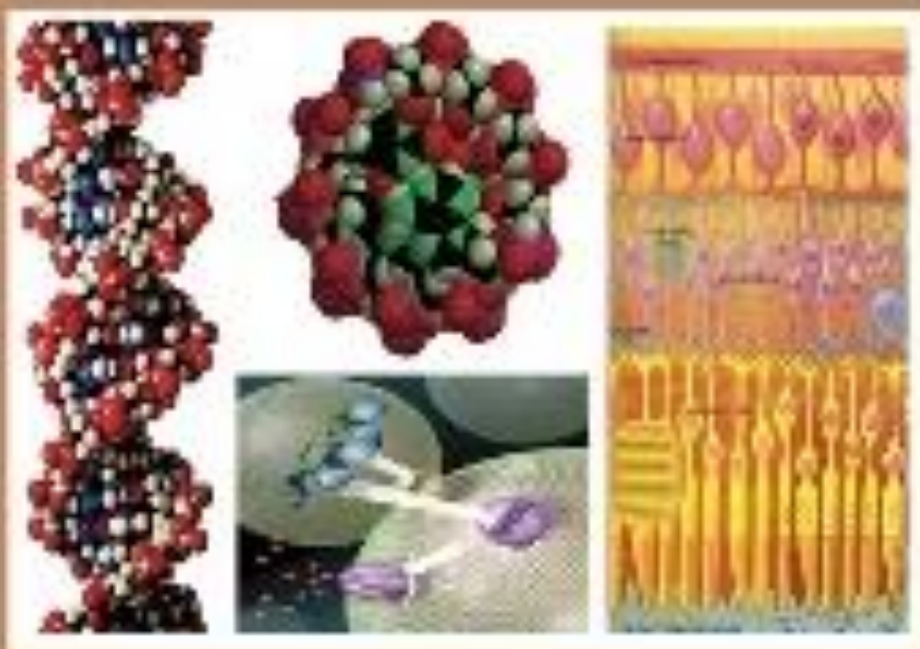




EGYPTIAN ACADEMIC JOURNAL OF
BIOLOGICAL SCIENCES

PHYSIOLOGY & MOLECULAR BIOLOGY

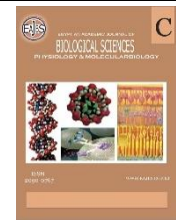
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ISSN
2090-0767

WWW.EAJBS.EGYPTNET

Vol. 16 No. 1 (2024)



Nutritional Status of School Adolescents in the Sidi-Bel-Abbes City, Algerian western region

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ARTICLE INFO

Article History

Received:2/12/2023

Accepted:19/1/2024

Available:23/1/2024

Keywords:

Adolescent,
malnutrition,
obesity. Overweight,
diet, BMI, IOTF.

ABSTRACT

The present study consists of evaluating, through anthropometric parameters, the different forms of malnutrition among school adolescents in the Sidi-Bel-Abbes city (north-west Algerian region). Our survey was carried out among 223 adolescents aged 16 to 18. The parameters of the students are age, weight and height. The calculation of the body mass index (BMI) was carried out for the entire population studied. At the same time, a questionnaire on food consumption was used. From these data, we determined the nutritional status of young adolescents. The analysis of the results revealed an average weight (for both sexes) of 61.60 ± 12.87 kg (between 36 kg and 112 kg) and an average height of 1.70 ± 0.086 m (between 1.52 m and 1.96 m). The BMI values (according to the International Obesity Task Force "IOTF" references) indicate that most girls and boys have a normal build. About underweight, the obtained results indicate a high rate among boys (4.0%) compared to girls (2.2%). However, the obesity prevalence was almost twice as high among girls (3.14%) as among boys (1.79%). Being overweight during adolescence is a predictor of chronic disease risk at a young age. The nutritional status evaluation of adolescents is a necessary step to maintain and improve their nutritional status and prevent metabolic diseases.

