International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Dietary Patterns among Overweight / Obese School Children of District of Constantine (Algeria): A Longitudinal Study

Amira Sayed[1], Hajer Daoudi[2], Abdelkader Rouabah[3], Naim Akhtar Khan[2], Leila Rouabah[5]

[1, 2, 3, 5]Laborartoire de Biologie Cellulaire & Moléculaire, Université de Constantine 1, Constantine (Algérie);

[4]Physiologie de la Nutrition & Toxicologie (NuTox), INSERM U866, Université Bourgogne Dijon, France.

Abbreviated title: Dietary patterns in overweight and obese children

Abstract: ***Background:*** *We determined the changes in the incidence of overweight/obesity in a population of schoolchildren, aged from 7 to 11 years, in the district of Constantine (Algeria)during 2010 and 2013. We also identified the eating patterns in these children in a follow-up study.* ***Methods:*** *We recorded the age, weight and height of recruited children (n=599). The study included a qualitative food frequency questionnaire to assess usual dietary intakes at break-fast, lunch and dinner. The weight status of these children was determined as per WHO references of 2007. Factor analysis was used for identifying major dietary patterns.* ***Results:*** *The incidence of overweight/obesity in school children was 34.7 % in 2010; it was reduced to 27.1 % in 2011 and to 26.4 % in 2013.However, the incidence of obesity alone increased at the end of 3rd year. The overweight and obese children took the same break-fast during the course of 3 years. However, there was a progressive decrease in the consumption of milk, during break-fast time, by overweight (15.4 % in 2010, 14.9 % in 2011 and 4.7 % in 2013) and obese children (13.2 % in 2010, 11.5 % in 2011 and 6.1% in 2013).As regards lunch, we observed a decrease in eating habits in 3 years both in overweight (17.1 % in 2010, 13.9 % in 2011, 9.30 % in 2013) and obese children (11% in 2010, 14.80 % in 2011 and 9.60 % in 2013). During the 3 years, for dinner, overweight children exhibited an increase in its consumption (0.90 % in 2010, 2% in 2011 and 2.40 % 2013). On the contrary, the obese children showed a progressive decrease in the feeding habits for dinner (3.30 % in 2010, 1.60 % in 2011 and 0.90% in 2013).Obese children exhibited a preference for high energy density food composed of sweets, chocolate, chips, biscuits and cakes.* ***Conclusions:*** *Childhood obesity has increased over the last three years. A perturbation in the eating patterns may contribute to energy imbalance and consequently to the incidence of obesity.*

Keywords: children, obesity, Constantine, food habit.

1. Background

Since 1980, the prevalence of overweight and obesity among children is increasing, by leaps and bounds, in many countries [1]. During the last two decades, the incidence of overweight and obesity has increased 2-4 folds in developing countries [2].South Mediterranean countries like Algeria have also been affected by overweight and obesity, and these physiological conditions are becoming major public health issues in this region [3].There seems a link between the persistence of childhood overweight and its impact on obesity in the later stage of life[4].The childhood obesity has been suggested to trigger increased risk of cardiovascular disease, diabetes, hyperlipidemia, hypertension and metabolic syndrome[5-8].Though there are a number of factors like interaction between genes and environment, psycho-social situations and adoption of a western diet, rich in fried fast food products, a perturbation in dietary intake has been suggested as a major contributor to overweight and obesity among children [2].

The analysis of the dietary pattern has revealed to be a better approach to study the impact of eating habits on obesity since the interaction of a single nutrient provides isolated facts [9-11]. Indeed, there exists a relationship between eating of sweet snacks and low-quality dietary patterns, and overweight among children [12-15]. It is noteworthy that a small imbalance in energy intake might contribute to obesity, for example, an intake of 100 kcal per day would result in the increase of 5 kg body weight in one year [16]. Interestingly, no study is available on the impact of dietary patterns in Algerian overweight and obese children. Therefore, it was thought worthwhile to conduct the present study in order to identify major dietary patterns in relation to overweight and obesity among school children in the district of Constantine, situated in the North-Eastern region of Algeria, in a longitudinal study from 2010 to 2013.

