Original Article   Open Access

Sociodemographic and Economic Determinants of Overweight and Obesity for Public-school Children in Geneva State, Switzerland: A Cross-sectional Study

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ABSTRACT

Background: Obesity among children and adolescents is a growing public health problem. The purpose of this study is to assess the prevalence, socioeconomic and demographic determinants of overweight and obesity in schoolchildren from Geneva.

Methods: A cross-sectional study was undertaken at the Public School of Geneva canton in Switzerland. A total of 8544 public school children were collected and analyzed: 2577 were in second grade, 2641 in fifth grade and 3326 in eighth grade. To identify overweight and obesity we used the definition issued by the International Obesity Task Force. Child characteristics included gender, age, socioeconomic status (SES) of father and mother, and school grade. The multivariate logistic regression model was used to examine potential predictors of overweight/obesity.

Results: The prevalence of overweight or obese children was 14.4% in second grade, 17.3% in fifth grade and 18.6% in eighth grade. Multivariate logistic regression analyses reveal that children that have a low economic status or certain citizenships are more likely to be overweight or obese. Children of Kosovar origin, have a higher risk of OBO in second grade (adjusted odds ratio [OR] = 2.19; 95% confidence interval [CI]: 1.20–4.00), fifth grade (adjusted OR = 2.36 95% CI: 1.27–4.39) and in eighth grade (adjusted OR = 2.15 95% CI: 1.27–4.39). Association between SES and overweight was high with regards to the father's SES in fifth grade (adjusted OR = 4.21 95% CI: 2.83–6.25).

Conclusions: Overweight and obesity is associated to socioeconomic and sociodemographic factors. The analyzes reveals that children with a low economic status and/or from certain countries are more likely to be overweight or obese than Swiss children. There is an urgent need for action to prevent further increase in overweight or obesity among children.

Keywords: Childhood, obesity, school

INTRODUCTION

Overweight and obesity (OBO), among children, are having an increased public health impact.[1] Excess weight in childhood is associated with an array of adverse health conditions, as well as increasing the risk of becoming overweight or obese at an adult age.[2]

One of the important determinants of childhood OBO is socioeconomic disparity, which is often observed in high-income countries, both in adults and children.[3] OBO are more common in the lower social classes of affluent societies and in the upper social classes of poorer societies.[4,5] It has been hypothesized that a higher level of education provides specific knowledge about health and a larger cultural background that might facilitate interpretation of health-related information.[6] Previous studies on the prevalence of obesity in adult populations have shown varying increases in obesity rates over time by gender, socioeconomic status (SES) and ethnicity.[7,8] However, only a few studies have examined these variables in adolescents.[9,10]

Geneva is a multicultural canton, with about 40% of the population being of foreign origin as well as being the area with the highest proportion of foreigners (38.1%), in Switzerland. The most represented communities in the canton in 2010 were: Portuguese (18.2% of the foreign population), Italians (15%), French (11.9%) and Spanish (11.1%). This multicultural population gives us an excellent sample to measure intercultural and demographic differences.

The primary aim of this study is to measure the prevalence of OBO among 5–6, 10–11 and 13–14 years old children in Geneva's public schools. The second aim being to establish the relationship between excess weight, socioeconomic, and demographic characteristics.

METHODS

Subject
This cross-sectional study was initiated during the 2011–2012 school year. The population studied comprised all schoolchildren aged 5–6, 8–9 and 13–14 years attending the second, fifth and eighth grades of schools, located in the canton of Geneva.

The particularity of Geneva is that all newly enrolled children undergo a health visit, together with their parents, during the 1st year of school. During this visit, the school nurses question the parents and the child about health-related topics including vaccination, nutrition, exercise, well-being, and integration. For the fifth and eighth grades, all the children undergo a mandatory health visit. During this visit, children can express any health concerns they have to a school nurse, who screens for scoliosis and controls vaccination status.

Only children enrolled in the public schools of the canton of Geneva were included in the study. The pupils attending private schools (10–15%) were excluded because the School Health Service of Geneva (Service Santé de la Jeunesse) is not mandated to carry out health controls in private schools.

For the purpose of this study, school nurses weighed and measured all children and plotted the data on a weight to height and body mass index (BMI) curve.[11] Children were measured on regularly calibrated SECA™ digital scales (SECA™ Alpha, Model 770, Hamburg, Germany) and measured on, regularly calibrated, either wall-mounted or balance-mounted height scales. Weight was measured while the children were in underclothes without their shoes. Height was measured during inspiration. The protocol and equipment used for all measurements were the same for all schools. During the health visit, the data were discussed with the child and his parents. If the parents or the child showed any concern about the values, the school nurse scheduled another meeting for further explanations.