INTRODUCTION

Currently, it is established that diet is a determining factor, which significantly influences the populations' health state and individuals in modern societies, affecting all aspects of their lifestyle, in particular their nutritional behavior patterns and consequently their state health. Inappropriate diets are the cause of many non-communicable diseases, such as diabetes mellitus, obesity and cardiovascular diseases. Responsible for chronic morbidity and premature mortality, a healthy diet is associated with well-being and increased life expectancy and improved gene expression (Katz and Meller, 2014). Nutritional diseases have become one of the world's major public health challenges. In 2009, the WHO (World Health Organization) estimated that 25.2% of total mortality worldwide was attributable to a combination of nutritional risk factors. Obesity worldwide has almost doubled since 1980, leading to an increase in cardiovascular diseases and type 2 diabetes. One of the possible causes of this negative evolution is the increased consumption of energy-rich foods, particularly fats. The type and amount quantity of dietary fat have a significant influence on the metabolic pathways involved in obesity development, metabolic syndrome, type 2 diabetes, cancer and cardiovascular diseases (Voisin *et al.*, 2014).

The obesity problem is not limited to high-income countries, but now also exists in low- and middle-income countries where 115 million people are affected by obesity. Thus, according to a recent FAO (Food and Agriculture Organisation) report in 2013, certain countries such as Mexico and Egypt have overtaken the United States in the proportion of obese people with, respectively, 32.8% and 34.6% of the population affected, compared to 31.8% for the United States. The confirmed trend is that by 2030, 47% of the world's population will be overweight (Finkelstein *et al.*, 2015). The situation is just as alarming among children and adolescents. Indeed, significant disparities between some countries are observed throughout the world (Finkelstein *et al.*, 2015).

In the United States, obesity prevalence has doubled among children and quadrupled among adolescents over the last 30 years. In Algeria, overweight has reached 13.7% and obesity 3.2% among adolescents aged 13 to 15 (GSHS, 2013). Among adolescents, excess weight presence is also associated with a greater probability of becoming overweight or obese in adulthood by 20% to 50% before puberty and by 50% to 70% after puberty (Suchindran *et al.*, 2010; HAS, 2011), as well as the early occurrence of various health problems (Fennoy, 2010).

Furthermore, the risk of becoming an obese adolescent is estimated at 78% for boys and 63% for girls. The Body mass index (BMI) in adolescence is a predictive factor of type 2 diabetes and coronary heart (cardiovascular) disease in adulthood (Tirosh *et al.*, 2011). The diet during adolescence is more difficult to modify later on and therefore becomes a risk for obesity and the development of chronic diseases in adulthood (Linos *et al.*, 2010). Thus, early prevention of obesity in adolescents is therefore essential for the prevention of chronic diseases in adulthood (Inge *et al.*, 2013). Consequently, the knowledge of adolescents' food consumption patterns is one of the most important research priorities for the conception of appropriate prevention

programs and the application of effective approaches to improve health status.

However, transversal studies are carried out in some regions, however, the public should be alerted to the fact that overweight-obesity among children and adolescents is on the increase and could become a real public health problem. Ultimately, there is an urgent need to act at a social, educational and industrial level to raise awareness of healthier diets and to promote a more healthy diet, and to motivate to reduce excessive use of fats and sugars, salt and other ingredients (colorants, preservatives, etc.) that are damaging to health in commercialized food products (Bouchenak, 2014). The main objective of our study focuses on the estimation of the nutritional status of adolescents aged 16 to 18 attending public secondary schools in Sidi-Bel-Abbes city and the relationship with their lifestyles.. The specific objectives are: The quantitative and qualitative analysis of anthropometric data, and the distribution of adolescents according to their morphology, based on BMI and the determination of the adolescent's nutritional and physical activity habits.

MATERIALS AND METHODS

We performed a transversal investigation in the Western Algerian region (Sidi-Bel-Abbes city) during the months of January, February and March 2019 with a sample of 223 high school students (120 boys and 103 girls). We followed the high school students at the screening and school supervision unit (SSSU) of Houcini Houcine high school. The parameters considered included anthropometric measurements (height, weight, body mass index "BMI"), as well as a questionnaire on dietary patterns, physical activity, chronic diseases, health status, visual acuity, socio-economic level, order between brothers and sisters, habits and qualities of life.

