



Micronutrition for the management of obesity in Morocco, country in nutritional transition

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Abstract

According to the World Health Organization, the obesity prevalence in Morocco grew from 13.2 to 20% between 2000 and 2017. With this current prevalence, overweight and obesity can pose a serious public health problem in Morocco, which is why we conducted this study, which aims to describe the weight status of our sample and then describe the outcome of supporting obese subjects through nutritional coaching and the prescription of specific micronutrients. This study was conducted on a sample of 594 people over the age of 18 from 2014 to 2021. Weight and height measurements were obtained in accordance with WHO guidelines. The body mass index is the metric being measured (BMI). A questionnaire was used to obtain nutritional information. In both sexes, 43% of patients are obese, 24% are overweight, 22% are enormously obese, and 10% are morbidly obese, according to our sample. Also, 41% of obese persons experience food cravings, and nutritional coaching was generally beneficial, with nearly half of the patients, or 47.8%, losing between 15 and 20 kg. The correlations between the nutritional coaching frequency and the weight loss were tested. Overall, we found significant and positive correlations between nutritional coaching frequency and weight loss. We found a correlation coefficient equal to 0.309 which can be considered as a moderate correlation. Obesity therapy should go beyond techniques that focus on caloric assessment with all of the deleterious excesses to a global medicine of micronutritional obesity that gives a global approach to both the individual and nutrition.

Keywords: Micronutrition, Dietary behavior, obesity, nutritional transition, Morocco.

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1. Introduction

Morocco is not immune to the global trend of the increasing prevalence of obesity; according to the latest epidemiological survey of the prevalence of risk factors for non-communicable diseases by the Ministry of Health carried out in collaboration with the WHO, between 2000 and 2017, the obesity rate in Morocco increased from 13.2 to 20%, an increase of about 7 points. 20% of Moroccans are obese and 53% are overweight. Obesity affects three times more women (29%) than men (11%) and is found more in urban areas (22.8%) than in rural areas (14.9%) [1]. With this current prevalence, overweight and obesity can represent a real public health problem in Morocco with an annual cost of 2.8% of the country's gross domestic product (GDP), or 24 billion dirhams [2]. Alongside with its serious complications in terms of health consequences and economic cost, another public health problem is emerging. Morocco with regard to several developing countries is going through a nutritional transition marked by the coexistence of nutritional

deficiencies and overload diseases within the same household. By combining the two forms of malnutrition (by excess and by deficiency), this double burden of malnutrition affected 9.48% of households and 12.90% of individuals [3]. Our Obese people are therefore multi-deficient in micronutrients (vitamins and minerals) and micro-nutritional deficiencies alone cost 5% of the GDP [4,5].

To fight against this scourge, a new perspective must be taken to the impact of food on health, which focuses on the non-caloric component of our foods, that we call micronutrition [6,7], which consists in meeting the micronutrient needs of the person, through a healthy diet, and if necessary personalized supplementation [8].

2. Materials and methods

2.1. Anthropometric measurements and indices

Size and weight were measured in accordance with WHO (World Health Organization) guidelines, with weight (in kg) collected on an electronic scale with a 0.1 kg precision. The size (in m) was measured with 0.1 cm

precision using a Moroccan roof. Individuals' weight status is assessed using BMI (kg/m²), according to WHO.

