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EVALUATION OF THE IMPACT OF LIFESTYLE ON ACCUMULATION OF EPICARDIAL ADIPOSE TISSUE IN ADULTS WITH CARDIOVASCULAR DISEASES USING CARDIAC MAGNETIC RESONANCE IMAGING

Summary of Doctoral Dissertation

Biomedical sciences, public health (09 B)

Vilnius, 2017

The doctoral dissertation was prepared at the Institute of Public Health, Faculty of Medicine, Vilnius University, during the period from 2012 to 2016.

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The doctoral dissertation will be defended at the Public Health Research Council of Vilnius University.

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The official defense of the dissertation is going to be held at 2:00 p. m. on 5 June 2017 at the open session of the Public Health Council in the Great Auditorium of Faculty of Medicine, Vilnius University.

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VILNIAUS UNIVERSITETAS

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ŠIRDIES IR KRAUJAGYSLIŲ LIGOMIS SERGANČIŲ SUAUGUSIŲJŲ GYVENSENOS ĮTAKOS EPIKARDINIO RIEBALINIO AUDINIO SANKAUPŲ DYDŽIUI VERTINIMAS TAIKANT MAGNETINIO REZONANSO TOMOGRAFIJĄ

Daktaro disertacijos santrauka

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ABBREVIATIONS

BMI – body mass index

CI – confidence interval

DICOM – Digital Imaging and Communications in Medicine (standard)

EAT – epicardial adipose tissue

MRI – magnetic resonance imaging

OR – odds ratio

$OR_{adj.}$ – adjusted odds ratio

p-value – statistical significance

ROC – receiver operating characteristic (plot)

WHO – World Health Organisation

χ^2 – chi square

INTRODUCTION

Statement of the problem and relevance

According to WHO, cardiovascular diseases remain the most frequent cause of death worldwide. Annually, around 17.5 million people die from cardiovascular diseases, it accounts for one third of all deaths in the world. More than 7 million people die from coronary artery disease (WHO 2016, WHO 2015). Approximately, 3 million of these deaths occure among the population under 60 years old. The number of these deaths can be reduced by eliminating risk factors such as smoking, unhealthy nutrition, obesity, physical inactivity, abuse of alcohol (WHO 2015, Mendis et al. 2011). The importance of healthy lifestyle formation and control of these risk factors is highlighted in the European policy framework and strategy for the 21st century "Health 2020" (WHO 2013) as well as in "Lithuanian Health Program 2014-2025" (The Seimas of the Republic of Lithuania 2014).

According to the literature, Lithuania falls into the high mortality rate zone from cardiovascular diseases (WHO 2014). In 2015 crude rate of mortality from diseases of circulatory system was 812 per 100 000, from ischemic heart disease – 536 per 100 000 (Institute of Hygiene 2015). Standardized rate of mortality from cardiovascular diseases in Lithuania was 4 times higher than in Japan where this rate is the lowest in the world (WHO 2014).

Cardiovascular diseases are associated with large amount of adipose tissue, occurring as overweight or obesity (Calle et al. 1999). Several studies have revealed that not only the amount of adipose tissue but also its distribution is important for cardiovascular risk. Visceral adipose tissue is associated with significantly higher risk than peripheral adipose tissue (Talman et al. 2014). During the past decade depots of epicardial adipose tissue have been the subject of interest among many researchers. Studies have revealed that epicardial adipose tissue, due to its direct relation to myocardium and coronary arteries, plays an important role in the development of coronary artery or other heart diseases. Recently, scientists have stated that epicardial adipose tissue is a biomarker and may become an important diagnostic tool at early stages of cardiovascular diseases (Talman et al. 2014, Dicker et al. 2013, Muhib et al. 2013).

Studies have revealed that epicardial adipose tissue, depending on nutrition, physical activity, smoking and consumption of alcohol, may differ significantly (Jonker et al. 2013, Wilund et al. 2010, Kim et al. 2009b, Iacobellis et al. 2008, Kim et al. 2009a, Fu et al. 2013, Ormseth et al. 2012, Demircelik et al. 2014, Vaideeswar et al. 2014). However, there is a small number of studies where relationship between lifestyle and accumulation of epicardial adipose tissue is analyzed. Single lifestyle factor impact or results of a short-time intervention are mostly analysed in these studies. There is a lack of complex studies where impact of lifestyle on accumulation of epicardial adipose tissue was analysed. Accumulation of epicardial adipose tissue has not been studied in Lithuania yet.

The aim and objectives

The aim of this study is to assess lifestyle habits and their impact on accumulation of epicardial adipose tissue among adults with cardiovascular diseases.

Objectives:

1. To determine and assess nutritional habits and their influence on the accumulation of epicardial adipose tissue among adults with cardiovascular diseases.
2. To determine and assess habits of alcohol consumption and its impact on the accumulation of epicardial adipose tissue among adults with cardiovascular diseases.
3. To determine and assess smoking habits and their impact on the accumulation of epicardial adipose tissue among adults with cardiovascular diseases.
4. To determine and assess physical activity and its impact on the accumulation of epicardial adipose tissue among adults with cardiovascular diseases.
5. To determine and assess emotional stress and its impact on the accumulation of epicardial adipose tissue among adults with cardiovascular diseases.

Scientific novelty and practical value

Studies have revealed that larger depots of EAT are associated with a greater risk for the development of cardiovascular diseases. It is known that the amount of EAT is associated with nutrition, alcohol consumption, smoking, physical activity and mental health. However, most of the studies analyze the impact of personalized interventions on the amount of EAT. Meanwhile, the impact of self-controlled lifestyle habits was analyzed only in a few studies. In this dissertation the accumulation of EAT was measured from cardiac magnetic resonance images. The association between these results and social characteristics and lifestyle habits were assessed complexively. EAT depots were studied for the first time in Lithuania.

The results of this dissertation may be useful for public health professionals in the development of programs for health promotion and prevention of cardiovascular diseases. This study may also be useful for physicians in the assessment of risk of coronary artery disease and myocardial infarction.

MATERIAL AND METHODS

The search for scientific literature

Scientific publications of Lithuanian and foreign authors were analyzed in preparation of this dissertation.

The search for publications of Lithuanian authors was performed in Lithuanian scientific peer-reviewed biomedical journals included in the list of publications of scientific articles recognized giving academic degree (indexed and included in "ISI Web of science" and/or "Index Copernicus" databases): "Acta Medica Lituanica", "Medicina", "Theory and Practice in Medicine", "Health Sciences", "Public Health".

The search for publications of foreign authors was performed in databases accessible to Vilnius university, open access databases and archives indexed in EBSCO and/or Primo Central catalogues, as well as Medline (Pubmed) and/or Google Scholar. The search was performed using combinations of these keywords: *adipose, tissue, fat, epicardial, visceral, subcutaneous, measurement, cardiac, MRI, thickness, volume, depots, distribution, cardiovascular, risk, coronary artery disease, myocardial infarction, hypertension, cardiomyopathy, nutrition, diet, eating, alcohol, consumption, cigarette, smoking, physical activity, stress, depression, lifestyle, habits, BMI, body mass index, whole grain, refined grain, vegetables, fruits, food selection criteria, salt, beer, wine, social status, parent.*

Publications and databases of WHO, Lithuanian Department of Statistics and Institute of Hygiene as well as references cited in the selected publications were also included in the search.

In total 217 scientific publications were used in the preparation of this dissertation.

Methods of data collection and assessment

The study was conducted according to the Vilnius Regional Biomedical Research Ethics Committee permission. The permission was received in February 12, 2013 (No: 158200-13-576-178), and supplemented in April 8, 2014 (No: 158200-576-PP1-14).

Population of the study

The study involved all 30 to 75-year-old patients appointed for cardiac magnetic resonance tomography at Vilnius University Hospital Santariškių Klinikos from April 2014 to April 2015. Only patients who agreed to participate in the study were involved.

The data collection was carried out for one year.

Assessment of lifestyle habits

Lifestyle habits were assessed using a questionnaire. All respondents were interviewed personally by one researcher. Respondents were asked about their nutritional habits

(criteria of food selection, number of meals per day, nutritional regime, frequency of consumption of various food products, inclination to salt already prepared meals, subjective opinion about eligibility of their nutritional habits for health), consumption of alcohol beverages, smoking, physical activity, emotional stress, current or previous diseases, risk factors, social and demographic factors. The questionnaire for this study was prepared according to the questionnaire which was verified by "European Centre on Health of Societies in Transition" and Regional Office for Europe of World Health Organisation and used for studies of lifestyle habits in Lithuania since 1997 (Pomerleau et al. 1999, Barzda 2011). In order to reduce the impact of informational errors the questionnaire was tested before the beginning of the study: intraclass correlation coefficients >0.8 ($p<0.05$), kappa coefficients >0.4 ($p<0.05$).

Assessment of depots of epicardial adipose tissue

Accumulation of EAT was measured on cardiac magnetic resonance tomography images. Cardiac magnetic resonance imaging was performed for each participant using Siemens MAGNETOM Avanto 1,5T MRI device (Siemens AG, Erlangen, Germany).

Cardiac magnetic resonance images were used to measure volume and thickness of epicardial adipose tissue. Measurements were performed using "MedDream WEB DICOM Peržiūra" – DICOM viewer accessible via web browser (LLC "Softneta", Kaunas, Lithuania).

For higher accuracy, each measurement of EAT was performed by 2 researchers independently (according to methodology which is described further in this document). Average values of measurements provided by both researchers were used for statistical analysis.

Measurement of volume of epicardial adipose tissue

Volume of EAT was estimated according to modified Simpson rule (Fluchter et al. 2007). Using end-diastolic short axis images area of visible EAT was measured in each slice. Area calculation tool of the mentioned software was used for this task. Depots of EAT on left and right ventricles were outlined by hand (Figure 1). Volume of epicardial adipose tissue was calculated by summing up all area measurements and multiplying the sum by the distance between slices.

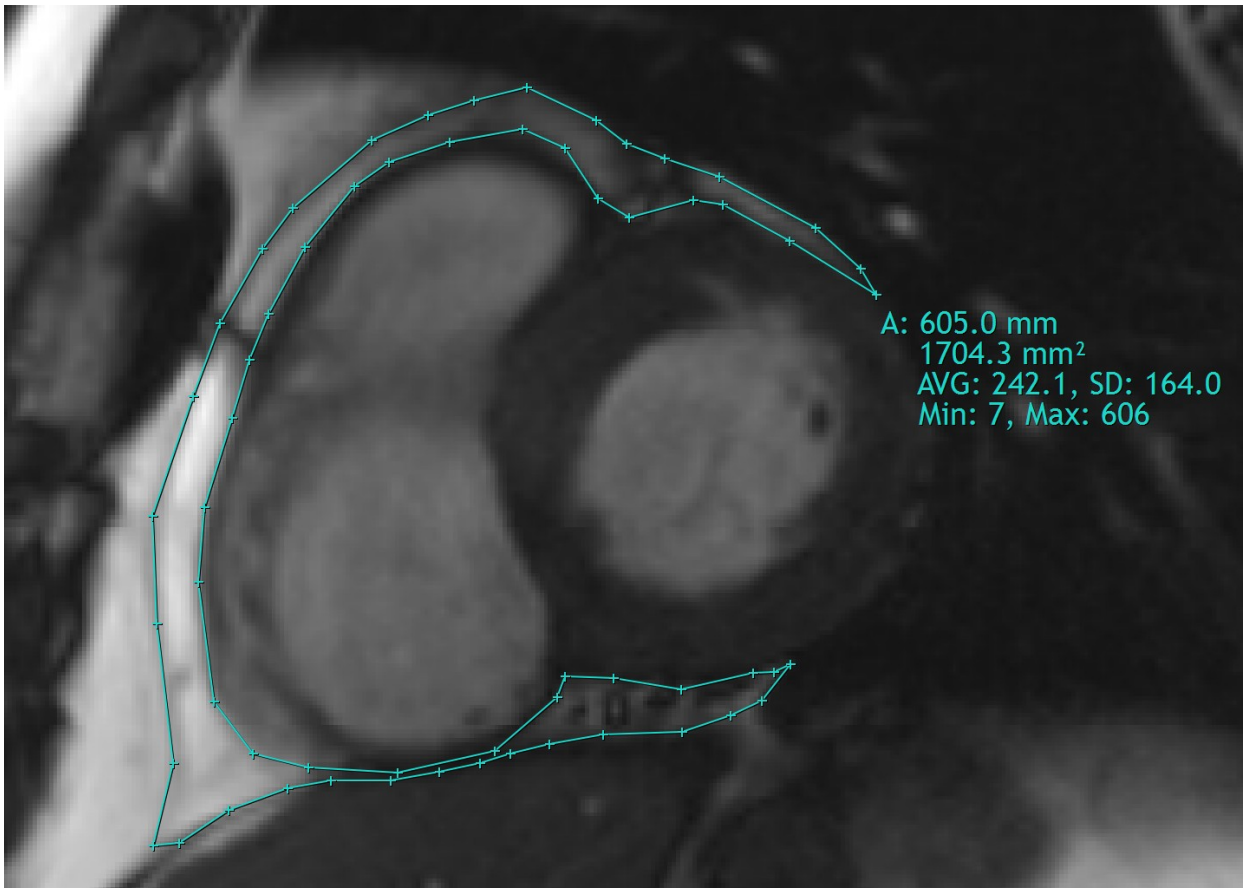

Figure 1. Measurement of EAT area using end diastolic short-axis cardiac magnetic resonance images (for the calculation of EAT volume)

Measurement of thickness of epicardial adipose tissue

Thickness of EAT depots was measured in 11 locations. End-diastolic long-axis images were used for measurements of EAT thickness in right and left atrioventricular grooves and anterior interventricular groove. End-diastolic short-axis images were used to measure thickness of EAT depots on free walls of the left and right ventricles as well as in the superior and inferior interventricular grooves. All locations of the measurements are presented in the Figure 2.

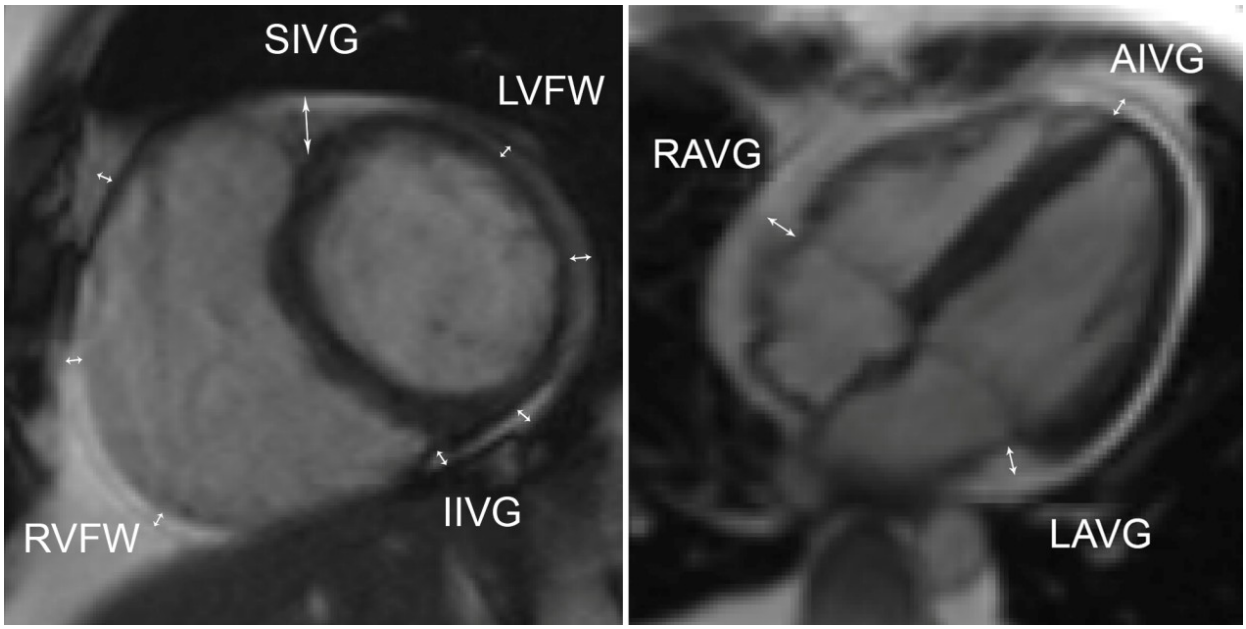

Figure 2. EAT thickness measurement locations using cardiac magnetic resonance imaging: end-diastolic short-axis (left) and long-axis (right) images. LAVG – left atrioventricular groove, RAVG – right atrioventricular groove, AIVG – anterior interventricular groove, IIVG – inferior interventricular groove, SIVG – superior interventricular groove, RVFW (3 locations) – right ventricular free wall, LVFW (3 locations) – left ventricular free wall

Statistical analysis of data

Normality of the distribution of variables was tested using the Shapiro-Wilk test. Levine's test was used to assess homogeneity of variances of normally distributed variable pairs. According to the results of Levine's test an appropriate t-test was used for the comparison of means. Mann-Whitney U test was employed for the comparison of ordinal variables that did not comply the assumptions of normality. Frequencies between groups were compared using the χ^2 criterion when 80% and more of predicted values were greater than 5. If more than 20% of predicted values were lower than 5, Fisher-Freeman-Halton Exact Test was used. Receiver operating characteristic (ROC) curve analysis was performed in order to specify cut-off values for continuous variables. A logistic regression model was composed for the prediction of EAT volume by variables describing demographic characteristics and lifestyle habits. Odds ratios and confidence intervals were calculated for each statistically significant variable of the model. Hosmer-Lemeshow goodness of fit test was applied for the model. Significance level α=0.05 was chosen for statistical analysis. Average values of numeric variables are presented as follows: mean ± standard deviation, if a variable was normally distributed, or median (first quartile - third quartile), if the distribution of a variable was not normal.