2. Methods

2.1 Population

This is a longitudinal study, conducted over a period of three years (2010, 2011, and 2013). We could not continue the study in 2012 as we could not obtain the permission from the Primary Education Department of Constantine. The study included the schools of Constantine district (Algeria) selected by a multi-stage cluster random sampling method.The health of all children was periodically assessed by physicians, nurses and physician assistants of Primary Health Care Canters.Participants with any history of a chronic condition such as cardiovascular disease, diabetes, liver or kidney disease were excluded from the study. The sample size of recruited children (n=599), aged from 7 to 8 years, was sufficient to provide with the information on risk factors (confidence interval, 95%).The children were recruited in 2010 and followed-up to the year 2013.

Through a questionnaire, we collected information on eating patterns of the children for breakfast, lunch and dinner. The

Licensed Under Creative Commons Attribution CC BY

questionnaire contained the list of foods, served at break-fast, lunch and dinner, with a standard serving size consumed in Algeria. The frequency of food intake was also, sometimes, cross-checked with the mothers. Parents gave a written consent for the participation of the children and they were assured that the data will be collected in respect of confidentiality. They were informed about the purpose, protocol and potential risks of the study. All personal data such as names and dates of birth were removed from the database after some essential variables for the analyses were derived from these data, such as ethnic group and age at measurement. The protocol of the study was approved by the research council of the University of Constantine.

2.2 BMI criteria

Body Mass Index [BMI=weight/(height)2] is generally used as a proxy for body fat. In adults, a BMI value of ≥25 kg/m2 but <30 kg/m2 is generally defined as overweight and a BMI value of ≥30 kg/m2 as obese. As body composition and proportions change during physical development of children, these BMI criteria are unsuitable for children.In our study, the used the growth graphs of WHO 2007 to determine the overweight and obesity.

2.3 Statistical analyses

The data were given codes, and the results were analyzed using Epi-info software (version 6.04 and Microsoft Office Excel 2007). We used the following formula: $n=K\,[E^2P(1-P)]/i^2$. In our study, we used Student *t*-test and Ki-square tests to compare mean values.

3. Results

3.1 Changes in body weight during three years

The 2010 survey shows that the frequency of normal weight children is 53.6%, while that of overweight and obese children is respectively 19.5% and 15.2%. Lean children are 11.7% in 2010, this number has remarkably decreased to 4% in 2011, but this phenomenon contributed to an increase in the incidence of normal weight children to 68.9% in this year. Besides, there was a decrease in the number of overweight and obese children, respectively, 16.9% and 10.2% in 2011. In 2013, there were 7.4% overweight children, while the number of obese children increased to 19%. Moreover, there was a slight decrease in the frequency of normal weight, *i.e.,* is 66.9%; however, the incidence of underweight children increased up to 6.7% in this year.

3.2 Food intake patterns of breakfast during three years

All the children consumed the food products listed as follows: milk, jam, croissant bread, cheese, yoghurt and fruit juice.

(a) Normal Weight Children

During the three years, the children consumed either milk (15.3% in 2010, p=0.04, 13.3% in 2011, p=0.01, 12% in 2013 p=0.01) or milk along with bread (15.60% in 2010, p=0.04, 13.30% in 2011, p=0.01, 13.2% in 2013 p=0.01). This food pattern was accompanied by croissant bread(11.5% p=0.04 in 2010, 7.30% in 2011, p=0.01, 17% 2013 p=0.01). Some of the children consumed jam, bread and milk (5% in 2010, p=0.04, 5.50% in 2011, p=0.01, 4.70% in 2013, p=0.01). During the three years, there was a significant correlation among normal weight and type of food (either alone or combination) consumed during breakfast (p=0.02, $p<10^{-3}$, p=0.01).

(b) Overweight Children

Breakfast of these children was composed of milk alone (15.4 % in 2010, 14.9 % in 2011 and 4.7 % in 2013) or milk combined with normal bread (16.2 % in 2010, 11.9 % in 2011, and 7% in 2013). There was an increasing trend in some of the overweight children as regards the intake of milk along with croissant bread (5.1 % in 2010, 10.9 % in 2011 and18.6 % in 2013). Interestingly, there was no significant difference with the type of food, consumed by these children, during the three years (p=0.12 in 2010, p=0.09 in 2011, p=0.24 in 2013).

