STUDY OF RISK FACTORS ASSOCIATED TO OVERWEIGHT AND OBESE CHILDREN IN BATNA CITY

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Abstract
The objective of this study is to determine the frequency and risk factors of overweight and obesity among children attending 9 schools in city of Batna (Algeria). 90 pupils between 9 and 18 years old divided between 36 boys and 54 girls interviewed from 1st February to30th July 2020.
The respondents were asked to submit a questionnaire on the predictive characteristics of obesity in children and adolescents such as socio-demographic situation, parents' occupation, main meals, eating habits, sedentary lifestyles and physical activity. Obesity and overweight were determined according to the International Obesity Task Force (IOTF) criteria. A Pearson correlation test analysis was conducted to determine risk factors for overweight and obesity.
The incidence of overweight and obesity was estimated at 8.3% and 83.3% respectively. Girls are more affected by obesity than boys (50% versus 33.3%). The most representative age group is 9 to 12.5 years old with a rate of 34.4%. A significant association was observed between student obesity and the consumption of certain foods (meats, starches, sweets, pizza) ($p< 0.05$). Significant correlations were found between childhood obesity, afternoon taste and frying ($p< 0.05$).
Overweight and obesity have become a public health problem that threatens Algeria for which means of struggle must be deployed.
Keywords: BMI, obesity, overweight, food habits, physical activity, cross-sectional study.

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1. INTRODUCTION

Obesity is a multi-factor disease and its development is the result of multiple interactions between genes and the environment (Maffeis, 2000). It's a global public health issue (Bonsaksen et *al.*, 2013). It affects all categories of the world's population, regardless of their age, gender or socio-economic status. This is very worrying, especially since it also affects children even very young. The obese child or adolescent is victim of childhood obesity, a disease he or she has not chosen and is not responsible for. This explosion of childhood obesity is a real public health problem both in terms of the quality of life of children and their health (Didaoui, 2018). Obesity is the combined product of a child's exposure to an unhealthy environment and inadequate behavioural and biological responses to it. These responses vary from person to person and are strongly influenced by developmental or life-cycle factors (Lake and Townshend, 2006). Eating disorders are characterized by an eating sickness. These disorders are associated with extreme emotions, attitudes and behaviours with respect to body weight and dietary issues (Didaoui, 2018). Casazza et *al.* (2013) confirmed that the development of unhealthy eating habits during childhood is one of the leading causes of later obesity.

According to Taleb (2011), obese children have a high incidence of subclinical abnormalities in lipids, blood pressure, orthopedic, endocrine and diabetes type 2. Cardiovascular abnormalities, consequences associated with obesity are often grouped into: high blood pressure, dyslipidemia, abnormalities of myocardial function and endothelial functions, insulin resistance (major risk of type 2 diabetes later). These risk factors are the same as for adults. Their presence in childhood predicts

cardiovascular morbidity in adulthood (Reilly, 2003).

Since the 1980s, obesity has reached epidemic proportions. The increase in overweight is observed in children and adolescents. The WHO said that the number of obese children and adolescents in the world will be higher than the number of underweight children. This number has increased tenfold over the past four decades among obese children aged of 5 to 19 years. If the current trend continues, in 2022 the number obese children and adolescents will be higher than children with moderate to severe underweight (WHO, 2017).

Comparing the prevalence of overweight and obesity among children and adolescents across countries is particularly difficult, due to differences in the age groups studied, the thresholds used, and the years in which the surveys were conducted. Lobstein et *al.*, (2004) tried to gather the data in such a way as to make them as comparable as possible.

According to Cole et *al.*, (2000); Lobstein et *al.*, (2005) in Europe, 15-30% of children are overweight and in North America the prevalence exceeds 30% (Ogden, 2006). In Switzerland, 15-20% of school children are overweight and 2-5% are obese depending on the reference values used (Zimmermann, 2000). In Algeria, little work has been published. In 2004, a survey of 850 children aged 8 to 13 in Constantine showed that 6.2% were overweight (including obesity) according to the IOTF (Oulamara et *al.*, 2004). In Tébessa, a survey of 912 children aged 6 to 12 years between 2006 and 2007 found a prevalence of 23.10% of overweight including obesity, according to the IOTF (Taleb and Agli, 2009). In Oran, the prevalence of overweight including obesity is 13.1% (Raiah et *al.*, 2012).

Inorder to study the relationship between food habits,frequency of overweight and obesity among school children andameliorate their prevention in Batna province, a cross-sectional study based on detailed questionnaire in function of their age and sexis conducted.