2.2. The micronutrition consultation

The micronutrition consultation includes two stages: screening for food deficits and imbalances, using food and functional questionnaires QFP. The questionnaire was pre-tested on a sample of about thirty patients and the internal consistency of its items was evaluated by the Cronbach Alpha reliability index, which was equal to 0.77, i.e. an acceptable internal validity. This questionnaire is used to assess the health status and to identify the micronutritional profile. The questions asked are grouped around 4 micronutritional profiles: Neuromediator profile, Cardiometabolic profile, Deficit profile, and digestive profile. During the consultation, the doctor proposes a tailor-made treatment corresponding to this profile, and gives the keys to regain or maintain weight in a sustainable way while optimizing the state of health [9], supplemented if necessary by nutritional biology and the correction of these imbalances and deficits, by individualized dietary adjustment, and if necessary by dietary supplementation [10]. An irritable, impatient profile, starting at a quarter turn, never managing to settle down, having sweet cravings at the end of the day suggests a breakdown of serotonin secondary to a lack of tryptophan and vitamin D [11,12,13]. As for the abdominal fat storage profile probably due to poor insulin management, a major risk factor for diabetes mellitus raises the suspicion of insulin resistance [14, 15, 16, 17, 18].

Screening for deficiencies in vitamins, nutrients and trace elements should not be neglected, because certain deficiencies are incompatible with weight loss and this is the prerogative of the deficit profile.

2.3. Study design

594 patient files were selected out of a total of 1288 files, covering a period from 2014 to 2021, having as criteria; a minimum age of 18 years, with no upper age limit and a follow-up period of at least 3 months in order to have sufficient hindsight to judge the relevance of nutritional management. After review of patient records, the following were excluded from the analysis:

- Records containing a statement of refusal to participate in the survey.
- Subjects who did not meet our age criteria (over 18 years old).
- Cases with edema on clinical examination by the doctor.
- Patients with a follow-up time of less than three months.

Otherwise, all patients who met the inclusion criteria were included in the study.

2.4. Ethical considerations

All precautions according to the Declaration of Helsinki [19] were taken to protect the privacy and confidentiality of the personal information of those involved in the research. Informed consent was obtained from the

participants, who were properly informed of the objectives and methods.

2.5. Statistical analysis

Results are presented as means or frequencies (percentage). Statistical Software for Social Science SPSS 17.5 was used to enter and analyze data. The study used Pearson's correlation to test the underlying hypotheses.

3. Results and Discussions

3.1. Descriptive statistics

Almost equally (30%) of the 30–40-year-olds and the 40–50-year-olds are the most represented age groups in this panel, whether for men or women; with respectively 19 and 77 for the youngest and oldest patient, which testifies to an awareness from the 30-40 years of the importance of a healthy lifestyle for better health. (43%) of patients are in grade 1 obesity, (24%) in overweight, (22%) in grade 2 massive obesity and (10%) in grade 3 morbid obesity, whether in men or women. The first nutritional follow-up cost which does not remain within the reach of all the purses, testifies that ¾ of the patients followed the nutritional coaching for duration less than 6 months. According to our survey, 21% of all consultations are conducted by women, whereas 79% are conducted by males (8 out of 10 consultations concern women), Results are summarized in Table 1.

3.2. Micro-nutritional profiles

Regarding micro-nutritional profiles, 41% of patients have deficit profiles for both sexes, which reinforces this notion of nutritional transition marked by the coexistence of a double burden combining nutritional deficiencies and overload diseases; followed by the neuromediator profile then the digestive profile in women, while in men it is rather the insulin-resistant profile which comes in second position followed by the neuromediator profile; we can conclude that the micro-nutritional deficit is the prerogative of obesity in both sexes, while women are more prone to disrupt the dopamine-serotonin axis while for men it is more about a problem of insulin resistance. Figure 1 presents the obtained results.

3.3. The impact of personal coaching on weight gain

Overall, the nutritional coaching was positive since almost half of the patients, 47.8% lost between 15 and 20Kg, 36.7% lost between 5 and 15 kg and 12% of patients lost between 15 and 25 kg, with a maximum loss of 44.9 Kg in less than a year (116.3 kg to 71.4 kg) with a loss of 58 cm (144 cm to 86 cm) which went from a BMI of 40.24 kg/m² to 24.71 kg/m².

