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Psychosocial risk factors in relation to other cardiovascular risk factors in coronary heart disease: Results from the EUROASPIRE IV survey. A registry from the European Society of Cardiology

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Abstract

Background: Depression and anxiety are established psychosocial risk factors for coronary heart disease. Contemporary data on their prevalence and associations with other risk factors were evaluated as part of the EUROASPIRE IV survey.

Design: The design of this study was cross-sectional.

Methods: The study group consisted of 7589 patients from 24 European countries examined at a median of 1.4 years after hospitalisation due to coronary heart disease events. Depression and anxiety were assessed using the Hospital Anxiety and Depression Scale.

Results: Symptoms of anxiety (Hospital Anxiety and Depression Scale-Anxiety score $\geq$8) were seen in 26.3% of participants and were more prevalent in women (39.4%) vs men (22.1%). Of the patients, 22.4% (30.6% of women and 19.8% of men) had symptoms of depression (Hospital Anxiety and Depression Scale-Depression score $\geq$8). Nevertheless, antidepressants and anti-anxiety medications were prescribed to only 2.4% of patients at hospital discharge, and 2.7% and 5.0% of patients, respectively, continued to take them at interview. Both anxiety and depression were associated with female gender, lower educational level and more sedentary lifestyle. Anxiety was more prevalent in younger age groups and depression rates increased with advancing age. Depression was positively associated with current smoking, central obesity and self-reported diabetes. A number of positive lifestyle changes reduced the odds of anxiety and depression.

Conclusions: A substantial proportion of patients have anxiety and depression symptoms after coronary heart disease events but these conditions are undertreated. These disorders, especially depression, are associated with other risk factors, including educational level, sedentary lifestyle, smoking, unhealthy diet and reduced compliance with risk factor modification.

Keywords

Anxiety, cardiovascular risk, coronary artery disease, depression

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Introduction

Both depression and anxiety are acknowledged as psychosocial risk factors for coronary heart disease (CHD) along with low socio-economic status, lack of social support, stress at work and in family life, hostility and the type D personality. The European Society of Cardiology (ESC) has summarised the available knowledge on psychosocial risk factors, their role in CHD incidence and prognosis and their assessment in relevant sections of the European Guidelines on cardiovascular disease prevention in clinical practice (version 2012).[1] The Cardiac Rehabilitation Section of the European Association for Cardiovascular Prevention and Rehabilitation (EACPR), has subsequently issued a position paper with a comprehensive review of psychosocial aspects in cardiac rehabilitation.[2]

Data on associations of anxiety and depression with CHD incidence, outcomes and survival stem from large-scale high quality epidemiological, prospective studies and meta-analyses. The INTERHEART case-control study,[3] performed in 52 countries throughout Africa, Asia, Australia, Europe, the Middle East and northern and southern America, is one example of seminal studies in this area. The study reported that perceived stress and depression accounted for approximately 30% of the attributable risk of acute myocardial infarction (MI). Several systematic reviews and meta-analyses identified clinical depression or depressive symptoms as predictors of incident CHD.[4–7] Evidence of a relationship between anxiety and incident CHD is less conclusive,[8] but a meta-analysis confirmed that anxiety is an independent risk factor for CHD occurrence.[9]

In CHD patients both anxiety and depression are associated with increased rates of cardiovascular disease (CVD) events and all-cause mortality.[10–12] Coronary patients with either symptoms of anxiety or depression have a 2.2-fold increased mortality risk.[13] Mechanisms that link psychosocial factors and CHD outcomes include unhealthy lifestyle (more frequent smoking, unhealthy food choices and less physical activity), low adherence to lifestyle modification (for instance, to smoking cessation) and cardioprotective drug therapy, and lower rates of participation in cardiac rehabilitation.[14–19] There is also some evidence regarding the role of alterations in autonomic function, dysfunction of the hypothalamic–pituitary axis and of other endocrine markers, altered haemostatic and inflammatory processes, endothelial function and myocardial perfusion.[20–25] In addition, the role of adverse effects of tricyclic antidepressants cannot be excluded.[26]

One should consider not only the mere presence or absence of depression or anxiety but also the time course of symptoms.[27] There is some evidence that a history of depression without current depression is not associated with adverse outcomes.[28] Moreover, according to a recent meta-analysis, mental health treatments in CHD patients improve depression, show moderate efficacy for reducing CHD events but do not reduce total mortality.[29] These facts highlight the necessity of further research in this field.

