An assessment of health effects of a cardiological prophylaxis programme in a local community with the use of the SCORE algorithm

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Abstract

Introduction: In 2009, the SDR due to cardiovascular diseases was 356.3 per 100,000 people in Poland. The Prophylaxis and Early Detection of Cardiovascular Diseases Programme (PEDCCP) aimed at decreasing mortality caused by cardiovascular diseases (CVD) in Poland by 25%. The global risk of SCORE (European Systematic Coronary Risk Evaluation) has become a reason for implementing pro-health recommendations in order to eliminate risk factors in CVD.
Methods: The presented observation study encompassed 458 participants of the PEDCCP from 2009 – 2011. The subjects received two arterial blood pressure tests as well as anthropometric measurements. Also, TC, LDL, HDL and TG levels were measured in laboratory tests. Statistical analysis included elements of descriptive and analytical statistics, with bivariate and multivariate logistic regression (odds ratios with 95% CIs).
Results: A positive change in SCORE was observed in 13.3% of the subjects. It was higher in almost every third subject of the authors' own study (29.5%). Mostly gender and age contributed to the change in SCORE, but regular glucose levels and no tendency to compete were also relevant.
Conclusions: There is a need to continue such prophylaxis programmes in primary health care to better estimate the risk of mortality due to CVD in local communities.

Key words

cardiovascular diseases, SCORE algorithm, prophylactic programmes, Poland, local community

INTRODUCTION

Diseases of the cardiovascular system are the main causes of deaths, disabilities and incapacity to work in the majority of developed countries [1, 2, 3, 4]. Analyses performed by the World Health Organization indicate that cardiovascular diseases contribute to almost 30% of deaths worldwide. In comparison with other continents, the situation in Europe looks alarming, as for a long time, cardiovascular diseases have contributed to the highest death rate. Each year in the European Union, diseases of the cardiovascular system contribute on average to 2 million deaths. In 2009, the standardized death rate to which cardiovascular diseases contributed was 232.8 per 100,000 people (288.9 per 100,000 males and 188.3 per 100,000 females). Of the European Union countries, the highest death rate due to cardiovascular diseases is seen in Poland [5]. In 2009 the standardized death rate was 356.3 per 100,000 people (464.8 per 100,000 males and 275.9 per 100,000 females) [6]. It must be emphasized that mortality caused by cardiovascular diseases depends on location. The death rate remains the highest in the Łódź voivodeship, and this cause contributes to the highest number of life years lost because of premature mortality [7]. In 2009, the standardized death rate was 387.2 per 100,000 people (512.5 per 100,000 males and 300.2 per 100,000 females). It

is important to initiate activities which would eliminate such differences. Examples of such activities include Health in an All Policy approach in Europe [8], and the Prophylaxis and Early Detection of Cardiovascular Diseases Programme in Poland. Figure 1 presents how the program is conducted.
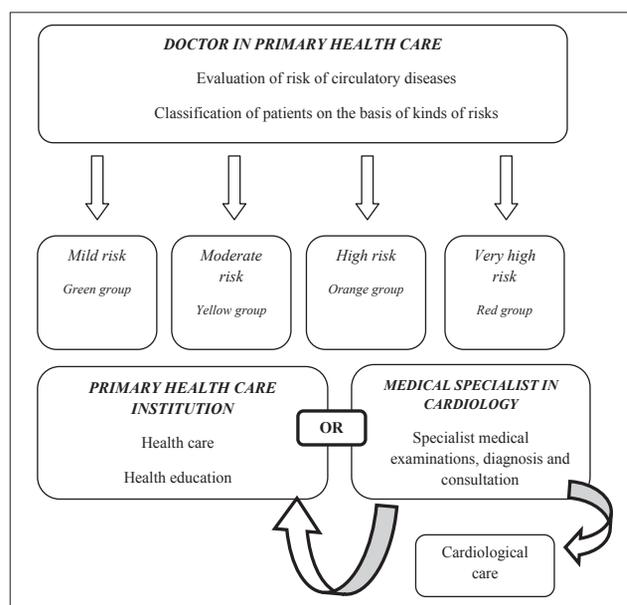

