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How does the risk of cardiovascular death and cardiovascular risk factor profiles differ between socioeconomic classes in Poland: A country in transition

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Abstract

Background: *Socioeconomic status (SES) is an important factor for cardiovascular diseases (CVD) development. A decline in death rate from CVD among subjects with high SES is observed in developed countries. The aim of this study was to assess differences in cardiovascular risk (CV) between socioeconomic classes in Poland, a country currently in transition.*

Methods: *A sample of 15,200 people was drawn. A three stage selection was performed. Eventually, 6170 patients were examined (2013/2014). Data was collected using a questionnaire in face-to-face interviews, anthropometric data and blood tests were also obtained. Education was categorized as incomplete secondary, secondary and higher than secondary school. Monthly income per person was categorized as low (≤ 1000 PLN), medium (1001–2000 PLN) and high (≥ 2001 PLN). Education and income groups were analyzed by prevalence of CVD risk factors and high CVD risk (SCORE ≥ 5%).*

Results: *Higher education was associated with lower prevalence of all analyzed CVD risk factors ($p < 0.001$), having the highest income with lower prevalence of hypertension, currently smoking, obesity and lower high density lipoprotein cholesterol. Multivariable analysis showed that frequency of high CVD risk decreased with increasing education level (OR 0.61; 95% CI 0.49–0.76; $p < 0.01$), a similar favorable impact of higher income on high CVD risk was demonstrated in the whole group (OR 0.81; 95% CI 0.67–0.99; $p = 0.04$).*

Conclusions: *Socioeconomic status is an independent predictor of high CV risk of death. A favorable impact on the prevalence of high CV risk was demonstrated for education and partly for income in the whole group. It may reflect a transition being undergone in Poland, moreover, it predicts how socioeconomic factors may generate health inequalities in other transitioning countries.* (Cardiol J 2019; 26, 5: 493–502)

Key words: socioeconomic, education, income, cardiovascular risk factors, cardiovascular disease

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Introduction

Cardiovascular diseases (CVD) remain a leading cause of morbidity and mortality, despite improvements in treatment outcomes. Age-adjusted coronary artery disease (CAD) mortality has declined since the 1980s, particularly in high-income regions in Europe. However, inequalities between countries persist and prevalence of many risk factors, particularly obesity and diabetes mellitus (DM), have been increasing substantially [1]. It is estimated that ≥ 80% of all CVD mortality now occurs in developing countries [2].

Cardiovascular diseases morbidity and mortality are affected by social, environmental and economic factors. Socioeconomic status (SES) focused attention as an important factor related to CVD. During the past decades a widening of the relative gap in death rates between upper and lower socioeconomic groups has been reported for several European countries [3]. In Poland, the social gradient of CVD mortality has increased since the onset of economic transition. At the beginning of this period (1991–1993), the mortality of men with primary education was 2.2 times higher than for men with higher education, but in the (years) 2010–2012 it became 4.2 times higher. Additionally, the death rate of men with higher education decreased by 62% while for men with primary education by only 28% [4]. In epidemiological studies, education and income are determinants commonly used in SES evaluation. Education is the most widely used SES indicator as it is constant throughout life and its measurement is relatively easy, moreover, objective. Income is also an important indicator as it determines access to material goods and services, including medical care.

Recently published data indicate that low SES is related to increased morbidity and CVD mortality [5, 6]. An unhealthy lifestyle and prevalence of premature CVD are more common in lower socioeconomic groups [7].

To estimate the risk of CVD development, various models of multifactorial risk assessment have been proposed, Systematic Coronary Risk Evaluation (SCORE) algorithm is the most widely used [8]. The high or very high risk group included subjects with a likelihood of CVD death within 10 years ≥ 5%, and with significantly increased values of single risk factors, DM and moderate to severe chronic kidney disease (CKD) (glomerular filtration rate < 60 mL/min/1.73 m^2) and those with already diagnosed CVD [1]. Poland, which is considered a high risk country, using current CVD mortality rates and data on major CVD risk factors, prevalence in the Polish population, has recently updated SCORE tables (Pol-Score 2015) [9].

In this paper the aim was to examine the relationship between SES and cardiovascular risk assessed by SCORE algorithm and assess differences in CVD risk between socioeconomic classes in Poland, the first Eastern Bloc country which adopted political and economic changes and was still in transition.