Table 1. Descriptive statistics of respondents

Variable		Mean	percentage
Sex	Women	-	79%
	Men	-	21%
Age groups	20- 30 years old	-	9%
	30- 40 years old	-	30%
	40- 50 years old	-	30%
	50- 60 years old	-	17%
	60- 70 years old	-	11%
	<20 years old	-	2%
	>70 years old	-	1%
Weight loss		14,77	-
During (days)		144,04	-
Weight status	Normal	-	1 %
	Grade 1 obesity	-	43 %
	Grade 2 obesity	-	22 %
	Grade 3 obesity	-	10 %
	Overweight	-	24 %
weight loss slices	3 months	-	23%
	3 to 6 months	-	56%
	6 to 9 months	-	15%
	9 to 12 months	-	3%
	>1 year	-	3%

Table 2. Correlations between nutritional coaching frequency and weight loss

Nutritional coaching frequency	Treatment adherence
Pearson correlation (r)	0.309**
Significance (Bilateral) (p)	<.001

Note: ** The correlation is significant at the 0.01 level (bilateral)

Table 3. Correlations between frequency of nutrition coaching and weight loss by sex

		Treatment adherence
Females	Pearson correlation (r)	0.325**
	Significance (Bilateral) (p)	<.001
Males	Pearson correlation (r)	.441**
	Significance (Bilateral) (p)	<.001

Note: ** The correlation is significant at the 0.01 level (bilateral)