Previously, the implications of anxiety and depression for CHD patients were studied in EUROASPIRE III (2006–2007).[30] The analysis revealed a high prevalence of depression and anxiety, moreover depression was associated with body mass index (BMI), waist circumference, fasting glucose, and greater frequency of self-reported diabetes. Both anxiety and depression were related to a lower frequency of lifestyle modification.

As patient population characteristics change with time, in the present substudy of the EUROASPIRE IV survey, which was carried out in 2012–2013, we aimed to re-evaluate psychosocial aspects in coronary patients and to provide the most contemporary data regarding the following:

1. Prevalence of depression and anxiety in CHD patients from 24 participating European countries;
2. The association of depression and anxiety with demographic variables, education, diagnostic category, traditional CHD risk factors, adherence to lifestyle modification and to cardioprotective drug therapy.

Methods

Altogether, 24 European countries participated in EUROASPIRE IV, namely Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Finland, France, Germany, Greece, Ireland, Latvia, Lithuania, the Netherlands, Poland, Romania, Russia, Serbia, Slovenia, Spain, Sweden, Turkey, Ukraine and the United Kingdom. A detailed description of the study design, samples and methods has been published.[31] For the EUROASPIRE IV administrative structure, study centres and investigators, see the Supplementary Material. Briefly, applying a cross-sectional design, one or more geographical areas with a defined population were selected in each country, and hospitals serving this population were identified. Consecutive patients of both sexes, at age of $\geq$18 years and <80 years, with one or more of the following clinical diagnoses or treatments for CHD were retrospectively identified: (a) coronary artery bypass graft surgery (CABG); (b) percutaneous coronary intervention (PCI) (both revascularisation categories could include emergency procedure for acute myocardial

Table 1. Prevalence of anxiety and depression by country.

Country	*n*	Anxiety score HADS-A (%)		Depression score HADS-D (%)	
		8–10	≥11	8–10	≥11
Belgium	342	14.0	13.7	15.2	7.0
Bosnia Herzegovina	188	13.3	6.4	21.8	4.8
Bulgaria	120	29.2	21.7	21.7	13.3
Croatia	404	18.8	12.1	13.1	6.9
Cyprus	90	14.4	10.0	21.1	7.8
Czech Republic	490	12.0	5.5	15.3	8.2
Finland	445	8.8	4.5	6.1	3.6
France	368	16.0	16.3	17.7	9.8
Germany	531	18.3	9.6	11.7	6.6
Greece	43	14.0	20.9	18.6	9.3
Ireland	201	16.4	13.4	9.0	5.5
Latvia	291	15.5	9.6	14.8	6.9
Lithuania	479	19.6	10.6	19.6	10.4
Netherlands	494	8.5	9.5	11.7	4.7
Poland	308	23.4	16.2	22.1	9.1
Romania	522	13.6	15.9	14.4	8.2
Russian Federation	421	15.7	12.4	16.4	10.9
Serbia	391	14.6	13.6	16.6	11.5
Slovenia	244	8.2	7.8	10.2	3.7
Spain	169	10.7	7.7	8.9	2.4
Sweden	349	9.5	6.3	4.6	1.4
Turkey	187	22.5	16.0	23.5	17.1
Ukraine	266	18.0	7.5	19.9	9.8
United Kingdom	246	17.9	20.3	15.9	13.0
All	7589	15.0	11.3	14.6	7.8

HADS-A: Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D: Hospital Anxiety and Depression Scale-Depression Subscale. Classification of scores: 8–10, mild anxiety or depression symptoms; ≥11, moderate or severe anxiety or depression symptoms.

infarction (AMI); (c) AMI, both ST-elevation and non-ST-elevation; and (d) unstable angina (UA) without evidence of infarction (troponin negative). Identified patients were invited for examination, which had to take place not before six months and no more than three years after the index clinical event.