Figure 1. The Prophylaxis and Early Detection of Cardiovascular Diseases Programme – means of implementation.
Source: authors' own work on the basis of a Public Information Bulletin of Łódz City Council; http://bip.uml.lodz.pl

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The implementation of prophylaxis brings visible financial profits and health benefits to a population [9, 10]. Thanks to the Prophylaxis and Early Detection of Cardiovascular Diseases Programme coordinated by the National Health Fund, roughly 50,000 people with cardiac or vascular diseases were diagnosed in Poland in 2005 and 2006. The cost of detection of one case where it is possible to implement effective preventative methods is about 250 PLN. The cost of the treatment of a sick person is about 7,000 PLN [11]. The mentioned Prophylaxis and Early Detection of Cardiovascular Diseases Programme has been carried out by the National Health Fund since the middle of 2003. The programme is mainly aimed at decreasing mortality caused by cardiovascular diseases among its participants by as much as 25%. The programme is meant for people aged 35, 45 and 55. Since 2003, the SCORE algorithm invented by the European Society of Cardiology has been in use. It is needed to estimate the 10-year risk of cardiac death. This risk evaluation incorporated the following variables: gender, TC level, systolic blood pressure and tobacco smoking. The SCORE algorithm allows people with risk factors to be classified into four categories. The first category includes mild risk of death (up to 1%) which is likely to happen within a period of 10 years and is caused by cardiovascular problems. Next, is moderate risk with 2% possibility of death. High risk includes a 3–4% possibility of death. If the likelihood of cardiovascular problems-related death is 5% or above, the risk is classified as very high.

The global risk of SCORE (European Systematic Coronary Risk Evaluation) has become a reason for implementing pro-health recommendations in order to eliminate risk factors in cardiovascular diseases. The SCORE algorithm was also used in the guidelines of the Polish Society of Cardiology [12]. The presented study attempts to evaluate the relationship between participation in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme, and the change in the death risk according to SCORE in a group of inhabitants of a medium-sized town.

MATERIALS AND METHOD

The study was conducted in Zgierz – a medium-sized town located in central Poland, whose population in January 2011 was 58,066 inhabitants. Of 19 health care centres, one non-public health care institution was selected in simple random sampling. The subjects taking part in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme between 2006 – 2008 were included in the sample and subject to a 3-year observation. It should be stressed that the patients with circulatory diseases or diabetes confirmed by anamnesis were excluded from the study.

The study was conducted from December 2009 – January 2011. The subjects who were to take part in the trial were invited by mail or phone. Those who accepted the invitation were asked to complete a questionnaire prepared with the authors' study tool. In a separate room, in the presence of a family nurse, the respondent was asked to complete the questionnaire which consisted of 41 questions, covering such areas as smoking, physical activity, diet and stress, which allowed the respondent's knowledge of risk factors of cardiovascular diseases to be evaluated, as well as his/her health behaviour (Fig. 2). Each respondent was
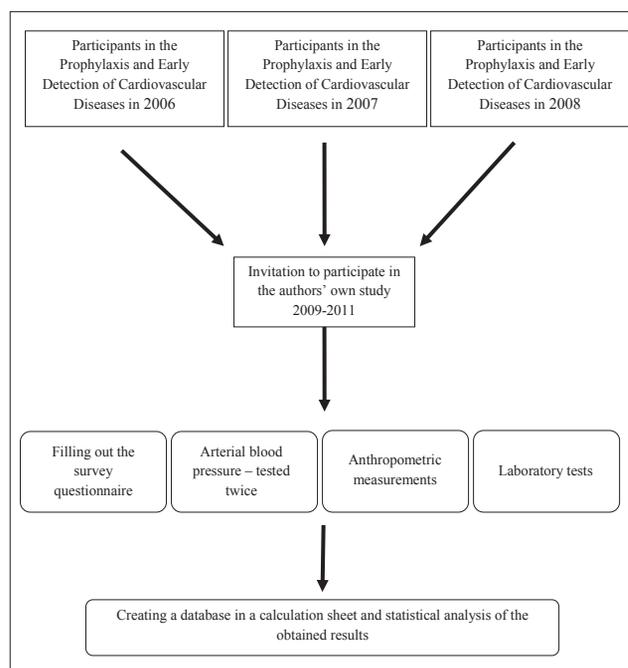

