Identifying associations between the social network index, its components, and the prevalence of cardiovascular diseases in Polish adults. Results of the cross-sectional WOBASZ II study

Aleksandra M Piwońska[1]*, Jerzy Piwoński[1]*, Alicja Cicha-Mikołajczyk[1], Magdalena Kozela[2], Andrzej Pająk[2], Witold Śmigielski[1], Magdalena Kwaśniewska[3], Tomasz Zdrojewski[4], Andrzej Tykarski[5], Krystyna Kozakiewicz[6], Wojciech Drygas[1]

[1]Department of Epidemiology, Cardiovascular Disease Prevention, and Health Promotion, National Institute of Cardiology, Warszawa, Poland
[2]Department of Epidemiology and Population Studies, Institute of Public Health, Jagiellonian University Medical College, Kraków, Poland
[3]Department of Preventive Medicine, Medical University of Lodz, Łódź, Poland
[4]Department of Preventive Medicine and Education, Medical University of Gdansk, Gdańsk, Poland
[5]Department of Hypertension, Angiology and Internal Medicine, Poznan University of Medical Sciences, Poznań, Poland
[6]Division of Cardiology and Structural Heart Diseases, Medical University of Silesia, Katowice, Poland
*Both authors equally contributed to the study

Editorial
by Rutledge et al.

Correspondence to:
Aleksandra Piwońska, MD, PhD, Department of Epidemiology, Cardiovascular Disease Prevention and Health Promotion, National Institute of Cardiology, Alpejska 42, 04–628 Warszawa, Poland, phone: +48 22 812 55 86, e-mail: apiwonska@ikard.pl

DOI: 10.33963/v.kp.98066

Received:
August 1, 2023

Accepted:
October 31, 2023

Early publication date:
November 13, 2023

ABSTRACT

Background: Psychosocial risk factors are important determinants of cardiovascular diseases (CVDs): people involved in positive relationships live longer than those with low social support (SS).

Aims: Our study aimed to evaluate the association between SS, components of the social network, and CVDs.

Methods: A cross-sectional population-based survey WOBASZ II conducted in the years 2013–2014 included a sample of 6043 individuals, aged 20 and over, who completed the Berkman-Syme questionnaire to assess SS using the social network index (SNI).

Results: Higher percentage of low SS was observed in women (52.15%) compared to men (45.4%) (P <0.001). People with a low SNI had a worse CVD risk factor profile. None of the analyzed social contacts (with children, relatives, or friends), regardless of how satisfactory they were, was associated with CVDs in men. In women, satisfying contact with children or relatives appeared to be associated with better cardiovascular health. Furthermore, active participation in organized social activity increased the chance of arrhythmia in both sexes: 1.50 (1.04–2.15); P = 0.029 in men; 1.47 (1.11–1.95); P = 0.007 in women. Although a low SNI was associated with analyzed CVDs in the univariate analysis, it was not confirmed in the fully adjusted model.

Conclusions: More women had low SS compared to men. People with low SS had a worse CVD risk factor profile. There was a significant independent relationship between different components of the SNI, such as social contacts and CVDs in women and active participation in organized social activity and arrhythmia in both sexes.

Key words: Berkman-Syme questionnaire, cardiovascular diseases, cross-sectional study, Polish population, social support

WHAT'S NEW?

The main novelty of our study was that we not only analyzed the social support (SS) index as a whole but also particular components of the social network index (SNI), taking into account their quality. We showed worse cardiovascular disease (CVD) risk factor profile in individuals with a low SNI and found that social contact (with children, relatives, or friends), its quality, and the number of sources of social ties (none or 1, 2, and 3) were associated with cardiovascular health, but only in women. In turn, active participation in organized social activity increased the chance of arrhythmia in both sexes and, additionally, CVDs in women. The results of our study let us draw attention to the issue of SS as it is known that persons receiving higher support have better physical and psychological health, better lifestyle, and greater medication adherence.

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality, responsible for most social costs, deterioration in quality of life, and shortening of life expectancy [1]. It is well known that people involved in positive relationships live longer than those with low social support (SS) [2]. This is especially true for people with low SS, low socioeconomic status, or depression. The simplest definition of SS was proposed by Sarason: social support means assistance available to the individual in a difficult or stressful situation [3]. Lack of social support affects people negatively [4]. Some psychological factors that lead to chronic physiological stress, such as low SS or depression, are considered determinants of cardiovascular health because they can cause chronic systemic inflammation and increase the frequency of potentially negative behaviors that lead to the formation of new or increased intensity of current risk factors [5, 6]. In turn, a high level of SS has a positive impact on health behavior as well as on compliance with physician recommendations.

Although the overall beneficial effect of SS has been consistently reported in most studies, components of SS in different populations may not have the same effect. Different forms, sources, and types of SS can be critical in protecting various communities. In post-transformation Poland, after profound social and economic changes, the level of social support is similar to that of Western European countries [7] although it has recently decreased [8]. Furthermore, it is impossible to ignore the effect of the COVID-19 pandemic. Because of restrictions during the pandemic, the frequency of social face-to-face contact and its quality has changed, which influenced social well-being. Also, new forms of contact were created, e.g. online SS (home working, home education), which had existed before the pandemic but have increased during it, and some of them have remained since the COVID-19 pandemic ended.

This study aimed to evaluate the association between social support in general, as well as different components of the social network and CVDs, taking into account the quality of social contacts.

METHODS

Research design and participants

The methods of the National Multicenter Health Examination Survey (Polish acronym WOBASZ II) were previously published [9]. In summary, the study was carried out in 2013–2014 in a sample of the Polish population, aged 20 and over. The random selection of participants stratified according to sex, administrative units, and type of urbanization was carried out using the electronic database of national individual personal identification numbers (PESEL) with a response rate of 46.5%. The study was accepted by the Field Bioethics Committee (no. 1344/12). Before data collection, all respondents signed an informed consent for both questionnaires, physical examination, and blood tests. Finally, 6043 individuals (2710 men and 3333 women) were examined who completed the Berkman-Syme questionnaire [10].

Data assessment

The study protocol involved conducting a face-to-face questionnaire, physical examination, and laboratory tests. For the present analysis, we identified people who suffered: from ischemic heart disease (IHD), arrhythmia, and cardiovascular diseases (CVDs) based on self-reported data. Individuals with IHD had a medical history of diagnosis or hospitalization for acute coronary syndrome including myocardial infarction (MI), percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), a history of MI, or a diagnosis of IHD without hospitalization. Persons with arrhythmia had a medical history of diagnosis or hospitalization for arrhythmia, including atrial fibrillation and other heart rhythm disturbances, or an implanted pacemaker/cardioverter-defibrillator. Hypertensive people were defined as those with arterial blood pressure ≥140/90 mm Hg (mean taken from the 2nd and 3rd blood pressure measurements made during the survey) and/or those reporting use of antihypertensive medication. Subjects with a self-reported medical history of diabetes or with a fasting blood glucose level ≥7.0 mmol/l or on hypoglycemic treatment were considered diabetic. Obesity was diagnosed as a body mass index (BMI) ≥30 kg/m^2. The current smoker was a person who regularly smokes at least one cigarette a day, a former smoker was a person who had smoked in the past, stopped smoking, and did not smoke at the time of the survey; and a non-smoker was a person who had never smoked cigarettes.

