands, Switzerland.
‡Eastern Europe = Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Hungary, Kosowo, Macedonia, Moldavia, Poland, Romania, Russia, Serbia, Ukraine, Yugoslavia.

RESULTS

Of the 2020 children who fulfilled the inclusion criteria, 1979 parents (98.0%) agreed to participate in the study. Overall, a sample of 1974 children remained for the final analysis after exclusion of one child without determination of anthropometric measures and another four children without information on the nationality of the mother.

Table 1 gives basic characteristics of the study population. About half of the children were boys, and the majority were 6 years of age (78.9%). About one quarter of the children had a nationality other than German. Most of them were Turkish children (32.3%) or came from Eastern European countries (21.9%).

Table 2 presents the prevalence of overweight in German and non-German children according to German and international reference values. Based on the German values, a BMI ⩾90th centile was seen in 7.2% of the German children, but prevalence was more than twice as high (14.8%) in the children with other nationality ($p < 0.0001$). There were no differences in the prevalence of overweight due to sex, neither among the German ($p = 0.85$) nor among the non-German children ($p = 0.49$). Dividing the other children by regions of origin, children from Turkey had the highest prevalence of overweight (21.2%). In children from Southern Europe, combining the countries Italy, Greece, Spain, and Portugal, overweight was prevalent in 18.2% of the preschoolers. Prevalences of overweight were generally higher according to the international reference values, but variation of overweight between nationalities was very similar for both classification schemes. Therefore, further analyses regarding variation of overweight by nationality were carried out using the German reference values only.

Table 3 shows the prevalence of several factors known or suggested to be associated with overweight. Children with other nationality had less exercise and watched TV more often than German children; 31.9% of parents of non-German children compared to 8.6% of parents of German

Table 2 Prevalence of overweight in German children and children with other nationality defined by German and international cut-off points for overweight

Gender	Nationality	German reference values*		International reference values†	
		n	%	n	%
Boys	German children	56	50.9	69	42.6
	Children with other nationality	30	44.8	33	37.9
Girls	German children	54	49.1	93	57.4
	Children with other nationality	37	55.2	54	62.1
Both	German children	110	7.2	162	10.6
	Children with other nationality	67	14.8	87	19.3
	Turkish children	31	21.2	38	26.0
	Children from Southern Europe	6	18.2	9	27.3
	Children from Central Europe	0	0.0	2	6.1
	Children from Eastern Europe	11	11.1	15	15.2
	Children from other countries	19	13.5	23	16.3

*Cut-off point for overweight: BMI ⩾90th centile.
†Cut-off point for overweight: defined to pass through BMI of 25 kg/m^2 at the age of 18.

children reported their children watching TV for two hours and more on weekdays. Also consumption of unhealthy food like savoury snacks, soft drinks, and fast-food more often than once a week was more prevalent in children of non-German nationality. Furthermore, parents of non-German children were more often overweight themselves and were less educated than parents of German children.

Table 4 presents the analysis regarding the contribution of suggested risk factors to the differences in prevalence of overweight by nationality. In crude analysis children with nationality other than German had a 2.23-fold odds to be overweight compared to children of German nationality. This association could mostly be explained by education of the mother and by watching TV on weekdays. The OR for nationality was reduced to 1.37 after inclusion of these two covariates in the logistic regression model. The additional consideration of other risk factors did not change the OR substantially. After simultaneous inclusion of all considered risk factors in the multivariate analysis, there remained a moderate, statistically non-significant independent association of nationality with overweight (OR 1.30, 95% CI 0.87 to 1.93). Additionally the same analysis was done dividing

Table 3 Prevalence of risk factors for overweight by nationality among preschool children living in Germany