Methods

Study population and design

This Multi-center National Population Health Examination Survey (WOBASZ II study) was carried out in Poland in 2013 and 2014. The WOBASZ II study is a cross-sectional study consisting of a random sample of 15,200 Polish residents above the age of 19. A sample of both genders was drawn from the national, electronic population register (PESEL) at the Department of State Registers of the Ministry of the Interior. The selection was performed as a three stage sampling, stratified according to administrative units (voivodships), type of urbanization and gender. For each voivodeship: 2 small communities (below 8000 citizens), 2 medium communities (8000–40, 000 citizens) and 2 large communities (over 40, 000 citizens) were selected. In each community persons above the age of 19, 70 women and 70 men were drawn. The total drawn sample size was 15,120 men and women. Finally, 6170 participants (2752 men and 3418 women) were examined, response rate exceeded 45% [10]. Additionally, a subpopulation was distinguished as free of CVD (CAD, ischemic stroke and/or transient ischemic attack, peripheral artery disease), diabetes and CKD. In this group, consisting of 2482 subjects (1078 men and 1404 women), cardiovascular risk was evaluated based on the SCORE algorithm for high risk countries. The selection process is shown in Figure 1. All participants provided written consent and the study was approved by the Bioethical Committee.

The project consisted of a survey questionnaire, physical examination (blood pressure and heart rate measurements, anthropometric measurements: height, weight, waist circumference and hip circumference) and biochemical tests. Body mass index (BMI) [kg/m^2] and waist-to-hip ratio (WHR) were calculated. Subsequent to fasting, blood was collected from a vein to a disposable, vacuum tube, then centrifuged and frozen. Serum samples were transported on dry ice to a Central

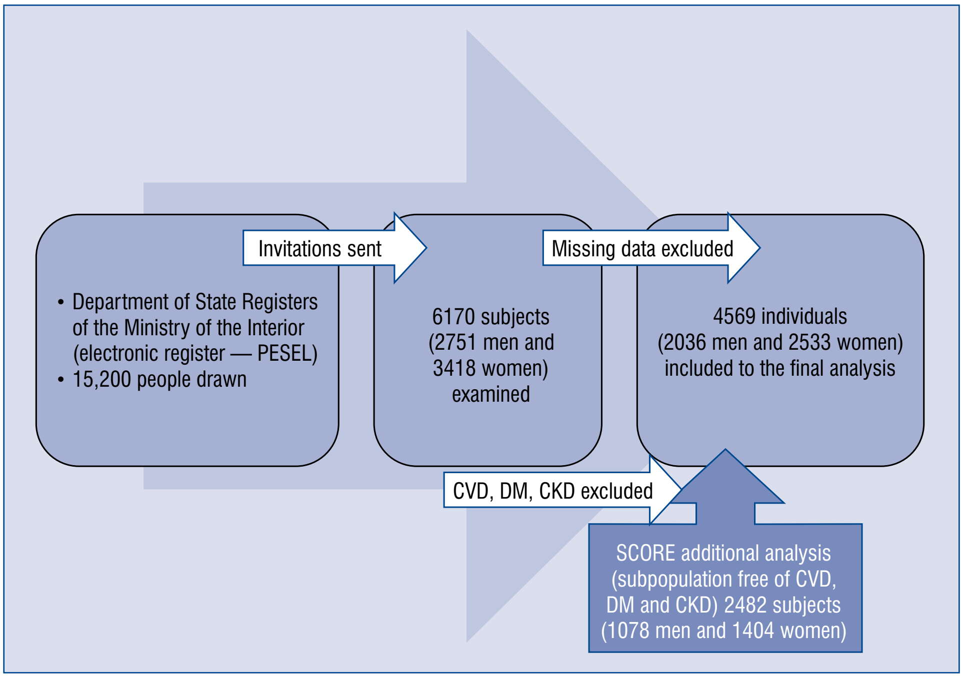

Figure 1. Patient flow chart; CKD — chronic kidney disease, CVD — cardiovascular diseases, DM — diabetes mellitus.

Laboratory, where all biochemical tests (glucose during fasting, total cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C) were conducted. All biochemical analyses were performed using analyzer Cobas 6000, by Roche. The project has been described in detail before [10].

Data analysis

One of the basic research tools used in the project was a comprehensive questionnaire, which included data on demographics, health knowledge, working status, education, income, physical activity, cigarette smoking, and a detailed medical history.