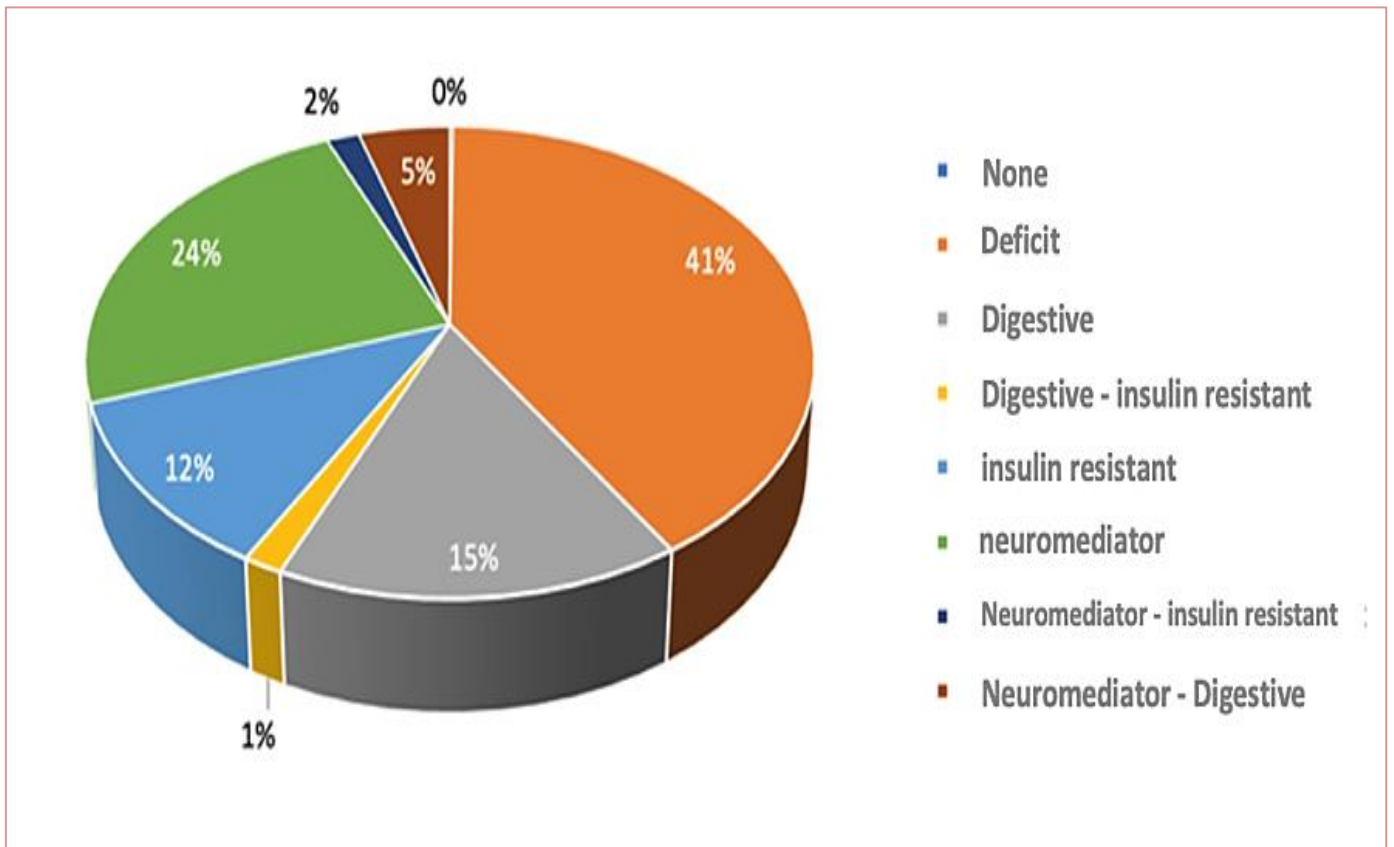


Figure 1. Circular histogram present the frequency of nutritional deficiencies