The aim of this survey is to identify risk factors related to the development of obesity within children aged between 9 and 18 years, then to study the epidemiological association between dietary risk factors associated to overweight and obesity in public schoolsduring the schoolyear 2019-2020 in Batna city due to the limited epidemiological data available and their heterogeneity.

2. MATERIALS AND METHODS

This is a cross-sectional descriptive survey applied on sample of 90 pupils from 6 primary schools, 3 middle school and 1 college located in the city of Batna. The recruitment of pupils was carried out by simple random sampling during a period of 6 months (from 1st February to 30th July 2020). The students surveyed are subjected to interrogation and anthropometric measurements either at school level. The data collection was carried out through a validated individual questionnaire consisting of more than 71 questions on the predictive characteristics of obesity in children and adolescents such as socio-demographic situation, occupation of parents, eating the main meals, eating habits, sedentary lifestyles and physical activity. The questionnaire was presented to the students using two methods, the first one consists in the direct conduct of the interview by the interviewers and the second by online and through social networks.

The dietary habits questionnaire is a quantitative questionnaire using the same structure as that used in the adult eating and obesity Survey in Batna city (Bediaf and Saouli, 2018).

The anthropometric measurements collected concern the weight and the height to calculate the Body Mass Index (BMI). The weight is measured by means of a person scale, with a capacity of 120 Kg and an accuracy of 100g. The waist is measured in the upright position using a tape measure with a belt clip and a lock for measuring to the nearest millimetre. The corpulence of each individual and the degree of overweight are evaluated by calculating the Body Mass Index (BMI) according to the formula:

BMI = Weight (kg)/Size^2 (m^2).

Classification of weight status is performed by selecting the IOTF reference using a BMI curve and age to identify this status. The IOTF C-25 percentiles (percentile reaching 25 kg/m² at 18 years of age) and IOTF C-30 (percentile reaching 30 kg/m² at 18 years of age) define overweight and obesity, respectively (Cole et *al.*, 2000). IOTF thresholds are primarily intended to assess the prevalence of obesity in epidemiological studies.

We conducted two types of analysis, a univariate analysis (distribution of study population by sex and age), and a Bi-Variate Analysis that consists of establishing the relationships between two variables using cross-tabulations. Pearson's correlation is carried out for analyzing the data obtained from different types of date, and to study the relationship between body mass and the different factors related to overweight and obesity. Data were reported in order to highlight the existence or not of statistical relationships between two variables via the Pearson correlation coefficients r, *p* values< 0.05 were regarded as significant and *p* values< 0.01 very significant. Data were analyzing using SPSS statistical software (Version 20.0) and XLSTAT software – 2009.

3. RESULTS AND DISCUSSION

Univariate analysis

Distribution of Pupils according to their sex and age

The distribution of the pupils surveyed according to there sex and age (Figure 1) shows a proportion of **40%** of the male and **60%** of the female sex.

The age of the interviewed pupils varies between 9 and 18 years with an average age of **13.5years**. The most representative age group of our study population is 13 - 16 years old with **37.7%** of which **38.9%** are girls and **36.1%** are boys.

The overall incidence of obesity and overweight

The frequency of overweight alone affects **8.9%** of children while the frequency of obesity is **83.3%.** Overall, the proportions of overweight and obese children and adolescents are high compared to that of the cross-sectional survey carried out at the primary school level in municipality of Oran during the school year 2010-2011 where 3.1% of children are obese and 10% overweight (Raiah et *al.*, 2012). As well as the found results in the Gauthier study (2014) where the frequency of obesity is 11.70%. The obesity rate in developed countries is twice more than in developing countries. In contrast, the number of children affected is much higher in developing countries.

Bivariate analysis

Relationship between corpulence, sex and age

Statistical analysis showed that corpulence is not significantly associated with sex (**r=0.662, *p*> 0.05**) (table1). The proportions of girls are more affected by obesity than boys (**50%** versus **33.33%**). It was common to see more overweight or obese girls (United States: 31% and 15.1% among girls versus 28.2% and 13.9% among boys; France: 12.8% and 4% among girls versus 9.8% and 2.7% among boys) (Celi et *al.*, 2003; Speiser et *al.*, 2005).

Age is very strongly correlated with corpulence (p< 0,01) whose peak frequency of obesity is observed in the age group **9 to 12,3** years with a rate of **34,4%** (table1). A study of children and adolescents aged from 6 to 16 years in the region of Khroub « 2001-2002 » (Mekhancha et *al.*, 2005), showed a prevalence of obesity 6.4%. Also in Constantine, in 2004 (Oulamara et *al.*, 2004) the prevalence of obesity among 810 children aged 7 to 13 years was 7,4%.

