

Determinants of changes in lipid levels in a prophylactic programme

Research Article

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Abstract: Introduction. The aim of this study was to evaluate changes in the levels of certain lipids in a group of participants in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme and also to determine factors contributing to positive changes in the variables. Materials and methods. The study was conducted in Zgierz, a town in central Poland. 458 people, former participants of the Prophylaxis and Early Detection of Cardiovascular Diseases Programme, were included in the study. The study tool was a questionnaire. The authors made laboratory tests to determine the lipid profile and serum glucose. They also took arterial pressure twice and made anthropometric measurements. The authors used single-factor logistic regression to evaluate the obtained results. They adopted statistical significance level of $p < 0.05$. The data were presented as odds ratios (OR) with 95% confidence intervals (CIs). Results. A positive change in TC levels was observed in 64% of the respondents, LDL cholesterol level in 47.8% and HDL cholesterol level in 60.7%. In 46.5% of the respondents, a decrease in the level of triglycerides was observed. Conclusions. There is a need to initiate prophylactic activities, especially among males, people who are less educated and also among older people.

Keywords: *Prophylaxis programmes on cardiovascular diseases • Lipid balance • Poland*

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1. Introduction

Abnormal levels of lipids in the serum are risk factors for the development of cardiovascular diseases, which are the main cause of mortality and life years lost due to premature deaths in Poland [1-3]. Disturbances in the lipid balance might include an elevated level of total cholesterol (TC), LDL cholesterol, triglycerides as well as a decreased level of HDL cholesterol. These disturbances can occur separately or in combination; when combined, their negative synergistic effect on a body is intensified [4,5].

Disturbances in the lipid balance are classified according to lipid levels in the serum; they might include: hypercholesterolemia (diagnosed when the level of TC exceeds 200mg/dl–5.18 mmol/l and the level of LDL cholesterol is higher than 130 mg/dl–3.37 mmol/l), atherogenic dyslipidemia (diagnosed when levels of all the lipids are abnormal) and triglyceridemia (diagnosed when the level of triglycerides is higher than 200 mg/

dl–2.26 mmol/l and the level of the other lipids remains the same) [6].

The National Multicenter Health Survey, carried out in Poland in 2006–2008, confirmed dyslipidemia in 74% of males and 69% of females. Hypercholesterolemia was diagnosed in 67% of males and 64% of females, and its severe form was observed in 2% of males and 3% of females. An elevated level of serum triglycerides was noted in 31% of males and 20% of females. Low levels of HDL cholesterol were observed least frequently, i.e., in 15% of males and 17% of females. The study also confirmed huge regional differences in lipid disturbance.

In the Łódź province, hypercholesterolemia occurred in 73% of males and 67% of females.

Hypertriglyceridemia was diagnosed in 28% of males and 17% of females, and a low HDL level was observed in 17% of males and 20% of females [7]. The Polish NATPOL III Plus study confirmed that a regular level of TC can be noted only in every third person in Poland [8]. A study called LIPIDOGAM 2004 confirmed

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that lipid disorders become increasingly more common in an older ages [9].

An attempt to decrease the number of people suffering from lipid disorders, as well as to increase the detection and enhance the effectiveness of treating these abnormalities, have become priorities of the National Health Plan 2003-2014 [10] and the National Health Programme 2007-2015 [11].

It was confirmed that a change in the level of TC, LDL and HDL cholesterol decreases the risk of death by cardiovascular diseases to a high degree [12-15]. The level of TC in the serum is a component of the SCORE (European Systematic Coronary Risk Evaluation) algorithm used in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme, which aims at assessing the risk of death resulting from cardiovascular diseases. The programme has been implemented by the National Health Fund since 2003. It also has an educational character, as it aims at propagating knowledge on methods of preventing lipid disturbances. Polish society still has not become fully cognizant of such methods. According to the National Multicenter Health Survey, only 24% of males and 31% of females were aware of their abnormal levels of lipids. In the LIPIDOGRAm 2004 study, 51.6% of the subjects knew they had some lipid disorders [9].

