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The Impact of Eating Behavior on Obesity in Northwestern Morocco: Kenitra Region

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Abstract **Introduction**: Several studies show that there is a relationship between obesity and individual eating habits. **Objective**: To describe the relationship between dietary behavior and staturo-ponderal status in individuals of Kénitra. **Materials and methods:** This work was developed in Kénitra (February 01 to March 30, 2021), it was carried out on a sample of 100 subjects including both sexes with an age range between 18 and 65 years. Data are collected through a questionnaire that includes anthropometric measurements, dietary habits, age and gender. **Results:** Individuals who had three meals per day had a high BMI average (36.41 kg/m^2) with a significant difference (p=0.0404) between BMI and the number of meals per day. As well as individuals who consumed high-fat foods, their mean BMI was high (36.41 kg/m^2) with a significant difference (p=0,0120) between intake of high-fat foods and BMI. **Conclusion:** It is shown that there is a relationship between obesity and eating behavior, and obesity and eating high-fat foods, suggesting that controlling eating behavior helps individuals reduce body weight and have a normal high weight.

Keywords Dietary Behavior, Obesity, Kenitra, Morocco

1. Introduction

Obesity is a rapidly growing epidemic worldwide, and its prevalence has almost doubled in more than 70 countries since 1980. In 2015, 107.7 million children and 603.7 million adults were obese [1]. The prevalence of obesity is increasing dramatically and various factors have been identified as potential causes of obesity such as eating behavior, making eating behavior a primary focus [2,3]. According to Rohrer et al. [4], individuals with unbalanced eating behavior are exposed to the problem of obesity. Eating behavior is the set of rules adopted by a population with regard to the foods consumed. Eating behavior depends on the products consumed, the way of preparing them, the components of the meals, the times and the way of eating the foods [5]. On the other hand, eating behavior is the result of learning that starts from childhood until aging, where it is represented by a group of individuals, to habits and culture that will remain throughout its life (Institut Danone France, 2002),[6]. Experimental studies suggest that behavioral change in food consumption (e.g., consumption of high energy foods) influences obesity [7,8], and other studies show that there is a relationship between the number of meals per day and the structure of these meals and the eating behavior included in the food consumption model. [9,10]. This work is designed to study certain behaviors that may influence the balance of nutritional status of individuals in the Moroccan city of Kenitra.

2. Material and Method

2.1. Study Medium and Sample

This cross-sectional study was conducted in the city of Kenitra from early February to late March 2021, and the health precautions measures imposed by the Ministry of Health during the Covid-19 pandemic were adopted. The targeted sample consists of 100 individuals aged 18 to 65 years with a balanced sex ratio (50% women (25±6) and 50% men), excluding pregnant women. The assessment of the sweetness, soils and fat content in foods were based on A table reference (Table Ciqual 2020). The respondents are randomly selected in the city of Kénitra.

2.2. Anthropometric Measurements and Indices

Table 1. The table presents the meaning of BMI according to WHO criteria.

BMI (kg/m^2)	Indicator	Associated morbidity risk
<18.50	Thinness	Weak
18.50-24.99	Normal Corpulence	Medium
25.00-29.99	Overweight/pre-obese	Increased
>30	Obesity	Massive

Size and weight were measured according to WHO (World Health Organization) standards, weight (in kg) was taken using an electronic scale with an accuracy of 0.1 kg. The size (in m) was measured using a roof made in Morocco with an accuracy of 0.1 cm. The weight-status assessment of individuals is determined by BMI (kg/m^2) according to WHO.

2.3. Statistical Analysis

The results are expressed as mean or frequency. The data was entered and analyzed by Statistical Package for Social Science (SPSS) Version 17.5. and (SAS) 9.3 for DUNCAN test. The correlation between BMI and food type is assessed by the Pearson test and the comparison of BMI averages to meal intake frequency is performed by the ANOVA test. Statistical tests are considered significant if the $p < 0.05$ value.