RESULTS

Characteristics of the respondents

A total number of 506 adults with various cardiovascular pathology participated in this study. There were 60.3% males and 39.7% females. Median age was 55.0 (46.0-64.0) years, median BMI – 27.2 (24.2-30.8) kg/m^2. There was no statistically significant difference in age and BMI between genders (respectively, p=0.875 and p=0.257). Only one third of the sample had normal BMI (18.5 kg/m^2 <= BMI < 25.0 kg/m^2), one third were overweight (25.0 kg/m^2 <= BMI < 30.0 kg/m^2) and one third were obese (BMI >= 30.0 kg/m^2) (Figure 3).

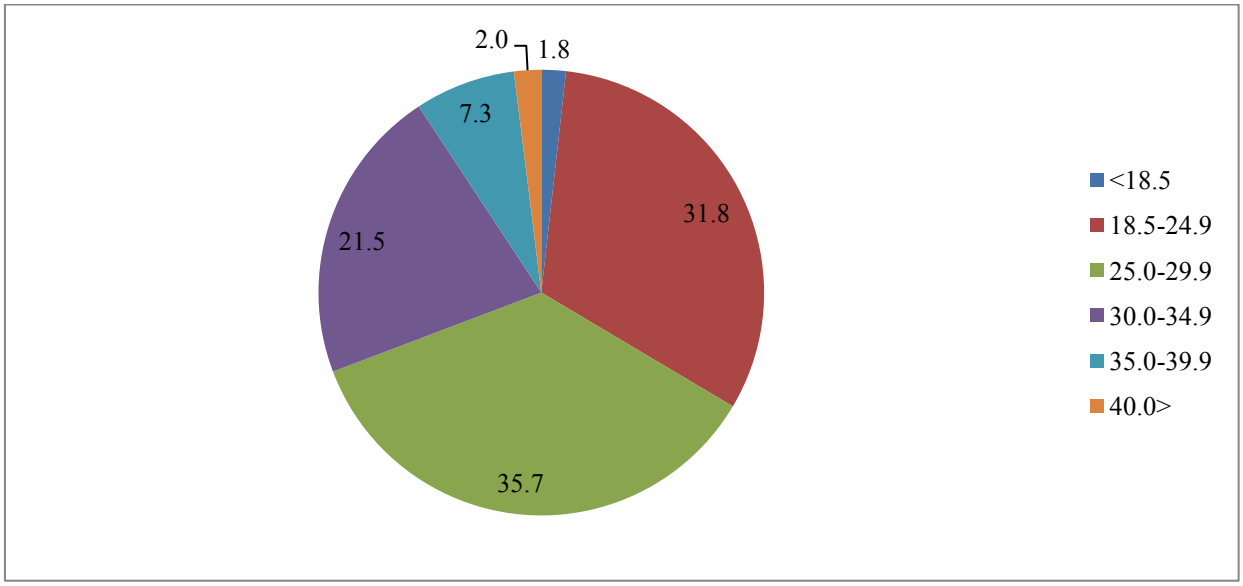

Figure 3. Distribution of the respondents (%) by categories of BMI (kg/m^2)

Most of the participants were married, urban residents. Wast majority of the respondents had children. Sociodemographic characteristics of the participants of the study is presented in Table 1.

Table 1. Sociodemograhic characteristics of the respondents

Variables	Males		Females		Total	
	N	%	N	%	N	%
Total	305	60.3	201	39.7	506	100
EDUCATION						
Lower	180	59.6	122	40.4	302	59.7
High	125	61.3	79	38.7	204	40.3
PLACE OF RESIDENCE						
Urban	244	60.7	158	39.3	402	79.4

Rural	61	58.7	43	41.3	104	20.6
MARITAL STATUS						
Married	263	64.9	142	35.1	405	80.0
Single	42	41.6	59	58.4	101	20.0
HAVE CHILDREN						
Yes	278	60.0	185	40.0	463	91.5
No	27	62.8	16	37.2	43	8.5
EMPLOYMENT						
Employed	200	65.8	104	34.2	304	60.1
Unemployed	105	52.0	97	48.0	202	39.9
AVERAGE INCOME PER MONTH (AFTER TAXES)*						
0-1500 LTL	157	55.5	126	44.5	283	55.9
More than 1500 TL	137	65.9	71	34.1	208	41.1

* 1 LTL = 0.29 EUR

Lifestyle of the respondents

Nutritional habits

Palatability and improvement of health (disease prevention) were the main criteria for food selection. Respectively, 36.3% and 29.0% of the sample chose food according to these criteria. Only one tenth of the respondents indicated price as the main criteria for the selection of food (Figure 4).

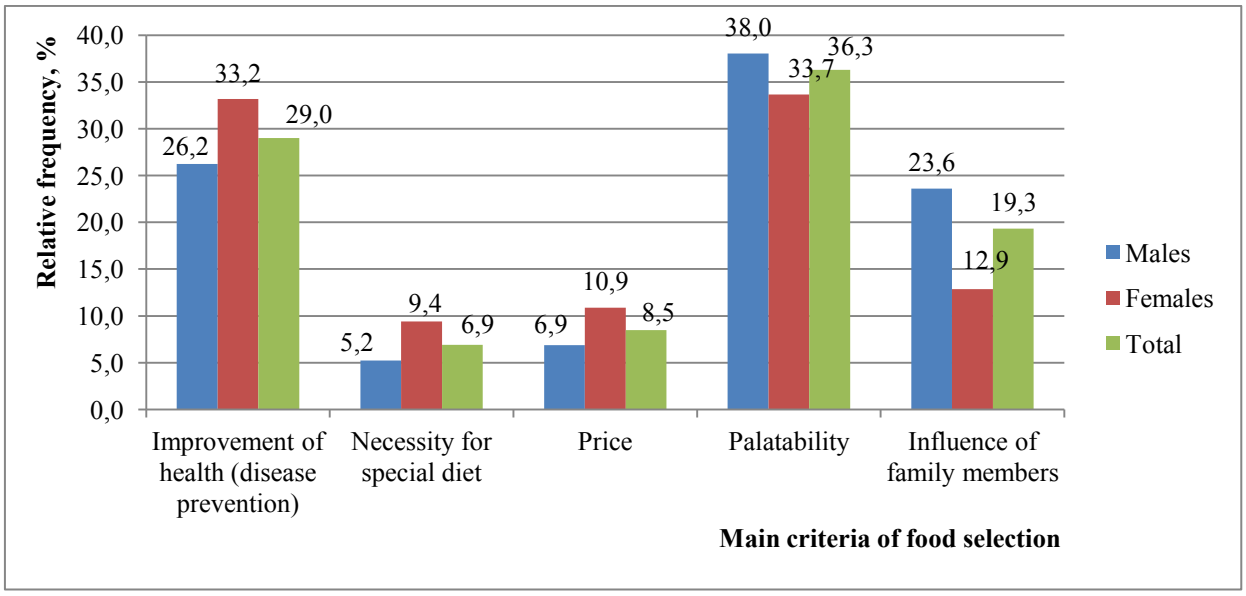

Figure 4. Distribution of the respondents (%) by food selection criteria and gender

Most of the participants (60.7%) indicated that they usually took 3 meals per day (apart snacking). About one fourth (22.9%) of the sample ate four and more times per day. 16.4% of the respondents were eating 1 or 2 times per day.

For the half of the sample (47.9%) snacks were occasional. Meanwhile, 31.2% and 18.1% of the respondents were snacking "always" or "often" respectively.

Most of the respondents (76.3%) were taking meals regularly (at least 4 times per week at the similar time of the day). However, 23.7% of the respondents did not comply with nutritional regimen.

Distribution of the respondents by frequency of consumption of fresh and boiled/steamed vegetables, fruits, grain products, fish and fish products, meat and meat products, milk and dairy products, eggs, sweets and semi-finished products is presented in Table 2.

Table 2. Distribution of the respondents (%) by frequency of consumption of different groups of products

Variables	**Frequency of consumption**			
	Never or less than once per week	**1-2 times per week**	**3-5 times per week**	**Everyday or almost everyday**
Fresh vegetables (excluding potatoes)	1.6	10.3	40.7	47.4
Boiled or steamed vegetables (excluding potatoes)	2.2	13.8	46.4	37.7
Fruits	2.6	10.3	26.8	60.3
Grain products	0.6	4.0	13.3	82.2
Fish and fish products	15.8	60.0	23.1	1.2

Meat or meat products	2.2	10.1	37.3	50.5
Milk and dairy products	4.1	13.2	33.5	49.1
Eggs as a separate dish	20.6	58.3	19.0	2.2
Sweets	20.5	31.6	24.1	23.9
Semi-finished products	60.0	31.4	7.9	0.8

One third (29.0%) of the respondents were salting already prepared meals additionally whilst most of the patients (71.0%) did not consume additional salt enhanced meals (Figure 18).

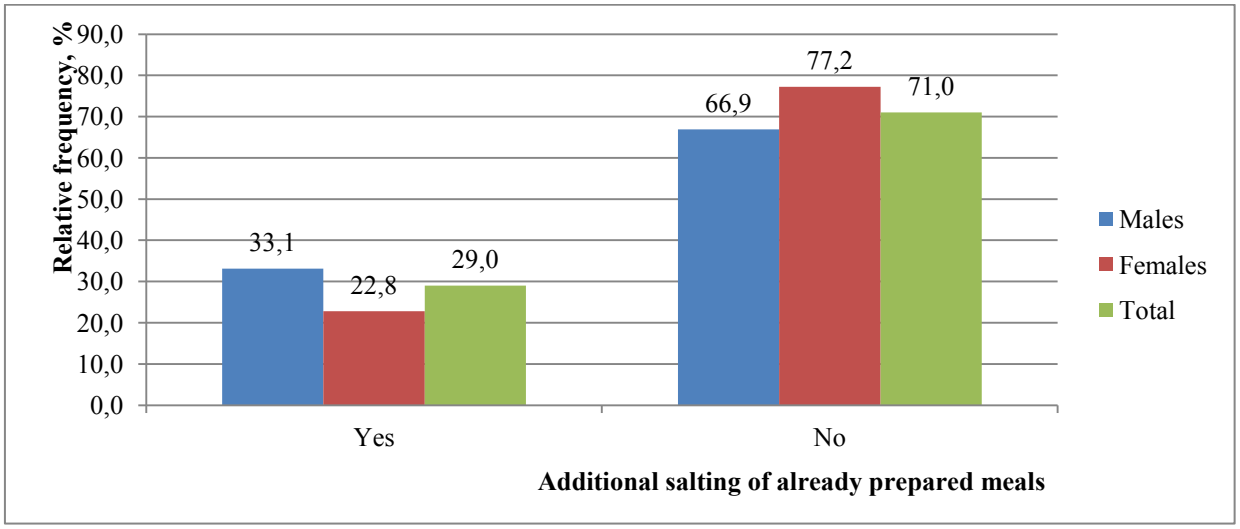

Figure 5. Distribution of the respondents (%) by additional salting of already prepared meals and gender

Vegetable oil was mostly used for cooking among 72.2% of the respondents. However, about one fifth of the sample most frequently used butter (Figure 6).

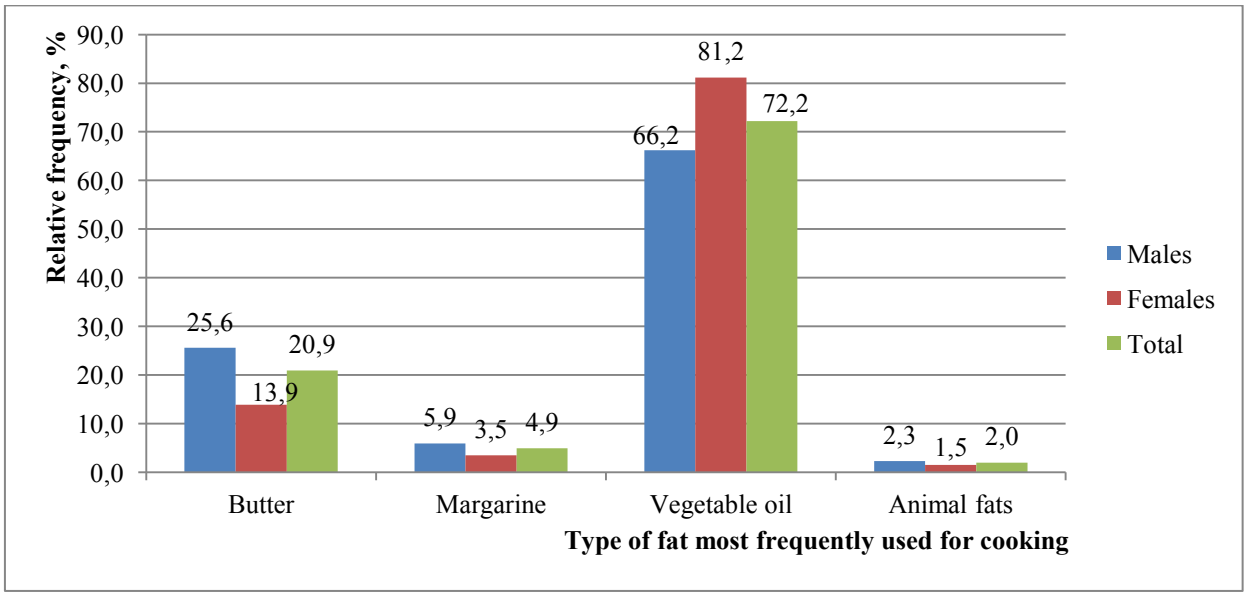

Figure 6. Distribution of the respondents (%) by gender and type of fat most frequently used for cooking

One fourth (26.6%) of the respondents did not consume food supplements while 23.9% took food supplements occasionally. The rest half (49.5%) of the respondents split into three almost equal groups: those who were taking food supplements almost everyday, 3-4 months per year and 1-2 months per year.

Most of the respondents (65.1%) considered their nutrition as appropriate (good), providing enough nutrients. The remaining one third of the sample (34.9%) expressed negative opinion on their nutrition.