In the present study, data on education and income was used. The questionnaire included 9 categories of education (lack of education, primary, middle school, vocational after primary school, vocational after high school, high school/technical, secondary, bachelor degree and higher and 7 income categories determined by monthly net income per person in the household: less than 500 PLN, 501–1000 PLN, 1001–1500 PLN, 1501–2000 PLN, 2001–2500 PLN, 2501–3000 PLN, above 3000 PLN. Three groups of education were distinguished for analysis: incomplete secondary, secondary and higher than secondary. Regarding monthly net income per person in the household, 3 income groups were distinguished: low (below 1000 PLN), medium (1001–2000 PLN) and high (above 2001 PLN). The lower limit of income was determined by the value of social minimum, which, according to the Central Statistical Office, in 2013 amounted to 1061 PLN. In the defined education and income groups, the prevalence of classic CVD risk factors were analyzed.

Smoking status was defined as follows: current smokers included individuals who smoked at least 1 cigarette a day, ex-smokers were considered as subjects who smoked cigarettes regularly for at least 1 year in the past, but currently do not smoke, non-smokers included participants who have never smoked or smoked cigarettes for less than 1 year in the past. Hypertension diagnosis was defined as systolic blood pressure (SBP) $\geq$ 140 mmHg and/or diastolic blood pressure (DBP) $\geq$ 90 mmHg, previously diagnosed hypertension and currently under antihypertensive treatment. Obesity and overweight were defined by BMI (overweight: BMI 25.0–29.9 kg/m^2; obesity: BMI $\geq$ 30.0 kg/m^2). Abdominal obesity was diagnosed according to the WHR ($\geq$ 0.90 men, $\geq$ 0.85 women).

The lipid disorder diagnosis was based on the European Guidelines on cardiovascular disease prevention in clinical practice [1] and included hypercholesterolemia (total cholesterol $\geq$ 5 mmol/L), high LDL-C (LDL levels $\geq$ 3 mmol/L), low HDL-C

(HDL levels < 1 mmol/L in men and < 1.2 mmol/L in women), hypertriglyceridemia (triglyceride ≥ 1.7 mmol/L) and actual lipid-lowering treatment. Diagnosis of diabetes was based on medical history, medication use, and fasting serum glucose level above 126 mg/dL.

Additionally, in a subpopulation free of CVD consisting of 2482 subjects, evaluated cardiovascular risk was based on the SCORE algorithm. Then, in defined education and income groups, the prevalence of high and very high CVD risk was analyzed (SCORE ≥ 5%). The high risk group included both "high" and "very high" risk according to SCORE.

Statistical analysis

Categorical variables were summarized by counts and percentages. Statistical significance of between-group differences was calculated by χ^2 test. The Cochran-Armitage test for trends was used to test the trend in contingency tables. To examine significance of CVD risk factor interactions and the independent influence of education and income on high CVD risk (SCORE ≥ 5%) in age and gender categories, multivariable analysis for gender, education and income status was performed, using multiple logistic regression. Logistic odds ratio (OR) and their 95% confidence intervals (95% CI) adjusted for gender, education and income status were calculated. All statistical analyses were computed using SAS, version 9.4 (SAS Institute Inc., Gary, NC), with the statistical significance level at $\alpha = 0.05$.

Results

Study sample characteristics

After excluding subjects with missing data, 4569 individuals (2036 men and 2533 women) were included in the final analysis. High prevalence of classic CVD risk factors was observed in the whole sample. It is a remarkable that hypercholesterolemia, including increased LDL-C (OR = 58.1%; 95% CI 56.6–59.5% and OR = = 50.5%; 95% CI 49.1–52.0%) and abdominal obesity (OR = 56.3%; 95% CI 54.9–57.8% in the whole sample and OR = 71.6%; 95% CI 69.6–73.5% in men) were found in more than a half of participants (Table 1). Higher education was substantially more frequent in women in comparison with men (OR = 24.5%; 95% CI 22.8–26.2% vs. OR = 18.8%; 95% CI 17.1–20.5%; p < 0.01). Men more frequently than women declared the highest income OR = 17.8%; 95% CI 16.1–19.4% vs. OR = 11.3%; 95% CI 10.1–12.5%; p < 0.01) (Table 1).

