



Original/Síndrome metabólico

Nutritional adequacy in subjects with metabolic syndrome

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Abstract

Introduction: The nutritional approach in the treatment of metabolic syndrome is a fundamental factor. It is important to raise awareness to patients about the benefits of following the treatments when you want to promote changes in lifestyle.

Objective: The aim of this study was to assess nutritional adequacy in subjects with metabolic syndrome according to the dietary recommendations prescribed.

Methods: Quasi-experimental research with 72 subjects with metabolic syndrome, held in southern Brazil. A nutritional orientation was conducted, related or not with physical exercise for three months. A 24-hour recall and two-day food record, were the reference method of dietary intake assessment. Nutritional adequacy was determined by the energy and nutrient intakes as defined by the Brazilian Food Guide Pyramid groups.

Results: Volunteers reached on average 80% of the energy consumption recommended. Protein and lipid intake was higher, and carbohydrate consumption was lower than recommended levels. There was a low intake of cereals, vegetables, dairy product and beans ($p < 0.001$) as compared with the recommended servings. A high consumption of meat ($p < 0.001$) and an adequate intake of fruit ($p = 0.149$) were observed.

Conclusion: The dietary intake was insufficient to meet the recommendation of energy, although the goal for weight loss was achieved. Still, the results show the need for a balance in food intake and quality of the diet to achieve nutritional adequacy.

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LA ADECUACIÓN NUTRICIONAL EN SUJETOS CON SÍNDROME METABÓLICO

Resumen

Introducción: La terapia nutricional en el tratamiento del síndrome metabólico es un factor clave. Es importante educar los pacientes sobre los beneficios de seguir el tratamiento cuando se quiere promover cambios nel estilo de vida.

Objetivo: El objetivo fue evaluar la adecuación nutricional en individuos con síndrome metabólico de acuerdo con las recomendaciones dietéticas prescritas.

Métodos: Un ensayo clínico con 72 sujetos con síndrome metabólico, llevados a cabo en el sur de Brasil. Asesoramiento nutricional se llevó a cabo, asociada o no con el ejercicio físico durante tres meses. Un retiro de alimentos de 24 horas, y un registro de alimentos de dos días fueron los métodos de referencia para el consumo de alimentos. La adecuación nutricional se determinó mediante la ingesta de energía y nutrientes, grupos de alimentos definidos por la Pirámide de Alimentos del Brasil.

Results: Los voluntarios alcanzado un promedio del 80% del consumo de energía se recomienda. La ingestión de proteínas y lípidos fue mayor de lo esperado, y la ingesta de hidratos de carbono fue inferior a los niveles recomendados. Hubo una baja ingesta de cereales, verduras, productos lácteos y frijoles ($p < 0,001$) en comparación con las porciones recomendadas. Se observaron un alto consumo de carne ($p < 0,001$) y la ingesta de fruta adecuada ($p = 0,149$).

Conclusión: El consumo dietético fue insuficiente para cumplir con las recomendaciones de la energía, aunque se logró la meta de pérdida de peso. Aún así, los resultados muestran la necesidad de un equilibrio de la ingesta de alimentos y calidad de la dieta para lograr la adecuación nutricional.

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Palabras clave: *Síndrome metabólico X. Terapia nutricional. Terapia de dieta. Factores de riesgo. Necesidades nutricionales.*

Abbreviations

NCD; Non-communicable chronic diseases
AHA/NHLBI; American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement
HDL; HDL-cholesterol
PUCRS; Pontifícia Universidade Católica do Rio Grande do Sul
IMC; Body mass index
SPSS; Statistical Package for Social Sciences
ANOVA; One-way analysis of variance

Introduction

In the western world, shifts in lifestyle observed over the years include changes in eating habits and intensity of physical activity in the population. These changes have contributed to the increase in non-communicable chronic diseases (NCD) such as obesity, diabetes mellitus, hypertension, dyslipidemia and cardiovascular diseases^{1,2}. It is estimated that there are currently at least 400 million obese people in the world³. In this scenario, in Brazil about 49% of adults are overweight and approximately 14,8% of the population has obesity⁴.

