

## IMPACT OF LOW CALORIC DIET AND EXERCISE ON ATHEROGENIC INDICES IN OBESE HYPERTENSIVE ADULTS

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### Abstract

**Background and aims:** The influence of a low caloric diet with exercise were studied on several biochemical parameters including the lipid profile and atherogenic indices in overweight subjects including obesity with hypertension. **Material and method:** The study focused on 327 patients (144 men and 183 women) aged 54-73 years selected randomly, We chose hypertensives who live in the city of Tiaret and are over 50 years old, because it is the age group most affected by hypertension in Algeria and even in the world. We invited the subjects of our study to follow a program involving a low caloric diet, which was characterized by the suppression of the consumption of sucrose and refined white flour and by the choice of low-fat products, especially dairy products. **Results:** We observed a decrease in the mean value of blood pressure with its two components, systolic and diastolic. Systolic blood pressure ranged from  $13.06 \pm 1.40$  cm Hg for the overall sample to  $13.01 \pm 1.12$  cm Hg after the six-month program. The same finding is made for diastolic pressure, which decreased by 1.58% for the study population. For biochemical parameters, we observe a decrease in the mean value of all parameters after participation in the low-calorie diet and physical activity program, with the exception of HDL-c, which experienced an increase of 6.25%. **Conclusions:** The hypocaloric diet with exercise that we proposed to a group of hypertensives showed its effectiveness. A healthy lifestyle including a healthy and balanced diet with physical activity therefore allow better management of the hypertensive subject and could actually prevent atherosclerosis.

**key words:** Low caloric diet, exercise, atherogenic indices, obese, hypertensive

### Background and aims

Despite progress in improving primary prevention and medical treatment, cardiovascular disease is the leading cause of mortality and morbidity worldwide [1], with 18 million deaths each year [2]. Increasing evidence supports the pivotal function of nutrition in the development of cardiovascular diseases [3]. Diet

and lifestyle are the dominant underlying cause of systemic inflammation, which leads to the development of atherosclerosis [3,4]. Diet and lifestyle are key modifiable risk factors for cardiovascular disease prevention and have been the subject of intense research.

The cardiovascular risk is better controlled by using the atherogenic indices accompanied by the various parameters of the lipid profile.

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Generally, the two most used indices (APO B / APO A1, Total Cholesterol / HDL-c) give a clear picture of the pathological condition of the hypertensive patient. A healthy diet with sufficient and continuous physical activity can contribute to improving these atherogenic index values.

It is in this approach, that the present study tried to verify the hypothesis of the influence of a low caloric diet and exercise on these indices.

## **Material and method**

### *Study design and patients*

The study focused on 327 patients (144 men and 183 women) aged 54-73 years selected according to inclusion criteria represented mainly by the absence of any cardiovascular or other complication that could prevent the participation of patients in the study, all patients recruited in the study must live in the city of Tiaret. The participants were chosen randomly, we worked with hypertensive patients at home and in a hospital with the presence of a doctor.

### *Criteria for inclusion and exclusion*

We chose hypertensives who live in the city of Tiaret and are over 50 years old, because it is the age group most affected by hypertension in Algeria and even in the world, so we excluded several hypertensives aged less than 50 years, we recruited patients who agreed to participate in the study after receiving an explanation of its objectives. We exclude all hypertensive individuals suffering from another disease or a complication of hypertension and we have worked with treated hypertensive subjects. We also excluded patients with resistant hypertension, defined as hypertension that remains high despite the concomitant use of three antihypertensives. It would cover 20 to 30% of the hypertension worldwide [5].

### *Anthropometric measurements*

The measurement of body weight (in kilograms) was performed using an electronic scale and the height (in meters) was measured using a body meter. The body mass index ( $\text{kg} / \text{m}^2$ ) was calculated as weight in kilograms divided by the square of height in meters. Adults were classified according to their BMI in three groups: normal weight (BMI: 18.5-24.9  $\text{kg} / \text{m}^2$ ), overweight (BMI: 25.0-29.0  $\text{kg} / \text{m}^2$ ) and obesity (BMI  $> 30 \text{ kg} / \text{m}^2$ ). Subsequently, we only took patients who are at least overweight, and in this study we recruited overweight hypertensives including obesity.

