Influence of physical activity and dietary habits on lipid profile, blood pressure and BMI in subjects with metabolic syndrome


Abstract

Background: The present study was determined the influence of physical activity and dietary habits on lipid profile, blood pressure (BP) and body mass index (BMI) in subjects with metabolic syndrome (MS).

Aims: Identify the relationship between physical activity and proper nutrition and the probability of suffering from myocardial infarction (MI).

Methods: Hundred chronically ill with MS who were active and followed a healthy diet were classified as compliant, while the remaining subjects were classified as non-compliant.

Results: The compliant subjects show lower BMI values (30.8 ± 4.9 vs 32.5 ± 4.6), as well as lower levels of triacylglycerol (130.4 ± 48.2 vs 242.1 ± 90.1), total cholesterol (193.5 ± 39 vs 220.2 ± 52.3) and low-density lipoprotein cholesterol (185.2 ± 38.3 vs 139.2 ± 45). They show higher values in terms of high-density lipoprotein cholesterol levels (62.2 ± 20.1 vs 36.6 ± 15.3), with statistically significant differences. In terms of both systolic and diastolic pressure, no differences were revealed between the groups; however, those who maintain proper dietary habits show lower systolic blood pressure levels than the inactive subjects. The probability of suffering from MI greatly increases among the group of non-compliant subjects.

Conclusions: Our results demonstrate how performing aerobic physical activity and following an individualized, Mediterranean diet significantly reduces MS indicators and the chances of suffering from MI.

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Key words: Physical activity, Dietary habits, Health. Metabolic syndrome.

INFLUENCIA DE LA ACTIVIDAD FÍSICA Y LOS HÁBITOS NUTRICIONALES SOBRE EL PERFIL LIPÍDICO, PRESIÓN ARTERIAL E IMC EN SUJETOS CON SÍNDROME METABÓLICO

Resumen

Introducción: En el presente estudio se determinó la influencia de la actividad física y los hábitos nutricionales sobre el perfil lipídico, presión arterial (PA) e índice de masa corporal (IMC) en sujetos con SM.

Objetivos: Comprobar la relación entre realizar actividad física y una nutrición adecuada, y la posibilidad de sufrir infarto de miocardio (IM).

Método: Se evaluaron 100 sujetos con SM. Los sujetos que manifestaban ser activos y llevaban una alimentación saludable fueron clasificados como cumplidores, mientras que al resto se les clasificó como no cumplidores.

Resultados: Los sujetos cumplidores presentan valores menores en cuanto a su IMC (30.8 ± 4.9 vs 32.5 ± 4.6) y sus niveles de triglicéridos (130.4 ± 48.2 vs 242.1 ± 90.1), colesterol total (193.5 ± 39 vs 220.2 ± 52.3) y colesterol unido a lipoproteínas de baja densidad (185.2 ± 38.3 vs 139.2 ± 45); y valores mayores en los niveles de colesterol unido a lipoproteínas de alta densidad (62.2 ± 20.1 vs 36.6 ± 15.3) siendo las diferencias estadísticamente significativas. La PA, tanto sistólica como diastólica, no muestra diferencias entre ambos grupos; en cambio el grupo que manifiesta realizar una alimentación adecuada obtiene unos niveles de presión arterial sistólica menores que el grupo que no la realiza. La posibilidad de padecer IM aumenta significativamente en el grupo de sujetos no cumplidores.

Conclusión: Nuestros resultados muestran como la realización de actividad física de tipo aeróbica y llevar a cabo una alimentación individualizada de tipo mediterráneo reduce significativamente los parámetros relacionados con el SM y las posibilidades de sufrir IM.

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Introduction

Metabolic syndrome (MS) refers to heterogeneous clustering of risk factors associated with increased probability of suffering from a cardiovascular disease (CVD) or diabetes mellitus (DM). Such factors include abdominal obesity, hydrocarbon metabolism alterations or dysglycaemia, arterial hypertension and atherogenic dyslipidemia, with insulin-resistance as a common physiopathological base.

