

Association between cardiovascular diseases and depressive symptoms in adults. A pooled analysis of population-based surveys: WOBASZ, NATPOL 2011, and WOBASZ II

Jerzy Piwoński^{1*}, Aleksandra M. Piwońska^{1*}, Tomasz Zdrojewski², Alicja Cicha-Mikołajczyk¹, Marcin Rutkowski², Piotr Bandosz², Jakub Stokwiszewski³, Andrzej Pająk⁴, Andrzej Tykarski⁵, Krystyna Kozakiewicz⁶, Wojciech Bielecki⁷, Wojciech Drygas^{1,7}

¹ Department of Epidemiology, Cardiovascular Diseases Prevention, and Health Promotion, National Institute of Cardiology, Warsaw, Poland

² Department of Preventive Medicine and Education, Medical University of Gdansk, Gdańsk, Poland

³ National Institute of Public Health – National Institute of Hygiene, Warsaw, Poland

⁴ Department of Epidemiology and Population Studies, Institute of Public Health, Jagiellonian University Medical College, Kraków, 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

⁷ Department of Social and Preventive Medicine, Medical University of Lodz, Łódź, Poland

KEY WORDS

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see p. 497

Correspondence to:
Aleksandra M. Piwońska,
MD, PhD, Department of Epidemiology,
Cardiovascular Diseases
Prevention and Health Promotion,
National Institute of Cardiology,
ul. Alpejska 42, 04-628 Warszawa,
Poland; phone: +48 22 812 55 86;
email: apiwonska@ikard.pl
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* JP and AMP contributed equally to this work.

ABSTRACT

INTRODUCTION Psychosocial risk factors play an important role in the origins of cardiovascular risk.

OBJECTIVES The aim of the study was to evaluate the prevalence of depressive symptoms (DSs) in relation to some sociodemographic characteristics and selected cardiovascular diseases (CVDs) and to assess the relationship between self-reported CVDs and the severity of DSs.

PATIENTS AND METHODS Three cross-sectional population-based surveys: WOBASZ (2003–2005), NATPOL 2011 (2011), and WOBASZ II (2013–2014) covered a total sample of 20 514 participants (9614 men and 10 900 women), aged 20 to 74 years, who all completed the Beck Depression Inventory.

RESULTS One-fifth of men and one-third of women had DSs. The prevalence of DSs increased with age, was higher in unmarried persons and in individuals with a medical history of CVDs, and decreased with increasing education level. Individuals with DSs, both men and women, even those with borderline depression, had from 1.5- to more than 2-fold higher odds of either coronary artery disease or arrhythmia, and 2- to almost 4-fold higher chance of previous stroke in their medical history.

CONCLUSIONS This study showed that DSs were a frequently observed condition in the general Polish population including patients with CVDs. We also demonstrated that there is a relationship between self-reported CVDs and severity of DSs regardless of age, marital status, education, and concomitant disorders.

INTRODUCTION There are more than 41 million annual deaths associated with noncommunicable diseases all over the world, which poses an important challenge for global health.¹ The leading cause of mortality in developed countries is coronary artery disease (CAD). Age-adjusted CAD mortality has declined since the 1980s, particularly in high-income regions.² In Poland, cardiovascular diseases (CVDs) are the major cause of

mortality below 65 years of age and a primary health, social, and economic problem. The number of CVD deaths have decreased in Poland since 1991, but it is still one of the highest in Europe, and according to Statistics Poland, in 2017, CVDs were responsible for 41.5% and CAD for 11.1% of all deaths.³ Depression is probably one of the most prevalent health problems in primary care,⁴ the most common mental health condition

WHAT'S NEW?

Psychosocial factors are considered to be risk factors for cardiovascular diseases and the association between depression and these disorders is of constant great interest to researchers around the world. Our study is within this scope. A combined data set of 3 large cross-sectional studies: WOBASZ, NATPOL 2011, and WOBASZ II, which aimed to examine 3 independent samples of the Polish adult population (more than 20 000 participants) providing very reliable results. To our best knowledge, this is the first analysis of psychosocial risk factors in such a large population in Poland. We demonstrated an association between cardiovascular disease and severity of depressive symptoms (DSs) regardless of age, marital status, education, and concomitant disorders. Furthermore, DSs were a frequently observed condition in Polish adults, thus, we would like to emphasize the necessity of screening patients with chronic diseases toward DSs.

