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ORIGINAL ARTICLE

Child overweight in France and its relationship with physical activity, sedentary behaviour and socioeconomic status

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Objective: (1) To assess the prevalence of childhood overweight (OW) and obesity in France; (2) to examine how physical activity and sedentary behaviour are involved in the association between socioeconomic status (SES) and OW, while taking into account total energy intake.
Design and subjects: Representative sample of French children aged 3–14 years ($n = 1016$) taken from the 1998–1999 cross-sectional French INCA (Enquête Individuelle et Nationale sur les Consommations Alimentaires) food consumption survey.
Measurements: Weight and height, leisure-time physical activity (LTPA), sedentary behaviour (TV viewing and video-game use), and SES were reported by parents or children by answering questionnaires; total energy intake was assessed using a 7-day food record.
Results: In total, 15.2% (95% CI: 13.0–17.6) of the children are OW (including obese), according to the IOTF (International Obesity Task Force) definition. OW is inversely associated with SES in children over 6 years of age. LTPA is negatively correlated to OW among the 3 to 5-year-old children only, whereas sedentary behaviour is positively related to OW in childhood and adolescence. From 6 years old on, SES is inversely associated with sedentary behaviour, which consequently may partly mediate the relationship between SES and OW.
Conclusion: This study confirms the association between SES, sedentary behaviour and childhood OW in France. It was performed before the launching of the French Program of Nutrition and Health (PNNS) in 2001 and will be repeated in 2006. This will contribute to monitoring both childhood OW and its main determinants at the population scale.
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Introduction

Obesity is now reaching epidemic proportions in the paediatric population worldwide (Lobstein *et al*., 2004). In France, a review performed by Inserm in 2000, based on regional data and on the French definition of child obesity (Rolland-Cachera *et al*., 1991), highlighted the fact that prevalence has increased more than twofold among children aged 5–12 years since the 1980s (Inserm, 2000). The rapid increase in the prevalence of obesity in recent decades primarily suggests the role of behavioural factors, which are influenced by social and economic environments. Poor eating habits have often been linked with weight gain, and the decrease in energy expenditure in recent decades has also been suggested as a significant contributing risk factor, even if the results of studies performed to investigate the impact of physical activity on child overweight (OW) or obesity are equivocal (Lobstein *et al*., 2004). Regarding the environmental context, recent data suggest that, in industrialized countries, excess weight gain in children is more prevalent

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among lower income families (Wang *et al*., 2002a). However, there is a relative paucity of published studies that assess the impact of socioeconomic status (SES) on lifestyle behaviours in children, particularly those of preschool age. According to Batty and Leon (2002), in their review of the relation of SES to coronary heart disease risk factors in children, no consistent pattern of association between SES and indices of physical activity was apparent. However, food intake was found less healthy in terms of fats and fibre in low SES groups.

Given this background, the present study used data from the French INCA (Enquête Individuelle et Nationale sur les Consommations Alimentaires) food consumption survey: (1) to assess the prevalence of OW (including obesity), defined according to the IOTF (International Obesity Task Force) standards, in a nationally representative sample of French children aged 3–14 years, and (2) to explore whether physical activity and sedentary behaviour are involved in the association between SES and overweight, while taking into account energy intake. For the first time, this study offers, at the national scale and for a wide age range, data on French children related to energy intake, energy expenditure, and weight status, the three components of the energy balance equation. These results should provide useful information on a national basis from data collected before the launching of the French Program of Nutrition and Health (PNNS) by the Ministry of Health in 2001.

Subjects and methods

Subjects

The French INCA food consumption survey was performed between August 1998 and June 1999 by the Research Centre for the Study and the Observation of Way of Life (CREDOC) and the French Food Safety Agency (AFSSA). This cross-sectional survey was primarily designed to assess the food intake patterns of French children and adults. A complex sampling design was used to obtain a nationally representative sample of people living in French households. The survey design and sampling frame have been described in more detail elsewhere (Volatier, 2000). Briefly, the sample, composed of 1985 adults (aged 15 years and over) and of 1016 children (aged 3–14 years), was made representative of the French population diversity through stratification (region of residence, agglomeration size) and use of the quota method (age, gender, household size, head of household socioprofessional status) (Deville, 1991).

