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Nutritional and Metabolic Profile in Diabetic Patients and Relationship with Metabolic Syndrome

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Abstract

Background & Objectives: Diabetes and metabolic syndrome spread alarmingly throughout the whole world including Algeria, so our study makes the links closer between these two entities and that through studying nutritional, metabolic and physical profiles. Study Design: 204 patients were recruited and interviewed (anthropometric measurements, blood pressure, age, sex, personal and family history, the practice of physical activity and evaluation of food consumption). Patients and Methods: A cross-sectional survey was conducted in the western Algerian region (Sidi Bel Abbes). Patients with MetS are defined according to the criteria of the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III). Results: The results show that the frequency of the metabolic syndrome is 86.27% with predominance of women (92.15% women vs 80.39% men). The age group most affected by the MetS among women and men is [54 - 79] years. We also note that 51.28% of men present three criteria of MetS, while 65.21% of women have four and five criteria. The results show that the criteria most dominant in men are hypertension and type 2 diabetes, whereas in women, the high waist is the most abundant criterion. Moreover, the whole is underlined by a low physical activity with only 21.56% who practice it regularly (15.95% women vs 28.04% men). The estimate of food intake shows a qualitative imbalance: protein intake is 19.65% in women vs. 19.43% in men represented mainly by vegetable protein (83.72% for women vs. 72.85% for men); lipids intake is characterized by a lower consumption than the recommendation of the Mediterranean diet concerning the mono-unsaturated fatty acids (MUFA) (39.44% among women vs 40.24% at the men), as in poly unsaturated fatty-acids including (PUFA) (23.30% among women vs 23.64% at the men) whereas an increase in the consumption of the saturated fatty-acids (SFA) is observed in the whole population including (37.24% among women vs 36.10% at the men); lower concentration in calcium, magnesium and en fibers; important concen-

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tration of sodium and an insufficient contribution of water. **Conclusion:** We should be aware of the importance of the modulation of these risk factors through harmonization of "lifestyle" to prevent the occurrence of metabolic syndrome.

1. Introduction

Diabetes is one of the most common chronic diseases worldwide affecting nearly 200 million people, and is the fourth or fifth leading cause of death in the developed world [1] [2]. Each year, 3.2 million people around the world die from complications associated with diabetes. Type 2 diabetes, which accounts for 90 per cent of all diabetes, has become one of the major causes of premature illness and death, mainly through the increased risk of cardiovascular disease (CVD) which is responsible for up to 80 percent of these deaths [3] [4]. Several pathogenic processes are involved in the development of diabetes.

The association between obesity, type 2 diabetes, hypertension and several lipid anomalies is known since decades. It was proposed to regroup it in unique entity named metabolic syndrome [5]. MetS is characterized by insulin resistance related to an abnormal production of cytokines by adipocytes. It leads to an excess of plasma free fatty acids exert their toxicity especially in the liver and muscle level.

Metabolic syndrome is a pathology very frequent due especially to a modern life style with its excesses (unbalanced diet, inactivity). In Europe, the prevalence of metabolic syndrome is very high in the range of 10% - 25% depending on sex and age [6]. Situation is even more worrying in the United States, where it is currently 26% and more than half of Americans aged 60 years are affected [7]. In Algeria, the situation is worrying, since the last statistics show alarming results. The prevalence of MetS in Algeria is 26.33%, indicating a national health survey which results are announced at the 2nd Congress of the Algerian Society of Vascular Medicine. The results of this survey in 16 Wilaya, based on a sample of 4.818 persons aged between 35 and 70 years old [8]. Another prospective study was conducted in 2008 in Tlemcen, a semi-urban town in northwestern Algeria, on a sample of 1088 subjects (612 women, 476 men), age ≥ 25 years (mean age: 42.6 years), the rate of metabolic syndrome according to NCEP-ATP III is 17.4% [9].

The first official definition of the MetS appeared in 1999 by a working group of the World Health Organization (WHO) [10], followed by many other definitions, Working Group US National Cholesterol Education Program NCEP-ATP III [11], European Group for the Study of Insulin Resistance EGIR in 2002 [12], and finally, the American Association of Clinical Endocrinologists in 2003 [13].

However, different definitions are not only in the components proposed but also in the points defining each component. These divergences cause confusion.

