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IMPACT OF DIETARY, SOCIOECONOMIC, AND PHYSICAL FACTORS ON OBESE AND OVERWEIGHT SCHOOLCHILDREN LIVING IN SIDI-BEL-ABBES (WEST OF ALGERIA) AND AIN DEFLA (CENTRE)

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Abstract

Background and aims: *The aim of the current study was to assess the impact of environmental factors; food, socio-economic, and physical activity, on a group of obese children living in Ain-Defla (Center Algeria) and Sidi-Bel-Abbes (West Algeria).* ***Material and methods****: The protocol was carried out on a cohort of 125 school children aged of 5 to 11 years, including 64 boys and 61 girls, and 139 school children, including 93 boys and 46 girls in Ain Defla and Sidi-Bel-Abbes respectively. Concerning the classification of obesity and overweight, we referred to the International Obesity Task Force and the French References' curves.* ***Results:*** *Regarding dietary intake our results showed that 34% of students from both regions took their breakfast, compared to 66% who did not take. Furthermore, 73% of students skipped at least one meal, however 23% respected meals frequency i.e. 4 meals a day. Regarding socio-economic factors and physical activity, our findings showed that obesity rates were high (36%) among children whose fathers are workers. However, for mothers who are housewives, obesity increases among their children (88%). The relationship was reversed between the parents' education level and the Body Mass Index. We found an opposite relationship between Body Mass Index and physical activity, and investigated children use screen devices for long time periods.* ***Conclusions:*** *Our study showed a positive relationship between obesity and overweight and environmental factors.*

key words: *obesity, children, environmental factors, International Obesity Task Force, body mass index*

Background and aims

Overweight and obesity are a major public health issue since their potential health impact and increasing frequency worldwide. Overweight is an important determinant of health that exposes people to several cardiovascular diseases, metabolic unbalances, and cancer pathologies, as well as an increased mortality level. Social consequences have also been highlighted with negative attitudes and stigmatization, even discrimination among many obese people [1].

For this reason, the purpose of our study was based on studying the relationship between the frequency of risk factors such as diet, socio-

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economic factors, and physical activity and childhood obesity. This could lead to identify children with high risk and to suggest preventive actions. Those actions should not include just individual approaches but they should take into consideration children's social and physical environment too.

Material and Methods

Our study is a prospective survey carried out during the period 2015-2017 in Ain Defla and Sidi-Bel-Abbes areas, at the level of several districts and municipalities. The recruitment of children was based on the calculation of BMI. Access to schools, to carry out our protocol, was authorized by the Education Academy authorities of both cities.

Selection of obesity indicators

Since Algerian standards are missing, we referred to obesity indicators recommended by the IOTF [2] and the French Reference curves [3].

Questionnaire

The survey was carried out using a questionnaire containing two sections:

The first section concerned information about investigated children: age, sex, weight, height and socio-professional status of parents, dietary risk factors associated with obesity and physical activity practice;

The second section concerned behavior of children such as frequency of time spent in front of a television screen, video game console or computer.

Anthropometric measurements

The body weight (kg) was measured with *Secaprisma*® 825 weighing scale with a maximum of 130 kg and a precision of 1 kg. The children were weighed standing, motionless, without support, their feet bare and slightly clothed. The height (cm) was measured by a tape measure, in appropriate position (feet joined without shoes, legs stretched), converted in meter for the calculation of the BMI. The BMI was then calculated with the ratio; Weight / Height^2 (Kg / m^2).

Data analysis and processing

All filled out questionnaires were processed using Stat View 5 program for statistical analysis. Calculation of percentage values, means and the standard deviations as well for the plotting of the graphs were performed. The analysis of the body status of investigated children was carried out using the corpulence curves cited above. The quantitative variables in groups were compared by Student's "*t*" test.

Results

Population's characteristics

Patient's general characteristics are shown on Table 1.

Results of our survey indicate that the participation rate was about 33% and 67% for girls and boys in Sidi-Bel-Abbes and 61% and 64% in Ain Defla. The sex ratio, boys / girls was equal to 2.02 and 1.04 in Sidi-Bel-Abbes and Ain Defla respectively.

The sample was divided into 7 subgroups according to their difference of age [5-6] years, [6-7] years, [7-8] years, [8-9] years, [9-10] years, [10 -11] years, [11-12] years. Distribution of the 7 subgroups group is summarized on Table 2.