The study visit encompassed a structured interview by means of a standard questionnaire, measurements of BMI, waist circumference, blood pressure, carbon monoxide in breath, and blood sample collection. The following information was obtained: personal and demographic data, education (the educational level was regarded as low in cases of no more than primary education), history of diabetes, reported lifestyle, and risk factor management in relation to smoking, diet, body weight and drug therapy. Activity levels were assessed by means of the International Physical Activity Questionnaire (IPAQ).[32] Depression and anxiety were assessed using the Hospital Anxiety and Depression Scale (HADS).[33] The questionnaire was translated to local languages including a retranslation control procedure. HADS scores ≤7 were considered as normal, 8–10 as mild depression or anxiety symptomatology, and >10 as moderate or severe symptoms of depression or anxiety.

Current smoking was defined as self-reported smoking and/or a breath carbon monoxide exceeding 10 ppm. Venous blood samples were collected for serum total cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, calculated low-density lipoprotein (LDL) cholesterol. The samples were analysed in the central laboratory as described previously.[31]

National coordinators were responsible for obtaining the approval of local Research Ethics Committees. Written informed consent was obtained from each participant by the investigator by means of a signed declaration. All statistical analyses were undertaken using IBM SPSS statistical software (version 21.0). Descriptive statistics were used to estimate the patients' characteristics. The distributions of depression and anxiety scores across levels of demographic characteristics were compared with the Chi-square test. The impact of depression and anxiety scores on continuously scaled CHD risk factors was evaluated according to multilevel linear regression modelling. Similarly, self-reported adherence to lifestyle changes and cardioprotective medications were compared between categories of HADS depression and anxiety according to multilevel logistic modelling.

Results

The survey was undertaken at 78 centres across 24 European countries. A total of 7998 CHD patients attended the interview. HADS data were available on 7589 patients. The median time (interquartile range (IQR)) between index event and interview was 1.4 years (IQR = 1.0–1.9 years). Of the participants, 5751 (75.8%) were male and 1838 (24.2%) were female. The highest proportion of female participants were interviewed in Latvia (38.5%) and the lowest proportion (9.5%) in Spain. The mean age (standard deviation (SD)) of the interviewed population was 64.1(9.6) years. Regarding age, 30.3% were ≥70 years old and 8.4% participants were under 50 years old. More than a half of the interviewed patients (55.5%) were enrolled after PCI ($n = 4213$), 1609 (21.2%) after AMI, 1004

Table 2. Prevalence of depressive symptoms in coronary heart disease (CHD) patients of different diagnostic categories by country.