in psychiatry and the most underdiagnosed condition in clinical practice. In general, mental disorders increase the risk for communicable and noncommunicable diseases and contribute to unintentional and intentional injury.⁵ Conversely, many health conditions increase the risk for mental disorders and comorbidity complicates help-seeking, diagnosis, and treatment and affects prognosis, and thus are a challenge for public health.⁵ Depression can impair the ability to function and is ranked by the World Health Organization (WHO) as the single largest contributor to global disability and to suicide death.⁶ According to the WHO Regional Office for Europe, each year, about 25% of the population suffers from depression or anxiety, about 50% of major depressions are untreated, and up to 50% of chronic sick leave is due to depression/anxiety. The cost of mood disorders and anxiety in the European Union (EU) is about 170 billion EUR per year.⁷ The results of the GBD (Global Burden of Disease) study, analyzing more than 350 causes of disease and injuries from EU countries, demonstrated that in 2017, depressive disorders took a very high ninth place in age-standardized rates of disability-adjusted life-years.⁸

The pathogenesis of atherosclerosis that leads to CVDs is multifactorial and with the exception of conventional risk factors like hypertension, dyslipidemia, and tobacco smoking, psychosocial risk factors (mainly depression, chronic stress, low social support) are an important component of cardiovascular risk.⁹ The results of a meta-analysis of 30 prospective cohort studies (893 850 participants) suggest that depression is independently associated with an increased risk of CAD and myocardial infarction (MI) with pooled risk ratio of 1.3 for both.¹⁰ Psychosocial risk factors not only enhanced the risk of the first coronary event but also worsened the outcome and compliance to drug therapy and to lifestyle modification.¹¹ Furthermore, there is evidence from a large prospective HAP-IEE (Health, Alcohol and Psychosocial Factors in Eastern Europe) study, carried out in Poland,

Czech Republic, and Russia, that depression is a strong predictor of CVDs and all-cause mortality in the population of Eastern Europe (comparable to the classic CVD risk factors).¹² The European Guidelines (2016) recommended, in addition to behavioral intervention and health education, psychosocial therapy in order to improve psychosocial health, quality of life, classical risk factors, and illness prognosis in patients with established CVDs and psychological symptoms (class of recommendation, I; level of evidence, A).¹³

The objective of our study was to evaluate the prevalence of depressive symptoms (DSs) in relation to some sociodemographic characteristics and selected self-reported CVDs in a random sample of the adult Polish population and to study the association between CVDs and the severity of DSs.

PATIENTS AND METHODS Data were obtained from 3 cross-sectional surveys: 2 multi-center studies, the WOBASZ and WOBASZ II (National Population Health Examination Surveys) and the NATPOL 2011 (2011 National Polish Study to Evaluate the Prevalence of Cardiovascular Disease Risk Factors). In the first study, the WOBASZ (2003–2005), 6392 men and 7153 women aged 20 to 74 years were screened, and in the second one, the WOBASZ II (2013–2014), included 2751 men and 3418 women aged 20 or older. Sample drawing, using an electronic register database of national individual personal identity numbers (PESEL), had 3 stages and was stratified according to administrative units (voivodeships), type of urbanization (commune), and gender. For each province, 2 small, 2 medium, and 2 large communes were selected. The WOBASZ II covered the same communes as those participating in the WOBASZ study; however, the sample of individuals drawn in each commune was independent. The aims and methods of the WOBASZ and WOBASZ II were described previously.^{14,15} The examination was conducted by trained nurses or interviewers and the total participation rate was 76.9% for the WOBASZ and 45.5% for the WOBASZ II.

The NATPOL 2011 study examined 2413 persons aged 18 to 79, randomly selected in territorial bundles including 11 subjects on average, with stratification according to the place of residence, age, and gender. Sampling was made, as in the WOBASZ studies, using PESEL register database. Respondents were examined by trained nurses and the response rate was 66.5%. A detailed description of the NATPOL 2011 was published previously.¹⁶

The present analysis involved a total sample of 20 514 participants (9614 men and 10 900 women), aged between 20 and 74 years. Alongside the main questionnaire, all of the respondents filled in a psychological questionnaire and signed a written informed consent form prior to data collection. The studies were accepted by the Field Bioethics Committee.

For the purpose of the present analyses, we identified subjects with DSs, CAD, hypertension, arrhythmia, stroke, and diabetes. Individuals with CAD were defined based on a self-reported medical history of hospitalization due to acute coronary syndrome including MI, percutaneous coronary intervention, coronary artery bypass grafting, a history of MI, or a diagnosis of CAD without hospitalization. Patients with arrhythmia were identified based on a self-reported medical history of arrhythmia or hospitalization due to arrhythmia (in the NATPOL 2011, only information on atrial fibrillation was available, so the prevalence of arrhythmia in this survey was underestimated). Hypertensive persons were defined as those with arterial blood pressure of 140/90 mm Hg or greater (mean taken from the second and third blood pressure measurement made during the survey) or the use of an antihypertensive drug. Those with a medical history of diabetes or with fasting blood glucose level of 7 mmol/l or greater or on hypoglycemic treatment were considered diabetic. We also included concomitant diseases as a variable and defined them as a self-reported presence of at least 1 of following diseases: hypertension, CAD, arrhythmia, stroke, diabetes.