The objective of this investigation was to determine the prevalence of overweight and obesity among school-age adolescents and then to study the relationship

between obesity and overweight on dietary practices as well as physical activities.

The most commonly used indicator is BMI, corresponding to the formula weight/height formula². The thresholds used in this study are those defined by the “International Obesity Task Force (IOTF)” in 2000, and they correspond to the BMI percentile curves based on data from different countries. The percentile curve crossing a BMI equal to 25 at 18 years old makes it possible to define the overweight threshold including obesity (IOTF 25) and the percentile curve passing through a BMI equal to 30 at 18 years old makes it possible to define obesity threshold (IOTF 30).

The IOTF thus defines a threshold value for overweight and obesity for each sex and at each age. Data from “French References” were also used to define underweight, the corresponding thresholds being obtained by using the 97th percentile (p97) to define overweight (including obesity).

We used the 24-hour dietary reminder method, which consists evaluating of all foods and drinks consumed by the participant during the 24-hour period preceding the investigation date. The nature, quantity, cooking method and brand of food

consumed are noted on a pre-established questionnaire.

The anthropometric data were initially entered and analyzed using Calimco-2 (the software for evaluating and monitoring children's corpulence), which automatically calculates the BMI as well as tracing weight, height and BMI curves according to the children's age and sex.. It also calculates the level of overweight and/or obesity according to the IOTF thresholds and French references; the results are then exported to an Excel file. The NutriServy 2007 program was used to process the data collected during the 24-hour reminder. This program is based on the BLS food table (1100 foods with over 160 nutrients). Data processing was carried out with SPSS (Statistical Package for the Social Sciences) software version 24.0.

RESULTS

1-The Distribution of Participants of Both Sexes:

The comparison between boys (63.11 ± 13.18 kg) and girls (59.84 ± 12.33 kg) showed no significant difference ($p = 0.059$) in terms of body weight. While the average height between boys and girls indicates a very significant difference ($p < 0.001$). However, the BMI values showed a very significant difference ($p = 0.001$), but most girls and boys have normal corpulence (Table 1).

Table 1. The distribution of participants of both sexes according to body weight, height and BMI

	Gender	Number	Age (years)	Weight (kg)	Size (m)	BMI (kg/m ²)
Mean± Standard deviation	Female	103	16,96±0,55	59,84 ± 12,33	1,63 ± 0,05	22,25 ± 4,35
	Male	120	16,74±0,62	63,11 ± 13,18	1,75 ± 0,06	20,45 ± 3,98
p* test t of Student	Female	103	0,006	0,059	<0,001	0,001
	Male	120				

(*) A value of $p \leq 0,05$ was considered significant.

2-Comparison of Corpulence Classes Between The Two Sexes:

As illustrated in Table 2, and based on the French references established by Rolland-Cachera, the overweight prevalence among girls was higher than the prevalence observed among boys, at 4.9% and 3.1% respectively. Similarly, the obesity prevalence was almost

twice as high among girls (3.1%) as among boys: 3.1% versus 1.8%.

As for underweight, the figures indicate a high rate among boys (4.0%) compared to girls (2.2%). Normal corpulence rates represent 44.8% among males compared to 35.9% among females.

Over the entire study and according

to the parametric chi-square test, sex does not show a significant effect on the four corpulence classes (underweight, overweight, obesity) ($p=0.284$).

Table 2. Comparison of corpulence classes between the two sexes according to the French references.