Assessment of social support

Social support was evaluated according to the "social network scale" by Berkman-Syme [10]. The Berkman-Syme

questionnaire, composed of 31 questions on marital status, contacts with children, friends, and relatives, and active participation in organized social activities, was used to assess SS in the examined population. The respondents' answers received codes or points, and suitable code tables were used to calculate the social network index (SNI) to identify low, medium, high, and very high SS in the examined persons. For our analysis, the last two subgroups were combined into one "high" SS group. The method applied in the study was in agreement with the WHO MONICA Psychosocial Optional Study (MOPSY) guidelines [11]. Additionally, we analyzed different components of the SNI, e.g., contacts with at least 1 child, at least 1 relative, or at least 1 friend, together with their quality (combined none or unsatisfactory contact vs. satisfactory contact, according to subjective assessment) and also participation in at least 1 organization: social, political, sports, charity organizations and unions (combined no or passive vs. very or moderately active participation). Furthermore, we assigned participants to 3 groups, according to the number of sources of satisfactory social contacts (children, relatives, friends; at least 1 satisfactory contact) — none or 1 source, 2 sources (i.e., children & relatives, children & friends, relatives & friends), or 3 sources.

Statistical analysis

The study population was divided into three groups according to the SNI (low, moderate, high). All analyses were performed separately in men and women. Quantitative and qualitative variables were presented as median (IQR — interquartile range) and number (percentage), respectively. The Kruskal-Wallis or Mann-Whitney tests were used for comparison of continuous traits and the χ^2 test for categorical attributes. The prevalence of SNI components was adjusted for age and presented as means with a 95% confidence interval (95% CI). Logistic regression models were applied first to investigate the associations between the level of SNI or its components and risk factors, and, second, between them and CVDs, IHD, and arrhythmia. The multivariable models were adjusted for socio-demographic and CVD risk factors and comorbidity. The results of logistic regression were presented as odds ratios (OR) with 95% CI. Statistical analyses were performed with SAS version 9.4 (SAS, Cary, NC, US). A *P*-value <0.05 was considered statistically significant.

RESULTS

The characteristics of the study participants by sex and SS level are shown in Table 1. In general, men were younger than women (median [IQR] age, 49.0 [35.0–61.0] years vs. 51.0 [37.0–62.0] years; $P = 0.005$). Both men and women differed significantly in all analyzed parameters except for the prevalence of obesity and CVDs. Furthermore, compared to women, men were more often smokers and were more frequently diagnosed with hypertension, diabetes, and IHD. On the other hand, women were better educated, less likely to be single, more likely to be widows, and they were more often diagnosed with arrhythmia and low SS. Both men and women differed in age between SNI groups. Median age decreased with higher SNI. Additionally, significant disparities were observed in the prevalence of the analyzed risk factors/comorbidities between SNI groups, with the highest prevalence in people with a low SNI (Table 1).

Taking into account the relationship between the prevalence of CVDs, IHD, and arrhythmia and the quality of social contacts with children, relatives, or friends, we found that, regardless of participants' age, none of these three types of social relationships, no matter how satisfactory they were, was associated with CVDs in men. However, women who reported satisfactory contacts with at least one child or one relative had a significantly lower prevalence of CVDs, IHD, or arrhythmia (Table 2). Furthermore, the prevalence of CVDs, IHD, and arrhythmia in women decreased significantly with more sources of satisfactory social contact, while active participation in organized social activities was associated with a higher prevalence of arrhythmia in both men and women (Table 2).

The frequency of satisfactory contacts with children, relatives, or friends increased with a higher SS both in men and women. In general, slightly more women than men reported satisfactory social contacts, except for the high SNI group, where there were no differences between men and women. Additionally, women reported more often support from three sources of social contacts, regardless of the level of the SNI. Men and women did not differ in their active participation in organized social activities. More than 70.0% of men and women with a high SNI actively participated in organized social activities, compared to none in the low SNI group (Table 3).

Although raw data on study population characteristics showed that there were significant differences in the prevalence of CVD risk factors (smoking, hypertension, diabetes mellitus [DM], and obesity) between the SNI groups, with the highest frequency in the lowest SNI group, in regression models adjusted for age and education, a significant association was found only between smoking and a low SNI in men and between hypertension and a low SNI in women (Table 4, Model 1). In the SNI component-based model (marital status, number of sources of satisfactory social ties, and active participation in organized social activity) adjusted for age and education, we found more associations between SNI components and risk factors. Married status was associated with less smoking in both sexes and more prevalent obesity in men. In turn, having two sources of satisfactory social contacts (compared to none or just one source) was associated with lower chance of hypertension in men, while active participation in organized social activities was associated with lower chance of DM in men and lower odds of hypertension and smoking in women (Table 4, Model 2).

In the univariate regression analysis (Table 5, Model 1), it was found that a low or moderate SNI (compared to a high SNI level) was associated with much higher odds of

Table 1. Participants characteristics. The WOBASZ II Study (n = 6043)