Comparison of anthropometric characteristics in both sexes

No significant difference ($p>0.05$) was found between boys and girls in body weight and BMI. However, a significant difference was observed in height ($p<0,05$).

Table 1. Anthropometric parameters of the studied population (N= 264).

	Body Weight (Kg)		Height (m)		BMI (Kg/m²)	
	Sidi-Bel-Abbes n= 139					
	Boys	Girls	Boys	Girls	Boys	Girls
M ±SD [Min – Max]	46.44 ± 11.84 [30.00-74.00]	52.26 ± 10.66 [38.00-73.00]	1.23 ± 0.13 [1.020-1.570]	1.30 ± 0.13 [1.090-1.560]	30.09 ± 4.14 [23.49-43.82]	30.53 ± 1.25 [27.77-34.79]
P value	0.187		0.020		0.174	
	Body Weight (Kg)		Height (m)		BMI (Kg/m²)	
	Ain Defla n=125					
	Boys	Girls	Boys	Girls	Boys	Girls
M ±SD [Min-Max]	59.03 ± 12.66 [32.00-80.00]	60.03 ± 15.77 [35.00-100.00]	1.36 ± 0.12 [1.020-1.530]	1.36 ± 0.12 [1.090-1.580]	31.61 ± 3.78 [25.60-41.504]	31.80 ± 4.77 [24.30-44.44]
P value	0.779		0.872		0.859	

Table 2. Anthropometric parameters of the studied population according to age brackets (N= 264)

	Body Weight (Kg)		Height (m)		BMI (Kg/m²)	
Age intervals (year)	Sidi-Bel-Abbes n= 139					
	Boys	Girls	Boys	Girls	Boys	Girls
[5-6] years	32±0.50	38.83±0.75	1.02±1.01	1.11±0.15	30.55±0.66	31.44±1.25
[6-7] years	33.09±1.90	40.62±2.12	1.12±1.13	1.16±0.23	26.42±1.92	29.84±1.51
[7-8] years	42±1.26	41.33±4.04	1.17±0.49	1.22±0.46	35.65±5.88	30.22±0.49
[8-9] years	49±4.27	56.57±6.82	1.27±0.75	1.34±0.92	30.56±0.21	30.97±1.68
[9-10] years	56.06±1.34	59.66±3.98	1.34±0.22	1.39±0.47	30.54±0.88	31.04±0.79
[10-11] years	58.87±6.81	65.80±16.54	1.38±0.88	1.45±0.08	30.84±3.86	30.34±0.96
[11-12] years	66.42±6.29	74±6.78	1.39±0.73	1.49±0.75	30.72±4.66	29.80±0.69
	Body Weight (Kg)		Height (m)		BMI (Kg/m²)	
Ageintervals (year)	Ain Defla n= 125					
	Boys	Girls	Boys	Girls	Boys	Girls
[5-6] years	32 ±2.11	39.05±1.33	1.02±0.11	1.14±0.02	30.76± 0.01	29.12± 1.17
[6-7] years	35±1.13	40.5±2.12	1.13±0.13	1.15±0.078	27.41± 1.11	31.00±2.58
[7-8] yeans	43±2.83	46±1.41	1.22±0.03	1.29±0.021	28.89±1.90	27.88±1.77
[8-9] years	57±3.54	50.71±3.19	1.33±0.12	1.29±0.069	32.12±2.72	30.52±3.14
[9-10] years	60±4.95	57.86±14.87	1.34±0.12	1.40±0.122	33.05±6.17	29.12±3.43
[10-11] years	66.07±3.54	74±16.54	1.42±0.06	1.45±0.083	32.70±3.86	35.10±5.90
[11-12] years	69±18.34	69±6.87	1.37±0.08	1.39±0.046	29.48±4.66	35.75±3.15

Dietary assessment

The results are shown on Table 3.

Concerning breakfast, our results showed a poor level of investigated children taking this meal; 33 and 35% in Sidi-Bel-Abbes and Ain Defla cities, respectively, while the majority (67 and 65%) go on an empty stomach.