The aim of the present authors was to evaluate changes in the levels of certain lipids (including the level of TC, LDL and HDL cholesterol, as well as triglycerides) in a group of participants of the Prophylaxis and Early Detection of Cardiovascular Diseases Programme, and also to determine factors contributing to positive changes in the selected variables.

2. Materials and methods

The study was conducted in Zgierz – a medium-sized town located in central Poland – between December 2009 and January 2011. The respondents of the Prophylaxis and Early Detection of Cardiovascular Diseases Programme, implemented from 2006 till 2008, were included in the study. The study tool was a questionnaire prepared by the authors. It consisted of five sections: knowledge of risk factors contributing to cardiovascular diseases; nicotine smoking; physical activity; diet; and stress. The authors also referred to the examination card of the subject in which they entered information on demographic and anthropometric measurements as well as the results of the laboratory tests and the value of arterial pressure.

The authors performed the study in three stages in one non-public health care institution selected by simple random sampling. The first stage was carried out with the use of the authors' survey questionnaire. The second stage included making anthropometric measurements and taking arterial pressure. In the third stage, the authors conducted laboratory tests.

The Bioethics Committee of Lodz Medical University approved the research project (resolution of RNN/481/09/KB from 9 June 2009). Each respondent was shown a questionnaire together with information on the study and the description of the study. Prior to the study, the respondents had to give informed consent for such a study to be conducted. Anthropometric measurements of body weight (in kg; with an accuracy of 1 kg), height (in cm), waist (in cm), hips (in cm) were taken with a measuring tape with an accuracy of 1 cm.

In each subject, arterial blood pressure (diastolic and systolic) was taken twice by a family nurse after a 5–10 minute rest. The authors of the study did not take any measurements after an immediate exposure to stress, physical exercise, nor after drinking coffee or any other drink containing caffeine (up to 30 min.) and/or smoking a cigarette. Arterial blood pressure was taken again, 2–3 minutes after the first measurement. The level of blood pressure was an arithmetic mean of the two measurements. Arterial blood pressure was measured in a treatment room of the appointed clinic with an Omron M2 Basic blood pressure manometer using an oscillometric method. The instrument could produce measurements ranging from 0 to 299 mmHg (measurement accuracy ± 3 mmHg). In the laboratory tests, the levels of TC, LDL and HDL cholesterol, as well as triglycerides and glucose in the blood serum, were measured. The authors evaluated the parameters using enzymatic colorimetric tests. To evaluate potential lipid disturbances, the researchers referred to the guidelines introduced by the European Society of Cardiology in 2003. According to the adopted standards, the TC level should not be higher than 190 mg/dl (4.92 mmol/l). The maximum correct level of LDL cholesterol is 115 mg/dl (2.97 mmol/l) and the minimum level of HDL is different for males and females. The European Society of Cardiology recommends the following minimum levels: for males, 40 mg/dl (1.03 mmol/l); and for females, 46 mg/dl (1.19 mmol/l). The triglyceride level should not exceed 150 mg/dl (1.69 mmol/l). It was concluded that health education, including changes in health behaviour and medical care (pharmacological treatment), contributed to positive changes in the studied parameters.

3. Statistical analysis

To verify the hypotheses, the authors applied descriptive and analytical statistics. All data were presented as a percentage or fraction of the patients giving corresponding answers. When the studied group consisted of more than 100 subjects, the data were presented as a percentage (%). When it was smaller, the data were presented as a fraction (f). To evaluate dependence between the selected variables the authors used chi-square test, adopting statistical significance level of $p < 0.05$. The authors used chi-square test with Yates–Fisher's modifications; Pearson's coefficient (C) was applied to determine the strength of the relationship between the variables. Moreover, the authors used a bivariate logistic regression to determine a relationship between selected demographic and social characteristics and the change in the analyzed health parameters (dependent variables). The data were presented as odds ratios (ORs) with 95% confidence intervals (CIs). The software program Statistica 9.0. PL version, StatSoft production, was used for statistical calculations.