At present, various authors consider physical inactivity to be one of the main problems affecting public health in the XXI century. An increase in aerobic physical activity leads to an increase in aerobic capacity, which is inversely related to different health indicators, such as lipid profile, insulin-resistance, fat mass, MS indicators and arterial resistance. Epidemiological studies demonstrate that performing moderate to vigorous physical activity daily prevents the incidence of chronic illnesses and premature death, and when carried out according to certain criteria concerning the type, duration, intensity, frequency and progression of the activity, it adapts to the individual’s potential. In this way, the exercise helps to improve his or her health and assists the treatment of illnesses, especially coronary artery disease, arterial hypertension, DM, osteoporosis, colon cancer and depression, not to mention the way in which physical activity affects the development of obesity and CVD.

In addition to a decrease in the performance of physical activity, social and technological changes imply transformations in dietary behaviours, such as an increased consumption of high-calorie foods rich in saturated fats, and a low consumption of unrefined carbohydrates. Some authors have emphasized that dietary treatment should vary, depending on the presence of different components of MS, and that treatment should be individualized according to the specific metabolic disorders aching each patient. It has been demonstrated that following a healthy diet, such as the Mediterranean diet, yields a negative relationship between the highest scores of adherence to such a diet and central obesity, fasting glycaemia and plasma triacylglycerols, and a positive relationship with HDL-C levels.

The objective of this paper was to determine the influence of physical activity and dietary habits on lipid profile, blood pressure (BP) and body mass index (BMI) in subjects with MS. Likewise, the authors evaluated the influence of physical activity and proper nutrition on the probability of suffering from myocardial infarction (MI).

Methods

Sample

The sample group is representative of people chronically ill with MS. Selected participants are from a town in the province of Malaga (Spain) and receive treatment at a primary care nursing service which pays special attention to care for chronic patients. 100 subjects participated in the study, including 64 females and 36 males, with an average age of 68.4 ± 10.9. The MS diagnosis is made when an individual meets three of the five following diagnostic criteria (modified ATP-III): BMI > 28.8; BP ≥ 130/85 mmHg; high density lipoprotein cholesterol (HDL-C) < 40 mg/dl in males or < 50 mg/dl in females; triacylglycerols (TAG) ≥ 150 mg/dl; basal fasting glycaemia ≥ 110 mg/dl or receiving hypoglycaemia treatment, or the presence of previously diagnosed DM. Abdominal obesity was evaluated on the basis of a BMI ≥ 28.8 instead of abdominal circumference, a modification which has been validated previously in large cohorts. All participants acted voluntarily, and the Declaration of Helsinki about ethics in research was respected. The University of Granada human research ethics committee approved this study.

Measurements

Body Composition: The anthropometric measurements were taken in the same place, by the same researcher, following all of the standards set by the International Society for the Advancement of Kinanthropometry (ISAK). Height was measured with a stadiometer (GPM, Sertex Inc., Carlstadt, New Jersey) with an exactness of 0.1 cm, and weight was determined on a portable scale (model 707, Seca Corporation, Columbia, Maryland) with an exactness of 0.1 kg. BMI was calculated as weight/height², with weight expressed in kilograms (kg) and height in meters (m).

Lipid Profile: All subjects were fasting since 12 hours before the experience started. The biochemical components were determined through blood analysis. Measured indicators included: total cholesterol (TC) (mg/dl), HDL-C (mg/dl), LDL-cholesterol (LDL-C) and TAG (mg/dl). In the laboratory, the blood serum and plasma were then separated to calculate the different fractions of the sample. Enzymatic methods were used.

Blood pressure: Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured weekly with mercury pygmonanometers, taken with the utmost care and following the method approved by international guidelines. The BP levels were also determined in situ on the day of the consultation (casual BP).

