

## **FOOD CHOICES, PHYSICAL ACTIVITY AND METABOLIC HEALTH IN OBESE PATIENTS**

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### **ABSTRACT**

The aim of the current study was to analyse the food choices and physical activity of obese adult Estonian persons, and associations with the prevalence of metabolic syndrome. The study was carried out on 76 patients aged over 35 years whose body mass index was  $\geq 30$  kg/m<sup>2</sup>. The subjects were recruited through family physicians. The subjects' consumption of three food groups (fruit, vegetables, whole-grain products) and physical activity based on the IPAQ questionnaire was compared with the prevalence of metabolic syndrome based on five indicators (waist circumference, triglycerides, HDL-cholesterol and fasting plasma glucose, blood pressure). The prevalence of metabolic syndrome was found to be 50%. The results of the study did not show statistically significant correlations between prevalence of metabolic syndrome and age or gender. Neither were there any significant age or gender differences in the subjects' nutritional and activity behaviour. Comparison of the nutritional behaviour of persons with and without the metabolic syndrome showed that daily consumers of fruit had a 4.48 times lower risk of metabolic syndrome than those who ate fruit more seldom. No statistically significant correlation was found between physical activity and prevalence of metabolic syndrome. Based on the current study, the daily consumption of fruit can be an essential protective factor against metabolic syndrome in obese patients and provides a simple recommendation physicians can give their patients to follow.

**Keywords:** *obesity; physical activity; eating habits; metabolic syndrome*

## INTRODUCTION

According to the World Health Organisation (WHO) criteria, obesity is defined by having a body mass index (BMI) of more than 30 kg/m<sup>2</sup> [41]. In 2014, 13% of the world population [40] and 32% or approximately one third of the population of Estonia [12] were obese.

The metabolic syndrome (MetS) is a complex of risk factors for diabetes and cardiovascular disease (CVD) [2]. An estimated 20–25% of the world's adult population suffer from MetS [3] and only 6–32% of obese persons do not have MetS, meaning they are metabolically healthy [27].

Obese persons have a 1.7–1.9 times higher risk of CVD, and this is directly correlated with the person's BMI; for example in the case of morbid obesity (BMI  $\geq$  40 kg/m<sup>2</sup>), the risk of CVD can already be 3.1 times higher [19]. Patients with MetS, however, have a 2.3 times higher cardiovascular morbidity and 2.4 times higher CVD mortality, 2 times higher risk of myocardial infarction, 2.3 times higher risk of stroke and 1.6 times higher over-all mortality [22]. In addition, according to different estimations, they have a 2–11 times higher risk of type 2 diabetes [32].

The exact reason why some obese people are healthier than others is not known [14]. The possible causes are several factors of lifestyle and heredity, like physical activity, genetic background, nutrition, etc. [1].

For example, a meta-analysis summarising the correlations between fruit and vegetable consumption and MetS found that consumption of fruit and vegetables has a positive influence on the decrease of diastolic blood pressure but not on the general prevalence of MetS [33]. Gender has also been found to be a protective factor of metabolic health; namely, several studies have found that in obese women MetS occurs more seldom than in men [11, 21, 30].

It has also been found that the probability of “metabolic health” decreases with age [6, 11, 23, 29, 34, 39]. Therefore, the absence of MetS in obese persons has been considered only a transitional phase before its onset [23]. At that, in the case of the elderly, the problem can lie in the inappropriateness of the BMI as an indicator of their health and obesity, as it does not show the amount of the adipose tissue, and thus, research results can mistakenly show a decrease in the proportion of metabolically healthy obesity with an increase of age [1].

There have also been many studies of associations between physical activity and metabolic health. For example comparisons of the level of physical activity in patients with MetS and without MetS [9, 18, 24], leisure time physical activity in relation to MetS [15, 35], sedentary time in relation to MetS [24, 31] and intervention studies of physical activity for obese persons with MetS [7,

20, 25]. Still, no consensus has been reached as a result of these studies on the association between the prevalence of MetS and physical activity.

As obesity is very prevalent, and having MetS increases the risk of morbidity even more, it is essential to find the reasons why some obese people are healthier than others and give obese persons simple recommendations for staying healthy.