Nutritional habits were analysed according to sociodemographic characteristics. The analysis showed that males more frequently additionally salted already prepared meals, used butter and animal fats, ate meat and its products, also semi-finished meals. Furthermore, they less frequently snacked between the main meals, less frequently ate fresh vegetables, fruits and food supplements. Nevertheless, males more frequently considered their nutrition as appropriate (good) for health. Lower educated respondents more frequently chose food without concern about improvement of their health (disease prevention) and tended to consume more salt. They less frequently ate at the similar time of the day. Also, they snacked and consumed grain products more frequently. Rural population and married respondents more frequently used butter and animal fats for cooking. Single respondents snacked more frequently between the main meals, they also more frequently consumed semi-finished products. Respondents with children less frequently consumed milk and dairy products. Employed respondents less frequently consumed grain products, milk and dairy food, they also ate less times per day. Lower income was associated with more frequent consumption of grain products and less frequent consumption of food supplements. Respondents with lower income less frequently selected food with concern about improvement of health (disease prevention), they ate more times per day, their nutrition was less regular. Probabilities of equal distributions between groups are presented in Table 3.

Table 3. Probabilities of equal distribution between groups by sociodemographic factors (χ^2 test)

Variables	**Sociodemographic characteristics**						
	Gender	**Education**	**Place of residence**	**Marital status**	**Have children**	**Employment**	**Average monthly income**
Food selection criteria	**0.004**	**<0.001**	0.365	**0.028**	0.521	**<0.001**	**<0.001**
Number of the main meals per day	**0.025**	0.085	0.916	0.787	0.992	**0.017**	0.094
Frequency of eating between the main meals	**0.001**	**0.049**	0.489	0.227	0.696	**<0.001**	**0.039**
Frequent eating at the similar time of the day	0.996	**0.015**	0.491	0.187	0.499	0.655	**0.003**
Frequency of eating fresh vegetables (excluding	**0.020**	0.637	0.799	0.155	0.128	0.715	0.252

potatoes)							
Frequency of eating boiled or steamed vegetables (excluding potatoes)	0.610	0.117	0.433	0.469	0.086	0.390	0.385
Frequency of eating fruits	**<0.001**	**0.011**	0.546	0.104	0.569	**0.003**	**0.023**
Frequency of eating grain products	0.081	0.068	**0.009**	0.345	0.980	**0.002**	**<0.001**
Frequency of eating fish and fish products	0.127	0.161	0.969	0.446	0.692	0.418	0.196
Frequency of eating meat or meat products	**0.049**	**0.006**	0.971	0.214	0.994	0.086	**0.022**
Frequency of the consumption of milk and dairy products	0.496	0.066	0.224	**0.014**	0.145	**0.036**	0.064
Frequency of eating eggs as a separate dish	0.378	0.711	0.214	**0.002**	0.938	0.267	0.546
Frequency of the consumption of sweets	0.071	0.210	0.440	0.336	0.678	**0.035**	0.305
Frequency of eating semi-finished products	**0.004**	0.437	0.584	**0.006**	**0.020**	0.922	0.658
Additional salting of already prepared meals	**0.012**	**0.025**	0.665	0.166	0.863	0.288	0.071
Type of fats most frequently used for cooking	**0.003**	0.347	**0.003**	0.064	0.507	0.681	0.529
Frequency of the consumption of food supplements	**0.008**	0.087	0.926	0.221	0.964	0.423	**0.019**
Subjective opinion about the wellness of current nutrition	**<0.001**	0.308	0.089	0.876	0.513	0.799	0.395

Alcohol consumption habits

Most of the respondents (62.7%) consumed strong alcohol beverages containing 40% and more alcohol few times per year or less while 14.2% of the sample drank such beverages at least once per week (Figure 7). Males, employed respondents and participants with higher income more frequently drank strong liquors (respectively, $p<0.001$, $p<0.001$ and $p=0.002$).

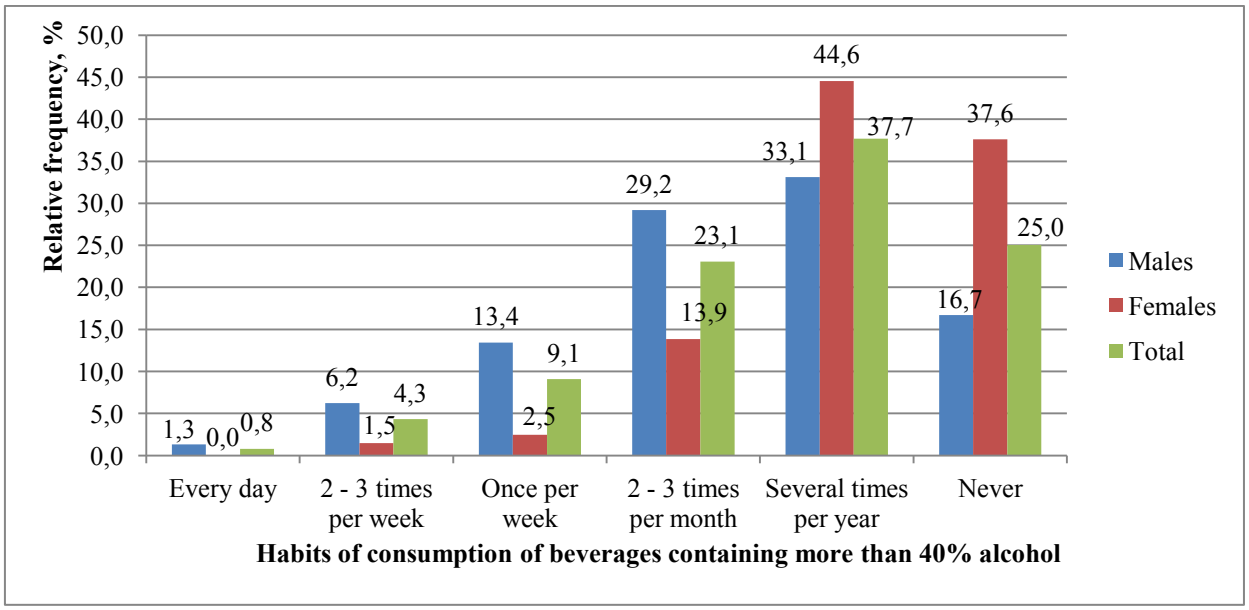

Figure 7. Distribution of the respondents (%) by gender and the consumption of strong alcohol beverages, containing 40% or more alcohol

More than a half (54.1%) of the respondents consumed light alcohol beverages few times per year or never (Figure 8). Quarter of the sample (25.2%) consumed light alcohol beverages every week. Males, higher educated, urban, married, employed and with greater income respondents consumed such beverages more frequently than females, lower educated, rural, single, unemployed respondents as well as participants with lower income (respectively, p<0.001, p=0.001, p=0.025, p=0.010, p<0.001, p<0.001).

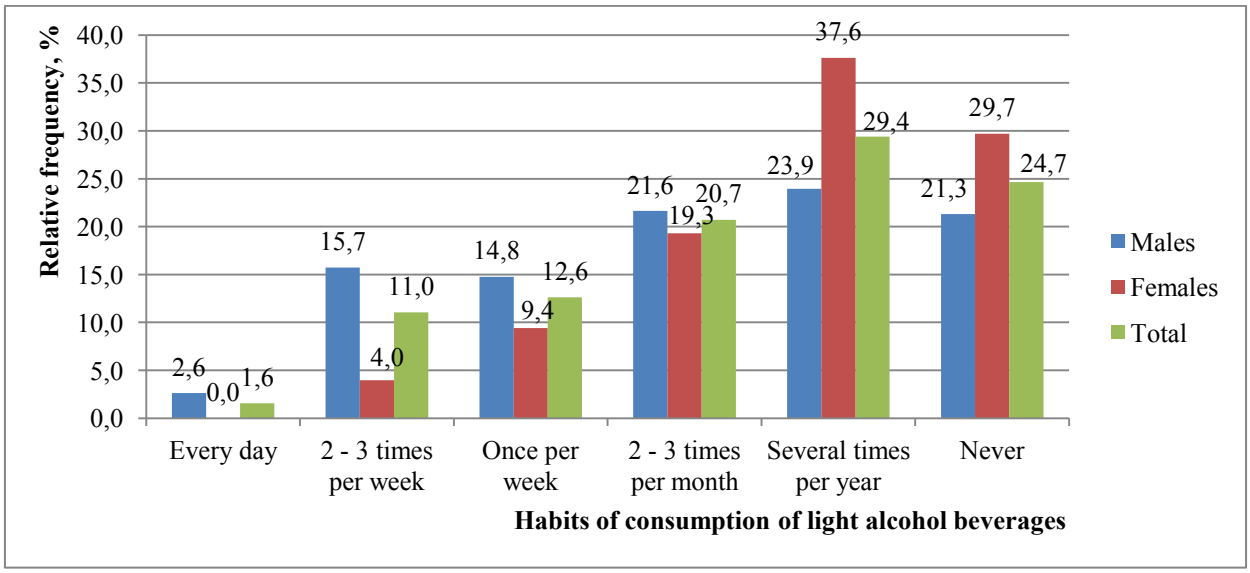

Figure 8. Distribution of the respondents (%) by gender and the consumption of light alcohol beverages

Smoking habits

Smokers accounted for one fifth (19.1%) of the sample while 80.9% of the respondents indicated not smoking (Figure 9). However, one third (32,5%) of the sample were ex-smokers. Hence, less than a half (48,3%) of the respondents were never-smokers. Previous or current smoking was more prevalent among males (p<0,001).

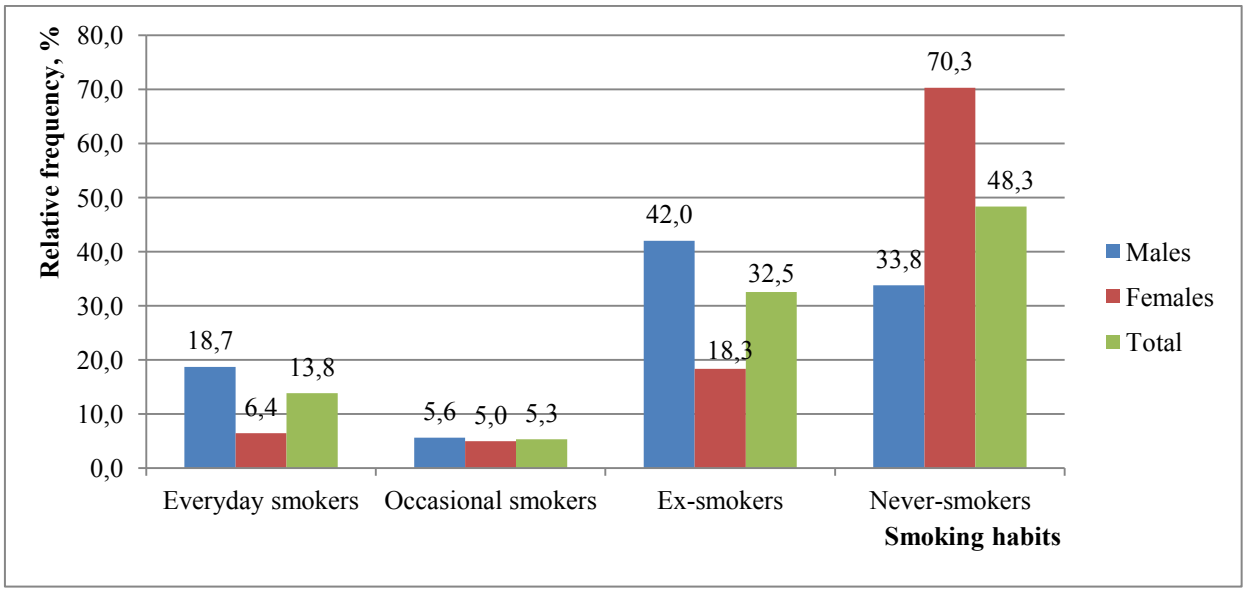

Figure 9. Distribution of the respondents (%) by gender and smoking habits

Most of the ex-smokers (77.6%) had quit smoking more than two years ago. Males and females distributed equally by duration of being an ex-smoker (p=0.512).

About two thirds (64.5%) of the smokers smoked less than 20 cigarettes per day, one third (34.7%) – 20 and more cigarettes per day, 0.8% indicated non-cigarette smoking. Significantly more men than women smoked 20 and more cigarettes per day (respectively, 41.0% and 14.0%, p=0.003).

Median duration of being a smoker among current-smokers or ex-smokers was 20.0 (10.0-30.0) years. Median duration of being a smoker was greater among males than females (respectively, 25.0 (10.0-35.0) years and 15.0 (5.5-20.0) years, p<0.001).

Physical activity

Majority of the respondents (66.7%) had sedentary jobs (Figure 10). There was no significant difference between males and females (p=0.315). Higher educated, urban, employed respondents, and with higher income had lower physical activity at work (current or previous) than lower educated, rural, unemployed respondents and participants with lower income (respectively, p<0.001, p=0.001, p=0.006, p<0.001).

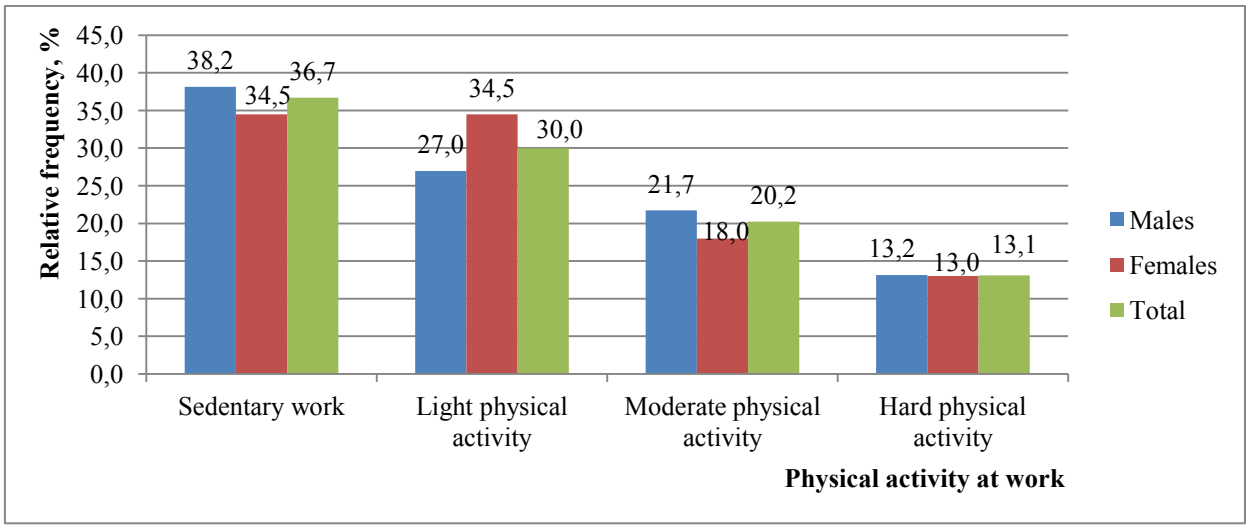

Figure 10. Distribution of the respondents (%) by gender and physical activity at work

Leisure physical activity was also low, 59.0% of the respondents indicated that their leisure time was without greater physical exertion (Figure 11). It did not differ between genders (p=0,127).

