Micronutrition and diabetes: a new view at prevention and treatment

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ABSTRACT

Worldwide, millions of people suffer from diabetes. Our study aimed to describe the sample's weight status and the effects of providing individualized micronutrient prescriptions and nutritional counseling to individuals with diabetes. Of the 46 patients (26 women and 20 men) enrolled in this study between 2014 and 2021, 41% had insulin-resistant diabetes and were over the age of 18. In compliance with the World Health Organization guidelines, anthropometric measurements were taken. The impedencemeter was used to measure the visceral fat. Diabetes affected 41% of the patients, with women making up the majority (74%). An impedencemeter's average measurement of 6 for visceral fat loss was encouraging, and a glycated hemoglobin analysis of diabetics revealed an average loss of 1.6%. A good sign for lowering the therapeutic load is that 16% of diabetic patients were able to stop taking any medication at all, and 79% of patients were able to reduce their dosage. This study served as a strong foundation for the creation of customized nutritional management programs in Morocco to enhance the metabolic health of patients who are obese and insulin-resistant.

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Informed consent: informed consent was obtained from the participants, who were properly informed of the objectives and methods.

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Introduction

In our quest for a better understanding of the impact of diet on health, we are refocusing our attention on micronutrition. This approach examines the influence of micronutrients such as vitamins, minerals, trace elements, essential fatty acids, flavonoids, amino acids and probiotics on health, seeking to optimize the body's micronutrient status.

Micronutrition's fields of application are multiple, as it offers a holistic perspective, touching on various aspects of health, including digestive disorders,[1-3] weight management,[4] mood and sleep disorders,[5] healthy eating,[6] anti-aging,[7,8] sports nutrition,[9] cardiovascular disease prevention,[10] and many others.

Type 2 diabetes is a complex, multi-faceted disease, which conventional medicine often tackles by focusing on balance and curative treatment. However, micronutrition proposes a preventive approach, acting on the different stages in the development of diabetes, from insulin resistance and sugar intolerance to pre-diabetes, with the aim of preventing the onset of diabetes.

There are certain key micronutrients in the evolution of this pathology, notably, vitamin C, despite its antioxidant properties, presents challenges in diabetics due to competition with sugar for the same cellular transporters. In addition, vitamin E, when supplemented, improves glycemia in type 2 diabetics with vitamin E deficiency.[11]

Vitamin D deficiency is linked to insulin resistance and secretion in type 2 diabetics. It improves insulin sensitivity, helping to regulate blood sugar levels.[12]

Magnesium deficiency contributes to insulin resistance,[13] and supplementation improves blood glucose levels

in patients with pre-diabetes.[14,15] It also plays a crucial role in normalizing blood pressure and insulin sensitivity.[16-18]

Chromium increases insulin efficiency, and supplementation contributes to better glycemic control in diabetics.[19] Plasma chromium levels are low in diabetes (33-50% lower than in healthy people),[20] and with age, chromium levels in the body decline by 25-40% .[21]It also reduces the appeal of sweet foods, underlining its role in managing patients' diets.[22]

Alpha-lipoic acid supplementation shows significant benefits in lowering blood glucose and glycated hemoglobin and even improves the manifestations of polyneuropathy.[23,24]

And finally, L-carnitine lowers blood sugar and HbA1c levels, increases insulin sensitivity,[25,26] improves neuropathy in diabetic patients,[27] and, according to preliminary research, may prevent certain forms of heart failure in diabetes.[28]

The objective of our study was to describe the weight status of our sample and then describe the outcome of supporting diabetes subjects through nutritional coaching and the prescription of specific micronutrients.

Materials and Methods

Study design and population

46 patients were recruited in this study (26 women, 20 men), 41% were insulin-resistant diabetics, covering a period that went from 2014 to 2021, having as criteria; a minimum age of 18 years, and a follow-up period at least 3 months in order to have sufficient hindsight to judge the relevance of nutritional management.

The insulin resistant profile has been defined based on three factors:

First, we questioned the patients using a simplified weight functional questionnaire, taken from the book "*Maigrir avec la micronutrition*",[29] whose questions were as follows: i) weight gain occurs more in the abdominal area; ii) diabetics in the immediate family; iii) excessive weight gain during menopause; iv) rapid weight gain after stopping sport; v) sedentary; vi) diet rich in fatty, sweet, and salty-foods (pastries, snack cakes).