	Post AMI and UA		Post PCI and CABG	
	8–10 HADS-D	≥11 HADS-D	8–10 HADS-D	≥11 HADS-D
Belgium	12.2% (6/49)	12.2% (6/49)	15.7% (46/293)	6.1% (18/293)
Bosnia Herzegovina	15.7% (8/51)	5.9% (3/51)	24.1% (33/137)	4.4% (6/137)
Bulgaria	18.2% (8/44)	13.6% (6/44)	23.7% (18/76)	13.2% (10/76)
Croatia	18.8% (16/85)	5.9% (5/85)	11.6% (37/319)	7.2% (23/319)
Cyprus	29.7% (11/37)	8.1% (3/37)	15.1% (8/53)	7.5% (4/53)
Czech Republic	13.9% (20/144)	9% (13/144)	15.9% (55/346)	7.8% (27/346)
Finland	5.8% (3/52)	5.8% (3/52)	6.1% (24/393)	3.3% (13/393)
France	28.9% (11/38)	15.8% (6/38)	16.4% (54/330)	9.1% (30/330)
Germany	7.2% (6/83)	3.6% (3/83)	12.5% (56/448)	7.1% (32/448)
Greece	16.7% (4/24)	12.5% (3/24)	21.1% (4/19)	5.3% (1/19)
Ireland	11.5% (12/104)	6.7% (7/104)	6.2% (6/97)	4.1% (4/97)
Latvia	14.3% (5/35)	5.7% (2/35)	14.8% (38/256)	7% (18/256)
Lithuania	19.4% (35/180)	10% (18/180)	19.7% (59/299)	10.7% (32/299)
Netherlands	13.5% (19/141)	5% (7/141)	11% (39/353)	4.5% (16/353)
Poland	24.9% (58/233)	8.2% (19/233)	13.3% (10/75)	12% (9/75)
Romania	15% (29/193)	9.3% (18/193)	14% (46/329)	7.6% (25/329)
Russian Federation	17.3% (17/98)	12.2% (12/98)	16.1% (52/323)	10.5% (34/323)
Serbia	18.4% (27/147)	15% (22/147)	15.6% (38/244)	9.4% (23/244)
Slovenia	13.9% (15/108)	1.9% (2/108)	7.4% (10/136)	5.1% (7/136)
Spain	8.9% (13/146)	2.1% (3/146)	8.7% (2/23)	4.3% (1/23)
Sweden	2% (1/50)	2% (1/50)	5% (15/299)	1.3% (4/299)
Turkey	28.9% (24/83)	10.8% (9/83)	19.2% (20/104)	22.1% (23/104)
Ukraine	20% (24/120)	11.7% (14/120)	19.9% (29/146)	8.2% (12/146)
United Kingdom	15.7% (20/127)	16.5% (21/127)	16% (19/119)	9.2% (11/119)
All	16.5% (392/2372)	8.7% (206/2372)	13.8% (718/5217)	7.3% (383/5217)

AMI: acute myocardial infarction; CABG: coronary artery bypass grafting; HADS-D: Hospital Anxiety and Depression Scale-Depression Subscale; PCI: percutaneous coronary intervention; UA: unstable angina.

(13.2%) after CABG surgery and 763 after UA (10.1%).

Of the interviewed patients, 1271 (16.9%) had a low educational level (no more than primary education) with a very pronounced heterogeneity between participating countries (from 1.1% in Ukraine to 64.7% in Ireland).

Distribution of HADS depression and anxiety scores in participants from different countries is presented in Table 1. In general, symptoms of anxiety (HADS-A score ≥8) were seen in 26.3% of participants, and were more prevalent in women (39.4%) than in men (22.1%). 22.4% of patients had symptoms of depression (HADS-D score ≥8), and again more often in women (30.6%) compared with men (19.8%). Of note, according to hospital discharge letters, antidepressants and anti-anxiety medication were prescribed to 2.4% of patients. Of the patients, 2.7% and 5.0% continued to take antidepressants and anti-anxiety medications at the time of the interview.

Prevalence of moderate and severe anxiety symptoms varied substantially between countries from 4.5% in Finland to 21.7% in Bulgaria. The proportion of patients with HADS-A score ≥11 was more than 10% in 13 countries, and in three countries it was more than 20%. Moderate or severe depressive symptoms were seen generally less frequently than anxiety with six countries having enrolled more than 10% of such patients. The lowest proportion of patients with HADS-D ≥11 among the interviewed population was in Sweden (1.4%) and the highest was in Turkey (17.1%).

The prevalence of different degrees of depression symptomatology in patients from participating countries by diagnostic category (patients after acute coronary syndromes vs patients after revascularisation procedures) is presented in Table 2. In general both mild and moderate/severe depression were slightly more prevalent in post-AMI and UA patients (16.5% and 8.7%, respectively) as compared to patients after PCI and CABG (13.8% and 7.3%, respectively).

Table 3. Prevalence of anxiety symptoms in coronary heart disease (CHD) patients of different diagnostic categories by country.