4. Results

Four hundred and fifty eight people, 288 females (62.9%) and 170 males (37.1%), took part in the study. The feminization rate was 169.4. For statistical purposes, the respondents were divided into three age groups: ≤ 40 , 41–50 and ≥ 50 years. Table 1 presents characteristics of the respondents. The mean level of TC in the first analysis, i.e., after entering the prophylaxis programme, was 206.5 mg/dl (5.33 mmol/l) $\pm$ 42.4 mg/dl (1.08 mmol/l) and changed significantly ($p < 0.001$) during the authors' study to 199.9 mg/dl (5.15 mmol/l) $\pm$ 43.4 mg/dl (1.11 mmol/l). Statistically significant changes in the individual components of the lipid profile were observed.

A positive change in the level of TC between the day of entering the prophylaxis programme and the day when the authors conducted their study was observed in 293 respondents (64.%), in 203 females (70.5%) and in 90 males (52.9%).

The laboratory test carried out during the prophylaxis programme showed that the mean level of

LDL cholesterol was 123.8 mg/dl (3.20 mmol/l) $\pm$ 34.1 mg/dl (0.89 mmol/l). It should be pointed out that in study conducted by the authors, the level of LDL cholesterol increased to 125.7 mg/dl (3.26 mmol/l) $\pm$ 33.1 mg/dl (0.85 mmol/l) ($p > 0.05$). However, the authors observed an improvement in 219 respondents (47.8%) – in 150 females (52.1%) and 69 males (40.6%).

The level of HDL cholesterol also improved. A positive change was noted in 278 respondents (60.7%), in 192 females and 86 males (66.7% and 50.6% respectively). In the prophylaxis programme, the mean level of HDL cholesterol was 54.5 mg/dl (1.39 mmol/l) $\pm$ 11.2 mg/dl (0.28 mmol/l) and in the study conducted by the authors, the level increased to 56.0 mg/dl (1.45 mmol/l) $\pm$ 11.5 mg/dl (0.31 mmol/l).

It is worth stressing that the mean level of triglycerides in the first analysis was 149.6 mg/dl (1.69 mmol/l) $\pm$ 139.9 mg/dl (1.58 mmol/l) and during the next test it was 145.3 mg/dl (1.63 mmol/l) $\pm$ 102.8 mg/dl (1.16 mmol/l). A positive change in triglycerides was observed in 213 (46.5%) subjects: in 46.9% of females (135 females) and in 45.9% of males (78 males). Bearing in mind the results obtained, the authors tried to discern which characteristics contributed to a more positive change in the components of the lipid profile. The single-factor logistic regression confirmed that being a female increases the probability of improving TC (OR=2.17) and LDL and HDL cholesterol. Demographic variables such as age and education also contributed to that improvement. It was concluded that university education might improve the results 14-fold. It should also be pointed out that white-collar workers more frequently demonstrated an improvement in all the studied components of the lipid profile.

It must be emphasized that the improvement of all the studied components of the lipid profile depended on the relationship between the components. A positive change in the level of TC resulted in a chance of obtaining better levels of LDL cholesterol and triglycerides in the blood serum. A change in the LDL level correlated with a lower TC level (Table 3). A positive correlation between the studied parameters of the lipid profile and lower body weight, a decreased level of serum glucose and decreased arterial blood pressure was also observed.

With regards to the respondents who demonstrated knowledge on risk factors of cardiovascular diseases, the chances for a better level of TC (OR=9.39; $p < 0.001$), LDL cholesterol (OR=5.22; $p < 0.001$) and triglycerides (OR=4.04; $p < 0.01$) were 9-fold higher.