Measurements

A 7-day record was used to note all food and drink consumption during the week of the survey. Participants estimated portion sizes by comparing their actual consumption with photographs in the Su.Vi.MAX (SUpplémentation en VItamines et en Minéraux AntioXydants) food portion-size manual (Hercberg *et al*., 1994). Together with the CIQUAL (Centre d'Information sur la Qualité des Aliments) food composition tables (Favier *et al*., 1995), we assessed the average daily energy intake (kcal daily). The other variables, that is, anthropometrical, behavioural and sociodemographical, were self-reported using questionnaires. Documents were delivered at home by a trained and certified investigator, who explained to the parents and their child how to fill them out. The last day of the survey week, he also checked the accuracy of the information reported in both the food record and the questionnaire. When the children were 9 years old or under, parents completed both documents together with their children.

Subjects were separated into three age groups, namely 3–5, 6–10 and 11–14 years, which correspond to the preschool, primary and secondary school levels in France. The head of household's occupation determined the child SES, which was divided into low, middle and high. 'High' was assigned to executive, top-management and professional categories; 'middle' to middle professions (employees, technicians and similar) and 'low' to the others (including unemployed people). Self-reported weight and height were used to calculate the child body mass index (BMI, as weight/height^2, expressed in kg/m^2). Although BMI is not ideal as a measure of adiposity, it has been validated against other more direct measures of body fatness and can therefore be used to define OW and obesity in children and adolescents (Bellizzi and Dietz, 1999). OW and obesity were then estimated according to the IOTF age- and gender-specific child BMI cutoff points (Cole *et al*., 2000). These cutoff points were derived from a large international sample using regression techniques by passing a line through the health-related adult cutoff points at 18 years, that is, BMI values of 25 and 30 kg/m^2.

Physical activity in children generally consists in activities undertaken in leisure time, physical education at school, getting to and from school, and activity related to everyday-life tasks, such as washing and eating. Of all these variables, Guillaume *et al*. (1997) showed that leisure-time physical activity (LTPA) exhibits the largest variations among the different age and sex groups studied. Consequently, in the present study LTPA was chosen as an overall indicator. Watching TV and, more recently, playing video-games, are also components of leisure time and have been considered as a good indicator of sedentary behaviour (Guillaume *et al*., 1997).

In this context, the physical activity questionnaire was derived from the French translation (Deheeger *et al*., 1997) of the Modifiable Activity Questionnaire designed for adolescents by Kriska *et al*. (1990) and adapted for children (Fontvieille, 1993). It asked for the usual amount of time spent taking part in several sports outside school in an ordinary week. The physical activities taken into account were, firstly, informal ones such as cycling, roller-skating or

running, and secondly, more organized activities, such as dancing, team sports or tennis. A physical activity indicator was thus derived from the average time (but not intensity) spent doing such sports and used as a proxy of LTPA. It should be noted that this physical activity questionnaire is probably less suitable for children in the 3–5 years age range. Unfortunately, at the time of the INCA survey, validated physical activity questionnaires adapted for preschool children did not exist. Three levels of LTPA, that is, 'no LTPA', 'intermediate' and 'high', were assessed using two thresholds that corresponded to the value of zero and to the 80th percentile of the time distribution within each age group.

Sedentary behaviour was established from the time spent either watching television (TV) or playing videogames in an ordinary week. An average daily time was calculated and weighted from the values reported for each type of day, that is, school or nonschool days. Therefore, in this paper, 'television viewing and videogame use' will be used as the measurement of sedentary behaviour (or inactivity) and will often be referred to as 'watching TV'. Within each age category, the 20th and the 80th percentiles of the time distributions determined the three levels of sedentary behaviour, that is, 'low', 'intermediate' and 'high'.