	AMI and UA		PCI and CABG	
	8–10 HADS-A	≥11HADS-A	8–10 HADS-A	≥11HADS-A
Belgium	12.2% (6/49)	24.5% (12/49)	14.3% (42/293)	11.9% (35/293)
Bosnia Herzegovina	9.8% (5/51)	5.9% (3/51)	14.6% (20/137)	6.6% (9/137)
Bulgaria	34.1% (15/44)	22.7% (10/44)	26.3% (20/76)	21.1% (16/76)
Croatia	20% (17/85)	11.8% (10/85)	18.5% (59/319)	12.2% (39/319)
Cyprus	18.9% (7/37)	13.5% (5/37)	11.3% (6/53)	7.5% (4/53)
Czech Republic	13.9% (20/144)	6.9% (10/144)	11.3% (39/346)	4.9% (17/346)
Finland	5.8% (3/52)	7.7% (4/52)	9.2% (36/393)	4.1% (16/393)
France	15.8% (6/38)	28.9% (11/38)	16.1% (53/330)	14.8% (49/330)
Germany	26.5% (22/83)	3.6% (3/83)	16.7% (75/448)	10.7% (48/448)
Greece	16.7% (4/24)	25% (6/24)	10.5% (2/19)	15.8% (3/19)
Ireland	13.5% (14/104)	17.3% (18/104)	19.6% (19/97)	9.3% (9/97)
Latvia	8.6% (3/35)	5.7% (2/35)	16.4% (42/256)	10.2% (26/256)
Lithuania	20.6% (37/180)	12.2% (22/180)	19.1% (57/299)	9.7% (29/299)
Netherlands	10.6% (15/141)	9.2% (13/141)	7.6% (27/353)	9.6% (34/353)
Poland	22.3% (52/233)	18.5% (43/233)	26.7% (20/75)	9.3% (7/75)
Romania	13.5% (26/193)	21.8% (42/193)	13.7% (45/329)	12.5% (41/329)
Russian Federation	7.1% (7/98)	11.2% (11/98)	18.3% (59/323)	12.7% (41/323)
Serbia	13.6% (20/147)	13.6% (20/147)	15.2% (37/244)	13.5% (33/244)
Slovenia	15.7% (17/108)	12% (13/108)	2.2% (3/136)	4.4% (6/136)
Spain	10.3% (15/146)	6.2% (9/146)	13% (3/23)	17.4% (4/23)
Sweden	6% (3/50)	10% (5/50)	10% (30/299)	5.7% (17/299)
Turkey	20.5% (17/83)	15.7% (13/83)	24% (25/104)	16.3% (17/104)
Ukraine	21.7% (26/120)	8.3% (10/120)	15.1% (22/146)	6.8% (10/146)
United Kingdom	21.3% (27/127)	20.5% (26/127)	14.3% (17/119)	20.2% (24/119)
All	16.2% (384/2372)	13.5% (321/2372)	14.5% (758/5217)	10.2% (534/5217)

AMI: acute myocardial infarction; CABG: coronary artery bypass grafting; HADS-A: Hospital Anxiety and Depression Scale-Anxiety Subscale; PCI: percutaneous coronary intervention; UA: unstable angina.

In some countries the proportion of moderately to severe depressed patients after AMI and UA was 1.5–2 times higher than after revascularisation (e.g. Belgium, Greece, UK, Serbia, France), in other countries the situation was quite the opposite (e.g. Turkey, Spain, Slovenia, Germany) and there was no marked differences between these diagnostic categories in the Netherlands, Lithuania and Bulgaria. The prevalence of mild and moderate to severe anxiety symptoms by diagnostic category and by country is presented in Table 3. As is the case for depression, both mild and moderate/severe anxiety were only slightly more prevalent in post-acute coronary syndrome patients vs those enrolled after revascularisation. But, again, one similar heterogeneity existed between countries: in Belgium, Cyprus, France, and Poland there were 1.5–2 times more post-AMI and UA patients with HADS-A≥11, while in Germany the situation was quite the opposite. As shown in Table 4, both anxiety and depression were significantly associated with female gender and lower level of education. Anxiety was significantly more prevalent in younger age groups; on the contrary, depression rates increased with advancing age. Table 5 presents data on associations between anxiety, depression and traditional cardiovascular risk factors. Presence of any anxiety (HADS-A>8) was also associated with lower physical activity level. Depressed patients (HADS-D>8) were significantly older and more likely to be female. As with anxiety, depression was significantly inversely associated with higher educational level and also inversely with more physical activity according to the IPAQ. Unlike anxiety, depression was significantly positively associated with current smoking, presence of central obesity and self-reported diabetes. Anxious patients also showed a trend to more self-reported diabetes of borderline significance. Neither elevated blood pressure nor LDL-cholesterol showed any link with anxiety and depression.