The aim of the current study was to analyse food choices and physical activity of obese adult Estonian persons, associated factors and correlations with MetS.

## **MATERIAL AND METHODS**

The study is based on the cross-sectional research project “Associations between chronic diseases and ageing, changes in bone, fat and muscle tissue and impact of endocrine factors”. The study was supported by the Estonian Research Agency’s grant Institutional Research Funding 2–8.

The subjects were adult persons with a BMI over 30 kg/m<sup>2</sup> who volunteered to participate in the study. Persons aged over 35 years were recruited so that the potential health changes associated with obesity would have been developed. The subjects were invited to participate in the study through family physicians of Tartu and Tartu County (24 in total). The subjects were recruited into the study from 1 May 2016 to 28 June 2018.

Family physicians measured the patients’ blood pressure, body weight and height, took blood samples and gave them questionnaires to be filled in at home. The blood samples were analysed at Tartu laboratory of Synlab.

The current study is based on three parts of the questionnaire: general information, questionnaire on lifestyle and International Physical Activity Questionnaire (IPAQ). The patients were invited to a densitometric investigation where the questionnaires filled by them were collected.

The following five indicators were used as MetS criteria: glucose, HDL-cholesterol and triglycerides levels in blood, blood pressure values and waist circumference. For diagnosing of MetS, at least three indicators out of five had to exceed the set level:

1. Waist circumference greater or equal to 102 cm in men and 88 cm in women.
2. Triglycerides level in blood higher or equal to 1.7 mmol/l.

3. HDL-cholesterol level in blood less than 1.0 mmol/l in men and 1.3 mmol/l in women.
4. Systolic blood pressure higher or equal to 130 mmHg.
5. Glucose level in blood higher or equal to 5.6 mmol/l. [2]

The patients were considered metabolically “healthy” if they had no MetS indicators or had less than three indicators out of five exceeding the criteria.

Associations of the prevalence of MetS and the subjects’ food choices and physical activity were analysed using questionnaires filled by the subjects themselves. The questionnaire included three binary questions on nutrition: “How often do you eat fruit?”, “How often do you eat vegetables?” and “How often do you eat whole-grain products?”, to which the subjects replied if it was daily or less than daily.

The subject was considered a healthy eater if she/he consumed products of at least two food groups (fruit, vegetables, whole-grain products) daily.

To measure physical activity, the short form of IPAQ was used, which is suitable for retrospective studies [8]. The questionnaire consists of seven questions about physical activities of different intensity and their duration during the last week. Activities of different intensity were weighed according to categories, and MET-minutes (metabolic equivalent) per week were found. The MET-minute shows estimated resting energy expenditure. Based in this, the respondents were divided into three groups: persons with high, moderate and low physical activity.

Statistical analysis was performed with Stata/IC 14.2 data analysis program. To find correlations between categorical variables, the Fisher test was used and, when statistically significant correlations were found, the logistic regression model was used to find the direction of the correlation.

The study has a permission from the Research Ethics Committee of the University of Tartu 255/M-13.

## **RESULTS**

Altogether 88 patients were recruited; 12 of them were left out as one or more significant variables for performing the analysis were missing; thus, the final sample included 76 persons. The subjects’ mean age was 51 years; the youngest of them was 34 and the oldest 75 years old. The demographic data of the study group are presented in Table 1.

**Table 1.** Description of the sample

	Men			Women			Total		
	N	%	SD	N	%	SD	N	%	SD
<b>Sample</b>	28	37		48	63		76	100	
<b>Mean age</b>	51		10	51		10	51		10
<b>Mean BMI</b>	31		9	36		7	35		8
<b>Prevalence of MetS</b>	17	45		21	55		38	50	