Secondly, waist circumference >102 cm in men and >88 cm in women, since there is a close association between abdominal (visceral) obesity and metabolic syndrome: in the Third National Health and Nutrition Examination Survey study, a waist circumference greater than 102 cm in men and 88 cm in women was associated with a significant increase in the prevalence of diabetes, hypertension and dyslipidemia, independently of body mass index (BMI).[30]

Finally, the Tanita Body Composition Analyzer measures visceral fat index on a scale from 1 to 59. A score between 1 and 12 indicated a healthy level of visceral fat. A score between 13 and 59 indicated excess visceral fat that secretes a retinol-binding protein correlated with insulin resistance, according to a study published in the British Journal of Nutrition.[31]

The micronutrients administered to patients were: Chromium, prescribed at a dose of 200 µg/day,[32] Alpha lipoic acid at a dose of 300 mg/day,[33] and L-carnitine at a dose of 5000mg/day.[34]

Anthropometric measurements

Size and weight were measured in accordance with World Health Organization (WHO) guidelines, with weight (kg) collected on an electronic scale with a 0.1 kg precision. The size (m) was measured with 0.1 cm precision using a Moroccan roof. Individuals' weight status is assessed using BMI (kg/m^2), according to WHO.

The BMI is calculated according to the mathematical formula:

$$BMI = \frac{(weight\ kg)}{(\text{height m}^2)}$$

with, BMI in kg/m^2, weight (kg) and height (m).

Following current guidelines,[35] overweight was defined as a BMI from 25.0 to 29.9 and obesity as a BMI of 30.0 or higher. Obesity can be further subdivided into grade 1 (BMI 30-<35), grade 2 (BMI 35-<40), and grade 3 (BMI ≥40).[35]

Statistical analysis

Results are presented as frequencies (percentage). The data analysis was entered and performed using Excel 2013.

Ethical consideration

All precautions according to the Declaration of Helsinki 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.

Results

Description of demographic and obesity profile the study population

In our sample of 46 patients, including 26 women (56.5%) and 20 men (43.5%), the most represented age group is 60-70 years (48%) (Figure 1). Among them, 46% had grade 1 obesity, followed by 28% with grade 2 obesity (Figure 2). The majority of patients, over 60%, had been in follow-up for three to six months, and 26.08% between six and nine months (Figure 3).

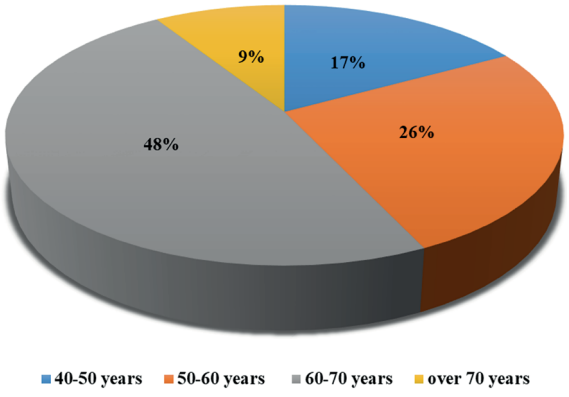

Figure 1. Distribution of study population by age group.

Insulin-resistant population and glycated hemoglobin analysis

The evolution of glycated hemoglobin in diabetics by age group is presented in Figure 4. For insulin-resistant diabetic patients (41%), with a female predominance (74%) (Figure 5), HbA1c analysis revealed a slightly higher loss of 2.3% in the 40-50 age group, followed by 1.66% in the 60-70 age group.

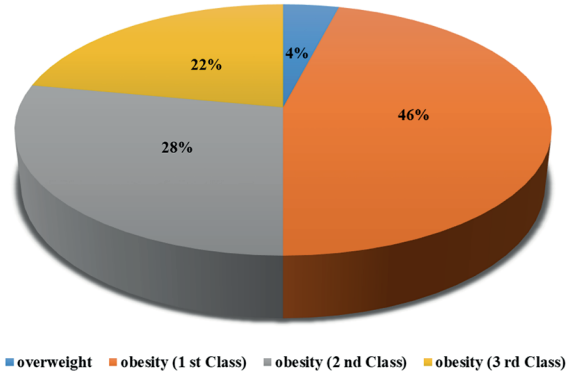

Figure 2. Distribution according to body mass index.