Data analysis

OW prevalence (including obesity) was estimated by age and SES. Other univariate descriptive analyses stratified by age were performed to assess the relationships between the behavioural variables, that is, LTPA and sedentary behaviour, the total daily energy intake and socioeconomic characteristics. An additional stratification on sex was not kept because of statistical power constraints. χ^2 and Fisher's exact tests were used to compare frequencies. Means were compared using Student's *t*-tests.

Multivariate logistic regressions were then performed to investigate the associations between OW as the dependent variable, and behavioural variables and sociodemographic patterns. Multivariate models were conducted separately in the three age classes and adjusted for sex and age (introduced as a continuous variable to eliminate any remaining potentially confounding effect of age within each age category). Model 1 included sociodemographical variables: SES; sex; and age. Model 2 included the demographical variables (sex and age) of Model 1 plus other behavioural factors that may affect body weight: LTPA; sedentary behaviour; and total energy intake, as a continuous adjustment variable. Model 3 included SES in addition to variables from Model 2. The lowest category of each discrete variable was taken as the reference group for odds ratio assessment. Before performing these multivariate analyses, the log-linearity of the relationships between OW and both age and energy intake was checked. All analyses were computed on SAS 8.2 software.

Results

Documents (food records and questionnaires) were completed by 56% of the eligible children. Sociodemographical, anthropometrical, and behavioural characteristics of the sample are listed in Table 1. We checked that the sample compared satisfactorily for age, sex and socioprofessional category with the national census (available from: www.recensement.insee.fr) for 1998 published by INSEE (French National Institute of Statistics and of Economic Studies). Of the 1016 children included in the study, 30 observations were eliminated in the final multivariate analyses because of incomplete data (behaviours: $n=3$; anthropometry: $n=27$). These children represent 3% of the initial sample and did not differ from the others with regard to age, sex or SES.

Univariate results

OW prevalence rates by age are presented in Table 1. In total, 15.2% (95% CI: 13.0–17.6) of the children were OW, of whom 3.5% (95% CI: 2.5–4.9) were obese. The percentage of OW children tended to be lower among those aged 11–14 years ($P=0.09$). SES and OW were inversely associated in children over 6 years of age (Figure 1). Children from higher SES aged 6–10 years and 11–14 years were, respectively, three and eight times less likely to be OW than their counterparts in the low SES group (8.1% vs 21.7%, $P=0.01$, and 2.1% vs 17.3%, $P=0.003$, respectively).

Average time spent on LTPA was found to be almost three times higher in the 11 to 14-year-old class than in the 3 to 5-year-old class (Table 1). For more than half of the preschool children no LTPA at all was declared. This figure dropped later in childhood to about 18%. When considering the average time spent watching TV, children displayed more sedentary behaviour with increasing age (1.6 h per day in preschool age vs 2.2 h per day in secondary school levels). Only a very small percentage did not watch any TV at all, that is, $<6\%$ among children aged 3–5 years and $<1\%$ among their older counterparts. Moreover, in the different categories of age, there was no significant association between the levels of LTPA and sedentary behaviour (results not shown). Thus these two discrete variables were included simultaneously in the multivariate logistic regression models.

Sedentary behaviour was more strongly and consistently associated with SES than LTPA. There was a negative relationship between inactivity levels and SES. The proportion of children with a low level of sedentary behaviour increased with SES (Figure 2). Conversely, whatever their age, the percentage of children above the 80th percentile of the television watching time distribution were more likely to be in the lower SES category (results not shown). A positive relationship ($P=0.002$) between LTPA and SES was observed among children aged 6–10 years only (results not shown).

Lastly, among all age groups, energy intake was not significantly related to either sedentary behaviour, or SES.

