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Research paper

Depressive symptoms and health care within 30 days after discharge from a cardiac hospital unit

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A R T I C L E I N F O

Keywords:
Depression
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CHD
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A B S T R A C T

Objective: To determine the association between depressive symptoms in CHD patients and in- and outpatient health care utilization during the 30 days following treatment in a cardiac hospital unit.
Method: The study sample consisted of 949 CHD patients who completed a measure of depressive symptom severity (the Patient Health Questionnaire [PHQ-9]). Cardiac disease severity and medical comorbidities were assessed by chart review. Follow-up questionnaires were mailed to patients assessing in- and outpatient health care.
Results: Among patients with elevated depressive symptoms (PHQ-9 score of ≥7), 19.9% had at least one outpatient hospital visit (hospital-based medical centers, outpatient clinics, and emergency departments) within the first 30 days after the initial hospitalization, compared to 11.8% of patients without depressive symptoms ($p = 0.002$). This association remained significant after adjustment for sociodemographic and medical covariates. Elevated depressive symptoms also predicted a higher number of outpatient physician visits (adjusted OR = 2.36; 95% CI 1.75 – 3.18; $p < 0.001$). Results were similar for the PHQ-9 continuous score. There was no association between depressive symptoms and re-hospitalizations.
Conclusions: After hospitalization for cardiac care, patients with elevated depressive symptoms may be at higher risk for utilizing outpatient physician and outpatient hospital care. This is not explained by more severe cardiac disease or more comorbidities.

1. Introduction

Depression is common among patients with coronary heart disease (CHD) and leads to more recurrent cardiovascular events and a higher risk for mortality [1–3]. This has been linked to biological mechanisms such as low heart rate variability and higher levels of inflammation [4–7], but also to behavioral mechanisms such as physical inactivity and smoking [1,7,8]. At the same time, CHD is assumed to increase the risk for comorbid depression [9,10].

It is well known that depression plays an important role in health care utilization and costs, in cardiac as well as non-cardiac populations. It has been shown that depression leads to poor medication adherence

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and thus increases health care costs [11–13]. In addition, depression has a direct impact on health care costs. Depressed people living in the community have an increased general health care utilization compared to non-depressed people, even though this association cannot be linked to specific types of health care services [14]. In samples of older adults, depression has been associated with more hospitalizations, longer mean length of stay and higher utilization of outpatient services [15–19]. In the German general adult population, depression has been associated with an almost twofold increased risk for hospitalization [20]. Most of these studies showed that the association is mainly due to more somatic comorbidities and increased functional impairment in depressed patients. However, depressive symptoms remained an independent risk factor for higher health care utilization [15–18].

Cardiac patients with depression tend to have more outpatient contacts and hospitalizations than those without depression [21–23]. However, studies showing these associations have focused on a 12-month follow-up period or longer, and have included only patients after myocardial infarction (MI) [21–23]. The impact of depressive symptoms on short-term usage of outpatient services, particularly general practitioner (GP) visits and specialist care following a hospitalization, as well as the association with short-term re-hospitalizations in patients hospitalized for any CHD-related condition has not been investigated.

The current study aims to determine the association between depressive symptoms in coronary heart disease patients and the use of inpatient and outpatient health care during the 30 days following treatment in a cardiac hospital unit. Specifically, associations between depressive symptoms and number of subsequent hospitalizations as well as outpatient hospital visits and physician visits were analyzed.

2. Methods

2.1. Study design

The current study was part of the CDCare ("Depression Care for Hospitalized Coronary Heart Disease Patients") study. Patients were considered eligible if they had a diagnosis of CHD and were hospitalized in one of the two university hospitals in Germany (Universitätsklinikum Münster; Charité – Universitätsmedizin Berlin). Patients were excluded if they had a chart-documented dementia disorder, cognitive impairment, insufficient language proficiency, the presence of a terminal disease or if they were unavailable for follow-up. Recruitment took place from July 2012 until July 2014. The study was approved by the Institutional Review Boards of both institutions and written consent was obtained from all participants.

Patient data was collected with a questionnaire at baseline and after 1 month, 6 months and 12 months. The questionnaire included demographic characteristics (age, gender, partner status and living situation) and a brief measure of depressive symptoms (the Patient Health Questionnaire [PHQ-9]) [24]. At all follow-up time points, participants were mailed a follow-up questionnaire including questions about health care utilization in the preceding weeks/months. The present analyses contained information about outpatient hospital and physician visits from the 1-month questionnaire while using the PHQ-9 from the baseline questionnaire. For re-hospitalizations and rehabilitation stays, information from the 6-month questionnaire regarding the 30-day post-discharge period was additionally included, since some participants provided information on re-hospitalizations within the 30-day post-discharge period only in the 6-month (and not in the 1-month) questionnaire. Fig. 1 displays the study flow chart.