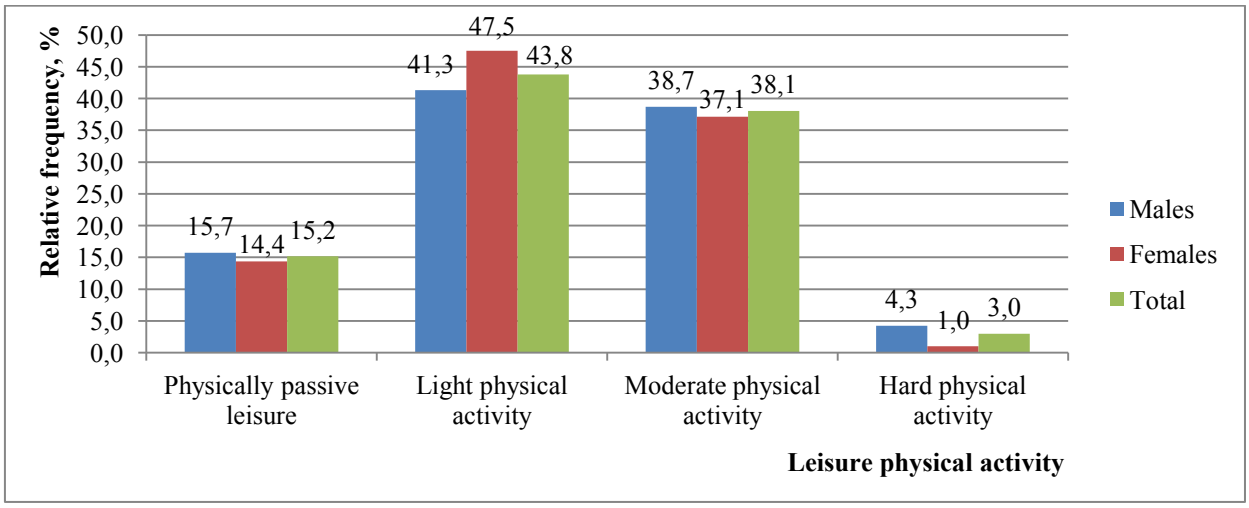

Figure 11. Distribution of the respondents (%) by gender and leisure physical activity

Emotional stress

Majority of the respondents felt tension, anxiety, suppression, slowness, were tormented of troubled thoughts and concerns rarely or occasionally. However, a big part of the respondents indicated such feelings as more often (Table 4).

Table 4. Distribution of the respondents (%) by frequency of feeling emotional stress

Variables	Frequency	
	Rarely or occasionally	**More often**
Frequency of feeling tension and anxiety	56.8	43.2
Frequency of feeling suppression and slowness	73.6	26.4
Frequency of torment of troubled thoughts and concerns	57.5	42.5

Analysis by sociodemographic characteristics showed that females felt tension, anxiety, suppression, slowness as well as were tormented of troubled thoughts and concerns more often than males. Participants with lower income indicated more frequent feeling of suppression and slowness (Table 5).

Table 5. Probabilities of equal distributions between groups of respondents by sociodemographic characteristics (χ^2 test)

Variables	Sociodemographic characteristics						
	Gender	**Education**	**Place of residence**	**Marital status**	**Have children**	**Employment**	**Average monthly income**
Frequency of feeling tension and anxiety	**<0.001**	0.333	0.507	0.102	0.655	0.938	0.605
Frequency of feeling suppression and slowness	**0.005**	0.102	0.418	0.406	0.894	0.068	**0.010**
Frequency of being tormented of troubled thoughts and concerns	**0.007**	0.978	0.701	0.115	0.823	1.000	0.562

Half (52.7%) of the sample could often sit calmly an relax, almost the same number (47.3%) of the participants could do it less frequently or rarely (Figure 12). The ability to sit calmly and relax did not differ between genders (p=0.089). Employed respondents were able to do so less frequently than the unemployed ones (p=0.012).

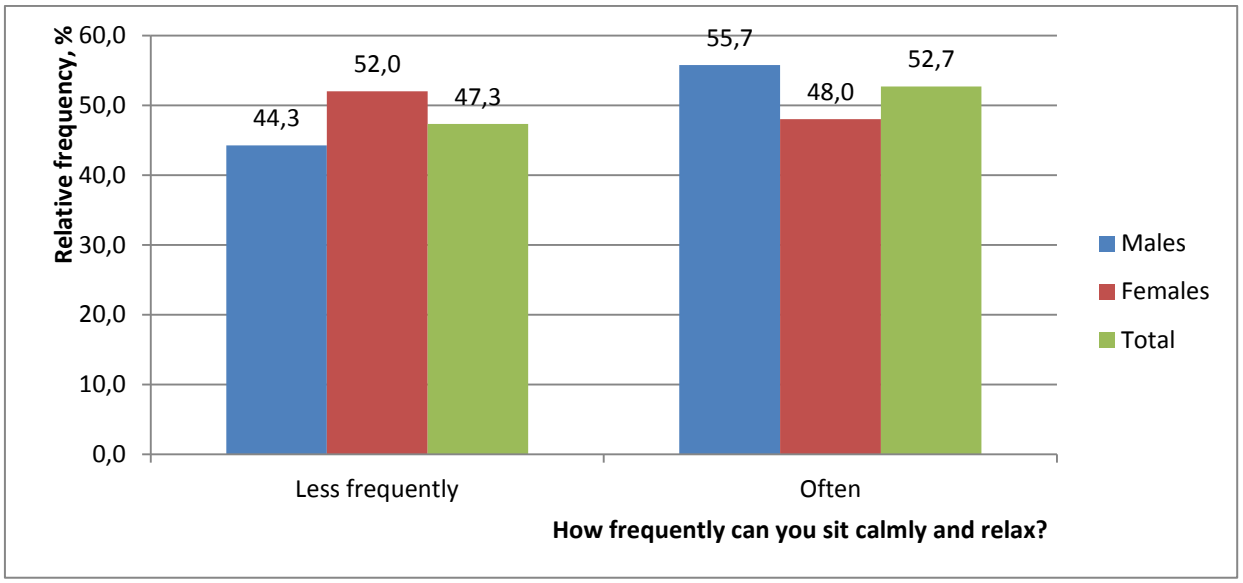

Figure 12. Distribution of the respondents (%) by gender and the ability to sit calmly and relax

Prevalence of diabetes mellitus and cardiovascular diseases among the respondents

Analysis has shown that 83.4% of the sample had at least one of the following diseases: coronary artery disease, myocardial infarction, hypertension, cardiomyopathy or diabetes mellitus (Figure 13). This was more prevalent among males than females (respectively, 88.0% and 76.5%, p=0.002). Relative frequency of coronary artery disease among males was 55.2%, while among females it was 33.2% (p<0,001). Subsequently, myocardial infarction was also more common among males than females (respectively, 38.4% versus 18.9%, p<0.001). Prevalence of hypertension, cardiomyopathy and diabetes mellitus did not differ between genders (respectively, p values were 0.240, 0.155 and 0.837).

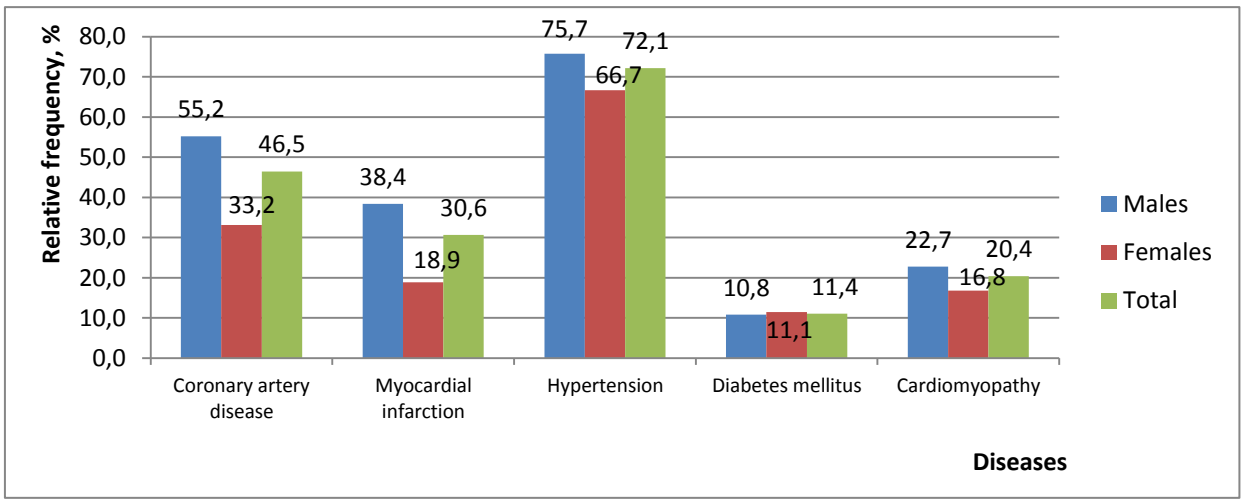

Figure 13. Distribution of the respondents by gender and coronary artery disease, myocardial infarction, hypertension, cardiomyopathy and diabetes mellitus

Accumulation of epicardial adipose tissue

Median EAT volume of the sample was 137.9 (111.2-165.0) cm^3. Median thickness of EAT depots in the interventricular and atrioventricular grooves was 8.0 (6.4-9.4) mm, on free walls of ventricles it was 3.2 (2.6-4.0) mm, on the left ventricular free wall – 2.0 (1.0-3.0) mm, on the right ventricular free wall – 4.3 (3.7-5.3) mm.

Size of EAT depots differed significantly between genders. Males had larger EAT volume, EAT thickness in the interventricular and atrioventricular grooves, also on the right ventricular free wall (p<0,001). Median EAT thickness on the left ventricular free wall did not differ between genders (p=0,662).

Lower educated, unemployed respondents and participants with lower income had larger EAT depots. EAT volume of respondents with children was greater than EAT volume of participants who were not parents. Size of EAT depots did not differ in accordance to marital status or place of residence (Table 6).

Table 6. Size of EAT depots in accordance to sociodemographic characteristics

Variables	**Dimensions of epicardial adipose tissue**				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
EDUCATION					
Lower	143.7 (115.9-172.7)	8.2 (6.8-9.6)	3.5 (2.7-4.3)	4.7 (3.7-5.7)	2.3 (1.3-3.3)
High	125.1 (102.5-157.3)	7.8 (6.2-9.0)	3.0 (2.5-3.7)	4.0 (3.3-4.7)	1.7 (1.0-2.7)
p-values	**0.002**	**0.003**	**<0.001**	**<0.001**	**0.001**
PLACE OF RESIDENCE					
Urban	137.5 (110.4-164.6)	8.0 (6.4-9.2)	3.2 (2.5-4.0)	4.3 (3.7-5.3)	2.0 (1.0-3.0)
Rural	142.8 ± 40.3	8.2 ± 2.0	3.3 (2.7-4.3)	4.3 (3.3-5.3)	2.3 (1.3-3.3)
p-values	0.427	0.379	0.450	0.915	0.152
MARITAL STATUS					
Married	137.6 ± 35.1	7.9 ± 1.7	3.4 ± 1.0	4.4 ± 1.2	2.3 (1.3-3.0)
Single	137.6 (111.1-167.1)	8.0 (6.4-9.4)	3.2 (2.5-4.0)	4.3 (3.7-5.3)	2.0 (1.0-3.0)
p-values	0.536	0.685	0.742	0.779	0.608

HAVE CHILDREN					
Yes	138.1 (112.8-166.1)	8.0 (6.5-9.4)	3.3 (2.7-4.0)	4.3 (3.7-5.3)	2.0 (1.0-3.0)
No	129.8 ± 45.2	7.6 ± 2.0	3.2 (2.5-3.8)	4.0 (3.3-4.7)	1.7 (1.0-3.0)
p-values	**0.049**	0.118	0.214	0.078	0.575
EMPLOYMENT					
Employed	136.2 (107.6-161.8)	7.6 (6.2-9.1)	3.0 (2.3-3.8)	4.0 (3.3-5.0)	1.7 (1.0-3.0)
Unemployed	142.4 (117.0-174.4)	8.4 ± 1.8	3.7 (3.0-4.5)	4.7 (4.0-5.7)	2.7 (1.6-3.3)
p-values	**0.031**	**0.001**	**<0.001**	**<0.001**	**<0.001**
AVERAGE INCOME PER MONTH (AFTER TAXES)*					
0-1500 LTL	143.5 (117.2-174.3)	8.2 (6.8-9.6)	3.5 (2.8-4.3)	4.7 (4.0-5.7)	2.7 (1.3-3.3)
More than 1500 LTL	130.9 (101.9-156.6)	7.6 (6.2-9.0)	2.8 (2.3-3.6)	4.0 (3.3-4.7)	1.7 (1.0-2.7)
p-values	**<0.001**	**0.003**	**<0.001**	**<0.001**	**<0.001**

* 1 LTL = 0.29 EUR

Size of depots of epicardial adipose tissue by nutritional habits

Respondents who selected food without concern to improve health (or prevent diseases) and consumed grain products more frequently had larger median EAT volume and thickness of EAT depots on free ventricular walls. In addition to this, median EAT volume was larger among patients with more frequent consumption of salt, meat and its products, butter and animal fats. Also, larger median EAT volume was noted among those who consumed less sweets, food supplements. Median thickness of EAT depots in the interventricular and atrioventricular grooves was larger among respondents who were snacking less frequently, had positive opinion about their nutrition wellness and additionally salted already prepared meals. Respondents who ate main meals more frequently had larger median thickness of EAT depots on ventricular free walls. Larger median thickness of EAT depots on the left ventricular free wall was noted among respondents who consumed less vegetables (Table 7).

Table 7. Size of EAT depots by different nutritional habits

Variables	Dimensions of epicardial adipose tissue				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
FOOD SELECTION CRITERIA					
Improvement of health (disease prevention)	126.6 (100.9-160.9)	7.8 (6.4-9.2)	3 (2.5-3.8)	4.3 (3.3-5)	1.7 (1-3)
Other	140.2 (115.3-167.4)	8.2 (6.4-9.4)	3.3 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3)
p-values	**0.005**	0.544	**0.039**	0.339	**0.031**
NUMBER OF THE MAIN MEALS PER DAY					
1 or 2	132.2 (113.8-157.9)	7.4 (6-9.2)	2.8 (2.4-3.8)	4 (3.3-4.7)	2 (1-3)
3 or more	138.0 (110.4-166.3)	8 (6.6-9.4)	3.3 (2.7-4.2)	4.3 (3.7-5. 3)	2 (1-3)
p-values	0.464	0.117	**0.033**	**0.011**	0.245
FREQUENCY OF EATING BETWEEN THE MAIN MEALS (SNACKING)					
Never or occasionally	142.3 (110.0-164.3)	8.3 ± 1.8	3.3 (2.5-4.1)	4.3 (3.7-5.3)	2.3 (1.2-3)
Often or always	137.4 (113.1-166.3)	7.8 (6.4-9)	3.2 (2.7-4)	4.3 (3.5-5)	2 (1-3)
p-values	0.991	**0.004**	0.455	0.305	0.772
FREQUENT EATING AT THE SAME TIME					
Yes	138.4 (108.6-167.0)	8 (6.6-9.4)	3.3 (2.5-4)	4.3 (3.7-5.3)	2 (1-3)
No	138.8 ± 36.3	7.8 (6.2-9.4)	3.2 (2.7-4.2)	4.3 (3.7-5.3)	2 (1.3)
p-values	0.785	0.282	0.935	0.889	0.610
FREQUENCY OF EATING FRESH VEGETABLES (EXCLUDING POTATOES)					
Up to 5 times per week	142.5 (114.4-170.4)	8 (6.4-9.4)	3.4 (2.5-4.2)	4.3 (3.7-5.3)	2.3 (1-3.3)
Everyday or almost everyday	133.3 (108.1-161.3)	7.9 ± 1.8	3.2 (2.7-3.8)	4.3 (3.7-5.3)	2 (1.3-3)