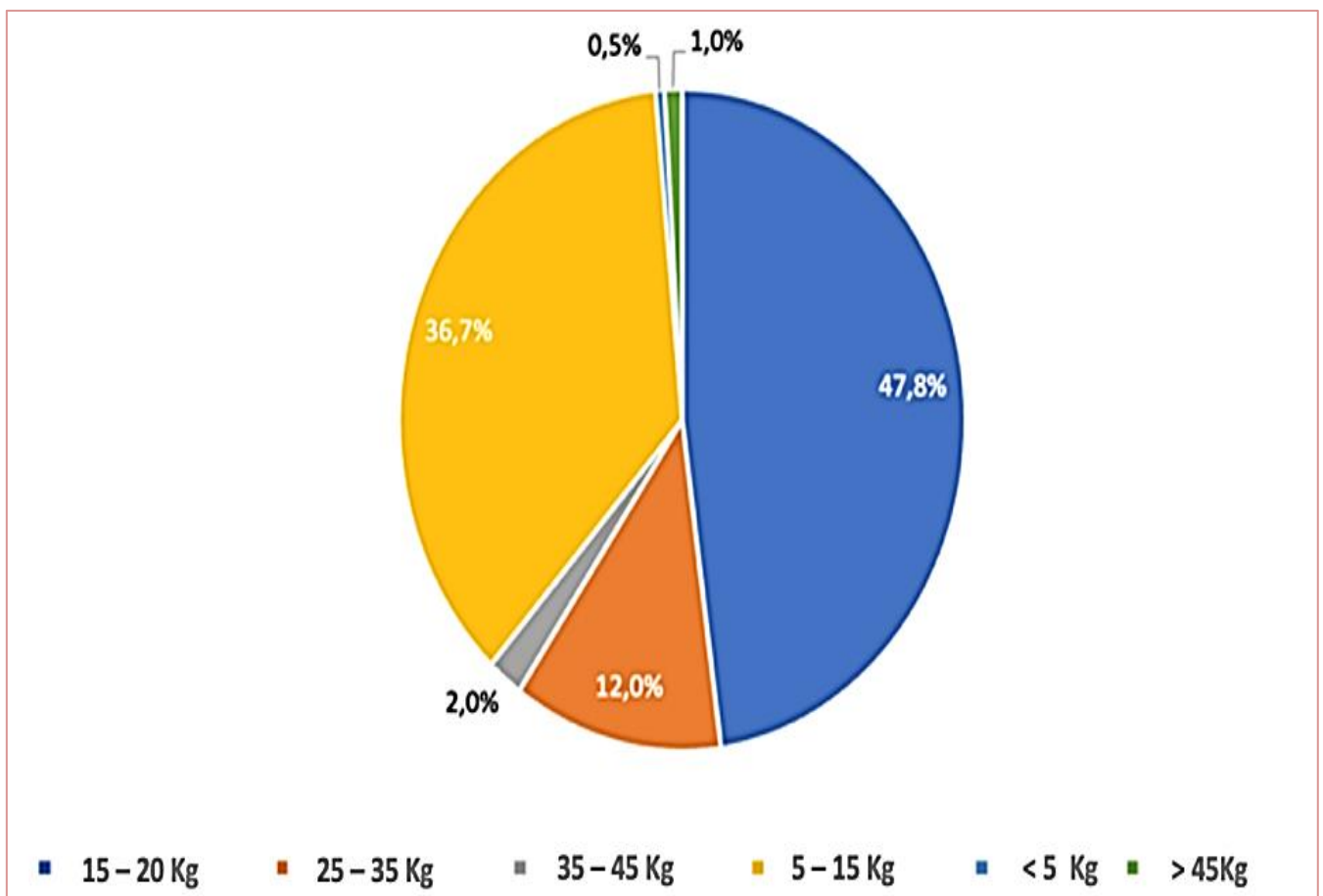


Figure 2. Circular histogram shows the rate of weight loss.