(c) Obese Children

The milk consumption by obese children decreased progressively (13.2% in 2010, 11.5% in 2011 and 6.1% in 2013). Some of the obese children preferred the following combinations: milk and normal bread (15.4% in 2011, 6.6% in 2012 and 12.2% in 2013) or milk with croissant bread(14.3% in 2010, 11.5% in 2012 and 21.7% in 2013). We note that there was a significant correlation in obese children and type of food consumed only in 2010 (p=0.01) but not in 2011 (p=0.26) and 2013 (p=0.15).

3.3 Food intake patterns of lunch during three years

The proposed list of food products consumed during lunch was composed of following: vegetables/salads, fried food, meat, chicken, fish, pasta and other traditional products like rice.

(a) Normal Weight Children

In 2010, 13.7% of normal weight children preferred the products listed here-upon, 5% children ate all the products of the list except meat and fish whereas 4.70% children reported taking fried food, pasta and other products ($p<10^{-3}$). In 2011, 10.40% children ate all the food constituents of the list whereas, the 2.90% children preferred traditional products like rice, and 3.10 %of them ate fried food along with pasta ($p<10^{-3}$). During 2013, 20.8% children consumed all the products listed here-upon, and 3.50% of them consumed fried food and pasta ($P<10^{-3}$).

(b) Overweight Children

Most of the overweight children consumed all the products listed here-upon, but with a decreasing frequency (17.1% in 2010, 13.9% in 2011and 9.30% in 2013). Some of children consumed fried food and pasta (2.60 % in 2010, 5.90% in 2011 and 4.7% in 2013). The comparison between the three years shows a significant correlation to the type of food consumed in overweight children ($p<10^{-3}$ in 2010 and2011, p=0.02 in 2013).

(c) Obese Children

The obese children who consumed all the products of the list mentioned here-upon were as follows: 11% in 2010, 14.80%

Licensed Under Creative Commons Attribution CC BY

in 2011 and 9.60% in 2013. Some of the children (5.50% in 2010 and 6.6% in 2011) ate all the products of the list except rice. Some of them (8.2% in 2011 and 3.5% in 2013) preferred fried food, pasta and other products. There was a significant correlation of the food intake pattern in obese children during the three years ($p<10^{-3}$).

3.4 Food intake patterns of dinner during three years

All the children, regardless of their body weight, reported eating all the products mentioned in the list. These children exhibited a preference for pasta, fried foods, meat, chicken and vegetables/salads, but a lower percentage for rice and fish (Table I, Table II and Table III).

3.5 Body weight and intake of soft drinks

We observed that in 2010, 89.40% of normal weight children consumed soft drinks whereas the overweight and obese children consumed them, respectively, by 83.80% and 89% (p=0.43). However, there is a significant correlation among normal weight and frequency of intake of sweet drinks; it is the same for overweight and obese children, $p<10^{-3}$. However in 2011, there was no significant correlation among different weight status and the frequency of intake of soft drinks, p=0.112. In 2013, all the children, irrespective to their body weight, consumed soft drinks ($p<10^{-3}$).

3.6 Patterns of food snacking in normal weight, overweight and obese children

The list of snacking food products contained the following: peanut, potato chips, candy, cake, chocolate, cookie, date, biscuit and breads.

The normal weight children, in 2010,ate all the products listed here-upon. In 2011, these children took all the products except peanuts, cake and biscuits. In 2013, these children consumed the food products of the list except peanuts, chocolate and candy. There was a significant difference between the types of food in normal weight ($p<10^{-3}$) during the three years.

As regards the overweight children, all of them consumed the food products mentioned in the list but with a decreasing frequency (11.80% in 2010, 5.10% in 2011 and 2% in 2013). In 2011, 1.9% of overweight children nibbled all the products of the list except date, bread, peanut and cake ($p<10^{-3}$). In 2013, these children preferred eating candy (7%), potato chips (2.30%), chocolate, chips and candy (7%) (p=0.14).

