Trends and sociocultural factors for childhood overweight in La Reunion Island

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Abstract

Objective. – To examine time trends (study 1) and sociocultural factors associated with childhood overweight (study 2) in La Reunion Island.

Design. – Study 1: a longitudinal analysis of anthropometric data available from health services in the town of Saint-Pierre. Study 2: a case–control study.


Measurements. – Study 1: overweight at birth (birth weight > 4 kg) and at age 4 and 6 using French references and references from the International Obesity Task Force. Study 2: parental and perinatal data, child’s lifestyle and representation of food, all collected from the mother.

Results. – Study 1: a dramatic increase in the prevalence rate of overweight at 4 and at 6 is observed, more severe in girls. Study 2: multivariate logistic regressions showed that mother’s overweight was the only variable significantly associated with overweight in both the sexes. The other associated factors were related to sociocultural and family features and sedentarity. Logistic probability functions derived from these data are proposed as a tool for detection of at risk families.

Conclusion. – Our results show the need for a targeted prevention of overweight. We offer a proposal based on education and behaviour modification in La Reunion Island.

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Résumé

Évolution du surpoids de l’enfant et facteurs socioculturels à l’île de la Réunion

Objectifs. – Examiner l’évolution temporelle (étude 1) et les facteurs socioculturels associés au surpoids de l’enfant (étude 2) à l’île de la Réunion.

Type d’études. – Étude 1 : analyse longitudinale de données anthropométriques issues des services de santé scolaire de la ville de Saint-Pierre. Étude 2 : étude cas témoins.


Données collectées. – Étude 1 : le surpoids à la naissance (poids de naissance > 4 kg), à quatre et à six ans, en utilisant les références françaises et celles de l’International Obesity Task Force. Étude 2 : données parentales et périnatales, données collectées auprès des mères, relatives au mode de vie de l’enfant et à leur représentation de l’alimentation.

Résultats. – Étude 1 : nous avons observé une spectaculaire augmentation de la prévalence du surpoids à quatre et à six ans, en particulier chez les filles. Étude 2 : des régressions logistiques multivariées ont montré que le surpoids de la mère était la seule variable associée au surpoids pour les deux sexes, de façon significative. Les autres facteurs associés sont liés à des caractéristiques socioculturelles et familiales, et à la sédentarité. Les fonctions de probabilité logistiques dérivées de ces données sont proposées comme un outil pour la détection des familles à risques.

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Conclusion. – Nos résultats montrent le besoin de réaliser une prévention ciblée du surpoids. Nous faisons une proposition basée sur l’éducation et des modifications comportementales à la Réunion.
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Keywords: Child; Overweight; Familial environment; Socioeconomic determinants

Mots clés : Enfant ; Surpoids ; Environnement familial ; Déterminants socioéconomiques

1. Introduction

Over the last few decades, childhood overweight has undergone a rapid increase all over the world [1–3]. The concern is particularly high in tropical islands where several risk factors coexist for early obesity and type 2 diabetes: lifestyle changes characterised by rapid urbanisation, low socio-economic status, migration, which all add to a genetic susceptibility. In addition to Nauru, which has the highest prevalence of type 2 diabetes in the world, high prevalences of overweight and obesity in adults and children have been found in Seychelles [4], New Caledonia [5], Mauritius [6], Martinique [7], Polynesia [8] and La Réunion [9].

The most deleterious consequence of childhood obesity is its persistence into adulthood, with all its associated health risks [10]. Increased weight gain in children represents the main factor that contributes to the increase in incidence of type 2 diabetes [11]. Obesity is a complex disorder, with environmental and genetic components. The dramatic increase in the prevalence of obesity is probably due to significant changes in the physical and social environment. A decrease in physical activity and an increase in high-energy food and drink consumption have been shown to be the major factors in the current epidemic of obesity [12]. The role of the familial and home environment in the development of childhood obesity has been recognized for a long time; however, few studies have documented to which extent the home environment contributes to childhood obesity [13]. This is the reason why it seems important to detect high-risk groups and familial environment determinants.

Within this scope, the following survey was conducted in the town of Saint-Pierre (in La Reunion) with two main objectives: first, to study the trends in the prevalence of overweight in preschool children; secondly, to assess the familial and sociocultural factors associated with childhood overweight, in order to prepare the basis for preventive actions in Reunion Island.