CVD risk factors and education

Prevalence of CVD risk factors by education level is presented in Table 2. There was a strong relationship between CVD risk factors and education. Higher education was associated with a lower prevalence of all CVD risk factors taken into account (p < 0.001). CVD risk factors were the most common in the incomplete secondary education group. The prevalence of hypertension and obesity (by BMI) in persons with incomplete secondary education was twice that compared to the higher education group (OR = 51.6%; 95% CI 49.4–53.9% vs. OR = 24%; 95% CI 21.4–26.7% and OR = 32%; 95% CI 30–34.2% vs. OR = 16%; 95% CI 13.7–18.2%, respectively, p < 0.0001), and almost five times higher for those with DM (OR = = 16.7%; 95% CI 15–18.3% vs. OR = 3.5%; 95% CI 2.4–4.6%; p < 0.0001) (Table 2).

CVD risk factors and income

Distribution of CVD risk factors in the income groups was ambiguous, compared to education-related ones. The highest income was associated with a lower prevalence of hypertension, current smoking, obesity and lower HDL-C but with a higher prevalence in former smokers, overweight and non-HDL lipid disorders, however results for dyslipidemias were not statistically significant (border significant for increased LDL-C, p = 0.06) (Table 3).

High CVD risk (SCORE) in categories of education and income

In a subgroup of participants free of CVD, DM and CKD, SCORE risk was evaluated. Higher education was associated with a lower frequency of high CVD risk of death (Fig. 2), results for income were not statistically significant (p = 0.14).

Multivariable logistic regression model. Odds ratio for CVD risk factors prevalence according to age, gender, education and income

Almost all of analyzed CVD risk factors (except hypercholesterolemia) were more common in men, especially smoking (OR = 3.25; 95% CI 2.79–3.78 for former smoker and OR = 2.29; 95% CI 1.97–2.66 for current smoker; p < 0.001) and abdominal obesity (OR = 3.57; 95% CI 3.12–4.09; p < 0.001). Similarly, almost all of them (except current smoker) were more common in older

Table 1. Study group characteristics.

Variable	Whole group	Men	Women	P
Gender	4569 (100%)	2036 (44.5%)	2533 (55.5%)	
Age [years]:				
19–29	568 (12.4%)	283 (13.9%)	285 (11.2%)	0.06
30–39	809 (17.7%)	357 (17.5%)	452 (17.8%)	
40–49	778 (17.0%)	353 (17.3%)	425 (16.7%)	
50–59	979 (21.4%)	419 (20.5%)	560 (22.1%)	
60–69	878 (19.2%)	395 (19.4%)	483 (19.0%)	
≥ 70	557 (12.1%)	229 (11.2%)	328 (12.9%)	
CVD risk factors				
Former smoker	1198 (26.2%)	645 (31.7%)	553 (21.8%)	< 0.01
Current smoker	1143 (25.0%)	685 (33.7%)	458 (18.0%)	
Hypertension	1877 (41.1%)	866 (42.5%)	1011 (39.9%)	0.07
Overweight (BMI ≥ 25 kg/m^2)	1700 (37.2%)	888 (42.5%)	812 (32.0%)	< 0.01
Obese (BMI ≥ 30 kg/m^2)	1233 (26.8%)	533 (26.2%)	690 (27.2%)	
Abdominally obese (WHR)	2574 (56.3%)	1457 (71.6%)	1117 (44.1%)	< 0.01
Hipercholesterolemia	2653 (58.1%)	1164 (57.2%)	1489 (58.8%)	0.27
Increased LDL-C	2310 (50.5%)	1076 (52.8%)	1234 (48.7%)	< 0.01
Decreased HDL-C	939 (20.5%)	450 (22.1%)	489 (19.3%)	0.02
Hypertriglyceridemia	1259 (27.5%)	712 (35.0%)	547 (21.6%)	< 0.01
Diabetes	507 (11.1%)	250 (12.3%)	257 (10.1%)	0.02
SCORE ≥ 5% (n = 2482)	644 (25.9%)	464 (43.0%)	180 (12.8%)	< 0.01
Education groups				
Incomplete secondary	1902 (41.6%)	942 (46.2%)	960 (37.9%)	< 0.01
Secondary	1665 (36.4%)	712 (35.0%)	953 (37.6%)	
Higher than secondary	1002 (21.9%)	382 (18.8%)	620 (24.5%)	
Income groups				
Low (< 1000 PLN)	2074 (45.4%)	862 (42.3%)	1212 (47.8%)	< 0.01
Medium (1001–2000 PLN)	1848 (40.4%)	813 (39.9%)	1035 (40.9%)	
High (≥ 2001 PLN)	647 (14.2%)	361 (17.8%)	286 (11.3%)	

BMI — body mass index; CVD — cardiovascular diseases; HDL-C — high density lipoprotein cholesterol; LDL-C — low density lipoprotein cholesterol; SCORE — systematic coronary risk evaluation; WHR — waist-to-hip ratio

Table 2. Prevalence of cardiovascular diseases risk factors according to education level.