Figure 2. Authors' own study – means of implementation.
Source: authors' own work

shown a questionnaire together with information on the study and a description of the study. Prior to the study, the respondents had to give their informed consent for the study to be conducted. The Bioethics Committee of Łódz Medical University issued a consent for this research study (resolution of RNN/481/09/KB, dated 9 June 2009).

Arterial blood pressure was taken twice, at rest and in a sitting position. No measurements were taken after immediate exposure to stress, physical exercise, drinking coffee, or any other drink containing caffeine (up to 30 min.), or smoking a cigarette. Arterial blood pressure was taken again, 2–3 min. after the first measurement. The level of blood pressure was an arithmetic mean of two measurements. Blood pressure was taken with an Omron M2 Basic blood pressure manometer. An oscillometric method of measuring arterial blood pressure was used. The measurements ranged from 0–299 mm Hg (measurement accuracy ± 3 mm Hg). To evaluate the arterial blood pressure, the scale introduced by the European Society of Hypertension was used.

Respondents' anthropometric measurements (waist, hips, body weight, height) were taken. The subjects also underwent laboratory tests where the levels of TC, LDL and HDL cholesterol, as well as triglycerides and glucose in the blood, were measured. The authors evaluated the parameters with the use of enzymatic colorimetric tests carried out in one of the selected medical laboratories, in the same in way that tests for the Prophylaxis and Early Detection of Cardiovascular Diseases Programme were performed.

The levels of TC cholesterol, LDL cholesterol and TG were considered higher when they exceeded 4.92 mmol/l, 3.36 mmol/l and 1.69 mmol/l, respectively. HDL cholesterol was not considered regular when its level was lower than 1.03 mmol/l in males and lower than 1.19 mmol/l in females. The subject was diagnosed with irregular glycaemia on an empty stomach when glucose level was 5.56–6.93 mmol/l and diabetes at a level of ≥6.99 mmol/l.

To evaluate the risk of death because of cardiovascular problems, the recommendation of the European Society of Cardiology was followed and SCORE charts used for high-risk countries. The change in the SCORE value was considered positive when the rate improved, or at least remained unchanged after some time.

Statistical analysis. Statistica Windows Vista, 9.0. PL version, StatSoft, USA, was used for statistical purposes. Statistical analysis included methods of descriptive and analytical statistics. To evaluate associations between selected variables, the c^2 test of independence was used, with a statistical significance level of $p<0.05$. The dependence was evaluated with C-Pearson's coefficient (C). The analysis of death risk due to cardiovascular problems was carried out with single-factor and multi-factor regression models, odds ratio with 95% confidence intervals (CIs).

RESULTS

Four hundred and fifty eight people – 288 females (62.9%) and 170 males (37.1%), took part in the study (Tab. 1). For statistical purposes, the respondents were divided into three age groups. The youngest respondents were aged up to 40 years old, and were not younger than 35 when included in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme. The second group consisted of respondents aged 41–50. The oldest group consisted of respondents aged 51 or older, thus at the time of their participation in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme they were 50 or 55 years of age. The youngest respondents in the presented study were 38 and the oldest – 60 years of age.

The majority of the respondents (n=308; 67.2%) belonged to the mild death risk group. In 12.2% of the respondents, the risk was moderate, in 8.1% – high and in 12.4% – very high. It should be stressed that mild risk was more often observed in females (77.8%). Moreover, very high risk was noted almost 10 times more frequently in males (27.7% vs. 3.5%). The correlation between gender and cardiovascular risk was statistically confirmed (c^2=80.050; p<0.001; C=0.396) (Fig. 3).