2. Population and methods

2.1. Location and demography

La Reunion Island is a French department (administrative area, similar to a county) of 766,000 inhabitants. Its surface area is 2500 km². It is located about 800 km east of Madagascar, and belongs to the Mascareignes archipelago (including Mauritius and Rodrigues) in the Indian Ocean. Saint-Pierre is the second city of the island with 70,000 inhabitants. The island was included in the French Republic as a department in 1946. This political decision induced thorough changes in the local population, essentially rural and traditionally marked by a low life expectancy, poverty, scarcities or even famines. Over a few decades, it became a consumer society of western type with a decline of mortality, an increase of energy consumption, and a decrease of physical activity. Its population doubled between 1946 and 1980; in 2004, 44% of the population was less than 25 years old. In the same time, the island has known a very rapid epidemiologic transition: the proportion of infectious diseases in causes of death was 47% in 1931 and less than 3% in 1981. On the other hand, the prevalence rate of type 2 diabetes has been estimated at 20.2% in 1999–2001 in the adult population (30–69 years) and the prevalence of overweight at 36% in men and 39% in women [9]. In 2004, La Reunion Island was the French department where cardiovascular mortality was the highest. In spite of the global improvement of living conditions, strong social disparities and economic difficulties still characterise an important part of the population: around 15% are illiterate and more than 30% are unemployed.

2.2. Study 1

The health status of children is usually followed through different structures: first, weight and height at birth are systematically recorded; then, a clinical examination is performed in specific centres (“Mother and Child Protection Centres”) around the age of 4; after entering school, a first clinical examination is performed around the age of 6. At this stage, all the data previously collected are centralised in the register of the Health Department in charge of the follow-up of children at school. In the area of Saint-Pierre, this register includes 25,000 medical school records of children born since 1977 and who attended school up to 2002 in this particular area.

The study population consists of children born between 1977 and 1996 and registered in the Health Department of Saint-Pierre. We first made a random selection of 3200 records: 80 by birth year and sex. Secondly, we studied the 1753 complete records including all the data of interest: birth date, birth weight, height and weight at 4 and 6 years and exact age at the two mandatory medical visits.

Overweight at birth was defined by a birth weight higher than 4 kg. We used two references to define overweight at ages 4 and 6, both based upon the BMI (Body Mass Index = weight (kg)/height² (m²)): the French references (97th percentile) [14] and the international reference proposed by the International Obesity Task Force (IOTF) (using the cut-off values...
defined to pass through BMI of 25 kg/m² at age 18) [15]. Regression analysis was used to test variations of birth weight and BMI over time.

We describe the evolution of overweight from birth to age 6 by 4-year intervals of birth. Trend of overweight at age 6 is also presented in each sex, by 4-year intervals of birth.

2.3. Study 2

After studying the trends in overweight prevalence, we studied risk factors for childhood overweight, using a case-control study design, in the area of St Pierre including the town of Le Tampon.

Every academic year, a school doctor examines all 6-year old children. Between September 2003 and August 2004, school doctors of St Pierre and Le Tampon recruited 101 overweight children (according to French references BMI > 97th percentile). These 101 overweight children were sex-matched with 101 children of normal weight (3rd percentile < BMI < 90th percentile), also recruited by school doctors.

For each of these 202 6-year children, school doctors carried out medical examinations including measurements of height and weight. In addition, the children’s mothers were interviewed at home.

The following data were obtained: parental data (height, weight, ethnic origin, study level, professional activity, smoker or not, family history of type 2 diabetes), family structure (single parent family, number of children), perinatal data (gestational age, rank, birth weight and height, breast feeding), child’s lifestyle (hobbies, frequency and duration of television watching, eating snacks or meals in front of television, meals duration, snacks between meals, appetite of the child, sleep duration,) and representation of food (what is good food? what does “eating well” mean? Criteria of choice of food supply, type of food and place of purchase).

The statistical analysis was performed in three steps: first, the relations between overweight and the sociologic and behavioural factors were studied according to sex, using classical tests (Chi² and Student’s t tests) and univariate odds ratios (OR) adjusted for age and birth weight. Secondly, logistic regression models were used for boys and girls, to estimate the relative risk of overweight at age 6 on the basis of the sociologic and dichotomic behavioural variables. The individual values of the logistic function y including the significant variables, as determined by the logistic regression analysis were computed for each sex. Then, we computed the logistic probability function of overweight for each child, that is:

\[ p = \frac{e^y}{1 + e^y} \]

in young boys and girls. Thus, p represents the probability to be classified as having overweight using only the variables included in the regression model. Finally, different thresholds of probability were tested to define overweight, and the corresponding sensitivity and specificity calculated in comparison with the observed nutritional status of the children.

All statistics were computed using StatView version 5.0 from the SAS Institute.