Risk factors	Nationality				
	German (n = 1522)		Other (n = 452)		
	n	%	n	%	p value*
Doing sports or playing outside					
⩽1×/week	88	5.8	76	16.9	<0.0001
Watching TV on weekdays					
⩾2 hours/day	130	8.6	143	31.9	<0.0001
Watching TV on weekends					
⩾2 hours/day	288	19.0	212	47.2	<0.0001
Consumption of sweets					
>1×/week	1364	90.1	368	82.0	<0.0001
Consumption of savoury snacks					
>1×/week	390	26.0	220	49.8	<0.0001
Consumption of soft drinks					
>1×/week	344	22.7	190	42.4	<0.0001
Visit to fast-food restaurants					
>1×/week	70	4.6	61	13.6	<0.0001
BMI of mother					
<25 kg/m^2	1090	75.0	257	62.4	<0.0001
⩾25–<30 kg/m^2	251	17.2	115	27.9	
⩾30 kg/m^2	113	7.8	40	9.7	
BMI of father					
<25 kg/m^2	693	54.5	164	42.5	0.0002
⩾25–<30 kg/m^2	479	37.6	173	44.8	
⩾30 kg/m^2	100	7.9	49	12.7	
Education of mother					
<9 years	35	2.3	92	20.8	<0.0001
9 years	309	20.4	133	30.0	
10–12 years	423	27.9	103	23.3	
13 years	748	49.4	115	26.0	
Education of father					
<9 years	33	2.3	63	14.8	<0.0001
9 years	343	23.5	121	28.4	
10–12 years	284	19.5	89	20.9	
13 years	797	54.7	153	35.9	

*p value from χ^2 test (without adjustment for sex).

children with other nationality into subgroups (data not shown). For the Turkish children the crude odds to be overweight was 3.46 (95% CI 2.23 to 5.38); however, this association was again strongly reduced and no longer statistically significant after full adjustment (OR 1.66, 95% CI 0.97 to 2.83).

DISCUSSION

Our analyses of the prevalence of overweight by nationality among 1974 preschool children attending the 2001/2002 obligatory health examination before school entry in the city of Aachen, Germany, indicated a higher prevalence of known risk factors for obesity and a two times higher prevalence of overweight in children with other than German nationality than in German children. In Turkish children, the largest group of foreign children, the prevalence of overweight was three times higher than in German children. Multivariate analyses revealed that most of the difference in prevalence of obesity by nationality is explained by known risk factors of overweight, especially education of mother and watching TV, whereas there remained only a moderate, statistically non-significant association of nationality with overweight after control for these risk factors.

The proportion of people with other than German nationality living in Germany in 2001 was 8.9%. However, the proportion of children with other than German nationality was higher (children 0–5 years of age: 9.7%; children 6–14 years of age: 10.5%),[19] and there is substantial regional variation with a much higher proportion of foreign children in the Western part than in the Eastern part of Germany. In this study 22.9% of the subjects were children with other than German nationality. Most of them held Turkish nationality (32.3%) or came from Eastern European countries (21.9%). This distribution is in accordance to corresponding national figures.[19] Furthermore, the city of Aachen is a typical German city with respect to the population's age distribution and indicators of socioeconomic status, such as unemployment rates and the proportion of inhabitants receiving welfare payments.[20] Particular strengths of this study were the very large number of participating children and the very high participation rate, making selection bias very unlikely.

Our findings of significant differences in prevalence of overweight between different ethnic groups within a country are consistent with those of US studies, generally considering ethnic groups.[9 10 21 22] Only a few European studies on BMI in children examined different ethnic groups within a country. Based on data from 1983, Caucasian and Afro-Caribbean children in Britain were found to have a similar weight-for-height index, but it was higher than that for Asian children in younger age groups.[23] These patterns have been confirmed in later investigations from 1993[24] and 1999.[25] In France, children with Maghrebian origin were found to have a higher prevalence of obesity.[26] Brussaard and colleagues,[27] who investigated migrants in the Netherlands, figured out a higher risk of overweight for Turkish and Moroccan children aged 4–15 years than for Dutch children, based on data from 1992/1993. In a recent study from Germany the frequency of overweight in non-German boys was 1.9 times higher and in non-German girls 1.5 times higher than in German boys and girls, respectively.[28] However, none of these studies established determinants responsible for the prevalence differences.