3. Results

3.1. Food Evaluation

Figure 1 shows the weekly frequency of daily meals taken by the study group. In addition, 67% of the individuals eat 3 times per day while 24% eat several times per day, then 8% eat 2 times per day, and 1% eat only once per day.

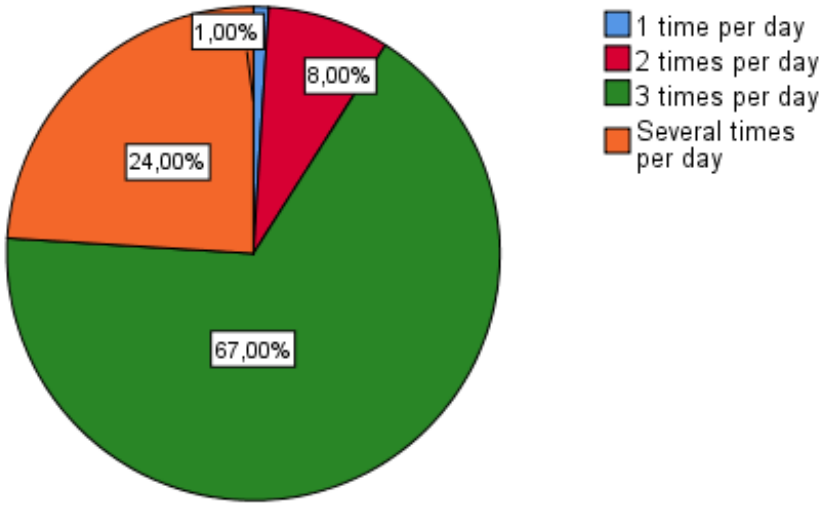

Figure 1. Circular histogram shows how often meals are taken per day.

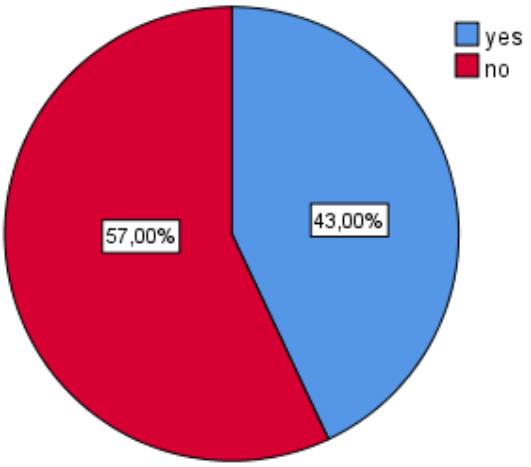

Figure 2. Circular histogram Present the frequency of intake of fatty foods taken

Figure 2 shows circular histogram of the weekly frequency of intake of fatty foods (Sheep skewers; minced meat …). The figure shows that 28% of the individuals consume fatty foods and 72 % do not.

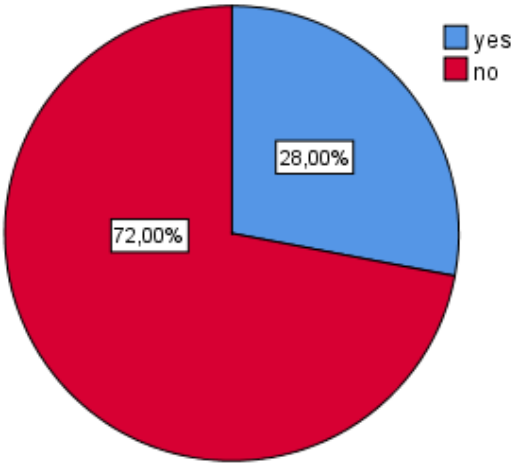

Figure 3. Circular histogram presents the frequency of intake of too salty foods taken

Figure 3 shows circular histogram of the weekly frequency of intake of salty food (the fish; Moroccan soup …). The figure show that 43% consume foods that are too salty and 57% do not.

