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Research Article

Unhealthy lifestyle and the risk of metabolic syndrome- the Romanian experience

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Abstract

Background. Metabolic syndrome (MetS) represents a clustering of metabolic risk factors for cardiovascular disease. Many studies have shown the influence of an unhealthy lifestyle on the risk of MetS, yet some aspects remain controversial. Aim of the study: to investigate the relationship between an unhealthy lifestyle and the risk of MetS.

Materials and Methods. The study was conducted using a sample of 181 patients, 54 (29.8%) males and 127 (70.2%) females, aged 59.95±10.8 years. The baseline survey involved the completion of structured questionnaires and clinical examination.

Results. Rural environment, lower education level, past smoking, the absence of fruit/vegetables in the diet, carbonated soft drinks, and the consumption of significant amounts of alcohol were risk factors for the MetS.

Conclusion. A precise etiology for the MetS remains unclear, but it is known to result from a complex interaction of genetic, metabolic, and socio-economic and environmental factors.

Keywords : metabolic syndrome, unhealthy lifestyle, insulin resistance

Highlights

- ✓ MetS is currently considered as a public health problem and identifying the risk factors is very important. The most important risk factors for MetS in this study are the rural environment and a low education level.
- ✓ This study suggests the importance of healthy dietary patterns for reducing the incidence of MetS.

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Introduction

During the 1990s, cardiovascular disease became the leading cause of death in developing countries (1), Romania having one of the highest mortality rates due to cardiovascular diseases in the world (2). In order to decrease cardiovascular disease related mortality as well as morbidity, risk factors must be analyzed and then addressed through an extensive primary health care program (1).

Metabolic syndrome (MetS) represents a cluster of metabolic interrelated factors like insulin resistance, impaired glucose tolerance, hyperinsulinemia, abdominal obesity, hypertension, dyslipidemia (3, 4), and also a proinflammatory and/ or prothrombotic state. It represents a common cause in the development of atherosclerotic vascular disease and type 2 diabetes (5), and it confers an increased risk not only of cardiovascular disease- related morbidity (3, 4) and mortality (6, 7), but also all-cause mortality (3, 4). Genetic predisposition, environmental factors like physical inactivity, and increased caloric intake would be responsible for this predisposition to metabolic syndrome.

The prevalence of MetS is rapidly increasing, with considerable ethnic variation within and across populations (8-11) depending on different studies (12-15) (due to the probably polygenic predisposition of the studied populations, their exposure to environmental factors, and the diagnostic criteria used) (16-19). Values reported for various populations (US Asian Indians, Native American population, African American population, Chinese population, Indian population, Northern Jordanians, Lebanese population, Iranian population, Spanish population, Turkish Mediterranean population, Greek Mediterranean population, Slovakian population, Australian population) have generally ranged between 30% and 50% (20-22).

However, the majority of studies have shown a higher prevalence than previously estimated, with continual increases globally. Over the past decades, modern society has experienced rapid socioeconomic growth, resulting in lifestyle changes that promote the development of components of metabolic syndrome within the population. Even in populations previously considered to have a low prevalence (Italian population, Greek population), values have reached 20-25% (23, 24). These differences cannot be fully explained only by population genetics and may be more readily indicative of the interplay between environmental influences, lifestyle, and socio-demographic factors (25).

Over the past several decades, Romania has experienced lifestyle changes (increasing consumption of a contemporary high-fat diet, carbonated soft drinks, meat, fast food, and processed foods) that have promoted the development of components of the metabolic syndrome within the population. However, the prevalence of MetS in Romania remains largely unknown, the data published so far reporting a prevalence of approximately 40% (26).

It has been suggested that therapeutic lifestyle changes for the management of patients with metabolic syndrome are undoubtedly necessary (3, 27), a multifactorial approach based on exercise, diet, and education being required to develop effective public health intervention (3, 28). However, for effective intervention, it is mandatory, in the first place, to emphasize the role of an unhealthy lifestyle in the development of the metabolic syndrome. This study aimed to investigate the relationship between an unhealthy lifestyle and the risk of metabolic syndrome.

Material and Methods

The study was performed on a representative sample of 181 patients, 54 (29.8%) males and 127 (70.2%) females, aged 59.95±10.8 years (minimum 36, maximum 87 years) drawn from a Romanian population (81% from urban environment). The baseline survey was conducted between October 2015 and January 2016, in the Rehabilitation Hospital Cluj-Napoca and involved completion of a simple self-administered structured questionnaire and a clinical exam. The local institutional Ethics Committee approved the study and all participants gave written informed consent.