It was confirmed that 13.3% of the respondents demonstrated a positive change in the SCORE risk after they were included in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme. It is worth mentioning, however, that more than half of the subjects (57.2%) did not
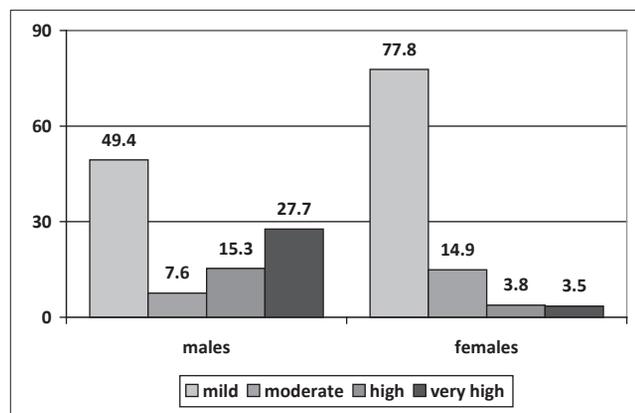
Table 1. Characteristics of the study group.

Variables	Females n=288	Males n=170	Total N=458
Age	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
Employed, %	84.4	88.2	85.8
Unemployed, %	8.8	7.7	8.3
Disability pension, %	3.4	0.6	3.5
Retirement pension, %	3.4	3.5	2.4
White-collar workers, %	61.3	40.0	53.2
Blue-collar workers, %	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
LDL, mmol/l	3.05±0.72	3.54±0.93	3.26±0.85
HDL, mmol/l	1.50±0.31	1.37±0.26	1.39±0.28
TG, mmol/l	1.32±0.67	2.18±1.53	1.64±1.16
Glucose, mmol/l	4.77±0.72	5.32±1.16	4.99±0.94
BP, mmHg	124/75±14.7	134/83±15.6	128/78±15.9
BMI, kg/m²	24.9±4.31	27.9±4.00	26.0±4.43
Hypertension, %	19.8	42.9	28.4
TC ≥ 4,92 mmol/l,%	7.3	23.5	13.3
LDL ≥ 3,36 mmol/l,%	33.3	54.1	41.1
HDL< 1,03 mmol/l,%	14.9	8.2	12.4
TG ≥1,69 mmol/l,%	8.7	32.9	17.7
Glucose, ≥ 6,99 mmol/l,%	2.1	7.6	4.1
BMI > 24,5 kg/m², %	26.4	51.2	35.6
BMI > 29,9 kg/m², %	13.5	25.3	17.9
Very good health, %	17.0	15.0	16.0
Knowledge of cardiovascular risk factors, %	90.0	88.0	89.0
Knowledge of regular level of RR, %	85.0	81.0	83.0
Regular heating habits, %	50.0	36.0	43.0
Increase in physical activity, %	37.8	23.9	31.0
Fish consumption, %	79.0	63.0	71.0
Salt consumption at a daily dose > 5g, %	16.0	30.0	23.0
Being stressed, %	26.3	31.2	28.2
Tendency to compete, %	28.1	63.5	41.3

Abbreviations: TC – Total cholesterol; LDL – low-density cholesterol; HDL – high-density cholesterol; TG – triglycerides; BP – blood pressure; BMI – Body Mass Index
* If not specified otherwise, data are presented as mean (SD). *Source:* authors' own calculations.

demonstrate a negative change in the risk. Undoubtedly, the programme has been successful since chronic diseases naturally progress with time. It must be pointed out that the period of time between the participation in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme and the participation in the presented study was on average three years. No significant statistical correlation between the change in the SCORE risk and the time gap between the participation in the prophylaxis programme and the presented study was observed (p>0.05).

Figure 3. Patients according to gender and SCORE algorithm (%).
Source: authors' own calculations.

