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Excess weight among children and adolescents in Switzerland – prevalence and correlates for the early 2010s

Hanspeter Stamm[a], Angela Gebert[a], Lisa Guggenbühl[b], Markus Lamprecht[a]

[a] Lamprecht und Stamm Sozialforschung und Beratung AG, Zurich, Switzerland
[b] Gesundheitsförderung Schweiz / Health Promotion Switzerland, Berne, Switzerland

Summary

OBJECTIVE: To determine the prevalence of overweight and obesity, and some of their social correlates among children in Switzerland.

METHODS: Data from population and sample studies of school children of different grades from eleven Swiss towns and cantons, gathered in the framework of medical examinations at state schools in the school years 2010/11, 2011/12 or 2012/13, were used. Body mass index (BMI) was used to classify children as normal weight, overweight or obese. The term "excess weight" refers to children who are either obese or overweight.

RESULTS: A total of 17.0% of the children and adolescents were affected by excess weight (including obesity), of which 3.9% were obese. Excess weight was more prevalent at higher school levels (highest level: 20.5%; middle level: 18.2%; basic level: 12.3%), among foreign nationals (basic level: 19.0%; middle level: 26.1%; highest level: 29.3%) as opposed to Swiss nationals (basic level: 11.4%; middle level: 15.2%; highest level: 19.8%) and among children whose parents had only attended compulsory school (basic level: 24.5%; middle level: 37.6%; highest level: 28.3%) as opposed to children whose parents had tertiary schooling (basic level: 8.4%; middle level: 10.6%; highest level: 14.3%). Differences with respect to sex and area of residence were rather small and disappeared in multivariate statistical analyses controlling for the effect of nationality and social background.

CONCLUSIONS: Excess weight is widespread but not equally distributed among children in Switzerland. Strategies aimed at reducing the number of overweight children need to take into account social differences between different groups.

Key words: *overweight; obesity; children; adolescents; health; social gradient*

Introduction

The World Health Organization (WHO) has identified overweight and obesity as the fifth most important health risk factor on a global scale. In highly developed countries, overweight is the third most important risk factor behind tobacco consumption and hypertension [1]. A few years earlier, overweight had "only" been the tenth most important risk factor globally and the fifth in highly developed countries [2] thus confirming what the WHO has called a "global epidemic" [3].

Switzerland is no exception to the rule of increasing overweight and obesity rates [4]. On the basis of interview data, the Swiss Health Survey suggests that the proportion of overweight and obese persons aged 18 years and older has increased from 32% in 1992 to 41% in 2012 [5], and a recent study by the Federal Office for Public Health that was based on effective measurements of a sample of 1448 persons aged 15 and more, has classified 45% of the population as either overweight or obese [6].

Available evidence suggests that the prevalence of being overweight and obesity increases with age [5–7], but that it is already substantial among children and adolescents. Excess weight (i.e., overweight plus obesity) currently amounts to about 15% to 20% of all children [8–12] and to about 25% of all male conscripts aged 19 or 20 years [13]. Most of the differences between recent studies appear to be due to the different points in time when and different areas where they were carried out, to differing age groups in the studies, and to different threshold values used to identify overweight and obesity.

The article adds to the existing body of knowledge on the prevalence of overweight and obesity among children and adolescents in Switzerland. It presents results from a study based on prospective, as well as retrospective, data from 2010 to 2013 from eleven Swiss towns and cantons that was initiated and financed by Health Promotion Switzerland [11, 14]. Whereas the original study was mainly concerned with differences between cantons and towns, the article looks at pooled results for all cantons and towns participating in the study. In addition, it examines a question hardly ever addressed in current epidemiological research on childhood overweight and obesity, namely the association between children's social background and their body weight. To this end, a number of descriptive and multivari-

ate analyses linking body weight to sex, age, place of residence (metropolitan vs nonmetropolitan areas), nationality and parents' educational background were performed. Some implications for the planning and implementation of target group specific strategies to prevent overweight and obesity will be discussed in the concluding section.