The data collected by the nurses were anonymously transferred to a database where the BMI was calculated and compared with international norms,[11] thus making it possible to estimate the prevalence for each age group. The sociodemographic and economic factors studied included; gender, citizenship, district of residence and the socio-professional category of both the mother and the father. This data were supplied by the Service for Research in Education of the canton of Geneva (SRED) based on official government databases.

Definition
The BMI or Quetelet index is a measure for human body shape based on an individual's mass and height. BMI for each child was calculated as weight in kilograms divided by height in square meters (kg/m^2, Quetelet's equation). In children, BMI varies with age and between genders. Hence, there is no single cut-off point to define overweight and obesity, as there is for adults. To identify overweight and obesity, we used the definition issued by the International Obesity Task Force (IOTF) based on the distribution of close to 200,000 children from six countries.[11] Children were divided into normal (including underweight) ISO-BMI <25; overweight ISO-BMI 25-30, and obese ISO-BMI >30, groups.[11]

Socioeconomic status of each parent was subdivided into the five categories used by the SRED: Leaders and senior executives, executives and employees, self-employed, workers and "others". Unemployed people, or those whose profession were not in one of the previous four categories, were included in the "others" group. Parents with a profession that remained unknown were also included in the "others" category.

Citizenship corresponds to the country, which is indicated on the child's passport and was categorized in the following groups (>150 observations): Switzerland,

Portugal, Italy, France and Kosovo. Other European countries, concern America (North, Central and South America), Africa, Asia, and others.

To create sufficiently large groups for statistical analysis, the administrative units of residence (45 villages or towns in the canton of Geneva) were separated into three groups of similar numbers of inhabitants, according to the annual median income per inhabitant of the village or town.

Statistical analysis

Statistical analysis was performed using Stata™ 10.0 (http://www.stata.com/) and Spotfire™ S + 9.1 for Windows (http://spotfire.tibco.com/). Normality of the distribution of the continuous variables was analyzed using the Kolmogorov–Smirnov test. Normally distributed continuous variables, were expressed as mean and standard deviation and categorical variables were reported as frequencies (%). Contingency tables were drawn to investigate the distribution of overweight or obesity according to the various factors, followed by Chi-square tests. Level of significance was set at $P < 0.05$. For the three age groups, a multivariate logistic regression model was used to investigate the link between obesity or overweight. The following factors were collected: Sex, SES of the father, and mother, nationality and the median income per inhabitant of the place of residence. The final model was selected with a stepwise procedure based on Akaikes information criterion, and the results were expressed within odds ratios (ORs) with 95% confidence intervals (CI).

RESULTS

Figure 1 shows the flow chart of the study with the sampling and analytic structure, as well as the number
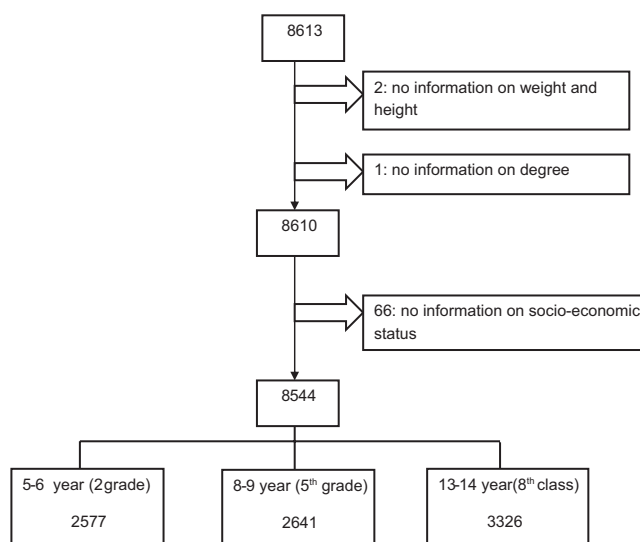

Figure 1: Flow chart and sampling strategy

of subjects excluded from the study. During the 2011–2012 school years, 8'613 records were collected, covering the three age groups. Three children were removed from the analysis because height, weight or the school grades were missing. Sixty-six other children were removed due to lack of data on the SES of the father or mother. The final statistical analysis was made on the remaining 8'544 children of which; 2'577 were in second grade, 2'641 in fifth grade and 3'326 in eighth grade. The 8'544 children represent 90% of all the children attending the public schools of the canton. The remaining 10%, correspond to children who refused (or their parents), that their personal (SES, citizenship) data be matched to their weight and height.

