

# Factors Related to Unhealthy Eating Habits and to Physical Inactivity among Moroccan University Students

M. El Fessikh<sup>1</sup>, H. Rkain<sup>2,3</sup>, T. Dakka<sup>2</sup>, Y. Bakri<sup>1</sup>, N. Dakka<sup>1,\*</sup>

<sup>1</sup> Laboratory of Human Pathologies Biology, Faculty of Science,  
University Mohammed V (Rabat, Morocco).

<sup>2</sup> Laboratory of Physiology, Faculty of Medicine and Pharmacy,  
University Mohammed V (Rabat, Morocco).

<sup>3</sup> Laboratory of Information and Research on Bone Diseases (LIRPOS-URAC 30),  
University Mohammed V (Rabat, Morocco).

\*Corresponding author. E-mail: nadiadakka [AT] gmail.com

---

**ABSTRACT**— *Several studies in the Arab world have reported that the dietary habits of the people have become more westernized. We aimed to identify prevalence of unhealthy eating habits and to physical inactivity among university students of Rabat (Morocco) and to search possible factors associated with eating habits and to physical inactivity. A study of 223 healthy Moroccan students aged 20-25 years was conducted. Height, weight and waist circumference were measured, using standardized equipment and procedures. Skinfold thickness was measured using a Harpenden skinfold caliper. Eating habits and physical activity were examined using a questionnaire. Sixteen point six percent of students were overweight or obese, 24.7% had an abdominal obesity and 34.1% had excess of fat. Students feeding included a high consumption of animal products and not enough fruits and vegetables. This reflects the remoteness of the Mediterranean diet in favor of the Western diet. One in three student skipped breakfast and more than 7/10 students nibbled between meals. These imbalances appeared more significant amongst women. A sedentary lifestyle, with no practice of regular physical activity, concerned 2/3 of the surveyed students and was associated with female sex and higher fat thickness. Precautionary measures must be urgently set in place to control the growing overweight and obesity frequencies. A protocol to make students aware of the harm of physical inactivity and an imbalanced diet, and of the necessity to follow a well-balanced diet and to increase physical activity for better health surveillance.*

**Keywords**— Eating behavior, Exercise, Overweight, Obesity

---

## 1. INTRODUCTION

Bad food habits coupled with physical inactivity are among the risk factors common to many non-communicable diseases including obesity and overweight. The Mediterranean diet, usually adopted by people living around the Mediterranean Sea, is characterized by an abundance of plant foods (vegetables, fruits, whole grains, nuts, dried pulses...), a small quantity of red meat (few times a month), some chicken and eggs and lots of fish (several times a week), fresh cheese and yogurt almost every day, olive oil as the main source of fat, a limited consumption of sugary foods and moderate amounts of wine [1]. It is considered a model of a healthy diet, because of its contribution to a better health and to a better quality of life. Indeed, several studies have shown that the Mediterranean diet can significantly decrease the risk of global mortality from cardiovascular diseases or cancers and incidence of Parkinson's disease and Alzheimer [2].

Morocco is experiencing a dietary transition that affects both urban and rural areas. Urbanization, industrialization, economic development and enlarged and diversified offer of foods are the cause of changes in eating habits. The nutrition transition is related to the emergence of Western diet, which will gradually replace the traditional Mediterranean diet. This transition is accompanied by the emergence of metabolic diseases and a rising prevalence of overweight and obesity [3]. Moroccan diet, of Mediterranean type, is based largely on cereals, fruits and vegetables. Food is gradually diversified, especially in urban households and in the wealthier classes. It includes more foods that are rich in meat and animal fat. Ready to eat foods and food services are becoming more common, promoting the consumption of foods rich in sugar and fat [4]. The nutrition transition is related to the emergence of Western-style diet, which is gradually replacing the traditional Mediterranean-type diet [2], [4].

The practice of regular physical activity reduces the risk of many chronic conditions, such as coronary heart disease and cerebrovascular accident, metabolic syndrome, type II diabetes, hypertension, colon cancer, breast cancer and depression [5]. Moreover, physical exercise is an essential determinant of energy expenditure, and thus fundamental to energy balance and weight control [6]. For adults aged 18-64 years, it is necessary to practice at least 150 minutes of moderate-intensity physical activity during the week, or to do at least 75 minutes of vigorous-intensity physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity [7]. The nutrition transition, coupled with reduced physical activity, is accompanied by the emergence of metabolic diseases and an increase in the prevalence of overweight and obesity [2], [4]. Several studies in the Arab world have reported that the dietary habits of people have become more westernized [8], [9].