Methods

Data collection

In most Swiss cantons (the regional entities of Switzerland), there is a system of regular medical examinations at state schools. These examinations usually take place two to three times during a pupil's school career, namely at its beginning (preschool, 1st grade), in the middle (3rd–5th grade) and towards the end (8th–9th grade). The examinations are officially mandated by regional or local authorities, are aimed at determining children's general health, are carried out by doctors or nurses and usually include measuring and weighing the children.

The data gathered in the framework of these examinations usually remain with the doctors and nurses and are not recorded and analysed systematically. Against this background, Health Promotion Switzerland (HPS), a public foundation established by the Federal Health Insurance Act and a national player in health promotion, has initiated the "BMI Monitoring Project" encouraging local and cantonal health authorities to record and analyse data in a comparable fashion. Since the school year 2005/06, childhood overweight and obesity rates in the cities of Berne and Zurich and the canton of Basel City have been analysed on an annual basis in the framework of this project [11]. In addition, HPS has attempted to enlarge its sample of towns and cantons, and in 2009 a first comparative report including data from eight cantons and towns was published [15]. This exercise was repeated in 2012/13 with a total of 11 participating cantons and towns [14].

The data and the basic methodology from that study were used for the present article. Table 1 gives an overview of the cantons and towns participating in the study and indicates that retrospective full population data from selected school grades were available in five cantons and towns (BS, BE city, GE, JU, ZH city). In a further canton (OW), a prospective full population survey was carried out. In the remaining five cases, samples were used. In three of these cases (BL, LU, SG) retrospective samples from school medical examinations were electronically recorded from existing paper files. In one of the two remaining cases a prospective sample study was carried out (GR), in the other case (BE), a sample of school doctors were asked to record the results of their current school examinations electronically.

The full population studies were aimed at covering all pupils of selected grades. It is important to note, however, that data were only gathered in state schools; private schools as well as grammar schools that exist in some cantons were not part of the exercise. In the sample studies, care was taken to choose schools and classes from different areas (metropolitan vs nonmetropolitan) and covering different social groups (e.g. working class as well as white-collar areas). In all participating cantons and towns, the examinations and data collection were carried out by officially appointed specialists and monitored by the appropriate authorities based on local laws and regulations concerning the gathering and use of personal data. In addition, the ethics commission of the canton of Zurich (Kantonale Ethikkommission KEK) reviewed and approved the design of the study.

The measurement of body weight and height was carried out with calibrated scales and fixed tape measures; children were asked to remove their shoes and to wear light indoor clothing only. Data were recorded electronically either using MS Excel or SPSS software. Personal information was removed from the data files prior to analysis to ensure the privacy of all examined subjects. The data sets were subsequently pooled by the study team and prepared for analysis. As can be seen from table 1, most data were gathered in the school year of 2011/12, but some of the data were from the year before or after. In addition, the examinations took place at different school levels (see table 2). In the cantons of Geneva and Berne, there were only data from preschool classes, whereas there were data on three different grades in six cantons and towns (BS, BE city, GR, LU, SG, ZH), and in the remaining cantons two grades were examined.

Preparation of data

All data sets included school grade, age, sex, height and weight of the examined children and a code for the city or canton under study. Depending on the canton, further data on place of residence, children's nationality and parents' educational level were included.

Data preparation included the following steps.

Table 1: Overview of participating cantons and towns and their studies on school children.

Region	Acronym	Data collection	School year
Canton of Basel-Country	BL	Recording of a representative sample of school medical examinations	2011/12
Canton of Basel-City	BS	Full survey by school medical and health authorities	2011/12
Canton of Berne (without city)	BE	Sample study in the framework of school medical examinations	2012/13
Berne city	BE city	Full survey by school medical and health authorities	2011/12
Canton of Geneva	GE	Full survey by school medical and health authorities	2010/11
Canton of Grisons	GR	Special sample study of selected communities/schools	2011/12
Canton of Jura	JU	Full survey by school medical and health authorities	2010/11
Canton of Lucerne	LU	Recording of a representative sample of school medical examinations	2011/12
Canton of Obwalden	OW	Full survey in the framework of a special study by school medical authorities	2011/12
Canton of St Gall	SG	Recording of a representative sample of school medical examinations	2010/11
Zurich city	ZH city	Full survey by school medical and health authorities	2011/12

Table 2: Overview of data, adjustments and weighting factors.