The excess weight associated with other chronic diseases or NCD gives rise to a clinical condition known as metabolic syndrome, which is represented by a set of cardiovascular risk factors present in a single individual⁵ and can raise mortality due to cardiovascular disease⁶. Around 17 million deaths are caused by cardiovascular diseases, especially heart attack and stroke¹.

Specifically concerning the Brazilian population, there is a lack of data representative on the prevalence of metabolic syndrome. According to the American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement (AHA/NHLBI)⁵, the diagnosis of metabolic syndrome is determined by the presence of three or more of the following factors: increased waist circumference, high blood pressure, impaired glucose tolerance, hypertriglyceridemia and low blood concentrations of HDL-cholesterol (HDL).

The nutritional approach used in the treatment of metabolic syndrome is a fundamental factor whose main goals are weight loss and, consequently, the mitigation of associated risk factors such as blood pressure, glucose, cholesterol, and triglycerides. The nutritional treatment must be individual and must be adjusted according to each subject, and provides a 7% to 10% reduction in the current body weight during a period of 6 to 12 months⁵. To achieve these goals, the individual should be directed towards adopting a balanced diet avoiding simple carbohydrates and choosing foods that are high in fiber like fruits, vegetables, legumes and whole grains, since these are sources of minerals and vitamins. Also, a balanced diet includes the decreased intakes of saturated fatty acids. At the same time, monosaturated fatty acids present in vegetable

sources like plant oils and nuts as well as polyunsaturated fats found in fish (salmon, sardines and tuna) and vegetable oils should be more consistently consumed^{5,7}. To assist in the alimentary recommendations are used dietary guidelines that should favoring nutrition education using terms which are reasonable, simple and clear for most consumers, indicating the necessary modifications in food patterns⁸. The Brazilian Food Guide Pyramid is an example of these guides.

Studies have found that awareness of unhealthy lifestyle and perceptions of susceptibility to chronic diseases lead individuals to have greater participation in programs to change eating habits and physical activity^{9,10,11}. It is important to raise awareness to patients with chronic diseases about the benefits of following the treatments when you want to promote changes in lifestyle¹¹.

Therefore, the objective of this study was to assess nutritional adequacy in subjects with metabolic syndrome according to the dietary recommendations prescribed.

Methods

A quasi-experimental research was performed at Rehabilitation Center of Hospital São Lucas of the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, Brazil. Including criteria were age between 30 and 59 years and diagnosis of metabolic syndrome according to criteria defined by AHA/NHLBI⁵, which is determined by the presence of at least three of the following factors: waist circumference ≥ 102 cm for men and ≥ 88 cm for women, systolic and diastolic blood pressure ≥ 130 mmHg ≥ 85 mmHg, respectively, fasting glucose ≥ 100 mg/dL, triglycerides ≥ 150 mg/dL, HDL < 40 mg/dL for men and < 50 mg/dL for women. We considered the following exclusion criteria: use of medications for weight reduction and/or lipid-lowering drugs, history of cardiovascular event, body mass index > 40 kg/m² (BMI calculated as kg/height²)¹². Data were collected between May 2006 and July 2009. Initially this study included 98 adult volunteers. Throughout the study, 26 subjects dropped out, with 72 participants (48 females) remaining until the end.

The nutritional intervention was performed by the nutrition team, and physical exercise sessions were supervised by the team of physiotherapists, all properly trained. Monitoring occurred individually and lasted three months. The initial assessment comprised food record, a 24-hour recall, and measurement of weight, height and waist circumference. Also, subjects were asked to record their food intake for two days (one week day and one weekend day) to be brought in the initial of study. After the evaluation, individualized diet plans were presented to each patient. Follow-up visits occurred every two weeks to discuss changes in eating habits, nutrition guidelines, and the importance of compliance with the diet to promote weight loss and to improve the quality of health. The dietary in-

intervention included written and oral instructions given as a lecture, visually aided using a series of posters. The achievement of goals and mainly difficulties to adhere to diet were verified in all consultations. The physical exercise sessions included walking on a treadmill uninterruptedly for 30 min, three times a week, totaling 36 sessions. Allowing speed and incline to maintain a range of 65 to 75% of maximum heart rate predicted for age.