In this work, we aimed to identify the prevalence of unhealthy eating habits and physical inactivity among students of the Mohammed V University of Rabat (Morocco) and to search for possible factors (as overweight and obesity) associated with eating habits and physical inactivity.

## 2. METHODS

This study included a questionnaire about general characteristics (age and gender), anthropometric parameters, practice of physical activity and dietary habits.

### 2.1 Study Sample

A group of 223 unrelated and healthy Moroccan individuals, 76 men and 147 women, aged 20 to 25 years old, participated voluntarily in this investigation. All individuals were students pursuing their studies at two Faculties in Rabat (Faculty of Science and Faculty of Medicine and Pharmacy). This study was approved without the advice of ethics committee.

### 2.2 Measure of parameters

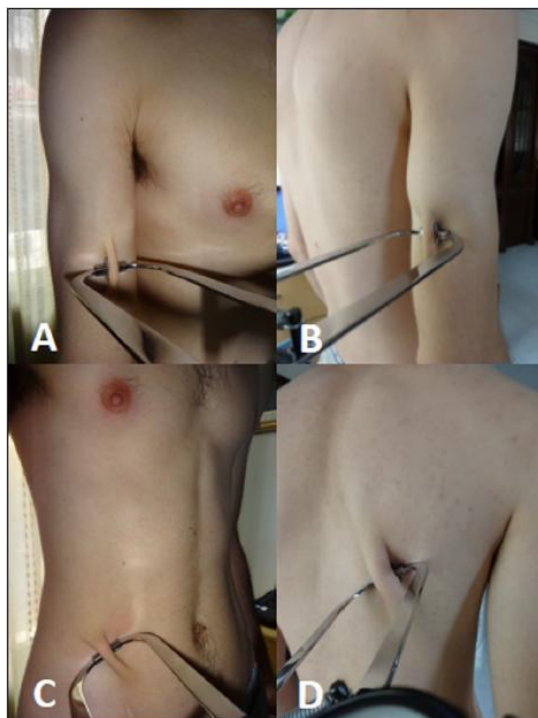
Anthropometric parameters of the study population included body weight, height, body mass index, waist circumference and percentage of body fat measured with a Harpenden skinfold caliper. Body weight (kg) was measured using a mechanical scale. The balance was placed on a flat surface. The subjects were dressed in minimal clothing and without shoes. Height (cm) was measured using a measuring rod fixed to the wall. The subject, without shoes, standing straight, looking forward, knees straight and heels in contact with the wall were measured. The body mass index ( $\text{kg/m}^2$ ) was calculated by dividing weight (kg) by the square of height (m). The body mass index values were used to define the indices of obesity. These indices were defined according to World Health Organization (WHO) for those aged 18 and older [10]. Measure of the waist circumference (cm) was taken halfway between the last rib and the iliac crest with subject standing. Abdominal obesity was defined by waist circumference > 80 cm for women and waist circumference > 94 cm for men [10]. Body fat percentage was estimated by skinfold thickness measurement using Harpenden skinfold caliper (HSB-BI; Division of Quality Measurement Ltd, Victoria Road, Burgess Hill, West Sussex, UK). The four sites measured were biceps (A), triceps (B), suprailiac (C) and subscapularis (D) (figure 1). Taking measurements was made on the right side of the body, on dry skin with muscles relaxed the whole time of the measurements. We selected the average value, after repeating the measurements 2 times for each site. The results were interpreted according to Durnin and Womersley for 4 folds [11]:

Body density (BD) =  $C - [M (\text{Log}_{10} \text{ sum of all four skinfolds})]$

C and M are both variable constants according to age and sex.

The Siri equation is the formula for converting body density to body fat percentage [12]:

Fat% =  $[(4.95 / \text{body density}) - 4.5] \times 100$



**Figure 1:** Measure of the fat mass using the Harpenden skinfold caliper.

### **2.3 Dietary habits and practice of physical activity**

The questionnaire provides information on food consumption and physical activity. It was auto-filled by the surveyed individuals, informing about food habits in describing meal contents. We split the day into five periods (breakfast, lunch, snack, dinner and snacking). For each period, we determined the frequency and the choice of foods and drinks consumed during the day. Evaluation according to the recommendations of the French National Nutrition and Health Program (PNNS) included six questions on the various groups of food [13]. The answers of the students concerned the number of times food was consumed or a group of foods per day or per week. About salt consumption, students were asked if they ate salty foods and if they added salt in food of their already salted plates. For sugar consumption, subjects were asked if they consumed soft drinks and if they added sugar in their sugary drinks.