3. Results

3.1. Study 1

In the final complete sample with all data, the age distribution was similar to that observed in the others. Table 1 gives a description of the sample by 4-year intervals of birth. The final sample (N = 1753) includes more children born between 1985 and 1992 than in the other periods, and slightly more girls (51.4%) than boys.

There was no significant difference in the mean birth weight between the different periods of four years of birth. The mean BMI values at age 4 increased significantly over time (slope a = 0.030 kg/m² per year, P < 0.04): +3.7% between children born in the 1977–1980 period and those born in 1993–1996. At age 6, the mean BMI values also increased regularly (slope a = 0.056 kg/m² per year, P < 0.002): +6.7% over the same period.

Fig. 1 shows an increase in the prevalence rate of overweight from birth to age 4 and from age 4 to 6, whatever the study period. No secular trend was observed in the evolution of overweight from birth to age 6 by 4-year intervals of birth.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Boys (n)</td>
<td>147</td>
<td>128</td>
<td>208</td>
<td>207</td>
<td>162</td>
</tr>
<tr>
<td>Girls (n)</td>
<td>166</td>
<td>131</td>
<td>237</td>
<td>217</td>
<td>150</td>
</tr>
<tr>
<td>Total</td>
<td>313</td>
<td>259</td>
<td>445</td>
<td>424</td>
<td>312</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>3.11</td>
<td>3.07</td>
<td>3.13</td>
<td>3.11</td>
<td>3.14</td>
</tr>
<tr>
<td>Age at 4 (year)</td>
<td>3.8</td>
<td>4.3</td>
<td>4.4</td>
<td>4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>BMI at 4 (kg/m²)</td>
<td>15.02</td>
<td>15.04</td>
<td>15.54</td>
<td>15.54</td>
<td>15.58</td>
</tr>
<tr>
<td>Age at 6 (year)</td>
<td>6.5</td>
<td>6.5</td>
<td>6.3</td>
<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>BMI at 6 (kg/m²)</td>
<td>14.96</td>
<td>15.14</td>
<td>15.65</td>
<td>15.8</td>
<td>15.96</td>
</tr>
</tbody>
</table>

Fig. 1. Evolution of overweight (using French references) from birth to age 6 by 4-year intervals of birth.
the prevalence rate of overweight at birth, which remained between 3.0% and 4.0% except for 1981–1984 (1.2%). In contrast, the prevalence rate of overweight at age 4 increased regularly over time: from 3.8% for children born in 1977–1980 to 12.8% for those born in 1993–1996, according to French references (from 6.1% to 15.4 according to IOTF references), as well as the prevalence rate of overweight at age 6: from 5.4% for children born in 1977–1980 to 15.7% for those born in 1993–1996 according to French references (from 6.7% to 19.2% with IOTF references).

Fig. 2 shows the trends in the prevalence rate of overweight at age 6 according to sex, using French references. Girls have a greater prevalence rate of overweight than boys since the 1981–1984 period of birth. Between the last two periods of birth, 1989–1992 and 1993–1996, the prevalence rate was still rising in boys, up to 13.6% whereas a small decrease was observed in girls from 18.9 to 18.0%. The use of IOTF references gave trends from 7.5 to 17.9% in boys, and from 6.0 to 20.7% in girls.

3.2. Study 2

Tables 2 and 3 show the results of the Chi² method for sociologic and behavioural factors linked to overweight in young boys and girls in univariate analysis. Mother’s overweight was strongly correlated to child’s overweight, in young boys \( (P < 0.002) \) and girls \( (P < 0.0001) \). The mothers of overweight children declared their child had “a very hearty appetite” more frequently than mothers of controls, in boys \( (P = 0.01) \) as well as in girls \( (P = 0.002) \). The other factors related to overweight differed by sex. In boys, the items “to be the last child of the family” and “eating often in front of television” were related with overweight in the univariate analysis. In girls, four other items were specifically related to overweight: “eating well means to satisfy hunger”, “the first criteria of choice of food supply is the cost”, “existence of a family history of type 2 diabetes”, and “the two hobbies of the child are sedentary activities”. None of the other factors potentially related to overweight, present in the interview of the mothers, was found significantly different between cases and controls.

A logistic regression model was fitted separately according to sex. The independent variables considered in the regression models were binary categorical variables that were close to significance in the univariate analysis \( (P < 0.10) \). As in the univariate analysis, the multivariate odds ratios were adjusted by age and birth weight of the child. As shown in Tables 2 and 3, the variables significantly associated with overweight in the univariate analysis were also significant in the multivariate models, except for the item “child with a very hearty appetite” in both sexes. The main factor remained “mother’s overweight”.