Table 1 Sociodemographical, anthropometrical and behavioural characteristics of the sample ($n=1016$)

	School levels (age range)				
	Preschool 3–5 years (n = 242)	*Primary 6–10 years (n = 441)*	*Secondary 11–14 years (n = 333)*	*All 3–14 years (n = 1016)*	P-*value*[a]
Sex					
% Males (95% CI)	54.1 (47.6–60.5)	52.4 (47.6–57.1)	49.9 (44.4–55.4)	52.0 (48.8–55.1)	0.58
% Females (95% CI)	45.9 (39.5–52.4)	47.6 (42.9–52.4)	50.1 (44.6–55.6)	48.0 (44.9–51.2)	
SES					
% Low (95% CI)	49.2 (42.7–55.7)	46.9 (42.2–51.7)	52.0 (46.4–57.4)	49.1 (46.0–52.2)	0.63
% Middle (95% CI)	36.8 (30.7–43.2)	36.3 (31.8–41.0)	33.9 (28.9–39.3)	35.6 (32.7–38.7)	
% High (95% CI)	14.1 (9.9–19.1)	16.8 (13.4–20.6)	14.1 (10.6–18.3)	15.3 (13.1–17.6)	
OW (including obesity)					
% (95% CI)	17.9 (13.2–22.6)	16.4 (13.0–20.2)	11.7 (8.4–15.6)	15.2 (13.0–17.6)	0.09
LTPA (h/week)					
% No LTPA (95% CI)	55.4 (48.9–61.8)	17.5 (14.0–21.3)	18.6 (14.6–23.2)	26.8 (24.1–29.7)	<0.0001
Mean (s.d.)	1.9 (3.7)	3.6 (3.9)	5.1 (5.5)	3.7 (4.6)	<0.0001
80th percentile	3.0	5.5	7.0		
Television viewing (h/day)					
% No TV viewing (95% CI)	5.4 (2.9–9.1)	0.7 (0.1–2.0)	0.6 (0.1–2.2)	1.8 (1.1–2.8)	<0.0001
Mean (s.d.)	1.6 (1.2)	1.9 (1.2)	2.2 (1.3)	1.9 (1.2)	<0.0001
20th percentile	0.8	1.0	1.2		
80th percentile	2.4	2.9	3.1		
Energy intake (kcal/day)					
Mean (s.d.)	1576 (405)	1909 (504)	2124 (702)	1900 (593)	<0.0001

Abbreviations: LTPA, leisure-time physical activity; OW, overweight.
[a]Between-age comparisons.

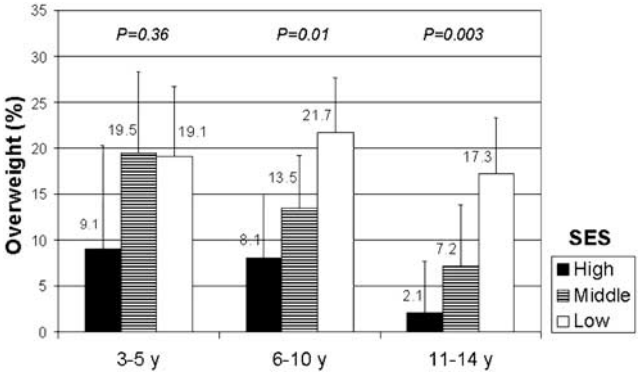

Figure 1 Percentage (%) distribution of OW (including obesity) according to age and SES.

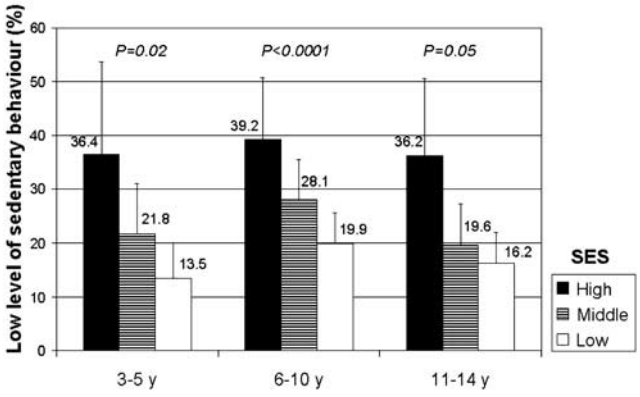

Figure 2 Percentage (%) of children in the low level of sedentary behaviour according to age and SES.

However, total daily energy intake was positively associated with the level of LTPA ($P=0.02$ in children aged 3–5 and 6–10 years; and $P=0.003$ among those aged 11–14 years).