For physical activity, the questionnaire was established using recommendations of Global recommendations on physical activity for health [7] (HHS, 2008). The questionnaire included the practice of regular physical activity per week and per day in minutes.

### **2.4 Statistical analysis**

Results were subjected to statistical analysis using the statistical package for the social sciences (SPSS) software package version 20. For quantitative data, the results are presented as means with standard deviation (SD). For qualitative data, the results are expressed as a percentage. According to the nature of the studied associations, diverse statistical tests were used: Chi-squared test for the comparisons of groups with qualitative variables, Student's t-test for the comparisons of quantitative variables, and the Pearson correlation test, to study the relation that could exist between two quantitative variables. The degree of meaning retained to assert a difference was to be lower than 5%.

## **3. RESULTS**

### **3.1 Anthropometric parameters**

A total of 223 subjects aged 20-25 years, of both genders were included in this study. Mean age was  $21.8 \pm 1.8$ , the majority was of female gender (66%) and 34% were male ( $n=76$ ). The mean body mass index was  $21.8 \pm 3.3 \text{ kg/m}^2$ . Descriptive characteristics of the sample are shown in table 1. Overweight and obesity were found in 16.6% of students. A fourth of students (24.7%) had abdominal obesity. One student out of three (34.1%) had an excess of fat mass assessed by measure of the skinfold thickness. The women presented significantly higher excess of fat mass ( $p=0.001$ ) and abdominal obesity ( $p=0.000$ ) than men.

**Table 1:** General characteristics of the students.

	n=223	Women (n=147)	Men (n=76)
<b>Anthropometric parameters</b>			
Weight <sup>1**</sup>	60.8±10.5	57.7±9.3	66.9±10.1
Height <sup>1**</sup>	167±8.7	162.4±5.6	175.9±6.7
BMI <sup>1</sup>	21.8±3.3	21.9±3.5	21.6±2.8
Thinness	11.7	12.2	10.5
Normal weight	71.7	70.1	75
Overweight and obesity	16.6	17.7	14.5
WC <sup>1</sup>	78.7±8.9	78±8.5	79.9±9.4
Abdominal Obesity <sup>**</sup>	24.7	29.3	16
Percentage of FM <sup>1**</sup>	18.9±6.9	21.2±7.1	14.6±4
Excess FM <sup>1*</sup>	34.1	41.5	19.7
<b>Dietary habits</b>			
Three meals/day	33.2	29.9	39.5
Breakfast <sup>†</sup>	61	56.5	69.7
Lunch <sup>†</sup>	74	77.6	67.1
Dinner <sup>*</sup>	74.9	69.4	85.5
Snack	81.6	83	79
Nibbling <sup>*</sup>	74.9	81	63.2
Nibbling frequency <sup>1</sup>	2.2±0.9	2.1±0.9	2.3±0.9
<b>Physical activity</b>			
Regular Physical Activity <sup>**</sup>	34.1	18.4	64.5
Duration of PA ≥ 30 min/day at least 3 times/week <sup>**</sup>	16.6	6.8	35.5

Notes: BMI; body mass index, WC; waist circumference, FA; fat mass, PA; physical activity.

Tests used: <sup>1</sup>Student's t-test and <sup>2</sup>Chi square test. Results presented in percentage (%) and means±SD (standard deviations). <sup>†</sup>p<0.1, \*p<0.05, \*\*p<0.001.

### 3.2 Dietary parameters

A detailed description of the contents of different meals taken during the day by the students (breakfast, lunch, snack and dinner) was provided. Table 1 shows that only 33.2% of students took three meals per day (breakfast (61%), lunch (74%) and dinner (74.9%)). Nibbling was reported by 74.9% of the studied population. Compared to male students, female students were more likely to skip breakfast (p=0.05), dinner (p=0.008) and to nibble (p=0.004).

Concerning the contents of the meals, we note the following:

- Most students consumed starchy foods (refined grains and French fries) and olive oil;
- The majority of students consumed animal products (especially chicken and dairy products), as well as fast-food meals;
- Most students did not consume fruits, vegetables and fish in their meals.