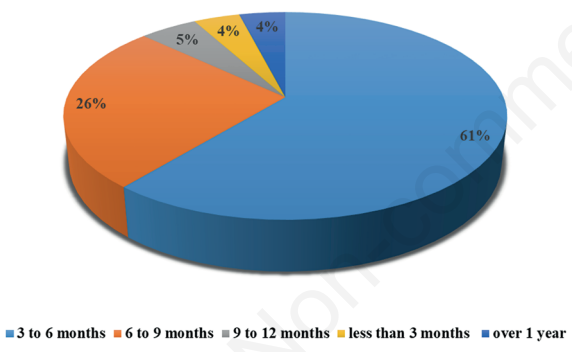

Figure 3. Average length of accompaniment.

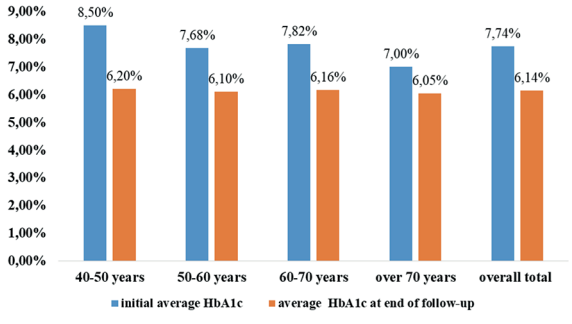

Figure 4. Evolution of glycated hemoglobin in diabetics by age group.

Evolution in visceral fat levels in diabetics and non-diabetics

The average loss of visceral fat in diabetics and non-diabetics is shown in Figures 6 and 7. This loss was almost identical in both diabetic and non-diabetic groups, with a maximum of 6 in the non-diabetic group, represented by the over 70 age group.

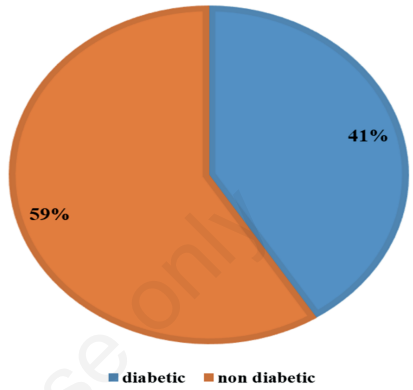

Figure 5. Proportion of diabetics in the study.

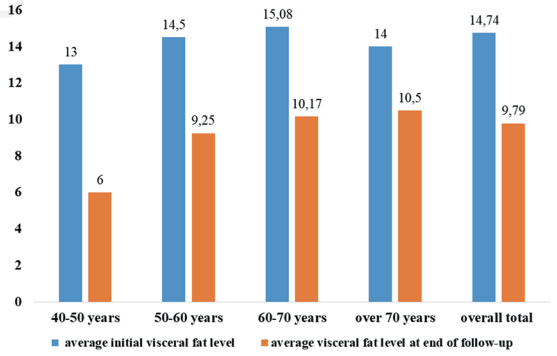

Figure 6. Evolution in visceral fat levels in diabetics.

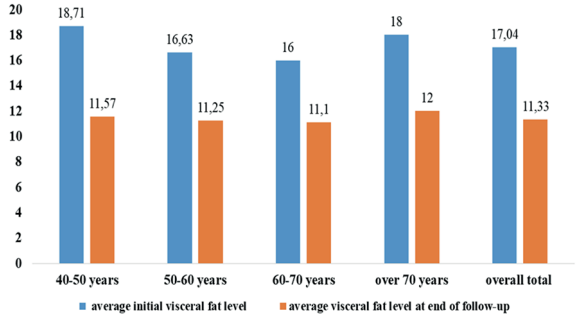

Figure 7. Evolution in visceral fat levels in non-diabetics.

Evolution in the therapeutic load in diabetics

The analysis of therapeutic treatment shows that 79% of diabetic patients have been able to reduce their therapeutic load, and 16% have even stopped taking their medication altogether. The remaining 5% continue to take their medication (Figure 8).