p-values	0.101	0.400	0.074	0.565	**0.042**
FREQUENCY OF EATING BOILED OR STEAMED VEGETABLES (EXCLUDING POTATOES)					
Up to 5 times per week	137.9 (109.0-164.9)	8.2 (6.6-9.4)	3.2 (2.5-4)	4.3 (3.7-5.3)	2 (1-3)
Everyday or almost everyday	137.7 (113.9-165.9)	7.8 (6.4-9.2)	3.2 (2.7-4)	4.3 (3.7-5.3)	2 (1-3)
p-values	0.996	0.325	0.957	0.983	0.839
FREQUENCY OF EATING FRUITS					
Up to 5 times per week	143.4 (114.3-173.8)	7.8 (6.2-9.2)	3.2 (2.5-3.8)	4.3 (3.7-5.3)	2 (1-3)
Everyday or almost everyday	134.4 (110.4-160.4)	8 (6.8-9.4)	3.3 (2.7-4.0)	4.3 (3.7-5.3)	2 (1.3-3)
p-values	0.078	0.236	0.318	0.207	0.539
FREQUENCY OF EATING GRAIN PRODUCTS					
Up to 5 times per week	123.6 (102.3-156.9)	7.7 ± 1.8	3 (2.5-3.7)	4 (3.7-5)	1.7 (1-2.7)
Everyday or almost everyday	143.5 (112.9-167.2)	8.2 (6.6-9.4)	3.3 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3.2)
p-values	**0.004**	0.076	**0.020**	0.240	**0.005**
FREQUENCY OF EATING FISH AND FISH PRODUCTS					
Up to 1 time per week	137.9 (109.7-161.0)	8 (6.6-9.2)	3.2 (2.5-4)	4.3 (3.3-5)	2.3 (1-3)
2 times per week or more	137.9 (111.3-166.4)	8 (6.4-9.4)	3.3 (2.7-4.1)	4.3 (3.7-5.3)	2 (1-3)
p-values	0.473	0.854	0.550	0.109	0.653
FREQUENCY OF EATING MEAT OR MEAT PRODUCTS					
Up to 3 times per week	129.7 (106.6-157.2)	7.7 ± 1.8	3 (2.5-3.9)	4.3 (3.3-5)	2 (1.3-3)
4 times per week or more	140.3 (112.8-168.9)	8 (6.4-9.4)	3.3 (2.7-4.1)	4.3 (3.7-5.3)	2 (1-3)
p-values	**0.035**	0.456	0.172	0.095	0.743
FREQUENCY OF THE CONSUMPTION OF MILK AND DAIRY PRODUCTS					
Up to 5 times per week	137.5 (111.1-164.8)	7.9 ± 1.8	3.2 (2.5-4.2)	4.3 (3.7-5.3)	2 (1-3)
Everyday or	138.4 (111.8-	8.2 (6.4-9.6)	3.3 (2.7-4)	4.3 (3.7-5.3)	2 (1-3.3)

almost everyday	167.0)				
p-values	0.718	0.370	0.543	0.602	0.698
FREQUENCY OF EATING EGGS AS A SEPARATE DISH					
Up to 2 times per week	137.5 (109.7-165.5)	8 (6.4-9.4)	3.2 (2.7-4)	4.3 (3.7-5.3)	2 (1-3)
3 times per week or more	142.5 ± 41.3	8.1 ± 1.9	3.3 (2.5-4)	4.3 (3.7-5)	2.3 (1.3-3.1)
p-values	0.463	0.700	0.671	0.923	0.459
FREQUENCY OF THE CONSUMPTION OF SWEETS					
Up to 1 time per week	146.3 (114.3-172.0)	8 (6.4-9.4)	3.3 (2.5-4.2)	4.3 (3.7-5.3)	2 (1-3)
2 times per week or more	128.2 (107.2-154.3)	8 (6.5-9.2)	3 (2.7-3.8)	4.3 (3.7-5)	2 (1-3)
p-values	**0.001**	0.627	0.254	0.213	0.647
FREQUENCY OF EATING SEMI-FINISHED PRODUCTS					
Up to 1 time per week	137.9 (110.9-163.9)	8 (6.4-9.4)	3.3 (2.7-4.0)	4.3 (3.7-5.3)	2 (1-3)
2 times per week or more	137.4 (111.2-173.4)	8.0 ± 1.8	3.2 (2.5-4)	4.3 (3.3-5)	2 (1-3)
p-values	0.747	0.805	0.356	0.246	0.733
ADDITIONAL SALTING OF ALREADY PREPARED MEALS					
Yes	146.1 (121.9-174.3)	8.3 ± 1.9	3.5 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1-3)
No	136.2 (107.7-160.9)	7.8 (6.4-9.2)	3.2 (2.5-4)	4.3 (3.7-5)	2 (1-3)
p-values	**0.002**	**0.043**	0.185	0.186	0.666
TYPE OF FATS MOST FREQUENTLY USED FOR COOKING					
Butter or animal fats	146.2 (117.2-171.3)	8.2 (6.6-10)	3.3 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3.3)
Oil or margarine	136.2 (108.1-163.8)	8 (6.4-9.2)	3.2 (2.5-4)	4.3 (3.7-5.3)	2 (1-3)
p-values	**0.043**	0.154	0.389	0.961	0.235
FREQUENCY OF THE CONSUMPTION OF FOOD SUPPLEMENTS					
Never or occasionally	140.9 (114.5-172.9)	8 (6.4-9.4)	3.2 (2.5-4.2)	4.3 (3.7-5.3)	2 (1-3)

At least 1 month per year	134.9 (108.1-159.7)	8 (6.6-9.2)	3.3 (2.7-4)	4.3 (3.7-5)	2 (1.3)
p-values	**0.045**	0.767	0.872	0.664	0.932
SUBJECTIVE OPINION ABOUT THE WELLNESS OF CURRENT NUTRITION					
Positive	144.3 (112.8-169.5)	8.1 ± 1.8	3.3 (2.5-4.2)	4.3 (3.7-5.3)	2 (1-3)
Negative	131.8 (108.4-157.8)	7.6 (6.2-9)	3.2 (2.7-3.8)	4.3 (3.7-5)	2 (1.3)
p-values	0.059	**0.033**	0.255	0.098	0.987

Size of depots of epicardial adipose tissue by different habits of consumption of alcohol beverages

There was a significant difference in size of EAT depots among responders with different consumption frequency and type of alcohol beverages. Patients who consumed strong alcohol beverages at least once per month had larger median EAT volume. In contrast, patients who consumed light alcohol beverages more frequently had lower thickness of EAT depots on free ventricular walls. There was no difference in median EAT volume according to various frequency of light alcohol consumption (Table 8).

Table 8. Size of EAT depots according to alcohol consumption habits

Variables	**Dimensions of epicardial adipose tissue**				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
CONSUMPTION OF STRONG ALCOHOL BEVERAGES					
Several times per year or less	130.8 (106.8-158.7)	7.8 (6.4-9.4)	3.2 (2.5-4)	4.3 (3.3-5.3)	2 (1-3)
More frequently than 1 time per month	147.3 (122.0-176.0)	8.2 (6.6-9.4)	3.3 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3.3)
p-values	**<0.001**	0.345	0.144	0.250	0.170
CONSUMPTION OF LIGHT ALCOHOL BEVERAGES					
Several times per year or less	137.9 (112.1-164.8)	8.1 ± 1.9	3.5 (2.7-4.2)	4.7 (3.7-5.3)	2.3 (1.3-3.3)
More frequently than 1 time per month	137.5 (109. 9-165.6)	7.8 (6.4-9.2)	3 (2.5-3.7)	4 (3.3-5)	1.7 (1-3)
p-values	0.840	0.106	**<0.001**	**0.001**	**0.007**

Size of depots of epicardial adipose tissue by smoking habits

Ex-smokers had larger EAT depots (volume and thickness in the interventricular and atrioventricular grooves) than never-smokers. Meanwhile, size of EAT depots did not differ between current-smokers and non-smokers. On the other hand, higher number of cigarettes per day and longer smoking history was associated with larger EAT depots. Duration of freedom from smoking was not associated with differences of EAT depots (Table 9).

Table 9. Size of EAT depots by different smoking habits

Variables	**Dimensions of epicardial adipose tissue**				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
CURRENT SMOKING					
Yes	141.3 (113.7-177.2)	7.9 (6.45-9.4)	3.2 (2.5-4)	4.3 (3.7-5.6)	1.7 (1-3)
No	137.5 (110.4-161.5)	8 (6.4-9.4)	3.3 (2.7-4)	4.3 (3.7-5.3)	2 (1.3-3)
p-values	0.115	0.931	0.538	0.939	0.218
PREVIOUS SMOKING					
Ex-smokers	147.2 (118.8-175.8)	8.3 ± 1.9	3.5 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1-3)
Never-smokers	131.4 (108.2-156.1)	7.8 (6.4-9.1)	3.2 (2.5-4)	4.3 (3.3-5)	2 (1-3)
p-values	**<0.001**	**0.031**	0.145	0.075	0.599
QUANTITY OF CIGARETTES PER DAY					
Less than 20	133.5 (106.7-168.8)	7.8 (6.2-9.2)	3 (2.5-3.8)	4.3 (3.7-5.3)	1.7 (1-3)
20 and more	163.3 ± 37.5	8.9 ± 1.8	3.7 (2.8-4.5)	4.7 (4-5.7)	2.3 (1.3-3.3)
p-values	**<0.001**	**<0.001**	**0.003**	**0.020**	**0.010**
NUMBER OF YEARS OF SMOKING					
Less than 20	130.2 (105.7-161.2)	7.4 (6.1-9)	3 (2.5-3.7)	4 (3.7-5)	1.7 (1-2.8)
20 or more	157.1 ± 41.2	8.6 ± 1.8	3.7 (2.8-4.3)	4.7 (4-5.7)	2.3 (1.3-3.3)
p-values	**<0.001**	**<0.001**	**<0.001**	**0.001**	**0.023**

NUMBER OF YEARS OF BEING EX-SMOKER					
Less than 2	144.7 ± 39.0	8.7 ± 1.9	3.5 (2.3-4.4)	4.5 ± 1.2	2.3 (1-3.7)
2 or more	146.7 (118.4-177.3)	8.1 ± 1.8	3.5 (2.7-4.2)	4.3 (4-5.3)	2.3 (1.3-3)
p-values	0.801	0.145	0.840	0.861	0.543

Size of depots of epicardial adipose tissue by habits of physical activity

Physical activity at work was not associated with differences in volume of EAT depots. On the other hand, sedentary or low-intensity leisure physical activity was associated with larger thickness of EAT depots on the left ventricular free wall (Table 10).

Table 10. Size of EAT depots according to habits of physical activity

Variables	**Dimensions of epicardial adipose tissue**				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
PHYSICAL ACTIVITY AT WORK					
Sedentary or low-intensity physical activity	137.8 (108.4-163.7)	8 (6.6-9.4)	3.2 (2.7-4)	4.3 (3.7-5.3)	2 (1-3)
Intensive or very intensive physical activity	138.0 (114.5-168.8)	7.8 ± 1.8	3.2 (2.5-4)	4.3 (3.7-5)	2 (1-3)
p-values	0.273	0.099	0.367	0.357	0.591
LEISURE PHYSICAL ACTIVITY					
Sedentary or low-intensity physical activity	137.5 (108.3-167.4)	7.8 (6.4-9.2)	3.3 (2.5-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3.3)
Intensive or very intensive physical activity	138.0 (112.2-164.8)	8.2 (6.6-9.4)	3.2 (2.7-4)	4.3 (3.7-5.3)	2 (1-3)
p-values	0.507	0.418	0.379	0.642	**0.043**

Size of depots of epicardial adipose tissue by emotional stress

Less frequent emotional stress was associated with larger EAT depots. Patients under less frequent tension and anxiety had larger EAT volume. Participants with ability to

relax more frequently had larger EAT volume as well as thickness of EAT depots in the interventricular and atrioventricular grooves (Table 11).

Table 11. Size of EAT depots by frequency of feeling emotional stress

Variables	**Dimensions of epicardial adipose tissue**				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
FEELING OF TENSION AND ANXIETY					
Rarely or occasionally	144.4 (113.7-169.3)	8.2 (6.45-9.4)	3.2 (2.5-4)	4.3 (3.7-5.3)	2 (1-3.3)
More often	131.1 (106.8-161.3)	7.9 ± 1.9	3.3 (2.7-4)	4.3 (3.7-5.3)	2.2 (1-3)
p-values	**0.017**	0.344	0.497	0.255	0.929
FEELING OF SUPPRESSION AND SLOWNESS					
Rarely or occasionally	140.2 (112.3-165.3)	8 (6.6-9.4)	3.3 (2.5-4)	4.3 (3.7-5.3)	2 (1.2-3)
More often	137.0 ± 36.9	7.8 (6.4-9.25)	3.2 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1-3)
p-values	0.268	0.337	0.769	0.586	0.840
TORMENT OF TROUBLED THOUGHTS AND CONCERNS					
Rarely or occasionally	141.0 (111.9-163.6)	8 (6.4-9.2)	3.3 (2.7-4)	4.3 (3.7-5.3)	2 (1.3-3.3)
More often	134.6 (109.4-168.2)	8.1 ± 1.7	3.2 (2.5-4.2)	4.3 (3.7-5.3)	2 (1-3)
p-values	0.433	0.309	0.369	0.835	0.140
BEING ABLE TO SIT CALMLY AND RELAX					
Less frequently	133.5 (111.1-158.3)	7.8 (6.4-9.2)	3.2 (2.5-3.8)	4.3 (3.7-5)	2 (1-3)
Often	145.0 (111.3-172.9)	8.2 (6.8-9.6)	3.3 (2.7-4.2)	4.3 (3.7-5.3)	2 (1.3-3.3)
p-values	**0.050**	**0.050**	0.071	0.226	0.051

Size of depots of epicardial adipose tissue according to cardiovascular diseases and diabetes mellitus

Coronary artery disease, myocardial infarction, hypertension, cardiomiopathy and diabetes mellitus was associated with larger EAT volume (Table 12). These diseases were associated with larger thickness of EAT depots in most cases. Cardiomyopathy was not associated with differences in thickness of EAT depots.

Table 12. Size of EAT depots by cardiovascular diseases and diabetes mellitus

Variables	**Dimensions of epicardial adipose tissue**				
	Volume, cm^3	**Average thickness in grooves, mm**	**Average thickness on free ventricular walls, mm**	**Average thickness on the right free ventricular wall, mm**	**Average thickness on the left free ventricular wall, mm**
DIABETES MELLITUS					
Yes	151.3 (124.8-182.2)	8.8 ± 2.0	3.7 (3-4.2)	5 (4-5.5)	2.3 (1.3-3)
No	136.4 (108.3-163.5)	7.8 (6.4-9.2)	3.2 (2.5-4)	4.3 (3.7-5.3)	2 (1-3)
p-values	**0.002**	**0.002**	**0.015**	**0.002**	0.459
CORONARY HEART DISEASE					
Yes	155.8 (136.3-178.2)	9.2 ± 1.4	3.7 (3-4.5)	4.8 (4-5.7)	2.7 (1.3-3.3)
No	118.3 (99.3-147.4)	6.8 (6-8)	2.8 (2.3-3.7)	4 (3.3-4.7)	1.7 (1-2.7)
p-values	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
MIOCARDIAL INFARCTION					
Yes	156.6 (138.0-178.1)	9.2 ± 1.5	3.7 (3-4.5)	5 (4.3-6)	2.7 (1.7-3.7)
No	124.6 (103.0-154.8)	7.2 (6-8.6)	3 (2.3-3.8)	4 (3.3-5)	1.7 (1-3)
p-values	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
HYPERTENSION					
Yes	147.0 (119.6-172.7)	8.2 (7-9.5)	3.5 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3.3)
No	111.2 (91.6-140.7)	7 (6-8.8)	2.8 (2.3-3.7)	4 (3.3-4.7)	1.3 (1-2.7)

p-values	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
CARDIOMYOPATHY					
Yes	155.4 (129.1-198.4)	8.2 (6.3-9.4)	3.5 (2.7-4.3)	4.6 ± 1.2	2.3 (1.3-3.3)
No	135.0 (108.0-159.2)	8 (6.6-9.3)	3.2 (2.5-4)	4.3 (3.7-5.3)	2 (1-3)
p-values	**<0.001**	0.934	0.116	0.122	0.178
ONE OR MORE OF THESE DESEASES					
Yes	147.0 (119.5-173.0)	8.4 (7-9.6)	3.5 (2.7-4.2)	4.3 (3.7-5.3)	2.3 (1.3-3.3)
No	103.8 ± 26.3	6.6 ± 1.4	2.7 (2.2-3.2)	3.7 (3-4.3)	1.3 (1-2.3)
p-values	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

The most significant factors associated with greater accumulation of epicardial adipose tissue and related diseases

ROC curve analysis of EAT size variables for clasification of patients with at least one of the diseases (coronary artery disease, myocardial infarction, hypertension, cardiomyopathy, diabetes mellitus) was performed (Figure 14). The largest area was observed under the curve of EAT volume (0.837). The maximal distance from the diagonal line was estimated at 111.3 cm^3 EAT volume. Areas under curves for BMI, average thickness of EAT depots in the interventricular and atrioventricular grooves, on free ventricular walls totally and separately on the right and the left ventricular free walls respectively were 0.774, 0.771, 0.718, 0.710 and 0.651.