Region	School levels	Mean age (yr.)	Total population of age group*	No. of cases before adjustment	% of total population	No. after adjustment**	% of cases before adjustment	Population weight***
BL	Preschool	5.3	2,515	1,112	44	1,039	93	0.92
	4th grade	10.3	2,636	1,416	54	1,288	91	
	Total		5,151	2,528	49	2,327	92	
BS	Preschool	5.2	1,494	1,509	(100)	1,439	95	0.30
	3rd grade	9.1	1,413	1,270	90	1,233	97	
	9th grade	15.3	1,554	1,294	83	1,167	90	
	Total		4,461	4,073	91	3,839	94	
BE	Preschool	6.1	7,952	866	11	823	95	8.30
BE city	Preschool (2 years)	5.7	1,932	1,646	85	1,523	93	0.25
	4th grade	10.0	829	701	85	585	83	
	8th grade	14.7	847	780	92	704	90	
	Total		3,608	3,127	87	2,812	90	
GE	Preschool	5.7	4,936	3670	74	3,636	99	1.08
GR	1st grade	7.2	1,725	425	25	398	94	1.40
	5th grade	11.3	1,958	426	22	346	81	
	9th grade	15.3	2,092	394	19	306	78	
	Total		5,775	1,245	22	1,050	84	
JU	1st grade	7.0	721	694	96	668	96	0.47
	8th grade	14.4	876	851	97	735	86	
	Total		1,597	1,545	97	1,403	91	
LU	Preschool	5.6	3,862	363	9	313	86	2.92
	4th grade	10.2	3,687	471	13	413	88	
	8th grade	14.5	4,383	474	11	370	78	
	Total		11,932	1,308	11	1,096	84	
OW	Preschool	5.9	360	377	(100)	361	96	0.42
	5th grade	11.1	407	417	(100)	365	88	
	Total		767	794	(100)	726	91	
SG	Preschool	6.2	4,779	948	20	939	99	1.58
	5th grade	11.3	5,274	964	18	856	89	
	8th grade	15.0	5,727	887	15	806	91	
	Total		1,5780	2,799	18	2,601	93	
ZH city	Preschool	5.3	3,239	2,954	91	2,833	96	0.35
	4th grade	10.1	2,622	1,976	75	1,814	92	
	8th grade	14.3	2,554	1,765	69	1,747	99	
	Total		8,415	6,695	80	6,394	96	
Total	Basic level	5.7	33,515	14,560	43	13,972	96	
	Middle level	10.2	18,826	7,652	41	6,900	90	
	Higher level	14.7	18,033	6,438	36	5,835	91	
	Total		70,374	28,650	41	26,707	93	
Total number of children of relevant age group at the end of 2011		5	78,980		Number of children in sample as a percentage of all children:		18	
		10	77,822				9	
		14	84,096				7	
		Total	240,898				11	

* Population at the end of 2011 except for BE (2012) and GE, JU and SG (2010), source: Federal Statistical Office [19].

** Adjustment refers to the exclusion of children with incomplete data on age, sex, weight and height as well as the exclusion of children from half-year age groups <100 or 50 respectively (see text for details).

*** Population weights were calculated on the basis of the population aged 19 years and younger in the different regions [19].

Table 3: Demographic information: distribution and coding of independent variables.

Variables		n	%	
			Unweighted	Weighted
School grade	Basic level (preschool, 1st grade)	13,972	52.3	63.4
	Middle level (3rd–5th grade)	6,900	25.8	20.7
	Higher level (8th–9th grade)	5,835	21.8	15.9
Sex	Female	13,044	48.8	48.2
	Male	13,663	51.2	51.8
Place of residence	Metropolitan	18,534	69.4	43.0
	Nonmetropolitan	8,173	30.6	57.0
Nationality	Swiss	14,421	71.1	77.9
	Foreigners	5,856	28.9	22.1
Parents' educational level	Compulsory schooling	843	13.7	8.7
	Secondary level schooling	3,051	49.7	55.7
	Tertiary level schooling	2,248	36.6	35.5

Controlling for sampling distortions and corrections

As children may have been absent from school (e.g. because of an illness) or because they or their parents refused to participate in the examinations, even the population studies only included about 90% of all pupils (see table 2). According to the participating school medical services, the data do not exhibit any systematic distortions due to social background of the parents and thus appear to be representative. As shown in table 2, sample studies include about 10% to 50% of the children of the respective towns or cantons. In two of the sample studies (LU, SG) there were some distortions in the distribution of children from rural and urban areas that were corrected with a weighting factor reflecting the effective distribution of children in the population (correction for SG: from originally 55% to 15% [urban] and 45% to 85% [rural]; LU: from 45% to 40% [urban] and 55% to 60% [rural]).