Questionnaires

The questionnaires covered socioeconomic characteristics (age, education, occupation), personal medical history, psychosocial factors, diet, and cigarette smoking, alcohol drinking, and regular exercise habits.

Participants were divided into three groups according to their education level, i.e., high (those who completed PhD, university or college studies), medium (those who completed middle or high school studies), and low (those who completed elementary school studies).

Participants were asked about their routine daily dietary pattern (number of meals/day, caloric intake, amount, preference for some foods) as well as the number of meals/day (>3/day vs ≤ 3/day). They provided information on the amount of dietary salt, being assigned to the following categories: those with no

dietary salt intake, those who used dietary salt substitutes, those with a low dietary sodium intake, and those with dietary salt intake. Patients of the first two categories were classified as "no dietary salt intake," while patients in the last two categories were classified as those "with dietary salt intake."

Concerning dietary fat intake, patients reported to have no dietary fat intake, low dietary fat intake, or high dietary fat intake. The patients in either one of the last two categories were considered to have a "fat diet." Depending on the type of meat consumed, patients were divided into 3 categories: those who consumed no meat, those who consumed only white meat (chicken or fish), and those who consumed red meat (alone or associated with white meat). Patients reported to consume fresh fruit and vegetables in no cases, on a weekly basis, or a daily basis. Patients were assimilated to the group that consumed fruit or vegetables only if they reported to consume them almost daily.

Participants reported the consumption of sugar-sweetened beverages, including soft drinks (Coke, Pepsi, Sprite, or other carbonated soft drinks). Drinkers were divided into three groups depending on the amount of alcohol consumed: almost never drinkers (never or occasional i.e. a few times/years), moderate drinkers (between 1-2 times per month and 1-2 times per week) and heavy drinkers (almost daily or many times/day). Regarding smoking, individuals were classified based on whether the respondent was a non-smoker, a past-smoker (discontinuance of 3 months or more), or a current smoker. Past smokers were those who reported that they had smoked at least 100 cigarettes during their lifetime but who did not currently smoke cigarettes. Pipe or cigar smokers are very rare among Romanian people and none existed in this cohort.

Regarding physical exercise, patients who performed physical exercise or a sport at least once a week were considered active.

Anthropometric measure

For each patient, weight, height, and abdominal circumference were measured. The waist circumference was taken midway between the inferior margin of the last rib and the iliac crest in the horizontal plane while in an upright position. The body mass index (BMI) was calculated and expressed in kg/m2. Patients who had a total serum cholesterol value higher than 200 mg% or a serum triglyceride value higher than 150 mg% were considered to by dyslipidemic. Patients were divided depending on their BMI into normal weight (BMI<25 kg/m2), overweight (BMI between 25 kg/m2 and 29.99 kg/m2) or obese (BMI≥30 kg/m2).

Blood pressure and cardiovascular diseases

Data on blood pressure were collected. For the measurement of blood pressure, participants rested initially for 15 min. A qualified person measured afterwards the blood pressure. Uncomplicated hypertension was not recorded as a cardiovascular disease, being considered a cardiovascular risk factor. At the same time, data on cardiovascular pathology were recorded. All patients submitted to an ECG examination. Cardiovascular diseases included coronary heart disease, heart failure, stroke, peripheral artery disease, or other confirmed cardiovascular diseases.

Blood samples

Blood samples were obtained from the antecubital vein, with the patient in seated position, in the morning after a 12-hour overnight fast. Samples were subsequently analyzed at a certified central laboratory. Plasma lipid values (total cholesterol, HDL-cholesterol, LDL-cholesterol and serum triglycerides) and glycemia were determined.

Metabolic syndrome definition

The classification of the metabolic syndrome was based on the IDF guidelines (29), metabolic syndrome being defined as abdominal obesity (> 94 cm in men, > 80 cm in women) plus 2 other criteria from the following: fasting plasma glucose or previously diagnosed type 2 diabetes, high blood pressure or treatment of previously diagnosed hypertension, low HDL-cholesterol (< 40mg/dl in males, <50 mg/dl in females), and high triglycerides ≥ 150mg/dl.