To evaluate the presence and severity of DSs, the 1961 version of the Beck Depression Inventory (BDI) was used.¹⁷ The BDI is a patient-rated scale with 21 items, scored by the respondent from 0 to 3, depending on symptom severity. The BDI focuses on cognitive rather than somatic symptoms of depression. It assesses mood, pessimism, sense of failure, lack of satisfaction, feelings of guilt, expectations of punishment, self-dislike, desire to die, crying, irritability, social withdrawal, body image, problems at work, sleeplessness, fatigue, loss of appetite, body weight reduction, and somatic complaints. The presence of DSs was defined as a BDI score of at least 10.¹⁸ According to the original descriptors, we divided Beck scores into following grades of depression: scores from 0 to 9 indicated no or minimal depression; 10 to 14, borderline depression; 15 to 20, mild depression; 21 to 63, moderate/severe depression.

Statistical analysis Statistical analyses were performed using the Statistical Analytical Software, version 9.4 (SAS, Cary, North Carolina, United States). For all analyses we assumed a significance level of 0.05 and performed them separately for men and women. Categorical variables were presented as frequencies with 95% CI (GLM procedure). Frequencies between groups were compared using the least squares method. To analyze the relation between selected CVDs (dependent variable) and DSs independent of age, marital status, education, and concomitant diseases, multivariable logistic regression analysis was used. A generalized linear model with random effects of survey (GENMOD procedure) was applied to conduct logistic regression analyses due to the pooled analysis of data from 3 different surveys.

RESULTS The characteristics of the included studies are presented in [TABLES 1](#) and [2](#). Among persons who participated in the psychological part of combined WOBASZ, NATPOL 2011, and WOBASZ II surveys, 46.9% were men, about 70% of both men and women were older than 35 years of age, and the majority of them had at least secondary education and were married. With the exception of arrhythmia, men when compared with women, significantly more often had CAD, hypertension, and diabetes regardless of age. We found significant differences between the studies when analyzing them separately for sociodemographic and health status characteristics (except for the prevalence of hypertension and stroke in women and the rates of secondary educated women). Additionally, about one-fifth of men and one-third of women had DSs ([TABLES 1](#) and [2](#)), but more than 80% of them had borderline or mild depression (BDI score, 10–20). The observed prevalence of DSs in the WOBASZ II was lower compared with WOBASZ and NATPOL 2011 ([TABLES 1](#) and [2](#)). The rates of DSs increased with age of participants, decreased with higher education levels and were higher in unmarried persons ([TABLE 3](#)).

After analyzing the prevalence of DSs in persons with and without medical history of self-reported CVDs or diabetes, we found higher rates of DSs in individuals with a medical history of each of the analyzed conditions, regardless of age. It was especially visible in individuals with CAD and with previous stroke ([TABLE 4](#)).

In the analysis of the association between particular selected CVDs (CAD, arrhythmia, and stroke as dependent variables) and the severity of DSs, we observed higher odds of having each of analyzed CVDs when DSs were present. This was a dose-response relationship because the chance of CVDs raised with severity of DSs. Individuals with DSs, both men and women, even those with borderline depression, had also from 1.5- to more than 2-fold higher odds of either CAD or arrhythmia, and from more than 2- to almost 4-fold higher odds of stroke ([TABLES 5](#) and [6](#)).

DISCUSSION The results of pooled data from cross-sectional, national-based surveys (WOBASZ, NATPOL 2011, and WOBASZ II) confirmed that in the Polish population, DSs were a frequently observed condition. Furthermore DSs were significantly associated with selected CVDs (CAD, arrhythmia, stroke). The odds of CVDs raised with the severity of DSs, starting from borderline depression (BDI score, 10–14).

Up until now, we published only data from the WOBASZ¹¹ and the NATPOL 2011,¹⁹ and the obtained results were inconsistent. Therefore, we pooled individual data from all population-based cross-sectional surveys made in the last 2 decades in Poland (WOBASZ, WOBASZ II, and NATPOL 2011) and analyzed again the association between DSs and CVDs.