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Unfortunately, the SCORE risk increased in almost every third respondent in the presented study (29.5%). The change in the risk depended on the gender of the respondents (c^2=11.781; p<0.001; C=0.158). It was confirmed that while the risk remained constant in females, it was raised in males. There was a statistically significant correlation between the age of the respondents and the change in the risk (c^2=148.339; p<0.001; C=0.495). Respondents from the oldest group usually demonstrated a higher death risk due to cardiovascular problems. In the group of younger respondents the risk remained the same.

In the bivariate logistic analysis many analyzed characteristics proved to be statistically significant variables which contributed to the improvement of SCORE (Tab. 2). In females, the chance of the SCORE risk changing positively or remaining at the same good level was almost twice as probable as that in males (p<0.01; OR=1.85). The chances for a positive change in the SCORE risk or remaining at the same good level were 18 times higher in respondents aged 40 or younger, compared with older respondents (aged 51 or older). In those aged 41–50, these chances were 12 times higher (OR=18.7 and OR=12.7). Secondary and university education rather than elementary or vocational contributed to the SCORE level; it either improved or remained stable, although about twice as much time elapsed after the respondents took part in the prophylaxis programme.

In comparison with old age pensioners and those receiving disability pensions, both the kind of work, i.e. white collar work (OR=4.39) and blue collar work (OR=3.80), as well as work activity, significantly contributed to the improvement of the SCORE level. A positive change in BMI increased the chance 1.7 times and better TC improved the chance twice (OR=2.07). A positive change in the glucose level contributed to the SCORE level, which either improved or remained stable at a regular level (OR=1.84). The knowledge of risk factors of circulatory diseases (p<0.05) and a regular level of arterial pressure (RR) (p<0.01) proved to be other significant factors contributing to potential changes in the SCORE risk. It is worth mentioning that eating habits, physical exercise (p<0.05) and the ability to cope with stress (p<0.001) significantly contributed to the SCORE risk.

In the multivariate regression model (Tab. 3) the following variables either contributed to a decrease in the SCORE risk due to cardiovascular diseases or did not change it, despite three years passing since the respondents participated in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme: gender (female) (OR=2.50), age up to 40 (OR=19.2), glucose level (improved or remaining stable) (OR=2.32), knowledge of risk factors of circulatory diseases and no tendencies to compete.

DISCUSSION

The aim of the presented study was to evaluate the correlation between the participation in the Prophylaxis and Early Detection of Cardiovascular Diseases Programme and changes in negative health behaviour of the respondents. The study findings showed that despite a widespread health education campaign, which was part of the prophylaxis programme described earlier, the death risk still remains quite high.

Table 2. Improvement in SCORE level or level remains unchanged. Evaluation on the basis of bivariate logistic regression analysis.