### *Laboratory and clinical data collection*

Taking blood pressure measurements were done by us in the presence of the attending physician. The OMRON automatic digital blood pressure monitor was used to calculate the blood pressure. We performed three readings and the average reading is taken as blood pressure. The measurements are expressed in centimeters or millimeters of mercury (Hg). Then, a program containing a low-calorie diet and a physical activity of 30 minutes a day three times a week was offered to patients for six months.

Regarding blood sampling, in the morning, venous blood samples were collected with 12 hours of fasting from each participant for biochemical tests. The blood was centrifuged for plasma separation. The enzymatic colorimetric methods (Spinreact Reagents, Spain) [6] were used to determine the serum concentrations of glucose, total cholesterol, high-density lipoprotein cholesterol, direct low-density lipoprotein cholesterol (LDL-c) and triglycerides (TG). Apo A1 and apo B were determined quantitatively using turbidimetric tests (Spinreact Reagents, Spain) [7]. The glycosylated hemoglobin (HbA1c) levels were quantified by an ion exchange resin separation

method. Finally, the TC/HDL-c and the apo B/apoA1 ratios were calculated. The same biochemical parameters were measured after the end of the program to see if there were any changes. None of the participants used vitamins or mineral supplements.

#### *Diet program*

We invited the subjects of our study to follow a program involving a low caloric diet, which was characterized by the suppression of the consumption of sucrose and refined white flour and by the choice of low-fat products, especially dairy products.

This program was offered to patients for six months with an interview with each participant after three months of the start of the plan to verify compliance with our instructions. As a result, we excluded several hypertensives from the study because of non-compliance with the program.

#### *Statistical analysis*

Data was expressed as mean  $\pm$  SD. We used SPSS 20.0 for Windows (SPSS Inc., Chicago, IL, USA) for statistical analyses. A p-value  $<$  0.05 was considered statistically significant with a confidence interval of 95%. The student t-test was used to compare means of anthropometric measurement and blood parameters by gender and the Chi-square test was employed for comparing percentage values.

## **Results**

[Table 1](#) shows patients' characteristics of the study population. The hypertensives that were the subject of our study are divided into 144 men and 183 women, respectively 44.03% and 55.96%, with a sex ratio (women / men) of 1.27. Their average age is  $53.75 \pm 10.21$  years. The average age for women is  $52.63 \pm 9.75$  years, while it is  $56.72 \pm 9.17$  years for men.

In order to ensure a good representation of our sample, we have tried to ensure that the number of patients surveyed for each geographical district of the city of Tiaret is well distributed according to gender and age.

In our study population selected, there is a dominance of women against men, our random selection of subjects recruited in the study suggests that it is the actual distribution of the target population. This distribution of the two genders is of no statistical significance. The average age of men is slightly higher than that of women with no significant difference. The opposite is found for weight and BMI. The average height of men is significantly higher than that of women ( $p = 0.003$ ). Men in our study population have higher blood pressure than women, the difference between arterial pressures is not significant.

**Table 1.** Patients Characteristics n=327

Variables	All patients	Men	Women	P-value
N	327	144(44,03%)	183(55,96%)	-
Age (years) mean $\pm$ SD	53,75 $\pm$ 10,21	56,72 $\pm$ 9,17	52,63 $\pm$ 9,75	0,627
Weight status, mean $\pm$ SD				
Weight (kg)	81,11 $\pm$ 10,63	80,72 $\pm$ 9,13	84,27 $\pm$ 10,05	0,002
Height (cm)	163,16 $\pm$ 6,24	168,37 $\pm$ 4,19	161,70 $\pm$ 5,82	0,003
BMI (kg m <sup>-2</sup> )	28,53 $\pm$ 3,73	28,04 $\pm$ 4,11	28,78 $\pm$ 3,57	0,002
Blood pressure, mean $\pm$ SD				
Systolic pressure (cmHg)	13,06 $\pm$ 1,40	13,22 $\pm$ 1,72	13,11 $\pm$ 1,19	0,727