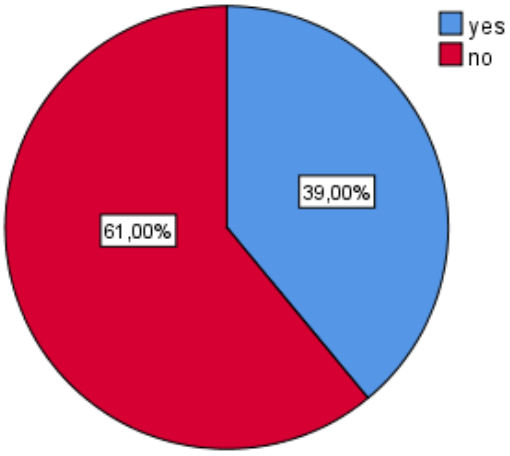

Figure 4. Circular histogram presents the frequency of intake of over sweetened foods taken

Figure 4 shows circular histogram of the weekly frequency of intake too sweet foods (Pastilla; honey cakes …). The figure shows that 39% of the individuals consume foods that are too sweet, while 61 % do not.

3.2. The Relationship between BMI and the Number of Meals per Day

The highest mean of BMI was 36.41 kg/m^2 (obesity) in individuals who ate 3 times a day. Then there is a significant difference (p=0.0404) between the frequencies of meal intake studied, indicating a relationship between overweight (overweight and obesity) and the frequency of meal intake 1 time per day, 2 times per day, 3 times per day and several times per day. This is based on the ANOVA test (Table 2).

The Duncan test (Fig.5) was used to confirm the results obtained by the ANOVA test (Tab.1). This test revealed three statistical groups a, b and ab and allowed us to observe that people who eat their meals twice with a BMI average of 24,628 kg/m^2 (Normal body weight) and 3 times per day with a BMI average of 25,519 (overweight) are in group (a) followed by individuals who eat their meals several times per day in group (ab) with an average of 23,348 kg/m^2 (normal body weight), and individuals who eat only once a day in group (b).

Table 2. The relationship between the number of meals per day and BMI

The frequency of meals	Body Mass Index (BMI)					ANOVA test
	T (Moy/Et)	NC (Moy/Et)	OW (Moy/Et)	O (Moy/Et)	MO (Moy/Et)	
1 time per day	0,00±0,00	19,14±0,00	0,00±0,00	0,00±0,00	0,00±0,00	0,0404*
2 times per day	0,00±0,00	21,88±1,47	26,92±0,8	33,79±0,00	0,00±0,00	
3 times per day	13,86±3,78	22,53±1,51	27,03±1,32	31,62±0,98	36,41±0,75	
Several times per day	17,43±1,33	22,11±2,26	27,09±1,48	31,25±0,00	0,00±0,00	

*Significant difference

T: thin, NC: Normal Corpulence, OW: Overweight/near-obese, O: Obese, MO: Morbid Obesity