			Gender			Total
			Female	Male	p^* test Khi ²	
French Definition	Normal body	Effective	80	100	0,284	180
		% on French definition	44,4%	55,6%		100,0%
		% Total	35,9%	44,8%		80,7%
	Underweight	Effective	5	9		14
		% on French definition	35,7%	64,3%		100,0%
		% Total	2,2%	4,0%		6,3%
	Obesity	Effective	7	4		11
		% on French definition	63,6%	36,4%		100,0%
		% Total	3,1%	1,8%		4,9%
	Overweight (not obese)	Effective	11	7		18
		% on French definition	61,1%	38,9%		100,0%
		% Total	4,9%	3,1%		8,1%
Total		Effective	103	120		223
		% on French definition	46,2%	53,8%		100,0%
		% Total	46,2%	53,8%		100,0%

(*) A value of $p \leq 0,05$ was considered significant.

3-Comparison of Corpulence Classes Between The Two Sexes:

Our results indicate that, according to the IOTF references; the overweight prevalence alone (obesity not included) in girls was higher than the prevalence observed in boys: 7.17% compared to 4.48%.

Similarly, the obesity prevalence was almost twice as high among girls (3.14%) as among boys (1.79%). 47.53% of boys and 35.87% of girls had a normal corpulence, neither obesity nor overweight. The gender effect is not significant (Table 3)

Table 3. Comparison of corpulence classes between the two sexes according to French references IOTF International Obesity Taskforce.

			Sexe			Total
			Feminine	masculine	<i>p</i> * test Khi²	
IOTF Definition	Obesity	Effective	7,17	4,48	0,102	11
		% of IOTF Def	63,6%	36,4%		100,0%
		% total	3,14%	1,79%		4,9%
	No overweight or obesity	Effective	80	106		186
		% of IOTF Def	43,0%	57,0%		100,0%
		% total	35,87%	47,53%		83,4%
	Overweight (not obese)	Effective	16	10		25
		% of IOTF Def	61,5%	38,5%		100,0%
		% total	7,2%	4,5%		11,7%
Total		Effective	103	120	223	
		% of IOTF Def	46,2%	53,8%	100,0%	
		% total	46,2%	53,8%	100,0%	

(*) A value of $p \leq 0,05$ was considered significant

4-Comparison of Energy Intakes for The Nutrients Between The Two Sexes:

The adolescent's energy and nutritional requirements must be sufficient to allow them to adapt to the physiological changes and actively participate in their growth. The results of the present study reveal an energy intake, that remains lower than the recommended intakes for both sexes. However, the carbohydrate proportions, protein and lipid intake were respected.

No significant differences were observed between the two sexes for macronutrients, water and polyunsaturated fatty acids (Table 4). A very significant difference ($p=0.001$) was noted for dietary fiber intake, and intakes still remained lower than the recommended values of (≈ 25 gr/day). As for dietary cholesterol intakes in both sexes; they exceed the norm which is 300 mg/day.

Table 4. Comparison of energy intakes for the nutrients between the two sexes.

	Mean± Standard deviation	According to Gender	Mean± Standard deviation	p^* test t of Student
Energy (kcal)	1518,37±80,92	Female	1603,88±107,96	0,144
		Male	1444,98±459,15	
Water (g)	2566,09±145,31	Female	2507,00±191,23	0,575
		Male	2616,81±89,40	
Protein (g)	59,77±30,43	Female	59,97±35,17	0,928
		Male	59,60±25,82	
Lipids (g)	65,32±26,75	Female	68,46±6,64	0,105
		Male	62,63±6,66	
Carbohydrates (g)	166,60±12,35	Female	158,18±60,01	0,347
		Male	173,82±15,89	
Dietary fiber (g)	12,96±5,51	Female	14,23±5,80	0,001
		Male	11,87±5,02	
Polyunsaturated fatty acids (g)	9,75±6,31	Female	9,73±5,88	0,965
		Male	9,77±6,67	
Cholesterol (mg)	385,94±31,45	Female	367,30±29,43	0,413
		Male	401,94±33,12	

(*) A value of $p \leq 0,05$ was considered significant

5-Comparison of Vitamin and Mineral Salt Intake Between The Two Sexes:

The results for vitamin and mineral salt intake do not show any significant difference between the two sexes.