Moreover, a healthy lifestyle also contributed to more positive results on the laboratory tests. Increased physical exercise contributed to improved levels of TC. The probability was then 2-fold higher (OR=2.18; $p < 0.001$). This variable did not affect the levels of LDL cholesterol and triglycerides.

Non-smokers demonstrated a much higher chance of improving the levels of TC and triglycerides. The odds ratios were OR=3.72; $p < 0.001$ and OR=1.67; $p < 0.05$,

Table 1. Characteristics of the study group

Variables	Females n=288	Males n=170	Total N=458
Age, years	47.6 ± 7.03	47.9 ± 7.1	47.7 ± 7.07
Elementary education, %	6.9	6.5	6.8
Vocational education, %	21.2	23.5	22.0
Secondary education, %	44.4	45.9	45.0
University education, %	27.4	24.1	22.1
White-collar worker, %	61.3	40.0	53.2
Blue-collar worker, %	38.7	60.0	46.8
Tobacco smokers, %	22.2	31.8	25.8
Alcohol drinkers, %	55.2	90.0	72.6
TC, mmol/l	4.86 ± 0.95	5.64 ± 1.2	5.18 ± 1.11
TC ≥ 4.92 mmol/l, %	7.3	23.5	13.3
LDL, mmol/l	3.05 ± 0.72	3.54 ± 0.93	3.26 ± 0.85
LDL ≥ 3.36 mmol/l, %	14.9	8.2	12.4
HDL, mmol/l	1.50 ± 0.31	1.37 ± 0.26	1.39 ± 0.28
HDL < 1.03 mmol/l, %	33.3	54.1	41.1
TG, mmol/l	1.32 ± 0.67	2.18 ± 1.53	1.64 ± 1.16
TG ≥ 1.69 mmol/l, %	8.7	32.9	17.7
Glucose, mmol/l	4.77 ± 0.72	5.32 ± 1.16	4.99 ± 0.94
FPG, ≥ 6.99 mmol/l, %	2.1	7.6	4.1
BP, mmHg	124/75 ± 14.7	134/83 ± 15.6	128/78 ± 15.9
Hypertension, %	19.8	42.9	28.4
BMI, kg/m ²	24.9 ± 4.31	27.9 ± 4.00	26.0 ± 4.43
BMI > 24.5 kg/m ² , %	26.4	51.2	35.6
BMI > 29.9 kg/m ² , %	13.5	25.3	17.9
Regular heating habits, %	50.0	36.0	43.0
Fish consumption, %	79.0	63.0	71.0
Meat consumption > 1 per day %	15.9	52.4	29.5
Fruits and vegetables consumption > 1 per day, %	39.6	21.2	32.6
Animal fat consumption, %	49.7	65.9	55.7
Olive oil consumption, %	69.1	60.0	65.7
Natural coffee consumption daily, %	42.4	58.2	48.2
Positive change of physical activity, %	37.8	23.9	31.0
Being stressed, %	26.3	31.2	28.2
Being nervous, %	48.2	70.6	56.6

Source: the authors' calculations

Abbreviations: BMI, body mass index; BP, blood pressure; FPG, fasting plasma glucose; HDL, high-density lipoprotein; LDL, low-density lipoprotein; TC, total cholesterol; TG, triglycerides.

respectively. Smoking did not contribute to a change in the levels of LDL and HDL cholesterol.

A proper diet greatly contributed to changes in the studied parameters. Regularly eaten meals, proper food – especially fish – and reduced intake of alcohol

and coffee played an important role in balancing the lipid profile. Regular meals increased the chance of gaining a positive level of TC 3-fold (OR=3.33; p<0.001); the LDL fraction more than 2-fold (OR=2.09; p<0.01) and the HDL fraction about 1.5-fold (OR=1.59; p<0.05). Eating

Table 2. Change in TC, LDL cholesterol and triglycerides levels in the blood with change in the analyzed parameters. Single-factor logistic regression.