	Men					Women					$P_{M vs. W}$
	Total	Social network index			*P*-value	Total	Social network index			*P*-value	
		Low	Moderate	High			Low	Moderate	High		
N (%)	2710 (44.9)	1229 (45.4)	944 (34.8)	537 (19.8)	–	3333 (55.1)	1738 (52.1)	1136 (34.1)	459 (13.8)	–	–
Age, years, median (IQR)	49 (35–61)	55 (42–65)	48 (36–59)	34 (25–48)	<0.001	51 (37–62)	55 (41–65)	47 (35–58)	39 (26–53)	<0.001	0.005
Education											
Primary, n (%)	388 (14.3)	263 (21.4)	95 (10.1)	30 (5.6)	<0.001	605 (18.2)	453 (26.1)	137 (12.1)	15 (3.3)	<0.001	<0.001
Vocational, n (%)	842 (31.1)	433 (35.2)	301 (31.9)	108 (20.1)		607 (18.2)	377 (21.7)	190 (16.8)	40 (8.7)		
Secondary, n (%)	962 (35.5)	376 (30.6)	349 (37.1)	237 (44.1)		1251 (37.6)	637 (36.7)	437 (38.5)	177 (38.6)		
High, n (%)	516 (19.1)	157 (12.8)	197 (20.9)	162 (30.2)		865 (26.0)	268 (15.5)	370 (32.6)	227 (49.4)		
Marital status											
Married/cohabited, n (%)	1892 (69.8)	978 (79.6)	686 (72.7)	228 (42.5)	<0.001	2152 (64.6)	1186 (68.2)	776 (68.3)	190 (41.4)	<0.001	<0.001
Single, n (%)	591 (21.8)	117 (9.5)	184 (19.5)	290 (54.0)		446 (13.4)	67 (3.9)	154 (13.6)	225 (49.0)		
Divorced/separated, n (%)	126 (4.7)	72 (5.9)	42 (4.4)	12 (2.2)		225 (6.7)	119 (6.8)	88 (7.7)	18 (3.9)		
Widowed, n (%)	101 (3.7)	62 (5.0)	32 (3.4)	7 (1.3)		510 (15.3)	366 (21.1)	118 (10.4)	26 (5.7)		
Risk factors & comorbidities											
Smoking status											
Current smoker, n (%)	784 (29.0)	379 (30.9)	255 (27.1)	150 (28.1)	<0.001	642 (19.3)	355 (20.4)	211 (18.6)	76 (16.6)	0.08	<0.001
Former smoker, n (%)	914 (33.8)	463 (37.7)	312 (33.2)	139 (26.0)		623 (18.7)	334 (19.2)	216 (19.0)	73 (15.9)		
Non-smoker, n (%)	1004 (37.2)	385 (31.4)	374 (39.7)	245 (45.9)		2066 (62.0)	1049 (60.4)	708 (62.4)	309 (67.5)		
Comorbidity											
Hypertension, n (%)	1318 (49.3)	676 (55.6)	458 (49.4)	184 (34.7)	<0.001	1361 (41.3)	868 (50.4)	387 (34.6)	106 (23.3)	<0.001	<0.001
Diabetes, n (%)	299 (11.4)	182 (15.2)	85 (9.4)	32 (6.2)	<0.001	291 (9.1)	206 (12.3)	71 (6.5)	14 (3.1)	<0.001	0.003
Obesity, n (%)	658 (25.5)	313 (26.9)	241 (26.7)	104 (20.1)	0.008	848 (26.9)	497 (30.3)	276 (26.0)	75 (16.9)	<0.001	0.20
Cardiovascular health status											
Cardiovascular disease, n (%)	519 (19.4)	291 (24.1)	168 (18.1)	60 (11.3)	<0.001	677 (20.7)	398 (23.4)	214 (19.2)	65 (14.4)	<0.001	0.21
Ischemic heart disease, n (%)	299 (11.1)	168 (13.8)	101 (10.8)	30 (5.6)	<0.001	277 (8.4)	182 (10.6)	73 (6.5)	22 (4.8)	<0.001	<0.001
Arrhythmia, n (%)	239 (9.0)	130 (10.8)	77 (8.3)	32 (6.0)	0.004	393 (12.1)	211 (12.5)	144 (12.9)	38 (8.4)	0.035	<0.001
Atrial fibrillation, n (%)	116 (4.3)	61 (5.0)	40 (4.3)	15 (2.8)	0.11	160 (4.9)	101 (5.9)	48 (4.3)	11 (2.4)	0.005	0.34
Other heart rhythm disturbances, n (%)	185 (6.9)	101 (8.4)	57 (6.1)	27 (5.1)	0.022	294 (9.0)	148 (8.7)	116 (10.3)	30 (6.6)	0.053	0.004

P-value — for comparisons between social network index levels; P_{MvsW} — for comparisons between sexes; obesity — body mass index ≥30 kg/m^2

Abbreviation: IQR, interquartile range

CVDs, IHD, or arrhythmia in both sexes (with a higher OR in men), but in the fully adjusted model (Table 5, Model 2) no significant associations were observed between the SNI and CVDs, IHD, or arrhythmia.

Active participation in organized social activities in the univariate analysis (Table 6, Model 1A) was significantly associated with CVDs and IHD in men and only with IHD in women but was not observed in the fully adjusted model. The number of sources of satisfactory social contact did not matter in men in the context of the analyzed diseases, but, in women, having at least two sources of satisfactory social contact was associated with 40%–50% lower chance of CVDs and arrhythmia, compared to those with none or one source of social bonds (Table 6, Model 1B). In the fully adjusted model (Table 6, Model 2), active participation in organized social activities was associated with higher chance of arrhythmia in both sexes and CVDs in women. We included the results of further in-depth analyses regarding arrhythmia in Supplementary material (*Tables S1* and *S2*). No significant association was found between the number of sources of satisfactory social contact in men, but in women having more than two sources of satisfactory social contact was related to lower chance of CVDs and arrhythmia, compared to having none or just one source. Marital status was not related to any of the analyzed diseases.

Based on our analysis, it is worth noting that risk factors/comorbidities turned out to be more strongly related to cardiovascular health status than social ties.

DISCUSSION

Cardiovascular diseases are the leading cause of mortality in people under 65 years of age and are a primary health, social, and economic problem in Poland. The number of CVD

Table 2. Relationship between prevalence of CVD, IHD, and arrhythmia and satisfaction with different components of the social network by sex (data adjusted for age). The WOBASZ II Study (n = 6043)

Organized social activity	Men		*P*-value	Women		*P*-value
	Active participation[a]			Active participation[a]		
	No	Yes		No	Yes	
N (%)	2012 (74.4)	693 (25.6)	–	2625 (78.9)	702 (21.1)	–
CVD, % (95% CI)	19.1 (17.5–20.7)	20.4 (17.6-23.1)	0.43	20.2 (18.8-21.7)	22.6 (19.7-25.4)	0.15
IHD, % (95% CI)	10.9 (9.6–12.2)	11.7 (9.4–13.9)	0.56	8.6 (7.6–9.6)	7.6 (5.6–9.5)	0.35
Arrhythmia, % (95% CI)	8.3 (7.1–9.5)	10.8 (8.7–12.9)	0.047	11.3 (10.1–12.6)	14.6 (12.2–17.0)	0.017
Social contact with child/children[b]	**Social contact**		***P*-value**	**Social contact**		***P*-value**
	None or unsatisfactory	Satisfactory		None or unsatisfactory	Satisfactory	
N (%)	71 (3.6)	1908 (96.4)	–	43 (1.5)	2732 (98.5)	–
CVD, % (95% CI)	23.6 (14.5–32.7)	22.7 (20.9–24.4)	0.84	36.4 (24.5–48.3)	22.5 (21.0–24.0)	0.023
IHD, % (95% CI)	14.3 (6.9–21.8)	13.2 (11.7–14.6)	0.77	18.7 (10.4–27.0)	9.2 (8.2–10.3)	0.027
Arrhythmia, % (95% CI)	16.8 (9.8–23.8)	10.2 (8.8–11.5)	0.07	21.0 (11.0–31.0)	12.8 (11.5–14.0)	0.11
Social contacts with at least 1 relative	**None or unsatisfactory**	**Satisfactory**	***P*-value**	**None or unsatisfactory**	**Satisfactory**	***P*-value**
N (%)	217 (8.1)	2480 (91.9)	–	198 (6.0)	3123 (94.0)	–
CVD, % (95% CI)	19.6 (14.7–24.5)	19.4 (18.0–20.9)	0.94	27.1 (21.7–32.4)	20.4 (19.1–21.7)	0.018
IHD, % (95% CI)	11.7 (7.8–15.7)	11.1 (9.9–12.2)	0.76	8.3 (4.6–12.0)	8.5 (7.5–9.4)	0.95
Arrhythmia, % (95% CI)	9.7 (6.0–13.4)	8.8 (7.7–9.9)	0.67	19.4 (14.9–23.9)	11.6 (10.5–12.8)	0.001
Social contacts with at least 1 friend	**None or unsatisfactory**	**Satisfactory**	***P*-value**	**None or unsatisfactory**	**Satisfactory**	***P*-value**
N (%)	383 (14.2)	2314 (85.8)	–	440 (13.2)	2885 (86.8)	–
CVD, % (95% CI)	18.5 (14.8–22.2)	19.7 (18.2–21.2)	0.55	21.7 (18.1–25.3)	20.6 (19.2–22.0)	0.56
IHD, % (95% CI)	10.8 (7.8–13.8)	11.2 (10.0–12.4)	0.82	9.3 (6.9–11.8)	8.3 (7.3–9.2)	0.43
Arrhythmia, % (95% CI)	8.7 (5.9–11.6)	9.0 (7.9–10.2)	0.86	12.0 (8.9–15.0)	12.1 (10.9–13.2)	0.95
	Number of sources of social contacts		***P*-value**	**Number of sources of social contacts**		***P*-value**
	0 or 1	2	3		0 or 1	2	3	
N (%)	190 (7.2)	912 (34.6)	1531 (58.2)	–	126 (3.9)	877 (27.0)	2241 (69.1)	–
CVD, % (95% CI)	18.1 (12.9–23.3)	21.6 (19.2–24.0)	18.3 (16.4–20.1)	0.09	31.2 (24.5–37.8)	21.7 (19.1–24.2)	19.7 (18.1–21.3)	0.003
IHD, % (95% CI)	11.3 (7.0–15.5)	12.7 (10.7–14.7)	10.2 (8.7–11.7)	0.16	11.6 (6.9–16.2)	10.5 (8.8–12.3)	7.4 (6.3–8.5)	0.005
Arrhythmia, % (95% CI)	9.5 (5.6–13.5)	9.6 (7.8–11.5)	8.3 (6.9–9.7)	0.51	20.1 (14.4–25.7)	12.4 (10.3–14.5)	11.3 (10.0–12.7)	0.011