Multivariate results

Similar results were obtained for children aged 6–10 years and their older counterparts. Consequently, the following results are shown for two age groups: the 3 to 5-year-old on the one hand, and the 6 to 14-year-old on the other hand. Only the results of the final full model (Model 3) are presented in Table 2. No significant interaction was observed between the explanatory variables (SES, LTPA, sedentary behaviour) and sex, and between SES and sedentary behaviour. When taking into account both LTPA and inactivity, and after adjusting for energy intake, sex, age

Table 2 Adjusted odds ratio (95% CI) for OW (including obesity) according to age, sex, SES, LTPA, sedentary behaviour and energy intake

Model 3	*3–5 years (n = 234)*	*6–14 years (n = 752)*
Age		
Year	2.0 (1.2–3.2)	0.9 (0.8–1.0)
Gender		
Males	1.0	1.0
Females	1.8 (0.9–3.8)	1.2 (0.7–1.8)
LTPA		
No LTPA	1.0	1.0
Intermediate	0.2 (0.1–0.7)	0.7 (0.4–1.2)
High	0.5 (0.2–1.3)	0.8 (0.4–1.6)
Sedentary behavior		
Low	1.0	1.0
Intermediate	0.9 (0.3–2.5)	2.2 (1.2–4.1)
High	2.1 (0.7–6.6)	2.3 (1.1–4.8)
Energy intake		
Kcal/day	1.0 (0.9–1.1)	1.0 (0.9–1.1)
SES		
Low	1.0	1.0
Middle	1.3 (0.6–2.9)	0.5 (0.3–0.8)
High	0.4 (0.1–1.7)	0.3 (0.1–0.7)

Abbreviations: LTPA, leisure-time physical activity; OW, overweight; SES, socioeconomic status.

(continuous variable) and SES: (1) LTPA was negatively associated with OW only among preschool children: those who performed LTPA were significantly less likely to be OW than children who reported no LTPA; (2) the level of sedentary behaviour tended to be positively correlated to OW at any age but this relationship was statistically significant and stronger among children aged 6–14 years. The adjustment for SES had no effect on behavioural variables in children aged 3–5 years. In the older children, the correlation between watching TV and OW was stronger before adjustment for SES (Model 2): compared to the lowest level, the odds ratio for the 'intermediate' and 'high' inactivity levels were 2.5 (95% CI: 1.3–4.6) and 2.9 (95% CI: 1.4–6.0), respectively. However, the strength of the association between SES and OW was similar before and after adjustment for behavioural variables (Models 1 and 3).

Discussion

Child OW in France and Europe

To our knowledge, this study on OW in French children aged 3–14 years is the first national survey to cover such a wide age range. It thus provides useful insights into the problem of OW in young people in France, its prevalence and associated behavioural risk factors. It confirms that childhood OW prevalence is high in France, as already suggested by three recent national surveys, each on a narrower age range. These showed prevalence rates of OW (including obesity) of 14.5% in children aged 5–6 years (1999–2000) (Labeyrie and Niel, 2003), 18.1% in children aged 7–9 years (2000) (Rolland-Cachera *et al*., 2002), 20.0% in preadolescents aged 10–11 years (2001–2002) (Labeyrie and Niel, 2004), and 11.6% in adolescents aged 11–16 years (2001–2002) (Janssen *et al*., 2005), with respect to the same IOTF definition (Cole *et al*., 2000). Lastly, the results of the ObEpi (Obesity Epidemiology), another national survey performed in 2000 on a larger sample of children aged 2–17 years, but which did not account for behavioural risk factors, gave 13.3% (Basdevant and Guy-Grand, 2004). The consistency of these results with those of the INCA survey further suggests that no major selection bias was introduced by the sampling method used (quota).

Self-report of weight and height may affect accuracy of BMI values and lead to underestimation of the prevalence of OW. Indeed, it has been demonstrated that adolescents aged >15 years tend to underestimate their weight and overestimate their height (Wang *et al*., 2002b; Brener *et al*., 2003). However, according to Strauss (1999), calculations of BMI are less inaccurate in children since they tend to underestimate both weight and height. As our OW prevalence compares favourably with other studies cited above conducted at a national scale on narrower age ranges and using measured weight and height (Rolland-Cachera *et al*., 2002; Labeyrie and Niel, 2003; Labeyrie and Niel, 2004), we believe that any underestimation would be insignificant.