Risk factor	Education			P (a) vs. (b) vs. (c)
	Incomplete secondary (a)	Secondary (b)	Higher (c)	
Hypertension	982 (51.6%)	654 (39.3%)	241 (24.0%)	**< 0.0001**
Former smoker	519 (27.3%)	415 (24.9%)	209 (20.8%)	**< 0.0001**
Current smoker	564 (29.6%)	457 (27.4%)	177 (17.7%)	**< 0.0001**
Overweight (BMI ≥ 25 kg/m^2)	723 (38.0%)	626 (37.6%)	351 (35.0%)	**< 0.0001**
Obese (BMI ≥ 30 kg/m^2)	610 (32.0%)	453 (27.2%)	160 (16.0%)	**< 0.0001**
Abdominally obese (WHR)	1292 (67.9%)	886 (53.2%)	396 (39.5%)	**< 0.0001**
Diabetes	317 (16.7%)	155 (9.3%)	35 (3.5%)	**< 0.0001**
Hipercholesterolemia	1153 (60.6%)	978 (58.7%)	522 (52.1%)	**< 0.0001**
Hypertriglyceridemia	613 (32.2%)	447 (26.8%)	199 (19.9%)	**< 0.0001**
Increased LDL-C	1015 (53.3%)	849 (51.0%)	446 (44.5%)	**< 0.0001**
Decreased HDL-C	439 (23.0%)	322 (19.3%)	178 (17.7%)	**0.001**

BMI — body mass index; HDL-C — high density lipoprotein cholesterol; LDL-C — low density lipoprotein cholesterol; WHR — waist-to-hip ratio

Table 3. Cardiovascular disease risk factors according to income groups.

Risk factor	Income			P (a) vs. (b) vs. (c)
	Low (a)	Medium (b)	High (c)	
Hypertension	819 (39.5%)	816 (44.1%)	242 (37.4%)	**0.001**
Former smoker	471 (22.7%)	492 (26.6%)	180 (27.8%)	**< 0.0001**
Current smoker	609 (29.3%)	439 (23.8%)	150 (23.2%)	**0.0001**
Overweight (BMI ≥ 25 kg/m^2)	735 (35.4%)	692 (37.4%)	273 (42.2%)	**0.014**
Obese (BMI ≥ 30 kg/m^2)	555 (26.8%)	514 (27.8%)	154 (23.8%)	**0.014**
Abdominally obese (WHR)	1187 (57.2%)	1032 (55.8%)	355 (54.9%)	0.49
Diabetes	238 (11.5%)	209 (11.3%)	60 (9.3%)	0.27
Hipercholesterolemia	1204 (58.0%)	1053 (57.0%)	396 (61.2%)	0.17
Hypertriglyceridemia	564 (27.2%)	500 (27.0%)	195 (30.1%)	0.28
Increased LDL-C	1047 (50.5%)	910 (49.2%)	353 (54.5%)	0.06
Decreased HDL-C	469 (22.6%)	357 (19.3%)	113 (17.5%)	**0.04**

BMI — body mass index; HDL-C — high density lipoprotein cholesterol; LDL-C — low density lipoprotein cholesterol; WHR — waist-to-hip ratio

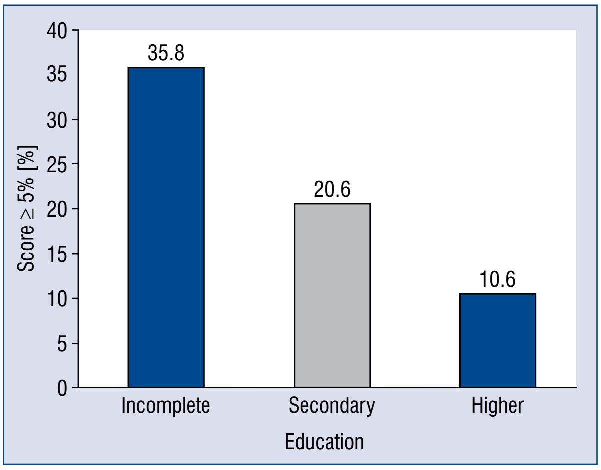

Figure 2. Prevalence of high cardiovascular disease risk (SCORE ≥ 5%) according to education level.