The prevalence of mental diseases in the general population reaches up to 30% and even more

TABLE 1 Sociodemographic characteristics and health status of men who participated in the psychological part of national surveys

Characteristics	Combined (n = 9614)	WOBASZ (n = 6074)	NATPOL 2011 (n = 1011)	WOBASZ II (n = 2529)	P value (for difference between studies)
Age groups					
20–34 y	27.2 (26.3–28.1) ^a	27.6 (26.5–28.8)	29.4 (26.6–32.1)	25.5 (23.7–27.2)	0.03
35–54 y	42.6 (41.6–43.6) ^a	43.9 (42.6–45.1)	40.8 (37.7–43.8)	40.1 (38.2–42.1)	0.003
55–74 y	30.2 (29.3–31.1) ^a	28.5 (27.3–29.6)	29.9 (27–32.7)	34.4 (32.6–36.2)	<0.001
Education					
Primary	17.2 (16.5–18) ^b	21.3 (20.4–22.2) ^c	10.5 (8.2–12.7) ^c	10.3 (8.9–11.7) ^c	<0.001
Secondary/vocational	67.7 (66.8–68.7) ^b	66.7 (65.5–67.9) ^c	69.4 (66.5–72.2) ^c	69.6 (67.8–71.4) ^c	<0.001
Higher/incomplete higher	15 (14.3–15.8) ^b	12 (11.1–12.9) ^c	20.2 (18–22.3) ^c	20.1 (18.8–21.5)	<0.001
Marital status					
Single	21.9 (21.2–22.5) ^b	20.7 (19.8–21.6) ^c	22.5 (20.3–24.6) ^c	24.4 (23–25.8) ^c	<0.001
Married/cohabiting	72.3 (71.4–73.2) ^b	74.1 (73.1–75.2) ^c	70.7 (68.2–73.3) ^c	68.5 (66.9–70.1) ^c	<0.001
Divorced/separation	3.6 (3.2–4) ^b	3 (2.5–3.4) ^c	4.3 (3.2–5.5) ^c	4.9 (4.2–5.6) ^c	<0.001
Widowed	2.2 (1.8–2.7) ^b	2.2 (1.9–2.6) ^c	2.5 (1.6–3.4) ^c	2.2 (1.6–2.7) ^c	<0.001
Health status					
Coronary artery disease	10.1 (9.5–10.6) ^b	11.2 (10.5–11.9) ^c	7 (5.3–8.8) ^c	8.7 (7.6–9.8) ^c	<0.001
Hypertension	43.2 (42.3–44.1) ^b	41.1 (39.9–42.2) ^c	48.1 (45.3–51.9) ^c	46.5 (44.7–48.3) ^c	<0.001
Stroke	1.8 (1.6–2) ^b	1.6 (1.2–1.9) ^c	2.6 (1.8–3.4) ^c	2 (1.5–2.5) ^c	0.054
Arrhythmia	8.5 (7.9–9.1) ^b	9.6 (8.9–10.3) ^c	5.1 (3.4–6.8) ^c	7.2 (6.2–8.3) ^c	<0.001
Diabetes	8.5 (7.9–9) ^b	7.6 (6.9–8.3) ^c	8 (6.4–9.7) ^c	10.7 (9.6–11.8) ^c	<0.001
Depressive symptoms	22.3 (21.4–23.2) ^b	24.2 (23.2–25.2) ^c	24.2 (21.6–26.7) ^c	17.3 (15.7–18.9) ^c	<0.001
Borderline	13.6 (12.9–14.4) ^b	14.8 (14–15.7) ^c	12.8 (10.7–14.9) ^c	11.3 (10–12.6) ^c	<0.001
Mild	6 (5.4–6.5) ^b	6.5 (5.9–7.1) ^c	7.4 (6–8.9) ^c	4.2 (3.3–5.2) ^c	<0.001
Moderate/severe	2.7 (2.3–3.1) ^b	2.9 (2.5–3.3) ^c	3.9 (2.9–4.9) ^c	1.8 (1.1–2.4) ^c	<0.001

Data are presented as frequencies with 95% CIs.

a Adjusted for survey

b Adjusted for age and survey

c Adjusted for age

among individuals with chronic disorders.²⁰ In Poland, after a stable situation between 2003 and 2011, when DSs were present on average in 24.2% of men and 34.3% of women in 2003 to 2005,¹¹ and 24.2% and 35.2%, respectively in 2011,¹⁹ we observed a decline in the prevalence of DSs to 17.3% of men and 23.4% of women in 2013 to 2015. In the European Healthcare Panel, a study performed in the years 2007 to 2008 in a population of 240 005 individuals aged 18 to 69 years from 5 countries (the United Kingdom, the Netherlands, Germany, France, and Italy), the rate of self-reported history of depression ranged from 31% in the Netherlands to 46% in France.²¹

