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Overweight in Swiss Children and Associations With Children's and Parents'

Characteristics

et

Worldwide Trends in Childhood Obesity

THESE

préparée sous la direction du Professeur Fred Paccaud, Directeur de l'Institut Universitaire de Médecine Sociale et Préventive, avec la collaboration du Docteur Pascal Bovet, PD et MER, et du Docteur Arnaud Chiolero et présentée à la Faculté de biologie et de médecine de l'Université de Lausanne pour l'obtention du grade de

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par

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Rapport de synthèse

Introduction

La prévalence du surpoids et de l'obésité chez les enfants et les adolescents augmente rapidement dans le monde. Le surpoids a un impact important de santé publique : il tend à se pérenniser à l'âge adulte et est associé à de nombreuses maladies, notamment cardiovasculaires, endocriniennes, ostéo-articulaires, et à des problèmes psycho-sociaux.

De ce contexte, nous avons mesuré la prévalence du surpoids et de l'obésité chez les enfants de 12 ans du canton de Vaud, ainsi que les associations avec des facteurs parentaux et comportementaux (1). Nous avons aussi comparé l'évolution séculaire de la prévalence l'obésité chez les enfants de 6 à 12 ans dans trois régions du monde : la Suisse, les Seychelles et les Etats-Unis (2). Ces recherches ont fait l'objet d'un article original (1) et d'une lettre scientifique (2) publiés en 2007 dans des journaux à politique éditoriale.

(1) Surpoids chez les enfants suisses et associations avec certaines caractéristiques chez les enfants et leurs parents

Le but de cette étude était de mesurer la prévalence du surpoids et de l'obésité chez les enfants de sixième année du canton de Vaud (âge moyen de 12 ans) et les facteurs associés au surpoids.

Les données ont été récoltées lors d'une étude menée par l'Institut universitaire de médecine sociale et préventive. Tous les enfants scolarisés en 6^{ème} année à l'école publique du canton de Vaud entre septembre 2005 et mai 2006 étaient éligibles à participer à cette étude. Le taux de participation a atteint 76% (soit 5207 enfants de 12,3 ans en moyenne). Le poids et la taille des enfants ont été mesurés à l'école par des assistants de recherche et les enfants ont rempli, en classe, un questionnaire structuré sur leur mode de vie (notamment : temps quotidien passé à regarder la télévision, à jouer à des jeux sur écran; fréquence de la pratique de diverses activités physiques; fréquence de la consommation de fruits ou de légumes). Des informations sur les parents (niveau d'éducation, nationalité, poids et taille) ont été récoltées au moyen d'un questionnaire structuré envoyé par courrier à ceux-ci.

Nous avons utilisé les critères de l'*International Obesity Task Force*, qui définit les valeurs-seuils de l'indice de masse corporelle pour le surpoids et pour l'obésité, par âge et par sexe. La prévalence du surpoids (obésité incluse) dans la population était de 15% chez les garçons et de 12% chez les filles, et la prévalence de l'obésité était de 2% dans les deux sexes. Nous avons trouvé que le surpoids était associé de façon indépendante avec le temps passé à regarder la télévision, ainsi qu'avec certaines caractéristiques des parents, comme le surpoids, un bas niveau d'éducation et une nationalité étrangère.

En conclusion, un enfant sur sept est en surpoids ou obèse dans le canton de Vaud. Ces chiffres indiquent un important défi de santé publique, même si cette prévalence dans le canton de Vaud est, actuellement, moindre que dans beaucoup d'autres pays d'Europe, et bien moindre qu'en Amérique du Nord. Les associations entre le surpoids infantile et le temps passé à regarder la télévision, ainsi que les associations avec des variables liées au milieu socio-culturel des parents indiquent plusieurs pistes d'intervention pour prévenir le surpoids chez les enfants. Il est probable que les mesures de prévention ne devraient pas se limiter aux approches individuelles, mais devraient aussi inclure des mesures structurelles sur l'environnement social, physique et économique visant à réduire les facteurs obésogènes dans la société.

(2) Tendances mondiales de l'obésité infantile

Nous avons comparé l'évolution de la prévalence de l'obésité chez les enfants âgés de 6 à 12 ans dans trois populations différentes : en Suisse, aux Etats-Unis et aux Seychelles.

Pour la Suisse, nous avons utilisé les données des quatre études publiées: deux dans la région de Zurich, une entre 1960 et 1965, et l'autre entre 1980 et 1990 ; une étude basée sur un échantillon représentatif de la population suisse en 2002 ; et une étude dans le canton de Vaud en 2005-2006 (cf. article ci-dessus). Pour les Etats-Unis, nous avons utilisé des données de plusieurs enquêtes nationales. Pour les Seychelles, nous avons utilisé des données d'enquêtes menées chaque année depuis 1998 auprès de tous les enfants de toutes les écoles.