[a]Active participation in at least 1 organization; [b]Only for people who declared having a child/children

Abbreviations: CVD, cardiovascular disease; CI, confidence interval; IHD, ischemic heart disease

Table 3. Distribution of satisfaction with social contacts, number of sources of social contacts, and organized social activity by the social network index and sex. The WOBASZ II Study (n = 6043)

	Social Network Index								
	Low			Moderate			High		
	Men	Women	*P*-value	Men	Women	*P*-value	Men	Women	*P*-value
N (%)	1229 (45.4)	1738 (52.1)	<0.001	944 (34.8)	1136 (34.1)	0.54	537 (19.8)	459 (13.8)	<0.001
Marital status									
Married	978 (79.6)	1186 (68.2)	<0.001	686 (72.7)	776 (68.3)	0.030	228 (42.5)	190 (41.4)	0.73
Satisfaction with contacts with at least									
1 friend, n (%)	911 (74.6)	1351 (78.0)	0.030	878 (93.5)	1079 (95.1)	0.12	525 (97.8)	455 (99.1)	0.09
1 relative, n (%)	1072 (87.9)	1584 (91.7)	<0.001	882 (93.7)	1090 (96.0)	0.017	526 (98.1)	449 (98.0)	0.91
1 child, n (%)	984 (95.5)	1551 (98.1)	<0.001	690 (97.7)	944 (98.9)	0.048	234 (96.3)	237 (98.7)	0.08
Number of sources of social contacts									
0–1, n (%)	132 (11.1)	88 (5.3)	<0.001	44 (4.8)	29 (2.6)	0.009	14 (2.7)	9 (2.0)	0.50
2, n (%)	369 (31.2)	452 (27.0)	0.015	262 (28.3)	219 (19.5)	<0.001	281 (53.7)	206 (46.0)	0.016
3, n (%)	683 (57.7)	1134 (67.7)	<0.001	620 (66.9)	874 (77.9)	<0.001	228 (43.6)	233 (52.0)	0.009
Organized social activities									
Active participation[a], n (%)	0 (0.0)	0 (0.0)	-	317 (33.6)	369 (32.5)	0.62	376 (70.2)	333 (72.6)	0.40

[a]Active participation in at least 1 organization

Table 4. Impact of the social network index level, sources of social contacts, and organized social activities on selected CVD risk factors in men and women. The WOBASZ II Study (n = 6043)