Variables	Positive change in TC level			Positive change in LDL level			Positive change in HDL level			Positive change in TG level		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Sex												
Males	1.00	RG	–	1.00	RG	–	1.00	RG	–	NS	NS	NS
Females	2.17	1.46–3.22	p<0.001	1.79	1.22–2.62	p<0.01	1.83	1.24–2.71	p<0.01	NS	NS	NS
≤ 40	1.45	0.88–2.40	p>0.05									
Age												
41–50	1.57	1.01–2.46	p<0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS
≥ 51	1.00	RG	–									
Education												
Elementary and vocational	1.00	RG	–	1.00	RG	–						
Secondary	3.37	2.13–5.32	p<0.001	2.70	1.70–4.28	p<0.001	NS	NS	NS	NS	NS	NS
University	14.29	7.14–28.60	p<0.001	3.83	2.27–6.48	p<0.001						
Type of work												
Desk-bound employee	5.63	2.52–12.58	p<0.001	NS	NS	NS	2.33	1.07–5.06	p<0.05	1.26–2.91	p<0.05	1.26–2.91
Manual worker	1.84	0.84–4.03	p>0.05				2.19	1.00–4.76	p<0.05	1.34	0.58–3.12	p>0.05
BMI improved	2.80	1.79–4.38	p<0.001	1.70	1.13–2.55	p<0.05				1.89	1.25–2.85	p<0.01
BMI no change	1.89	1.09–3.28	p<0.05	1.72	1.02–2.91	p<0.05	NS	NS	NS	1.05	0.62–1.78	p>0.05
BMI worsened	1.00	RG	–	1.00	RG	–				1.00	RG	–
BP improved	5.36	2.98–9.61	p<0.001	3.37	1.98–5.75	p<0.001				2.36	1.40–3.97	p<0.01
BP no change	3.10	1.96–4.90	p<0.001	2.36	1.50–3.73	p<0.001	NS	NS	NS	1.49	0.95–2.33	p>0.05
BP worsened	1.00	RG	–	1.00	RG	–				1.00	RG	–
Change in glucose level												
Glucose improved	2.24	1.47–3.41	p<0.001	1.66	1.10–2.51	p<0.05				1.96	1.29–2.98	p<0.01
Glucose no change	2.08	0.61–7.13	p>0.05	1.64	0.53–5.24	p>0.05	NS	NS	NS			
Glucose worsened	1.00	RG	–	1.00	RG	–				1.00	RG	–
Tobacco smoking												
Regularly	1.00	RG	–							1.00	RG	–
Occasionally	2.10	0.88–5.03	p>0.05	NS	NS	NS	NS	NS	NS	1.00	RG	–
Non-smoking	3.72	2.38–5.80	p<0.001							1.67	1.12–2.51	p<0.05
Positive change in physical activity												
Yes	2.18	1.40–3.40	p<0.001	NS	NS	NS	1.00	RG	–	NS	NS	NS
No	1.00	RG	–				0.98	0.66–1.47	p>0.05			
Regular eating every day	3.33	2.07–5.35	p<0.001	2.09	1.33–3.31	p<0.01	1.59	1.00–2.52	p<0.05			
Regular heating at weekends	2.20	1.32–3.67	p<0.01	1.82	1.11–3.02	p<0.05	1.11	0.67–1.82	p>0.05	NS	NS	NS
No	1.00	RG	–	1.00	RG	–	1.00	RG	–			

Notes: NS, not-statistically significant; OR, odds ratio; RF, reference group; the model of univariate logistical regression presented in this table is based on the principle that the analysed positive change of a parameter compared to the negative change was contingent on variables under study. For TC, LDL and TG, a positive change means a decrease of the level of these parameters among the study subjects during the period analysed, whereas for HDL, a positive change means an increase in the level. Source: the authors' calculations

Table 3. Mutual relationships of the lipidogram components. Single-factor logistic regression.