	Variable	OR	95%CI	p
Gender	Females	1.85	1.22–2.78	p<0.01
	Males	1.00	Reference group	
Age	Up to 40	18.7	9.23–37.9	p<0.001
	41–50	12.7	7.34–21.8	p<0.001
	51 and above	1.00	Reference group	
Education	Elementary and vocational,	1.00	Reference group	
	Secondary	1.82	1.14–2.91	p<0.05
	University	1.79	1.05–3.10	p<0.05
Occupation	Blue-collar worker,	3.80	1.67–8.60	p<0.01
	White-collar worker,	4.39	1.94–9.95	p<0.001
	Disability pension/ Retirement pension	1.00	Reference group	
Work activity	Unemployed,	2.91	1.05–8.12	p<0.05
	Employed,	4.72	2.09–10.67	p<0.001
	Does not work: Disability pension/ Retirement pension	1.00	Reference group	
Change in BMI level	BMI improved,	1.77	1.13–2.78	p<0.05
	BMI no change,	1.34	0.76–2.67	p>0.05
	BMI worsened	1.00	Reference group	
Change in TC level	TC improved and no change,	2.07	1.37–3.13	p<0.001
	TC worsened	1.00	Reference group	
Change in glucose level	Glucose improved and no change,	1.84	1.20–2.84	p<0.01
	Glucose worsened	1.00	Reference group	
Health	Very good,	3.60	1.71–7.58	p<0.001
	Good,	2.74	1.52–4.94	p<0.001
	Average,	1.41	0.79–2.52	p>0.05
	Bad and very bad	1.00	Reference group	
Knowledge of risk factors	Yes	2.13	1.17–3.91	p<0.05
	No	1.00	Reference group	
Knowledge of regular BP level	Yes	2.16	1.30–3.61	p<0.01
	No	1.00	Reference group	
Regular eating habits	Regular eating every day,	1.91	1.18–3.09	p<0.01
	Regular eating at weekends	1.63	0.96–2.77	p>0.05
	No	1.00	Reference group	
Positive change in physical activity	Yes	1.73	1.10–2.73	p<0.05
	No	1.00	Reference group	
Fish consumption	Yes	1.88	1.22–2.92	p<0.01
	No	1.00	Reference group	
Excessive salt consumption	No	3.01	1.89–4.79	p<0.05
	Yes	1.00	Reference group	
Drinking alcohol	No	1.66	1.05–2.62	p<0.05
	Yes	1.00	Reference group	
Being stressed	No	4.32	1.70–11.0	p<0.01
	Rather not	2.24	1.27–3.95	p<0.01
	Yes, to some extent,	1.92	1.19–3.11	p<0.01
	Yes, highly stressed	1.00	Reference group	
Tendency to compete	No	2,10	1.40–3.16	p<0.001
	Yes	1.00	Reference group	

Source: authors' own calculations.

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Table 3. Improvement in SCORE level or level remains unchanged. Evaluation on the basis of multivariate logistic regression analysis.

	Variable	OR	95%CI	p
Gender	Females	2.50	1.28–4.76	p<0.01
	Males	1.00	Reference group	
Age	Up to 40	19.2	8.17–44.9	p<0.001
	41–50	15.9	8.19–30.9	p<0.001
	51 and above	1.00	Reference group	
Change in glucose level	Improved and unchanged	2.32	1.24–4.34	p<0.01
	Worsened	1.00	Reference group	
Knowledge of cardiovascular risk factors	Yes	1.00	Reference group	
	No	0.35	0.11–1.10	p<0.05
Tendency to compete	No	1.98	1.05–3.74	p<0.05
	Yes	1.00	Reference group	

Source: authors' own calculations.

In the study group, mild risk was observed in 67.2% of the respondents, moderate – in 12.2%, high – in 8.1%, very high – in 12.4%. Mild risk was most frequently observed in both males and females. A very high risk was observed much more frequently in males (27.7%). With regard to females, very high risk was observed in 3.5 % of the respondents. It should be pointed out that the majority of the respondents of the presented study did not demonstrate a negative change in the SCORE risk; hence, their health did not worsen. It can be then concluded that the prophylaxis programme turned out to be successful since chronic diseases naturally progress with time.

Evaluation of death risk due to cardiovascular problems remains a subject of many analyses, although analyzing the probability of death with the use of the SCORE algorithm is quite controversial. An essential element needed in this evaluation is the age of respondents. The risk increases with age; therefore, patients aged 40 or younger are classified as mild risk patients, i.e. between <1% and 1%, irrespective of risk factors of cardiovascular diseases. When it comes to initiating some prophylactic procedures in this age group, some problems might arise because a low risk of having a cardiovascular disease does not motivate the patient to change his/her lifestyle, even if it does not follow any recommendations of the world health societies, and is very unhealthy [13]. In the study group, patients aged 40 or younger made up 26.2% of the total number of respondents. Mild risk was observed in this age group in 96.7% of the respondents.