2.2. Utilization of health care services

2.2.1. Hospital re-admissions

At the 1-month follow-up, patients were asked if they had been re-admitted to a hospital since their initial discharge from the index hospitalization. At the 6-month follow-up, patients were asked if they had been re-admitted to a hospital in the past 5 months.

Reports about hospital re-admissions were verified by contacting the respective hospitals and requesting discharge letters for each hospitalization. If a patient reported a hospitalization which was not verified, this patient was excluded from the present analyses (see Fig. 1).

For patients who did not return the follow-up questionnaire, we additionally performed an active search for hospital re-admissions in the databases of the departments of cardiology, cardiac surgery and vascular surgery of the Charité – Universitätsmedizin Berlin and the University Hospital of Münster, respectively. If a patient was transferred to a different hospital or department during the stay, this was considered part of the same hospitalization.

If a patient reported a hospitalization which was in fact an outpatient visit, this visit was added to the number of outpatient visits (s. below).

2.2.2. Rehabilitation

To account for the fact that many patients in our sample were referred to cardiac rehabilitation, which is likely to decrease the number of outpatient visits, we asked at each follow-up whether they had undergone in- or outpatient medical rehabilitation after their discharge from the initial hospitalization. For all reported rehabilitations, discharge letters were requested from the respective clinics or outpatient rehabilitation centers. If a patient had not answered the question whether he or she had participated in a rehabilitation program, or if the information provided was not verified by a discharge letter, this patient was excluded from the analyses.

Patients who had started an inpatient rehabilitation program during the first 30 days after discharge from the index hospitalization were excluded from the analyses of outpatient visits. Inpatient rehabilitation stays typically last for at least 14 days, and the clinics provide most medical care that can be performed outside of a hospital (see Fig. 1).

2.2.3. Outpatient hospital visits and outpatient physician visits

At the 1-month follow-up, patients were asked whether they had had any outpatient hospital visits (i.e., emergency department visits without overnight stay or visits to any hospital-affiliated medical treatment center) after their discharge from the initial hospital stay.

Outpatient ambulatory physician visits were also assessed via self-report. A questionnaire from the German Health Interview and Examination Survey for Adults (DEGS) was used [25]. Patients were asked whether and how often they had visited any physician from various medical specialties since their discharge from the initial hospitalization: general practitioner (GP), internist, gynecologist, ophthalmologist, orthopedist, ear, nose and throat specialist, surgeon, dermatologist, radiologist, urologist, dentist, neuropsychiatrist, psychiatrist, neurologist, medical psychotherapist and psychological psychotherapist and "other doctor". For the present analyses, we report the number of visits to GP, to neuropsychiatrist, psychiatrist, neurologist, medical psychotherapist and psychological psychotherapist, as well as the number of visits across all physician specialties.

2.3. Measure of depression

Depressive symptoms were measured using the German version of the Patient Health Questionnaire (PHQ-9) [24]. For the present analyses, we used the PHQ-9 as a continuous score as well as a dichotomous outcome (no depressive symptoms versus elevated depressive symptoms). In the literature, several cut-offs for elevated depressive symptoms have been proposed for the PHQ-9 [26]. Here, we used the cut-off of 7. A previous analysis with data from this sample showed that this cut-off had the best combination of sensitivity and specificity for a clinical depression diagnosis [27].