Table 3. Dietary habits of the studied population (N= 264)

	Yes	No	Cous.	Spag.	VS	Piz.	Gri.	Fre.	Stm.	1/2 GS	3/4 GS	>4 GS	NA	NS	1 TW	2-3 TW	ED
	Sidi-Bel-Abbes n=139																
Breakfast %	33	67															
Skipping Meals%	78	22															
Favorite dishes%			13	32	4	51											
Fat content %														5	15	10	70
Dairy products														7	13	30	50
Favorite method of cooking %							71	29	0								
Meat Consumption %														7	45	35	13
Water quantity%										32	18	25	25				
	Ain Defla n=125																
Breakfast %	35	65															
Skipping Meals%	75	25															
Favorite dishes%			15	30	6	49											
Fat content %														5	17	13	75
Dairy products%														7	13	20	60
Favorite method of cooking %							75	25	0								
Meat Consumption %														6	46	34	14
Water quantity%										35	15	25	25				

There were 78 and 75% of students who often skip at least one meal, while only 22 and 25% who respected the four meals in Sidi-Bel-Abbes and Ain Defla respectively.

Pizza and Spaghetti represented the most preferred dishes of about (32 % and 51%) (30% and 49% in Sidi-Bel-Abbes and Ain Defla respectively, 13 % and 15% for couscous in Sidi-Bel-Abbes and Ain Defla respectively and vegetable soup (4% and 6%) in Sidi-Bel-Abbes and Ain Defla respectively.

70% and 75% of our investigated children (in Sidi-Bel-Abbes and Ain Defla respectively) consumed everyday fat (from animal and vegetable oils). However, 17 and 15% consumed only one time a week. The remaining 10 and 13% consumed 2 to 3 times a week. It should be mentioned that a low percentage (5%) never or rarely consume fatty foods.

Concerning dairy products, 50 and 60% of investigated children (in Sidi-Bel-Abbes and Ain Defla respectively) consumed every day. 20 and 30% consumed 2 to 3 times per week. However, 13% were children who consumed 1 time a week. We noticed that 7% of our sample never consume dairy products.

Approximately, the majority of the population preferred grilled or fried foods with an estimated rate of 71 and 75% in Sidi-Bel-Abbes and Ain Defla respectively. 25 and 29% preferred fresh prepared foods. Nobody prefers steamed foods. 45 and 46% of Sidi-Bel-Abbes and Ain Defla population respectively consumed 1 time a week meat. 35 et 34% consumed 2 – 3 times a week. However, 13 and 14% consumed everyday meat products. While 6 and 7% rarely consumed meat.

Concerning water consumption, 25 % of investigated children did not answer this question. 32 and 35 % consumed daily 1 to 2 glasses. About 18% and 25% of ours ample consumed 3 to 4 glasses. However, 15% and 25% consumed more than 4 glasses a day.

Socioeconomic factors

The majority of our children lives with their parents (98.48%). All mothers are in live and the percentage of died fathers is low 3.03% and 4% in Sidi-Bel-Abbes and Ain Defla respectively.

Obesity rates were high among children whom fathers are officials (36% and 37% in Ain Defla and Sidi-Bel-Abbes respectively).

Obesity is high among children when their mothers are housewives (88%) in both Ain Defla and Sidi-Bel-Abbes.

We observed that obesity rate was low when the parents' level of education is high for fathers/mothers: 5% / 6%, and 5% / 8% in Ain Defla and Sidi-Bel-Abbes respectively.

Furthermore, we noticed that obesity was high among children living in traditional houses 26% and 49% in Ain Defla and Sidi-Bel-Abbes respectively.

Concerning physical activity, our investigation showed that 44 % and 45 % of boys in Sidi-Bel-Abbes and Ain Defla respectively, had a low activity. Nevertheless, for girls, low activity was observed in 66% and 62% in Sidi Bel bbes and Ain Defla respectively;

Our survey reported that 56% / 58% of boys and 45% / 42% of girls practice sports in Ain Defla and Sidi-Bel-Abbes respectively.

The favorite sport among females was running (50% and 60%) in Ain Defla and Sidi-Bel-Abbes respectively. However, for males, football was the favorite sport: 45% and 40% in Ain Defla and Sidi-Bel-Abbes respectively.

Concerning hobbies, we recorded that TV and electronic games were the most favorite for both genders; 56% and 38% in Ain Defla and Sidi-Bel-Abbes respectively.

Lifestyle

Children sleeping more than 10 hours, represented 20% and 17% in Ain Defla and Sidi-Bel-Abbes respectively. For the majority (80, 83 %), the time spent for sleeping remains insufficient as shown on Table 4. 50% of children take a nap during the holidays with a duration of 1h: 30min.