Discussion

The impact of micronutrition on obese and insulin-resistant patients in Morocco provides significant data on the management of metabolic health. The results highlight the scale of the problem, in particular the under-reporting of diabetes in a section of the population.

The demographics of our study reveal a high prevalence of obesity, with 46% of patients suffering from grade 1 obesity, which underlines the need for appropriate weight management strategies. In the same sense, a study conducted in Algeria in 2008 on a sample of 1088 people showed that obesity was found in 19.1% of subjects, with a predominance of women (25.6%).[36] According to a recent study of 200 countries, the prevalence of obesity worldwide has increased sixfold over the last 40 years. In Europe, the prevalence of obesity varies between 12% and 26%, a range in which the figures for the Spanish adult population also fall, at around 22%.[37] This rise is largely attributable to a sedentary lifestyle, lack of physical activity, changing eating habits (snacks, fast food) and more generally, to changes in lifestyle as a whole.

The results of our study showed that 41% had diabetes, the majority of whom were women (74%), highlighting a significant predominance of women. According to the 9th edition of the International Diabetes Federation, diabetes is on the elevation worldwide, with a prevalence rate of 9.3% in 2019, increasing to 10.2% by 2030 and 10.9% by 2045,[38,39] and in the 20-79 age group, the worldwide prevalence of diabetes has been estimated at 10.5% in 2021 and rising to 12.2% in 2045.[40] A study carried out in China in 2013 revealed that the prevalence of diabetes was around 10.9%, and 35.7% of the population showed abnormalities in glucose hemostasis.[41]

The increase in the prevalence of diabetes, particularly in our study, can be explained by the rise in the prevalence of overweight and obesity, which in recent years has been compounded by malnutrition and infectious diseases.

Another important result of the study was the average loss of visceral fat, as assessed by an impedance meter which was encouraging, with an average of 6, and a more detailed analysis showed similar results in diabetics and non-diabetics. The results of a study carried out in Denmark showed that visceral fat content fell rapidly with diet-induced weight loss in both diabetic and obese groups.[42]

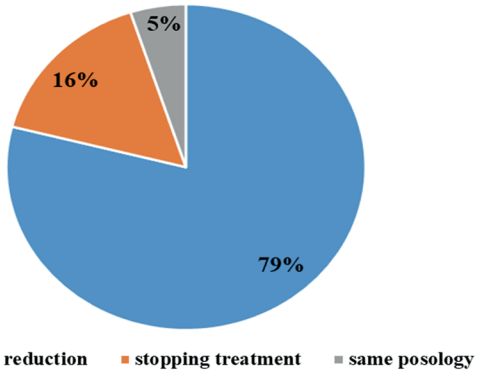

Figure 8. Evolution in the therapeutic load in diabetics.

Our results also showed a positive aspect with regard to reducing the therapeutic load, with 79% of diabetic patients reducing their medication and 16% managing to stop taking any medication at all, which indicates encouraging results in terms of nutritional management.

Analysis of glycated hemoglobin in diabetics showed an average loss of 1.6%, underlining the significant improvement in blood sugar levels. In the same sense, a study conducted in Denmark revealed that none of the patients with type 2 diabetes had an HbA1c level below 6%, but after diet-induced weight loss, 31% of patients had achieved this level, 64% after 4 months, and 67% after 18 months.[42]

Conclusions

Micronutrition is a valuable complement to conventional medicine in the prevention and treatment of type 2 diabetes. By exploring the specific benefits of certain micronutrients, we are paving the way for a more holistic approach to managing this complex disease. This study provides a solid basis for developing specific nutritional management programs in Morocco, aimed to improve the metabolic health of obese and insulin-resistant patients. The encouraging results underline the importance of continuing research in this area to refine and extend nutritional approaches in the Moroccan context since this latter has shown significant improvements in metabolic parameters, particularly in diabetic patients; and among other things the reduction in the therapeutic load in the majority of diabetic patients opens up promising prospects for an integrated nutritional approach to the management of type 2 diabetes. However, the need for personalized strategies based on gender and age underlines the importance of holistic management, taking into account patients' individual characteristics.

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