Sex	Model	Predictor	Cardiovascular risk factor			
			Smoking	Hypertension	Diabetes	Obesity
			OR (95% CI); *P*-value	OR (95% CI); *P*-value	OR (95% CI); *P*-value	OR (95% CI); *P*-value
Men	**Model 1**	**Age**	0.97 (0.97–0.98); <0.001	1.06 (1.06–1.07); <0.001	1.06 (1.05–1.07); <0.001	1.02 (1.02–1.03); <0.001
		Education				
		Primary	4.35 (3.07–6.16); <0.001	0.95 (0.68–1.31); 0.75	1.70 (0.998–2.90); 0.051	0.91 (0.64–1.31); 0.62
		Vocational	3.84 (2.88–5.13); <0.001	1.25 (0.97–1.61); 0.09	1.43 (0.88–2.34); 0.15	1.29 (0.97–1.71); 0.08
		Secondary	2.33 (1.76–3.08); <0.001	1.14 (0.89–1.46); 0.29	1.66 (1.02–2.71); 0.040	1.41 (1.07–1.85); 0.014
		SNI level				
		Low	1.35 (1.05–1.74); 0.020	0.97 (0.76–1.25); 0.83	1.05 (0.68–1.61); 0.83	1.05 (0.80–1.38); 0.72
		Moderate	1.07 (0.83–1.38); 0.60	1.09 (0.85–1.39); 0.51	0.90 (0.58–1.40); 0.64	1.17 (0.89–1.53); 0.26
	Model 2	**Age**	0.98 (0.97–0.99); <0.001	1.06 (1.05–1.07); <0.001	1.06 (1.05–1.07); <0.001	1.02 (1.01–1.02); <0.001
		Education				
		Primary	3.93 (2.74–5.64); <0.001	1.03 (0.73–1.44); 0.88	1.57 (0.89–2.75); 0.12	1.16 (0.80–1.70); 0.44
		Vocational	3.92 (2.91–5.28); <0.001	1.36 (1.04–1.77); 0.023	1.33 (0.80–2.23); 0.28	1.42 (1.05–1.91); 0.023
		Secondary	2.28 (1.71–3.03); <0.001	1.23 (0.96–1.58); 0.11	1.66 (0.999–2.76); 0.050	1.56 (1.17–2.07); 0.002
		Marital status				
		Married	0.78 (0.63–0.97); 0.028	0.87 (0.70–1.09); 0.23	0.91 (0.66–1.26); 0.57	2.15 (1.66–2.78); <0.001
		Number of sources of social contacts				
		3	0.79 (0.55–1.11); 0.17	0.82 (0.57–1.17); 0.27	0.96 (0.59–1.56); 0.86	1.38 (0.90–2.10); 0.14
		2	0.89 (0.63–1.26); 0.51	0.62 (0.43–0.89); 0.010	0.81 (0.49–1.36); 0.42	1.26 (0.81–1.95); 0.30
		Organized social activity				
		Active participation[a]	0.87 (0.70–1.07); 0.19	1.21 (0.98–1.48); 0.07	0.65 (0.45–0.94); 0.022	1.16 (0.93–1.44); 0.19
Women	**Model 1**	**Age**	0.98 (0.98–0.99); <0.001	1.09 (1.08–1.10); <0.001	1.07 (1.05–1.08); <0.001	1.04 (1.03–1.04); <0.001
		Education				
		Primary	2.09 (1.48–2.95); <0.001	1.43 (1.05–1.95); 0.023	2.25 (1.29–3.92); 0.004	1.88 (1.38–2.56); <0.001
		Vocational	2.85 (2.13–3.80); <0.001	1.84 (1.41–2.41); <0.001	2.22 (1.29–3.82); 0.004	1.81 (1.37–2.39); <0.001
		Secondary	2.34 (1.82–3.01); <0.001	1.23 (0.97–1.56); 0.08	1.51 (0.90–2.53); 0.12	1.46 (1.14–1.87); 0.003
		SNI level				
		Low	1.26 (0.94–1.69); 0.12	1.37 (1.03–1.82); 0.033	1.58 (0.88–2.84); 0.12	1.13 (0.84–1.51); 0.43
		Moderate	1.12 (0.83–1.50); 0.46	1.14 (0.84–1.53); 0.40	1.35 (0.74–2.48); 0.33	1.28 (0.95–1.72); 0.10
	Model 2	**Age**	0.98 (0.98–0.99); <0.001	1.09 (1.08–1.10); <0.001	1.06 (1.05–1.08); <0.001	1.04 (1.03–1.04); <0.001
		Education				
		Primary	1.99 (1.40–2.84); <0.001	1.43 (1.05–1.97); 0.025	2.50 (1.39–4.46); 0.002	1.87 (1.37–2.56); <0.001
		Vocational	2.81 (2.10–3.76); <0.001	1.86 (1.41–2.44); <0.001	2.59 (1.47–4.55); <0.001	1.75 (1.31–2.32); <0.001
		Secondary	2.24 (1.73–2.89); <0.001	1.21 (0.95–1.54); 0.12	1.60 (0.93–2.76); 0.09	1.39 (1.08–1.79); 0.001
		Marital status				
		Married	0.76 (0.63–0.93); 0.007	0.98 (0.81–1.19); 0.87	0.83 (0.63–1.11); 0.21	1.11 (0.93–1.34); 0.26
		Number of sources of social contacts				
		3	1.50 (0.90–2.50); 0.12	0.70 (0.43–1.14); 0.15	0.71 (0.40–1.26); 0.24	1.08 (0.69–1.68); 0.75
		2	1.28 (0.75–2.16); 0.36	0.81 (0.49–1.35); 0.42	0.64 (0.35–1.17); 0.15	0.97 (0.61–1.54); 0.89
		Organized social activities				
		Active participation[a]	0.75 (0.59–0.96); 0.021	0.76 (0.61–0.94); 0.011	0.80 (0.54–1.17); 0.24	0.86 (0.69–1.07); 0.16

Reference: high SNI, high education level, unmarried, 0–1 sources of social contacts, none or passive participation in organized social activities

[a]Active participation in at least 1 organization

Abbreviations: OR, odds ratio; SNI, social network index; other — see Table 2

deaths was decreasing in Poland from 1991, but due to the COVID-19 pandemic, this positive trend of declining CVD mortality was reversed with a 17% excess in CVD deaths in 2020 [12]. Poland still belongs to countries with high cardiovascular risk, with standardized rates of CVD deaths higher by about 40% compared to the European average [13].

Psychosocial risk factors such as low SS, social isolation, stress, and depression were shown to play an important role in CVD pathogenesis and the risk of cardiovascular death. In the Framingham Heart Study, a low SNI score was associated with 62% higher all-cause mortality compared to the highest SNI group [14]. Deficiencies in social relationships are associated with increased risk of developing coronary heart disease and stroke [15]. Undoubtedly, social support, its changes and the way of its provision during the COVID-19 pandemic played a particularly important role, which requires further research.

Researchers in the Australian questionnaire substudy (ASPREE Longitudinal Study of Older People — ALSOP), conducted in more than 11 000 individuals aged 70 and over, suggest that social isolation and low SS should be considered in future CVD risk prediction models [16]. Data from the Multi-Ethnic Study of Atherosclerosis (MESA), which examined CVD risk factors, showed that emotional

Table 5. Impact of SNI level on CVD, IHD, and arrhythmia in men and women (logistic regression analysis). The WOBASZ II Study (n = 6043)

Sex	Model	Predictor	Cardiovascular disease	Ischemic heart disease	Arrhythmia
			OR (95% CI); *P*-value	OR (95% CI); *P*-value	OR (95% CI); *P*-value
Men	Model 1	SNI level			
		Low	2.49 (1.85–3.36); <0.001	2.68 (1.79–4.01); <0.001	1.89 (1.26–2.82); 0.002
		Moderate	1.74 (1.27–2.38); <0.001	2.04 (1.33–3.11); 0.001	1.41 (0.92–2.16); 0.11
	Model 2	Age	1.08 (1.07–1.09); <0.001	1.08 (1.06–1.09); <0.001	1.06 (1.04–1.07); <0.001
		Education			
		Primary	0.82 (0.52–1.31); 0.41	1.32 (0.73–2.37); 0.36	1.04 (0.57–1.89); 0.90
		Vocational	0.94 (0.63–1.39); 0.74	1.54 (0.90–2.62); 0.11	0.97 (0.57–1.66); 0.91
		Secondary	1.19 (0.81–1.76); 0.37	1.47 (0.86–2.49); 0.16	1.48 (0.88–2.46); 0.14
		Current smoker	0.67 (0.51–0.89); 0.005	0.65 (0.45–0.92); 0.016	0.59 (0.40–0.88); 0.010
		Hypertension	1.69 (1.30–2.20); <0.001	1.60 (1.15–2.22); 0.005	2.08 (1.44–2.98); <0.001
		Diabetes	1.81 (1.34–2.45); <0.001	1.73 (1.23–2.42); 0.002	1.61 (1.11–2.34); 0.012
		Obesity	1.09 (0.85–1.41); 0.49	1.21 (0.90–1.64); 0.21	0.95 (0.68–1.33); 0.77
		SNI level			
		Low	0.85 (0.58–1.24); 0.38	0.79 (0.49–1.27); 0.32	0.75 (0.46–1.21); 0.23
		Moderate	0.97 (0.66–1.42); 0.85	1.02 (0.63–1.66); 0.92	0.90 (0.55–1.45); 0.66
Women	Model 1	SNI level			
		Low	1.82 (1.37–2.43); <0.001	2.34 (1.49–3.69); <0.001	1.55 (1.08–2.23); 0.017
		Moderate	1.42 (1.05–1.92); 0.024	1.37 (0.84–2.24); 0.21	1.61 (1.11–2.35); 0.013
	Model 2	Age	1.06 (1.05–1.07); <0.001	1.09 (1.07–1.10); <0.001	1.04 (1.03–1.05); <0.001
		Education			
		Primary	1.02 (0.71–1.46); 0.91	2.01 (1.06–3.80); 0.033	0.70 (0.46–1.05); 0.09
		Vocational	0.91 (0.64–1.28); 0.58	1.60 (0.83–3.08); 0.16	0.68 (0.45–1.01); 0.06
		Secondary	0.95 (0.71–1.28); 0.73	1.57 (0.86–2.88); 0.14	0.78 (0.56–1.09); 0.15
		Current smoker	1.07 (0.83–1.38); 0.59	0.86 (0.56–1.34); 0.51	1.07 (0.79–1.45); 0.66
		Hypertension	1.31 (1.04–1.64); 0.020	2.15 (1.49–3.09); <0.001	1.27 (0.97–1.67); 0.08
		Diabetes	1.21 (0.90–1.62); 0.21	1.17 (0.82–1.68); 0.38	1.23 (0.88–1.72); 0.23
		Obesity	1.56 (1.26–1.92); <0.001	1.71 (1.28–2.29); <0.001	1.39 (1.09–1.79); 0.009
		SNI level			
		Low	0.76 (0.54–1.07); 0.11	0.61 (0.35–1.05); 0.07	0.87 (0.58–1.31); 0.51
		Moderate	0.93 (0.66–1.31); 0.67	0.70 (0.40–1.24); 0.22	1.22 (0.81–1.82); 0.34