Statistical analyses

Data were analyzed using SPSS 16.0 (Demo Version). Descriptive analysis was used to evaluate the demographic and clinical characteristics of the patients. We calculated the mean and standard deviation for normally distributed quantitative variables.

Differences between quantitative variables were examined using the Student test (independent-sample T test), and for qualitative variables, the $\chi 2$ test. Odds ratios (OR) are presented together with their 95% confidence interval. A p-value < 0.05 was considered statistically significant.

Results

The mean age of the women was 58.6±10.64 years, of men, 63.11±10.62 years (p=0.01).

The global prevalence of metabolic syndrome was 68% (123 patients), no significant sex differences being found between the two sexes (63.8% in women vs 77.8% in men, p=NS).

No significant differences in total cholesterol or LDL-cholesterol were found between patients with and without metabolic syndrome.

Patients with metabolic syndrome presented higher values of abdominal circumference, systolic and diastolic arterial blood pressure, serum triglycerides and glycemia, and lower HDL-cholesterol values. At the same time, they were more frequently hypertensive (79.7% vs 43.1%, p=0.0001), diabetic (36.6% vs. 1.7%, p=0.0001), and obese (47.2% vs 15.5%, p=0.0001). Table 1 shows the baseline characteristics of patients with metabolic syndrome compared to those patients without metabolic syndrome.

Table 1. Baseline patient characteristics

	MetS present	MetS absent	Global	p
	Mean ± SD	Mean ± SD	Mean ± SD	
Age (years)	60.60 ±10.85	58.57±10.67	59.95±10.81	NS
Weight (kg)	84.84 ±17.92	70.31±11.13	80.18±17.41	<0.001
Height (cm)	165.95±17.18	163.57±6.89	165.19±14.71	NS
Waist (cm)	102.62 ±13.55	87.93±11.05	97.91±14.50	<0.001
Body mass index (kg/m^2)	30.47±4.86	26.26±3.71	29.11±4.92	<0.001
Systolic blood pressure (mmHg)	138.46±25.84	120.86±37.38	132.82±31.03	<0.001
Diastolic blood pressure (mmHg)	85.24±15.26	76.38±23.20	82.40±18.59	<0.001
Glycemia (mg/dl)	109.11±27.07	88.33±9.91	102.45±24.95	<0.001
Total cholesterol(mg/dl)	209.63±47.73	215.86±39.35	211.62±45.20	NS
LDL-cholesterol(mg/dl)	131.44±39.81	141.48±34.56	134.66±38.40	NS
HDL-cholesterol(mg/dl)	42.24±8.47	51.52±8.41	45.22±9.48	<0.001
Triglycerides (mg/dl)	180.48±90.26	113.93±45.65	159.15±84.56	<0.001
Education	**Number (%)**	**Number (%)**	**Number (%)**	
Low	5(4.1)	3(5.2)	8(4.4)	NS
Medium	89(72.4)	29(50)	118(65.2)	0.005
High	29(23.6)	26(44.8)	55(30.4)	0.006
Alcohol				
Never	94(76.4)	44(75.9)	138(76.2)	NS
Moderate	24(19.5)	14(24.1)	38(21)	NS
Heavy	5(4.1)	0(0)	5(2.8)	NS
Smoking status				
Never	76(61.8)	35(60.3)	111(61.3)	NS
Past	30(24.4)	8(13.8)	38(21)	NS
Present	17(13.8)	15(25.9)	32(17.7)	NS
Hypertension	98(79.7)	25(43.1)	123(68)	0.0001
Diabetes mellitus	45(36.6)	1(1.7)	46(25.4)	0.0001
Dyslipidaemia	93(75.6)	37(63.8)	130(71.8)	NS
Overweight	56(45.5)	32(55.2)	88(48.6)	NS
Obesity	58(47.2)	9(15.5)	67(37)	0.0001
Physical exercise	35(28.5)	15(25.9)	50(27.6)	NS

*p- between MetS+ vs. MetS -

In addition, we studied the influence of lifestyle factors on the presence of metabolic syndrome. Rural environment, lower education level, past smoking, the absence of fruit/vegetables in the diet, carbonated soft drinks, and heavy alcohol consumption were risk factors for the metabolic syndrome. The strongest risk factor was the rural environment (OR = 2.554), followed by a low level of education (OR = 2.63), past smoking (OR =1.72), and heavy alcohol consumption. Current smoking, the consumption of small alcohol amounts and the consumption of fruit/vegetables seemed to have a protective effect on metabolic syndrome development. In contrast, dietary salt intake and red meat consumption were not statistically significant risk factors for the metabolic syndrome. All data are shown in Table 2.