A further weighting factor was introduced for analyses covering all cantons and towns: As the different regions differ greatly in size – for example, there are only about 8,000 persons under the age of 20 years in the canton of Obwalden, whereas there are over 100,000 in the canton of St Gall – the data from the towns and cantons were weighted to reflect their effective population size on the basis of data regarding the population aged younger than 20 years (population data from the Federal Statistical Office). The weighting factors used are given in the last column of table 2. The weighted and unweighted distributions of key variables can be found in table 3.

To assess the total prevalence of being overweight or obese, a further weighting factor was introduced. As shown in table 2, there are more data from the basic school grades (preschool and 1st grade) than from the higher grades. As a result, an additional weighting factor for all school grades was introduced that is based on the assumption of an equal distribution of examined persons throughout all levels.

Measures for overweight, obesity and excess weight

Height and weight were used to calculate the body mass index (BMI). Using information on age and sex, the threshold values of Cole et al. [16] were used to classify children and adolescents into the three groups of normal weight, overweight and obesity. The categories of Cole et al. correspond to the conventional reference values for persons aged 18 years and more (normal weight: BMI <25 kg/m^2; overweight: 25 kg/m^2 ≤ BMI <30 kg/m^2; obesity: BMI ≥30 kg/m^2). In addition, the category "excess weight" refers to children who are either overweight or obese. Children with incomplete information regarding weight, height, age and sex had to be excluded from the analysis.

School levels versus age groups

It is important to note that the school medical examinations take place in specific grades and not at a specific age. As a consequence, age groups are not homogenous. Rather, there were some children in a given grade who were either "too young" (e.g. because of having skipped a grade) or "too old" (having repeated one or more grades). Whether a child is "too old" or "too young" does not appear to be random but rather to be associated with sex (girls on average being more mature than boys of the same age), nationality (lacking language skills hindering scholarly performance) and social background (better educated parents being more supportive).

As a result, children from half-year age groups including fewer than 100 persons (fewer than 50 in the cantons with small samples, namely LU, OW, SG) were excluded from the analysis to avoid distortions at the margins of the age distribution. Of a total of 28,650 children and adolescents, 26,707 (93.2%) were included in the analysis (see table 2). These correspond to about 11% of all children of the relevant age group (table 2). An analysis of the excluded children shows significantly higher proportions of boys (55.1% vs 51.2% in the groups with fewer than 50/100 children), foreign nationals (42.5% vs 27.7%) and children from parents with no schooling beyond compulsory school (21.4% vs 13.7%; all differences significant with $p < 0.01$).

Coding of independent variables (see table 3)

School grade/age

Three different school levels were used. The basic level refers to preschool and 1st grade children, the middle level to children in grades 3 to 5 and the higher level to adolescents attending 8th or 9th grade. The average age of the children at the different levels is given by canton and town in table 2. The different school levels can be used as an approximation of age differences.

Metropolitan versus nonmetropolitan area of residence

Cantons and towns were classified into metropolitan (towns with over 70,000 inhabitants, i.e. Berne, Zurich, Basel City, Geneva, St Gall and Lucerne) and other areas (remaining cantons and areas) to test for differences that may reflect, among others, different physical activity opportunities or a differing density of fast food restaurants. It is important to note that the data do not permit a more elaborate distinction of rural and small-town areas.

Language region

The variable language region distinguishes between children from the French (Geneva, Jura) and German speaking areas (other cantons and towns). As can be seen from table 2, reliable analyses with this variable can only be performed for children at the basic level because the number of cases is too small at the higher levels.