Table 2
Sociologic and behavioural factors linked to overweight in young boys: adjusted odds ratios in univariate and multivariate analysis

<table>
<thead>
<tr>
<th>Risk factors or overweight</th>
<th>Cases ( (N = 41) )</th>
<th>Controls ( (N = 41) )</th>
<th>Univariate analysis</th>
<th>Multivariate analysis ( (N = 79) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother is overweight</td>
<td>67.5 ( ^a )</td>
<td>32.5</td>
<td>4.3</td>
<td>5.5</td>
</tr>
<tr>
<td>To be the last child of the family</td>
<td>73.2</td>
<td>46.3</td>
<td>3.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Child with a very hearty appetite</td>
<td>29.3</td>
<td>7.3</td>
<td>5.2</td>
<td>4.1</td>
</tr>
<tr>
<td>Child often eats in front of television</td>
<td>32.5 ( ^b )</td>
<td>9.8</td>
<td>4.5</td>
<td>4.1</td>
</tr>
</tbody>
</table>

\(^a\) OR adjusted on exact age 6 and birth weight of the child.
\(^b\) One missing value.

Table 3
Sociologic and behavioural factors linked to overweight in young girls: adjusted odds ratios in univariate and multivariate analysis

<table>
<thead>
<tr>
<th>Risk factors or overweight</th>
<th>Cases ( (N = 60) )</th>
<th>Controls ( (N = 60) )</th>
<th>Univariate analysis</th>
<th>Multivariate analysis ( (N = 115) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother is overweight</td>
<td>73.3</td>
<td>28.1 ( ^1 )</td>
<td>7.1</td>
<td>5.8</td>
</tr>
<tr>
<td>Child with a very hearty appetite</td>
<td>21.7</td>
<td>3.3</td>
<td>8.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Eating well means to satisfy hunger</td>
<td>68.3</td>
<td>43.3</td>
<td>2.8</td>
<td>3.4</td>
</tr>
<tr>
<td>First criteria of choice of food supply is the cost</td>
<td>50.0</td>
<td>26.7</td>
<td>2.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Existence of a family history of type 2 diabetes</td>
<td>65.0</td>
<td>38.3</td>
<td>3.0</td>
<td>2.8</td>
</tr>
<tr>
<td>The two hobbies are sedentary activities</td>
<td>31.7</td>
<td>16.7</td>
<td>2.3</td>
<td>3.2</td>
</tr>
</tbody>
</table>

\(^1\) OR adjusted on exact age and birth weight of the child.
\(^2\) 3 missing values.
weight” identified as an independent risk factor of childhood obesity both for boys and girls.

Table 4 shows the results of the logistic probability functions in young boys and girls. We chose two different empirical thresholds for each of them. In boys, while the value of the function is higher than 0.46 we found a sensitivity of 56% and a specificity of 78%. With the threshold 0.38 we found a better sensitivity (66%), but the specificity decreased to 73%. In girls, the function provided a better discrimination of overweight. The threshold 0.43 provided a specificity of 87% with a sensitivity of 73%. With the threshold 0.28, we obtained a better sensitivity (83%) with a specificity of 77%.

4. Discussion

Our study found a dramatic increase in the prevalence of overweight among 4 and 6 year old children born between 1977 and 1996. The prevalence at age 4 was multiplied by 2.5 and at age 6 by 2.9 in less than 20 years. Similar trends have been observed in many developed and developing countries [3]. In the United States, between 1976–1980 and 1999–2000 [1], the prevalence of overweight doubled among children 6–11 years of age and tripled among those 12–17 years of age. We found a prevalence of overweight at age 6 for the period of birth from 1993–1996 (i.e., for examinations realised in 1999–2002) equal to 19.2% (IOTF references). A national French study realized in 2000 found a similar prevalence (19%) in a sample of 502 7-year old children [16]. The prevalence of overweight was found more important in girls than in boys. This difference may be linked to the practice of physical activities, which is often found more important in boys than in girls [17]. Besides, in girls, lower levels of body fat are associated with more time spent in physical activity, even light activity [18]. Such results were observed in many other studies: in the USA [19], Europe [20], Australia [21] and other tropical islands [4].

This study has some limitations. To assess the evolution of nutritional status over time, we had to select children with all the necessary information over 6 years. In study 1, 3200 children came indeed for the examination, but the data were not reported in the individual form for all of them, in particular at the 4-year examination (29.3%). This phenomenon was linked to a lack of time of the nurses in charge of reporting data. Therefore, the health status and the individual characteristics of the subject were not involved in the absence of data, since the child was present. No difference of age distribution at the examinations was found between the final sample and the others.