subjects. Higher education was independently associated with a lower prevalence of almost all investigated CVD risk factors, results for increased LDL-C were border significant (OR = 0.84; 95% CI 0.70–1.01; p = 0.06) (Table 4). Participants with higher income, showed an increased prevalence of overweight, obese (BMI ≥ 30), hypercholesterolemia, hypertriglyceridemia and increased LDL-C (p < 0.05) (Table 4), however this association was inverse for decreased HDL-C (OR = 0.74; 95% CI 0.57–0.95; p = 0.009) (Table 4).

High SCORE risk according to education and income

Higher education was independently associated with a lower prevalence of high CVD risk according to SCORE (OR = 0.46; 95% CI 0.29–0.74; p = 0.01) (Table 5). Results for high SCORE risk according to income were not statistically significant (p = 0.5) (Table 5). High CV risk was also more common in men and in older subjects (Table 5).

SCORE high risk, education and income in different age and gender groups

We found important correlation between education and high CVD risk in the whole group and in the subgroups of men and women. The prevalence of high CVD risk decreased with increasing education level in the whole group (OR = 0.61; 95% CI 0.49–0.76; p < 0.01) and in subgroups of men (OR = 0.52; 95% CI 0.39–0.70, p < 0.01) and women aged 50–59 years (OR = 0.37; 95% CI 0.14–0.99, p = 0.05) (Fig. 3). Results for other subgroups were not statistically significant.

A significant, favourable impact of income on prevalence of high CVD risk was also demonstrated in the whole group (OR = 0.81; 95% CI 0.67–0.99; p = 0.04) and in the subgroup of men (OR = 0.69; 95% CI 0.53–0.90, p < 0.01), which means that subjects declaring a higher income have decreased prevalence of high CVD risk (Fig. 4). The analysis of the women subgroup and other age subgroups showed no significance (p ≥ 0.05).

Discussion

Socioeconomic status is an important factor related to CVD. However, the fact that it may be assessed in many different ways caused uncertainty as to which SES indicators would be the

Table 4. Odds ratio for cardiovascular disease risk factors prevalence according to age, gender, education and income.

Variable	Age			Gender (male vs. female)			Education (higher vs. incomplete)			Income (high vs. low)		
	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P	OR	95% CI	P
Hypertension	1.06	1.06–1.07	< 0.0001	1.20	1.05–1.37	**0.007**	0.68	0.55–0.85	**0.005**	1.32	1.06–1.66	**0.05**
Former smoker	1.01	1.01–1.02	< 0.0001	3.25	2.79–3.78	**< 0.001**	0.73	0.57–0.93	**0.01**	1.26	0.99–1.62	0.06
Current smoker	0.98	0.97–0.98	< 0.0001	2.29	1.97–2.66	**< 0.001**	0.32	0.25–0.41	**< 0.001**	1.04	0.81–1.33	0.74
Overweight (BMI ≥ 25)	1.03	1.03–1.04	< 0.0001	1.91	1.65–2.21	**< 0.001**	0.89	0.71–1.11	0.30	1.45	1.15–1.84	**0.001**
Obese (BMI ≥ 30)	1.04	1.04–1.05	< 0.0001	1.36	1.16–1.64	**0.001**	0.56	0.43–0.73	**< 0.001**	1.45	1.11–1.89	**0.006**
Abdominally obese (WHR)	1.03	1.03–1.04	< 0.0001	3.57	3.12–4.09	**< 0.001**	0.53	0.44–0.65	**< 0.001**	1.10	0.89–1.37	0.22
Diabetes	1.06	1.05–1.07	< 0.0001	1.30	1.07–1.59	**0.007**	0.41	0.27–0.62	**0.001**	1.35	0.96–1.91	0.10
Hypercholestero-lemia	1.02	1.01–1.02	< 0.0001	0.92	0.81–1.05	0.21	0.82	0.68–0.99	**0.01**	1.33	1.08–1.63	**0.001**
Hypertrigly-ceridemia	1.02	1.01–1.02	< 0.0001	1.92	1.69–2.22	**< 0.001**	0.60	0.48–0.75	**< 0.001**	1.38	1.11–1.72	**0.002**
Increased LDL-C	1.02	1.01–1.02	< 0.0001	1.17	1.04–1.33	**0.008**	0.84	0.70–1.01	0.06	1.31	1.07–1.61	**0.001**
Decreased HDL-C	1.01	1.01–1.02	0.0006	1.22	1.05–1.40	**0.009**	0.95	0.75–1.21	0.99	0.74	0.57–0.95	**0.009**