The body weight of individuals was measured using a mechanical balance (Cauduro™) with maximum capacity of 160 kg. Participants were required to wear the minimum possible clothing and no shoes. Height was obtained using a stadiometer, with two meters of height and a half centimeters accuracy level. Waist circumference was measured two centimeters over the umbilical scar¹³, using a common tape measure inextensible and inelastic with 150 cm in length.

The recommended diet plan was based on calorie equivalents. The food groups and serving sizes of each food group were established in accordance with the Brazilian Food Guide Pyramid¹⁴. Four groups of calorie levels were established, in accordance with the recommendation of 20 to 25 kcal/kg^{15, 16}, aiming at the weight loss of 5% of initial weight within three months⁵. The four groups of calorie levels established were: 1.600, 1.900, 2.200 and 2.500 kcal per day, distributed as 50-60% carbohydrates (predominantly from foods rich in complex carbohydrates, especially whole grains), 20-30% of lipids (preferably polyunsaturated and monounsaturated fats) and 10-15% protein (animal sources and dairy products provide smaller amounts of fat). Adherence to diet was analyzed by assessing the nutritional recommendations through the caloric levels and servings of the food groups of the Brazilian Food Guide Pyramid prescribed and ingested, for every calorie level. The 24-hour recall and two-day food record (obtained at the end of three months) were used to calculate nutritional adequacy. The energy consumption of macronutrients and servings of food groups were classified as below the recommended value, adequate and above the recommended value.

The Brazilian Food Composition Table was used in the nutritional analysis of dietary surveys¹⁷. The data were tabulated and submitted to statistical analysis with the aid of software Excel® 2007 and Statistical Package for Social Sciences (SPSS®) version 17.0. To compare food consumption in each group of energy level the one-way analysis of variance (ANOVA) was used, supplemented by the Scheffe post-test. The chi-square test was used to measure the association between categorical variables, and the Student's t-test was employed to verify differences between the recommended and ingested values of energy and food servings in each group of calorie level. For the purpose of analysis we used a significance level of 5% (p<0.05). The groups of calorie level 2.200 and 2.500 kcal were pooled for a proper statistical analysis, because of the limited number of volunteers in the 2.500 kcal group (n = seven).

The research protocol was started after approval by the Ethics in Research Committee of PUCRS (process of number 159/06) and written informed consent was obtained from all the volunteers.

Results

The mean age of the subjects was 50±6 years, BMI of 33,3±4 kg/m² classified as obese level I and average criteria of metabolic syndrome are presented of table I. The table II show the percentage of food intake in relation to the calorie level recommended. We observed the following number of volunteers: 18, 30, 17 and seven for groups of calorie level 1.600, 1.900, 2.200 and 2.500 kcal, respectively. The groups were not quantitatively homogeneous because the volunteers were allocated in

Table I
Characteristics of individuals. Porto Alegre (RS), 2009

Variable	Value
Age (years)	50.9±6.6
Weight (kg)	88.1±13.9
Height (m)	1.6±0.1
BMI (kg/m ²)	33.3±4.2
Waist circumference (cm)	106.6±9.2
Total cholesterol (mg/dL)	228.7±51.0
Fasting glucose (mg/dL)	107.2±37.6
Triglycerides (mg/dL)	212.4±112.2
HDL cholesterol (mg/dL)	44.4±10.2
LDL cholesterol (mg/dL)	139.7±43.1
Systolic blood pressure (mmHg)	131.1±15.5
Diastolic blood pressure (mmHg)	82.8±11.0
Fasting insulin (µUI/mL)	18.9±10.5

The results represent mean ± SD.