The prevalence of obesity among 5-12 year olds increased four fold in France between the 1960 and 2000, while between 1971-74 and 1999 it tripled in the United States among 6-11 year olds (DE Lauzon and Charles, 2004).

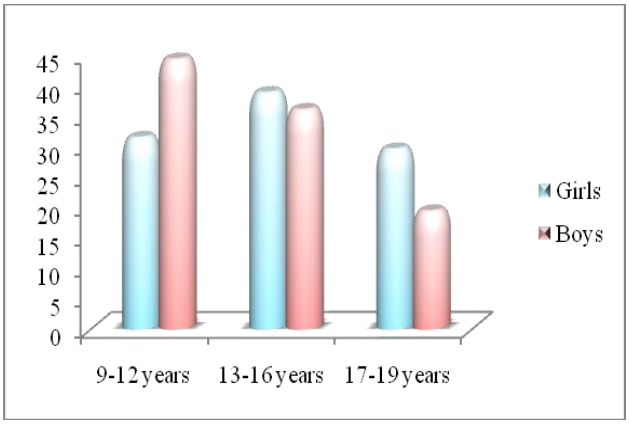

Figure1. Distribution of pupils according to the sex and age

Relationship between corpulence and hereditary factor

65.6% of obese children have at least one obese family member with a non-significant difference (**r=0,052, *p*> 0,05**) (table1). Our results are not consistent with those of Taleb (2011) which indicates that parental obesity is a significant risk factor. When both parents are overweight, 29.47% of children are overweight compared to 14.97% when both parents are normal weight (p = 0.0042). This means that children are twice as likely to be overweight when both parents are overweight compared to children whose parents are both normal weight-loss. Whitaker et *al.*, (1997) analysed the risk of becoming obese as adults in children aged 1-2 years, based on the weight status of the parents, children with two obese parents compared to children with normal weight parents have a significantly increased risk (odds ratio =13.6). Parental obesity is a significant risk factor. For example, children are two times more likely to be overweight when they have a hereditary factor of overweight compared to children who have no family history (ORa = 2.2; 95% CI = [1.6-3.0]) (Raiah et *al.*, 2012).

Relationship between corpulence and occupation of parents

There were no significant differences between the profession of the parents and the size of the pupils (***p*> 0.05**). Fathers with liberal professions stand out among pupils with obesity (**40%**). In contrast, the incidence of mothers without work is higher among obese children (**55.6%**) (table1). This result is consistent with that of Daoudi (2016) for the profession of the fathers on the one hand and is opposed on the other hand to the profession of the mother and corpulence of the pupils. Rolland-Cachera and Bellisle (1986), found 4 times more obese in the children of workers aged 7 to 12 than in the children of managers. In addition, more obese children are found in priority education areas, where family financial difficulties are more prevalent. A high socio-economic level is also a risk factor for obesity in poor countries such as Brazil and in developing countries such as Thailand or China (Anaes, 2003).

Relationship between corpulence and the Taking of meals

Breakfast is more consumed by obese students with a rate of **56.7%** per contribution to overweight students **4.4%** with a non-significant relationship (**r=0,027,*p*>0.05**) (table2). Our results are lower than those obtained by Guerouache and Ghodbane (2016) which reveal that overweight children are more likely to eat breakfast every day, 75.30% compared to obese 68%. While the study carried out by Taleb between 1995 and 2007 shows that normal weight children are more likely to have breakfast (75%).

In our study, obese children who eat breakfast declare that they only consume milk. This result is in line with that of Guerouache and Ghodbane (2016), which shows that many obese people take milk only in the morning compared to overweight children. Thus the study of Sayed et *al.*, (2014) showed that overweight children take, at breakfast, sweet products, bread, croissants and dairy under high percentages compared to normo-weight.

Morning snack is not correlated with body size (***p*> 0.05**). It is only taken daily by **40%** of obese children compared to **43.3%** report not taking it (table2). Our results are lower than

those of Guerouache and Ghodbane (2016) which shows that the morning snack is taken daily by 55.70% of obese. These results are consistent with several studies (Neumark-Sztainer et *al.*, 2003; Fulkerson et *al.*, 2009; Fiese and Hammons, 2011). 83.2% of adolescents do not take the morning snack, only 16.8% take it, which makes it difficult to determine the relationship between taking the snack and their body size. Our results are similar to those reported by Ouchfoun et *al.* (2011) where 24% of adolescents take morning tea versus 76% who say they do not take it.

