Stabilization of overweight prevalence and improvement of dietary habits in French children between 2004 and 2008

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Abstract

Objective: The objective of the present study was to describe changes in overweight and obesity prevalence and eating habits among 7.5–10.5-year-old children in Aquitaine (France) between 2004 and 2008, and to assess how the programme ‘Nutrition, Prevention and Health of children and teenagers in Aquitaine’ implemented in 2004 may have impacted these changes.

Design: Two cross-sectional studies were conducted in two samples of children: the ‘before programme’ sample during the school year 2004/2005 and the ‘after programme’ sample during the school year 2008/2009.

Settings: Data were collected on gender, age, weight, height, area of residence (rural/urban) and socio-economic status of the school (non-low socio-economic/low socio-economic). Multivariate analyses were used to assess the effect of the regional programme intervention on the evolution of overweight and obesity prevalence and eating habits independently.


Results: After adjustment of the model for age, residential area and socio-economic status of the area of residence, the prevalence of overweight including obesity (OR = 1.05; 95% CI 0.89, 1.23, P = 0.56) and of obesity (OR = 0.99; 95% CI 0.71, 1.39, P = 0.96) was found to have stabilized and eating habits had improved: intake of light afternoon meals had increased (OR = 1.38; 95% CI 1.13, 1.69, P = 0.002) while snacking in the morning (OR = 0.50; 95% CI 0.45, 0.57, P < 0.001) and nibbling (OR = 0.81; 95% CI 0.70, 0.93, P < 0.001) had decreased.

Conclusions: These results encourage the promotion and implementation of regional and national interventions among children regarding their eating habits in order to stabilize or decrease the prevalence of overweight.

Obesity has been recognized as a major public health epidemic by the WHO since 1998(1) and is a well-established risk factor for several chronic diseases(2–4). Over the past few years, the prevalence of overweight and obesity has increased dramatically among children and adolescents both in developed countries and other parts of the world(5–7). Several local and national studies in France have shown that overweight prevalence among children aged 5–17 years increased from 3% in 1965 to 5% in 1980, 12% in 1996 and 16% in 2000(8,9). Since the 2000s, a study carried out on representative samples of French children has shown that overweight prevalence on a national scale seems to have stabilized at about 16%(10–12). Obesity is known to be a multifactorial problem resulting from a reduction in physical activity(13,14) and changes in dietary habits(15–17). Several studies have shown that the principal risk factors for childhood overweight include parental obesity, low socio-economic status (SES), low physical activity, high level of sedentary activities and inappropriate diet such as the consumption of fatty and sugary foods(14,18,19). In France, the National Program on Nutrition and Health (PNNS) was launched by the Ministry of Health in 2001(18,20). One of its main objectives is to stop the increase in the prevalence of childhood obesity in France. Various public health actions for improving dietary habits and physical activity in children have been implemented. In accordance with the objectives and tools of the PNNS, a multidisciplinary public health programme called

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‘Nutrition, Prevention and Health for children and teenagers in Aquitaine’ (www.nutritionenfantaquitaine.fr) was launched in November 2004 in Aquitaine (south-west France) to improve the diet and physical activity of children and adolescents and to stabilize the prevalence of childhood obesity, by means of three key strategies:

1. early detection, prevention and management of childhood obesity by mobilizing stakeholders in Aquitaine;
2. improvement of the food supply in middle schools and implementing extracurricular activities; and
3. implementation of educational programmes on food and physical activity aimed at children, their families, and their educational and medical communities.

Before launching the programme, a study was conducted in 2004–2005 among 7–5–10-year-old children in order to guide the intervention and to provide baseline data on dietary habits, lifestyle, and overweight and obesity prevalence. Four years later, the study was repeated in order to evaluate the impact of the programme on children’s lifestyle.

The objective of the present study was therefore to describe changes in overweight and obesity prevalence and dietary behaviour among 7–5–10–5-year-old children in Aquitaine from 2004 to 2008 and to assess the impact of the programme ‘Nutrition, Prevention and Health of children and teenagers in Aquitaine’ on this evolution.

**Methods**

**Study design and participants**

Two cross-sectional surveys were conducted in 2004 and 2008 on representative samples of primary schools randomly selected in Aquitaine. Stratification variables were the district, the size of the school, the area of residence (urban or rural) and the zone category (low socio-economic (LSE) or non-LSE). Schools selected for each study could be different.