Procedure

A clinical and nutritional interview was given to each subject, using a worksheet with multiple indicators, assessing life habits, cardiovascular risk factors, micro-
and macro-vascular complications and dietary and/or pharmacological treatments. Also, BMI, BP and analytical determinations were calculated. The subject’s level of physical activity was evaluated as sedentary or active, with sedentary patients performing fewer than 30 minutes of moderately intense aerobic exercise (between 55 and 60% of theoretical maximum cardiac frequency) per day. The level of physical activity was determined through recording cardiac frequency, using Polar RS800cx pulsometers. Through analyzing the written list of food provided by the patient or person responsible for his or her nutrition, as part of the sample is illiterate, the subjects were classified according to their adherence to proper nutrition, according to the nutritional recommendations set by the WHO and guidelines of the Mediterranean diet. Dietary treatment was performed in an individualized manner, depending on the specific metabolic disorders affecting each patient. Subjects who met these two criteria (active and proper nutrition) were classified as compliant (C), while the remaining subjects were classified as non-compliant (NC).

Statistical analysis

Values were expressed as mean values with their standard errors. The obtained data was analyzed through the statistical package, SPSS 17.0. (SPSS, Inc.). After checking the normality of the variables and verifying the inexistence of significant gender-based differences, the t-test and non-parametric tests were performed, as applicable, in order to evaluate the statistical differences between the subjects characteristics in terms of various parameters. The χ² test was used to compare proportions.

Results

Figure 1 shows the prevalence of MS components among the sample groups. BMI, high basal glucose levels and high BP are the most common of these components among men, while women more commonly experience high glucose levels and BMI, and low levels of HDL-C. In all of the subjects, three of more of these components were altered.

Table I

| Differences in MS-related parameters in accordance with level of physical activity |
|--------------------------------------|---------------------------------|----------------|
|                                     | Sedentary | Active | P Value |
| TAG                                  | 241.5 ± 95.9 | 150.9 ± 83.8 | 0.007* |
| HDL-C                                | 35.9 ± 14.9  | 58.9 ± 21.1  | 0.000* |
| LDL-C                                | 193.3 ± 45.2 | 111.1 ± 41.2 | 0.002* |
| TC                                   | 219 ± 52.7   | 200 ± 83.1   | 0.061  |
| Glycemia                             | 154 ± 32.5   | 126.4 ± 28.3 | 0.001* |
| SBP                                  | 134.5 ± 17.5 | 133.9 ± 12.3 | 0.907  |
| DBP                                  | 71.2 ± 9.3   | 72.5 ± 8.2   | 0.481  |
| BMI                                  | 32.9 ± 4.5   | 30.5 ± 4.7   | 0.004* |

Table I demonstrates how physically active subjects show lower BMI values, as well as lower TAG and LDL-C levels, with statistically significant differences. TC values were also lower, but the differences were not statistically significant. Active subjects have higher HDL-C levels, with statistically significant differences when compared with sedentary subjects. Systolic and diastolic blood pressure (SBP and DBP, respectively) revealed no differences between the two groups.

Table II

| Differences in MS-related parameters according to diet type |
|-------------------------------------------------------------|---------------|----------------|
|                                                             | Healthy diet  | Unhealthy diet | P Value |
| TAG                                                         | 143.2 ± 71.2  | 275.2 ± 110.5 | 0.000* |
| HDL-C                                                       | 35.7 ± 21.1   | 33.1 ± 12.4   | 0.000  |
| LDL-C                                                       | 115.8 ± 39.9  | 141.7 ± 48.2  | 0.005* |
| TC                                                          | 198.7 ± 58.4  | 225.7 ± 57.1  | 0.008* |
| Glycemia                                                    | 166.1 ± 27.1  | 122.7 ± 24.4  | 0.000  |
| SBP                                                         | 130.8 ± 14.9  | 137.9 ± 15.6  | 0.022  |
| DBP                                                         | 71.3 ± 8.8    | 72.5 ± 9.7    | 0.449  |
| BMI                                                         | 31.4 ± 4.7    | 32.8 ± 4.6    | 0.026* |

p < 0.05; p < 0.01 (*); p < 0.001 (*). TAG: Triglycerides; HDL-C: High Density Lipoprotein Cholesterol; LDL-C: Low Density Lipoprotein Cholesterol; TC: Total Cholesterol; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; BMI: Body Mass Index.