Table 2 shows the results of evaluation according to the recommendations of the French National Nutrition and Health Program (PNNS) and sugar and salt consumption.

**Table 2:** Evaluation of the dietary habits following the PNNS (French National Nutrition and Health Program).

Eating habits	n=223
Taking drinks ≥ 1.5 l/day	48
Eating 5 fruits and vegetables/day	41
Taking 3 dairy products/day	39
Starchy foods consumption at every meal	32
Meats/eggs consumption once to twice/day	63
Fish consumption at least two times/week	52
Adding sugar	84
Adding salt	35

Notes: Results presented in percentage (%).

### 3.3 Physical activity

The majority of students (66%) did not practice physical activity. It was higher for women than for men (p=0.000). Only 16.6% of students practiced regular exercises at least 30 minutes 3 times per week (table 1).

### 3.4 Association study between anthropometric parameters, eating habits and frequency of physical activity

We found a negative correlation between the number of meals per day and the relative anthropometric parameters (body mass index and percentage of fat mass) among students. There was no association between physical activity, frequency of snacking and body mass index, percentage of fat mass and waist circumference (table 3).

**Table 3:** Analysis of the correlation between anthropometric parameters, eating habits, frequency of physical activity.

Eating habits and other parameters		BMI	WC	FM
Number of meals/day	pearson's r	0.160	-0.112	-0.200
	p-value	0.020	0.100	0.003
Frequency of snacking	pearson's r	0.022	0.050	0.045
	p-value	0.780	0.520	0.570
Frequency of PA	pearson's r	0.100	0.110	0.050
	p-value	0.400	0.350	0.690

Notes: BMI; body mass index, WC; waist circumference, FM; fat mass, PA; physical activity.  
Test used: Pearson correlation test.

Table 4 shows significant association between taking breakfast and normal weight status (p=0.05). No significant association was found between snacking and anthropometric parameters.

**Table 4:** Comparison of anthropometric parameters and eating habits.

Eating habits	Eating meals		p-value <sup>2</sup>
	Yes	No	
<b>Breakfast</b>			
WC <sup>1</sup>	78.4±8.8	79.1±9	0.60
Abdominal obesity	23.5	26.4	0.62
BMI <sup>1</sup>	21.8±3.1	21.7±3.6	0.80
Thinness	9.6	14.9	0.22
Normal weight	76.5	64.4	0.05
Overweight and obesity	14	20.7	0.19
Rate of FM <sup>1</sup>	18.3±6.7	20±7.3	0.07
Excess of FM	32.4	36.8	0.50
<b>Snacking</b>			
WC <sup>1</sup>	79.2±8.9	77.1±8.7	0.13
Abdominal obesity	25.7	21.4	0.52
BMI <sup>1</sup>	21.9±3.2	21.4±3.4	0.31
Thinness	9.6	17.9	0.09
Normal weight	72.5	69.6	0.70
Overweight and obesity	18	12.5	0.34
Rate of FM <sup>1</sup>	19.2±6.7	18.1±7.6	0.30
Excess of FM	36.5	26.8	0.18

Notes: BMI; body mass index, WC; waist circumference, FM; fat mass.

Tests used: <sup>1</sup>Student's t-test and <sup>2</sup>Chi square test. Results presented in percentage (%) and means±SD (standard deviations).

## 4. DISCUSSION

We conducted a cross-sectional study on a population of 223 university students of Rabat, aged 20 to 25 years old, by describing exhaustively way their lifestyles to identify prevalence of unhealthy eating habits and to physical inactivity and also to evaluate obesity and overweight of these students.

The prevalence of overweight and obesity in the studied population was 16.6%. In its 2016 annual report, the World Health Organization (WHO) reported that 52% of adults aged 18 and over were overweight or obese [14]. On the one hand, the percentage observed in our population, seems to us to be underestimated. This could be explained by the recruitment. First, overweight or obese students did not accept to take part in the study, refusing to have anthropometric measurements taken. On the other hand, the age of our study population was between 20 and 25 years, while that of the population studied by World Health Organization (WHO) extended from 18 years and over.

In this study, 24.7% of students had abdominal obesity. However, this android obesity, is now well recognized as a major risk factor for cardiovascular diseases, metabolic (as type 2 diabetes) disorders and certain cancers [15], [16], [17].