As regards obese children, 5.30% of them, in 2010,nibbledthe following food products: bread only, bread and cake or the whole list except peanut, potato chips, biscuit, chocolate and cake whereas 10.50% of them ate sweets, chips, biscuit, chocolate and cake(p=0.24). In 2011, 4.90% of them nibbled the following items: chocolate, chips and sweets. Some of them (3.3%) ate all the products of the list except date, whereas 4.90% of them ate whole list products except cake, date and bread. Sweets and cake were taken by 1.6% of the obese children. The same percentage of the obese children took sweets, chocolate and cake (p>0.05). In 2013, obese children continued to nibble the following foods: chocolate, potato chips and sweets (3.5%), all the products of the list except bread, date and cake (7.80%), and the entire list except bread (3.5%).Some of them (1.7%) consumed potato chips, chocolate, peanut, (1.7%) where the same percentage also consumed potato chips, chocolate, peanuts and cake except dates (1.70%) (p<0.05).

4. Discussion

Our study indicates that in 2010, the incidence of obesity in children, aged from 7 to 8 years, was 15.20%, and 19.50% were overweight. In 2011, the obesity and overweight decreased, respectively, to 10.20 and 16.90%. In 2013, 19% of children were obese and 7.40 % of them were overweight. Though the frequency of obesity decreased in 2011, it again increased in 2013. There was a significant decrease in the percentage of underweight children and, therefore, they become normal weight. As regards the children, aged 8 years, our results are supported by the study of Paineau & *al* [17] who concluded the prevalence of overweight 16.90 % in French children. Similarly, our results are very close to the study of Rolland-Cachera *& al* [18] conducted on children, 7 to 9 years, where the prevalence of overweight and obesity was18.1%. Our study suggests that obesity is on the increase among school children and in the coming years, it would be a major public health problem.

Another objective of our investigation was to identify dietary patterns. For breakfast, we observed milk along with croissant bread were favorable dietary components as obese, overweight and normal weight children took, respectively, at 21.70%, 18.60% and 17%.As regards drinking of milk alone during breakfast, normal weight, obese and overweight children were, respectively, 12%, 6.10% and 4.70%.The major combination of breakfast for the groups of children was composed of high energy density components like milk, croissants bread and jam. In addition, there was a significant correlation among normal weight children and different foods consumed at breakfast during the three years, overweight children showed a significant correlation only in 2010 as the obese children did.

Rapid changes in behavior of food consumption are currently considered as major determinants of overweight and obesity. During lunch, we observed that pasta, fried food and other products were mainly consumed. As compared to normal weight children, overweight and obese children consumed high energy food. Our observations are in agreement with the results of Fischer *et al* [19] who have reported that the 6-9 years old obese children preferred high caloric food. These investigators also established a positive correlationship in children between their adiposity, taste, their fat intake and dietary preference for lipids.

Regarding dinner, we observed more than 95% of children took their food (97.70 % normal weight, 97.10% overweight and obese 96.10%). Over the three years, the dinner was composed of fried foods and other products. These food products are the part of Algerian customs. Our results agree to the observations of Bellisle *& al*. [20] who have reported that obese children, aged 7 to 12 years, ate more at dinner

Licensed Under Creative Commons Attribution CC BY

than normal weight children, and the composition of dinner, mainly meat and chicken, corresponded to this study.

In our study, we observed that, each year, more than 90% of the obese children were prone to snacking, followed by overweight and normal weight children. Our results showed that overweight and obese children often nibbled chocolates, sweets, cakes, biscuit and also chips which were rich in carbohydrates and lipids. Our results are consistent to the study of Savige & *al.* [21] who reported that increased snacking constitute another element of disruption of eating patterns that may increase the risk of overweight. In addition, several investigators have concluded that foods, rich in sugar and fat, increase food and, therefore, promote obesity [22, 23]. Our results show that over 85% of kids drank sugar-containing soft drinks.