Afin de permettre la comparaison avec les données américaines, nous avons utilisé les critères des *Centres for Disease Control and Prevention* (CDC), qui définit des indices de masse corporelle limites pour l'obésité, par âge et par sexe. A noter que les études dans le canton de Vaud et aux Seychelles ont été effectuées par l'Institut universitaire de médecine sociale et préventive (IUMSP).

En Suisse, l'obésité chez les enfants de 6 à 12 ans était pratiquement inexistante jusque dans les années 1980, mais la prévalence a atteint 6.5% selon l'étude nationale en 2002 et 3.6% selon l'étude dans le canton de Vaud en 2006 chez les enfants de 12 ans. Aux Etats-Unis, la prévalence de l'obésité chez les 6-12 ans était déjà substantielle dans les années 1960 (4.2%), et a augmenté ensuite régulièrement pour atteindre 19% en 2004. Aux Seychelles, la prévalence de l'obésité chez les 6-12 ans était de 4.6% en 1998 et a atteint 9.4% en 2004. Le rythme le plus rapide de progression de la prévalence a été observé aux Seychelles, avec une augmentation moyenne de 0.8% par année. Aux Etats-Unis, cette progression annuelle était de 0.6% de 1991 à 2004, alors qu'en Suisse, le rythme était 0.3% durant ces 2 dernières décennies.

Ces données confirment les tendances séculaires haussières dans des populations différentes. Il n'y a aucun signe de ralentissement jusqu'à présent. La prévalence d'obésité est actuellement la plus élevée en Amérique du Nord, mais les observations dans un pays en développement (Seychelles) suggèrent que, pour être tardive, l'augmentation de la prévalence est aussi la plus forte. Ces tendances haussières au niveau mondial s'expliquent probablement par des changements du mode de vie de même nature dans toutes les populations, notamment une diminution de l'activité physique et une offre alimentaire abondante et facilement accessible dans tous les pays. Ces observations chez les enfants, qui font écho à des tendances séculaires similaires bien connues chez les adultes, soulignent l'urgence de mettre sur pied des mesures de prévention du surpoids.

Overweight in Swiss Children and Associations With Children's and Parents' Characteristics

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Abstract

LASSERRE, AURÉLIE M., ARNAUD CHIOLERO, FRANÇOIS CACHAT, FRED PACCAUD, AND PASCAL BOVET. Overweight in Swiss children and associations with children's and parents' characteristics. *Obesity*. 2007; 15:2912–2919.

Objective: The objective was to assess the prevalence of overweight and obesity in children in a canton of Switzerland and the association with various characteristics of the parents and the children.

Research Methods and Procedures: A cross-sectional survey was conducted in all children of the sixth school grade of the canton of Vaud, Switzerland. Weight and height were measured, and selected lifestyle variables were assessed with a self-administered semiquantitative questionnaire. Information on children's parents was gathered through a mailed structured questionnaire. Overweight and obesity were based on the International Obesity Task Force criteria.

Results: Of 6873 eligible children, 5207 (76%) participated (2621 boys, 2586 girls; mean age, 12.3 years; standard deviation, 0.5 year). The prevalence of overweight (including obesity) was 15.0% (95% confidence interval, 13.7% to 16.4%) in boys and 12.4% (11.1% to 13.7%) in girls, and the prevalence of obesity was 1.8% (1.3% to 2.3%) and 1.7% (1.2% to 2.2%), respectively. In both univariate and multivariate analyses, overweight was strongly associated with high television viewing time and selected characteristics of the parents (overweight, low educational level, and foreign nationality).

Discussion: The prevalence of pediatric overweight and obesity was lower in this region of Switzerland than in

several European countries. The correlates of overweight found in this region suggest areas for potential interventions.

Key words: television, education, diet, physical activity

Introduction

Overweight and obesity are reaching epidemic proportions among children in many countries (1). Childhood overweight is associated with multiple detrimental health outcomes, such as hypertension, insulin resistance, diabetes, dyslipidemia, and low self-esteem (2). In addition, childhood overweight tracks into adulthood (3); there is, therefore, a clear need for early prevention.

The epidemic of overweight likely involves changes in the balance between energy intake and energy expenditure. However, there is still ample debate on the underlying causes of this imbalance (4,5) and on effective interventions for prevention and treatment (6). Many studies found that childhood overweight was associated with low physical activity, sedentary behaviors, and several unhealthy dietary habits (7–9). However, these associations were not found consistently (5), especially when parental characteristics were taken into account (10,11). Parents' characteristics such as educational level (10), body weight status (3), or feeding pattern (12) may influence the occurrence of overweight in children. This stresses the need to include parents' characteristics in studies of childhood overweight in various settings.

The purpose of this study was to estimate the current prevalence of overweight and obesity in a region of Switzerland and to explore associations with behavioral and dietary factors in children and characteristics of their parents.