Table 4. Sleep duration among the studied population (N= 264)

	Ain Defla		Sidi-Bel-Abbes	
Duration of sleep	More than 10h	Less than 10h	More than 10h	Less than 10h
Percentage %	20	80	17	83

Discussion

Our results showed that there were incorrect dietary habits at early years of life among the studied children population are leading to eating disorders which could promote the emergence of energy imbalance considered in obesity etiology.

Breakfast was often missed in our investigated children. This can lead to uncontrolled and over food intake outside of meals due to hunger feeling. Indeed, we noticed 36% of the studied population who had breakfast, however 64% left on an empty stomach. Thus, the study of [4], showed that overweight children were more used to skip breakfast and nibbling.

It was shown that having morning collation does not reduce the caloric intake of the following meal and is not related to the caloric intake of breakfast [5].

Several studies agree that breakfast is important in the overall food balance. Regular taking of breakfast in children would reduce the risk of obesity and overweight compared to those who miss this meal [6]. Few studies have examined the importance of the meals timing, showing in particular the beneficial effect of breakfast or consuming caloric foods at the beginning of the day on some parameters such as body weight or insulin sensitivity [7].

It is well known that food habits are crucial for monitoring normal quantities to be ingested [8], and the disorder of traditional food rhythms (the four main meals of the day: breakfast, lunch, afternoon snack and dinner) can contribute to an

energy imbalance involved in the etiology of obesity.

Meals are regularly taken among all the investigated population. However, 72% skip at least one of the four main meals. The few controlled intervention trials, that examined meals frequency, with the limit of their sample size and their short duration, showed little or no beneficial impact of the increase in this frequency on body weight, energy balance and health, in iso-caloric or hypocaloric conditions [9].

Carbohydrates intake (refined cereals, sugars, and carbohydrates with high glycemic index) would determine blood levels of insulin, a hormone that in turn controls fat accumulation [10].

Excessive consumption of carbohydrates, especially in the form of sweets and drinks, represents another obvious cause of dietary imbalance. A role of proteins in the genesis of obesity is not resolved while their consumption exceeds the recommendations among the majority of children [11].

Results of several studies stated that food intake, following the consumption of food rich in protein was lower than that occurring after consumption of foods rich in lipids or carbohydrates.

Therefore, proteins are more satitogenic than carbohydrates and lipids. Data from an Algerian survey, on children, draw a relationship between consumption of various dishes with high calorie amounts, such as Couscous (traditional dish), spaghetti and fried potato. Children taking more than twice a week such dishes are more likely exposed to develop obesity or overweight [12].

In another study, vegetables and fruits are consumed every day in 11.83 % and 6.36% respectively among the studied population. Meat was daily consumed in 16.83% of the children group. Those authors observed that children eating more fatty foods and salt tend to eat less fruits and vegetables [13].

It is well known that water constitutes the unique essential drink for human organism. Our results showed that a consumption of 1 to 2 glasses a day was observed in 32% and 35% among the studied population in Sidi-Bel-Abbes and Ain Defla respectively. However, soft drinks were more consumed (60%) than fruit juices (40%).

Several studies, however, noticed the significant contribution of soft drinks to increase the risk of developing overweight and obesity in both children and adults. Mechanisms used to explain the deleterious role of soft drinks include a limited amount of satiety due to their rapid absorption [14]. Hence, every additional soft drink glass or can, take every day could lead to an increase (60%) of the risk of developing obesity or overweight [15].

Several parents put inside their children school bags some food as collation to take at 10 am believing that it will keep them waiting till lunch meal [16]. This could be explained either by skipping breakfast or the influence of other classmates during breaks.

Lipid-rich foods were the most preferred foods in our investigated children due to their organoleptic characteristics. A recent study reported that humans were able to detect different levels of fat in milk by odor, regardless of daily intake [17].

Fat consumption predominantly contributes to increase the daily calorie intake because their high caloric density (9 Cal/g) compared to the other macronutrients. Such high caloric density, associated with a rapid consumption, unbalance the process of satiation. The effects of dietary lipids are particularly marked in some individuals whose low ability to oxidize lipids favors their storage [18].

A positive correlation between obesity and high-density food intake of high caloric products was observed. The consumption of pasta, chips, chocolate, bread, wafers, and sweets was high in obese compared to normal weight children [19].

Through food variety, energy density of offered foods to children becomes more variable, depending on how foods are cooked. Thus, fat added to mashed potatoes could affect both nutritional and sensory properties [20].