BMI — body mass index; CI — confidence interval; HDL-C — high density lipoprotein cholesterol; LDL-C — low density lipoprotein cholesterol; OR — odds ratio; WHR — waist-to-hip ratio

most objective. Most epidemiological studies use a single SES indicator such as education, income, wealth or professional status. In the current paper the aim was to investigate CVD risk factors profile and CVD risk in a large population of Polish citizens using both education and income. This study revealed a significant and clear relationship of higher education being associated with lower prevalence of all analyzed CVD risk factors. This results directly in the subsequent level of overall CVD risk. The negative relationship between education and CVD risk remained significant after multivariable adjustment. It was found that higher education was independently associated with lower prevalence of high CVD risk of death. These findings are consistent with previous data [11–19]. The biggest differences in CVD risk factor frequency in education categories were found for actual smokers and obese, similarly as in the Tromso study [13].

The CVD risk gradient is distinctly affected by factors related to lifestyle. There is substantial evidence in the literature confirming that negative health-related behaviors are more frequent in lower SES groups. Mejean et al. [14] demonstrated that diet and lifestyle factors explained more than 70% of educational differences in CAD. Healthy lifestyle among subjects with higher social status may also be partially explained by higher health awareness in this group [11]. Evidence in the literature revealed that CVD risk might also be affected by psychosocial risk factors, like depression, marital status, lack of social support or chronic work stress [11].

In western countries higher education usually involves professional and financial benefits. In former communist countries of Central and Eastern Europe, including Poland, there was an observed weak association between income and education, suggesting that education attainment effects are less likely to be mediated by underlying differences in financial resources [20]. Kozakiewicz et al. [11] demonstrated in the WOBASZ I study, performed 10 (years) prior to the present study, that SES was defined as a combination of education and income categories and was an independent predictor of high CVD risk, but only in young men and women aged 30–39 years. Herein demonstrated a significant, favorable impact of both education and income on the prevalence of high CVD risk in the entire investigated group, which may reflect the undergoing transition in Poland.

The association between income and CVD is not as clear as with education. It was demonstrated that participants with higher income, reported higher prevalence of overweight, obesity (BMI ≥ 30),

Table 5. Odds ratio for high cardiovascular (CV) risk according to education and income adjusted for age and gender.

	High CV risk related to education					High CV risk related to income			
	OR	95%	CI	P		OR	95%	CI	P
Higher vs. incomplete	0.46	0.29	0.74	0.01	High vs. low	0.77	0.52	1.15	0.5
Age	1.36	1.33	1.40	< 0.0001	Age	1.37	1.34	1.41	< 0.0001
M vs. F	27.58	19.97	38.08	< 0.0001	M vs. F	28.20	20.43	38.91	< 0.0001

CI — confidence interval; F — female; M — male; OR — odds ratio

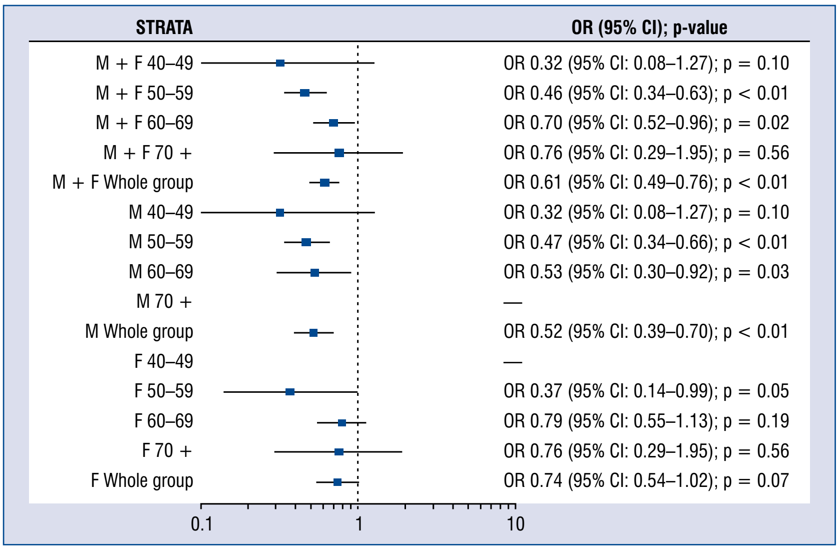

Figure 3. High cardiovascular disease risk according to higher education presented in age and gender subgroups. Odds ratio (OR) with confidence intervals (95% CI); F — female; M — male.