A comparison of the results of food diaries between the two sexes indicates that the daily rations of adolescent girls are

characterized by high consumption of vitamin A, carotene, vitamin B1 and vitamin C, as well as mineral salts in particular, potassium, calcium, phosphorus, magnesium and iron. In contrast, the boys' dietary intake is characterized by a high consumption of vitamin E, sodium and zinc (Table 5).

Table 5. Comparison of vitamin and mineral salt intake between the two sexes

	Mean± Standard deviation	According to Gender	Mean± Standard deviation	p* test t of Student
Vitamin A (µg)	886,47±86,34	Female	888,58±49,35	0,973
		Male	884,66±10,87	
Carotene (mg)	2,12±0,20	Female	2,28±0,22	0,273
		Male	1,97±0,19	
Vitamin E (eq.) (mg)	9,37±0,80	Female	8,85±0,74	0,364
		Male	9,83±0,84	
Vitamin B1 (mg)	0,67±0,06	Female	0,73±0,08	0,212
		Male	0,62±0,28	
Vitamin B2 (mg)	0,90±0,41	Female	0,90±0,44	0,923
		Male	0,89±0,39	
Vitamin C (mg)	93,18±7,33	Female	97,20±7,12	0,449
		Male	89,72±7,52	
Sodium (mg)	2508,25±252,89	Female	2325,75±132,64	0,319
		Male	2664,90±322,02	
Potassium (mg)	2040,65±96,56	Female	2107,06±95,32	0,342
		Male	1983,65±97,64	
Calcium (mg)	491,12±25,11	Female	493,37±28,19	0,902
		Male	489,19±22,24	
Magnesium (mg)	214,40±16,06	Female	224,62±20,42	0,380
		Male	205,63±11,05	
Phosphorus (mg)	835,10±35,24	Female	838,96±39,75	0,880
		Male	831,77±31,01	
Iron (mg)	8,68±3,83	Female	8,73±0,40	0,846
		Male	8,63±3,68	
Zinc (mg)	8,33±3,95	Female	8,04±4,19	0,316
		Male	8,57±3,72	

(*) A value of $p \leq 0,05$ was considered significant

6-Comparison of Energy Intakes of the Main Nutrients Between the Different Body Types:

The comparison of total caloric intakes and the main macronutrient intakes according to the French corpulence weight references indicates that normal weight subjects are characterized by a low intake of energy nutrients (proteins, lipids and carbohydrates) and also of cholesterol and consequently a total energy intake (1500 kcal) lower than normal values.

Subjects with excess weight

(overweight and obese) have a high caloric intake compared to other bodyweight classes. Similarly, their food rations provide more carbohydrates, proteins, lipids and cholesterol.

Although the intakes remain below the recommended values in all body weight groups. No significant difference was observed between the four bodyweight classes in terms of their total energy intake, macronutrients, fiber, PUFA (Polyunsaturated fatty acid), or cholesterol (Table 6).

Table 6. Comparison of energy intakes of the main nutrients between the different body types according to the French definitions.

	French Definition				<i>p* test</i> ANOVA <i>Kruskal-</i> <i>Wallis</i>
	Normal body Mean	Underweig ht Mean	Obesity Mean	Overweight (not obese) Mean	
Energy (kcal)	1500,05	1517,57	1613,60	1644,05	0,242
Water (g)	2524,71	2698,13	2514,20	2908,96	0,334
Protein (g)	58,57	66,37	68,87	61,15	0,842
Lipids (g)	64,71	66,61	63,51	71,55	0,956
Carbohydrates (g)	157,62	158,85	294,93	184,08	0,087
Dietary fiber (g)	12,83	13,28	15,14	12,70	0,857
Polyunsaturated fatty acids (g)	9,70	10,86	10,30	9,12	0,946
Cholesterol (mg)	372,18	428,79	407,19	477,32	0,811

(*) A value of $p \leq 0,05$ was considered significant (Kruskal-Wallis ANOVA is a non-parametric test)

7-Comparison Of Energy Intakes Of Main Nutrients Between The Different Body Weight Classes:

The comparison of intakes based on the 24-hour reminder dietary calendar based on IOTF references indicates that the subjects in the class (neither overweight nor obese) are characterized by low consumption of energy nutrients (protein: 58.98 gr; lipids: 64.90 gr and carbohydrates: 157.81 gr), fiber, PUFA (Polyunsaturated fatty acids) and cholesterol.