Research Methods and Procedures

The survey took place between September 2005 and May 2006 in the Canton of Vaud, Switzerland (13). The canton of Vaud is located in the western, French-speaking part of Switzerland and accounts for 9% of the Swiss population (7.5 million). Children attend school up to the 9th grade,

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with 96% in public schools. All children in 6th grade at all public schools were invited to participate in this survey. Subjects who were on diets were not excluded. A total of 5207 (76%) of the 6873 eligible children participated (2621 boys and 2586 girls; mean age, 12.3 years; standard deviation, 0.5 years, range, 10.1 to 14.9 years). The survey was approved by the ethical research committee of the University of Lausanne. Signed consent was obtained from the parents and children. Children were informed that individual results would not be communicated to teachers or parents.

Clinical officers measured weight and height with electronic scales and fixed stadiometers, respectively, on children wearing light clothing and no shoes. Children completed a self-administered semiquantitative questionnaire on sedentary behaviors, physical activity, and dietary habits. The questionnaire had been pre-tested for understandability on 37 children. Sedentary behaviors were assessed by daily television (TV)¹ viewing time (assessed by questions for each day of the week and responses of “Not watched,” “<1 hour,” “1 to 2 hours,” “3 to 4 hours,” or “>4 hours”) and daily time spent playing video games on a console or the Internet (average number of sessions per week and time spent on average per session). Questions on physical activity and food consumption were based largely on questions used in the Health Behavior in School Aged Children Study (14). Physical activity was assessed by daily walking time and the number of days per week of intense leisure physical activity (“physical activity resulting in perspiring or deeply breathing”). We assessed the frequency of the consumption of fruits, vegetables, candies, chocolates, chocolate bars, sugar-sweetened drinks, and chips with the question, “On how many days per week do you usually eat X?” (“<1 day per week,” “1 day/wk,” “2 to 4 days/wk,” “5 to 6 days/wk,” “7 days/wk,” “several times every day”). “Snacks” refer to the combination of sweets, chocolates, chocolate bars, and chips.

In addition, a structured questionnaire was mailed to the parents. The questionnaire enquired about educational level, nationality, and current weight and height of father and mother. Educational level was defined as the highest degree completed by either parent.

Overweight and obesity in children were defined according to the sex- and age-specific BMI criteria of the International Obesity Task Force (IOTF) (15). We also calculated the prevalence of “at-risk-of-overweight” and “overweight” based on the U.S. Centers for Disease Control and Prevention (CDC) criteria (16). “Overweight” (IOTF) generally corresponds well with “at-risk-of-overweight” (CDC), while “obese” (IOTF) is slightly more conservative

as compared with “overweight” (CDC) (17,18). For parents, overweight was defined as a BMI ≥ 25.0 kg/m² based on self-reported height and weight. Type of residence area was urban, semi-urban, or rural according to the definition of the Swiss Office of Statistics (available online at www.statistique.admin.ch).

The study was aimed at estimating the prevalence of overweight and obesity. With an expected sample of 5000, the power to provide a precision of 2% given a prevalence of 15% (overweight) was 97%, and the power to provide a precision for 2% given a prevalence of 5% (obesity) was >99%. Although the study was exploratory with regard to associations, the large sample size provided power to minimize errors in estimates of obesity. Estimates of the prevalence of overweight and obesity are provided with 95% confidence intervals. We examined the Spearman correlation coefficients between the considered characteristics. We used multivariate logistic regression to examine the independent association between the considered characteristics and overweight. We tested for interactions between TV viewing and snacking, TV viewing and physical activity, snacking and physical activity, and parents’ nationality and parents’ educational level. None was significantly associated with overweight. As the observed associations were similar in analyses carried out separately in boys and girls, we used a final model that included both boys and girls. *p* Values below 0.05 were considered significant. Statistical analysis was conducted using Stata 9.0 (StataCorp LP., College Station, TX).

Results

Table 1 shows the characteristics of the sampled children and the prevalence of overweight and obesity.

Table 2 shows the Spearman correlation coefficients among selected variables. Parents with higher educational levels were less frequently overweight than parents of lower educational levels. The level of parents’ education was inversely associated with TV viewing time and with sugar-sweetened drink consumption and directly correlated with the consumption of fruits and vegetables. TV viewing time was correlated with video game playing time and the consumption of sugar-sweetened drinks and energy-dense snacks. Correlations were also found among fruit and vegetable intake, walking time and physical activity frequency, and sugar-sweetened drinks and energy-dense snacks.

Table 3 shows the prevalence of overweight (including obesity; IOTF criteria) according to parents’ and children’s characteristics and the crude and adjusted odds ratios between overweight and these characteristics.

Overweight in children was strongly associated with parents’ educational level, nationality, and weight status in both univariate and multivariate analyses. Overweight was more frequent in urban areas than in semi-urban or rural areas.

¹ Nonstandard abbreviations: TV, television; IOTF, International Obesity Task Force; CDC, Centers for Disease Control and Prevention; IQR, interquartile range; .