Sex

Sex differences are well known for the adult Swiss population [5–7] but do not appear to play a major role in children [8, 11]. Sex was included as a control variable.

Nationality

Earlier studies in the framework of the HPS BMI monitoring project have shown marked differences with respect to children's nationality [11, 14]. The distinction between Swiss and foreign nationals was only available for eight towns and cantons (Basel City and Country, city and canton of Berne, Grisons, Obwalden, St Gall, Zurich).

Parents' educational background

In three cantons and one town (Basel City, canton and city of Berne, Grisons), data on parents' education was available. Differences in this respect have already been found in

earlier studies and conform to findings documenting strong correlations between social status and weight issues in the adult population [17, 18]. Parents' educational background was originally gathered by the school medical services on the basis of parents' occupation or educational achievements and coded into a three-point-scale distinguishing between compulsory schooling only, secondary level schooling (in Switzerland this is typically an apprenticeship) and tertiary level schooling. In cases where the mother and father had differing educational scores, the higher score was used.

Data analysis

In a first analytical step, bivariate analyses were performed with BMI classification of Cole et al. [16] as the "dependent" variable and the "independent" variables mentioned above. In order to assess the significance of differences, confidence intervals (CIs) at the 95% confidence level and chi-squared tests for independence between groups were calculated with the "Complex Samples" module of SPSS. In addition, in some instances gamma coefficients measuring the association between ordinal variables and corresponding significance levels are given. In most instances, only results referring to "excess weight" (i.e. overweight plus obesity) have been included in the results section. As analyses for overweight and obesity show similar results, they have been omitted to improve the legibility of the text.

In a further analytical step, multiple logistic regression models including the above mentioned independent variables and excess weight (coded as 0 for normal and 1 for excess weight) as dependent variable were calculated with SPSS. These models were aimed at testing which effects remain in the models and are most substantial if the influence of other variables is controlled simultaneously. For example, the metropolitan versus nonmetropolitan difference may be due to a different socio-demographic composition of populations and there may also be a correlation between educational level and Swiss nationality.

As data for parents' educational background were lacking in most towns and cantons, the full model including all independent variables could only be calculated for four towns and cantons. If parents' educational background was excluded from the analysis, there were a total of eight cantons and towns with data on all remaining independent variables. Finally, if nationality, too, was excluded, a reduced model only including sex, school grade and metropolitan versus nonmetropolitan region for all eleven cantons and towns could be calculated. Thus, there were three models that differ in the number of independent variables and cantons and towns that were analysed.

The models were estimated using a backward selection algorithm that introduced all independent variables in a first step and then eliminated insignificant variables based on log likelihood changes ($p < 0.05$). The results section reports odds ratios (ORs) for the different variable levels with the reference level having an OR of 1. In addition Nagelkerke's R^2 as an approximate measure of goodness of fit is given.

Results

Descriptive statistics

The data in table 4 show that 12.3% of all children at the basic level (average age: 5.9 years), 18.2% of the children at the middle level (10.5 years) and 20.5% of the children at the higher level (14.8 years) were either overweight or obese. The prevalence of obesity ranged from 3.0 (basic level) to 4.9% (higher level). Overall, and taking the different number of children at the three levels into account, 17.0% of all children carry excess weight; 3.9% are affected by obesity.

The differences between the three school levels suggest a considerable age effect with respect to overweight and obesity. This effect persists if one calculates level specific rates of excess weight with respect to sex, place of residence (metropolitan vs other), nationality and parents' educational level by school level. According to table 5, sex differences were not very substantial and not significant at the middle level. Differences with respect to language region were only calculated for the basic level and did not seem to matter.

The metropolitan versus nonmetropolitan difference is not significant and negligible at the basic level, it increases at the higher levels and amounts to 6.5% at the highest level with 24.5% of the metropolitan and 18.0% of nonmetropolitan adolescents being overweight.

The differences between Swiss and foreign nationals and with respect to parents' educational level were even more substantial and in most instances highly significant: At all levels, foreigners and children of parents with compulsory schooling only are more often overweight than Swiss children and children whose parents had been to university or similar institutions. The most striking difference could be found at the middle school level, where about 38% of all children of parents with compulsory schooling only were overweight but only 11% of the children of parents with tertiary education.