Table 2 - The influence of lifestyle factors on the presence or absence of metabolic syndrome

Risk factor	MetS + Number (%)	MetS - Number (%)	p	OR	95% CI
Male sex					
Male	42(34.1)	12(20.7)	0.06	1.98	0.95-4.15
Female	81(65.9)	46(79.3)			
Environment					
Rural	28(22.8)	6(10.3)	0.05	2.554	0.99-6.56
Urban	95(77.2)	52(89.7)			
Education level (high vs other)					
Low/Medium	94(76.4)	32(55.2)	0.05	2.63	1.36-5.097
High	29(23.6)	26(44.8)			
Past smoking vs no smoking					
Past	30(24.4)	8(13.8)	NS	1.72	0.71-4.14
Never	76(61.8)	35(60.3)			
Current smoking vs no smoking					
Current	17(13.8)	15(25.9)	NS	0.52	0.23-1.16
Never	76(61.8)	35(60.3)			
No meals/day > 3					
Yes	14(11.4)	7(12.1)	NS	0.936	0.36-2.39
No	109(88.6)	51(87.9)			
Dietary salt intake					
Yes	97(78.9)	46(79.3)	NS	0.973	0.45-2.08
No	26(21.1)	12(20.7)			
Fat diet					
Yes	79(64.2)	41(70.7)	NS	0.76	0.38-1.45
No	44(35.8)	17(29.3)			
Red meat consumption					
Yes	70(56.9)	33(56.9)	NS	1	0.53-1.873
No	53(43.14)	25(43.1)			
Fruit/vegetable consumption					
Yes	86(69.9)	44(75.9)	NS	0.74	0.36-1.50
No	37(30.1)	14(24.1)			
Carbonated soft drinks consumption					
Yes	38(30.9)	16(27.6)	NS	1.174	0.59-2.32
No	85(69.1)	42(72.4)			
Small alcohol amounts consumption					
Moderate	24(19.5)	14(24.1)	NS	0.80	0.37-1.69
Never	94(76.4)	44(74.9)			

*95% CI= confidence interval 95%

We also investigated the relationship between risk factors previously having an influence in producing the metabolic syndrome and the number of metabolic syndrome components, based on the observation that metabolic syndrome patients with a greater number of metabolic syndrome components (4 or 5) exhibited a higher proportion of "bad habits" (Table 3).

Table 3. Relationship between risk factors and the number of metabolic syndrome components

	Number of metabolic syndrome components		
	3	4	5
	Number (%)	Number (%)	Number (%)
Environment			
Rural	6(14)	12(24)	10(33.3)
Urban	37(86)	38(76)	20(66.6)
Education level (high vs other)			
Low/Medium	31(72.1)	38(76)	15(83.3)
High	12(27.9)	12(24)	5(16.7)
Smoking			
Never	32(74.4)	28(56)	16(53.3)
Past	7(16.3)	12(24)	11(36.7)
Current	4(9.3)	10(20)	3(10)
Fat diet			
Yes	28(65.1)	34(68)	17(56.7)
Red meat consumption			
Yes	28(65.1)	28(56)	14(46.7)
Fruit/vegetable consumption			
Yes	31(72.1)	33(66)	22(73.3)
Carbonated soft drinks consumption			
Yes	14(32.6)	13(26)	11(36.7)

Discussion

Metabolic syndrome (MetS) is currently a public health problem which has been given increasing attention yet which generates controversy regarding its relationship with cardiovascular disease and cardiovascular risk factors, as well as regarding its role as a risk factor (30). The fact that metabolic syndrome is a strong predictor of vascular risk, independent of insulin resistance, and a risk factor for the appearance of strokes is no longer news (31). Brown, in a very recent article, has shown that medication alone is not enough for the control of the prevalence of metabolic syndrome and, further, that intensive therapeutic lifestyle changes are needed (32). Recently published studies have shown that a healthy lifestyle (characterized by the daily consumption of fruit and vegetables, the low consumption of alcohol, non-consumption of carbonated soft drinks and saturated fats, avoidance of a sedentary lifestyle and non-smoking) is characterized by a decrease in cardiovascular risk (1). The likelihood of metabolic syndrome significantly decreases based on the number of healthy habits practiced (non-smoking, moderate food intake, moderate alcohol intake, regular exercise, adequate rest, adequate enjoyable activities) (33).