Fig. 1.—

Lifestyle in improving metabolic syndrome.

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Table III

<table>
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<td>TAG</td>
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<td>242.1±90.1</td>
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<td>HDL-C</td>
<td>62.2±20.1</td>
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<td>LDL-C</td>
<td>105.2±88.3</td>
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<td>TC</td>
<td>193.5±39</td>
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<td>Glycemia</td>
<td>121.7±25.5</td>
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<td>BMI</td>
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Table III demonstrates how C subjects show lower BMI values, as well as TAG, LDL-C and TC levels, with statistically significant differences. C subjects have higher HDL-C levels, with statistically significant differences in comparison with NC subjects. The two groups did not present differences in systolic and diastolic blood pressure.

Table IV shows how the probability of suffering from MI increases in a statistically significant way among the group of non-compliant subjects, compared with the group of compliant subjects.

### Discussion

This study suggests that performing moderate physical activity on a regular basis significantly reduces various MS-related parameters. Subjects who perform this type of physical activity show lower values in terms of TC, LDL-C, TAG, glycemia and BMI, and higher levels of HDL-C. These findings concur with previous studies which show that regular physical activity is an important protective factor against metabolic illnesses, as it prevents and reduces established atherosclerotic risk factors, including high TAG and low HDL cholesterol.27-31 Studies such as that of Ekelund et al., performed on a sample of 3,193 young Europeans, demonstrate how performing a minor physical activity reveals a positive relationship with a lesser prevalence of MS after making adjustments for age and sex.32

Our study shows how subjects who do not adopt proper dietary habits show greater MS-related parameters. A diet with excessive calorie intake is considered a risk factor for suffering from MS.33 Various bibliographic references confirm that the ideal diet for preventing MS should be personalized and include healthy eating habits, which are beneficial not only for effective weight loss, but also for body weight maintenance and the reduction of CVD and MS-related parameters.34

In recent years, there has been increasing interest in implementing Mediterranean diets, as the effect of this type of diet on CVD- and MS-inducing parameters has been demonstrated.35 Intervention studies such as ours show that following a Mediterranean diet reduces TC, LDL-C, TAG and BP levels due to the mono and polyunsaturated fats in olive oil,36 and increases HDL-C values.37

MI control is essentially based on the management of risk factors, such as diabetes, dyslipidemia, hypertension, abdominal obesity and smoking. In recent times, and with more and more relevance, this control is based on lifestyle, with the pillars of diet and physical exercise.38 Our study shows how compliant subjects have a lesser probability of suffering from MI. These results coincide with previous findings which demonstrate a relationship between physical inactivity, coronary artery disease and cardiovascular mortality,39 and between following a healthy diet and the production of benefits in terms of morbidity among patients with acute myocardial infarction. The findings are in accordance with previous cohort studies which show that subjects who adhere to healthy lifestyles have less than one-tenth of the probability of suffering from MI that subjects who do not lead a healthy lifestyle have.40-45

### Conclusions

Our results show how performing physical activity and adhering to an individualized, Mediterranean diet significantly reduces MS-related parameters. The results demonstrate the need to obtain more specific recommendations concerning the quantity and intensity of physical activity needed in order to prevent MS, as well as dietary studies which indicate the most effective diet for reducing MS-related parameters. Preventive efforts should focus on motivating people to improve their lifestyles. Governments and educational and health centres should join forces to implement programs which incorporate physical activity and the promotion of a Mediterranean diet, and which assist with the prevention of MS.

### Acknowledgements

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Table IV

<table>
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p<0.05
References