Reference: high SNI, high education level, currently nonsmoker, lack of hypertension, lack of diabetes, body mass index <30 kg/m^2

Model 1 — univariate analysis; Model 2 — multivariable analysis

Abbreviations: see Tables 2 and 4

SS played a protective role against severe CVDs (confirmed CHD death, confirmed or likely MI, resuscitated cardiac arrest, other atherosclerotic CVD death, or fatal or nonfatal stroke) [17].

As psychosocial risk factors influence health, they are worth considering in research studies to examine the scale of the problem both in the general population and in the population of people with high cardiovascular risk.

Social support can be obtained from relatives, friends, organizations, health care professionals, and even through the Internet, and it is a complex form of mutual interactions of its components (i.e., marital status, social contact with children, relatives or friends, and active participation in organizations), so its effect on health depends on the type of support and on who gives this support. Personal relationships and family support can be based on emotional support, also support in providing information about health promotion, preparing healthy food or accompanying during physical activities, so the role of social relationships in sustaining good health should be underlined [18]. The role of support groups (family and friends) in the preventive cardiology programs for high-risk individuals was underlined in the EUROACTION project [19]. Therefore, our study evaluated associations not only between SS as a whole index but also between particular components of SNI and CVDs in Polish adults based on the results of the population-based cross-sectional survey. In men, except for active participation in organized social activities, the type of social contact (with children, relatives, or friends) or the number of sources of social contact did not play a role in maintaining cardiovascular health. In women, satisfactory contact with children and relatives and support from more than one source of social contact were associated with better cardiovascular health. This is consistent with some findings from the Polish HAPIEE cohort, in which the associations between psychosocial risk factors and CVD incidence were much stronger in women than in men [20]. The number of social connections in women is not always associated with higher SS because women's involvement in many different social roles may be related to increased stress and overwork [21]. However, we did not confirm this relationship because more sources of satisfactory interpersonal contacts were independently associated with better CHS in women.

Table 6. Impact of SNI components on CVD, IHD, and arrhythmia in men and women (logistic regression analysis). The WOBASZ II Study (n = 6043)

Sex	Model	Predictor	Cardiovascular disease OR (95% CI); *P*-value	Ischemic heart disease OR (95% CI); *P*-value	Arrhythmia OR (95% CI); *P*-value
Men	Model 1A	Organized social activity			
		Active participation[a]	0.76 (0.61–0.96); 0.020	0.74 (0.55–0.99); 0.043	1.02 (0.75–1.38); 0.91
	Model 1B	Number of sources of social contacts			
		3	1.16 (0.79–1.70); 0.46	1.03 (0.65–1.64); 0.89	0.96 (0.58–1.59); 0.87
		2	0.77 (0.51–1.15); 0.20	0.67 (0.41–1.10); 0.11	0.67 (0.39–1.15); 0.14
	Model 2	Age	1.08 (1.07–1.09); <0.001	1.08 (1.06–1.09); <0.001	1.05 (1.04–1.07); <0.001
		Education			
		Primary	0.77 (0.48–1.25); 0.29	1.22 (0.66–2.24); 0.53	0.99 (0.53–1.85); 0.98
		Vocational	0.91 (0.61–1.38); 0.67	1.55 (0.89–2.68); 0.12	0.96 (0.55–1.67); 0.89
		Secondary	1.12 (0.75–1.67); 0.58	1.39 (0.80–2.40); 0.24	1.41 (0.84–2.37); 0.20
		Current smoker	0.66 (0.50–0.88); 0.005	0.63 (0.44–0.91); 0.013	0.57 (0.38–0.86); 0.008
		Hypertension	1.78 (1.36–2.33); <0.001	1.62 (1.16–2.26); 0.004	2.22 (1.53–3.22); <0.001
		Diabetes	1.92 (1.41–2.61); <0.001	1.75 (1.24–2.47); 0.002	1.66 (1.14–2.44); 0.009
		Obesity	1.10 (0.85–1.43); 0.49	1.23 (0.90–1.68); 0.19	0.98 (0.70–1.38); 0.92
		Organized social activites			
		Active participation*	1.12 (0.84–1.50); 0.45	1.22 (0.85–1.74); 0.28	1.50 (1.04–2.15); 0.029
		Number of sources of social contacts			
		3	1.19 (0.73–1.93); 0.49	1.03 (0.59–1.79); 0.91	0.98 (0.54–1.78); 0.95
		2	1.45 (0.87–2.41); 0.15	1.16 (0.65–2.09); 0.61	1.09 (0.58–2.04); 0.78
		Marital status			
		Married	0.95 (0.70–1.28); 0.72	0.98 (0.68–1.40); 0.90	0.80 (0.55–1.17); 0.25
Women	Model 1A	Organized social activity			
		Active participation[a]	1.00 (0.82–1.24); 0.97	0.70 (0.50–0.97); 0.033	1.22 (0.95–1.56); 0.12
	Model 1B	Number of sources of social contacts			
		3	0.55 (0.37–0.82); 0.003	0.65 (0.37–1.14); 0.13	0.53 (0.33–0.83); 0.006
		2	0.44 (0.29–0.66); <0.001	0.60 (0.33–1.09); 0.09	0.45 (0.27–0.73); 0.001
	Model 2	Age	1.06 (1.05–1.07); <0.001	1.09 (1.07–1.10); <0.001	1.04 (1.03–1.05); <0.001
		Education			
		Primary	1.07 (0.74–1.55); 0.72	2.14 (1.11–4.12); 0.022	0.72 (0.47–1.10); 0.13
		Vocational	0.95 (0.67–1.35); 0.78	1.61 (0.82–3.13); 0.16	0.72 (0.48–1.08); 0.11
		Secondary	0.99 (0.73–1.33); 0.92	1.61 (0.87–2.98); 0.13	0.82 (0.59–1.16); 0.26
		Current smoker	1.10 (0.85–1.42); 0.48	0.91 (0.59–1.41); 0.67	1.12 (0.83–1.53); 0.46
		Hypertension	1.35 (1.07–1.70); 0.011	2.12 (1.47–3.06); <0.001	1.31 (0.99–1.73); 0.06
		Diabetes	1.21 (0.89–1.64); 0.22	1.16 (0.80–1.67); 0.43	1.23 (0.87–1.74); 0.25
		Obesity	1.52 (1.23–1.88); <0.001	1.62 (1.21–2.19); 0.001	1.39 (1.08–1.79); 0.011
		Organized social activity			
		Active participation[a]	1.42 (1.11–1.82); 0.005	1.29 (0.87–1.91); 0.20	1.47 (1.11–1.95); 0.007
		Number of sources of social contacts			
		3	0.55 (0.34–0.89); 0.015	1.04 (0.53–2.05); 0.90	0.49 (0.30–0.82); 0.006
		2	0.52 (0.31–0.87); 0.012	1.03 (0.51–2.08); 0.95	0.50 (0.29–0.85); 0.011
		Marital status			
		Married	1.06 (0.86–1.32); 0.57	1.15 (0.84–1.58); 0.38	1.02 (0.79–1.31); 0.90