Table 1. Characteristics of the children and prevalence of categories of excess body weight.

	Boys	Girls	All
<i>N</i>	2621	2586	5207
Age (yrs) [mean (SD)]	12.3 (0.5)	12.3 (0.5)	12.3 (0.5)
Weight (kg) [mean (SD)]	44.1 (9.4)	44.6 (9.4)	44.3 (9.4)
Height (m) [mean (SD)]	153.2 (7.9)	153.8 (7.3)	153.5 (7.6)
Mean BMI (kg/m ²) [mean (SD)]	18.6 (2.9)	18.7 (3.1)	18.7 (3.0)
Excess weight category, IOTF (%) [mean (SE)]			
Overweight (including obese)	15.0 (0.7)	12.4 (0.6)	13.7 (0.5)
Obese	1.8 (0.3)	1.7 (0.3)	1.7 (0.2)
Excess weight category, CDC (%) [mean (SE)]			
BMI ≥ 85th percentile (“at risk” or “overweight”)	16.1 (0.7)	12.4 (0.6)	14.3 (0.5)
BMI ≥ 95th percentile (“overweight”)	4.2 (0.4)	3.0 (0.3)	3.6 (0.3)

SD, standard deviation; IOTF, International Obesity Task Force (15); SE, standard error; CDC, Centers for Disease Control and Prevention (16).

Mean TV viewing time was 1.2 hours [median, 0.8 hours; interquartile range (IQR), 0.5 to 2.0 hours] per weekday and 1.7 hours (median, 2.0 hours; IQR, 0.2 to 2.5 hours) per

weekend day. Only 2% of the children reported no TV viewing at all. TV viewing time above 1 hour per day was reported by 59% of boys vs. 47% of girls ($p < 0.001$). Most

Table 2. Spearman correlation coefficients between selected characteristics of the parents and the children

	Parents' education	Parents' nationality	Parents' overweight	Residence area	TV	Video games	Walk	Physical activity	Fruits	Vegetables	Sweet drinks
Parents' nationality	-0.27‡										
Parents' overweight	-0.17‡	0.17‡									
Residence area	-0.03	-0.16†	-0.01								
TV	-0.19‡	0.19‡	0.12‡	-0.05†							
Video games	-0.01	0.01	0.03	-0.01	0.27‡						
Walk	0.01	0.04†	-0.02	-0.05†	-0.01	-0.01					
Physical activity	0.02	-0.03	-0.02	0.05†	-0.03*	0.04*	0.17‡				
Fruits	0.12‡	-0.03	-0.03	-0.03	-0.16‡	-0.07‡	0.12‡	0.13‡			
Vegetables	0.18‡	-0.19‡	-0.08‡	0.02	-0.20‡	-0.05‡	0.08‡	0.08‡	0.34‡		
Sweet drinks	-0.15‡	0.18‡	0.07‡	-0.03	0.25‡	0.17‡	0.00	0.04*	-0.09‡	-0.16‡	
Snacks	0.00	0.03	-0.02	-0.00	0.18‡	0.19‡	0.01	0.02	0.02	-0.02	0.33‡

Nationality was coded as 0 if father and mother were Swiss, 1 if one parent was Swiss, and 2 if neither of the parents was Swiss. Residence area was coded as 0 for urban, 1 for semi-urban, and 2 for rural.

* $p < 0.05$.

† $p < 0.01$.

‡ $p < 0.001$.

Table 3. Association between overweight and selected characteristics of the parents and the children