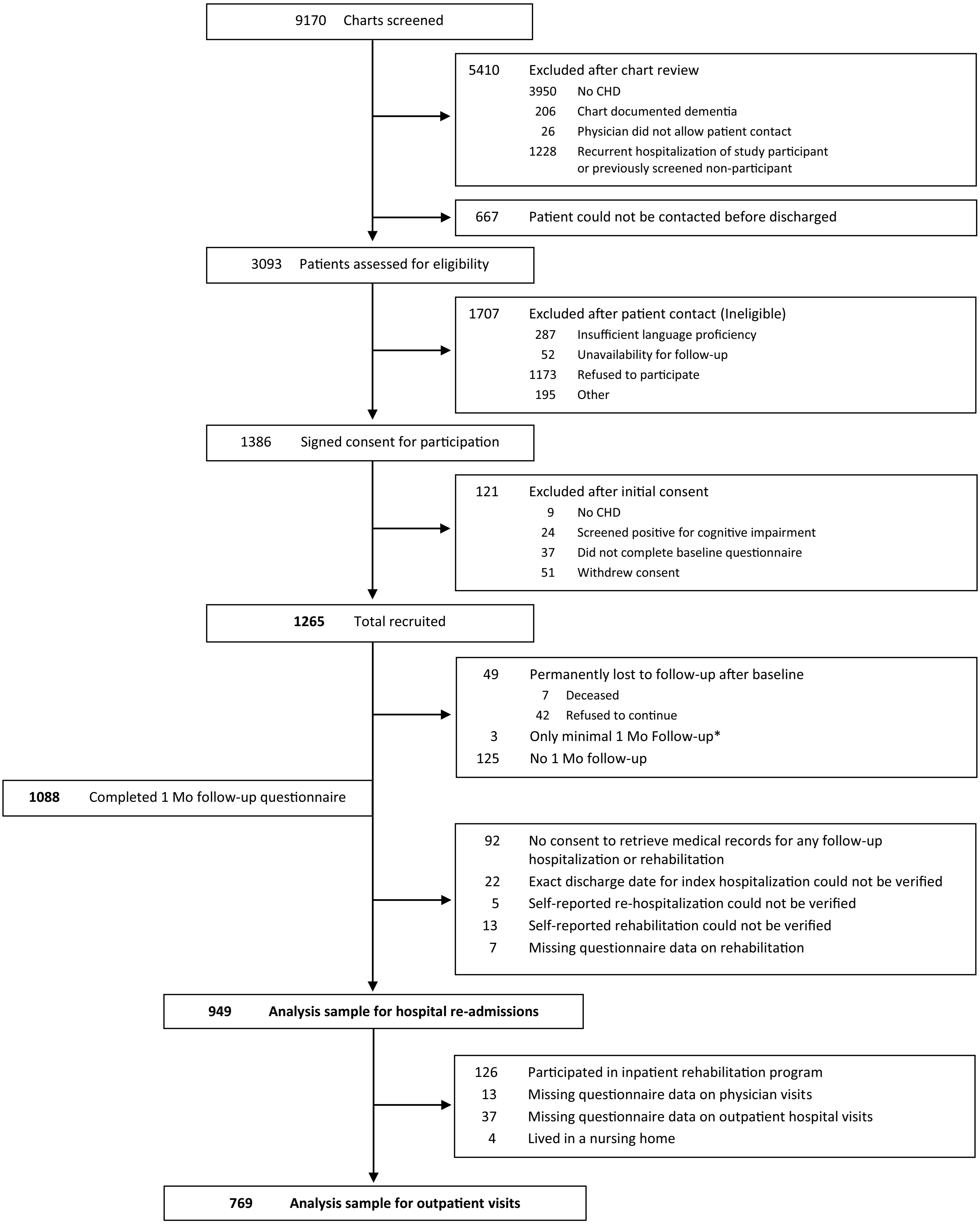

Fig. 1. Flow Chart.

2.4. Covariables

Somatic comorbidity was measured at baseline using the Charlson Comorbidity Index (CCI), an index for the classification of comorbid conditions [28]. The original index was used without the conditions 'myocardial infarction' and 'congestive heart failure' because presence and type of an acute coronary syndrome (ACS) at baseline admission, percutaneous coronary intervention (PCI) during baseline hospitalization as well as left ventricular ejection fraction (LVEF) were used as covariables in our analyses. Based on the distribution of the Charlson Comorbidity Index, we computed the following categories: 0, 1, 2 and 3 or more comorbidities.

We also controlled for age, gender and partner status in our analyses. Participants who lived in nursing homes were excluded from the analyses regarding outpatient physician and outpatient hospital visits (see Fig. 1).

2.5. Statistical analyses

Differences in group characteristics were analyzed using χ-squared tests for categorical variables and *t*-tests for continuous variables. As the maximum of hospital re-admissions in the sample was 2, two groups were formed for statistical analyses: "No hospitalization" and "1-2 hospitalizations". Similarly, for outpatient hospital visits, a dichotomous measure was used ("no visit" versus "one or more visits"). Four groups regarding outpatient physician visits were formed: 0 contacts, 1-2 contacts, 3-7 contacts and 8 or more contacts. The categorization was motivated by the fact that the number of users with 3-7 contacts was considerably smaller than expected from a Poisson distribution and the number of subjects with 0-2 or at least 8 visits was about equal or larger than expected from a Poisson distribution. Additionally, "zero" users were categorized in a specific category. For LVEF, a dichotomous measure was used in the analyses: ≥45% and < 45% [29].

Binary logistic and ordinal regression models were used to evaluate the association between depression and utilization of health care services with and without adjusting for the before mentioned covariables. The level of significance was 0.05 (two-sided).