Table 4: Rates of overweight and obese children and adolescents by school level (n = 26,706).

	Basic level (preschool + 1st grade)		Middle level (3rd–5th grade)		Higher level (8th–9th grade)		Chi-squared test (p-value)
	%	CI*	%	CI*	%	CI*	
Overweight	9.2	8.5–10.0	14.3	12.6–16.1	15.7	13.7–17.9	<0.001
Obesity	3.0	2.7–3.4	3.9	3.3–4.6	4.9	3.6–6.6	<0.01
Excess weight (sum of overweight and obesity)	12.3	11.5–13.1	18.2	16.0–20.6	20.5	17.2–24.3	<0.001
n	13,971		6,900		5,835		

* Confidence interval, $p < 0.05$; Threshold values were calculated on the basis of Cole et al. [15] and correspond to the following values for persons aged 18 and older: overweight: 25 kg/m^2 ≤BMI <30 kg/m^2; obesity: BMI ≥30 kg/m^2; excess weight: BMI ≥25 kg/m^2.
BMI = body mass index

Multivariate analyses

Table 6 shows the results of three logistic regression models. Model 1 refers to all 11 cantons and towns but only includes school level (age), sex and the metropolitan versus nonmetropolitan difference as independent variables and explains 2% of all variation. In accordance with the bivariate results, sex differences do not appear to matter, whereas there was a quite substantial age effect in the sense that younger children are less frequently overweight. In addition, children from metropolitan areas were more often overweight.

If Swiss versus foreign nationality is added to the model (see model 2 in table 6), the corresponding effect is substantial: the probability of Swiss children being overweight was about 42% lower than that of foreign children. Interestingly, the sex effect becomes significant in this model but is not very substantial.

Finally, model 3, which is based only on data from four cantons and towns, underlines the importance of social background regarding overweight. When parents' educational level was included as an independent variable, the degree of explained variance increases substantially, because the probability of being affected by overweight is 2.7 times higher for children whose parents had only compulsory schooling than for children with an academic family background. It is also important to note that the sex effect vanishes again in model 3 as do some of the age effects and the impact of a metropolitan place of residence. The fact that place of residence has already lost some of its size between models 1 and 2 is a strong indication that this difference is mainly due to a differing composition of the population of metropolitan and nonmetropolitan areas with the latter having a lower share of foreign residents (gamma = –0.28, p <0.01) and persons with only compulsory schooling (gamma = 0.23, p <0.01).

Discussion

The analysis shows that excess weight is a considerable problem affecting 17% of the school children in the eleven cantons and towns under study. The older the children become, the more they appear to be suffering from being overweight or obesity.

Switzerland has a total of 26 cantons. It is therefore difficult to tell whether the results from the present study apply to the whole of the country. The fact that data were taken from metropolitan as well as nonmetropolitan areas and from the French as well as the German language regions, which account for about 95% of the population, suggests that our results may be representative for the country as a whole except for the Italian-speaking part, which accounts for less than 5% of the total population.

In addition, our results are largely in line with the findings of representative studies of Swiss children aged between 6 and 12 years by Murer et al. [12] that reported 20.0% of boys and 17.8% of girls with excess weight in 2012 based on the Centers for Disease Control (CDC) threshold values. In addition, Aeberli et al. [8] and Murer et al. [12] reported a more-or-less stable development of overweight and obesity rates for the period between 2002 and 2012, and results from the HPS BMI Monitoring project suggest a similar stabilisation in Basel City and the cities of Berne and Zurich: For the time period 2005/06 to 2011/12 the overall rate of children with excess weight has only varied between 19.3% and 20.1% [11]. This finding appears to be in line with international studies [20–22] and contrasts with Swiss studies that showed a marked increase for earlier decades: in Basel City, the overall prevalence of excess weight for all three school levels increased from 10.5% in the late 1970s (1977/78 and 1978/79) to 25.9% in the early 2000s (2001/02 and 2002/03) [10], and Zurich showed a marked increase for the period between the mid-1990s and the early 2000s [23].

Table 5: Rate of excess weight (overweight plus obesity) of children and adolescents by sex, place of residence, nationality and parents' educational level.