The surveys were conducted on children of the same age group:

1. before implementation of the programme (2004/2005 school year), sample called ‘before programme’ (163 schools); and
2. after implementation of the programme (2008/2009 school year), sample called ‘after programme’ (210 schools).

All the children in third grade from the selected schools who were seen by the school nurse during the annual health check were included in the samples. Children aged less than 7.5 years or more than 10.5 years old were excluded from the analysis for the sake of homogeneity. Parents were informed of the survey and only children whose parents agreed were included in the study.

Data were collected by means of a questionnaire (see Appendix) completed by the school nurse in the presence of the child during the health check. Data transmitted for the analysis were anonymous.

**Data collection and measurements**

**Weight status**

Weight status was determined from weight and height measurements collected by school nurses. Weight and height were measured by school nurses in the morning or the afternoon (fasting was not necessary) using standardized procedures and measurement devices. Weight was measured with the child lightly dressed, without shoes, and with the school health centre scales; height was measured with the child standing up, his/her weight being equally distributed on both feet, with head, back and buttocks on the vertical part of the height gauge. Weight status was determined by BMI, calculated from measured weight and height data transmitted by school nurses as follows: BMI = [weight (kg)]/[height (m)]². Weight status (normal, overweight or obesity) was attributed with the International Obesity Task Force definition according to the BMI, gender and age of the child.

**Eating habits**

In both surveys, eating habits of children were assessed by school nurses who collected information on their usual breakfast intake (always, sometimes or never), morning snack intake (yes or no), light afternoon meal intake (yes or no) and nibbling habits (yes or no; in the present study, ‘nibbling’ refers to eating something between the light afternoon meal (food intake recommended for children) and dinner). The composition of each dietary intake was also described.

**School socio-economic status**

In France, state-run schools are described by the school administration as LSE (low SES) or non-LSE (non-low SES), according to their socio-economic characteristics. LSE schools have a high rate of school failure or are located in specific geographical areas (rural area, suburbs of big cities) where socio-economic difficulties are prevalent (including low SES of families). At the age of 5–10 years, most children go to school in the area where they live and their school address can be used as an indicator of SES of the area of residence.

**Other variables**

Children’s age and gender were collected for both surveys. According to the National Institute for Statistics and Economic Studies, the area of residence is classified as urban if continuously built up and accommodating 2000 persons or more. Rural populations are all those not classified as urban.

**Statistical analysis**

Data registration was performed using EpiData software. Differences between samples were assessed by the \( \chi^2 \) test or the Kruskal–Wallis test. All statistical tests were two-sided and a \( P < 0.05 \) was considered statistically significant. Models were fitted using the SAS statistical software package version...
Multivariate analyses were used and odds ratios were calculated to assess the effect of the regional programme intervention on the evolution of overweight and obesity prevalence and eating habits independently.

**Results**

**Study population**

The response rate of schools was 89.0% in 2004/2005 and 92.4% in 2008/2009. The ‘before programme’ sample included 1836 children and the ‘after programme’ sample included 3483 children, for whom both weight status and dietary habits were known.

Characteristics of both samples are described in Table 1. For both samples, the male:female ratio was close to 1 (P = 0.67). In the ‘before programme’ sample, the mean age of children and the rates of children who lived in low-SES areas and urban areas were slightly higher than in the ‘after programme’ sample (P < 0.05). Thus, results concerning the evolution of weight status and dietary behaviour after 4 years of programme implementation were adjusted for age, area of residence (rural/urban) and SES of the living zone in a multivariate analysis.

**Evolution of eating habits among children before and after the prevention programme**

Four years after the prevention programme, eating habits had changed globally (Table 2). The proportion of children who usually took a light afternoon meal had increased significantly (P < 0.01) while morning snack intake and nibbling

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.67</td>
</tr>
<tr>
<td>Boys</td>
<td>905</td>
<td>1738</td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>931</td>
<td>1745</td>
<td></td>
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<td>8.71</td>
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<td>1556</td>
<td>2937</td>
<td>0.85</td>
</tr>
<tr>
<td>Overweight (including obesity)</td>
<td>226</td>
<td>447</td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>54</td>
<td>99</td>
<td></td>
</tr>
</tbody>
</table>