The other two body weight categories (overweight and obesity) have high intakes of macronutrients, fiber and cholesterol. However, all the figures for the three morphologies remain below the recommended nutritional values for this age group which constitutes, par excellence, a period of life with rapid and remarkable physiological growth and psychological development, which requires careful management and monitoring for both sexes (Table 7).

Table 7. Comparison of energy intakes of main nutrients between the different body weight classes of the IOTF definitions.

	IOTF Def			<i>p* test</i> ANOVA <i>Kruskal-</i> <i>Wallis</i>
	No overweight or obesity	Overweight (not obese)	Obesity	
	Mean	Mean	Mean	
Energy (kcal)	1501,15	1601,35	1613,60	0,140
Water (g)	2556,87	2654,01	2514,20	0,783
Protein (g)	58,98	61,61	68,87	0,661
Lipids (g)	64,90	69,14	63,51	0,920
Carbohydrates (g)	157,81	175,18	294,93	0,069
Dietary fiber (g)	12,73	13,69	15,14	0,339
Polyunsaturated fatty acids (g)	9,89	8,58	10,30	0,515
Cholesterol (mg)	377,53	437,18	407,19	0,919

(*) A value of $p \leq 0,05$ was considered significant (Kruskal-Wallis ANOVA is a non-parametric test)

DISCUSSION

Adolescence is an important period of growth and maturity. It begins at puberty

and continues until the morphological and physiological modifications approach those of adulthood. These rapid changes can be

influenced by environmental, nutritional and health factors. Our retrospective transversal study included 223 students from Sidi-Bel-Abbès town aged 16 to 18, including 120 boys and 103 girls with a M/F sex ratio of 1.16. The average age of the participants was 16.84 ± 0.60 years (ages ranging from 15.26 years and 17.95 years) and the average weight was 61.60 ± 12.87 kg ranging from 36 kg and 112 kg. The average height of all participants was 1.70 ± 0.08 m. The results of our study reveal the simultaneous presence of overweight, obesity and underweight in both girls and boys without significant differences between the two sexes.

In our study, based on body mass index (BMI) and according to IOTF references, the prevalence of overweight was 7.2% in girls and 4.5% in boys; in contrast, the obesity prevalence was 3.1% among girls and 1.8% among boys. According to French references, underweight was 2.2% among girls and 4.0% among boys. This prevalence remains relatively low compared to other similar studies conducted around the world, with a few exceptions. The study by Allioua (2016) reported a frequency of overweight and obesity, in both sexes combined, of 10.58% and 2.92% respectively, which is different from our results. According to a study published in the Algerian Nutrition Society "SAN", journal; 13% of adolescents were overweight, almost 5% were obese and 16% were underweight. The study involved a group of 400 adolescents (aged between 10 and 17 years) in the Oran region. Which is inconsistent with our results. In a study cited by Taleb (2011) on children aged 5 to 18 years in the western (El-Bayad) and central region of the country (Teniat-El-Had) Algeria in 2005, the overweight prevalence including obesity was 12%. During the same period, in the East town of Jijel, the overweight prevalence, including obesity, was estimated at 14.5% and that of obesity at 1.2% (Oulamara, 2006), while that in the Tébessa city the overweight prevalence including obesity was 23.10%. This represents a fluctuation in the prevalence of corpulence throughout the country's regions. According

to Mekhancha-Dahel *et al.* (2005) and Oulamara *et al.* (2009), the obesity prevalence in Algeria increased to reach 9.5% in 2006. These rates are lower than international rates for the same period.