Using the international cut-off points recommended by the IOTF (11) 14.4% of children in second grade, 17.3% in fifth grade and 18.6% in eighth grade were found to be overweight or obese. The prevalence of overweight and obesity was higher for girls than boys in second and fifth grade and inversed in eighth grade.

Table 1 shows the characteristics of the children in relation to the school year and sex. The prevalence of overweight children in second grade was 12.6% for girls and 9.4% for boys while the prevalence of obesity was 3.6% for girls and 2.9% for boys. A significant difference in the prevalence of overweight ($P = 0.01$) between girls and boys was found, which was not the case for obesity ($P = 0.32$).

In fifth grade, the prevalence of overweight was 15.2% for girls versus 14.8% for boys and 2.6% versus 2.2% for obesity. The prevalence did not differ significantly between genders. In the 13–14 years old group, the prevalence of overweight was: 14.4% for girls, 15.3% for boys while 3.2% of girls and 4.2% of the boys were obese. No statistical differences between genders were observed.

Influence of citizenship

Table 2 shows the distribution of OBO children according to their sociodemographic characteristics (citizenship, socio-professional category of the mother and father and district of residence). The prevalence of OBO varied considerably between nationalities with the lowest levels observed in Swiss and French nationals (13.4% and 14.2%) and the highest levels in children coming from Kosovo (30%). The children of Portuguese, Italian and Spanish parents also showed relatively high prevalence of OBO (23–29%). The other geographical areas show relatively high levels of overweight and obesity, with varying proportions for each.

Influence of the socioeconomic group

Table 2 shows the prevalence for OBO according to the SES groups and the district of residence. The prevalence of overweight and obesity was considerably higher for workers as compared to other SES's. Children with

Table 1: Demographical and characteristics of the children; Mean values (standard deviations) and proportions (%) are given

| | 2nd grade | | 5th grade | | 8th grade | |
	Females	Males	Females	Males	Females	Males
N	1'405	1'172	1'285	1'356	1'622	1'704
Age (years)	5.8 (±0.35)	5.8 (±0.36)	10.7 (±0.44)	10.6 (±0.44)	14.0 (±0.55)	14.0 (±0.57)
Height (m)	1.15 (±0.05)	1.17 (±0.05)	1.45 (±0.07)	1.44 (±0.07)	1.61 (±0.06)	1.65 (±0.09)
Weight (kg)	21.1 (±3.5)	21.5 (±3.6)	37.7 (±8.4)	37.4 (±7.8)	53.6 (±10.4)	55.8 (±12.2)
BMI (kg/m2)	15.7 (±1.8)	15.7 (±1.7)	17.9 (±3.0)	17.9 (±2.8)	20.6 (±3.6)	20.4 (±3.6)
Overweight	12.6%	9.4%	15.2%	14.8%	14.4%	15.3%
Obese	3.6%	2.9%	2.6%	2.2%	3.2%	4.2%
Overweight or obese	16.2%	12.3%	17.8%	17.0%	17.6%	19.5%

Table 2: Socio demographical characteristics, overweight and obesity; Proportions (%) are given

	N	Overweight	Obesity	Overweight or obese
Citizenship				
Switzerland	5'477	11.4%	2.0%	13.4%
Portuguese	1'012	20.0%	4.8%	24.8%
Italian	225	20.9%	8.0%	28.9%
Kosovo	200	22.0%	8.0%	30.0%
Spanish	188	19.1%	4.3%	23.4%
France	176	10.2%	4.0%	14.2%
Other European	340	14.1%	4.4%	18.5%
America	332	18.7%	4.8%	23.5%
Africa	331	16.6%	7.3%	23.9%
Other	303	15.8%	3.3%	19.1%
Socio-professional categories mother				
Leaders and senior executives	614	8.3%	1.5%	9.8%
Executives and employees	3'388	12.4%	2.3%	14.7%
Self employed	126	10.3%	0.8%	11.1%
Workers	1'486	19.5%	4.6%	24.2%
Other	2'970	13.8%	3.9%	17.6%
Socio-professional categories father				
Leaders and senior executives	1'595	8.4%	2.0%	10.4%
Executives and employees	2'872	11.9%	2.0%	14.0%
Self employed	401	15.0%	3.0%	18.0%
Workers	2'528	17.7%	4.4%	22.1%
Other	1'188	16.8%	5.0%	21.7%
District of residence				
Higher median income	3'006	11.2%	2.1%	13.3%
Middle median income	2'148	13.4%	3.5%	16.9%
Lower median income	3'430	16.3%	3.8%	20.1%