**Table 1. Continued.**

Variables	All patients	Men	Women	P-value
Diastolic pressure (cmHg)	8,18±0,72	8,20±0,53	8,16±0,64	0,620
Biochemical parameters, mean±SD				
HbA1C (mmol mol <sup>-1</sup> )	55,22±8,12	56,18±9,80	54,72±8,19	0,592
Fasting glycaemia (g l <sup>-1</sup> )	1,10±0,32	1,05±0,27	1,08±0,20	0,019
Total cholesterol (g l <sup>-1</sup> )	1,40±0,21	1,51±0,30	1,41±0,29	0,023
HDL-c (g l <sup>-1</sup> )	0,32±0,10	0,30±0,11	0,33±0,10	0,087
LDL-c (g l <sup>-1</sup> )	1,01±0,18	1,03±0,15	1,01±0,19	0,572
TG (g l <sup>-1</sup> )	1,22±0,49	1,20±0,51	1,24±0,47	0,663
APO A1 (g l <sup>-1</sup> )	1,11±0,30	1,09±0,38	1,10±0,40	0,042
APO B (g l <sup>-1</sup> )	0,83±0,22	0,80±0,20	0,86±0,29	0,031
APO B/APO A1	0,75±0,27	0,73±0,31	0,76±0,34	0,022
Total cholesterol/HDL-c	4,37±1,02	4,49±0,92	4,32±0,88	0,039

With respect to biochemical parameters, we have noticed a tendency to see higher numbers in women than in men, such as Fasting glycaemia, HDL-c, TG, APO A1, APO B and APO B / APO

A1. Male subjects recorded larger numbers than women for HbA1C, Total cholesterol, LDL-c and Total cholesterol / HDL-c, with statistical significance for the majority of them.

**Table 2a.** Biochemical parameters of the patients after 6 months of the low caloric diet and exercise program

Variables	All patients	Men	Women	P-value
Weight status, mean±SD				
Weight (kg)	78,23±9,83	79,12±8,73	83,11±9,34	0,045
BMI (kg m <sup>-2</sup> )	27,84±3,43	27,33±4,02	28,18±3,11	0,048
Blood pressure, mean±SD				
Systolic pressure (cmHg)	13,01±1,12	13,12±1,43	13,05±1,05	0,623
Diastolic pressure (cmHg)	8,05±0,62	8,13±0,59	8,09±0,57	0,740
Biochemical parameters, mean±SD				
HbA1C (mmol mol <sup>-1</sup> )	54,33±8,53	55,28±8,93	54,11±7,34	0,524
Fasting glycaemia (g l <sup>-1</sup> )	1,04±0,27	1,03±0,22	1,03±0,25	0,033
Total cholesterol (g l <sup>-1</sup> )	1,35±0,29	1,43±0,33	1,40±0,22	0,041
HDL-c (g l <sup>-1</sup> )	0,34±0,17	0,32±0,14	0,34±0,16	0,054
LDL-c (g l <sup>-1</sup> )	0,98±0,11	1,01±0,11	0,99±0,14	0,343
TG (g l <sup>-1</sup> )	1,20±0,46	1,19±0,54	1,20±0,37	0,746
APO A1 (g l <sup>-1</sup> )	1,10±0,27	1,11±0,43	1,11±0,34	0,032
APO B (g l <sup>-1</sup> )	0,80±0,21	0,79±0,23	0,80±0,26	0,033
APO B/APO A1	0,73±0,24	0,71±0,27	0,72±0,36	0,023
Total cholesterol/HDL-c	4,04±1,11	4,23±1,03	4,12±0,93	0,032

Tables 2a and 2b show Biochemical parameters of the patients after 6 months of the low caloric diet and exercise program with the rate of change of biochemical parameters after the program. We observed a decrease in the mean value of blood pressure with its two components, systolic and diastolic. Systolic blood pressure ranged from 13.06 ± 1.40 cm Hg for the overall sample to 13.01 ± 1.12 cm Hg

after the six-month program. The same finding is made for diastolic pressure, which decreased by 1.58% for the study population. For biochemical parameters, we observe a decrease in the mean value of all parameters after participation in the low-calorie diet and physical activity program, with the exception of HDL-c, which experienced an increase of 6.25%.