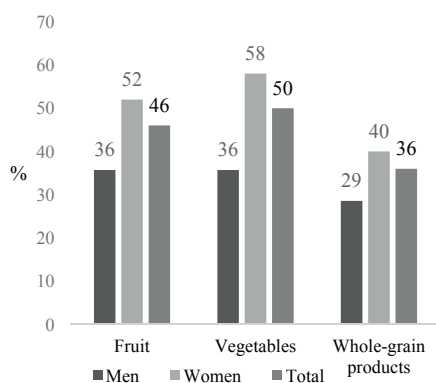
During the study, the BMI was calculated twice – first by the family physician to confirm the patient's suitability for the study and, for the second time, during data analysis based on the results of the densitometric study. Therefore, the body weight received as a result of the densitometric study is used below, as it was standardised for all subjects. The subjects' lowest BMI was 29.34 kg/m<sup>2</sup>, which is not considered obesity, although it is on the borderline between overweight and obesity. The highest BMI was 51.75 kg/m<sup>2</sup>.

Consumption of food groups by the sample is shown in Figure 1. There were only 8 persons who consumed the food of all the three groups (fruit, vegetables, whole-grain products) daily. When the subjects were divided into two groups according to a more lenient criterion (eating two out of the three food groups daily), they were divided nearly equally; the group of healthy eaters included 37 people and the group of less healthy eaters 39.

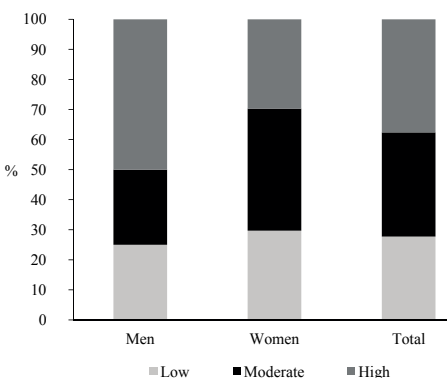
According to physical activity, the subjects were divided into three groups: low, moderate and high physical activity. The distribution of the sample into physical activity groups is shown in Figure 2. In the case of four patients, this could not be calculated, as they had answered "do not know". On average, sedentary time spent by subjects was 385 minutes per day (s=198).

**Table 2.** Levels of metabolic syndrome indicators in subjects

	Mean	95% CI
<b>Triglycerides (mmol/l)</b>	1.87	1.6–2.2
<b>HDL-cholesterol (mmol/l)</b>	1.35	1.28–1.43
<b>Systolic blood pressure (mm Hg)</b>	132	129–135
<b>Glucose (mmol/l)</b>	5.68	5.47–5.88
<b>Waist circumference (cm)</b>	111	109–114



**Figure 1.** Percentage of daily food groups consumption in Estonian obese patients, by gender and in total



**Figure 2.** Physical activity in Estonian obese patients based on IPAQ, by gender and in total

MetS criteria were fulfilled by exactly half of the subjects; consequently, its prevalence was 50%. In addition, the prevalence of each MetS indicator was viewed separately. Triglycerides level was heightened in 41%, systolic blood pressure in 48%, glucose in 49%, waist circumference in 100% of subjects; HDL-cholesterol level was lower in 19% of them.

Based on the nutrition groups, no statistically significant correlation was found between the prevalence of MetS and nutrition ( $F=0.17$ ). To find the correlations between the prevalence of MetS and consumption of specific food groups, logistic regression analysis was performed, which showed a significant correlation between the consumption of fruit and the prevalence of MetS (Table 3). When fruit was consumed less often than daily, the risk of MetS was 4.48 times higher than at daily consumption ( $p=0.004$ ). Although the result was statistically significant, its confidence interval was very broad. No statistically significant correlation was found between the consumption of vegetables and whole-grain products and the prevalence of MetS ( $p=0.62$  and  $p=0.63$  respectively).

**Table 3.** Logistic regression model of food choices and prevalence of the metabolic syndrome

Metabolic syndrome	Odds ratio	p-value	95% confidence interval
Fruit	4.48	0.004	1.60–12.55
Vegetables	0.78	0.62	0.30–2.08
Whole-grain products	0.77	0.63	0.27–2.22

No statistically significant correlation was found between physical activity and the prevalence of MetS. Neither was a statistically significant correlation found between the prevalence of MetS and sedentary time ( $p=0.5$ ).

## DISCUSSION

The current study analysed the nutrition and physical activity of 76 obese patients aged 34–75 years in primary care. The subjects' mean BMI was 35 kg/m<sup>2</sup>, and half of them had MetS.