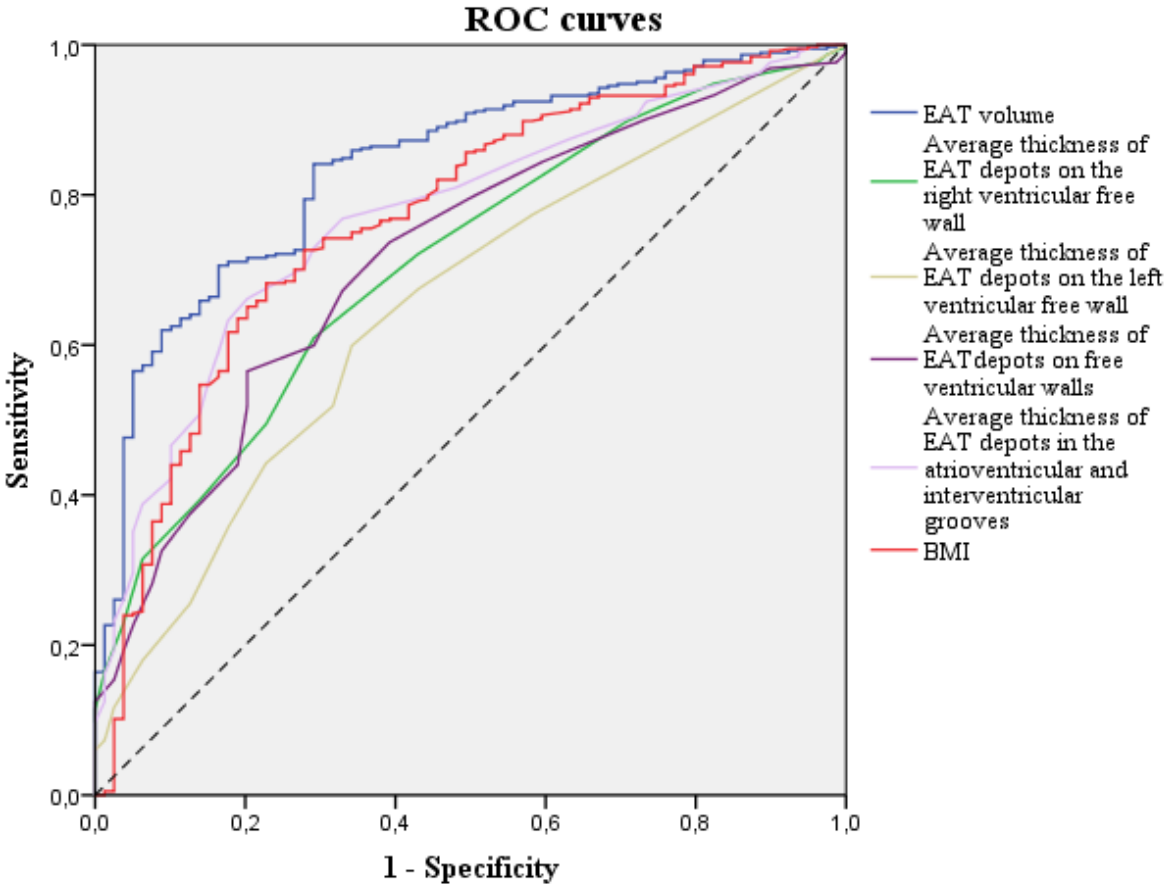

Figure 14. ROC curve analysis of EAT variables and body mass index in classification of patients with at least one of the following diseases: coronary artery disease, myocardial infarction, hypertension, cardiomyopathy, diabetes mellitus

According to the results of ROC curve analysis, patients distributed into two groups: 25.9% of patients with EAT volume up to 111.3 cm^3 and 74.1% of patients with higher EAT volume. For classification of the patients among these groups logistic regression model was formed. All the variables mentioned above in this document were used to form the model. After rejection of statistically insignificant variables 7 remained. The model classified 86.3% of the sample correctly. Statistically significant variables were BMI category, food selection criteria, additional salt intake, quantity of cigarettes per day, gender, age and income (table 13). According to the model, overweight or obese patients (BMI >= 25.0 kg/m^2) had high EAT volume (>111.3 cm^3) 7.9 times more often than participants with lower BMI. High EAT volume was 2.5 times more frequent among patients who chose food without concern to improve health or prevent diseases, as well as respondents who additionally salted already prepared meals. Heavy smoking (20 or more cigarettes per day), low income and male gender were associated with more frequent high EAT volume (respectively, for 3.4, 1.8 and 8.5 times).

Logistic regression analysis showed that males more frequently consumed meat and its products, butter and animal fats, light and strong alcohol beverages (respectively, OR was 1.7, 2.1, 2.5 and 4.6). They snacked less frequently (OR=1.6), consumed less fruits and food supplements (respectively, OR=2.3 and OR=1.5), and more often than females were smokers ($ŠS_b$=2.5). Males less frequently felt emotional stress (tension and anxiety,

suppression and slowness, respectively, OR=2.2 and OR=1.8), more of them had physically active leisure-time (OR=1.2). Participants with lower income consumed more meat and its products as well as grain products (respectively, OR=1.5 and OR=2.7), they less frequently consumed sweets and light alcohol beverages (respectively, OR=1.4 and OR=3.4). They also more frequently snacked (OR=1.6), more of them worked physically intensive work (OR=3.6), felt suppression and slowness (OR=1.7). Participants who selected food without concern to improve health or prevent diseases less frequently consumed fruits, vegetables and food supplements (respectively, OR was 2.3, 1.9 and 2.0). They more frequently consumed meat and its products, milk and dairy products, butter and animal fats (respectively, OR was 2.6, 1.4 and 1.8). Respondents who additionally salted already prepared meals more frequently consumed semi-finished products, butter and animal fats (respectively, OR=1.9 and OR=1.6), they less frequently consumed fruits as well as fish and its products (respectively, OR=1.9 and OR=1.8).

Table 13. Factors associated with high (>111.3 cm3) volume of epicardial adipose tissue

Variables	OR	ORadj.	95% CI (ORadj.)	p-values
Overweight/obesity (BMI >= 25.0 kg/m2)*	7.355	7.924	4.419 - 14.208	<0.001
Food selection without concern to improve health or prevent diseases*	2.147	2.464	1.359 - 4.467	0.003
Additional salting of already prepared meals*	2.849	2.466	1.220 - 4.983	0.012
Heavy smoking: great quantity (20 or more) of cigarettes per day*	5.345	3.405	1.056 - 10.977	0.040
Low income (0-1500 LTL per month)*	2.161	1.835	0.998 - 3.372	0.051
Male gender*	6.454	8.510	4.580 - 15.810	<0.001
Age**	1.436	1.059	1.032 - 1.086	<0.001

* values of binary variables that were associated with greater volume of EAT.

** odds ratio and confidence interval values per year.

Characteristics of the logistic regression model: N=467, $\chi 2$=214.168, df=7, p<0.001, Cox&Snell R2=0.368, Negelkerke R2=0.540, Hosmer-Lemeshow test p=0.956, classification accuracy 86.3%. Variable of morbidity of diabetes mellitus and/or cardiovascular diseases was not included in the formation of the model.

1 LTL = 0.29 EUR

DISCUSSION

Nutritional habits and their impact on the accumulation of epicardial adipose tissue

The results of this study were compared with the studies of the Lithuanian adult population performed in 2013-2014. Comparison revealed that food selection with concern to improve health or prevent diseases among the patients with cardiovascular diseases was up to 2.2 times more frequent, though the most frequent food selection criteria in both populations was palatability (Dobrovolskij, Stukas 2013, Barzda et al. 2016). There was no difference in frequency of the main meals per day and regularity of nutrition in both populations. Snacking among the patients was more frequent than among Lithuanian adults (Dobrovolskij, Stukas 2013, Barzda et al. 2016). Everyday consumption of vegetables among the patients with cardiovascular diseases was the same as typical (Dobrovolskij, Stukas 2013) or more prevalent (Barzda et al. 2016, Grabauskas et al. 2015). Consumption of grain products, milk and dairy products, meat and its products, fish and its products, sweets, food supplements was more frequent among the patients than in the Lithuanian adult population (Dobrovolskij, Stukas 2013, Barzda et al. 2016). Vegetable oil as the most frequently used type of fat for cooking was less prevalent (Dobrovolskij, Stukas 2013, Barzda et al. 2016), while butter was about 2 times more prevalent among the patients with cardiovascular diseases than in the Lithuanian adult population (Dobrovolskij, Stukas 2013, Barzda et al. 2016). On the other hand, overuse of salt was less prevalent among the patients than in the Lithuanian adult population (29% among the patients, from 35% to 42% in the Lithuanian adult population) (Dobrovolskij, Stukas 2013, Barzda et al. 2016).

Regression analysis of the lifestyle variables revealed that aditional salting of already prepared meals and food selection without concern to improve health or prevent diseases were associated with larger EAT depots. None of these nutritional habits is a direct factor for EAT enlargement. These habits are associated with composition of food and daily energy intake. Both of these habits were associated with less frequent consumption of fruits and more frequent consumption of butter and animal fats.

Greater use of salt is associated with higher energy intake, more frequent consumption of various beverages, overweight and obesity (Karppanen, Mervaala 2006, Grimes et al. 2013). It is also an important risk factor for hypertension (He, MacGregor 2009), what is associated with larger depots of EAT (Dicker et al. 2013).

Food selection criteria are strongly associated with BMI. Energy intake among the population with intention of weight loss is lower than among overweight or obese. In addition, people who intend to reduce body weight consume more dietary fibre (Raynor et al. 2011). People who select food with concern to improve health or prevent diseases tend to consume products that are more consistent with good health (Abegg, Bueter & Lutz 2012). This applies for both: people with better or worse nutritional knowledge (Saarela et al. 2013). According to the results of the study which was performed in Finland, following the reminder of weight control and its importance for health, supermarket visitors chose different products than usual (Saarela 2014).

Fruits, vegetables and whole grain foods are important sources of dietary fibre. Scientists from Italy revealed that more frequent consumption of fruits and vegetables is associated with smaller depots of EAT (Cena et al. 2015). According to other studies, more frequent consumption of vegetables, fruits and whole grain products along with reduced consumption of fats may help to reduce depots of body fat and sustain normal body weight (Shimabukuro 2009, Yilmaz 2012). It is known that higher intake of fats as well as lack of dietary fibre results in larger depots of visceral adipose tissue even when the energy intake is equal (van den Borst et al. 2012).

In this study, the kind of grain products was not assessed. According to this reason, differences in EAT depots among patients with different frequency of consumption of grain products could not be assessed unambiguosly. It is recommended by WHO to eat whole grain products (WHO/FAO 2003). Whole grain products are rich in dietary fibre, these products are associated with lower BMI and lower risk of cardiovascular diseases (Lovejoy, DiGirolamo 1992, Feskens, Loeber & Kromhout 1994, Marshall, Bessesen & Hamman 1997, Liu et al. 2003, Pereira et al. 2002, Lutsey et al. 2007, Fung et al. 2002). In contrast, refined grain products are associated with higher BMI (Liu et al. 2003) and unhealthy nutritional habits (Steffen et al. 2003).

Male gender, lower income and selection of food without concern to improve health or prevent diseases were associated with more frequent consumption of meat and meat products. Furthermore, patients who consumed meat and its products more frequently had larger EAT volume. Previously performed studies provide diverging results regarding the association between obesity and consumption of meat and its products. However, according to the study which involved 13602 adults, higher consumption of meat and its products is associated with greater BMI and central (visceral) obesity (Wang, Beydoun 2009). Studies have shown that more frequent consumption of meat (regardless of the kind) is associated with higher energy intake, higher consumption of fats, less frequent consumption of whole grain products, fruits and vegetables (Leitzmann 2005, Pan et al. 2012). Consumption of meat and its products is higher than consumption of vegetables (excluding potatoes and vegetable soups) among adult Lithuanian residents (Barzda et al. 2016).

Higher income was associated with more frequent consumption of sweets, EAT volume was lower among patients who consumed sweets more frequently. Despite the fact that variety of sweets was not assessed in this study, assumption that carbohydrates were the main source of energy intake in these patients can be made. According to the review of literature, currently there is not enough scientific evidence regarding the association between consumption of sweets and obesity (Van Baak, Astrup 2009). Other study has shown that high consumption of fats is the main factor for high energy intake, meanwhile consumption of carbohydrates is positive nutritional factor (Saris 2003). According to the study in which 2000 people were involved, consumption of sweets (in contrast to consumption of sugar sweetened beverages) was not associated with higher BMI (Nissinen et al. 2009). On the other hand, frequent consumption of sweets may be the cause of dental caries (Burt, Pai 2001, Anderson et al. 2009) or inferior nutrition (Nissinen et al. 2009).

Other nutritional habits consistent with nutritional recommendations (consumption of vegetable oil and margarine instead of butter and animal fats, aim to receive all necessary nutrients) among patients with cardiovascular diseases were associated with lower or same size of EAT depots (Health Education and Disease Prevention Center, Vilnius University & Kaunas University of Medicine 2010).

Habits of the consumption of alcohol beverages and their impact on the accumulation of epicardial adipose tissue

Consumption of alcohol beverages differed between the patients with cardiovascular diseases and the Lithuanian adult population. Consumption of strong alcohol beverages at least once per week was 2.25 times lower among female patients meanwhile consumption of strong alcohol beverages among male patients was similar to the population of Lithuanian adult males (respectively, 21% and 26%). Consumption of light alcohol beverages at least once per week among the male patients was less popular meanwhile consumption of light alcohol beverages among females was similar in both populations (Grabauskas et al. 2015).

According to logistic regression analysis, neither consumption of strong, nor consumption of light alcohol beverages was significant factor for EAT volume. On the other hand, average EAT volume was higher among the patients who consumed strong alcohol beverages more frequently which is consistent with results of other researchers (Vaideeswar et al. 2014, Nagata et al. 2015). In contrast, more frequent consumption of light alcohol beverages was associated with lower EAT depots on the free ventricular walls.

According to previous studies, association between accumulation of adipose tissue and consumption of different kinds of alcohol is a subject for discussion for several decades. Swedish researchers have shown that frequency of consumption of light alcohol (beer, wine) was not associated with higher BMI or waist circumference. Meanwhile, more frequent consumption of strong liquors was associated with an increase in these parameters (Risérus, Ingelsson 2007). Studies with laboratory animals have shown that consumption of red wine may prove beneficial aiming to sustain normal body weight and reduce the risk of cardiovascular diseases (Bargalló et al. 2006, Monteiro et al. 2009, Agouni et al. 2009, Gourineni et al. 2012). Association between lower BMI and more frequent consumption of wine (red or white) was observed in human studies as well (Risérus, Ingelsson 2007, Duncan et al. 1995, Flechtner-Mors et al. 2004, Sayon-Orea et al. 2011). Diverging results in regards to the association between adiposity and consumption of beer can be found in literature. Some studies show that consumption of beer like consumption of strong alcoholic beverages is associated with increase in waist circumference and BMI (Duncan et al. 1995, Sayon-Orea et al. 2011) while others provide results with no such association (Risérus, Ingelsson 2007) or even an inverse relation between adiposity and consumption of beer (Bobak, Skodova & Marmot 2003). These contradictions may be determined by differences in lifestyle habits. It hinders to assess the association between adiposity and consumption of beer. Studies have shown that lifestyle habits of beer consumers are less consistent with good health than lifestyle habits among people who consume wine (Bendsen et al. 2013).

In respect to the conflicting results mentioned above, lower thickness of EAT depots among the patients who consumed light alcohol beverages more frequently, also the fact that the variety of light alcoholic drinks was not assessed in this study, further research would be needed to establish whether the association between smaller EAT depots and consumption of light alcoholic beverages truly exists.