In this current study, evaluation of fat mass was studied using the Harpenden skinfold caliper. This method allowed evaluating excess of fat in almost one in three students (34.1%). It seems more sensitive than body mass index for detecting excess of fat mass. In fact, it is recognized that body mass index is an imperfect measure of body fatness, largely because it does not directly measure fat mass [18]. A sedentary lifestyle is considered in many countries, especially in Western countries, as a serious public health problem and awareness raising plans have been initiated in some countries. In our study we found a pronounced sedentary lifestyle among young people, with no practice of regular physical activity, it was found in almost two-thirds of the population studied. The adoption of a sedentary lifestyle, by these students could be explained by the increase in sedentary behavior over the business and domestic activities, transport use, time spent in front of a screen (computer or television). In fact, lack of physical activity and a sedentary lifestyle are two independent risk factors for multiple non-communicable diseases [19].

Our study also showed that women had a higher percentage of fat mass and abdominal obesity than men. This could be explained by the high proportion of physical inactivity and the flaws in eating habits, dominated by skipping breakfast and dinner and snacking.

Skipping meals, especially breakfast, could cause deregulation of appetite, see weight gain. A study of Song *et al.* [20] showed an inverse association between the consumption of breakfast and body mass index and regular consumption of breakfast was associated with normal weight.

Concerning eating habits, our study provided a detailed description of the contents of different meals taken during the day (breakfast, lunch, snack and dinner) by students. We note the following:

- Most students consumed olive oil and starchy foods, typical of traditional Moroccan food and Mediterranean diet. However, refined grains despite of whole grains cereals, and potatoes in the form of French fries;
- The majority of students consumed animal products (especially chicken and dairy products), as well as fast-food dishes. This typically reflects the influence of Western eating habits;
- Most students did not consume fruits, vegetables and fish. This is also far from the Mediterranean diet.

So, the Mediterranean diet is not the food mode widely followed by the students. This reflects, the change of the students from the Mediterranean traditional diet in favor of the Western diet. According to the study of El Rhazi [3], the nutritional profile of Moroccan, rather Westernized, is currently characterized by the introduction of more and more meat and dairy products. One of the peculiarities of this profile was the conservation of many elements of the traditional diet, such as the consumption of vegetables and cereals. According to the same study, the Mediterranean diet is no longer a diet common to the total Moroccan population. It is being abandoned independently of age and level of education in urban and in rural areas, among people of a high socioeconomic level.

The repercussions of these changes in food habits on the risk of the chronic diseases were perceived through the increase in the frequency of obesity and overweight. According to the Food and Agriculture Organization of the United Nations [4], this nutritional transition coupled with reduced physical activity, are at the origin of the progress of overweight and obesity in the adult population. It seems clear to us that the recommendations of the French National Nutrition and Health Program (PNNS) are not considered by the students.

Our results also show that more than one out of three students (39%) jumped breakfast, while the professionals insisted on the importance of this meal. The breakfast is part of classical dietary recommendations [21]. Taking breakfast had been related to body weight. A study by de Castro JM [22] showed that food intake in the morning (breakfast) in particular promoted satiety and allowed a reduction in the total energy of the day and therefore the prevention of overweight and obesity. Moreover, we found that the students who had breakfast often had a normal weight.

We also showed in this study that more than seven out of ten students (74.9%) nibbled between meals. Almost one out of two individuals reported nibbling at least twice a day foods such as pastries, cookies, chocolate and candies... Snacking is associated with an increase in the prevalence of overweight and/or obesity [23], [24].

In our study, we found a negative correlation between the number of meals per day and the anthropometric parameters (body mass index and percentage of fat mass) of students. As stated above, skipping meals could cause deregulation in appetite and weight gain. This is in agreement with previous studies, which reported an inverse relation between the frequency of feeding, the percentage of fat mass and body mass index [25], [26]. The addition of the sugar in supplement was frequently reported by the students (84%). One out of three students (35%) opted for salted food. This is against the recommendations of the specialists and of the World Health Organization (WHO), which recommend limiting the consumption of these two elements [27], [28]. According to the National Observatory of Human Development, the consumption of sugar and salt in Morocco is increasing, which engenders with other risk factors, an increased prevalence of certain diseases (hypertension, cardiovascular diseases, diabetes mellitus ...) [29].

This study has the advantage to give a detailed profile on a rather wide population of students, by describing in a rather exhaustive way their diet.