Table 4. Distribution of Hospital Anxiety and Depression Scale depression and anxiety scores by gender, age and education (*n*, %).

	HADS-A≥8 (*n*, %)	HADS-D≥8 (*n*, %)
All ($n = 7998$)		
Sex		
Men	22.1% (1273/5751)	19.8% (1136/5751)
Women	39.4% (724/1838)	30.6% (563/1838)
Significance	$p < 0.001$	$p < 0.001$
Age group (years)		
<50	29.3% (187/639)	20.8% (133/639)
50–59	30.7% (555/1805)	24% (433/1805)
60–69	24.6% (699/2843)	19.8% (563/2843)
≥70	24.2% (556/2302)	24.8% (570/2302)
Significance	$p < 0.001$	$p < 0.001$
Education level		
Primary	31.1% (395/1271)	27.8% (353/1271)
Secondary	26.4% (1198/4546)	22.5% (1022/4546)
High	22.6% (387/1716)	17.9% (308/1716)
Significance	$p < 0.001$	$p < 0.001$

HADS-A: Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D: Hospital Anxiety and Depression Scale-Depression Subscale. Significance based on univariate analyses (Chi^2 test).

Presence of anxiety and depression showed also some associations with health behaviour and risk factors control (Table 6). A lower probability of having any anxiety symptoms at interview was associated with attendance at a cardiac rehabilitation programme, with self-reported increase of physical activity and with smoking cessation. All these variables also significantly decreased the odds of having depression symptoms. Furthermore, attendance of any kind of fitness or walking groups, restriction of salt and dietary fat intake, and eating more fish, fruits and vegetables also reduced the odds of depression. Neither anxiety nor depression levels were associated with alcohol restriction, trying to curb sugar or lower caloric intake.

As for medication adherence, use of both antidepressants or anti-anxiety medications increased the probability of having anxiety and depression symptomatology by 2.5–3.5-fold. The analysis did not reveal any associations between anxiety and lipid-lowering or blood-pressure-lowering drug adherence. On the contrary, patients adherent to lipid-lowering medications had depression significantly less often, and those who used antihypertensive drugs had 1.5 times higher probability of depression.

Discussion

As was the case with EUROASPIRE III,[30] the EUROASPIRE IV survey revealed a considerable prevalence of anxiety and depressive symptoms both in female and male CHD patients. By the time of interview 32.3% of female EUROASPIRE III patients and 21.2% of men had depression symptoms; for anxiety the corresponding figures were 44.4% in women and 22.6% in men. The current survey revealed any degree of depressive symptomatology in 30.6% of female CHD patients and in 19.8% of men, and anxiety symptoms were seen in 39.4% of women and in 22.1% of men. Both studies demonstrated a high variation in the prevalence of anxiety and depression symptoms in CHD patients between participating European countries.

As in the EUROASPIRE III, in the present survey both anxiety and depression were more prevalent among female CHD patients. This corresponds to well-known gender differences of anxiety and depression in general population.[34] As in the previous survey, CHD patients with a lower level of education had significantly higher HADS scores for both anxiety and depression. A similar association was found in the general population, for instance, a large nationally representative study from the USA confirmed that low level of education is a common risk factor for anxiety and major depressive disorders.[35] As for age, according to multilevel linear regression analysis, older age showed a positive association with depression and a negative association with anxiety.