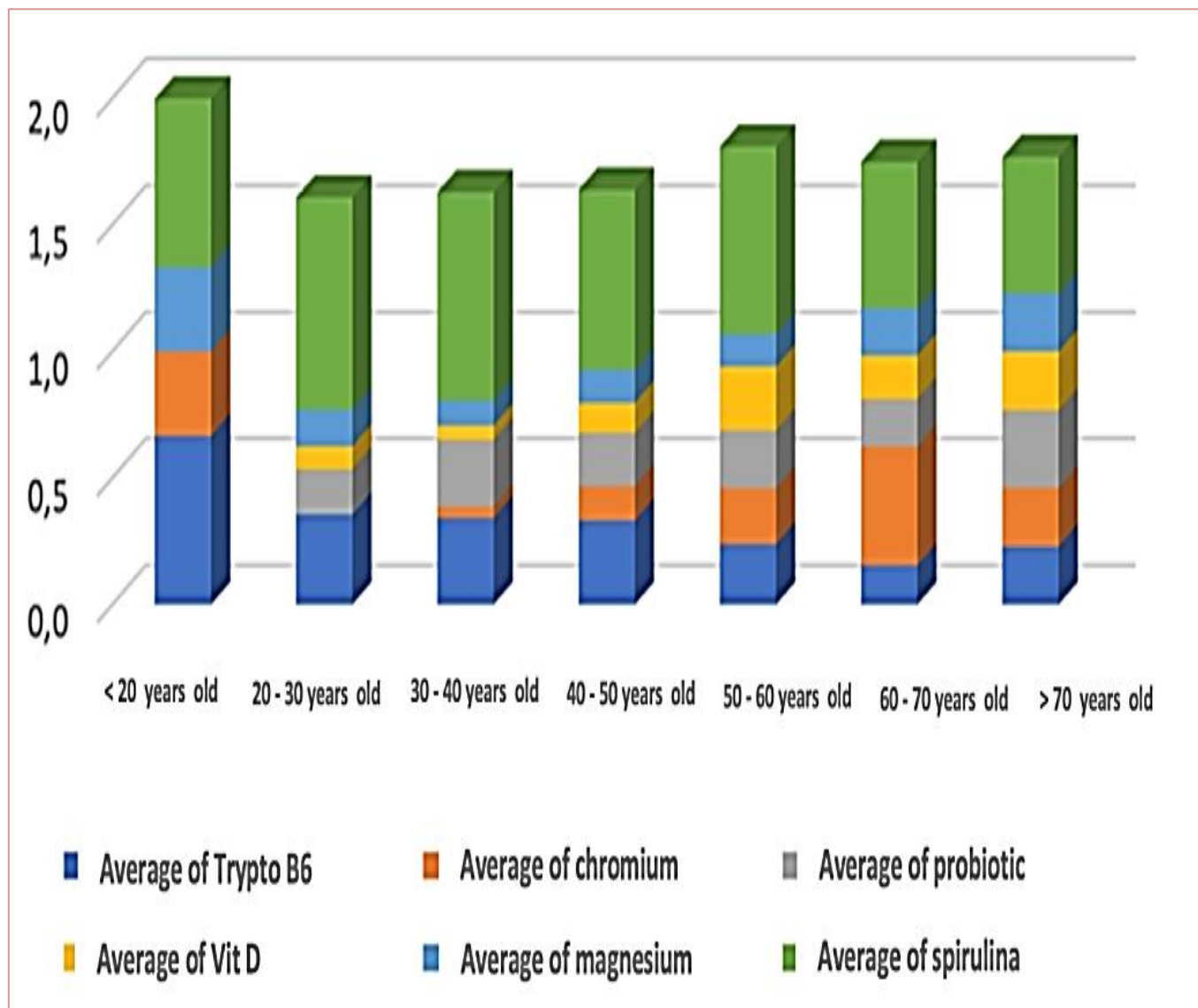


Figure 3. Diagram shows the rate of food supplements taken by the subjects of our sample.

The average weight loss is 14.8 kg for an average follow-up period of 143.9 days, which is about 3 kg on average per month, this average is slightly higher in men; which makes an average BMI gain of 5.3 Kg/M², concerning the loss of waist circumference, it reached an average of 17.8 cm, which makes an average of approximately 3.71 cm per month with a maximum of 58 cm (144 cm to 86 cm). Figure 2 presents the obtained results. To answer the question which suggests the presence of a positive association between nutritional coaching frequency and treatment adherence (weight loss), the correlations between the nutritional coaching frequency and the weight loss were tested. Overall, we found significant and positive correlations between nutritional coaching frequency and weight loss. We found a

correlation coefficient equal to 0.309 which can be considered as a moderate correlation. Results are summarized in Table 2. To examine correlations by gender, analysis of results by gender was conducted. Males have a relatively high correlation with weight loss ($r=0.441$) compared to females who have low correlations with weight loss ($r=0.325$). Table 3 summarizes the results obtained.

3.4. Dietary supplements prescribed according to age

The analysis of the prescription of food supplements was very interesting to analyze according to age groups since, of course it, confirms that micro-nutritional deficiencies are preponderant in obese people since spirulina is the first supplement prescribed especially in youngest 20-30 years

old, 30-40 years old and even those under 20 years old, this represents students and young workers among whom the majority of cases are most often done in fast food, on the other hand this analysis surprised us by an average higher prescription of tryptophan and magnesium in those who are less than a year old, which encourages us to review our awareness-raising and restoration policy among our university students so as not to make them obese with micro deficiencies at their graduation -nutritional. Moreover, this category comes second in insulin resistance which begins to appear around the age of 40-50 with the maximum peak in men of 60-70 years old; which implies that this age category of less than 20 years old must be the most sensitized on the importance of healthy nutrition for a better health capital and this through educational programs which must start from a young age for a better anchoring in eating habits. The older we get, the lower the average prescription of Tryptophan and Magnesium, which can be explained by an awareness of the micro-nutritional needs of patients; with an average vitamin D prescription increasing with age. Regarding the average prescription of probiotics, it is constant in all age categories, showing that microbiota disorders can occur at any age. Figure 3 presents the obtained results.