	<i>N</i>	Prevalence of overweight*		Model I unadjusted			Model II adjusted		
		%	SE	OR	95% CI	<i>p</i>	OR†	95% CI	<i>p</i>
Parents' education									
Primary	551	24.1	1.8	1			1		
Secondary	2509	14.5	0.7	0.5	0.4 to 0.7	<0.001	1.0	0.7 to 1.4	0.98
Tertiary	1741	9.1	0.7	0.3	0.2 to 0.4	<0.001	0.7	0.5 to 1.0	0.026
Parents' nationality									
Swiss	3125	10.2	0.5	1			1		
Swiss and non-Swiss	463	14.0	1.6	1.4	1.1 to 1.9	0.013	1.5	1.1 to 2.1	0.014
Non-Swiss	1196	22.2	1.2	2.5	2.1 to 3.0	<0.001	1.9	1.5 to 2.4	<0.001
Parents' overweight									
None	2234	7.4	0.6	1			1		
One parent	1906	12.6	0.8	1.8	1.5 to 2.2	<0.001	1.7	1.3 to 2.1	<0.001
Both parents	908	30.1	1.5	5.4	4.3 to 6.6	<0.001	4.6	3.5 to 5.8	<0.001
Residence area									
Urban	1521	17.2	1.0	1			1		
Semi-urban	2206	11.3	0.7	0.6	0.5 to 0.7	<0.001	0.7	0.6 to 0.9	0.014
Rural	1480	13.7	0.9	0.8	0.6 to 0.9	0.008	0.9	0.7 to 1.1	0.27
TV viewing (hours/d)									
<1	2314	9.9	0.6	1			1		
1 to 3	2230	16.1	0.8	1.7	1.5 to 2.1	<0.001	1.6	1.3 to 2.0	<0.001
>3	395	23.5	2.1	2.8	2.1 to 3.7	<0.001	2.3	1.6 to 3.4	<0.001
Video games playing (min/d)									
0	522	14.2	1.5	1			1		
1 to 30	3316	13.3	0.6	0.9	0.7 to 1.2	0.59	1.1	0.8 to 1.5	0.63
>30	1291	14.6	1.0	1.0	0.8 to 1.4	0.83	1.0	0.7 to 1.5	0.74
Walking time (min/d)									
<15	1266	13.7	1.0	1			1		
15 to 30	1978	13.5	0.8	1.0	0.8 to 1.2	0.93	1.2	0.9 to 1.5	0.20
>30	1863	13.5	0.8	1.0	0.8 to 1.2	0.91	1.0	0.8 to 1.3	0.84
Physical activity (days/wk)									
<1	717	16.0	1.4	1			1		
1 to 4	3272	13.6	0.6	0.8	0.7 to 1.0	0.09	0.9	0.7 to 1.3	0.70
>4	1200	12.5	1.0	0.7	0.6 to 1.0	0.030	0.7	0.5 to 1.0	0.035
Fruit (days/wk)									
<2	1111	13.1	1.0	1			1		
2 to 7	2951	14.0	0.6	1.1	0.9 to 1.3	0.50	1.2	0.9 to 1.5	0.25
>1 fruit per day	1131	13.9	1.0	1.1	0.8 to 1.4	0.61	1.5	1.1 to 2.0	0.013
Vegetables (days/wk)									
<2	785	16.4	1.3	1			1		
2 to 7	3211	13.3	0.6	0.8	0.6 to 1.0	0.025	1.1	0.8 to 1.4	0.58
>1 vegetable per day	1164	12.9	1.0	0.8	0.6 to 1.0	0.029	1.2	0.8 to 1.7	0.34

Table 3. Continued

	N	Prevalence of overweight*		Model I unadjusted			Model II adjusted		
		%	SE	OR	95% CI	p	OR†	95% CI	p
Sweetened drinks (days/wk)									
<2	2964	14.4	0.6	1			1		
2 to 7	1635	13.4	0.8	0.9	0.8 to 1.1	0.35	0.8	0.7 to 1.0	0.11
>1 drink per day	561	10.7	1.3	0.7	0.5 to 0.9	0.020	0.5	0.3 to 0.8	0.001
Snacks (days/wk)									
<2	2062	18.3	0.9	1			1		
2 to 7	2354	11.3	0.7	0.6	0.5 to 0.7	<0.001	0.6	0.5 to 0.7	<0.001
>1 snack per day	743	8.1	1.0	0.4	0.3 to 0.5	<0.001	0.3	0.2 to 0.5	<0.001

SE, standard error; OR, odds ratio; CI, confidence interval.

* Overweight (including obesity) according to IOTF definition (15).

† Adjusted for age, sex, and each variable in the table; *N* = 4155.

children reported playing video games 30 minutes per day or less, while 10% did not play video games at all. Boys played video games more often than girls (33% vs. 18% playing >30 minutes per day, $p < 0.001$). The prevalence of overweight and obesity increased gradually across TV viewing time categories (Figure 1). No similar association was found for video game playing time.

A majority of children reported walking for ≤ 30 minutes per day (60% of boys vs. 67% of girls, $p < 0.001$). A majority of children reported intense physical activity on 1 to 4 days per week. Intense physical activity less often than once a week was reported by 20% of girls vs. 8% of boys ($p < 0.001$). The sports practiced most frequently among boys were soccer and cycling, and among girls it was cycling and dance. Overweight was not associated with walking time but was inversely correlated with intense physical activity.

One-fourth of the children reported eating fruit daily, and a similar proportion reported eating vegetables daily. Based on the results of the adjusted analysis (Table 3, Model II), overweight was directly associated with intake of fruits, no association was found with intake of vegetables, and inverse associations were found with consumption of energy-dense foods (snacks and sugar-sweetened drinks).

Discussion

The prevalence of overweight (including obesity) at age 12 was 13.7% in this part of Switzerland. Overweight was strongly associated with several parents' characteristics, both socioeconomic (educational level and nationality) and anthropometric (parents' weight). While higher parents'

educational level was correlated with higher intake of fruits and vegetables and lower intake of snacks in children, overweight was associated directly with intake of fruits, no association was found with intake of vegetables, and inverse associations were found with consumption of snacks and sweetened drinks. Weak or null associations were found between overweight and reported physical activity. TV viewing time was strongly associated with overweight.