In Algeria, according to a study carried out in Constantine among children aged 5 to 18 years, the overweight prevalence including obesity increased from 8.27% in 1996/98 to 10.12% in 2004. However, the prevalence of obesity increased from 1.26% to 1.88. % (Oulamara, 2009). In the Maghreb region, the prevalence and obesity in Tunisia is 8.7%. The obesity rate increased from 3.3% to 5.8% between 1999 and 2007 (Oulamara *et al.*, 2009), these values are relatively comparable to the results of our study. In Morocco (Rabat), a study conducted by (Cherkaoui, 2014) revealed an overall percentage of overweight of 5.1%. In contrast, in another study carried out in Marrakech by Baali and Aboussad (2012), the overweight percentage was 17.3% and the underweight value was 5.5%. These data are difficult to compare due to the heterogeneity of the references used and the sociodemographic conditions of each population. In Algeria, public schools are generally attended by all social categories. Likewise, obesity perceptions and its causalities can vary widely from one society to another depending on cultural and social norms. In African countries, such as Togo, the obesity prevalence is relatively very low compared to that of our country, it is respectively 2.86% and 1.72% (Djadou *et al.*, 2010) due to malnutrition (famine, political and social problemsetc.).

Regarding energy and dietary fiber intake among our students, the reported values are lower than the recommended values. On the other hand, the dietary cholesterol intakes in both sexes exceed the recommended figures of 300 mg/day. However, despite the fact that intakes remain below the recommended values in all body weight groups. No significant differences were observed between the four bodyweight classes (according to IOTF references) in terms of total energy intake, macronutrients

and PUFA. This age group represents a period of life characterised by rapid and remarkable physiological growth and psychological development, which requires special care and attention in all aspects (nutritional, physical, intellectual, etc.).

In Africa, a caloric intake of 2,100 calories per day per person was considered to estimate the food poverty line. However, in 2006, approximately 52% of the consumed population had less than the minimum required number of calories per day (National Institute Statistics of UNISEF). Our study revealed a very low energy intake (1444.98 ± 459.15 kcal for girls and 1518.37 ± 80.92 kcal for boys). These results are largely related to the type of our dietary investigation (24-hour reminder), because adolescents, through negligence or inadvertence, do not precisely report the quantities of consumed food and cooking methods. However, with a larger sample, we can have a more approximate estimation of these types of dietary evaluations.

CONCLUSION

The overweight and obesity effects on health are numerous and varied, ranging from the risk of developing diseases that affect a person's quality of life to the risk of death. Their prevalence is increasing worldwide at an alarming rate. This problem appears to be progressing rapidly among both adolescents and adults. In the context of this problem, our study carried out in the region of Sidi-Bel-Abbes, the region in western Algeria based on the body mass index (BMI) and according to IOTF and French references, indicates a non-significant difference between overweight, obesity and underweight prevalence, between both sexes (girls and boys). This prevalence of different body types (corpulence) remains relatively low compared to other similar studies carried out around the world. However, in terms of nutritional status, the daily intake of energy and dietary fiber is slightly lower than the recommended intake levels. The lack of dietary fiber in the diet is damaging the intestinal transit quality, leading to inadequate absorption of the various essential

food constituents; In the longer term, insufficient consumption exposes people to a higher risk of diseases, such as obesity, type 2 diabetes and cardiovascular disease.

Consequently, an early diagnosis of the nutritional status of schoolchildren and adolescents is necessary in order to formulate, guide and adopt an adequate nutritional strategy. The objective would be to necessarily establish obligatory nutritional supervision at the level of educational establishments, in order to monitor the nutritional profile of schoolchildren.

Declarations:

Ethical Approval: Ethical Approval is not applicable.

Competing interests: The authors declare no conflict of interest.

Authors Contributions: I hereby verify that all authors mentioned on the title page have made substantial contributions to the conception and design of the study, have thoroughly reviewed the manuscript, confirm the accuracy and authenticity of the data and its interpretation, and consent to its submission.

Funding: No funding was received.

Availability of Data and Materials: All datasets analysed and described during the present study are available from the corresponding author upon reasonable request.

Consent for Publication: Not applicable.

Acknowledgements: Not applicable.