4. Discussion

Obesity was designated as an international epidemic by the WHO (World Health Organization) in 2003 it is described as an excess of fat mass which has physical, psychological, and social implications that affect one's quality of life [20]. Obesity has been identified as a risk factor for cardiovascular disease, diabetes, psychiatric problems, bone and joint damage, respiratory illnesses, and some malignancies [21, 22]. According to our study finding, which include both men and women samples, 43% of patients are obese, 24% are overweight, 22% are enormously obese, and 10% are morbidly obese. These findings support previous research suggesting that obesity affects 38.3% of women, 34.3% of men and implying that women were more afflicted by obesity than men between 2011 and 2014 [23]. To remedy this disease various medical cures have been applied like the nutritional coaching that was successful because nearly half of the patients, or 47.8%, lost between 15 and 20 kg. This is consistent with the findings of the 2019 Algerian study which found that patients, who adhered to the nutritional coaching program after 12 weeks, experienced an improvement in their glycemic balance and a significant decrease in HbA1c of 0.92% [24]. Another study found that mindfulness-based therapies reduced food impulsivity and binge eating in obese individuals who had not had surgery [25]. The obese patients in our sample had a nutritional shortfall in various foods, and to remedy these deficiencies, we recommended spirulina, vitamin D, and other foods. Many researches have demonstrated the value of spirulina in the medical area [26, 27]. They have also shown that Micronutrients, which nutrients that have no energy value, such as: vitamins, trace elements, polyunsaturated fatty acids, essential amino acids, and pre-probiotics, serve a variety of functions including carriers, reaction cofactors, messengers with antioxidant properties, and preventive properties against obesity and its complications. At the cellular level, several micronutrients play an antioxidant role particularly in the case of vitamin C

and fat-soluble vitamins. In addition, micronutrient with antioxidant properties are extremely important to prevent oxidative damage in the mitochondria, responsible for cellular energy production, and by extension, generates a large amount of free radicals, even though their roles are not directly related to the transformation of energy at the cellular level [28]. Micronutrients are required as coenzymes or cofactors for glycolysis and fatty acid oxidation to occur. Furthermore, a diet low in riboflavin (Vitamin B2) has even been demonstrated to reduce fatty acid oxidation, implying that poor micronutrient intake has very meaningful impacts on cellular action potential. Consequently, it is plausible to suppose that a lack of micronutrients in humans might lead to disruptions in the systems that govern food intake via a reduction in the capacity to use and/or metabolize energy substrates [29]. In our study, the analysis of correlation between treatment adherence and weight loss by gender was performed. Men had a relatively high correlation with weight loss ($r=0.441$) compared to women who had a low correlation with weight loss ($r=0.325$). The difference observed between the two sexes could be explained by the mediators that act in women such as the taking of contraceptives, the onset of menstruation, and the change of mood that would not allow a better adherence to the treatment compared to men. These results are supported by several studies. In a recent literature review published by Thomas and his team, he describes The interactions between obesity, hormones and the brain and their specific and sex related effects in studies of the effects of nutrition on behavior [30].

5. Conclusions

In conclusion, the management of obesity should go beyond approaches focused on caloric accounting with all the excesses harmful to health, to focus on a global medicine of micro-nutritional obesity which offers a global approach to the both of the individual and of nutrition. Obesity must be recognized as a disease and its cost must be reimbursed by the various social welfare organizations. Moreover, it would cost much less than the management of the consequences linked to this disease without omitting the psychological component since it is an essential indication in the treatment of obesity. Awareness and nutritional education is the key to a good policy for the management of this scourge, particularly among the youngest exposed young people so as not to make them predisposed to the metabolic syndrome with, in addition, micro-nutritional deficiencies. Educational programs must begin at a young age for better anchoring in eating habits, moreover it must not be limited to the school textbook, but it must be a more horizontal work which integrates the factors of nutritional transition in the fight against overweight and obesity such as "junk food", sedentary lifestyle and lack of sporting activities and this through the new generation 2.0 awareness campaigns that go through the new communication channels that are social networks, and also through a well-organized program on school nutrition and food standards while fighting against unhealthy food around schools, school canteens and university refreshment bars.

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