LSE, low socio-economic.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before programme (school year 2004/2005)</th>
<th>After programme (school year 2008/2009)</th>
<th>( P ) (( \chi^2 ) test)</th>
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<tbody>
<tr>
<td>Breakfast intake</td>
<td></td>
<td></td>
<td>0.14</td>
</tr>
<tr>
<td>Never or sometimes</td>
<td>67</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>1769</td>
<td>3383</td>
<td></td>
</tr>
<tr>
<td>Morning snack intake</td>
<td></td>
<td></td>
<td>&lt; 10^-4</td>
</tr>
<tr>
<td>Yes</td>
<td>804</td>
<td>974</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1032</td>
<td>2509</td>
<td></td>
</tr>
<tr>
<td>Light afternoon meal intake</td>
<td></td>
<td></td>
<td>&lt; 10^-2</td>
</tr>
<tr>
<td>Yes</td>
<td>1657</td>
<td>3232</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>179</td>
<td>231</td>
<td></td>
</tr>
<tr>
<td>Nibbling</td>
<td></td>
<td></td>
<td>&lt; 10^-2</td>
</tr>
<tr>
<td>Yes</td>
<td>356</td>
<td>559</td>
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<tr>
<td>No</td>
<td>1480</td>
<td>2924</td>
<td></td>
</tr>
<tr>
<td>Overweight (including obesity)</td>
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<td></td>
<td>0.58</td>
</tr>
<tr>
<td>Yes</td>
<td>226</td>
<td>447</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>1610</td>
<td>3036</td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>54</td>
<td>99</td>
<td>0.84</td>
</tr>
<tr>
<td>No</td>
<td>1782</td>
<td>3384</td>
<td></td>
</tr>
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</table>
had decreased significantly ($P<0.01$). Moreover, the number of children who took breakfast had stabilized ($P=0.14$; Table 2).

These results persisted after adjustment for age, area of residence and SES of the living zone: the increase in light afternoon meals (OR = 1.38; 95% CI 1.13, 1.69, $P=0.002$) and the decrease in morning snack intake (OR = 0.50; 95% CI 0.45, 0.57, $P<0.001$) and nibbling (OR = 0.81; 95% CI 0.70, 0.93, $P<0.001$) persisted (Table 5).

Moreover, the evolution was generally favourable with regard to the composition of breakfast, light afternoon meals and morning snacks. Fewer chocolates, candies and pastries were consumed (from 17.6% to 12.6% at morning snack intake and from 17.7% to 10.3% for light afternoon meals, $P<0.0001$), while there was a significant increase in fruit consumption (from 18.7% to 32.8% for morning snack intake and from 20.1% to 26.6% for light afternoon meals, $P<0.0001$).

### Evolution of overweight and obesity prevalence before and after the programme

The overall prevalence of overweight (including obesity) and obesity stabilized between 2004/2005 and 2008/2009 ($P=0.85$; Table 1). After adjustment for age, area of residence and SES of the living zone, the stabilization of overweight including obesity (OR = 1.05; 95% CI 0.89, 1.23, $P=0.56$) and obesity (OR = 0.99; 95% CI 0.71, 1.39, $P=0.96$) persisted (Table 3).

### Discussion

The present study shows that overweight (including obesity) and obesity prevalence of children aged 7–5–10–5 years stabilized in Aquitaine (south-west France) between 2004/2005 and 2008/2009. This stabilization, which was the main objective of both the regional and national programmes for nutrition and health$^{[20,25]}$, is consistent with recent studies conducted at national level in France among 7–9-year-old children$^{[12]}$, in other European countries$^{[26–29]}$ and in the USA, China and Australia$^{[29]}$.

Moreover, qualitative and quantitative improvements in children’s dietary habits were also observed between 2004/2005 and 2008/2009. First, the proportion of children having a light afternoon meal (usually after class, around 16.00 hours) increased between the two periods studied. Because of the duration of the school day in France, this light afternoon meal is recommended for children. The protective effect of the afternoon meal has been described previously and may be explained by a better distribution of energy intake, thus avoiding nibbling between lunch and dinner$^{[30]}$. On the other hand, the proportion of children having a morning snack or nibbling decreased. Many studies report that the foods eaten in morning snacks and nibbling are often fatty and sweet and have a negative impact on food balance$^{[30,31]}$. Finally, a slight but non-significant increase was observed in breakfast intake. This could be due to the fact that the percentage of children having breakfast every day in 2004/2005 was already high (96.5%).