To reduce this confusion, to standardize definitions and arrive at a consensus, the International Diabetes Federation (IDF) asked in 2005 to its working group on Epidemiology to gather experts from around the world (diabetes, cardiology, lipid, public health, epidemiology, genetics, metabolism, nutrition and public) to formulate a new worldwide definition of the metabolic syndrome [14].

However, these definitions, and the usefulness of the metabolic syndrome have been subject of many critical reviews from both European and American associations [15].

2. Patients and Methods

A cross-sectional survey was conducted in the western Algerian region (city of Sidi Bel Abbes) between (02/2009-03/2010) on a sample of 204 patients (SR = 1) which 15% at Endocrinology department (University hospital of Dr. Abdelkader HASSANI) and 85% at diabetology department (Guambeta Center).

Patients with metabolic syndrome are defined according to the criteria of the NCEP ATP III [11]. The study is detailed as follows:

2.1. Questionnaire

The questionnaire survey is a monitoring tool to quantify and compare the information which was collected on a card on which are recorded the necessary information.

In this type of investigation, it was considered:

2.1.1. Data Review
✓ Anthropometric measurements (weight, height, BMI, waist);
✓ Blood pressure measured by a manual sphygmomanometer twice. The result given is the average of two measurements.

2.1.2. Data Interrogation
✓ Age;
✓ Sex;
✓ Personal and family history;
✓ The practice of physical activity.

2.2. Food Consumption Survey

Evaluation of food consumption consist to note in a card for three consecutive days, the nature and quantity of all foods ingested during this period, we took in considering the different meals of the day (breakfast, lunch, tea and dinner) without neglecting snacking between meals. We tried to get the maximum of precise information by using the usual culinary instruments (cup, bowl, plate, glass, spoon, etc.) information.

The conversion of food into different nutrients was realized by program (Nutrilog 1.41 software).

We took as a reference diet, the Mediterranean diet (Md), firstly because Algeria is part of the Mediterranean region and so there are common types of food and secondly because a lot of studies and surveys have demonstrated the value of this type of diet on the health level. The recommendations of the Adult Treatment Panel III for patients with metabolic syndrome are consistent with the general dietary recommendations [16]. The Scientific Steering Committee of the American Heart Association declared that a Mediterranean-style diet had a significant effect on the progression of cardiovascular disease [17]. The mortality statistics from databases of the World Health Organization show that for the period ranging from 1960 to 1990, the health of Mediterranean populations is positively influenced by comparison with those of northern Europe [18].

Many variants of the MD have been identified, but they have in common seven basic nutritional characteristics [18] [19]:

1) High ratio of mono-unsaturated fatty acids;
2) Moderate consumption of ethanol;
3) High consumption of vegetables;
4) High consumption of cereals (even in the form of bread);
5) High consumption of fruits;
6) Low consumption of meat and meat products;
7) Moderate consumption of milk and milk derivatives.

2.3. Statistical Analysis

The statistical analysis was conducted by program (Statistica version 4.1, Statsoft, Tulsa OK 4.1). Quantitative variables are expressed as mean values and standard deviation, while qualitative variables are expressed as the percentage; the quantitative results were compared by Student's t test. The significance level used was 0.05.

3. Results

❑ The pattern of the settlement studied by age bracket shows that 70.58% of the women have an age bracket ranging between 41 and 66 years whereas 85.29% of the men present an age bracket between 54 and 79 years.

❑ The frequency of the metabolic syndrome is 86.27% whose predominance women which (92.15% women vs 80.39% men). The age group most affected by the MetS among women and men is [54 - 79] years. We note

also that 51.28% of men present three criteria of MetS, while 65.21% of women have four and five criteria (**Table 1**).

✓ The results show that the criteria most dominant in men are hypertension and type 2 diabetes, whereas in women, the high waist is the most abundant criterion (**Table 2**).

✓ Our population is in a state of overweight (BMI ≈ 29) whose women present an important percentage of 87.23% vs 71.95% men (**Table 3**).

✓ According on student test, the differences are significant (P < 0.05);

✓ Obesity (BMI > 30) among women is 2.3 times higher than for men (**Table 4**).