The SCORE algorithm is considered unreliable because of one more fact: it does not take carbohydrate metabolism into consideration. The authors confirmed that in the patients who demonstrated an improved empty stomach glucose level, the chances for an improved SCORE algorithm increased twice. Carbohydrate metabolism is considered one of main risks of cardiovascular diseases. One third of people who suffer from ischemic heart disease are also diabetics [14, 15, 16, 17]. In the study described by Juttilaninen et al., concomitant diabetes contributed to an increase in death rate by up to 67% in males and 71% in females [18]. This relationship was confirmed in *Euro Heart Survey on Diabetes and the Heart,* and also in *Framingham Heart Study,* where disorders in the cardiovascular system in diabetic patients were the causes of 50–80% of deaths. *The National Health and Nutrition*

Examination Study (NHANES) confirmed that mortality due to cardiovascular diseases was more than 20% higher in diabetic females [19, 20]. According to findings of *EPIDEPOC Study,* conducted in Spain, diabetes was observed in 1/3 of patients with a coronary disease [21]. Similar results were obtained in a study described by Uitewaal et al. [22].

Another negative aspect of the SCORE algorithm is the fact that it does not take the patient's body weight into consideration. Many authors stress the necessity to weigh patients during a visit [23, 24]. Introducing this procedure seems obvious; hence, it is comparable to measuring arterial blood pressure, which is compulsory [25, 26]. Hypercholesterolemia was much more often diagnosed in overweight patients, observed in 77.2% of overweight patients and in 51.2% of obese patients. Also, high levels of LDL cholesterol were noted in overweight patients.

The results of the presented study are similar to those of *The Strong Heart Study* in which a significant positive dependence between BMI index and levels of triglycerides and LDL cholesterol was observed, as well as a negative correlation between BMI and HDL cholesterol level [27]. Positive correlation between BMI and triglyceride concentration, and a negative correlation between BMI and HDL concentration were found in the PURE Poland Sub-Study [28]. The authors of *The Quebec Family Study* [29] and *The Attempt Study* [30] confirmed a correlation between high body weight and increased levels of LDL cholesterol and TC cholesterol [29]. Findings of the *National Health and Nutrition Examination Survey (NHANES)* show that patients with abdominal obesity might suffer from three out of five factors which are considered elements of metabolic syndrome, and the probability of being affected by these factors is five times higher [31]. Similar conclusions can be drawn from a study conducted in Finland by Hu et al. in which abdominal obesity correlated with an increase in a risk of ischemic heart disease, both in males and females [27].

The Prophylaxis and Early Detection of Cardiovascular Diseases Programme assumes that proper intervention, which includes evaluation of the respondents' health, early detection of factors predisposing to cardiovascular diseases, as well as giving instructions about how to prevent such diseases, will contribute to a decrease in morbidity and thus mortality due to cardiovascular disorders. It should be stressed that while evaluating the coronary risk, certain parameters have to be taken into consideration. They include the glucose level tested on an empty stomach and body weight. Patients should be classified into a proper weight category because, as confirmed by the presented study, controlling the body weight is highly essential in reducing the cardiovascular risk.

Limitations. The Prophylaxis and Early Detection of Cardiovascular Diseases Programme was introduced by the National Health Fund itself and cannot be modified for the need of a local community (e.g. level of education, income, unemployment rate, etc.).

Not all but only selected primary health care institutions which had won a tender were included in the programme, and due to insufficient financial resources not all the patients of these institutions were allowed to participate in the programme. They were included in the programme on a voluntary basis.

The factors mentioned above imply that the volunteers of the programme are better educated, have a more extensive

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knowledge of diseases of the circulatory system, and care about their health more than others (self-selection bias).

The financial resources allocated for the presented study reduced the number of the respondents. However, considering that the history of cardiovascular prophylaxis is short and the evaluation of such prophylactic activities is effective, the study is pioneering and serves a valuable purpose.

CONCLUSIONS

There is a need to continue prophylactic programmes in primary health care. The programmes should be aimed not only at early detection of cardiovascular risk factors but also at education which will facilitate the modification of health behaviour and reduce risk factors of cardiovascular disorders.

While evaluating the risk of cardiac death with the SCORE algorithm, some further parameters should be added, i.e. body weight and empty stomach glucose level. This will allow a more reliable evaluation of epidemiology of cardiovascular diseases.

Acknowledgement

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