These changes in dietary habits among Aquitaine children are consistent with nationwide nutritional recommendations made by the PNNS and relayed regionally by the programme ‘Nutrition, Prevention and Health for children and teenagers in Aquitaine’, especially though the dissemination of flyers concerning the importance of taking breakfast and an afternoon meal and cutting out morning snacks$^{[25,32]}$.

Actions undertaken on the basis of the PNNS$^{[33]}$ and the nutrition programme in Aquitaine$^{[25]}$ could be responsible for the stabilization of overweight and the improvement in dietary behaviour among 7–5–10–5-year-old children in Aquitaine. Besides promoting healthy dietary habits, other actions undertaken in Aquitaine, such as early detection of overweight and encouraging a physically active lifestyle, could also have played a part$^{[32]}$. However, since there was no control group, we cannot even partly attribute the stabilization of overweight and obesity prevalences from 2004/2005 to 2008/2009 and improvement in dietary behaviour to the Aquitaine prevention programme. Moreover, the studies were performed on the same age group but not on the same children: in 2008/2009, some children in third grade had already benefited from health education campaigns in their first year in school, so they were more likely to have better dietary habits than those included in the first study. However, in most studies describing recent stabilization of overweight and obesity

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**Table 3** Summary of associations found between weight status and eating habits and programme intervention between 2004/2005 and 2008/2009 among third-grade children in the Aquitaine region, France: multivariate logistic regression analysis (n 5319)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Point estimate</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight (including obesity)</td>
<td>1.05</td>
<td>0.89, 1.23</td>
<td>0.56</td>
</tr>
<tr>
<td>Obesity</td>
<td>0.99</td>
<td>0.71, 1.39</td>
<td>0.96</td>
</tr>
<tr>
<td>Breakfast</td>
<td>1.19</td>
<td>0.86, 1.62</td>
<td>0.30</td>
</tr>
<tr>
<td>Morning snack</td>
<td>0.50</td>
<td>0.45, 0.57</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Light afternoon meal</td>
<td>1.38</td>
<td>1.13, 1.69</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nibbling</td>
<td>0.81</td>
<td>0.70, 0.93</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Model adjusted for year of intervention, area of residence, zone category and age.
prevalence, the trend was associated with national, regional and/or local actions that had been implemented in many sectors of society\(^{(33,34)}\).

Another limitation of the present study is the fact that lifestyle habits were not assessed, especially physical activity and sleep, which are recognized as factors for obesity in children\(^{(35,36)}\). Data on physical activity and sedentary lifestyle were collected but only in the second study in 2008/2009. Consequently, any changes in the physical activity of children could not be assessed between 2004/2005 and 2008/2009.

No sleep data were collected because children’s assessment of their quality or duration of sleep is not necessarily reliable and in order to limit the time taken by school nurses to administer the survey.

On the other hand, one of the strengths of our study is the large representative samples studied in both analyses. Indeed, by conducting this survey at school, we were able to collect anthropometric data on a large number of children of the same age but with different lifestyles and SES. Another study strength is that data were collected by school health professionals, thereby ensuring high-quality data compared with self-reported data or multicentre measurements.

In addition, the multivariate analysis was adjusted for characteristics known to have an influence on overweight prevalence: age (increase in overweight prevalence with age)\(^{(10)}\), area of residence (higher prevalence of overweight among rural children)\(^{(34,37,38)}\) and especially SES of the living zone. Indeed, previous studies have shown that the stabilization of overweight prevalence seems to differ according to SES of the population, with a more significant slowing down of the increase in prevalence in non-low SES areas\(^{(39)}\).

These findings reinforce the relevance of implementing public health programmes such as the PNNS and the Aquitaine programme. Furthermore, they underline the importance of implementing and pursuing interventions in primary schools in order to achieve consistent behavioural changes, as recommended by recent international\(^{(1,16)}\), national\(^{(20,35)}\) and regional policies. New data are now needed to continue to assess the evolution of overweight and obesity prevalence and dietary behaviour among children in the Aquitaine region.