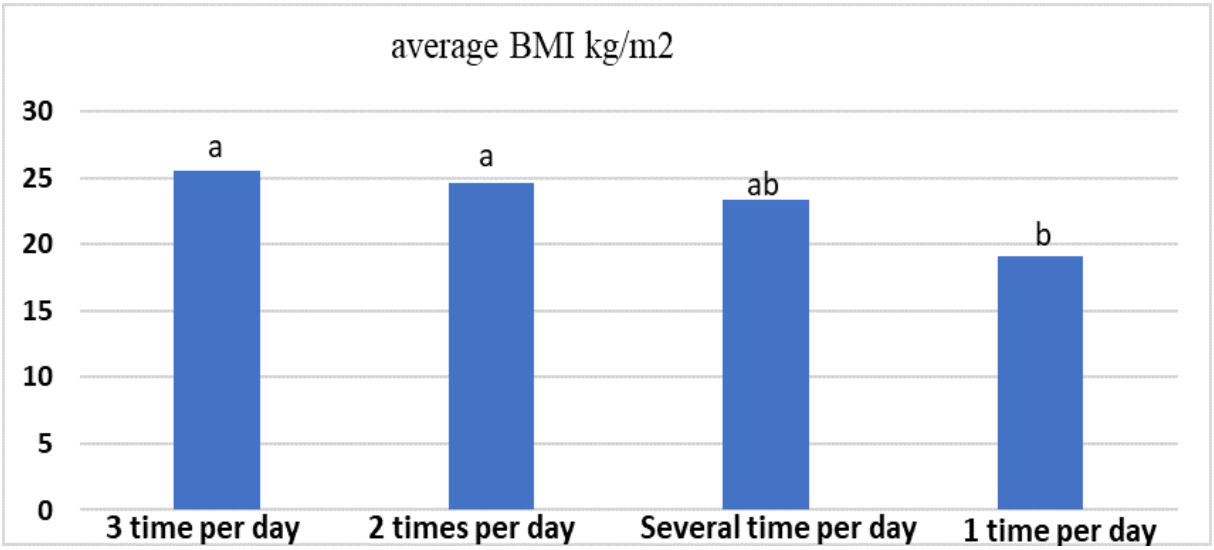

Figure 5. The distribution of BMI averages based on the frequency of daily meals

3.3. The Relationship between BMI and the Nature of the Foods Consumed

The average BMI is a maximum of 36.41 kg/m^2 (morbid obesity) in individuals who eat foods that are too sweet, too salty, and too fatty, indicating a significant difference between the frequency of taking fatty meals and body weight (p=0.012), while the frequency of taking sweet and salty meals is not statistically associated with corpulence (P =0.356; P=0.792) based on the Pearson test (Table 3).

The Duncan Test (Fig.6) was used to confirm the results obtained (Tab.2). This test revealed three statistical groups a, b and ab and it is found that individuals who consume fat with an average of 26,372 kg/m^2 (overweight) BMI are in the group (a) and individuals who consume salty foods with an average of 2 4.729 kg/m^2 (Normal Corpulence) in the group ab, and which consume sweet foods with an average of 24.17 kg/m^2 (Normal Corpulence) are in the group (b).

The dendrogramme is created with a final subdivision of 2 groups which occurs at one level. The first group (at the top) is composed of overfat and too salty food consumed by participants, with an average of 26,372 kg/m^2 (overweight) BMI for participants who consume overfat food (line 2) and an average of 2 4.729 kg/m^2 (Normal Corpulence) for participants who consume too salty food (line 3). The second group, at the bottom, is composed of too sweet food consumed with an average of 24.17 kg/m^2 (Normal Corpulence) (line 1).

Table 3. Association of BMI classes and frequency of consumption of some foods too sweet, too salty and too fatty

		Body Mass Index (BMI)					Pearson test
		T (Moy/Et)	NC (Moy/Et)	OW (Moy/Et)	O (Moy/Et)	MO (Moy/Et)	
Taking too sweet foods	Yes	14,74±3,07	22,62±1,64	26,74±0,88	31,50±1,29	36,41±0,75	0,356**
	No	18,37±0,00	22,01±1,87	27,15±1,42	31,90±1,10	0,00±0,00	
Taking too salty foods	Yes	16,49±0,00	22,46±1,90	26,33±0,68	31,67±1,76	36,41±0,75	0,792**
	No	15,36±3,73	22,08±1,68	27,36±1,38	31,85±0,69	0,00±0,00	
Taking too fatty foods	Yes	0,00±0,00	23,31±1,64	26,57±1,26	31,61±0,94	36,41±0,75	0,012*
	No	15,65±3,10	21,96±1,73	27,24±1,27	31,89±1,25	0,00±0,00	

*Significant difference, **No-significant difference

T: thin, NC: Normal Corpulence, OW: Overweight/near-obese, O: Obese, MO: Morbid Obesity