Obese children are the most to take the **afternoon taste** (**64.4%**) The corpulence is correlated with the afternoon taste (**r=0.250, *p*< 0.05**). This is confirmed by the study of Daoudi (2016) which reveals that the relationship was observed only between the 5:00 pm snack and the corpulence of students, with 62.5% obese. Various studies show that food intake outside meals and snacks consists of fatty or sweet products (cookies, pastries, ice creams, sweet drinks, chocolate...) (Daoudi, 2016). On the contrary, obese children, according to the study by Guerouache and Ghodbane (2016) are less likely to take tea 48.50% than other children.

The consumption of **dinner** is not correlated with corpulence (***p*> 0.05**). The majority of the children surveyed take their evening meals, which is rich and varied: **6.7%** overweight and **74.4%** obese. Our results are higher than those of Guerouache and Ghodbane (2016) which shows that 32% of obese students take their dinner while those who are overweight have a rate of 37.10%.

Relationship between corpulence and number of meals per day

Obese children consume more than 4 meals a day (**63.3%**) compared to overweight students (**4.4%**). There is no significant relationship between the number of meals and weight gain (***p*> 0.05**) (table2). Our results are consistent with similar studies in adults such as the Mills study(2011) from the University of Wisconsin in the USA which shows that the number of food intake, The frequency of snacking and eating breakfast is not significantly associated with overweight or obesity ($p > 0.05$).

The study by André (2005) confirm our study and show that there is no association between meal intake and the size of children. The risk of overweight was twice as high in children who had unstructured eating habits, that is, who did not usually participate in the 4 recommended daily food intakes (breakfast, lunch, afternoon tea and dinner). These associations seem to show the importance of the role of the "structuring" of the daily intake of the different meals and in particular the role of afternoon tea.

Relationship between corpulence, physical activity and sedentary lifestyle

Statistical analysis has shown that physical activity and sedentary lifestyles are not significantly related to the corpulence of obese children respectively (**r= 0.056**, ***p*>0.05**) (**r=0.085**, ***p*>0.05).** Weight gain is linked to reduced physical activity in **62.2%** of children who do not participate in a weekly sports activity and in **58.9%** of pupils who participate in school sports 2 hours per week. This result is close to that of Daoudi (2016) which shows that 59.6% of obese people report participating in sports classes at school with a pace of 2 hours per week. For those who go to school on foot, the walking time is at least 15 minutes for 33.3% of overweight students. This is lower than that of Daoudi (2016) which shows that 92.3% of overweight students walk at least 15 minutes to go to school. In Algeria, few studies have focused on estimating physical activity among children or adolescents. The study of Taleb and Agli (2009) confirmed that the prevalence of obesity and overweight is higher among adolescents who are not physically active.

Sedentary lifestyle is proven in **47.8%** of obese pupils by spending their free time watching television and video games (**27.8%**). Physical inactivity and time spent watching television have been clearly identified as a risk factor for obesity (Proctor et *al.*, 2003; Hill et *al.*, 2003). The majority of American children spend an

average of three to five hours a day in front of television, while 30% of European children watch it for at least four hours a day. The majority of American and European studies have shown a positive relationship between adiposity and time spent in front of television and an inverse relationship with participation in moderate to intense physical activities. The child's energy expenditure is significantly lower in front of television than during rest periods (Farpour-Lambert, 2004).

Relationship between corpulence and food consumption

The relationship between corpulence and consumption of **fish** (***p*<0.05**), **redmeat** and **chicken** (***p*<0.01**) are significant to highly significant (table3). This is consistent with Taleb's (2011) finding that overweight children consume more meat, fish and eggs. A study carried out in Denmark shows that excess proteins stimulate Insulin Growth Factors IGF1 and thus cause growth faster (Hoppe et *al.*, 2004). Our results corroborate with the results of Wang and Beydoun (2009) who showed in an American population that there was a positive association between meat consumption and obesity risk. Meat, is rich in saturated fatty acids and cholesterol (Schulze et *al.*, 2003), its overconsumption is associated with high BMI (Phillips et *al.*, 2012). Rouhani et *al.* (2014) also reported a direct association between red meat consumption and obesity. Several studies have shown that children consume too much fat and protein, and too little fiber. Nicklas et *al.* (2003) reported that obese children appear to be particularly attracted to fat-rich foods. Fat does not stimulate the regulation mechanisms of satiety as effectively as carbohydrates or proteins, and the energy expenditure associated with thermogenesis is less since fat is stored rather than oxidized. Concomitant protein intake stimulates the secretion of insulin-like growth factor I and insulin, which promotes fat storage and the proliferation of mature adipocytes.