Acknowledgements

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References

Appendix

**Questionnaire used for the study (translated from French)**

**EATING HABITS SURVEY AND PREVALENCE OF OBESITY IN CE2**

Questionnaire to be completed by school nurses

**GENERAL INFORMATION**

Name of nurse(s): ______________________

Name of school: _________________________

Date of birth of child: __/__/____
Date of visit: __/__/____

No. of children: __________

Sex:  □ Boy □ Girl

Birth weight: _____ kg

**ANTHROPOMETRIC MEASUREMENTS**

Height: _____ cm

Weight: _____ kg

The child will be lightly dressed and without shoes, barefoot or in thin socks. The child is measured standing, weight evenly distributed on both feet, heels together; head positioned so that the line of sight is perpendicular to the body. Head, back, buttocks and heels in contact with the vertical board fathom. The movable part of the measuring rod is brought into contact with the highest point of the head. Do not pull the child's head upwards. The child is weighed with scales accurate to at least 0.5 kg. The child is still in the centre of the plateau, weight evenly distributed on both feet.

**PROFESSION OF PARENTS**

Father: ___________________________

Mother: ___________________________
ENQUIRE IF POSSIBLE SOCIAL AND OCCUPATIONAL STATUS OF PARENTS (CSP)

Father:
[ ] Category I
[ ] Category II
[ ] Category III
[ ] Category IV

Mother:
[ ] Category I
[ ] Category II
[ ] Category III
[ ] Category IV

Rate the professional category (CSP) using the indicated profession by parents

**Category I:** CSP privileged: entrepreneurs, professionals, managers in public sector, teachers and related, professional sectors of information, arts and entertainment, administrators and business enterprise, engineers, technical and business managers, teachers and related.

**Category II:** CSP rather privileged: associate professionals in health and social sector, clergy and religious professionals (public administration, administrative and commercial business), technicians, foremen, supervisors, retired executives, associate professionals.

**Category III:** CSP average: farmers, artisans, traders and related, civil servants, officers in Public Service, police and military, corporate administrative workers, shop assistants, personal services to individuals, retirees farmers, retired craftsmen, traders and entrepreneurs.

**Category IV:** CSP disadvantaged: skilled and unskilled workers, labourers, employees and retired workers, the unemployed who have never worked, anyone without a professional activity.

EATING HABITS

1. Today did you have breakfast?
   - [ ] No
   - [ ] Yes

If ‘yes’ it is usually composed of:

- [ ] Biscuits, cakes, pastries
- [ ] Milk
- [ ] Breakfast cereals
- [ ] Chocolate milk
- [ ] Stewed fruit
- [ ] Sodas
- [ ] Yoghurt, cheese
- [ ] Others: __________________________
- [ ] Candy, sweets, chocolate bars

2. Today, do you have a snack in your schoolbag?
   - [ ] No
   - [ ] Yes

If ‘yes’, it is intended and used for:

- [ ] Morning break
- [ ] Afternoon break
- [ ] For the light afternoon meal (16h30)
- [ ] When I want, when I’m hungry

If ‘yes’ it is usually composed of:

- [ ] Biscuits, cakes, pastries
- [ ] Milk
- [ ] Breakfast cereals
- [ ] Chocolate milk
- [ ] Stewed fruit
- [ ] Sodas
- [ ] Yoghurt, cheese
- [ ] Others: __________________________
- [ ] Candy, sweets, chocolate bars

3. Do you usually have a light afternoon meal after school (16 h30–17 h)?
   - [ ] No
   - [ ] Yes

If ‘yes’ it is usually composed of:

- [ ] Biscuits, cakes, pastries
- [ ] Milk
- [ ] Breakfast cereals
- [ ] Chocolate milk
- [ ] Stewed fruit
- [ ] Sodas
- [ ] Yoghurt, cheese
- [ ] Others: __________________________
- [ ] Candy, sweets, chocolate bars

4. Do you eat something between 16 h30 and dinner?
   - [ ] No
   - [ ] Yes

If ‘yes’, why? ………………………………………………………………………………………

If ‘yes’, it is usually composed of:

- [ ] Biscuits, cakes, pastries
- [ ] Milk
- [ ] Breakfast cereals
- [ ] Chocolate milk
- [ ] Stewed fruit
- [ ] Sodas
- [ ] Yoghurt, cheese
- [ ] Others: _____
- [ ] Candy, sweets, chocolate bars

5. Do you drink sodas (sugary drinks)?
   - [ ] 1 or 2 times/week
   - [ ] More than 2 times/week
   - [ ] Daily

Comment: ………………………………………………………………………………………