5. Conclusions

Our survey shows that childhood obesity in the district of Constantine has increased over the last three years which requires the implementation of a program for prevention and early detection of childhood obesity. Perturbation of eating patterns may contribute to energy imbalance. The majority of children followed the frequency of 3 or 4 meals that can reach 5 daily doses.

Future interventions in this study will be; expand the number of sample with the measurement of energetic amount of each food eaten for breakfast or lunch and dinner in order to know the energetic contribution of each food on the one hand and the other hand to raise awareness the target population (the parent). Genetic study of obesity in children is essential to highlight under the influence of this factor on the occurrence of this phenomenon and to classify it with other factors such as physical activity, sedentary behavior and appearance food.

Competing interests: All of the authors have nothing to declare as far as competing interests are concerned.

6. Authors' Contributions

Study concept and design (LR, AR, NAK); acquisition of data (AS); analysis and interpretation of data (AS, NAK, LR); drafting of the manuscript (LR, AS, NAK, SS); critical review (HD, SD, AR) study supervision (NAK, LR).

References

[1] Karnik S, Kanekar A: Childhood obesity: A global public health crisis. Int J Prev Med 2012, 3:1-7.
[2] Blair NJ, Thompson JM, Black PN, Becroft DM, Clark PM, Han DY, et al: Risk factors for obesity in 7-year-old European children: The Auckland birth weight collaborative study. Arch Dis Child 2007, 92:71-866.
[3] Musaiger AO. Overweight and obesity in eastern mediterranean region: prevalence and possible causes. J Obes. 2011: 237-407.
[4] Venn AJ, Thomson RJ, Schmidt MD, Cleland VJ, Curry BA, Gennat HC, et al: Overweight and obesity from childhood to adulthood: A follow-up of participants in the 1985 Australian Schools Health and Fitness Survey. Med J Aust2007, 186:60-458.
[5] Andrade H, Antonio N, Rodrigues D, DaSilva M, Pego M, Providencia LA: High blood pressure in the pediatric age group. Rev Port Cardiol2010, 29:324-13.
[6] Weiss R, Caprio S: The metabolic consequences of childhood obesity. Best Pract Res ClinEndocrinolMetab 2005, 19:19-405.
[7] Dhuper S, Cohen HW, Daniel J, Gumidyala P, Agarwalla V, St Victor R, et al: Utility of the modified ATP III defined metabolic syndrome and severe obesity as predictors of insulin resistance in overweight children and adolescents: A cross-sectional study. CardiovascDiabetol 2007, 6:4-16.
[8] Vivian EM: Type 2 diabetes in children and adolescents: The next epidemic? Curr Med Res Opin 2006, 22:297-306.
[9] Tucker KL: Dietary patterns, approaches and multicultural perspective. ApplPhysiolNutrMetab 2010, 35:8-211.
[10] Rezazadeh A, Rashidkhani B: The association of general and central obesity with major dietary patterns of adult women living in Tehran, Iran. J NutrSciVitaminol (Tokyo) 2010, 56:8-132.
[11] Esmaillzadeh A, Azadbakht L: Major dietary patterns in relation to general obesity and central adiposity among Iranian women. J Nutr 2008, 138:63-358.
[12] Magnusson MB, Hulthén L, Kjellgren KI: Obesity, dietary pattern and physical activity among children in a suburb with a high proportion of immigrants. J Hum Nutr Diet 2005, 18:94-187.
[13] Craig LC, McNeill G, Macdiarmid JI, Masson LF, Holmes BA: Dietary patterns of school-age children in Scotland: Association with socio-economic indicators, physical activity and obesity. Br J Nutr 2010, 103:34-319.
[14] Lioret S, Touvier M, Lafay L, Volatier JL, Maire B: Dietary and physical activity patterns in French children are related to overweight and socioeconomic status. J Nutr 2008, 138:7-101.
[15] Nicklas TA, Yang SJ, Baranowski T, Zakeri I, Berenson G: Eating patterns and obesity in children. The Bogalusa Heart Study. Am J Prev Med 2003, 25:9-16.
[16] Jéquier E: Pathways to obesity. Int J Obes2002, 26:12-17.
[17] PaineauD : Etude longitudinale prospective alimentation et sante réflexions sur la prévention précoce de l'obésité infantile. Thèse pour obtenir le grade de Docteur de l'Institut des Sciences et Industries du Vivant et de l'Environnement (Agro Paris Tech), Spécialité : Nutrition Humaine soutenue le 02/07/2008 ; 18 p.
[18] Rolland-Cachera MF, Castetbon K, Arnault N, et al: Body mass index in 7-9-y-old French children: frequency of obesity, overweight and thinness. Int J ObesRelatMetabDisord2002,26:1610-1616.
[19] Fischer JO, Birch L: Fat preferences and fat consumption of 3 to 5 year oldchildren are related to parental adiposity. J. Am. Diet Assoc 1995, 95:64-759.
[20] Bellisle F, Rolland-cachera MF, Deheeger M, et al: Obesity and food intake in children: evidence for a role