It could be surprising that only half of the obese subjects met the MetS criteria. Previously, it has been estimated that only 6–32% of obese persons are “metabolically healthy” [27]. A study conducted in Finland found that only 3.3% of obese persons could not be diagnosed with MetS [26]. A study conducted in Estonia estimated that the prevalence of MetS was 26% of the general population [12].

The relatively low prevalence of MetS among the obese persons in the current study could be explained by notably higher physical activity than in other studies [9, 18, 26]. In the current study, 38% of the subjects were highly, 35% moderately and 28% lowly physically active. This distribution is rather unusual compared to earlier studies. Earlier, it has been found that up to 80% of the obese have a low physical activity level [9]. A reason for the current results can be that 54% of the subjects reside in rural areas, while according to the last Estonian census only 37% of people live outside of towns [10]. People living in rural areas may do more gardening and other housework that increase their physical activity. IPAQ, which was used in the current study, differs from several other physical activity questionnaires namely because it takes into consideration not only leisure time physical activity but also physical activity resulting from daily chores and physical work. This is supported by a study conducted in Estonia, which was also based on IPAQ and found a statistically significant positive correlation between people's place of residence and physical activity [28].

It was also found that the subjects' mean sedentary time was 385 minutes per day. The result was not statistically significantly related to the prevalence of MetS but shows again that the sample of the current study was more active than obese persons on average, as it is similar to the sedentary time of general population in earlier studies [4]. Previously, it has been found that obese persons spend more time sedentarily than the average person [16].

As a result of the study, it was found that fruit was consumed daily by 46%, vegetables by 50% and whole-grain products by 36% of the subjects. The Estonian National Dietary Survey found that, on average, Estonians ate 2 portions of fruit and vegetables daily, and there was no difference between normal-weight and obese persons [37]. Estonians consume whole-grain products in the form of porridges and bread products 16 portions per week, obese persons 17 portions per week [36]. Thus, the findings of the current study were surprising – the subjects' nutrition was considerably less healthy than of Estonians in general, even of other obese people. The difference in consumption of whole-grain products compared to The National Dietary Survey could result from the wording of the question. In The National Dietary Survey, the questions included more concrete food items like whole-grain bread, brown bread, porridges, etc., while in the current study, the term “whole-grain products” was used, which the subjects need not have always understood.

The current study found a statistically significant correlation between daily consumption of fruit and MetS prevalence, while at daily consumption of fruit, the risk of MetS was 4.48 times lower. A similar result was also received in meta-analysis which studied the influence of fruit and vegetable on MetS and its individual indicators. This analysis, however, revealed only a correlation between fruit and vegetable consumption and blood pressure, not with the prevalence of MetS in general [33].

The current study did not find statistically significant correlations between the prevalence of MetS or its individual indicators and consumption of vegetables and whole-grain products. It is possible that, to find a connection between nutrition as a whole and MetS, nutrition should be examined in greater detail, like it has been done in several earlier studies which have found a statistically significant correlation [5, 13, 17, 38].

A weakness of the study is using self-reported physical activity and food choices for analysis. The conductors of the study could not check whether the results could be influenced by social desirability or an information bias. Still, studies carried out with similar methodology were used at the comparison of results. The current study can include a selection bias. As the sample was small, it is possible that the people participating in the study were more interested in participation than average representatives of the obese population. Due to the research design, causal conclusions can't be made. On the other hand, researching the lifestyle and health of obese people could help prevent disease. Early interventions are necessary to help alleviate the seriousness of obesity-related illnesses.



## CONCLUSIONS

The current study did not find any correlations between physical activity, age, gender and the prevalence of MetS in obese patients. The prevalence of metabolic syndrome was 50%. The dietary choices of the participants were not in accordance with dietary guidelines. Physical activity, on the other hand, was higher than expected of an obese group. Based on nutritional behaviour, a significant correlation was found that daily consumption of fruit decreases the risk of having MetS 4.48 times. Based on this, obese patients can be recommended to consume fruit as it is an essential factor in prevention of more severe diseases associated with obesity.

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