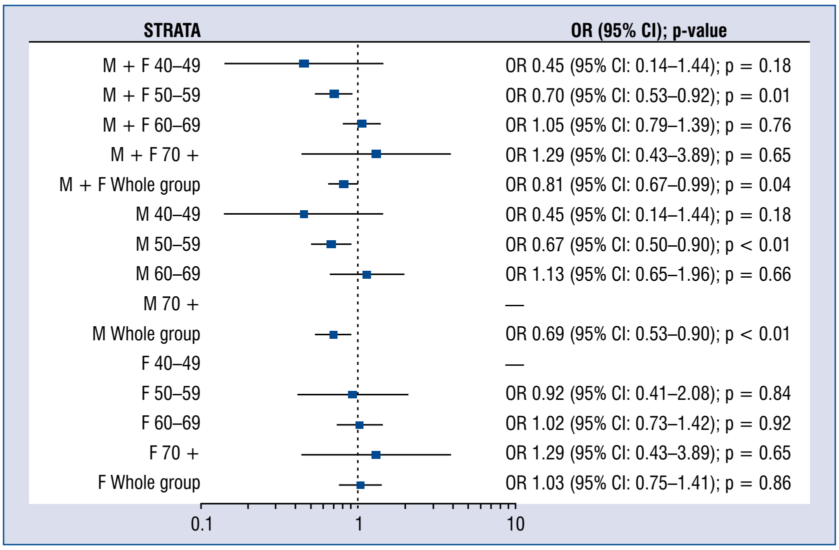

Figure 4. High cardiovascular disease risk according to high income presented in age and gender subgroups. Odds ratio (OR) with confidence intervals (95% CI); F — female; M — male.

hypercholesterolemia, hypertriglyceridemia, increased LDL-C, hypertension and former smoking but the inverse association for decreased HDL-C. However, when the subsample of participants free of CVD, DM and CKD diagnosed was analyzed, it was found that subjects declaring higher income have a lower prevalence of high CVD risk.

Results of other studies on the relation between SES and income and CVD risk factors are ambiguous. Stelmach et al. [20] showed that lower economic status did not affect CVD risk factors, similarly as in the Bobak and Marmot study [21]. Results of the Moli-sani study presented that healthy behaviors are strongly linked to material resources, even in a high-income country. Even small income differences produce gradient in modifiable risk factors, with more disadvantaged persons having not only more risk factors but also fewer protective factors [22]. According to Robert and House [23], financial assets remain associated with health until late in life and become more important relative to education.

Limitations of the study

The examined sample may not be representative of the whole population of Poland due to low response rate. Low response rates are a problem in many epidemiological studies, results of analysis regarding participation rates from the 1970s demonstrated that response rates decrease gradually [24]. It was found that study participants have better health than non-respondents [25]. Another limitation is the cross-sectional character of presented data, and in a consequence a problem of causality cannot be addressed.

Some estimates were based on interviews, and the answers may be inaccurate. This refers to the assessment of income, where people might have rated their income higher or lower. In this study, psychosocial factors were not taken into consideration, which could have affected cardiovascular risk.

Conclusions

This study, based on a large population of Polish citizens, showed that SES assessed by education and income is a significant and independent predictor of high cardiovascular risk of death as estimated by SCORE. Moreover, a favorable impact of education and income (in subgroup analysis) on the prevalence of high cardiovascular risk was demonstrated not only in younger subjects, as had been shown in previous Polish studies, but in the whole group investigated, which may reflect the fact that Poland was undergoing a socioeconomic transition. Data on SES and CVD interactions from Poland, the first Eastern Bloc country which had to adopt political and economic changes and was still in transition, may clarify and predict how socioeconomic factors generate inequalities in health in other transitioning countries. Considering the strong association between education and CVD, it would be beneficial to include it into cardiovascular risk estimations and screening tools along with reducing socioeconomic inequalities and developing effective prevention strategies focused on lower socioeconomic groups.

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