mothers in higher socioeconomic classes (leaders and senior executives), displayed the lowest prevalence of overweight and obesity, compared to the other socioeconomic classes ($P < 0.001$) with prevalence rates of 8.3% and 1.5%, respectively. We found a similar trend when studying this prevalence by stratifying the socioeconomic class of the father ($P < 0.001$; the prevalence rate for the overweight = 8.3% and 2% for obesity).

Influence of the district of residence

A significant gradient in the prevalence of overweight and obesity was found from one district to another, with 11.2% of children being overweight in the higher median income group, versus 16.3% ($P < 0.01$) in the lower median income group. Obesity shows an even–greater significant difference, with a prevalence of 2.1% in the higher median income group, versus 3.8% in the lower median income group ($P = 0.01$).

Table 3 presents the association, expressed as an OR, between sex, citizenship, socio-professional categories of the mother and father and the district of residence with OBO.

Boys were found to have a lower risk of being overweight or obese than girls in second grade (adjusted OR = 0.72; 95% CI: 0.57–0.90). This association was not found in the other grades (fifth and eighth grade).

There is a strong correlation between the citizenship and the risk of being overweight or obese. The children of Italian, American and Kosovar origins all had a substantially higher risk of being overweight or obese compared with the Swiss children (reference category), adjusted OR = 2.38, 2.36 and 2.19, respectively, in second grade. A similar trend was also found in the higher grades with slight variations in OR.

A significant correlation also exists between the socio-professional category of the mother and the risk of OBO. The children who have a mother in a low socio-professional class (workers), show an increased risk compared with the children whose mothers are in the highest socioeconomic group (leaders and senior executives = reference categories), adjusted OR = 1.83; in second grade. The association between SES and OBO is even more marked with regards to the father's

Table 3: Odds ratios (OR) for obesity or overweight by sex, citizenship, socio-professional categories of the mother and the father, and district of residence; 95% confidence intervals (CI) are given for the results of the multivariate analysis

	2nd grade			5th grade			8th grade		
	OR	Adjusted OR	95% CI	OR	Adjusted OR	95% CI	OR	Adjusted OR	95% CI
Se×[1]									
Male	0.73	0.72	0.57-0.90	0.94	-		1.13	-	
Citizenship[2]									
Portuguese	2.41	1.51	1.05-2.17	2.41	1.52	1.12-2.06	2.06	1.68	1.28-2.20
Italian	2.70	2.38	1.26-4.50	2.70	2.06	1.19-3.58	2.62	2.38	1.52-3.72
Kosovo	3.52	2.19	1.20-4.00	3.52	2.36	1.27-4.39	2.59	2.15	1.31-3.51
Spanish	3.02	1.55	0.75-3.18	3.02	2.17	1.24-3.77	1.32	1.15	0.62-2.14
France	0.90	0.84	0.35-2.01	0.90	1.02	0.42-2.45	1.37	1.28	0.69-2.38
Other European	1.85	1.19	0.69-2.05	1.85	1.87	1.11-3.16	1.46	1.31	0.82-2.08
America	2.27	2.36	1.42-3.91	2.27	1.74	1.05-2.89	1.48	1.26	0.81-1.95
Africa	2.10	1.82	1.13-2.93	2.10	1.56	0.89-2.74	2.01	1.72	1.13-2.63
Other	1.70	1.06	0.60-1.85	1.70	1.52	0.89-2.59	2.13	1.84	1.09-3.11
Socio professional categories mother[3]									
Executives and employees	1.83	1.77	1.02-3.05	1.60	-		1.43	1.33	0.85-2.08
Self employed	0.56	0.40	0.09-1.88	1.04	-		1.73	1.68	0.70-4.03
Workers	2.91	1.83	1.01-3.34	3.48	-		2.51	1.88	1.18-2.99
Other	1.72	1.30	0.75-2.27	2.22	-		2.00	1.58	1.01-2.48
Socio-professional categories father[3]									
Executives and employees	0.89	0.82	0.57-1.16	2.27	2.27	1.53-3.37	1.42	-	
Self employed	0.66	0.57	0.26-1.26	3.71	3.61	2.08-5.13	1.88	-	
Workers	1.78	1.30	0.90-1.88	5.09	4.21	2.83-6.25	1.80	-	
Other	1.72	1.33	0.88-2.01	4.33	3.27	2.08-5.13	2.02	-	
District of residence[4]									
Median income	1.21	1.13	0.82-1.55	1.21	0.95	0.71-1.28	1.45	1.28	1.01-1.62
Lower income	1.76	1.36	1.03-1.80	1.76	1.34	1.05-1.72	1.62	1.32	1.06-1.64