Licensed Under Creative Commons Attribution CC BY

of metabolic and/or behavioral daily rhythms. Appetite 1988, 11:111-118.
[21] Savige G, MacFarlane A, Ball K, et al: Snacking behaviors of adolescents and their association with skipping meals. Int. J. BehavNutPhysicActi 2007, 4:36.
[22] Dubot-Guais P : La prévention de l'obésité chez l'enfant et l'adolescent. Thesis for medical diploma. Université de Constantine-1, Constantine (Algeria); defended on September 16, 2005, 85-103.
[23] Golay A, Bobbioni E: The role of dietary fat in obesity. Int J ObesRelatMetabDisord 1997, 2:2-11.

Table 1: Food pattern of normal weight children at dinner

Type of food consumed	*Normal weight children (consumption percentage per year)*		
	2010 ($p<10^{-3}$) n=322	*2011 ($p<10^{-3}$) n=413*	*2013 ($p<10^{-3}$) n=401*
Rice	0.30%	0.50%	-
Other products	1.60%	2.90%	2.20%
Fried food and other products	1.20%	2.20%	2.50%
Vegetables/salads and pasta	1.20%	0.50%	0.50%
Fried food and pasta	1.20%	2.20%	2.50%
Fried food, pasta, chicken and other products	0.60%	1%	1.70%
All the products of the list	12.40%	12.10%	6.20%
Whole list except fish	4.70%	1.20%	1%
Whole list except vegetables/salads	3.10%	1.50%	-
Unknown products	0.90%	1.80%	2%

Table 2: Food pattern of overweight children at dinner

Type of food consumed	*Overweight children (consumption percentage per year)*		
	2010 ($p<10^{-3}$) N=117	*2011 ($p<10^{-3}$) N=101*	*2013 (p=0.08) n=43*
Vegetables/salads, fried food and chicken	1.70%	4%	2.30%
Fried food and pasta	0.90%	2%	2.30%
Fried food, pasta and other products	0.90%	2%	2.40%
All the products of the list	18.80%	14.90%	4.70%
Whole list except fish and rice	1.70%	2.9%	4.70%
Whole list except vegetables/salads	0.90%	2%	-

Table 3: Food pattern of obese children at dinner

Type of food consumed	Obese children (consumption percentage per year)		
	2010 ($p<10^{-3}$) N=91	2011 (p=0.002) N=61	2013 (p=0.005) N=115
Pasta	1.10%	1.60%	1.70%
Other products	5.50%	1.60%	0.90%
Vegetables/salads	3.30%	3.30%	6.10%
Fried food, pasta and other products	3.30%	1.60%	0.90%
Fried, pasta, meat, vegetables/salads and other products	2.20%	4.90%	2.60%
All the products of the list	16.50%	13.20%	4.30%
Whole list except fish	4.40%	1.60%	0.90%
Whole list except vegetables/salads	1.10%	1.60%	0.90%

Author Profile

Amira Sayed received my studies in biology at the University of Constantine 1, Algeria. I had my magister in 2009 in Molecular and Cellular Biology. I am hired as a teacher researcher in the same university, now I am a PhD student in the same specialty previously cited since 2010 for obtaining a doctoral degree in science. I'm straight to the laboratory biology cellular and molecular university Constantine 1

Licensed Under Creative Commons Attribution CC BY