Currently, there is ongoing interest in the influence of an unhealthy lifestyle on the risk of metabolic syndrome, yet some aspects of this relationship remain controversial, while the multiple interferences of risk factors and the therapeutic impact of a change in lifestyle are emphasized (34). At present, it is not known which of the different diet recommendations can most effectively reduce the risk of metabolic syndrome (35). The identification of the diet regime, of the food groups and the nutrients, and of the habits that may diminish the risk of metabolic syndrome will improve prevention strategies and the prognosis of metabolic syndrome (36). The identification of unhealthy habits and their reduction should become a standard in medical practice (37).

Considering the above and knowing the importance of some common risk factors in the production of cardiovascular disease, we attempted to study their role in the appearance of metabolic syndrome.

Previous studies have shown that low socioeconomic status is related to a higher risk for

cardiovascular diseases and metabolic syndrome (25, 38) and have argued that an improvement in overall socioeconomic status would decrease the prevalence of metabolic syndrome (1).

Various characteristics of individuals might contribute to explaining why low socioeconomic status may increase the risk of metabolic syndrome. For example, such persons are more likely to engage in unhealthy behaviors such as smoking, low physical activity, and poor diet, which correlate with obesity, high blood pressure, and a poor lipid profile (39). Also, it is well known that a low education level correlates with lower incomes and lower socioeconomic status. Under these conditions, our finding that a low education level represents a risk factor associated with metabolic syndrome comes as no surprise.

Previous studies have shown a strong association between education level and the risk of cardiovascular death (38). Our results, showing a greater prevalence of metabolic syndrome in the rural environment (OR = 2.54) and the influence of the education level on the risk of MetS (the risk for subjects with a medium/low education level being 2.63-fold higher) can be explained by a lower degree of information and awareness of a healthy lifestyle and its importance. This finding contradicts the results of Park (6, 40), who found no significant association between the metabolic syndrome and education level, yet is consistent with studies by Lee, Wamala or Santos (35, 41, 42).

Smoking is known to impair insulin action and may lead to insulin resistance (43-45). Smokers have been shown to be hyperinsulinaemic, dyslipidaemic, with a higher prevalence of abdominal obesity and hypertension, with higher triglyceride levels and lower HDL-cholesterol levels (6, 46-48). Past smoking is also known to be a risk factor for metabolic syndrome (49-51), the results of this study being consistent with others showing a 1.72-fold higher risk compared to non-smokers. At the same time, Hishida showed that smoking cessation significantly elevated the risk of MetS, this detrimental effect being only a short-term effect, the mechanism probably involved being weight gain (52).

In the present study, current smoking was found to be protective for metabolic syndrome, a finding that disagrees with other studies (6, 53, 54) but in accordance with another recently published study (42). In addition, Onat, in a study performed on more than 3000 participants, showed that heavy cigarette smoking is "protective" for future metabolic syndrome in Turkish women, mainly via protection from obesity, presumably due to induced lack of appetite (55); however, this apparent "protection" needs more confirmation (55).

It is already known that dietary factors contribute to the risk of developing metabolic syndrome (4), and the Westernized dietary pattern (high red meat, fat, alcohol consumption, low fruit and vegetable consumption) is suggested to be one of the links involved in the appearance of metabolic syndrome (4, 56).

The presence of a balanced diet with a constant number of meals/days was analyzed as a risk factor in the appearance of metabolic syndrome; subjects having a smaller number of daily meals (<3) had a higher risk compared to those having a constant number of regular meals.

Salty food (or dietary salt intake) was not associated with an increased risk for developing MetS, neither in our study nor in previously published studies (4). Hoffmann, in an article published in 2009, revealed that subjects with the metabolic syndrome might eat approximately 1.5-2 g more salt compared to those without the metabolic syndrome (57). A possible explanation for these discrepancies may lie in the incapacity of people to properly evaluate their salt intake (e.g., differences between people regarding the meaning of salty food).

Previous studies (4, 25, 27) have shown that a higher intake of oily foods was associated with an increased risk of MetS. In our population, a fat diet (rich in fats and oils) was not associated with the presence of metabolic syndrome. The explanation for this may be related to traditional Romanian eating habits, to the fact that Romanian people do not recognize all the fat foods (for example they did not take into account red meat, used cooking oil, and cream).