Both depression and anxiety were positively associated with lower levels of physical activity, depressed patients also had a higher prevalence of other major risk factors, namely smoking, obesity and diabetes. After adjustment for covariates, some healthier lifestyle choices were negatively related to the probability of depression and anxiety, as was seen already in the EUROASPIRE III: smoking cessation and doing more exercise decreased the odds of both psychosocial factors. Attaining more healthy dietary patterns was also linked to a lower probability of depression. Significant associations with adherence to cardioprotective medications were revealed only for depression, which was linked with a higher probability of using antihypertensive drugs but with lower compliance to a lipid-lowering drug regimen. One could speculate that depressed patients are not willing to take medicines that could increase their longevity without offering any symptomatic relief but adhere to their antihypertensive treatment because they could falsely attribute some somatic symptoms of depression to elevated blood pressure.

The EUROASPIRE survey remains a major source of data regarding the prevalence of anxiety and depression in the European population of CHD patients and their associations with other risk factors, as well as adherence to health behaviour and

Table 5. Association of psychosocial factors and traditional cardiovascular risk factors.

	HADS-A		HADS-D	
	ß (SE)	*p*-Value	ß (SE)	*p*-Value
Intercept	8.4 (0.5)	$p < 0.001$	4.6 (0.5)	$p < 0.001$
Age	−0.04 (0.006)	$p < 0.001$	0.02 (0.0)	$p < 0.001$
Gender				
Male	Reference			
Female	1.7 (0.1)	$p < 0.001$	0.7 (0.1)	$p < 0.001$
Educational level				
Primary	Reference		Reference	
Secondary	−0.5(0.2)	$p = 0.001$	−1.1 (0.2)	$p < 0.001$
High	−1.0(0.2)	$p < 0.001$	−0.4 (0.1)	$p = 0.007$
Smoking				
Yes	0.3 (0.1)	$p = 0.084$	0.7 (0.1)	$p < 0.001$
No	Reference		Reference	
IPAQ				
Low	Reference		Reference	
Moderate	−0.7 (0.1)	$p < 0.001$	−1.3 (0.1)	$p < 0.001$
High	−0.8 (0.1)	$p < 0.001$	−1.6 (0.1)	$p < 0.001$
Central obesity				
Yes	0.01 (0.1)	$p = 0.6$	0.3 (0.01)	$p = 0.004$
No	Reference		Reference	
Elevated BP				
Yes	0.05(0.1	$p = 0.7$	−0.1 (0.1)	$p = 0.3$
No	Reference		Reference	
Elevated LDL-cholesterol				
Yes	−0.2 (0.1)	$p = 0.2$	−0.2 (0.1)	$p = 0.2$
No	Reference		Reference	
Self-reported diabetes				
Yes	0.2 (0.1)	$p = 0.05$	0.5 (0.1)	$p < 0.001$
No	Reference		Reference	

BP: blood pressure; HADS-A: Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D: Hospital Anxiety and Depression Scale-Depression Subscale; IPAQ: International Physical Activity Questionnaire; LDL: low density lipoprotein; SE: standard error. Linear regression model (multilevel).

medications. The study design which involved interviews for assessment of depression and anxiety no less than six months after the index events was particularly useful because it ensured detection of sustained depression only. It is generally recognised that after acute coronary syndromes depression often resolves spontaneously without treatment, and only long-term persistence of depression predicts adverse CHD outcomes.[36]

Obvious limitations of the present study include enrolment of participants only in a limited amount of centres per country, often one or two centres, which could be academic or tertiary care facilities, so that accrued data cannot be regarded as representative for the respective country. Some countries, e.g. Greece, also recruited considerably fewer patients than others. Still, the prevalence of depression and anxiety symptoms in the EUROASPIRE IV population was in line with previous research,[37–39] which suggests that it can be as high as 30–40% of CHD patients.

The other limitation is a low interview rate, which averaged 48.7%, and those patients who did not come to interview or those who had not survived to that timepoint could have had a higher prevalence of anxiety and mood disorders. The study also shares the common limitation of all cross-sectional studies which can reveal associations but not causality.