Smoking and its impact on the accumulation of epicardial adipose tissue

Prevalence of current smoking among patients with cardiovascular diseases was lower than in Lithuanian adult population (respectively, 11% versus 17% among females, 24% versus 42% among males) (Grabauskas et al. 2015). Similar results were observed by other authors who studied population with cardiovascular pathology (Laurinskaitė, Šostakienė & Darginavičienė 2013, Norkienė, Šabliauskytė 2011, Kubilius et al. 2012). Regardless of these results, ex-smokers accounted for one third of the sample (33%). Other study also has shown similar findings (37%) (Norkienė, Šabliauskytė 2011). In contrast, ex-smokers account for 17% (24% of males and 13% of females) in Lithuanian adult population, never-smokers account for 50% (30% of males and 64% of females) (Grabauskas et al. 2015). In this dissertation, never-smokers accounted for a similar part (48% of the sample, 34% of males and 70% of females). Distribution of the patients by number of cigarettes per day was similar to Lithuanian adult population (Grabauskas et al. 2015).

Diverging results regarding the association between smoking and accumulation of adipose tissue in the body are presented in other studies. Some show that smoking is associated with smaller depots of adipose tissue (Matsushita et al. 2011, Mangubat et al. 2012), others – that there is no association at all (de Vos et al. 2008). Third group shows that smoking is related with larger depots of adipose tissue (Kim et al. 2012, Monti et al. 2014). In this dissertation, logistic regression showed that a number of cigarettes per day is a significant factor for EAT accumulation. In addition to this, previous smoking and longer smoking duration showed associations with larger EAT depots. Ormseth with colleagues observed similar results (Ormseth et al. 2012). Regardless of the conflicting findings mentioned above, studies with laboratory animals show that smoking is harmful and is related with higher risk of glucose tolerance (Friedman et al. 2009), oxidative stress, steatosis (Mangubat et al. 2011), metabolic disorders (Mangubat et al. 2012).

Physical activity and its impact on the accumulation of epicardial adipose tissue

Distribution of the patients with cardiovascular diseases by physical activity at work differed from the specific distribution of Lithuanian adults. Participants of this study stated 2.6 times more frequently that their physical activity at work was very intensive. Sedentary, physically passive work among male patients was 1.4 times more frequent while intensive physical activity at work was 1.5 less frequent. In contrast, female patients 6.5 times more frequently had very intensive physically active work (Grabauskas et al. 2015).

Leisure-time physical activity of most (59%) of the patients was low. These findings are consistent with study results representing leisure-time physical activity of Lithuanian

adults, 70% of whom indicate sedentery activities that last 4 hours and more every day (Grabauskas et al. 2015).

Certainly, physical activity is an important factor for accumulation of adipose tissue including EAT (Wilund et al. 2010, Kim et al. 2009b, Kahl et al. 2016, Wu et al. 2016). However, the results of this dissertation showed that subjectively assessed physical activity at work or during leisure-time was not related to significant differences in size of EAT depots among patients with cardiovascular diseases. According to other researchers, people tend to overestimate their physical activity (Shephard 2003, Sallis et al. 1985). This is consistent with the results of the study which revealed that intervention of physical activity relying only on self-controlled physical intensity without participation of trainers was not effective in the reduction of EAT depots (Jonker et al. 2013).

Emotional stress and its impact on the accumulation of epicardial adipose tissue

The tenth (11,6%) of the patients with cardiovascular diseases indicated frequently feeling tense and anxious, retarded and suppressed, tormented of troubled thoughts and concerns, inability to sit calmly and relaxed. At least 3 of these emotional stress indicators were prevalent among 27,4% of the participants of this study. Around 28% of the patients indicated none of these factors. According to WHO, depression affects about 10,2% of the world population (WHO 2016). However, Institute of Hygiene provides statistical information showing that prevalence of mood disorders and depressions in Lithuania is significantly lower (Institute of Hygiene 2015). According to the results of the study of Lithuanian adult population, 52% of the Lithuanian adult population felt depressed in period of past 12 months, 21% indicated that those feelings were more severe than earlier (Grabauskas et al. 2015).

According to multiple researches, more frequent emotional stress is associated with larger depots of adipose tissue. However, no significant association between emotional stress and size of EAT depots was observed (Marniemi et al. 2002, Drapeau et al. 2003, Kahl et al. 2014). Results of this dissertation show that more frequent emotional stress (frequent tension and anxiety, inability to sit calmly and relax) may be associated with smaller EAT volume. On the other hand, logistic regression analysis did not reveal emotional stress as significant variable for EAT accumulation.

It is known that emotional stress is associated with heart rate (Dishman et al. 2000) which may be associated with differences in size of EAT depots (Balcioğlu et al. 2015). Nevertheless, some authors have shown no correlation between heart rate and size of EAT depots (Iacobellis et al. 2003). On the other hand, emotional stress is associated with larger depots of visceral adipose tissue, obesity and higher risk of cardiovascular diseases, metabolic syndrome and diabetes mellitus (Tsigos, Chrousos 2006, Heraclides et al. 2012). Therefore, in this dissertation smaller EAT depots among patients who experienced more frequent emotional stress cannot be linked to a better health state.

Other factors and their impact on the accumulation of epicardial adipose tissue

According to the results of this study, size of EAT depots is strongly associated with sociodemographic factors. Logistic regression analysis revealed that age, gender and average monthly income significantly predicted EAT volume. Comparison of EAT volume accordingly to sociodemographic factors showed that males, parents and people with lower social status (lower educated, unemployed and with lower monthly income) had larger EAT depots. Larger EAT volume among men is consistent with the results of other studies stating that males tend to have larger depots of visceral adipose tissue (Park et al. 2011). Larger EAT depots among patients with children may be related with overeating habits. However, as detailed analysis of this subgroup was not performed a definitive conclusion cannot be drawn. On the other hand, studies in Poland have shown that prevalence of obesity among parents is lower than in general population of Polish adults (Berghöfer et al. 2008, Jodkowska et al. 2011). Larger depots of adipose tissue among people with lower social status may be specific for different countries as well (Buttenheim et al. 2010). Studies have shown that in highly developed countries lower social status is often associated with larger depots of adipose tissue, obesity and higher risk of cardiovascular diseases (McLaren 2007). In Lithuania, lower social status, lower education and living in a rural area is associated with greater mortality rates (Vincerzevskiene et al. 2017). According to other studies, visits to specialist physicians tend to be less frequent among rural respondents than among urban residents (Veugelers, Yip & Elliott 2003, Chaix et al. 2005, Habicht, Kunst 2005, Dunlop, Coyte & McIsaac 2000, Sibley, Weiner 2011). Results of this dissertation show that rural respondents accounted for a significantly smaller than expected part of the sample according to the Lithuanian adult population. Distribution of the patients by education was consistent with the general Lithuanian adult population (Lithuanian Department of Statistics 2016).

Like sociodemographic characteristics, diseases may be associated with differences in size of EAT depots as well (van den Borst et al. 2012). Results of this dissertation comply with the conclusion of systematic review of literature stating that EAT volume larger than 125 cm^3 may be considered abnormal (Bertaso et al. 2013). Average EAT volume of patients with coronary artery disease, myocardial infarction or hypertension was greater than 125 cm^3. Average EAT volume among patients without these diseases was lower. However, results of this dissertation do not comply with the other conclusion of the same systematic review of literature stating that 5 mm is the cut-off value for thickness of EAT depots on the free wall of the right ventricle. Thickness of EAT depots among the patients with and without diseases mentioned was lower. Regardless of the higher number of studies where the limit of 5 mm was stated, the review included several papers where such cut-off value was found to be lower (Ahn et al. 2008, Yun et al. 2009). Average volume and thickness of EAT depots (except thickness of EAT depots on the left ventricular free wall) were significantly higher among patients with diabetes mellitus than among patients without this disease. Similar results were presented in other studies as well (Chun et al. 2015, Song do et al. 2015). Average thickness of EAT depots was similar among patients with and without cardiomyopathy while EAT volume was higher among patients with cardiomyopathy. Diverging results were found in other studies comparing EAT amounts among people with and without cardiomyopathy. Doesch and his colleagues have found that patients with dilated or ischemic cardiomyopathy had lower amount of EAT comparing to EAT amounts among

people without cardiomyopathy (Doesch et al. 2010). Meanwhile, scientists from Italy have presented results similar to the results of this dissertation. They have found that patients with hypertrofic or hypertrofic-ischemic cardiomyopathy had larger EAT depots than people without cardiomyopathy (Corradi et al. 2004).

According to WHO, early diagnosis and treatment are essential among people with high risk of cardiovascular diseases (WHO 2016). Results of this dissertation as well as results of other studies have revealed that EAT depots can be measured in the routine imaging (echocardiography, computed tomography or magnetic resonance tomography) (Bertaso et al. 2013) and provide useful diagnostic information (Fu et al. 2013). In addition to this, differences in EAT accumulation among people with different lifestyles may be beneficial in selection of patients with higher risk of cardiovascular diseases and providing health education in order to reduce EAT accumulation.

CONCLUSIONS

1. Selection of food without concern to improve health or prevent diseases and the excessive consumption of salt are associated with larger depots of epicardial adipose tissue. These factors are less prevalent among adults with cardiovascular diseases than among general Lithuanian adult population.
2. Habit of alcohol consumption could not be evaluated as significant factor for accumulation of epicardial adipose tissue. Consumption of alcohol beverages was less prevalent among adults with cardiovascular diseases than in general Lithuanian adult population.
3. Heavier smoking is associated with larger depots of epicardial adipose tissue. In comparison to general Lithuanian adult population, among adults with cardiovascular diseases, current-smokers accounted for a smaller proportion, ex-smokers – for a larger.
4. Subjectively assessed physical activity could not be evaluated as a significant factor for the accumulation of epicardial adipose tissue. Physical activity at work and leisure time among adults with cardiovascular diseases was lower than in general Lithuanian adult population.
5. Emotional stress could not be evaluated as a significant factor for accumulation of epicardial adipose tissue. Every tenth of the adults with cardiovascular diseases often felt emotional stress.

RECOMMENDATIONS

1. Adults should select food with concern to improve health (prevent diseases), avoid excessive salt use, must not smoke.
2. Measurement of depots of epicardial adipose tissue should be performed by physicians and evaluated as an indicator of cardiovascular diseases.
3. The results and conclusions of this dissertation should be included in the development of cardiovascular disease prevention programs by Association of Public Health bureaus in conjunction with Lithuanian Heart Association.

SUMMARY IN LITHUANIAN

Tiriamoji problema ir darbo aktualumas

Pasaulio sveikatos organizacijos duomenimis, širdies ir kraujagyslių ligos išlieka dažniausia mirties priežastis visame pasaulyje. Jau ne vieną dešimtmetį širdies ir kraujagyslių ligos yra siejamos su dideliu riebalinio audinio kiekiu. Tyrimais nustatyta, kad svarbus ne tik riebalinio audinio kiekis, bet ir jo pasiskirstymas organizme. Pastaruoju metu pasaulyje aktyviai atliekami epikardinio riebalinio audinio sankaupų tyrimai. Dėl savo sąlyčio su miokardu ir širdį maitinančiomis kraujagyslėmis epikardinis riebalinis audinys atlieka svarbų vaidmenį vystantis širdies ir kraujagyslių ligoms (tarp jų ir koronarinei širdies ligai), todėl vertinant jo sankaupų dydį netgi atsiveria naujos galimybės šias ligas aptikti ankstyvose jų stadijose.

Epikardinio riebalinio audinio kaupimasis iki šiol buvo analizuojamas atsižvelgiant į pavienius gyvensenos veiksnius, pritaikytas trumpalaikes intervencijas, tačiau kompleksinių tyrimų, nagrinėjančių epikardinio riebalinio audinio kaupimąsi dėl žmonių gyvensenos įpročių, trūksta. Lietuvoje epikardinis riebalinis audinys iki šiol nebuvo tyrinėtas.

Darbo tikslas ir uždaviniai

Darbo tikslas – įvertinti širdies ir kraujagyslių ligomis sergančių suaugusiųjų gyvensenos įpročius ir jų įtaką epikardinio riebalinio audinio sankaupų dydžiui.

Darbo uždaviniai – nustatyti ir įvertinti širdies ir kraujagyslių ligomis sergančių suaugusiųjų:

1. mitybos įpročius ir jų įtaką epikardinio riebalinio audinio sankaupų dydžiui;
2. alkoholinių gėrimų vartojimo įpročius ir jų įtaką epikardinio riebalinio audinio sankaupų dydžiui;
3. rūkymo ypatumus ir jų įtaką epikardinio riebalinio audinio sankaupų dydžiui;
4. fizinį aktyvumą ir jo įtaką epikardinio riebalinio audinio sankaupų dydžiui;
5. patiriamą emocinį stresą bei jo įtaką epikardinio riebalinio audinio sankaupų dydžiui.

Darbo mokslinis naujumas ir praktinė reikšmė

Disertaciniame darbe naudojant magnetinio rezonanso tomografijos vaizdus buvo išmatuotos epikardinio riebalinio audinio sankaupos, o matavimų rezultatai kompleksiškai įvertinti pagal sociodemografines charakteristikas bei gyvensenos įpročius. Lietuvoje epikardinio riebalinio audinio sankaupų tyrimas atliktas pirmą kartą.

Disertacinio darbo rezultatai gali būti naudingi visuomenės sveikatos specialistams, rengiantiems sveikatos stiprinimo bei širdies ir kraujagyslių ligų prevencijos programas.

Gydytojams šio darbo rezultatai gali padėti įvertinti koronarinės širdies ligos bei miokardo infarkto riziką.

Ginamieji teiginiai

1. Maisto pasirinkimas ne sveikatos gerinimo tikslu, dažnas sūraus maisto vartojimas bei didelis per dieną surūkomų cigarečių skaičius yra reikšmingi su didesnėmis epikardinio riebalinio audinio sankaupomis susiję Lietuvos širdies ir kraujagyslių ligomis sergančių suaugusiųjų gyvensenos veiksniai.
2. Lietuvos širdies ir kraujagyslių ligomis sergančių suaugusiųjų alkoholinių gėrimų vartojimo, fizinio aktyvumo įpročiai bei emocinis stresas nėra reikšmingi epikardinio riebalinio audinio sankaupų dydį lemiantys veiksniai.

Tyrimo medžiaga ir metodai

Tiriamoji populiacija

Tyrime dalyvavo 506 širdies ir kraujagyslių ligomis sergantys 30–75 metų amžiaus Lietuvos suaugusieji, kuriems nuo 2014 metų balandžio iki 2015 metų balandžio Vilniaus universiteto ligonės Santariškių klinikų Radiologijos ir branduolinės medicinos centre buvo atliekama širdies ir kraujagyslių magnetinio rezonanso tomografija.

Gyvensenos tyrimas

Gyvensenos įpročių tyrimas buvo atliekamas tiesioginės apklausos būdu. Naudodamas parengtą anketą apklausą atliko disertacijos autorius. Respondentų buvo klausiama apie jų mitybos įpročius (maisto pasirinkimo kriterijus, valgymų skaičių per dieną, mitybos režimo laikymąsi, įvairių maisto produktų vartojimo dažnumą, polinkį sūdyti jau pagamintus patiekalus, subjektyvią nuomonę apie mitybos tinkamumą), alkoholio ir tabako gaminių vartojimo įpročius, fizinį aktyvumą, patiriamą stresą, ligas, kuriomis šiuo metu serga ir kuriomis sirgo anksčiau, susirgimo riziką didinančius veiksnius, sociodemografinius rodiklius. Anketai buvo panaudoti klausimai iš „European Centre on Health of Societies in Transition“ ir Pasaulio sveikatos organizacijos regioninio Europos biuro verifikuoto klausimyno, kurį naudojant Lietuvoje vykdomi mitybos ir gyvensenos tyrimai nuo 1997 metų.

Epikardinio riebalinio audinio sankaupų vertinimas

Kiekvienam tyrimo dalyviui epikardinio riebalinio audinio sankaupos buvo vertinamos naudojant širdies magnetinio rezonanso tomografijos vaizdus. Vaizdinimas buvo atliekamas širdies magnetinio rezonanso tomografijos *Siemens MAGNETOM Avanto 1,5T* aparatu. Panaudojant magnetinio rezonanso tomografijos vaizdus kiekvienam tyrimo dalyviui buvo išmatuotas epikardinio riebalinio audinio tūris ir storis. Siekiant didesnio matavimų tikslumo, kiekvieno paciento visi epikardinio riebalinio audinio

matavimai buvo atlikti nepriklausomai dviejų tyrėjų. Statistinei analizei buvo naudojami abiejų tyrėjų matavimo rezultatų aritmetiniai vidurkiai.