Child OW and obesity is rapidly increasing in Europe, and, as is true with respect to adults, France does not appear to be an exception, although it remains in a favourable position. Lobstein and Frelut (2003), who examined data using the IOTF cutoff points based on measured weight and height of 7 to 11-year-old children from 21 European countries, showed that prevalence of OW in France is similar to levels observed in northern European countries (12–22%), and much lower than those observed in southern Europe, mainly Spain (34%) or Italy (36%). Another review by Janssen *et al*. (2005), based on reported body measurements of 10 to 16-year-old schoolchildren from 34 European countries also based on IOTF cutoff points, ranked France in an intermediary position with levels close to those observed in northern countries (10–15%), higher than levels in eastern Europe (<10%) and lower than levels observed in Great Britain, Spain, Italy and Greece (15–20%). This review also suggested that French 10 to 16-year-old schoolchildren spend less time watching TV and using the computer than this age group in other European countries. As far as diet is concerned, the difference is less clear: although French schoolchildren appear to have a more frequent intake of vegetables, no systematic difference was observed for fruit, confectionary or soft drink intakes. Lambert *et al*. (2004) recently collected and evaluated data on dietary intake of children and adolescents across Europe. They noted less favourable patterns of fat and total carbohydrate intakes in southern Europe, than in the northern Europe. There were no other

clear differences in intake across the several regions of Europe.

SES, child OW and mediating factors

SES and child OW. A strong inverse relationship of SES to OW was observed in children aged 6 years and over, and this has also been observed in recent studies performed in other industrialized countries (McMurray *et al*., 2000; Tremblay and Willms, 2003). Faced with this growing body of evidence, it was tempting to explore how physical activity and sedentary behaviour were involved in the relationship between SES and OW, after adjustment for food energy intake.

Physical activity, sedentary behaviour and child OW. The inverse relationship between LTPA and OW observed in the 3 to 5-year-old group is consistent with two other studies performed on preschool children (Davies *et al*., 1995; Moore *et al*., 1995). The rate of 'no LTPA' among preschool children was high ($>50\%$), which may be partly explained by our measurement of LTPA. In fact, after-school participation in unstructured activities, which is likely to be an important source of energy expenditure in the 3–5 years age range, was only partially taken into account in this study. Although informal sporting activities such as cycling, roller-skating or running were included in the questionnaire, informal outdoor active games were not. However, being engaged in formal or informal sports is less frequent when aged 3–5 years and, therefore, could be a discriminant indicator of the global physical activity score in preschool children. Further research is needed to confirm this hypothesis since, in younger children, LTPA might reflect the wishes of the parents rather than the choice of the child, and the possibility can thus not be excluded that some children are completely passive during formal physical activities.

The absence of a significant relationship between physical activity and OW found in the preadolescent and adolescent groups is only partially shared in the literature. Cross-sectional and longitudinal studies are roughly divided between finding no effect (McMurray *et al*., 1995; Goran *et al*., 1997; Maffeis *et al*., 1998; Kimm *et al*., 2001), or a protective effect of activity (Moore *et al*., 1995; Hernandez *et al*., 1999; Berkey *et al*., 2000; O'Loughlin *et al*., 2000; Tremblay and Willms, 2003; Janssen *et al*., 2005).

Several reasons, notably based on the design of the studies, may account for this discrepancy. Firstly, most studies dealing with physical activity and obesity do not account for food consumption, a strong potential confounder. In addition, the ways of assessing obesity and physical activity are not consistent throughout the literature. As already demonstrated, notably by Rowlands *et al*. (2000), the strength of the observed relationship between the level of activity and body fat in children varies with the method with which physical activity is measured. Stronger relationships are identified when direct measures of movement are used such as observation or motion counter methods, than when questionnaires or heart-rate methods are used. Finally, it should be noted that, as we chose to gather data on OW and related behaviours over a large age range, which has not previously been performed in France, the stratification on age led to relatively small samples thus reducing statistical power. Larger samples could have shown statistically significant sex differences. These differences have been observed in other studies (Guillaume *et al*., 1997; McMurray *et al*., 2000; Wagner *et al*., 2004; Kettaneh *et al*., 2005), which suggest that contributory factors leading to obesity may be different in girls and boys.