[1]Female. [2]Swiss. [3]Leaders and senior executives. [4] Higher median income districts. -: Not selected in the multivariate model

SES (adjusted OR = 4.21; 95% CI: 2.83–6.25) in fifth grade. These correlations exist for all three school grades.

The district of residence is also significantly associated with a higher risk of OBO (adjusted OR = 1.36; 95% CI: 1.03–1.80) in second grade (adjusted OR = 1.34; 95% CI: 1.05–1.72), fifth grade (adjusted OR = 1.32; 95% CI: 1.06–1.64) and in eighth grade, with the lower medium income district being more at risk.

DISCUSSION

Our data reveals a relatively high prevalence for both overweight and obesity among school age children from Geneva. Using the international cut-off points recommended by the IOTF;[11] 14.4% of the children in second grade, 17.3% in fifth grade and 18.6% in eighth grade, are found to be overweight or obese. This underpins the importance of intervening early to prevent overweight and obesity, considering that the fastest increase in overweight happens between ages 1 and 5 if we consider overweight and obesity to be 0% at birth. There is approximately a 15% increase in overweight and obesity during the first 5 years of life (3%/year), followed by a 2.5% increase during the next 3 years (8%/year) and a further 2% during the last 3 years (7%/year). Prevention should, therefore, be aimed for the "at risk" children and families to start already during pregnancy, in the presence of risk factors (parental excess weight, gestational diabetes, and smoking).[12]

Comparing our findings, regarding the prevalence of overweight and obesity, to those reported in other Swiss cantons (data PSCH, http://www.gesundheitsfoerderung. ch/pdf_doc_xls/f/gesundes_koerpergewicht/ Grundlagen_Wissen/Monitoring/Rapport-Monitorage -IMC-08-09-Villes-et-cantons-aot-2010.pdf) and other European countries,[13,14] we found values comparable to other large Swiss towns (Bern, Zurich) and northern European countries such as Belgium and Holland. A North-South gradient has also been described with the lowest prevalence being seen in Northern Europe (Norway and Sweden) and a progressive increase in the south (Portugal and Spain). This distribution is also present in our data, with the children of Southern countries showing notably higher levels of overweight and

obesity than children from the more northern regions. This difference could be linked with the lower general SES of immigrants and with a potentially "cultural" predisposition to gain weight.[15]

From a longitudinal perspective, a 5 years longitudinal study on 5-year-old children from Geneva, recently reported stabilization in the prevalence of overweight and obesity.[16] Some studies from France, Sweden, Italy and the US, have also reported stabilization or even a decline in the prevalence of overweight[17-23] among children. The longitudinal evolution of BMI, however, has been shown to vary considerably depending on the ethnic origin, with "foreign" children having higher obesity rates and a continual rise in rates, contrary to Swiss children.[24]

In our study, girls are more likely to be overweight or obese at a young age than boys, which has also been observed in certain other surveys.[25] This observation shows a greater increase in weight for girls than boys, compared to the data used to establish our BMI norms,[11] about 10 years ago. Multiple hypotheses can be considered, going from hormonally-induced early puberty to a potentially stronger influence of environmental factors (food, exercise, diets) in girls compared to boys.

Our study shows a strong correlation between the citizenship of the children and the risk of OBO. The children of Kosovar origin, have a higher risk of OBO in second grade (adjusted OR = 2.19), fifth grade (adjusted OR = 2.36) and in eighth grade (adjusted OR = 2.15). Individual interviews (unpublished data) with children from Kosovo, has brought our attention to the importance of the change in environment and the strain-induced by immigration, on parents. The availability of highly palatable and relatively cheap food is very tempting when coming from relatively less "well off" areas.