Even though a previous study found that subjects adherent to a Western dietary pattern (including red meat, but also other high-fat dairy products, sweets and desserts, soft drinks) had significantly greater odds of developing MetS (57, 58), we did not find an association between red meat consumption and MetS.

However, the beneficial effects of fruit and vegetable intake in the framework of dietary patterns were previously reported (59) and the healthy food pattern (cereals, fish, vegetables and fruit) was inversely associated with MetS components (25). At the same time, the consumption of fruits and vegetables has been shown to have a protective effect on MetS development (4, 56, 60-61). Our results are consistent with these studies and emphasize the fact that those who consumed fruit or vegetables had a lower risk for developing

metabolic syndrome. Considering the favorable action of fruit and vegetable consumption on metabolic syndrome and inflammatory markers, it seems that an increased consumption of these products will reduce considerably the corresponding risk of metabolic disorders (59).

Several reports from the United States and Europe indicate increasing consumption of sugar-sweetened beverages, including soft drinks, among children, adolescents, and adults over the past 3 decades (62-64). The excessive intake of regular and diet carbonated soft drinks has been described as a risk factor for metabolic syndrome (58, 62). Davidson (in a study in rats) (65) proposes a possible explanation for the "negative effects" of carbonated soft drinks, suggesting that the consumption of artificial sweeteners impairs the ability of the body to predict the caloric content of foods and may lead to increased food intake and body weight. In addition, an association of the soft drink intake with obesity and higher insulin resistance were attributed to several factors such as a high fructose corn syrup content, lower satiety, higher caloric intake, accumulation of visceral adiposity, and increasing hepatic de novo lipogenesis, but also to the effect of fueling metabolic derangements (62, 66). In addition, soft drinks seem to have several psychological effects that may pose an adverse metabolic risk (62-64). Individuals with a higher intake also have a dietary pattern characterized by a higher intake of calories and saturated fats, lower consumption of fiber and dairy products, and a sedentary life style (67-68). The negative effect regarding the presence of the metabolic syndrome is found even in 1 soft drink/day consumers (62). Our results are consistent with the mentioned ones, showing that subjects who consume carbonated drinks have a 1.17-fold higher risk to develop metabolic syndrome.

A literature review shows that the relation between alcohol consumption and (MetS) is not consistent (69), studies reporting different results (54). Mild to moderate consumption of alcohol has a relative favorable influence on lipid metabolism, glucose regulation, and abdominal obesity; on the other hand, alcohol consumption is also related to hypertension and hypertriglyceridemia, constituting alcohol-related metabolic syndrome (69, 70). In some studies (including ours), light or moderate alcohol consumption has been associated with a decrease in the risk of cardiovascular mortality and morbidity (13), but also with a smaller odds ratio for metabolic syndrome (6, 69, 71). The possible explanation for this effect is related not only to the beneficial effect of mild alcohol consumption on HDL-cholesterol and blood pressure (6, 72, 73), but also to the inhibition of low-density lipoprotein cholesterol oxidation, the decrease of insulin levels, and the increase of insulin sensitivity (71).

We also studied the influence of an unhealthy lifestyle on the number of metabolic syndrome components and found that the percentage of subjects with an unhealthy lifestyle was directly proportional to the number of metabolic syndrome components.

The results obtained are important for the assessment of the multiple facets of the pathogenicity of the metabolic syndrome (74-75), in which environmental factors play an overwhelming role.

Limitations of the study include the small number of patients, the incapacity to perform an accurate investigation on the exercise program, on fat ingestion (number of calories, type of fats - saturated or unsaturated-), and on the exact salt amounts used. A more detailed questionnaire should be used in the future. Furthermore, data on some behaviors (such as alcohol consumption) are based on self-declaration with the possibility of misclassification of exposure due to under-reporting (76-77).

Conclusions

In conclusion, this research suggests the importance of healthy dietary patterns for reducing the incidence of metabolic syndrome. A rural environment, past smoking, a lower education level, the absence of fruit/vegetables in the diet, carbonated soft drinks, and the heavy consumption of alcohol represent risk factors for metabolic syndrome. The identification of unhealthy habits and their reduction should become a standard in medical practice. Further prospective studies are needed to clarify the role of dietary intervention on the prevention of metabolic syndrome and consequent morbidity and mortality.

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