Epikardinio riebalinio audinio tūris buvo apskaičiuojamas pagal modifikuotą *Simpson* metodiką. Rankiniu būdu trumpųjų ašių diastolės pabaigos magnetinio rezonanso tomografijos vaizduose buvo apibrėžiami kairįjį ir dešinįjį skilvelį dengiančio riebalinio audinio kontūrai. Taip apskaičiuotus skirtinguose pjūviuose matomo riebalinio audinio plotus padauginus iš pjūvių storio, buvo apskaičiuojami tuose pjūviuose užfiksuoti epikardinio riebalinio audinio tūriai. Bendras epikardinio riebalinio audinio tūris buvo apskaičiuotas sudedant skirtinguose pjūviuose išmatuotus skilvelius dengiančio riebalinio audinio tūrius.

Kiekvienam tyrime dalyvavusiam respondentui buvo išmatuotas epikardinio riebalinio audinio storis kairiojoje ir dešiniojoje prieširdinėje bei viršutinėje, apatinėje ir priekinėje tarpskilvelinėse vagose, taip pat trijose vietose ant kairiojo ir trijose vietose ant dešiniojo skilvelio laisvųjų sienų.

Statistinė duomenų analizė

Shapiro–Wilk testu buvo patikrintas skirstinių normalumas. Pagal normalųjį dėsnį pasiskirsčiusių skirstinių porų dispersijoms palyginti naudotas *Levene* testas, o remiantis jo rezultatais – atitinkamas *t testas* vidurkių palyginimui. Pagal normalųjį dėsnį nepasiskirsčiusiems ranginių bei tolydžiųjų kintamųjų skirstiniams palyginti buvo naudojamas *Mann–Whitney U* testas. Dažnių palyginimui skirtingose grupėse, kai 80 % ir daugiau prognozuojamų reikšmių buvo didesnės nei 5, buvo naudojamas χ^2 kriterijus, kai daugiau nei 20 % prognozuojamų reikšmių buvo mažesnės nei 5, naudotas *Fisher–Freeman–Halton* testas. Duomenų klasifikavimui pagal tolydžiuosius kintamuosius atlikta *ROC* kreivių analizė. Epikardinio riebalinio audinio tūriui prognozuoti buvo sudarytas logistinės regresijos modelis, kurio visiems statistiškai reikšmingiems kintamiesiems apskaičiuoti šansų santykiai bei pasikliautinieji intervalai. Modelio tinkamumas patikrintas *Hosmer–Lemeshow* testu. Statistiniams skaičiavimams pasirinktas reikšmingumo lygmuo α=0,05.

Rezultatai ir jų aptarimas

Iš tyrimo dalyvių 60 % sudarė vyrai, 40 % – moterys. Vidutinis tyrimo dalyvių amžius buvo 55 metai, vidutinis kūno masės indeksas – 27,2 kg/m^2. Šie rodikliai statistiškai reikšmingai nesiskyrė tarp lyčių. Trečdalio tyrime dalyvavusių suaugusiųjų kūno masė buvo normali, trečdalis pacientų turėjo antsvorį bei trečdalis buvo nutukę. Respondentų daugumą sudarė susituokę, turintys vaikų, mieste gyvenantys širdies ir kraujagyslių ligomis sergantys suaugusieji.

Lyginant su 2013–2014 metais atliktais suaugusių Lietuvos gyventojų tyrimais, širdies ir kraujagyslių ligomis sergantys pacientai iki 2,2 kartų dažniau maistą rinkosi sveikatos gerinimo ar ligų profilaktikos tikslu, nors dažniausias maisto pasirinkimo kriterijus abiem atvejais buvo skoninės savybės. Pasiskirstymas pagal pagrindinių valgymų skaičių per dieną bei įprotį valgyti tuo pačiu laiku šio ir Lietuvos suaugusiųjų populiacijos

tyrimų atveju buvo panašus, tačiau užkandžiavimo dažnis skyrėsi: širdies ir kraujagyslių ligomis sergantys pacientai užkandžiavo dažniau, nei būdinga Lietuvos suaugusiesiems. Lyginant su Lietuvos suaugusiųjų populiacija, kasdien šviežias daržoves vartojo tokia pati ar netgi didesnė sergančių žmonių dalis. Grūdinius produktus, pieną ir jo produktus, mėsą ir jos produktus, žuvį ir jos produktus, saldumynus, maisto papildus širdies ir kraujagyslių ligomis sergantys asmenys vartojo dažniau, nei būdinga Lietuvos suaugusiesiems. Mažesnė širdies ir kraujagyslių ligomis sergančių suaugusiųjų dalis nurodė augalinį aliejų kaip dažniausiai maistui vartojamus riebalus, sviestą kaip dažniausiai maistui vartojamus riebalus nurodžiusiųjų dalis buvo beveik 2 kartus didesnė, nei būdinga Lietuvos suaugusiesiems. Papildomai pagamintus patiekalus sūdydavo mažesnė širdies ir kraujagyslių ligomis sergančių tiriamųjų dalis negu Lietuvos suaugusiųjų gyventojų populiacijoje (29 % sergančiųjų, 35 % ir 42 % Lietuvos suaugusiųjų).

Stiprius alkoholinius gėrimus bent kartą per savaitę sergančios moterys vartojo 2,25 karto rečiau, nei būdinga Lietuvos suaugusiųjų populiacijai, o vyrų stiprių alkoholinių gėrimų vartojimo paplitimas buvo panašus: 21 % lyginant su 26 %. Silpnus alkoholinius gėrimus sergantys vyrai vartojo rečiau, o moterys – panašiai abiejose populiacijose.

Lyginant su Lietuvos suaugusių žmonių tyrimo rezultatais, apklausos laikotarpiu širdies ir kraujagyslių ligomis sergančių suaugusiųjų rūkymo paplitimas buvo mažesnis. Anksčiau rūkiusiųjų skaičius siekė 33 %. Lietuvos suaugusiųjų populiacijoje metusių rūkyti žmonių dalis sudaro 17 %, nerūkančių ir niekada nerūkiusių – 50 %. Niekada nerūkę širdies ir kraujagyslių ligomis sergantys pacientai sudarė panašią dalį – 48 %. Pagal surūkomų per dieną cigarečių skaičių rūkančių sergančiųjų pasiskirstymas buvo panašus į būdingą Lietuvos suaugusių žmonių populiacijai.

Lyginant su Lietuvos suaugusiųjų populiacija, 1,4 karto daugiau vyrų, sergančių širdies ir kraujagyslių ligomis, nurodė, kad dirba sėdimą, fiziškai pasyvų darbą, 6,5 karto daugiau sergančių moterų dirbo labai sunkų fizinį darbą. Dauguma tiriamųjų laisvalaikiu nebuvo pakankamai fiziškai aktyvūs ir laiką leido sėdėdami, gulėdami arba vaikščiodami. Panašūs rezultatai buvo gauti ir ištyrus Lietuvos suaugusius žmones.

Širdies ir kraujagyslių ligomis sergančių 11,6 % suaugusiųjų dažnai jautė emocinį stresą. Panašią depresija sergančių žmonių pasaulyje dalį nurodo ir Pasaulio sveikatos organizacija (apie 10,2 %), tačiau ji – gerokai didesnė nei Higienos instituto nurodomas ligotumas nuotaikos sutrikimais ir depresija.

Analizė parodė, kad epikardinio riebalinio audinio tūris cukrinio diabeto, koronarinės širdies ligos, miokardo infarkto, arterinės hipertenzijos bei kardiomiopatijų atveju buvo didesnis nei nesant šių ligų ($p<0,05$). Epikardinio riebalinio audinio storis taip pat buvo didesnis asmenų, sergančių širdies ir kraujagyslių ligomis ($p<0,05$), išskyrus kardiomiopatijas, kai nerasta statistiškai reikšmingų epikardinio riebalinio audinio storio skirtumų. Nustatyta, kad klasifikuojant minėtomis ligomis sergančius ir nesergančius pacientus, tikslingiausia remtis epikardinio riebalinio audinio tūrio matavimais. Plotas po epikardinio riebalinio audinio ROC kreive buvo didžiausias ir sudarė 0,837 viso galimo ploto. Didžiausias atstumas nuo įstrižinės linijos (*Youden* indeksas) susidarė esant 111,3 cm^3 epikardinių riebalų tūriui. Remiantis šiais rezultatais, pacientai buvo

suskirstyti į dvi grupes: 26 % pacientų, kurių epikardinio riebalinio audinio tūris buvo iki 111,3 cm^3, ir 74 % pacientų, kurių epikardinio riebalinio audinio tūris buvo didesnis. Pacientų pasiskirstymui tarp šių dviejų grupių prognozuoti buvo sudarytas logistinės regresijos modelis, į kurį bandyta įtraukti visus tyrimo metu registruotus kintamuosius: mitybos, alkoholinių gėrimų vartojimo, rūkymo, fizinio aktyvumo įpročius, patiriamą emocinį stresą, kūno masės indekso kategoriją, sociodemografinius rodiklius. Po vieną atmetus statistiškai nereikšmingus kintamuosius, buvo gautas modelis, teisingai suklasifikuojantis 86,3 % imties reikšmių. Statistiškai reikšmingi modelio kintamieji buvo kūno masės indekso kategorija, pagrindinis maisto pasirinkimo kriterijus, jau pagamintų patiekalų papildomas sūdymas, per dieną surūkomų cigarečių skaičius, lytis, amžius bei gaunamos pajamos. Remiantis sudarytu modeliu, per didelį kūno masės indeksą turintys pacientai 7,9 karto dažniau turi per didelį epikardinio riebalinio audinio tūrį, maistą besirenkantiems ne sveikatos gerinimo (ligų profilaktikos) tikslu per didelis epikardinio riebalinio audinio tūris išmatuojamas 2,5 karto dažniau. Pagamintus patiekalus papildomai sūdantiems respondentams per didelis epikardinio riebalinio audinio tūris būdingas taip pat 2,5 karto dažniau, 20 ir daugiau cigarečių per dieną surūkantiems pacientams – 3,4 karto dažniau, iki 1500 Lt per mėnesį uždirbantiems – 1,8 karto dažniau, vyrams – 8,5 karto dažniau nei priešingų grupių atstovams.

Analizė atskleidė, kad didesnes epikardinio riebalinio audinio sankaupas turėjo vyrai, vaikų turintys, žemesnio socialinio statuso (aukštojo išsilavinimo neįgiję, nedirbantys bei mažesnes pajamas gaunantys) asmenys, sergantys širdies ir kraujagyslių ligomis. Kitų tyrimų rezultatai rodo, kad išsivysčiusiose šalyse žemesnis socialinis statusas dažnai yra susijęs su didesnėmis riebalinio audinio sankaupomis, nutukimu ir didesne širdies ir kraujagyslių ligų rizika. Įgytas aukštesnis išsimokslinimas bei gyvenimas mieste yra reikšmingi sergančiųjų išgyvenamumo rodikliai. Remiantis tyrimų rezultatais, kaimo gyventojai pas gydytojus specialistus lankosi rečiau nei miesto gyventojai.

Šio disertacinio tyrimo bei kitų tyrimų rezultatai rodo, kad atliekant įprastus širdies vaizdinimo tyrimus (echokardiografiją, magnetinio rezonanso tomografiją ar kompiuterinę tomografiją) gali būti įvertintos epikardinio riebalinio audinio sankaupos, o tai padėtų diagnozuoti minėtas ligas. Nustatyti epikardinio riebalinio audinio sankaupų skirtumai esant skirtingiems gyvensenos įpročiams gali būti naudingi atrenkant didžiausią širdies ir kraujagyslių ligų riziką turinčius pacientus bei informuojant juos apie tai, kurie gyvensenos veiksniai šią riziką didina labiausiai.

Išvados

1. Maisto pasirinkimas ne sveikatos gerinimo tikslu ir dažnas sūraus maisto vartojimas yra susijęs su didesnėmis epikardinio riebalinio audinio sankaupomis. Sūraus maisto vartojimo ir maisto pasirinkimo ne sveikatos gerinimo tikslu paplitimas tarp sergančių širdies ir kraujagyslių ligomis suaugusiųjų buvo mažesnis, nei būdinga Lietuvos suaugusiųjų populiacijai.
2. Alkoholinių gėrimų vartojimo įpročių nebuvo galima įvertinti kaip reikšmingų epikardinio riebalinio audinio sankaupų dydį lemiančių veiksnių. Alkoholinių gėrimų vartojimo paplitimas tarp širdies ir kraujagyslių ligomis sergančių suaugusiųjų buvo mažesnis nei būdinga Lietuvos suaugusiųjų populiacijai.

3. Didesnis per dieną surūkomų cigarečių skaičius yra susijęs su didesnėmis epikardinio riebalinio audinio sankaupomis. Rūkantys širdies ir kraujagyslių ligomis sergantys suaugusieji sudarė mažesnę dalį, nei būdinga Lietuvos suaugusiųjų populiacijai, metusieji rūkyti – didesnę.
4. Subjektyviai vertinamo fizinio krūvio nebuvo galima įvertinti kaip nepriklausomo epikardinio riebalinio audinio sankaupų dydį lemiančio veiksnio. Širdies ir kraujagyslių ligomis sergančių žmonių fizinis aktyvumas darbe ir laisvalaikiu buvo mažesnis, nei būdinga Lietuvos suaugusiųjų populiacijai.
5. Patiriamo emocinio streso nebuvo galima įvertinti kaip reikšmingo epikardinio riebalinio audinio sankaupų dydį lemiančio veiksnio. Emocinį stresą dažnai jautė kas dešimtas širdies ir kraujagyslių ligomis sergantis suaugęs pacientas.

Rekomendacijos

1. Suaugusiesiems rekomenduojama maistą rinktis sveikatos gerinimo (ligų profilaktikos) tikslu, papildomai nesūdyti jau pagamintų patiekalų, nerūkyti.
2. Širdies magnetinio rezonanso tomografijos, kompiuterinės tomografijos ar echoskopijos tyrimus atliekantiems gydytojams rekomenduojama atlikti epikardinio riebalinio audinio sankaupų dydžio, kaip širdies ir kraujagyslių ligų indikatoriaus, matavimus.
3. Savivaldybių visuomenės sveikatos biurų asociacijai kartu su Lietuvos širdies asociacija rengiant širdies ir kraujagyslių ligų prevencijos programas atsižvelgti į disertacijos rezultatus ir išvadas.

PUBLICATIONS

Articles on present research results

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2. Austys D, Dobrovolskij A, Palionis D, Valevičienė N, Stukas R. Accumulation of Epicardial Adipose Tissue: Myocardial Infarction Versus Chronic Ischemia. Evolutionary Medicine: Pre-Existing Mechanisms and Patterns of Current Health Issues. June, 2016, Vilnius, Lithuania.
3. Austys D, Dobrovolskij A, Palionis D, Valevičienė N, Stukas R. Epicardial Adipose Tissue in Patients With Coronary Artery Disease: Healthy vs. Unhealthy Lifestyle. 9th European Public Health Conference // All for Health – Health for All. November, 2016, Vienna, Austria.

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Education			
Institution	**Qualification, degree**		**Year**
Vilnius University	Software engineering, Bachelor`s degree		2010
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Institution	**Position**	**Duties**	**Period**
Vilnius University. Faculty of Medicine, Institute of Public Health	Senior Specialist	• Technical assistance in statistical data analysis. • Technical assistance in the preparation of educational material. • Administration of the website of the Institute of Public Health, Faculty of Medicine, Vilnius University.	From 2010
Vilnius University. Faculty of Medicine, Institute of Public Health	Lecturer	Teaching of the following subjects: • Radiation protection for the students of Public Health • Public health for the students of Medicine	From 2012