It allowed us to highlight the high prevalence of physical inactivity, overweight and obesity (knowing that it was

underestimated by recruitment) and the importance of the flaws in eating habits, in particular those of snacking and skipping breakfast. These imbalances appear to be more important to women.

The use of the Harpenden skinfold caliper is a strong point, because this method is more rigorous than that of the body mass index.

The sample size is rather important, and would reflect alimentation of the students pursuing university studies.

It is to highlight the study limitations, including the lack of food evaluation by a food diaries, and the absence of the use of valid scores for more precise evaluation of physical activity.

## 5. CONCLUSION

This study describes the lifestyle of Moroccan students, their eating habits and physical activity, and also provides an opportunity to evaluate the fat levels of these students.

It emerged from this study that:

- Women have more abdominal obesity and excess body fat than men and are therefore at risk of developing diseases because they do not spend enough time performing physical activity;
- The Mediterranean diet is no longer the mode food followed by Moroccan students. It implies an estrangement of a part of this population from the traditional diet in favor of Western diets;
- Eating habits of students do not seem to be appropriate for a healthy lifestyle (snacking, skipping meals, adding salt and sugar in food already salted and sweetened).

These results are useful in establishing a sensitization protocol to the danger of physical inactivity and dietary imbalance, and the necessity of following a healthy balanced diet and performing regular physical activity.

## 6. ACKNOWLEDGEMENTS

The authors would like to acknowledge the contribution of the students and other individuals involved in the recruitment of subjects to this study.

## 7. REFERENCES

- [1] Davis, C., Bryan, J., Hodgson, J. and Murphy, K. 2015. Definition of the Mediterranean Diet; A Literature Review. *Nutrients* 7(11): 9139-53.
- [2] El Rhazi, K., Nejjari, C., Zidouh, A., Berraho, M. and Barberger Gateau, P. 2010. Prevalence of obesity and associated sociodemographic and lifestyle factors in Morocco. *Public Health Nutrition* 14(1): 160-7.
- [3] El Rhazi, K. 2010. Nutritional transition, associated factors and emergence of chronic diseases in Morocco: cross-sectional study in general adult population. Bordeaux, France and Fes, Morocco: Victor Segalen Bordeaux-II and Sidi Mohamed Ibn Abdillah Universities, MSc thesis.
- [4] Food and Agriculture Organization of the United Nations (FAO) Nutrition and Consumer Protection Division (NCPD). 2011. Nutrition country profiles: Kingdom of Morocco. Retrieved on 2018 from FAO Website: <http://fao.org/tempref/AG/agn/nutrition/ncp/mar.pdf>
- [5] Booth, F. W., Roberts, C. K. and Laye, M. J. 2012. Lack of exercise is a major cause of chronic diseases. *Comprehensive Physiology* 2(2): 1143-1211.
- [6] Hill, J. O., Wyatt, H. R. and Peters, J. C. 2012. Energy Balance and Obesity. *Circulation* 126(1): 126-132.
- [7] United States Department of Health and Human Services (HHS) Physical Activity Guidelines Advisory Committee (PAGAC). 2008. Physical Activity Guidelines Advisory Committee Report. Retrieved on January 21, 2018 from ODPHP Website: <https://health.gov/paguidelines/report/pdf/committeereport.pdf>
- [8] Musaiger, A. O. 2002. Diet and prevention of coronary heart disease in the Arab Middle East countries. *Medical Principles and Practice* 11(2): 9-16.
- [9] Mehio Sibai, A., Nasreddine, L., Mokdad, A. H., Adra, N., Tabet, M. and Hwalla, N. 2010. Nutrition transition and cardiovascular disease risk factors in Middle East and North Africa countries: reviewing the evidence. *Annals of Nutrition and Metabolism* 57(3-4): 193-203.
- [10] World Health Organization (WHO). 2003. Report of a WHO Consultation: obesity: preventing and managing the global epidemic. Retrieved on February 16, 2018 from WHO Website: [http://apps.who.int/iris/bitstream/10665/42734/1/WHO\\_TRS\\_894\\_fre.pdf](http://apps.who.int/iris/bitstream/10665/42734/1/WHO_TRS_894_fre.pdf)
- [11] Durnin, J. V. and Womersley, J. 1974. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. *British Journal of Nutrition* 32(1): 77-97.
- [12] Siri, W. E. 1956. The gross composition of the body. *Advances in Biological and Medical Physics* 4: 239-80.
- [13] National Institute for Prevention and Health Education (France) (INPES) The Steering Committee of the French National Nutrition and Health Program (PNNS). 2002. The food guide for all: health comes by eating. Retrieved on January 03, 2018 from INPES Website: <http://inpes.santepubliquefrance.fr/CFESBases/catalogue/pdf/581.pdf>
- [14] World Health Organization (WHO). 2018. Fact sheet N°311: obesity and overweight. Retrieved on March 2, 2018 from WHO Website: <http://www.who.int/mediacentre/factsheets/fs311/en/>