In comparison, the children of North America or of Italian origin are also at higher risk to be overweight or obese in second grade (adjusted OR = 2.36; 95% and adjusted OR = 1.51, respectively). The explanations for these ethnic differences in overweight are linked to a number of factors including the family environment, where the "ideal morphology", nutritional habits, physical activity and television/screen viewing, can be strongly conditioned by culture.[26,27] Family habits are in turn influenced by the local socio-cultural environment and seem to be adversely associated with lower social status.[28] Another interesting finding is that children with working mothers are more likely to be obese than those with mothers who stay at home, independently to physical activity.[29,30] This, again can be in relation with the lower SES of immigrants, where both parents tend to work and sometimes even have 2 jobs to "make ends meet".

This study also shows a correlation between the socio-professional category of the parents and the risk of overweight and obesity. Children with a mother in a low socio-professional class (workers), have an increased risk, compared to those with mothers in the highest socioeconomic group (adjusted OR = 1.83), in second grade. The association between SES and overweight was surprisingly high with regards to the father's SES in fifth grade (adjusted OR = 4.21). Considering the relative similarity in OR of SES between mothers and fathers in the other grades, this result should probably be interpreted with caution. SES is a complex, multidimensional frame that may be affected by several major factors, including an individual's income, education, occupation, employment, and family background. Although SES is often considered globally, it has been suggested that analyzing the different facets of the SES, might be of interest to a better understanding of the risk factors for OBO.[31,32]

Few studies have shown a clear relationship between overweight and ethnicity.[9] Our results, however, clearly show a difference in the tendency to become overweight and citizenship; non-Swiss children having an approximately two-fold higher tendency to become overweight. As mentioned above, a strong environmental change can induce important changes in eating habits and energy expenditure, keeping in mind that considerable genetic and biological factors also affect the predisposition to obesity.[33]

Limits of this study

Even though our data seems robust since weight and height, as well as SES characteristics, were collected by health professionals and were not self-reported,[34,35] there are nevertheless some limitations. First of all, the database does not include information on the prevalence of overweight or obesity amongst parents. Secondly, our database doesn't include environmental and cultural variables that may affect overweight or obesity rates. Thirdly, the fact that children from private schools were not measured tends to bias our data toward a proportionately higher prevalence of OBO. Private schools being very expensive in Geneva, the children enrolled would tend to be from higher SES and most probably be in the non OBO group.

Body mass index was used to estimate the prevalence of overweight and obesity, knowing that this value is handy, but moderately precise way of measuring body fat. It has been suggested that waist circumference might be a better anthropometric marker of intra-abdominal fatness and correlates better to abnormal lipoprotein profiles, other metabolic complications linked to cardiovascular risk and other chronic diseases.[34,35]

Another limit to our study is that a cross-sectional design can't identify causality. To obtain this, would have taken us to other analytic type of studies, like cohort studies. This is why; caution is required concerning the limitations and conclusions of this study.

CONCLUSIONS

This study shows the age related trends in OBO for children aged 5–12 years in Geneva. Overweight and obesity levels of about 14% are already present in children starting school at age 5, with girls being slightly more overweight than boys. This highlights the importance of early intervention to prevent the onset of OBO before children reach school, which has been suggested but rarely documented in the literature. The continuing, but slower increase in OBO up to age 14 (18.6%) tends to contradict the somewhat accepted concept that children "thin out" with growth, which again emphasizes the importance of tackling OBO earlier.

This study also helps to pinpoint a number of undocumented sociodemographic variables that are linked to OBO among children in Geneva. Nationality has a strong influence on childhood OBO, and so does the SES of parents, as well as the area of residence. The common element linking these risk factors being mostly economic since immigrants tends to be of lower SES and live in the more affordable areas of the Canton.

These findings have practical implications for the organization of the school health system, exacerbating the need to have better health coverage by school nurses and doctors, in certain areas, to develop culturally appropriate programs and documentation. A health promotional approach aims to encourage healthy behaviors for all (no food/drink distributors, green fork meals, rules for food and beverages brought to school), nutritional education during classes, global exercise and mobility promotion in and around school. Various specific and cultural activities (cooking ethnic food together), also exist and have been implemented, in some of Geneva's schools.

Because of the strongly stigmatizing potential aspect of approaching OBO children and families, amongst other elements due to various cultural beliefs, extreme caution must be taken to present the health promotional messages in a nonstigmatizing way by avoiding to talk about obesity, *per se*.

These observations emphasize again the importance of the social determinants of OBO and must question our traditional "therapeutic" approach to this problem. In the short-term, we will have to address the "causes of the causes" as it has been coined by the Commission on Social Determinants of Health, if we hope to change the mid-term evolution of this health issue.

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