A positive association was observed between sedentary behaviour and OW. This result is consistent with a growing body of evidence that, among children and adolescents, inactivity (particularly watching TV) is associated with body fatness in cross-sectional (Andersen *et al*., 1998; Hernandez *et al*., 1999; Tremblay and Willms, 2003), longitudinal (Maffeis *et al*., 1998; Berkey *et al*., 2000) and intervention studies (Gortmaker *et al*., 1999; Robinson, 1999). Obesity in children has even been reported to correlate in a dose-dependent manner with baseline daily duration of television viewing in longitudinal observations (Dietz and Gortmaker, 1985; Gortmaker *et al*., 1996), suggesting a cause–effect relationship.

Physical activity and sedentary behaviour as mediating factors. Among children aged 6–14 years, watching TV seems to be one of the intermediate factors between SES and OW. SES is negatively correlated not only to OW but also to sedentary behaviour, as also highlighted in other studies performed on preadolescents and adolescents (Gordon-Larsen *et al*., 2000; Tremblay and Willms, 2003). In addition, the positive association between inactivity and OW is weakened when the multivariate model is adjusted for SES, which is not the case for LTPA. Gordon-Larsen *et al*. (2000) support the hypothesis according to which physical activity and inactivity are influenced by different determinants. Their analyses in a national sample of American adolescents led to the conclusion that physical activity was most influenced by environmental factors, such as participation in school physical education programs and the use of neighbourhood community recreation centres. Conversely, inactivity, based on similar measurements to ours, was much more influenced by demographic and socioeconomic factors, such as higher level of education and family income.

Nevertheless, in our study, watching TV did not appear as a strong mediating risk factor between SES and childhood OW, as also suggested by Tremblay and Willms (2003) with a similar approach. Other intermediate factors probably include patterns of physical activity, other aspects of sedentary behaviour and food consumption, which were not taken into account in the present analyses.

It should be mentioned that we also performed all the analyses according to the French BMI cutoff points (Rolland-

Cachera *et al*., 1991) which differ slightly from the IOTF ones. Results (not shown) confirmed that prevalence rates estimated using the two definitions are quite similar. Moreover, adjusted odds ratio obtained using the French reference showed that the relationships between behavioural variables and OW are the same whatever the definition used for OW.

Strengths and limitations of the study

One strong point of the INCA survey is to have taken into account comprehensive variables related with the problem of obesity. However, not all variables known to be risk factors for childhood OW, such as maternal obesity and pubertal status, could be measured in this single survey and as a result could not be controlled for in the multivariate approach. Further, in such a large-scale study, precision and accuracy can not be optimal for all measurements. Potential over-reporting of LTPA (Cradock *et al*., 2004) and under-reporting of energy intake (Rennie *et al*., 2005) should not be excluded particularly in obese adolescents. Finally, it should be recalled that the associations observed between OW status and behavioural variables were based on cross-sectional data and therefore causality cannot be directly inferred.

Conclusion

Our results show that time spent watching TV and playing video-games is positively associated with childhood OW in France. Increased sedentary behaviour is also associated with lower SES but this relationship only partially explains the strong reverse association between SES and OW in children. Further, these behaviours, which are potential risk factors of childhood OW, are worth distinguishing from the risk indicators, such as SES. While the latter will allow the health authorities to target specific social groups for potential interventions, the former will help to identify ways of preventing childhood obesity. These two dimensions should be considered separately, not only for research projects, but also when organizing and evaluating health interventions. Finally, the next national dietary survey (2006), based on a larger sample ($n = 1800$) and on similar but improved methods, will contribute to monitoring childhood OW in France and its associated health-risk factors.

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