Table II
Percentage of food consumption in relation to the calorie level recommended. Porto Alegre (RS), 2009

Groups of calorie level (kcal)	Energy consumption (%)
1.600 (n=18)	93±16 ^a
1.900 (n=30)	82± 16 ^{a,b}
2.200 (n=17)	69 ±14 ^b
2.500 (n=07)	68±21 ^b
All (n=72)	80±18

The results represent mean ± SD. Different letters indicate means statistically different between the groups of calorie level (ANOVA p <0.05 Scheffe post-test).

groups according to initial body weight in the study. It was possible to observe that the 72 volunteers managed to ingest, on average, 80% of the calories in the diet prescribed. On average, 93, 82, 69 and 68% of the recommended calorie level was reached in groups 1.600, 1.900, 2.200 and 2.500 kcal, respectively. No statistically significant difference was observed in average consumption between groups of 1.900, 2.200 and 2.500 kcal and between groups of 1.600 kcal and 1.900 kcal.

Table III presents the energy consumption and macronutrients. The overall sample and groups of 1.900 kcal and 2.200/2.500 kcal had a significant reduction in caloric intake ($p < 0.001$) when compared to the values that were recommended in the diet. The average calorie intake of 1.600 kcal group was not statistically different ($p = 0.076$); however, there was a reduction of 7% over the recommended calorie level. In the analysis of the consumption of macronutrients, the overall sample and the four groups of calorie levels had mean carbohydrate intake below the recommended range. The average intake of lipids and protein was shown to be higher than the values prescribed in the diet for the overall sample and all groups.

Table IV shows the adequacy of macronutrient intake in groups of calorie level in relation to the recommended range. Considering carbohydrates intake, most of the volunteers (70.8%) had an intake below the required values in food. For lipids was found that 66.7% of the volunteers ate more than the recommended range. In the analysis of protein intake, 95.8% of participants had an intake above the recommended values. The results of the intra-group analysis of the adequacy of the macronutrients were similar to those of the total sample analysis. The chi-square test indicated no statistically significant difference between groups of calorie level 1.600, 1.900 and 2.200/2.500 kcal for the adequacy of macronutrients ($p = 0.299$, $p = 0.733$ and $p = 0.781$ for carbohydrates, lipids and proteins, respectively).

The recommended values and intake of servings from the pyramid food groups are shown in table V. For most volunteers, inadequacies were observed in main food groups, except the fruit group, in which appropriate levels were consumed (mean intake: 3.7 servings/day; $p = 0.149$). Each group consumed on average 3.1, 3.6 and 4.2 servings of fruit a day, when 3 servings were recommended for groups 1.600 and 1.900 kcal and 4 servings were indicated for groups 2.200 and 2.500 kcal. No significant difference was observed between the recommendations of this food group ($p = 0.765$, $p = 0.089$, $p = 0.704$). A significantly lower intake was observed for the group of cereals, vegetables and dairy groups, as compared to the recommended values ($p < 0.001$). In the meat group, a significantly increased consumption was observed in the three groups at intake: the volunteers ingested 1.9 servings of meat a day, when the recommended serving is one for 1.600 and 1.900 kcal groups ($p < 0.001$), and two servings per day in the group of 2.200/2.500 kcal (recommended value: 1.5 servings per day; $p = 0.024$). In the beans group the daily

Table III
Consumption of energy and macronutrients in the respective groups of calorie level

Groups of calorie level (kcal)	Energy consumption (kcal)	p*	Carbohydrate recommended (%)	Carbohydrate intake (%)	Lipids recommended (%)	Lipids intake (%)	Protein recommended (%)	Protein intake (%)	g protein/kg body weight
1.600	1.490.2±255.1	0.076	50-60	46.1±5.2	20-30	32.1±5.3	10-15	21.6±3.3	1.2
1.900	1.566.5±314.6	<0.001	50-60	46.2±8	20-30	32.9±6.3	10-15	21.3±3.6	1.0
2.200/2.500	1.579.6±382.7	<0.001	50-60	46.4±6.7	20-30	30.9±4.6	10-15	22.5±4.4	0.9
All	1.551±323	<0.001	50-60	46.2±6.9	20-30	32±5.6	10-15	21.8±3.8	1.0

The results represent the mean ± SD of consumption of calories and macronutrients. *The p value refers to the Student's t-test used for comparison between calories and recommended intake ($p < 0.05$).