		Basic level (preschool + 1st grade)		Middle level (3rd–5th grade)		Higher level (8th–9th grade)	
		%	CI*	%	CI*	%	CI*
Sex (n = 26,706 11 cantons/towns)	Female	13.5	12.5–14.5	18.7	17.3–20.2	17.5	13.6–22.3
	Male	11.2	10.3–12.2	17.7	14.3–21.7	23.1	19.4–27.3
	Chi-squared test (p-value)		<0.01		≥0.05		<0.01
Place of residence (n = 26,706 11 cantons/towns)**	Metropolitan	13.3	12.7–14.0	21.6	20.5–22.8c	24.5	23.3–25.8
	Nonmetropolitan	13.0	12.0–14.0	17.2	15.9–18.7c	18.0	16.3–19.8
	Chi-squared test (p-value)		≥0.05		<0.001		<0.001
Nationality (n = 1,850 8 cantons/towns)	Swiss	11.4	10.0–13.0	15.2	14.0–16.5	19.8	18.2–21.6
	Foreigners	19.0	16.0–22.3	26.1	23.8–28.6	29.3	26.2–32.7
	Chi-squared test (p-value)		<0.001		<0.01		<0.01
Parents' educational level (n = 6,142 4 cantons/towns)**	compulsory schooling	24.5	20.5–29.0	37.6	32.0–43.5	28.3	23.4–33.9
	secondary level schooling	16.3	14.4–18.3	22.6	20.1–25.4	25.5	22.9–28.3
	tertiary level schooling	8.4	6.9–10.2	10.6	8.6–13.1	14.3	11.8–17.2
	Chi-squared test (p-value)		<0.001		<0.001		<0.001
Language region**/*** (n = 13,97 11 cantons/towns)	French	13.6	12.9–14.2				
	German	12.4	11.5–13.4				
	Chi-squared test (p-value)		≥0.05				

* Confidence interval, p <0.05.

** Unweighted data were used to highlight the effect of place of residence, language region and parents' educational background.

*** Only basic level due to insufficient number of cases for other levels.

Note: Excess weight corresponds to body mass index ≥25 kg/m2 for persons aged 18 or older (Cole et al. [15]).

Interestingly, however, the stabilisation of excess weight does not yet appear to have reached the adult population, as evidenced by the latest survey data from the Swiss Health Survey (SES) that shows an increase of excess weight from 37.2% in 2002 to 41.2% in 2012 [5]. An interesting case is young, male adults: A recent study on conscripts suggests that the stabilisation has only started as recently as 2010 at rates of about 25% of excess weight [13]. These findings may be an indication that the focus on children in current "healthy body weight" programmes may have had some success (see also below). In addition, a number of other findings for the adult population from the SES are of importance for the interpretation of children's results.

First, there is a marked difference between men and women in that the former are more often overweight (39.3%) or obese (11.2 %) than the latter (overweight: 22.6%; obesity: 9.3%, SES data for 2012, [5, 24]). In children, this difference does not appear to play a major role yet: at the lowest level, girls are more often overweight or obese than boys, but at the higher school levels this relationship is reversed. Thus, the sex difference in adults only appears to come into play in adolescents but not in younger children.

Second, SES and other data suggest an increase in overweight and obesity rates with increasing age [5, 24]. Even though our data do not permit analyses for selected age groups, our results concerning the three school levels clearly show that the age effect is already present in children and adolescents.

Third, our findings on nationality and social background are in line with results from other studies on children [10, 11] and the adult population, which also show strong associations with occupation and income [17, 18, 25, 26]. Even though nationality and parents' education are highly correlated in our data (gamma = 0.54, p <0.01) in that the share of Swiss parents having secondary or tertiary schooling is higher than that of foreign nationals, both effects remain significant in the multivariate model. This indicates that nationality and social background have distinctive effects on the probability to become overweight or obese but may well reinforce each other by, for example, combining language problems and different cultural preferences for behaviours that may affect body weight (nutrition, physical activity) in the migrant population with health literacy issues and a low socioeconomic status in groups with a lower educational level. On the other hand, a high educational level of their parents may well counteract the "excess weight risk" of migrant children. Still, if we look at data for adults, there could be some degree of "inheritance of weight problems".