Depression is 2- to 3-fold less likely in people without a chronic disease^{20,22} compared to those with such diseases, like diabetes²³ or CAD.²⁴ It is considered to be a risk factor for CVDs, independent of classic risk factors. One study suggesting an independent role of psychosocial factors in cardiovascular risk origination is the meta-analysis by Rugulies,²⁵ who concluded that depression predicted coronary heart disease in initially healthy persons (risk ratio, 1.64; 95% CI, 1.29–2.09; $P < 0.001$) and that the relation

between depression and coronary heart disease was a dose-response relationship because the effect of clinical depression was much stronger than the effect of a depressive mood. In our study, we also observed a dose-response association between DSs and selected CVDs (CAD, arrhythmia, stroke) because the chance that a person with DSs also had a particular CVD raised with greater severity of DSs (higher BDI score).

Up to 40% of individuals who had a major cardiac event have had major depression.²⁶ In the population-based cohort of the PURE (Prospective Urban Rural Epidemiology) study conducted in 21 countries (including Poland) on 5 continents, it was found that DSs in persons aged 35 to 70 years were associated with an increased risk of CVDs and mortality, especially in urban areas.²⁷ The recurrent CAD or mortality from CAD in persons after an originally nonfatal MI could possibly be due to being less motivated and less adherent to cardiac rehabilitation programs, lifestyle modifications, and less likely to reduce CVD risk factors.⁵ We also demonstrated in our previous study that DSs adversely affect lifestyle. Especially lack of physical activity, tobacco smoking, and regular

TABLE 2 Sociodemographic characteristics and health status of women who participated in the psychological part of national surveys

Characteristics	Combined (n = 10 900)	WOBASZ (n = 6795)	NATPOL 2011 (n = 1053)	WOBASZ II (n = 3052)	P value (for difference between studies)
Age groups					
20–34 y	27.8 (27–28.7) ^a	29.1 (28–30.2)	31.7 (29–34.4)	23.5 (21.9–25.1)	<0.001
35–54 y	41.6 (40.6–42.5) ^a	43.1 (41.9–44.3)	33.5 (30.6–36.5)	40.9 (39.2–42.7)	<0.001
55–74 y	30.6 (29.7–31.5) ^a	27.8 (26.7–28.9)	34.8 (32–37.5)	35.6 (34–37.2)	<0.001
Education					
Primary	19.8 (19.1–20.5) ^b	25.1 (24.2–25.9) ^c	9.8 (7.6–12) ^c	11.4 (10.1–12.7) ^c	<0.001
Secondary/vocational	59.6 (58.7–60.5) ^b	60 (58.9–61.2) ^c	57.7 (54.7–60.6) ^c	59.4 (57.6–61.1) ^c	0.33
Higher/incomplete higher	20.6 (19.9–21.3) ^b	14.9 (14–15.8) ^c	32.5 (30.1–34.8) ^c	29.2 (27.8–30.6) ^c	<0.001
Marital status					
Single	15.2 (14.6–15.8) ^b	13.7 (12.9–14.4) ^c	22.5 (20.6–24.5) ^c	16.1 (15–17.3) ^c	<0.001
Married/cohabiting	68 (67.2–68.9) ^b	70.3 (69.2–71.4) ^c	54.5 (51.7–57.3) ^c	67.8 (66.1–69.4) ^c	<0.001
Divorced/separation	5.7 (5.3–6.1) ^b	4.5 (4–5.1) ^c	9.5 (8.1–10.9) ^c	7.1 (6.3–8) ^c	<0.001
Widowed	11 (10.6–11.5) ^b	11.6 (10.9–12.2) ^c	13.4 (11.7–15.2) ^c	8.9 (7.9–10) ^c	<0.001
Health status					
Coronary artery disease	8.5 (8–9) ^b	10.4 (9.8–11.1) ^c	6.4 (4.9–8) ^c	4.9 (4–5.9) ^c	<0.001
Hypertension	34.1 (33.3–35) ^b	33.6 (32.6–34.5) ^c	36.2 (33.7–38.6) ^c	34.7 (33.3–36.2) ^c	0.1
Stroke	1 (0.8–1.2) ^b	0.9 (0.7–1.2) ^c	1.5 (0.9–2.1) ^c	0.9 (0.6–1.3) ^c	0.18
Arrhythmia	11.2 (10.6–11.7) ^b	12.8 (12.1–13.6) ^c	5.6 (3.7–7.4) ^c	9.4 (8.3–10.5) ^c	<0.001
Diabetes	6.9 (6.4–7.4) ^b	6.6 (6–7.2) ^c	6.7 (5.2–8.2) ^c	7.7 (6.8–8.6) ^c	0.1
Depressive symptoms	31.4 (30.6–32.2) ^b	34.3 (33.2–35.3) ^c	35.2 (32.5–38) ^c	23.4 (21.8–25) ^c	<0.001
Borderline	17.5 (16.8–18.2) ^b	19 (18.1–19.9) ^c	16.9 (14.6–19.1) ^c	14.3 (13–15.6) ^c	<0.001
Mild	9.2 (8.7–9.7) ^b	10.2 (9.5–10.9) ^c	10.9 (9.1–12.6) ^c	6.2 (5.1–7.2) ^c	<0.001
Moderate/severe	4.7 (4.4–5.1) ^b	5.1 (4.6–5.6) ^c	7.5 (6.2–8.8) ^c	2.9 (2.2–3.6) ^c	<0.001