- [15] Oppert, J. M. and Basedevant, A. 2011. Cardiovascular complications. In Basdevant, A. (Eds). *Medecine Sciences Publications*, p. 197-201. Paris: Lavoisier.
- [16] Hartemann, A., Bourron, O. and Andreelli, F. 2011. Insulin resistance and diabetes. In Basdevant, A. (Eds). *Medecine Sciences Publications*, p. 192-195. Paris: Lavoisier.
- [17] Kaaks, R. and Calle, E. E. 2004. Overweight, obesity and cancer: epidemiological evidence and proposed mechanisms. *Nature Reviews Cancer* 4(8): 579-91.
- [18] Flegal, K. M., Shepherd, J. A., Looker, A. C., Graubard, B. I., Borrud, L. G., Ogden, C. L., Harris, T. B., Everhart, J. E. and Schenker, N. 2009. Comparisons of percentage body fat, body mass index, waist circumference, and waist-stature ratio in adults. *American Journal of Clinical Nutrition* 89(2): 500-508.
- [19] Berthouze-Aranda, S. E. and Reynes, E. 2011. The sedentary lifestyle: a physical-psychological process and a health risk factor for all. *Science et Sports* 26: 191-6.
- [20] Song, W. O., Chun, O. K., Obayashi, S., Cho, S. and Chung, C. E. 2005. Is consumption of breakfast associated with body mass index in US adults? *Journal of the American Dietetic Association* 105(9): 1373-82.
- [21] Giovannini, M., Verduci, E., Scaglioni, S., Salvatici, E., Bonza, M., Riva, E. and Agostoni, C. 2008. Breakfast: a good habit, not a repetitive custom. *Journal of International Medical Research* 36(4): 613-24.
- [22] de Castro, J. M. 2004. The time of day of food intake influences overall intake in humans. *Journal of Nutrition* 134(1): 104-11.
- [23] Zizza, C., Siega-Riz, A. M. and Popkin, B. M. 2001. Significant increase in young adults snacking between 1977-1978 and 1994-1996 represents a cause for concern! *Preventive Medicine* 32(4): 303-10.
- [24] Bertéus Forslund, H., Torgerson, J. S., Sjöström, L. and Lindroos A. K. 2005. Snacking frequency in relation to energy intake and food choices in obese men and women compared to a reference population. *International Journal of Obesity* 29(6): 711-9.
- [25] Fabry, P., Hejl, Z., Fodor, J., Braun, T. and Zvolankova, K. 1964. The frequency of meals: its relation to overweight, hypercholesterolaemia and decreased glucose-tolerance. *Lancet* 2(7360): 614-5.
- [26] Ma, Y., Bertone, E. R., Stanek E. J. 3<sup>rd</sup>, Reed, G. W., Hebert, J. R., Cohen, N. L., Merriam, P. A. and Ockene, I. S. 2003. Association between eating patterns and obesity in a free-living US adult population. *American Journal of Epidemiology* 158(1): 85-92.
- [27] World Health Organization (WHO). 2012. Geneva: World Health Organization. Guideline: Sodium intake for adults and children. Retrieved on November 14, 2017 from WHO Website: [http://apps.who.int/iris/bitstream/10665/77985/1/9789241504836\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/77985/1/9789241504836_eng.pdf)
- [28] World Health Organization (WHO). 2015. Geneva: World Health Organization. Guideline: Sugars intake for adults and children. Retrieved on November 14, 2017 from WHO Website: [http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028_eng.pdf)
- [29] National Observatory for Human Development (ONDH). 2007. Vision 2020: Kingdom of Morocco. Retrieved on February 16, 2018 from ONDH Website: [http://ondh.ma/sites/default/files/sante\\_vision\\_202020.pdf](http://ondh.ma/sites/default/files/sante_vision_202020.pdf)