**Table 2b.** Rate of change of biochemical parameters after the program (%)

Variables	All patients	Men	Women
Weight status			
Weight	-3,55%	-1,98%	-1,37%
BMI	-2,41%	-2,53%	-2,08%
Blood pressure			
Systolic pressure	-0,38%	-0,75%	-0,45%
Diastolic pressure	-1,58%	-0,85%	-0,85%
Biochemical parameters			
HbA1C	-1,61%	-1,60%	-1,11%
Fasting glycaemia	-5,45%	-1,90%	-4,63%
Total cholesterol	-3,57%	-5,29%	-0,70%
HDL-c	<b>+6,25%</b>	<b>+6,66%</b>	<b>+3,03%</b>
LDL-c	-2,97%	-1,94%	-1,98%
TG	-1,63%	-0,83%	-3,22%
APO A1	-0,90%	-1,83%	-0,90%
APO B	-3,61%	-1,25%	-6,97%
APO B/APO A1	-2,66%	-2,74%	-5,26%
Total cholesterol/HDL-c	-7,55%	-5,79%	-4,63%

## Discussion

The main objective of this study was to verify the impact of following a program of hypocaloric diet with physical activity on biochemical parameters including atherogenic indices in hypertensives. The average blood glucose value of the overall sample is  $1.10 \pm 0.32$  g/l, which is much higher compared to the results found in hypertensives in the TAHINA study [7] with an average value of 0.97 g/l. The average value of total cholesterol was  $1.40 \pm 0.21$  g/l for our hypertensives versus 1.83 g/l for TAHINA hypertensive patients. Triglyceride values in the same study were also higher compared to ours (1.62 vs  $1.22 \pm 0.49$  g/l). Virtually all average values of these parameters improved after six months of the program. The first findings related to the blood pressure figures of the patients who have decreased in a remarkable way. The program proposed to the subjects of this study was based on the decrease of the consumption of fat-rich dairy products, increasing lipid intake in energy intake is associated with overweight. A review of the results from 28 clinical trials that studied the

effects of a reduction in the amount of energy from fat in the diet showed that a reduction of 10% in the proportion of energy from fat was associated with a reduction in weight of 16 g/d, the same study conclude that dietary fat plays a role in the development of obesity [8]. Numerous studies have demonstrated the relationship between obesity and lipid energy percentage [8-11]. Other studies show not only that obese people eat more fat than non-obese people, but that excess consumption is correlated with their degree of obesity [12,13]. The decrease of the average values of LDL-c in the patients after 6 months of hypocaloric diet can confirm the relation between the fats consumed mostly of dairy origin and atherosclerosis, which has been evoked in several literature studies [5,14]. Enough and continuous physical activity allows a healthy lifestyle, the risk of obesity decreases by 10% per hour of intensive or moderate physical activity per day and increases by 12% per hour spent in front of a screen [15]. Total energy expenditure is the sum of basal metabolism (about 60%), digestion-related expenses (about 10%) and physical activity-related expenses (about 30%). Of these three

components, physical activity expenditures are the most easily modifiable. They can range from 15% in a sedentary subject to more than 50% of the total energy expenditure in a very active subject. This explains the fundamental role of physical activity in the prevention and treatment of obesity and therefore the prevention of such complication as atherosclerosis. Intensive exercise promotes a negative energy balance by a double influence on energy expenditure and energy intake without changes in appetite sensations [6,16].

Most studies on the subject show a significant association between time spent watching television and being overweight [7,17]. This association could be explained in two ways. On the one hand, the energy imbalance resulting from a sedentary lifestyle favors weight gain. On the other hand, watching television may encourage more fatty and sugary foods. For example, people who often eat their meals in front of the television eat more than others in

terms of energy, fatty foods and sugary foods and consume fewer fruits and vegetables.

## Conclusions

The hypocaloric diet with exercise that we proposed to a group of hypertensives showed its effectiveness. The body weight of the subjects and consequently their BMI are diminished in a remarkable way. The mean values of the atherogenic indexes showed an improvement, which proves the positive impact of a hypocaloric diet with physical activity on the atherogenic risk in hypertensives. A healthy lifestyle including a healthy and balanced diet with physical activity therefore allow better management of the hypertensive subject and could actually prevent atherosclerosis.

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