✓ Similarly, the frequency of visceral obesity is (95.74% women vs 59.75% men) and only 4.25% had normal waist versus 40.25% of men;

❑ Moreover, the whole is underlined by a low physical activity with only 21.56% who practice it regularly (15.95% women vs 28.04% men).

❑ The estimate of food intake shows that:

✓ The Carbohydrate intake is 60.97% among women compared to 60.54% in men whereas the complex carbohydrates represent (77% among women vs 74% at men) of the total carbohydrates contribution;

✓ Protein intake is 19.65% in women Vs. 19.43% in men represented mainly by vegetable protein (83.72% for women Vs. 72.85% for men);

✓ Lipids intake is caracterized by a lower consumption than the recommendation of the Mediterranean diet concerning the mono-unsaturated fatty acids (MUFA) which (39.44% among women vs 40.24% at the men), as in poly unsaturated fatty-acids including(PUFA) (23.30% among women vs 23.64% at the men) whereas an increase in the consumption of the saturated fatty-acids (SFA) is observed in the whole population including (37.24% among women vs 36.10% at the men);

✓ The consumption of water is insufficient with a daily contribution of 1.8 L among women against 1.7 L at the men; as for the consumed type of water, our results show that the majority of patients drink valve water which (84.78% women vs. 70.51% men);

✓ The daily intake of cholesterol in mg /day observed in patients with the metabolic syndrome is (266.44 mg among women vs. 262.60 mg in men);

✓ In the whole of the minerals salt intake, we note a higher consumption among women compared to men; (**Table 5**).

✓ The daily consumption of dietary fibers is (23.53 mg among women vs. 23.35 mg in men); (**Table 6**).

Table 1. Distribution of subjects according the number of criteria of MetS.

	Women (%)	Men (%)	All Population (%)
3 Criteria	34.78	51.28	42.35
4 Criteria	41.3	37.17	39.41
5 Criteria	23.91	11.53	18.23

Table 2. Distribution of different criteria of syndrome X.

(NCEP ATP III)	Women (%)	Men (%)	Total Population (%)
Type 2 Diabetes and/or Hyperglycaemia	81.91%	98.78%	89.77%
Abdominal Obesity	95.74%	59.75%	78.97%
Hypertension	82.97%	92.68%	87.50%
Dyslipidemia	69.14%	75.60%	72.15%

Table 3. Anthropometric parameters in both sexes.

	Women	Men	Total Population
BMI	30.50 ± 5.11	27.10 ± 3.57	28.88 ± 4.74
WAIST	102.64 ± 12.52	96.93 ± 9.53	99.88 ± 11.57

Table 4. Body mass index of patients with metabolic syndrome.

BMI	Women No. (%)	Men No. (%)	Total Population No. (%)
Normal Weight (18.5 - 24.99)	9 (9.57)	23 (28.04)	32 (18.18)
Overweight (25 - 29.99)	40 (42.55)	42 (51.21)	82 (46.59)
Moderate Obesity (30 - 34.99)	30 (31.92)	15 (18.29)	45 (25.56)
Severe Obesity (35 - 39.99)	12 (12.76)	2 (2.43)	14 (7.95)
Morbid Obesity (>40)	3 (3.19)	0 (0)	3 (1.7)

Table 5. Daily mineral intake expresses in mg per day.

	Women	Men	MD
Calcium	662.40	561.71	900
Potassium	3315.74	3169.64	4700
Magnesium	351.92	325.79	420
Phosphorus	1560.41	1455.03	700
Iron	18.83	18.21	9
Sodium	4001.73	3562.90	1500

Table 6. Daily fiber intake expresses in mg per day.

	Women	Men	MD
Fibers	23.53	23.35	30

4. Discussion

❖ Our study in the Wilaya of Sidi Bel Abbes is based on the evaluation of nutritional and metabolic characteristics among diabetic patients with metabolic syndrome; it provides alarming results that must be taken into consideration.

❑ In our population we found a very important frequency of metabolic syndrome especially in women; they have a percentage ≈1.3 times higher for those with four and five SM criteria.

Several studies show that the Metabolic Syndrome is more frequent among women.

✓ The results show also that high waist is the most abundant criterion in women.

Generally associations between the components of MS are different according to the kind [20]:

• Among women: low HDL-cholesterol, high waist.

• At the men: hypertension.

✓ The results of this study clearly show that obesity is a main actor of metabolic syndrome. Our population is in a state of overweight (BMI ≈ 29).