Table IV
Adequate intake of macronutrients in groups of calorie level

Groups of calorie level (kcal)	Carbohydrates (Recommended 50-60%)			Lipids (Recommended 20-30%)			Proteins (Recommended 10-15%)		
	Below (%)	Adequate (%)	Above (%)	Below (%)	Adequate (%)	Above (%)	Below (%)	Adequate (%)	Above (%)
1.600	77.8	22.2	0.0	0.0	33.3	66.7	0	0.0	100
1.900	73.3	20.0	6.7	3.3	26.7	70.0	0	6.7	93.3
2.200/2.500	62.5	37.5	0.0	0.0	37.5	62.5	0	4.2	95.8
All	70.8	26.4	2.8	1.4	31.9	66.7	0	4.2	95.8

The chi-square test indicated no statistically significant difference between groups of calorie level in 1.600, 2.200/2.500 and 1.900 kcal for the adequacy of macronutrients (p=0.299, p=0.733 and p=0.781 for carbohydrates, lipids and proteins respectively).

recommendation is one serving, regardless of the calorie level recommended. An adequate daily intake of this food group was recorded for the 1.600 and 1.900 kcal groups, 0.7 servings per day (p=0.145 and p=0.144, respectively), while in the 2.200/2.500 kcal group intake was not adequate, with 0.5 part per day (p<0.001).

Discussion

In this study a low energy and carbohydrates consumption and an elevated lipids and proteins intake can be observed. High amounts of lipids and proteins and insufficient carbohydrates consumption have been reported in the diet of the population in general^{18, 19}. This dietary pattern can lead to different consequences on the health of individuals, such as the development of NCD¹.

When the amount of protein per kilogram of body weight was analyzed, the protein consumption was also above the recommended value of 0.8 g/kg²⁰. The high percentage of protein intake may be related to low carbohydrate intake, showing an imbalance in the proportion of macronutrients consumed. This low carbohydrate consumption can be associated with energy deficit reported by the participants.

In a survey conducted in patients with cardiovascular disease, the results were similar to those of the present study. The authors observed that overweight or obese individuals tend to have an unbalanced diet, with inadequate intake of macronutrients, with the prevalence of low carbohydrate diet for both men and women²¹. The present study showed a carbohydrate intake below recommended levels, but Ackermann et al. observed that high consumption of carbohydrates, particularly those that are digested rapidly, contribute to increased risk of central obesity and development of metabolic syndrome²². This inadequacy in carbohydrate intake may be related to low cereals intake (3.3 servings) — all groups of calorie levels ingested about half the recommended amount for this food group. The low consumption of this group of the pyramid can be attributed to the influence of the media as manifested

in magazines, television programs, newspapers and the internet, which generally recommend a diet with low carbohydrate intake for rapid weight loss^{5, 18}. This reduction in cereal consumption accounts for a deficit of approximately 405 kcal in the caloric intake recommended. The average of servings of dairy products reached half the recommended value in general (1.5 servings). A multicenter study showed that an increased dairy consumption have a strong inverse association with insulin resistance syndrome among overweight adults and may reduce risk of type 2 diabetes and cardiovascular disease²³. There was a low consumption of vegetables, about half the recommended portion (2.3 servings), though fruit consumption was adequate (3.7 servings). Adequate fruit and vegetable intake have been shown to contribute for the prevention of cardiovascular diseases¹. Studies show that consumption of vegetables and fiber is inversely associated with overweight^{19, 24, 25}, and fruits contribute for body weight management²⁶. These foods are rich in antioxidants and the dietary antioxidant capacity may be inversely related to characteristics of metabolic syndrome²⁷.

The volunteers that participated in the present study had an insufficient intake in the group of beans, with 0.6 servings a day. A high consumption of the meat group was observed — the volunteers ingested about twice the recommended amount in the diet (two servings). Maskarinec et al. observed that individuals with overweight tend to have a high consumption of meat²⁴. Overweight is also associated with low levels of HDL, so high consumption of meat poses a risk factor for cardiovascular disease²⁵.