The strengths of this study include the population-based study design, the large sample size (to date, this survey was the largest performed in Switzerland), and a fair participation rate, which ensure that the results are representative of the general population. There are some limitations, however. Children were mainly 11 to 13 years of age, and results are not necessarily applicable to other age categories. We had no direct information on ethnicity or race. Detailed analysis by country of origin exceeds the scope of this short report. School nurses reported that overweight children declined to participate more frequently than non-overweight children, which may lead to some underestimation of the prevalence of overweight and obesity. The questionnaire submitted to the children included only a few questions to assess physical exercise and diet; such a crude assessment may have led to underestimation of the association of overweight with diet or physical activity. Finally, the cross-sectional design limits our ability to infer causation in the associations between children's behaviors and overweight.

The prevalence of overweight in our study is consistent with results of previous surveys in Switzerland. In 2002, a nationally representative survey among 2451 school-children 6 to 12 years of age found a prevalence of

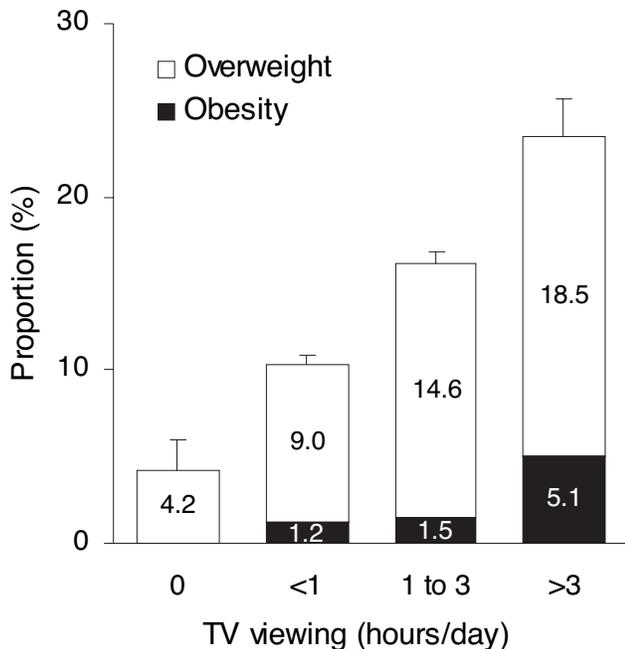


Figure 1: Prevalence of categories of excess body weight by TV viewing time. Overweight and obesity were defined according to standard criteria (IOTF) (15).

overweight of 19% among boys and 17% among girls (IOTF criteria) (19). In 1999, a regional survey in the Greater Zurich area among 872 schoolchildren 6 to 10 years of age found a prevalence of 14% (IOTF criteria) (20). In the largest city of the considered region (Lausanne, Canton of Vaud), overweight was found in 17.6% of boys and 14.0% of girls, based on repeated surveys of 1203 children 11 to 16 years of age between 1992 and 1996 (95% participation rate) (21). These figures tended to be lower compared with our findings in the urban area of Canton of Vaud (18.4% and 16.1% in boys and girls at age 11 to 13 years, respectively), which is consistent with an increasing prevalence of overweight in adolescents in the last decade. Two recent reviews estimated that the prevalence of overweight (including obesity) among Swiss children ranged between 15% and 20% and obesity between 0% and 6% (18,22). These results are consistent with lower prevalences of pediatric overweight in Switzerland than in many European countries (1).

Overweight in children was strongly and independently associated with some parental characteristics. The role of familial socioeconomic status and parents' overweight on children's weight status has often been described and can reflect shared environment and lifestyles at the family level, as well as genetic factors (3,10,20). Parents' height and weight were self-reported, which may result, at least among overweight individuals, in overestimation of height and underestimation of weight and BMI (23). In a separate

analysis adjusting for these differences, the association between overweight in children and overweight in parents remained almost unchanged.

Overweight prevalence was higher in urban than in semi-urban or rural areas. The proportion of children performing physical activity regularly did not differ by type of area, whereas children in rural areas watched TV less frequently. After adjustment for other variables, the association between overweight and type of area was reduced. More generally, differences between urban and rural settings have decreased in recent decades in many European countries (including Switzerland) with high gross domestic product; currently, there are little or no significant urban-rural differences in the prevalence of obesity in adults in these countries (24).

An association between overweight and TV viewing time has been reported in several cross-sectional and longitudinal studies (7,20), although, in some other studies (10,11), the relation weakened or disappeared after adjustment for parents' weight, socioeconomic status, or ethnicity. Interestingly, an association was found even at a fairly low level of TV viewing. Our study confirms previous findings of lower TV viewing time in Switzerland as compared with several other European countries or the United States (14). The association between TV viewing time and overweight has been linked to various factors, e.g., low energy expenditure, snacking during TV viewing, or reduced physical activity (7,25,26). Physical activity and TV viewing time were only weakly correlated, which further supports the view that preventive measures should aim at both reducing TV viewing time and increasing physical activity (27).