Several studies showed that 'obesity represents the significant factor in the etiology of metabolic syndrome, contributing to the hyperglycemia, hypertension and the hypercholesterolemy [21].

✓ Obesity (BMI > 30) in women is 2.3 times higher than in men.

Descriptive cross-sectional study on a representative sample of the population health sector Ain Taya (Blida) with 1511 individuals with age ≥ 20 years were included. 25.9% of the population is obese (32.8% women and 12.2% men). The prevalence of obesity among women was almost three times higher than men [22].

✓ It show also that abdominal is very frequent in our population with 1.6 times higher among women than men with;

Abdominal obesity is considered as diagnostic and pathogenetic factor element of MetS [23].

The same study of Chibane and al shows that the prevalence of abdominal obesity was very high (53.5%) of which 23.2% are men and 68.8% women. Abdominal obesity among women was significantly higher compared to men; [22].

❑ 47.15% of our population make a zero or low physical-activity (<30 minutes) including (48.93% women vs 48.78% men).

The physical-activity must be daily and adapted to the cardiorespiratory and articular capacities of each patient [24]. A minimum of 30 minute walks of intensity moderated per day is currently recommended and can naturally be associated with other types of physical activity and the most of our population don't practice it regularly.

❑ The estimate of food intake shows a qualitative imbalance.

✓ The Carbohydrate intake is important compared to the Mediterranean Diet (MD).

Several studies show that it is recommended to push patients with diabetes type 2 in overweight to follow a Mediterranean diet depleted in carbohydrates [25].

✓ An important qualitative protein imbalance is observed in our population including a vegetable protein intake (≈1.4) times higher in women vs (1.2) in men than the MD (60%).

It is true that the Mediterranean diet recommends a low animal protein intake compared to vegetable proteins, but the contribution is very low in our population.

✓ MD recommends a reduction of the saturated fatty-acids (25%) and an increase in the monounsaturated fatty-acids (50%) and our population present a contributions (≈1.47) time higher in SFA and (≈1.26) time less in MUFA compared to MD.

The intake of monounsaturated fatty acids is accompanied by an increase in the ratio of HDL to LDL cholesterol [26], decreased triglycerides and increased HDL-cholesterol [27]. These results indicate the beneficial effects of the consumption of monounsaturated fatty acids on the lipid profile in man.

✓ The daily intake of cholesterol in mg/day observed is lower compared to MD (300 mg)

This can be explained by the restriction of foods of animal origin compared to vegetables foods.

✓ The daily intake of calcium, potassium and magnesium are low compared to the recommendation of Mediterranean diet

In a five-year epidemiological study on more than 1000 healthy individuals, scientists have shown that a high intake of magnesium was associated with improved insulin sensitivity [28].

✓ The daily sodium intake is higher than MD recommendations which we noted a rate (2.66 times among women vs 2.3 in men) higher;

Epidemiologic studies and clinical trials have demonstrated that a reduced intake of dietary sodium lowers blood pressure in both hypertensive and normotensive persons [29] [30].

✓ The daily consumption of dietary fibers is low in both sexes compared to MD.

The use of fiber would affect glycemic regulation, reduce cholesterol, and may affect insulin resistance [31].

5. Conclusions

Those results ring the Alarm Bell, so we should be aware of the importance of the modulation of these risk factors through harmonization of "lifestyle" to prevent the occurrence of the metabolic syndrome which can provoke even other serious pathologies.

The prevention of the metabolic syndrome rests on three very important pillars:

Food diet: adapting a healthy diet rich in fiber and low in fat. Healthy eating reduces all the metabolic syndrome risk factors. It is simply recommended to reduce the caloric intake, restrict the consumption of saturated fatty acids, privilege on food with "low energy density", eat sufficient fruits and vegetables, etc., limit the salt consumption and increase the liquid contributions to reach a diuresis of two liters per day.

Physical activity: at least 30 to 60 minutes of exercise a day every day, if not five days a week. Physical activity allows a better use of glucose by the muscles. Moreover, regular practice helps to lose weight and especially to maintain a stable weight thereafter.

The psychic statute: psychic disturbances cause an important metabolic imbalance which it is recommended to take into account the psychic statute in the treatment and the prevention.

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