In our investigation education of the mother emerged to be the factor contributing most to the different prevalence of overweight between German and other children. In particular, the proportion of mothers with very low levels of school education was much higher among children with a nationality other than German than among German children. Low maternal education may be associated with an insufficient knowledge of the risk factors for obesity like an unhealthy diet with a high energy intake from fat and from sugar sweetened soft drinks and a sedentary lifestyle. Low education also often goes along with low socioeconomic status. An inverse relation between socioeconomic status of the parents and obesity in children has been reported in studies from developed countries.[29 30] In the study of the migrants in the Netherlands the lower socioeconomic position of the migrant groups partly explained their less favourable health status, but a study among Turkish people indicated that their health status was also lower than that of Dutch people of comparable socioeconomic status.[27]

Time spent watching TV, which can be considered an indirect indicator of (lack of) physical activity, was the other main factor contributing to the difference between overweight prevalence of German and other children. Physical inactivity is a risk factor for obesity in children.[31 32] Time spent with television viewing has been associated with body fatness in children of various ethnicities in some,[33–35] but not all studies.[36] Although time spent with television viewing is related to indicators of low socioeconomic status, such as low maternal education and low family income,[37] it further contributed to explain ethnic differences in overweight in our study even after consideration of maternal education.

One limitation of our study is that, as in other studies comparing children from various nationalities, anthropometric data from migrant children were compared to reference data for German children, based on pooled data of 17 studies conducted in various regions of Germany. No reference data for children with other nationality living in Germany are available yet, nor were reference data for Turkish children (the biggest group of children with other than German nationality in our study population) from Turkey published in the literature. However, when using international reference values for overweight in children,[18] the differences in prevalence of overweight between children of the considered nationalities essentially stayed the same, even though the absolute prevalence was higher in all subgroups. Another intriguing question that could not be assessed with adequate power in this study, despite its large size, was that of potential interactions between nationality

Table 4 Contribution of suggested risk factors to differences in prevalence of overweight (according to German reference values) by nationality

Included variables into the regression model	n	OR*	95% CI
Crude OR for other nationality	1974	2.23	1.62 to 3.09
OR for other nationality after adjustment for education of mother	1974	1.52	1.06 to 2.17
After additional adjustment for watching TV on weekdays	1965	1.37	0.95 to 1.99
After full adjustment†	1920	1.30	0.87 to 1.93

*Reference category: German nationality.
†Adjustment for education of mother and education of father, watching TV on weekdays and watching TV on weekends, doing sports or playing outside, consumption of sweets, consumption of savoury snacks, consumption of soft drinks, visiting fast-food restaurants, BMI of mother, and BMI of father.

What is already known on this topic

- Prevalences of overweight differ by ethnic groups

What this study adds

- Determinants responsible for prevalence differences are non-ethnic but socioeconomic factors

and lifestyle covariates—that is, potential variations in the role of lifestyle factors between nationalities. Such interactions, which might be of clear relevance for public health measures, should be specifically addressed in future, even larger studies.

In conclusion, our results clearly indicate that prevalence of overweight among children varies greatly between children of different nationalities and countries of origin living in the same country. These apparent ethnic differences can be explained by two non-ethnic but socioeconomic factors. Therefore, in order to prevent overweight in children, it is important to identify and deal with high risk environments rather than high risk ethnic groups. There is the need to change mothers' beliefs about diet, or about fat children being healthy children, and to inform especially low educated mothers about healthy lifestyle. Furthermore, there is the need to understand why children watch television a lot and to offer alternatives to TV as a form of low cost childcare. Due to the early onset of obesity at the age of 6, prevention efforts should start prior to school entrance. In Germany every child is offered nine routine paediatric check-ups between birth and the age of 6. These check-ups, which are attended by many children and their parents, might provide an excellent opportunity for paediatricians to address the weight development of the child and to consult the parents regarding prevention of overweight among their children.

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