The direct questioning the patient and the subjective evaluation of individual behavior are used for establish dietary adequacy⁹. It is known that the rates of non-adherence to various therapeutic treatments are high²⁸, showing that the patients find many it difficult to follow guidelines and requirements^{21, 28}. The main difficulties mentioned by patients who are in attendance for weight reduction are: following a meal plan on weekends, holidays and special occasions, lack of understanding of the nutritional guidelines, drastic chan-

Table V
Comparison between the recommended servings and intakes of food groups of the food pyramid

Food Groups	1.600 kcal			1.900 kcal			2.200/2.500 kcal			All		
	Recommended serving	Intake serving	P									
Cereals	5	3	<0.001	6	3.2	<0.001	7.3	3.5	<0.001	6.2	3.3	<0.001
Vegetables	4	2.3	<0.001	4	2.3	<0.001	4.5	2.2	<0.001	4.2	2.3	<0.001
Dairies	3	1.6	<0.001	3	1.5	<0.001	3	1.4	<0.001	3	1.5	<0.001
Fruits	3	3.1	0.765	3	3.7	0.089	4	4.2	0.704	3.3	3.7	0.149
Meats	1	1.9	0.001	1	1.9	<0.001	1.5	2	0.024	1.2	2	<0.001
Beans	1	0.7	0.145	1	0.7	0.144	1	0.5	<0.001	1	0.6	0.001

The results represent the average of the servings of their food groups. * The p value refers to the Student's t-test used for comparison between recommended servings and ingested (p < 0.05).

ge in eating habits, slow results and anxiety²⁸. The consequences of poor adherence include worsening health problems and rising costs⁹.

Linck et al.¹¹ verified that the patient's perception about the disease situation influences their adherence to treatment. Because chronic diseases initially do not produce symptoms, some patients fail to recognize their current health status and therefore need care. In the present study, participants had biweekly appointments to promote a good adherence to dietary treatment, when issues about how to obtain a healthy diet so as to reduce the presence of the criteria for metabolic syndrome were discussed. Thus, there was an awareness of the consequences of cardiovascular risk factors in terms of future health. On each return appointment, a conversation on the major difficulties that the participants encountered in connection to following the diet plan, which constituted another strategy to help them join the counseling.

The participants reduced their weight as expected (5%; p < 0.001; initial weight: 88.1 kg and final weight: 83.7 kg) as recommended by AHA/NHLBI, which corresponds to a reduction of 7% to 10% in body weight during a period of 6 to 12 months⁵. When the general sample is analyzed, we can observe the reduction of 5% in body weight in three months, that is, the recommended target was met in a short period of time. In a systematic review, Heymsfield et al.²⁹ found that different protocols of low-calorie diets lead to a loss of less than 50% of the expected value. It is assumed that the energy deficit reported by the individuals who participated in that study may have contributed to the reduction in weight, which was below the recommended threshold.

Some limitations in this study should be cited. Studies have shown a tendency to underreport food intake by female subjects^{30, 31}, overweight individuals^{24, 30} as well as by people who are undergoing treatment for weight loss³⁰. In this study, most of the sample consisted of female subjects, and all participants were overweight or obese in the process of reducing weight. These characteristics may indicate a possible underreporting of actual intake. Alternatively, the participants may have actually reduced caloric intake and intake of some food groups. In addition, factors such as emotional and moral judgments can influence the reporting of food intake²⁵. Another limitation in this study is linked to the methods of dietary surveys used. It is known that the information collected in the 24-hour recall and food record depend of memory and the cooperation of the patient. However, these methods are a widely used to collect data on eating behaviors and measuring energy intake in adults^{32, 33, 34}.

Conclusion

It is important to instruct individuals with metabolic syndrome about the ways a healthy diet can help to modify risk factors for developing cardiovascular disease [26]. In the population studied the dietary in-

take was insufficient to meet the recommendation of energy, although the goal for weight loss was achieved — a fundamental result in the treatment of metabolic syndrome. Still, the results show the need for a balance in food intake and quality of the diet to achieve nutritional adequacy. Therefore, nutritional education strategies and motivational aspects to dietary treatment should be improved.

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