Data are presented as frequencies with 95% CIs.

a Adjusted for survey

b Adjusted for age and survey

c Adjusted for age

alcohol consumption (only in women) were associated with DSs regardless of differences in sociodemographic characteristics or the risk factor profile.¹¹ Thus, patients with depression require particular care for both adequate treatment of their affective disorder and reduction of their cardiac risk.²⁸ Therefore, screening towards DSs among those with chronic diseases, especially diseases leading to major disability like stroke, CAD, heart failure, or chronic obstructive pulmonary disease is of great importance. In older depressed persons, such collaborative care with support towards a healthier lifestyle leads to a reduction of mortality by 25%²⁹ and reduces metabolic risk.³⁰ Furthermore, psychosocial risk factors are often cumulated in the same person, which additionally affects CVDs or other diseases.³¹ Indeed, cumulative exposure to low education, material deprivation, depression, and low perceived control was associated with an increased risk of CVDs in a 10-year observation of the population-based Polish cohort.³²

Among the mechanisms leading to an increase of cardiovascular risk, we can mention activation of the sympathetic nervous system and hypothalamic-pituitary-adrenal axis, endothelial

dysfunction,^{33,34} platelet activation, and production of proinflammatory cytokines.³⁵ People with depression experience mental stress, which among other factors may activate cardiac sympathetic nerves, resulting in an increased heart rate, ventricular arrhythmia,³⁶ MI,³⁷ and sudden death. In our study, arrhythmia in medical history was significantly related to DSs with odds ratio (OR) from about 1.5 to even 2.5 depending on the severity of symptoms.

There is no doubt that patients after stroke are at increased risk of depression.³⁸ Stroke survivors have a greatly elevated risk for clinically significant DSs even 2 or more years after stroke, independent of functional disability, cerebrovascular risk factors, and previous DSs.³⁹ Approximately one-third of them develop poststroke depression and its frequency is higher in the first year after stroke.⁴⁰ A 2014 meta-analysis of 61 studies (n = 25 488) revealed depression in 33% of patients one year after stroke with a decline to 23% at 5 years.⁴¹ In our study, the prevalence of DSs in individuals reporting stroke in their medical history was 45.6% of men and 51.3% of women and we found significant association between DSs and stroke (eg, for borderline depression, OR of

TABLE 3 Rates of depressive symptoms in relation to the sociodemographic status and gender

Sociodemographic status	Depressive symptoms	
	Men (n = 2153)	Women (n = 3413)
Age groups^a		
20–34 y	11.4 (9.8–12.9)	19 (17.4–20.6)
35–54 y	21.9 (20.7–23.2)	30.2 (28.9–31.5)
55–74 y	33 (31.5–34.5)	44 (42.5–45.5)
<i>P</i> value	<0.001	<0.001
Education^b		
Primary	29.2 (27.2–31.3)	40.2 (38.2–42.3)
Secondary/vocational	21.9 (20.9–22.9)	30.6 (29.5–31.7)
Higher/incomplete higher	16.6 (14.5–18.8)	24.9 (23–26.8)
<i>P</i> value	<0.001	<0.001
Marital status^b		
Married/cohabiting	20.3 (19.3–21.3)	28.9 (28–30)
Single	28.1 (26.1–30.1)	34.3 (31.9–36.7)
Divorced/separation	29 (24.7–33.2)	38.2 (34.6–41.7)
Widowed	23.4 (17.8–28.9)	39.6 (35.8–41.3)
<i>P</i> value	<0.001	<0.001