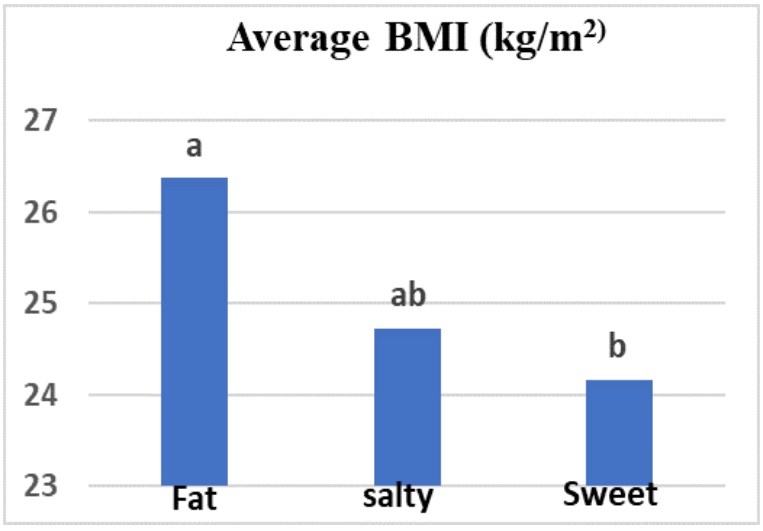

Figure 6. Distribution of BMI averages based on food types

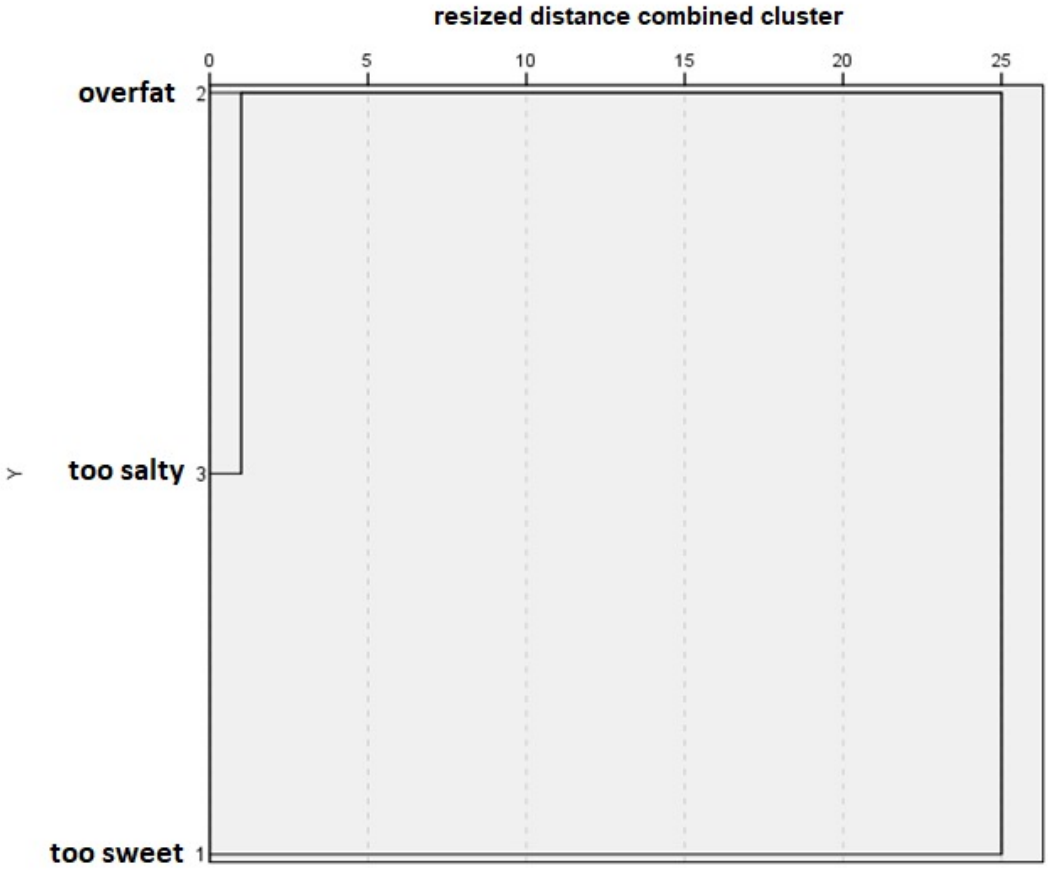

Figure 7. Dendrogramme using Average Distance (between groups)