No association was found between overweight and video game playing, consistent with some studies (10,28) but not all (20,29). This may relate to the fact that children in our study spent substantially less time playing video games than watching TV. In addition, playing video games has been found to be associated with higher energy expenditure than TV watching and is devoid of exposure to obesogenic food advertising (25).

Few children in our study had fruit and vegetable intakes in line with current recommendations, i.e., 3 to 5 cups of fruits or vegetables per day for children of this age (30). Our findings of a direct association of overweight with intake of fruits, no association with intake of vegetables, and inverse associations with consumption of snacks and sweetened drinks are counterintuitive. Previous studies found a positive or no association between overweight and snack and sugar-sweetened drink intakes (4,9). In a multi-national Health Behavior in School Age Children survey performed in 2001/2002, sweets intake was inversely associated with overweight in almost all participating countries (14). These results in unexpected directions can reflect various biases, e.g., underestimated reporting of actual consumption by overweight children (social desirability bias) (8,31), truly

decreased food intake by some overweight children to control their weight, or the inability of the questionnaire to capture complex food patterns such as snacking in replacement or in addition to regular meals (8). Also, since total calorie intake could not be estimated from our questionnaire, associations with dietary factors could not be adjusted for total caloric intake to account for inherently larger food intake by overweight persons (8).

In summary, TV viewing time and selected parental characteristics (educational level, nationality, and weight status) were strongly associated with overweight in Swiss children 12 years of age. Given that children often have access to TV, this association confirms a potentially important area for prevention. The relationship between children's overweight and social characteristics of the parents underlies life course causes of pediatric overweight and the need for multifaceted approaches to its prevention. The absence of associations between physical activity and dietary factors and overweight in this cross-sectional study is likely to be linked to methodological issues. However, the clearly low consumption of fruits and vegetables by children points to another area for intervention.

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Worldwide trends in childhood obesity

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The prevalence of childhood obesity is raising rapidly worldwide [1]. While paediatric obesity has long been associated with western countries, accumulating evidence shows that the epidemic extends to developing countries as well, in addition to an ongoing problem of under-nutrition in the latter [1]. In children as in adults, obesity is associated with chronic conditions such as type 2 diabetes or hypertension. In addition, obese children are at high risk of becoming obese adults. It has been suggested that failing to address the epidemic of overweight would expose current children generations to shorter life expectancy than their parents due to increased obesity-related disease burden [2].

We compared trends in the prevalence of obesity in school children aged 6–12 years from Switzerland and the USA – as examples of industrialised high-income countries – and in children from Seychelles – as an example of a middle-income developing country experiencing rapid health transition [3]. We chose the 6–12 age range because one recent national survey available in Switzerland was limited to this range [4]. We used published aggregated data for Switzerland [4–6] and the USA [7–9], and raw data for Seychelles [3].

In Switzerland, data are available from regional surveys in the city of Zurich in 1960/65 (n = 232) [4, 5] and 1980/90 (n = 205) [4, 6] and from a nationally representative sample of children aged 6–12 years in 2002 (n = 2431) [4]. For the United States of America, we report the prevalence of obesity among children aged 6–11 years from six national surveys in 1963/65 (n = 7119), 1971/74 (n = 2062), 1976/80 (n = 1725), 1988/94 (n = 1064), 1999/2002 (n = 1049) and 2003/04 (n = 981) [7–9]. For the Seychelles, we report the prevalence of obesity from seven national surveys conducted yearly between 1998 and 2004 in all students of all schools in four selected school grades (day-care, 4th, 7th and 10th years of mandatory school), from which we calculated the estimates for students aged 6–12 (n = 16996) [3].

For all three countries, obesity was defined according to the criteria of the American Centres for Disease Control and Prevention (CDC), ie a body-mass index (BMI) at or above the age- and sex-specific 95th percentile from the “2000 CDC Growth Charts: United

States” (notice that these 2002 CDC data are based on anthropometric measurements made in the 1970–80s, before the obesity epidemic) [10].

In Switzerland, the prevalence of obesity among school children aged 6–12 years was very low until the 1980s (figure 1). In 2002, the prevalence was 6.5% [4]. If the prevalence reported in the city of Zurich in the 80s was considered to be representative for the general population of Switzerland, this would correspond to an absolute increase of approximately 0.3 percentage point per year over the 20 past years. In the USA, the prevalence was 4.2% in the 1960s [7, 8] and it progressively rose to 18.8% in 2003/04 [9]: the increase of obesity was of 0.2 percentage point per year between 1964 and 1978, 0.4 between 1978 and 1991, and 0.6 between 1991 and 2003/04. In the Seychelles, the prevalence of obesity was 4.6% in 1998 and rose to 9.4% in 2004 [3], an increase of 0.8 percentage point per year over that period. The steepest increase over time was therefore observed in the Seychelles, where the prevalence of obesity has more than doubled in seven years and could now exceed the prevalence in Switzerland (figure 1). The trends shown in the figure were similar when examined separately in boys and girls.