Variables	Positive TC changes			Positive LDL changes			Positive HDL changes			Positive TG changes		
	OR	95%	p	OR	95%	p	OR	95%	p	OR	95%	p
Change in LDL level	7.00	4.46–10.96	p<0.001	–	–	–	–	–	–	2.14	1.47–3.12	p<0.001
	1.00	RG	–	–	–	–	NS	NS	NS	1.00	RG	–
Change in HDL level	1.31	0.88–1.94	p>0.05	–	–	–	–	–	–	–	–	–
	1.00	RG	–	NS	NS	NS	NS	NS	NS	NS	NS	NS
Change in TC level	–	–	–	7.00	4.46–11.0	p<0.001	–	–	–	2.27	1.52–3.38	p<0.001
	–	–	–	1.00	RG	–	NS	NS	NS	1.00	RG	–
Change in TG level	2.27	1.52–3.38	p<0.001	2.14	1.47–3.12	p<0.001	–	–	–	–	–	–
	1.00	RG	–	1.00	RG	–	NS	NS	NS	–	–	–

fish at least once a day increased the chances for an improvement in the level of TC 6-fold: TC (OR=6.67; p<0.001). The probability of a lower level of LDL cholesterol rose more than 2-fold. Subjects who consumed meat at least once per day demonstrated the opposite tendency: it was confirmed that such respondents had a lesser chance for an improved level of TC (OR=0.20; p<0.001), LDL (OR=0.37; p<0.001) and HDL (OR=0.47; p>0.05) cholesterol. Frequent consumption of fruit did not contribute to an improvement in the HDL cholesterol level. Those subjects who ate fruit and vegetables a few times a day demonstrated an improved level of TC (OR=6.31; p<0.001); the chances were 6-fold higher; for LDL (OR=3.43; p<0.01) the chances were more than 3-fold higher; and for triglycerides (OR=2.75; p<0.05) the chances were almost 3-fold higher. Those respondents who did not drink alcohol demonstrated a chance of obtaining improved TC levels twice more often than alcohol drinkers (OR=1.80; p<0.01). Cutting down on the amount of coffee drinking also contributed to improved TC and LDL cholesterol levels. In the respondents who drank coffee less frequently than once a week, a decrease in TC levels was observed ten times more often (OR=10.95; p<0.01) than in those who drank coffee every day. The decrease in LDL cholesterol levels was 4-fold higher (OR=4.67; p<0.01). Reducing the amount of animal fats significantly contributed to a decrease in TC (OR=1.93; p<0.01) and LDL cholesterol (OR=1.59; p<0.05) levels.

Stress also affected the lipid profile. The respondents who felt slightly stressed demonstrated a higher chance (1.5 times higher) of obtaining a low level of TC in the serum (OR=1.60; p<0.001). For those who did not feel stressed at all, the chance increased nearly 3-fold (OR=2.77; p<0.01) (Table 2).

5. Discussion

The results of the study confirm that a correct prophylaxis, including health education, is highly effective in creating a proper lifestyle that would contribute to an improvement in the lipid profile.

The authors confirmed that giving up smoking influenced the lipid profile considerably and positively. Many epidemiological studies show that smoking greatly affects the profile. Batic-Mujanovic et al. proved that smoking nicotine considerably reduced the level of HDL cholesterol to lower than 1.03 mmol/l (40.1 mg/dl) and increased the level of TC cholesterol, especially small-sized molecules of LDL cholesterol [16]. In the meta-analysis of 34 cohort studies conducted by Nakamura et al., it was confirmed that the level of TC in smokers was

much higher than that in non-smokers (1.54 vs. 1.38 mmol/l) [17]. Maeda et al. proved that giving up smoking significantly contributed to an increase in the level of HDL cholesterol but TC and LDL levels remained the same [18]. Gepner et al. obtained similar results, in which those who gave up smoking demonstrated improved levels of HDL cholesterol, but TC and LDL levels did not change [19].