Finally, some remarks need to be made on the vanishing differences with respect to place of residence. Aeberli et al. [8] and Murer et al. [12] found a significant positive association of an urban place of residence with the prevalence of childhood overweight in their 2007 study. By 2012, however, this finding was reversed with children from a rural context more often being overweight. Even though this latter finding conforms to bivariate results from a study on male conscripts [13] and the SES for the adult population [24], in our own study, the metropolitan versus non-metropolitan effect disappeared once social background variables were integrated into a multivariate model. Thus, differences based on place of residence mainly appear to reflect demographic and socioeconomic differences of children.

The findings point to a number of conclusions for current and future initiatives regarding a "healthy body weight". Some years ago HPS has initiated a prevention programme that is currently being carried out by a large number of

Table 6: Odds ratios of different multivariate logistic regression models with excess weight (overweight plus obesity) as dependent variable (confidence intervals in parentheses, p <0.05).

	Model 1	**Model 2**	**Model 3**
School level (reference category: higher level*)			
Basic level	0.52 (0.48–0.56)**	0.52 (0.48–0.57)**	0.61 (0.52–0.72)**
Middle level	0.87 (0.80–0.95)*	0.82 (0.74–0.90)**	n.s.
Sex (reference category: male*)			
Female	n.s.	0.90 (0.84–0.97)*	n.s.
Place of residence (reference category: nonmetropolitan*)			
Metropolitan	1.23 (1.14–1.32)**	1.18 (1.08–1.28)**	n.s.
Nationality (reference category: foreign nationality*)	–		
Swiss	–	0.58 (0.53–.62)**	0.59 (0.51–0.72)**
Parents' educational level (reference category: tertiary education*)			
Compulsory schooling	–	–	2.69 (2.17–3.33)**
Secondary level	–	–	2.06 (1.76–2.43)**
Constant	0.25**	0.42*	0.23**
Nagelkerke R^2	0.02	0.04	0.07
n	26,706	20,277	6,138
Number of included cantons/cities	11	8	4

Excess weight corresponds to body mass index ≥25 kg/m^2 for persons aged 18 or older (Cole et al. [15]).
* Reference categories have a value of 1.0.
Levels of significance: * p <0.01; ** p <0.001; n.s.: p ≥0.05.
n.s. = not significant

Swiss cantons. A large proportion of the implemented measures focus on preschool younger school children and their parents. The substantial age effect found in our study suggests that initiatives aimed at older school children should be more thoroughly implemented than they are currently. In view of the fact that available data show a continuous increase of the prevalence of overweight and obesity in the adult population until well beyond the pension age [5, 6], it could also be argued that the adult population should not be overlooked.

An overview of current approaches for (young) school children shows that there are two important kinds of initiatives (see the HPS website under www.gesundheitsfoerderung.ch): one type is aimed at all school children and promotes, for example, healthy and balanced snacks ("Znüni") or physically active breaks, and the other is aimed at nutrition and physical activity habits of (parts of) the migrant population which, in the light of our findings, is in fact an important target group for interventions. However, there are not yet any initiatives targeting children of socially disadvantaged parents regardless of their nationality. These parents and their children may be an important future target group as they may find it particularly difficult to understand (written) information provided by schools and health authorities and to develop and sustain behavioural patterns in line with the goal of a "healthy body weight".

The following limitations to the study need to be mentioned:

- Data were gathered and analysed at the level of school grades which are heterogenous with respect to age; it was not possible to analyse children by age-years.
- Data refer to children attending ordinary state schools; data from private and grammar schools (higher grades in some cantons) were not available. The exclusion of private schools should not matter greatly, however, as their pupils only amount to about 6% of all Swiss pupils [26].
- Children were weighed in light indoor clothing and without shoes, and therefore the prevalence of overweight and obesity may be slightly overestimated.
- Data were gathered in different school years. The oldest data were from 2010/11, the most recent from 2012/13. In view of the current stabilisation of overweight and obesity rates this should not matter greatly.

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Correspondence: *Hanspeter Stamm, PhD, Lamprecht und Stamm SFB AG, Forchstrasse 212, CH-8032 Zurich, Switzerland, info[at]lssfb.ch*

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