Reference: high SNI, high education level, unmarried, 0–1 sources of social contacts, none or passive participation in organized social activities, currently nonsmoker, lack of hypertension, lack of diabetes, body mass index <30 kg/m^2

Model 1A and Model 1B — univariate analysis; Model 2 — multivariable analysis

[a]Active participation in at least 1 organization

Abbreviations: see Table 2 and 4

In general, there is a difference between men and women in SS use. Men use support less often than women to deal with life experiences [22] although their health benefits from SS were the same or even greater than women's benefits. There are at least two probable reasons for that: first, men believe they do not need any help from others, and second, the traditional perception of gender roles, which emphasizes independence and low emotional disclosure in men, does not let them ask for help (this can be seen as a weakness). So, for men, the use of support is associated, to a greater extent than in women, with weighing costs (decreased sense of self-control and self-efficacy) and benefits (feeling better, more calm) [23].

Notable is the contribution of organized social activities in the SNI. They can be perceived as the fourth source of satisfying contacts, especially in people who have few or no sources of social ties, and in this sense, we tried to explain its protective impact in the univariate analysis. However,

we suppose that with the full and/or excessive involvement of the individual in social activities, the protective role of this component ends and it becomes an additional burden and/or workload, which is visible in the multivariable analysis in the case of arrhythmia (in both sexes). The observed association requires more detailed research, and we plan to do so in our future work. In the Framingham Heart Study, the results of the follow-up analysis on associations between the SNI and the incidence and mortality due to atrial fibrillation showed that among the components of SNI, only active participation in organized social activities was associated with a higher incidence of atrial fibrillation (HR, 1.35 [1.16–1.57]; $P = 0.001$) [14]. This is partly consistent with our results (we found a higher prevalence of arrhythmia in people who actively participated in organized social activities); however, our study was not observational.

In line with the results of the European Social Survey that indicated a relationship between education and social support and suggested the need to consider socioeconomic factors in research on health effects of social support [24], we included in our models the level of education. In contrast to our predictions, in a fully adjusted model, no significant and independent association between the SNI (as a whole index) and cardiovascular health was found. The sociodemographic risk factors (age, education) and risk factors/comorbidities (smoking, hypertension, DM, and obesity) were found to be more strongly associated with cardiovascular health compared to social ties.

People who receive more support are known to have better physical and psychological health, better quality of life [25, 26], greater sense of self-worth [27], better lifestyle, and increased compliance with medications and rehabilitation. On the contrary, lack of support is a barrier to adherence to a healthy lifestyle, as we showed in our previous study WOBASZ (2003–2005), where low SS was associated with unhealthy lifestyle [28].

Low SS was very prevalent in the Polish population, in 2013–2014 almost half of adult Poles had low SS (with predominance in women) compared to 31.0% of men and 39.0% of women in WOBASZ [28]. Individuals with low SS were older and characterized by a worse risk factor profile (higher prevalence of obesity, smoking, hypertension) and worse cardiovascular health (more cases of CVDs, IHD, and arrhythmia). The prevalence of classical risk factors in low SS individuals was even higher than the Polish population average [29].

Given that the prevalence of low SS has increased significantly since 2003–2005 (from 31.0% to 45.4%% in men, and from 39.0% to 52.2% in women), and probably has grown even more during the COVID-19 pandemic (this requires investigations), it is important to consider it as a CVD risk factor and also as a factor that plays an important role in CVDs prevention. Although data analyzed in our study were collected 10 years ago, the results allowed us to elucidate the importance of social contact and its associations with CVDs. We demonstrated that even if support measured by the SNI does not seem to matter, its components such as satisfactory social contacts and the number of social ties play an important role in relation to CVDs. Probably these associations persist, even if the social support mechanisms have changed. Last but not least, we are convinced that our data will be interesting for readers and will be used in future comparative analyses.

Limitations

A major limitation is the cross-sectional nature of the WOBASZ II study, which allowed us to analyze the associations, but not the cause-and-effect relationship between SNI and CVDs. Furthermore, the WOBASZ II study was an epidemiological survey, made on more than 6000 individuals, so according to the specificity of epidemiological studies, especially those made on thousands of participants, nearly all data including medical history are self-reported and based on questionnaires (without clinical verification). An additional limitation is the response rate of slightly less than 50% [9], which follows trends toward lower response rates in European studies.

CONCLUSIONS

The results of our study showed a higher prevalence of low SS (presented as a low SNI) in women compared to men. Participants with low SS had a worse cardiovascular disease risk factor profile. Low SS was associated with CVDs, IHD, and arrhythmia in both sexes only in a univariate analysis. None of the analyzed social contacts (with children, relatives, or friends), no matter how satisfactory they were, was associated with cardiovascular health in men. However, in women, satisfactory contact with children or relatives appeared to be associated with a lower prevalence of CVDs or arrhythmia. Active participation in organized social activities was associated with higher chance of arrhythmia in both sexes, regardless of other risk factors/comorbidities and age. However last finding should be interpreted with caution due to self-reported data on arrhythmia (without clinical verification of diagnosis), so it requires further investigations.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

Conflict of interest: None declared.

Funding: WOBASZ II was financed from the resources of the Polish Ministry of Health within the framework of the National Programme of Prevention and Treatment of Cardiovascular Diseases POLKARD (2010–2012) — Task: Analyses and epidemiology: "Monitoring of the epidemiological situation in Poland in the field of cardiovascular diseases" (no. 5/8/1/2012/101/945; to GB).