Data are presented as frequencies with 95% CIs.

a Adjusted for survey

b Adjusted for age and survey

TABLE 4 Mean rates^a of depressive symptoms in subjects with and without selected diseases

Self-reported selected diseases	Presence of depressive symptoms					
	Men (n = 9614)			Women (n = 10 900)		
	Yes	No	<i>P</i> value	Yes	No	<i>P</i> value
Hypertension	24.7 (23.4–26) n = 4137	20.7 (19.6–21.8)	<0.001	34.3 (32.7–35.9) n = 3705	29.8 (28.7–30.9)	<0.001
Coronary artery disease	35.8 (33.1–38.5) n = 965	20.9 (20–21.7)	<0.001	46.7 (43.6–49.7) n = 922	29.8 (28.9–30.7)	<0.001
Arrhythmia	33 (30.1–35.8) n = 814	21.4 (20.5–22.2)	<0.001	45.3 (42.8–47.9) n = 1209	29.5 (28.6–30.3)	<0.001
Stroke	45.6 (39.4–51.7) n = 171	22 (21.2–22.8)	<0.001	51.3 (42.7–59.8) n = 107	31 (30.1–31.8)	<0.001
Diabetes	32.2 (29.3–35.1) n = 783	21.5 (20.7–22.4)	<0.001	42.5 (39.1–45.9) n = 727	30.4 (29.6–31.3)	<0.001
Concomitant diseases ^b	25.7 (24.4–26.9) n = 4785	19.2 (17.9–20.4)	<0.001	35.8 (34.4–37.3) n = 4530	28.1 (26.9–29.3)	<0.001

Data are presented as frequencies with 95% CIs.

a Adjusted for age and survey

b Self-reported medical history of at least one of following diseases: arrhythmia, coronary artery disease, diabetes, hypertension, or stroke.

2.36 and 2.01, respectively for men and women). Results of the case-control INTERSTROKE study (made between 2007 and 2010) showed that depression is associated with an increased risk of first stroke with OR of 1.35 (95% CI, 1.1–1.68).⁴² The effective treatment of depression would improve not only patient symptoms but may also decrease stroke risk, influence functional recovery, decrease mortality, and reduce poststroke health-care utilization.⁴³

Gender, age, education, and marital status have been shown to be associated with depression. Our results also confirm this relationship. Beyond biological losses, older persons experience changes in their social position, losses of family, friends, and cognitive capacity resulting in a higher prevalence of DSs in older individuals compared with younger ones.⁴⁴ A simple association between increasing DSs and age is not always apparent. Data from 18 high- and low- to

TABLE 5 Cardiovascular diseases in relation to severity of depressive symptoms

Variables		Men (n = 9614)					
		Coronary artery disease (n = 965)		Arrhythmia (n = 814)		Stroke (n = 171)	
		OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Depressive symptoms	No depression	1	–	1	–	1	–
	Borderline	1.66 (1.51–1.82)	<0.001	1.48 (1.44–1.53)	<0.001	2.36 (1.86–3)	<0.001
	Mild	2 (1.95–2.05)	<0.001	1.95 (1.71–2.21)	<0.001	2.77 (2.27–3.39)	<0.001
	Moderate/severe	2.21 (2.02–2.42)	<0.001	2.24 (1.97–2.54)	<0.001	3.78 (3.1–4.61)	<0.001
Age, y		1.07 (1.06–1.09)	<0.001	1.04 (1.03–1.05)	<0.001	1.08 (1.06–1.1)	<0.001
Education	Higher/incomplete higher	1	–	1	–	1	–
	Secondary/vocational	1 (0.91–1.11)	0.95	1 (0.94–1.07)	0.91	1.62 (1.44–1.83)	<0.001
	Primary	0.9 (0.8–1)	0.06	0.74 (0.61–0.89)	0.001	1.31 (1.08–1.59)	0.005
Marital status	Married	1	–	1	–	1	–
	Unmarried	0.85 (0.73–0.98)	0.03	0.93 (0.72–1.21)	0.6	1.04 (0.99–1.1)	0.11
Concomitant diseases ^a		2.6 (2.43–2.79)	<0.001	2.68 (2.43–2.96)	<0.001	2.89 (2.23–3.75)	<0.001
Survey	WOBASZ	1	–	1	–	1	–
	NATPOL 2011	0.45 (0.48–0.5)	<0.001	0.44 (0.44–0.45)	<0.001	1.65 (1.59–1.7)	<0.001
	WOBASZ II	0.57 (0.56–0.58)	<0.001	0.71 (0.7–0.73)	<0.001	1.38 (1.35–1.41)	<0.001

a At least one of following diseases: for coronary artery disease—arrhythmia, diabetes, hypertension, or stroke; for arrhythmia—coronary artery disease, diabetes, hypertension, or stroke; for stroke—coronary artery disease, diabetes, hypertension, or arrhythmia