4. Discussion

The sample consists of 100 subjects, 50% female and 50% male who are healthy and consume different types of foods at different times in the day. The results of our study suggest that the average value of the highest BMI is 36.41 kg/m^2 (obesity) was observed in individuals who had their meals three times a day compared to those who had their meals one or two times a day. These findings support studies that suggest that eating behavior is associated with obesity [11,12].

According to Garaulet, Kulovitz and all [13, 14], the timing and frequency of eating may have a significant influence on weight control and weight loss. A very recent and in-depth study published by Kahleova and her colleagues [15] investigated 50,660 adult members of the seventh day Adventistic churches in the United States and Canada. The results showed that eating one or two meals a day is associated with a relatively lower BMI (body mass index) compared to eating three meals a day, these results are similar and confirm our results which also suggest that eating one or two meals is better than three or more.

On the other hand, another study on the animal model suggests that if an animal ingests these meals at intervals of elevated time (more than 6 hours between two successive meals), that animal will consume a higher quantity than usual and as a result has developed a successive weight gain that can result in obesity [16].

Our study also suggests that the average BMI value is up to 36.41 (morbid obesity) in individuals who took foods high in sugar, salt, and lipids with a significant difference between high-fat meal intake and BMI ($p=0.012$), indicating that high-fat food intake causes the risk of obesity, consistent with the results of several epidemiological and cross-sectional studies that describe a significant relationship between high-fat food intake and obesity [17]. In China [18,19], a longitudinal study shows that the high amount of lipids in foods leads to an increase in weight. This relationship is explained by several factors and among them there is the taste pleasure which is indicated by Blundell JE et al. [20] in their work which suggests that the consumption of foods high in hyperphagia lipid on several individuals exposed to the study.

Additionally, it is indicated that fat taste was tentatively related with an expanded chance of obesity and that count calories appeared to clarify this relationship impressively, and there's no noteworthy association between salt and sweet taste and corpulence hazard. The comes about for the positive affiliation between fat. The results for the positive association between fat taste and obesity risk were consistent with most cross-sectional studies

[21,22,23,24] and one longitudinal study [25].

The inability to degrade lipids used as a source of energy [26], and the genetic factor involved in the rate of lipid oxidation in individuals, Bouchard C and al. [27] indicate that the heritability of obesity can reach up to 30%.

The nature of fatty acids (saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids) consumed can influence weight gain. A study in Quebec City [28] of a group of 128 men shows that intake of foods that are high in saturated fat and associated with weight increase. Another study [29] showed that intake of foods rich in polyunsaturated fatty acids is associated with weight reduction. These results are explained by the rate of oxidation of fatty acids in cells. DeLany et al. [30] showed that saturated fatty acids are less oxidized than saturated fatty acids, poly- and mono-unsaturated fatty acids.

Our study did not consider whether these individuals ate in the workplace or at home, and whether these individuals brought their meals to work or whether they bought their lunch at the restaurant, etc. This may explain some of the difference in outcomes.

5. Conclusions

Dietary behavior and consumption of lipid-rich foods have an impact on the weight-status of individuals in Kénitra. Indeed, people who eat three meals a day are likely to be obese, and while eating high-fat meals increases the risk of obesity. These findings suggest that improved eating behavior can help reduce the risk of obesity and its public health consequences. The study revealed quite a few problems, but following a sampling problem, it was not possible to work on a very large sample because of the Covid-19 pandemic, and then we are looking at the prospect of doing a second long-term study, which is a much more developed research axis that includes other determinants such as physical activity.

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