REFERENCES

1. World Health Organization (WHO). Fact sheets: Cardiovascular diseases (CVDs). 2020. www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds) (accessed: July 25, 2023).
2. Ford ES, Ahluwalia IB, Galuska DA. Social relationships and cardiovascular disease risk factors: findings from the third national health and nutrition examination survey. Prev Med. 2000; 30(2): 83–92, doi: 10.1006/pmed.1999.0606, indexed in Pubmed: 10656835.
3. Sarason I, Levine H, Basham R, et al. Assessing social support: The Social Support Questionnaire. J Pers Soc Psychol. 1983; 44: 127–139, doi: 10.1037/0022-3514.44.1.127.
4. Rico-Uribe LA, Caballero FF, Olaya B, et al. Loneliness, social networks, and health: a cross-sectional study in three countries. PLoS One. 2016; 11(1): e0145264, doi: 10.1371/journal.pone.0145264, indexed in Pubmed: 26761205.
5. Dar T, Radfar A, Abohashem S, et al. Psychosocial stress and cardiovascular disease. Curr Treat Options Cardiovasc Med. 2019; 21(5): 23, doi: 10.1007/s11936-019-0724-5, indexed in Pubmed: 31028483.
6. Roncella A. Psychosocial risk factors and ischemic heart disease: a new perspective. Rev Recent Clin Trials. 2019; 14(2): 80–85, doi: 10.2174/1574887114666190301141628, indexed in Pubmed: 30836925.
7. WHO Health for all database. Availability of social support. https://gateway.euro.who.int/en/indicators/hfa_621-0600-availability-of-social-support/visualizations/#id=27318&tab=table (accessed: September 20, 2023).
8. Zhou J, Havens KL, Starnes CP, et al. Changes in social support of pregnant and postnatal mothers during the COVID-19 pandemic. Midwifery. 2021; 103: 103162, doi: 10.1016/j.midw.2021.103162, indexed in Pubmed: 34649034.
9. Drygas W, Niklas AA, Piwońska A, et al. Multi-centre national population health examination survey (WOBASZ II study): assumptions, methods, and implementation. Kardiol Pol. 2016; 74(7): 681–690, doi: 10.5603/KP.a2015.0235, indexed in Pubmed: 26620680.
10. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda county residents. Am J Epidemiol. 1979; 109(2): 186–204, doi: 10.1093/oxfordjournals.aje.a112674, indexed in Pubmed: 425958.
11. World Health Organization. MONICA Psychosocial Optional Study Manual: Suggested Measurement Instruments Copenhagen: WHO Regional Office for Europe, 1989.
12. Information of deaths in Poland in 2020 [article in Polish]. Ministry of Health 2021. www.gov.pl/web/zdrowie/raport-o-zgonach-w polsce-w 2020-r (accessed: September 20, 2023).
13. Wojtyniak B, Goryński P. Health situation of the Polish population and its determinants. National Institute of Public Health [text in Polish]. Warszawa, 2020.
14. Kornej J, Ko D, Lin H, et al. The association between social network index, atrial fibrillation, and mortality in the Framingham Heart Study. Sci Rep. 2022; 12(1): 3958, doi: 10.1038/s41598-022-07850-9, indexed in Pubmed: 35273243.
15. Valtorta NK, Kanaan M, Gilbody S, et al. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. Heart. 2016; 102(13): 1009–1016, doi: 10.1136/heartjnl-2015-308790, indexed in Pubmed: 27091846.
16. Freak-Poli R, Ryan J, Neumann JT, et al. Social isolation, social support and loneliness as predictors of cardiovascular disease incidence and mortality. BMC Geriatr. 2021; 21(1): 711, doi: 10.1186/s12877-021-02602-2, indexed in Pubmed: 34922471.
17. Riahi SM, Yousefi A, Saeedi F, et al. Associations of emotional social support, depressive symptoms, chronic stress, and anxiety with hard cardiovascular disease events in the United States: the multi-ethnic study of atherosclerosis (MESA). BMC Cardiovasc Disord. 2023; 23(1): 236, doi: 10.1186/s12872-023-03195-x, indexed in Pubmed: 37142978.
18. Berkman LF. The role of social relations in health promotion. Psychosom Med. 1995; 57(3): 245–254, doi: 10.1097/00006842-199505000-00006, indexed in Pubmed: 7652125.
19. Wood DA. EUROACTION: A European Society of Cardiology demonstration project in preventive cardiology: A cluster randomised controlled trial of a multi-disciplinary preventive cardiology programme for coronary patients, asymptomatic high risk individuals and their families. Summary of design, methodology and outcomes. Eur Heart J. 2004; 6(Suppl J): J3–J15, doi: 10.1093/eurheartj/6.suppl_j.j3.
20. Kozela M, Doryńska A, Bobak M, et al. Accumulation of psychosocial risk factors and incidence of cardiovascular disease: a prospective observation of the Polish HAPIEE cohort. Kardiol Pol. 2019; 77(5): 535–540, doi: 10.33963/KP.14814, indexed in Pubmed: 31066730.
21. Orth-Gomér K, Wamala SP, Horsten M, et al. Marital stress worsens prognosis in women with coronary heart disease: The Stockholm Female Coronary Risk Study. JAMA. 2000; 284(23): 3008–3014, doi: 10.1001/jama.284.23.3008, indexed in Pubmed: 11122587.
22. Taylor SE, Klein LC, Lewis BP, et al. Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. Psychol Rev. 2000; 107(3): 411–429, doi: 10.1037/0033-295x.107.3.411, indexed in Pubmed: 10941275.
23. Larsen BA. Psychological mechanisms of gender differences in social support use under stress. US San Diego Electronic Theses and Dissertations. https://escholarship.org/uc/item/1p66v767 (accessed: September 8, 2023).
24. von dem Knesebeck O, Geyer S. Emotional support, education and self-rated health in 22 European countries. BMC Public Health. 2007; 7: 272, doi: 10.1186/1471-2458-7-272, indexed in Pubmed: 17908313.
25. Shahin W, Kennedy GA, Stupans I. The association between social support and medication adherence in patients with hypertension: A systematic review. Pharm Pract (Granada). 2021; 19(2): 2300, doi: 10.18549/PharmPract.2021.2.2300, indexed in Pubmed: 34221197.
26. Luna E, Ruiz M, Malyutina S, et al. The prospective association between frequency of contact with friends and relatives and quality of life in older adults from Central and Eastern Europe. Soc Psychiatry Psychiatr Epidemiol. 2020; 55(8): 1001–1010, doi: 10.1007/s00127-020-01834-8, indexed in Pubmed: 32040668.
27. Thomas PA, Liu H, Umberson D. Family relationships and well-being. Innov Aging. 2017; 1(3): igx025, doi: 10.1093/geroni/igx025, indexed in Pubmed: 29795792.
28. Piwoński J, Piwońska A, Sygnowska E. Is level of social support associated with health behaviours modifying cardiovascular risk? Results of the WOBASZ study. Kardiol Pol. 2012; 70(8): 803–809, indexed in Pubmed: 22933212.
29. Pająk A, Jankowski P, Zdrojewski T. The burden of cardiovascular disease risk factors: A current problem. Kardiol Pol. 2022; 80(1): 5–15, doi: 10.33963/KP.a2022.0018, indexed in Pubmed: 35137945.