Abbreviations: OR, odds ratio

TABLE 6 Cardiovascular diseases in relation to severity of depressive symptoms

Variables		Women (n = 10 900)					
		Coronary artery disease (n = 922)		Arrhythmia (n = 1209)		Stroke (n = 107)	
		OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Depressive symptoms	No depression	1	–	1	–	1	–
	Borderline	1.52 (1.49–1.55)	<0.001	1.7 (1.44–2)	<0.001	2.01 (1.84–2)	<0.001
	Mild	1.83 (1.53–2.19)	<0.001	2.41 (2.11–2.75)	<0.001	2.78 (1.52–5.08)	<0.001
	Moderate/severe	2.28 (1.99–2.61)	<0.001	2.71 (2.04–3.58)	<0.001	1.94 (1.01–3.72)	0.047
Age, y		1.07 (1.06–1.09)	<0.001	1.04 (1.03–1.04)	<0.001	1.07 (1.05–1.09)	<0.001
Education	Higher/incomplete higher	1	–	1	–	1	–
	Secondary/vocational	1.33 (1.12–1.57)	0.001	0.79 (0.72–0.86)	<0.001	0.77 (0.41–1.44)	0.42
	primary	1.36 (1.12–1.65)	0.002	0.58 (0.55–0.62)	<0.001	1.01 (0.66–1.54)	0.96
Marital status	Married	1	–	1	–	1	–
	Unmarried	0.84 (0.78–0.9)	<0.001	0.84 (0.74–0.96)	0.008	0.77 (0.52–1.15)	0.2
Concomitant diseases ^a		2.86 (2.54–3.22)	<0.001	2.12 (1.62–2.77)	<0.001	5.46 (2.6–11.5)	<0.001
Survey	WOBASZ	1	–	1	–	1	–
	NATPOL 2011	0.54 (0.52–0.56)	<0.001	0.33 (0.32–0.33)	<0.001	1.78 (1.69–1.87)	<0.001
	WOBASZ II	0.47 (0.46–0.48)	<0.001	0.74 (0.73–0.75)	<0.001	1.2 (1.15–1.24)	<0.001

a At least one of following diseases: for coronary artery disease—arrhythmia, diabetes, hypertension, or stroke; for arrhythmia—coronary artery disease, diabetes, hypertension, or stroke; for stroke—coronary artery disease, diabetes, hypertension, or arrhythmia

Abbreviations: see [TABLE 5](#)

middle-income countries in the World Mental Health Survey Initiative showed that in high-income countries, younger age was associated with higher 12-month prevalence of a major depressive episode; by contrast, in several low-to middle-income countries, older age was associated with a greater risk of a major depressive episode.⁴⁵

People who are separated, divorced, or widowed have higher rates of depression than those currently married.^{46,47} We obtained similar results because currently unmarried persons had about a 60% higher odds of DSs compared with married persons.

Education and income are considered to be factors affecting the prevalence and severity of

DSs.⁴⁸ Many studies confirm a higher risk of depression among those with lower level of education.⁴⁴ Lorant et al⁴⁹ examined the results of 56 studies (215 490 participants) investigating socioeconomic status and found higher odds of DSs (OR [95% CI], 1.81 [1.57–2.1]) in persons with lowest scores of socioeconomic status compared with those with highest scores. The increase in the prevalence of depression with a lower education level varies depending on the wealth of a studied population, for example, the risk of depression among low-educated individuals was 14-fold higher in low-income India compared with high-income Germany, the Netherlands, or New Zealand.⁴⁵

Limitations Because WOBASZ, NATPOL 2011, and WOBASZ II are epidemiological studies, clinical verification of a depression diagnosis was not possible. In addition, due to the fact that BDI includes questions on nonspecific symptoms seen not only in depression but also in somatic disorders, some authors have suggested that the diagnostic threshold for DSs should be higher than 10 points. However, a cutoff point of a BDI score of 10 proposed by Beck is widely used in most analyses. A major limitation in the interpretation of the results is the cross-sectional nature of the original studies which does not allow to analyze the cause and effect relationship between DSs and CVDs. Also because of the response rate slightly less than 50%, the WOBASZ II is not a representative survey, but it follows trends of lower response rates in European studies.

ARTICLE INFORMATION

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