The present study confirmed that a proper diet contributed to an increase in the level of HDL cholesterol and a decrease in the level of TC and LDL cholesterol. Fatty components of a diet have an influence on many factors predisposing to development of cardiovascular diseases; however, they mostly affect the lipid profile. The Seven Countries Study confirmed that a high intake of saturated fatty acids contributed to an increase in TC levels in the blood serum [20]. The risk of death because of cardiovascular disturbances increased as well. Lauric, myristic, palmitic and stearic acids in particular have a negative effect on the body. The Geographical Pathology of Atherosclerosis Study and the Oslo Study confirmed a negative influence of saturated fatty acids and their contribution to the development of atherosclerosis. A reduced consumption of saturated fats contributed to a decrease in the risk of the ischemic heart disease. A similar result was obtained in North Karelia in Finland. In a period of twenty years, the researchers observed a considerable improvement of the lipid profile in people who reduced their intake of saturated fats [21].

The authors of the present study confirmed an important role for physical activity in the improvement of lipid levels. Increased physical activity is an excellent therapeutic element in cases with disturbances in the lipid balance. According to many studies, doing sports reduces the levels of TC, LDL cholesterol and triglycerides and increases the level of HDL cholesterol. In a study conducted by Kirkwood et al., regular physical activity contributed to a decrease in the level of LDL cholesterol by 0.53 mmol/l, and the TC level decreased by 0.45 mmol/l [22]. Similar observations were made in Tanzania proving that physical activity contributed to a decrease in the level of TC, LDL cholesterol and also triglycerides.

A decrease in the lipid level in the blood plasma was more significant in older respondents than that in younger ones. Moderate physical activity has a positive influence on the lipid balance of the elderly [23]. The ATTICA Study also confirmed a positive influence of physical activity on the lipid balance. In that study, the respondents demonstrated their lipid levels were decreasing when the physical activity was increasing [24]. In a study conducted by Pelletier et al., it was observed that in respondents who had a sedentary lifestyle, the level

of HDL cholesterol was on average 4 mg/dl lower than in physically active respondents [25]. Lack of physical activity is especially dangerous for obese people, as it enhances disturbances in the lipid profile. It also contributes to arterial hypertension, which, as it was confirmed by the authors of the present study, correlates with increased levels of TC, LDL cholesterol and triglycerides. Gordon et al. proved that the levels of triglycerides in obese people and in people with regular body weight differed significantly (1.67 vs. 1.51 mmol/l) [26].

6. Limitations

We are aware of the following limitations:

1. We did not have any reliable information on the administered drugs, including drugs reducing lipid levels, the period of time in which the drugs were administered. We did not know whether the respondents followed the doctor's recommendations. Thus, we cannot definitely answer whether and to what extent pharmacological therapy may have contributed to the improvement in the lipid profile and to what extent modified pro-health behaviour of the respondents contributed to this improvement.
2. The size of the study group was not large, which resulted from limited financial resources. It should also be pointed out that the participation in the study was voluntary. Therefore, most of the respondents were females, had university education and performed white-collar jobs. Such people are generally more careful about their health and more willingly take part in prophylaxis programmes. Prophylaxis programmes on cardiovascular diseases are a novelty in Poland, a post-communist country. Thus, our study may be considered pioneering and can become a guideline for further preventive activities.

7. Conclusions

1. There is a need to intensify prophylactic activities to eliminate disturbances in the lipid profile, especially in males, in people who are less educated and also in older people who are still in a productive age, including blue-collar workers.
2. Prophylaxis programmes should foster physical activity, dietary modifications and encourage giving up smoking, because a healthy lifestyle considerably contributes to a proper lipid profile.
3. Prophylaxis programmes should be continued in primary health care. They should include a control of lipid levels and an evaluation of preventive initiatives.

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Conflict of interest statement

Authors state no conflict of interest.

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