Based on the INCA (Individual and National Study on Food Consumption) study results, Lioret *et al.* (2007) [21] found an inverse relationship between overweight (including obesity) and socioeconomic. This relationship was determined by the family head occupation in children aged 6 to 14 years. Similarly, Thibaut et al. (2010) [22] showed that low socioeconomic status, as measured by the father's professional activity, increased the risk of overweight and obesity in children.

In both children and adults, the rate of obesity increases progressively as income decreases. This relationship is known as the "Obesity Social Gradient" [23].

Similar results were obtained by Taleb *et al.*, 2009 [24] in Algeria and Morocco. This could be explained by the fact that fathers provide a better living level for their children and accessibility to fast food (Charkaoui Dekkaki, 2014) [25].

According to a Canadian study, young people living in a household where no member has got performed high school studies were more likely to be overweight / obese than those living in a household where the level university studies [26-28].

Mothers educated could have a protective effect on overweight and obesity [29]. On average, the most disadvantaged groups have an overweight rate 2 to 3 folds higher and an obesity rate up to 7 folds higher than the most favored categories [30].

Socioeconomic conditions correlate with BMI [31]. The risk of becoming obese increases when children live in a single-parent family [32]. Children whose mothers are the unique person who raise them are 5 times more likely to experience poverty.

Concerning physical activity, the United States and the United Kingdom recommend 60 minutes of daily physical activity in children [33]. A negative relationship, between physical activity level and obesity, is observed in several cross-sectional studies [34,35]. Conversely, sedentary occupations are associated with a higher risk of obesity.

Longitudinal follow-up of 4-year-old children showed a protective effect of physical activity on fat gain in childhood and adolescence [36]. Furthermore, physical activity plays an important role in maintaining a good physical and psychosocial status among children and has a fundamental place in growth and maturation.

In interventional studies, the promotion of physical activity, apart from any action that targets eating or sedentarism, improves body weight and reduces the risk of overweight and obesity in children [37]. The level of physical activity required could be moderate to intense activity for approximately 60 minutes per day [38].

A cross-sectional study on 42 children at risk of developing obesity aged 8 years, showed that physical activity was inversely proportional to visceral adipose tissue [39]. Indeed, during any trip, the car is systematically preferred than cycling or walking, activities that are more beneficial for our body. Similarly, residents of buildings tend to use elevators rather than stairs. Children tend to use during long period screen devices such as TV, computer, game consoles, tablets, etc. It was reported that children watching TV for more than 2 hours a day are significantly more likely to be obese than those

who spend 1 hour or less. The study performed by Liang *et al.* (2009) [40] found that eating in front of TV screen negatively affects the consumption of fruits and vegetables. Indeed, those who eat in front of the screen consume more sweet drinks and snacks. These practices are increasingly leading to physical inactivity or at least considerably limit physical efforts, thus promoting obesity [41].

Insufficient sleep time, even excluding subjects with sleep apnea hypopnea, has been associated with obesity. Hypothetically, lack of sleep would result in light-sensitive central oscillator trouble in the suprachiasmatic nucleus and a disturbance of the hormonal cycles (leptin and ghrelin) and metabolic cycles. The recommended average lengths of sleep in children (children 4 years old: 11h, 6 years: 11h 50min, 7 years: 11h 30min, 8 years: 10h30min) [42].

Conclusions

This cross-sectional study highlighted the impact of diet and socio-economic factors on obese schoolchildren living in Sidi-Bel-Abbes and Ain Defla cities. Some anthropometric measurements such as body weight, height, and BMI were performed. A questionnaire on dietary habits and social economic factors was distributed.

According to obtained results, there was a slight difference observed between the two cities for which feeding behavior was similar. Most children do not take their breakfast with a suppression of one of the four main daily meals leading to a food imbalance that covers their energy needs.

Furthermore, we reported an inverse relationship between BMI and physical activity with a sleep rhythm disturbance. TV, electronic games, and the utilization of mobiles were highly practiced in the majority of investigated children. This can lead to a major lifestyle and habits changes in both cities, similar to other Algerian cities that promote the emergence of overweight and childhood obesity.

Socioeconomic factors play an important role too in the development of childhood obesity, as we reported in our results, making children with low revenue level the less exposed to this pathology.

Prevention strategies, with further investigations, and epidemiological surveillance in school children are therefore highly recommended and necessary.

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