Like the previous survey, the EUROASPIRE IV confirmed known relationships of anxiety and depression with a number of traditional risk factors, especially

Table 6. Association of psychosocial factors and appropriate lifestyle changes after index event and medications use at interview.

	HADS-A>8		HADS-D>8	
	OR[a] (95% CI)	*p*-Value	OR (95% CI)	*p*-Value
Attendance at CR programme	0.7 (0.6–0.9)	$p = 0.002$	0.6 (0.5–0.8)	$p < 0.001$
Increase physical activity	0.8 (0.7–0.9)	$p < 0.001$	0.6 (0.5–0.7)	$p < 0.001$
Fitness/walking group	0.8 (0.7–1.0)	$p = 0.06$	0.7 (0.5–0.8)	$p < 0.001$
Stop smoking if smoking at index event	0.8 (0.6–0.9)	$p = 0.01$	0.7 (0.6–0.9)	$p = 0.001$
Less alcohol	1.1 (1.0–1.2)	$p = 0.2$	1.1 (0.9–1.2)	$p = 0.3$
Less salt	1.0 (0.9–1.1)	$p = 1.0$	0.9 (0.8–1.0)	$p = 0.05$
Less fat	1.1 (0.9–1.2)	$p = 0.5$	0.8 (0.7–0.9)	$p = 0.002$
Less sugar	1.1 (0.9–1.2)	$p = 0.4$	1.0 (0.9–1.1)	$p = 0.8$
More fruit and vegetables	0.9 (0.8–1.1)	$p = 0.4$	0.8 (0.7–0.9)	$p = 0.002$
More fish	1.0 (0.1–1.1)	$p = 0.8$	0.8 (0.7–0.9)	$p < 0.001$
Calorie reduction	1.1 (0.9–1.2)	$p = 0.4$	0.9 (0.8–1.0)	$p = 0.1$
Blood pressure lowering medication	1.3 (1.0–1.7)	$p = 0.1$	1.5 (1.1–2.1)	$p = 0.005$
Lipid lowering medication	0.9 (0.8–1.1)	$p = 0.3$	0.8 (0.7–0.9)	$p = 0.008$
Anti-anxiety medications use	3.1 (2.4–3.9)	$p < 0.001$	3.5 (2.6–4.8)	$p < 0.001$
Antidepressant use	3.5 (2.6–4.7)	$p < 0.001$	2.5 (2.0-3.2)	$p < 0.001$

CI: confidence interval; CR: cardiac rehabilitation; HADS-A: Hospital Anxiety and Depression Scale-Anxiety Subscale; HADS-D: Hospital Anxiety and Depression Scale-Depression Subscale; OR: odds ratio.
[a]OR are adjusted for age, sex, education and country (multilevel)

related to unhealthy diet,[40,41] as well as with lower odds of positive lifestyle changes and lower adherence to cardioprotective medications (only for depression).

In spite of lacking evidence that screening for and treatment of depression may lead to better outcomes in CHD patients,[42] both European and American guidelines on CVD prevention postulate screening of all CHD patients for depression. The revealed associations between these disorders and probability of better compliance indicate that this is a prudent position. Still, only a minority of the surveyed population received specific antidepressant and anti-anxiety treatment and this problem should be addressed in the future.

Conclusion

A substantial proportion of CHD patients (every third woman and every fifth man) have anxiety and depression symptoms at 1.35 years follow-up after AMI, UA, CABG and PCI. Very few patients receive specific medication treatment for depression and anxiety. These disorders, especially depression, are associated with a number of CHD risk factors, including low level of education, low level of physical activity, smoking, unhealthy diet and reduced compliance with risk factor modification.

Author contribution

NP contributed to conception and design and drafted the manuscript. KK, DDB and DDS contributed to conception, design, data acquisition, analysis and interpretation, and critically revised the manuscript. RvK, JB and MD contributed to data analysis and interpretation and critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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