REFERENCES

- Allioua M (2016). Assessment of the dietary risk linked to the consumption of lipids among school-going adolescents in the Tlemcen region. Doctoral Thesis in Agronomy, Option: Nutrition, Abou University Bekr Belkaid de Tlemcen, p.68.
- Baali M, et Aboussad A (2012). Nutritional status and eating behavior of adolescents in the city of Marrakech, *Bulletins et Mémoires de la Société d'Anthropologie de Paris*, 2012, 24 (3-4), p. 179-189 ISSN 0037-8984

- Bouchenak Malika (2014). Obesity threatens young Algerians, Algerian Nutrition Society <http://www.revuedesante.com/Article/le-surpoids-touche-13-desadolescents-en-algerie-2086.html>.
- Cherkaoui I, (2014), Assessment of nutritional status among children attending public schools in the city of Rabat: role of factors. *Molecules*, 19(9), 14879-14901; <https://doi.org/10.3390/molecules190914879>
- Djadou. K.E. Sadzo-Hetsu a, K. Koffi b, K.S. Tsolenyanu c, E. Douti c, K. Afia d, K.D. (2010). Prevalence of obesity in urban scolar area (Togo), *Journal de Pédiatrie et de Puériculture* ; 335-339.
- Fennoy (2010). Fennoy I. Metabolic and respiratory comorbidities of childhood obesity. *Pediatric*, *National Center for Biotechnology Information*, 39(3):140-6. doi: 10.3928/00904481-20100223-08
- Finkelstein, E. A., Khavjou, O. A., Thompson, H., Trogon, J. G., Pan, (2015). Measuring direct and indirect effects: the example of obesity, *National Center for Biotechnology Information*; 14: 122. doi: 10.1186/s12937-015-0110-4
- GSHS (2013) Global School-Based Student Health Survey. Algeria-CDC Global School-Based Student Health Survey. Centers for Disease Control and Prevention, Atlanta.<http://www.cdc.gov/gshs/countries/africa/algeria.htm>
- Neslihan Koyuncuoğlu Güngör, (2014). Overweight and obesity in children and adolescents, *Journal of Clinical Research in Pediatric Endocrinology*; 6(3):129-143 ; DOI: 10.4274/jcrpe.1471
- Inge, Thomas H., KING (2013). The Effect of Obesity in Adolescence on Adult Health Status. *Pediatrics*, vol. 132, no 6, p. 1098-1104.
- Katz, D. L., & Meller, S. (2014). Can we say what diet is best for health? *Annual review of public health*, 35, 83-103.
- Linós, E., Willett, W.C., Cho, E. and Frazier, L. (2010) Adolescent Diet in Relation to Breast Cancer Risk among Premenopausal Women. *Cancer Epidemiology, Biomarkers & Prevention*, 19, 689-696. <http://dx.doi.org/10.1158/1055-9965.EPI-09-0802>
- Oulamara H, Agli A, Benatallah (2009). Prevalence and risk factors of overweight among schoolchildren in a town in eastern Algeria (Constantine), *Antropo*, 35, 91-102
- Pouraram, H., Abtahi, M., Djazayeri, A., Eshraghian, M.R. and Khodadadi, E. (2013) Dietary Pattern of Adolescent Girls in Relation to Socio-Economic Factors: A Comparison between North and South Tehran. *Journal of Paramedical Sciences*, 4, Vol.6 No.10.
- Suchindran, C., North, K. E., Popkin, B. M., & Gordon-Larsen, P. (2010). Association of adolescent obesity with risk of severe obesity in adulthood. *Jama*, 304(18), 2042-2047.
- Taleb. S, Oulamara. H, Agli A-N. Prevalence of overweight and obesity among schoolchildren in Tébessa (Eastern Algeria) between 1995 and 2007 ; *Eastern Mediterranean Health Journal*. Vol. 19 No. 7 ; 650-656 .
- Tirosh A, Shai I, Afek A (2011). Adolescent BMI trajectory and risk of diabetes versus coronary disease. *New England Journal of Medicine* ; 364 : 1315– 1325.
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