A significant correlation between **sweets, pastries** and corpulence exists in this study (table 3) (***p* < 0.01** for sweets, ***p* < 0.05** for pastries). This is called snacking, which most obese people munch on this type of food. Our results are consistent with those of Guerouache and Ghodbane, (2016), which shows that the most eaten foods during nibbling: finger food, chips, candies, wafers, biscuit, chocolate are energy-dense foods, high in carbohydrates and fat. Various studies on nibbling (PNNS, 2005; DE Kock, 2006) show that snack-eating children still eat this type of food and that they are high-calorie and low-density foods. These energy-dense foods increase daily calorie intake. Children have a certain preference for sugary and fatty foods because they have learned to choose foods with a high energy density to meet their energy needs. They associate the flavour of these foods with pleasant physiological signals that result from high energy intake, especially when they are hungry (Birch, 1992; Johnson et *al.*, 1991).

We also observed that obese children and adolescents consume more **fried foods** and **pizza** than normo-weighted with a significant relationship (***p*<0.05**) (table3). Our results are consistent with those of Kostecka (2014) which found that eating high-energy-dense foods, including fries and pizza contributes to weight gain and increases the risk of children obesity.

4.CONCLUSION

Finally, this study allowed us to show the existing link between the risk of developing obesity in children and adolescents and exposure to certain dietary factors. To prevent the onset of obesity in this population category, it is better to limit the consumption of foods that are considered as risk factors. Limit food consumption of snacks (sweets, cakes, chips, etc.). Children aged between 9 to 18 years should practice 60 minutes per day of intense to moderate physical activity. Launch a national prevention program with well-structured objectives for mothers and raise their about the serious consequences of obesity on the health of their children and even their future babies.

Table 1. Correlation between corpulence and socio-economic factors

Variables	Corpulence				r	*p*
	Overweight		Obesity			
	N	%	N	%		
Sex						
Girls	6	6,66	45	50	0,047	0,662
Boys	2	2,22	30	33,33		
Ages (years)						
9-12,5	2	2,2	31	34,4		
13-16,5	3	3,3	28	31,1	0,279**	0,008
17-18	3	3,3	16	17,8		
Father's profession						
Cadres	3	3,33	20	22,22	0,052	0,625
Liberal Professions	2	2,22	36	40,0		
worker	3	3,33	19	21,11		
Mother's profession						
Employees	4	4,44	25	27,77	0,054	0,614
Housewives	4	4,44	50	55,55		
Hereditary factor						
Yes	4	4	59	65,6	0,191	0,071
No	4	4	16	17,8		

N: number, **%**: percentage, **r**: Correlation coefficient, ***p***: error probability, ***p* value < 0, 01

Table 2. Correlation between corpulence, taking meals and number of meals

Variables	Corpulence				r	*p*
	Overweight		Obesity			
	N	%	N	%		
Taking meals						
breakfast	4	4,4	51	56,7	0,027	0,801
Snack	3	3,3	36	40,0	0,048	0,651
Taste	4	4,4	58	64.4	0,250* 0,013	0,017
Dinner	6	6,7	67	74,4		0,901
Number of meals						
Two	1	1,1	6	6,7	0,125	0,242
Three	3	3,3	12	13,3		
More than four	4	4,4	57	63,33		

N: number, **%**: percentage, **r**: Correlation coefficient, *p*: error probability, **p* value < 0, 05

Table 3. Correlation between corpulence and food consumption

Variables	Corpulence		r	*p*
	Overweight	Obesity		
	N	N		
Red meat				
Never	1	8	0,317**	0,002
Less frequent	4	59		
More frequent	3	8		
Chicken				
Never	0	6	0,302**	0,004
Less frequent	3	54		
More frequent	5	15		

Fish				
Never	1	23	0,224*	0,034
Less frequent	7	46		
More frequent	0	6		
sweets				
Never	3	20	0,209*	0,048
Less frequent	3	33		
More frequent	2	22		
Pizza				
Never	2	8	0,220*	0,037
Less frequent	5	49		
More frequent	1	18		
Fried foods				
Yes	7	74	0,241	0,022
No	1	1		

N: number, **%**: percentage, **r**: Correlation coefficient, *p*: error probability, **p* value < 0, 05,** *p* value < 0, 01

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