It was useful to study the factors associated with childhood obesity in this population, since environmental factors play an important role in the development of overweight, and may vary from one population to another [22]. In the study 2, information on the children collected through the mothers’ interviews was obviously marked by subjectivity. However, their answers gave us an insight about the representations of their child’s environment, and were considered as such.

Our objective was to target at-risk families in La Reunion Island, where prevention and control of childhood overweight are an important paediatric and public health issue. In the multivariate analysis, maternal overweight appeared to be the major determinant of overweight in 6-year old both boys and girls. Many other studies also identified parental overweight and obesity as the strongest determinants of childhood overweight [13,23–25]. Along this line, the existence of a family history of type 2 diabetes was also found to be a risk factor for overweight in girls. These aspects include genetic as well as behavioural factors, which are difficult to separate in a field study. Data from twin, adoption and family studies suggest that genetic factors may account for 25–90% of interindividual differences in fat mass [26]. Familial patterns of overweight may also be explained by familial similarities in eating patterns, dietary composition and physical activities [27,28].

We found correlations between family structure and overweight in boys: a last-born child has more risk to become overweight at age 6 than others. Similar results have been found in a previous survey in a population of 10-year old children who developed obesity after age 5 [29].

Regarding the relationship between overweight and socioeconomic level, we found no significant difference between the two groups, for education level and professional activity of the parents. However, in the girl sample, the first criteria of choice of food supply was more frequently cost in cases than in controls, suggesting a role of a low socioeconomic status in the child’s overweight. In many other studies, it has been observed that obesity was significantly more common in the more deprived families [30]. In Belgian children aged 12-year, it has been observed that, in girls, the lower was their social class, the higher the prevalence and severity of obe-
osity was; but, as in our study, there was no such significant relationship in boys [31]. Another item was specifically related to overweight in girls: “eating well means to satisfy hunger”. It gives us an idea of the representation of food in families with a problem of overweight. These families could have a utilitarian approach of food possibly explained by the rather recent periods of scarcity endured by the population of the island and by their low socioeconomic status. Still unconsciously traumatized, they would try to fill their child with food, without dietetic or pleasure considerations; just as a compensation process.

Overweight has also been correlated with sedentarity. In girls, the hobbies of the case subjects declared by the mother were more often sedentary activities than in controls; and mothers of male cases declared significantly more often than mothers of controls that their child was eating while watching television. The association of overweight with television use and lack of physical activity confirms results from other populations [32–34]. Various indicators show the actual context of becoming sedentary in La Reunion Island, linked to the development of urbanisation: since 1960, the number of cars for 1000 inhabitants has been multiplied by 13; in 1974, 30% of the households had a television set, versus 80% in 1987. This rising urbanisation should be linked to a reasoned town planning in order allow an important place for collective and leisure areas, such as parks, play areas, sports grounds, and also cycling tracks and pavements.

The logistic probability function provided a good discrimination of overweight, especially among young girls, with sensitivities and specificities around 80%. We suggest use of these results in order to detect families at risk for having overweight children. Therefore, we could make the most of the 6-year exam in health departments to systematically interview the mother with few targeted questions, independently of the nutritional status of the child: weight and height of the mother, family history of type 2 diabetes, first criteria of choice of food supply, “what does eating well mean”, citation of the two principal hobbies of the child, “does the child often eat watching television?” It would permit to target at risk families and to perform specific prevention based on education, in order to limit the impact of modern life. We should turn our attention particularly to overweight mothers and eventually to integrate them in prevention programs. Actions targeted at overweight adults, based on nutritional education and the practice of a regular and moderate physical activity have already been implemented in the Island. Significant losses of weight were obtained in participants versus controls [35].

In comparison to open, long-term interventions, it has been shown that more targeted and relatively short-term interventions were able to induce successful changes in BMI in children [36]. Our results show that more efforts are necessary to implement the recommendations from the National Nutrition and Health Program launched in France in 2001 [37]. A real challenge remains, to target at-risk families and help them to overcome this “obesogenic” environment [28] where the maintenance of energy balance is particularly difficult.

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Contributors: all investigators contributed to the study conception and design. X. Allirot and F. Favier co-ordinated the fieldwork. X. Allirot and A. Fianu supervised field data collection. X. Allirot, A. Fianu and L. Papoz obtained and analysed the data. X. Allirot and L. Papoz wrote the first draft of the article and all other authors critically revised the first draft and contributed to the final draft.

References