Other surveys have assessed the prevalence of obesity in Switzerland. However, other definitions for obesity were used [11–13] and/or children of other age categories were considered [13, 14]. In Lausanne, in a cohort of school children (n = 1203), the prevalence of obesity at age of 5–12 was 1.7% in boys and 2.7% in girls in 1985/91 [12]. In this survey, obesity was defined with the criteria of the International Obesity Task Force (IOTF) which tend to give lower estimates for obesity compared to the CDC criteria. In a nationally representative survey performed in 1999 (n = 595), the prevalence of obesity at

age 6–12 was 9.7% in 1999 [11]. In this survey, obesity was based on the former US definition of obesity, which tends to give higher estimates than the CDC criteria [15]. We recently reported a prevalence of obesity of 3.6% among 5207 children of the 6th grade of the canton of Vaud (mean age: 12.3 years (SD: 0.5); range: 10–14) (open circle on the figure) [14]. Prevalence of obesity was reported to be lower in young adolescents compared to younger children [1, 13] and may differ between regions of the country or between cities and countryside, depending on ethnicity and socio-economic characteristics of the population.

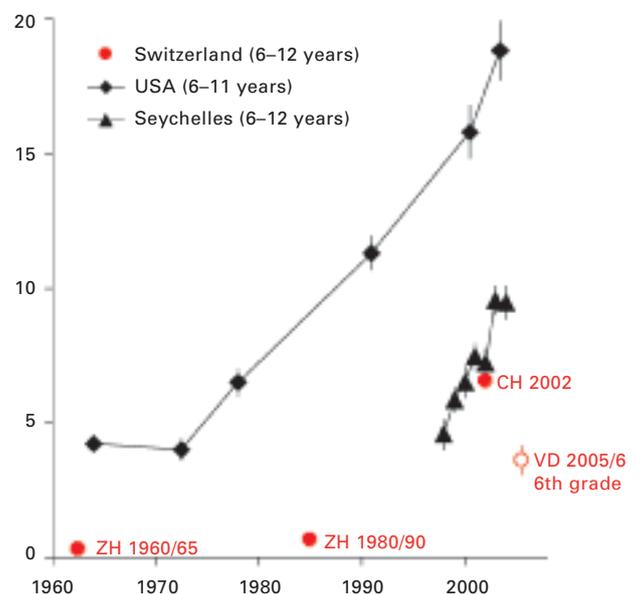
The trends that we report for Switzerland are consistent with findings in other European countries: the annual increase in the prevalence of childhood obesity (IOTF criteria) rose from below 0.1% per year in the 1980s to 0.3% per year in the late 1990s [16]. By 2010, it is expected that one of ten school children will be obese in Europe [16]. In Switzerland, as in many other western countries, paediatric obesity is associated inversely with socio-economic status [1, 14].

The rapidly increasing prevalence of paediatric obesity in the Seychelles is consistent with rapid socio-economic development, as observed in other developing populations like Brazil or Chile [1]. Our results in the Seychelles (gross domestic product of US\$ 8000/year per capita) are also consistent with the finding that the prevalence of obesity increases rapidly when a country's gross domestic product reaches about 5000 international dollars [17].

Decreasing physical activity and increasing sedentary behaviours are likely to be main forces driving the obesity epidemic [18]. In Switzerland, a decrease in sports practice was reported in adolescents during the last decade [19]. In the Seychelles, walking time and leisure physical activity decreased between

Figure 1

Prevalence of obesity in children aged 6–12 years in the Seychelles [3] and in Switzerland [4–6] (CH: Switzerland; ZH: Zurich), and in children aged 6–11 years in the United States [7–9], between 1963 and 2004. Obesity is defined as a body mass index (BMI) at or above the age- and sex-specific 95th BMI percentile from the 2000 CDC Growth Charts [10]. The open circle indicates prevalence of obesity among schoolchildren of 6th grade (mean age: 12.3 years (SD: 0.5); range: 10–14) of the canton of Vaud in 2005/06 [14].



1998 and 2004, and these factors were associated with overweight [3]. Unfavourable changes in the diet might also be involved, but few reliable data are available on trends in children. In Switzerland, changes in socio-economic and ethnic characteristics of children – which both relate strongly to obesity – can also account for upward trends in the prevalence of obesity in the population.

While the prevalence of obesity is increasing worldwide, there is yet no indication, in any country, that trends were successfully reversed or even curbed in youths or in adults [1, 8]. The rapid prevalence increase of paediatric obesity stresses the need for accelerating the development and evaluation of programs and policies aimed at promoting physical activity and healthy nutrition, as well as programs to provide appropriate health care to obese children.

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