Regression-based multiple imputation was conducted to deal with missing data (SPSS module for multiple imputation). Missing data on the PHQ-9 were imputed with age, sex, the remaining items as well as the depression subscale items of the Hospital Anxiety and Depression scale, which was also included in the baseline questionnaire, as predictors. Missing LVEF data was imputed with the following auxiliary variables: age, sex, smoking status, body mass index (BMI), prior myocardial infarction, current ACS, diabetes, number of significant lesions and occlusions, chronic heart failure, prior or current percutaneous coronary intervention (PCI), prior or current coronary artery bypass grafting (CABG), and chronic renal disease (in accordance with Biering et al [30] and Holmes et al [31]). With reference to Siew et al, missing creatinine values were imputed with age, sex, chronic heart failure, hypertension, peripheral vascular disease, diabetes, cerebrovascular disease, chronic liver disease, and chronic renal disease as independent variables [32]. Creatinine levels were used for the assessment of chronic renal disease as part of the CCI as a measure for somatic comorbidity. In the analysis sample for outpatient visits (N = 769), the number of physician visits was imputed among patients who indicated they had visited the respective physician without providing the exact number of visits. Predictors were age, sex, somatic comorbidity and all other items of the questionnaire.

Statistical analyses were carried out using SPSS software Version 23.

3. Results

3.1. Sample characteristics

Participant characteristics in the overall sample are shown in Table 1. Out of the 1265 patients from the CDCare study, we included 949 with sufficient data on utilization of health care, 190 of those were female (20.0%). Mean age in the overall sample was 63.8 years (*SD* = 10.1; range 36-88 years). In the sample for hospital re-admissions, 38.9% scored 7 or higher on the PHQ-9, mean score of the PHQ-9 was 6.2 (*SD* = 4.8).

In the sample for hospital re-admissions, 97 patients (10.2%) were

Table 1
Sample characteristics (*N* = 949).

Variable	No. (%) or mean (SD)
Female	190 (20%)
Age	63.8 (10.1)
Partner status[a]	
No partner	183 (19.3%)
Housing situation	
Nursing home	5 (0.5%)
Private home	890 (93.8%)
Other private home (with relatives)	12 (1.3%)
Other	42 (4.4%)
PHQ-9	
< 7	580 (61.1%)
≥7	369 (38.9%)
PHQ-9 (continuous score)	6.2 (4.8)
Charlson comorbidity index (CCI)	
0	518 (54.6%)
1	240 (25.3%)
2	114 (12.0%)
≥3	77 (8.1%)
ACS at admission or during baseline hospitalization	
No ACS	580 (61.1%)
STEMI	115 (12.1%)
NSTEMI	148 (15.6%)
Unstable angina	106 (11.2%)
PCI at baseline hospitalization	
Yes	455 (47.9%)
LVEF	
< 45%	233 (24.6%)
30-day post-discharge health care	
Re-hospitalization	
No	852 (89.8%)
Yes	97 (10.2%)
Medical rehabilitation	
None	771 (81.2%)
Outpatient rehabilitation	52 (5.5%)
Completed in the first 30 days	14 (1.5%)
Inpatient rehabilitation	126 (13.3%)
Completed in the first 30 days	33 (3.5%)
Outpatient hospital visits[b]	
0	654 (85.0%)
≥1	115 (15.0%)
Outpatient physician visits[b]	
No	28 (3.6%)
Yes	741 (96.4%)
Number of visits	
0	28 (3.6%)
1-2	275 (35.8%)
3-7	366 (47.6%)
≥8	100 (13.0%)
Physician visit – GP[b]	
No	142 (18.5%)
Yes	627 (81.5%)
Physician visits to mental health providers[b,c]	
0	702 (91.3%)
1	38 (4.9%)
≥2	29 (3.8%)

SD = Standard deviation. PHQ-9 = Patient health questionnaire. ACS = Acute coronary syndrome. STEMI = ST-segment elevation myocardial infarction. NSTEMI = non-ST-segment elevation myocardial infarction. LVEF = Left ventricular ejection fraction.

[a] Numbers do not add up to 100% due to missing data.
[b] For outpatient hospital visits and physician visits, *N* = 769.
[c] Visits to neuropsychiatrist, psychiatrist, neurologist, medical psychotherapist or psychological psychotherapist.

Table 2
Participant characteristics according to inpatient and outpatient health care.

Variable	Re-hospitalization within 30 days ($N = 949$)		
	No ($N = 852$; 89.8%)	Yes ($N = 97$; 10.2%)	
	No. (%) or mean (SD)		P
Gender			0.338
Female	167 (87.9%)	23 (12.1%)	
Male	685 (90.3%)	74 (9.7%)	
Age	63.6 (10.1)	64.7 (10.4)	0.330
Partner status (N=937)			0.653
No partner	163 (89.1%)	20 (10.9%)	
Partner	680 (90.2%)	74 (9.8%)	
Housing situation			0.448
Nursing home	4 (80.0%)	1 (20.0%)	
Private home	800 (89.9%)	90 (10.1%)	
Relatives	12 (100.0%)	0 (0.0%)	
Other	36 (85.7%)	6 (14.3%)	
Charlson comorbidity index			0.495
0	466 (90.0%)	52 (10.0%)	
1	219 (91.3%)	21 (8.8%)	
2	98 (86.0%)	16 (14.0%)	
≥3	69 (89.6%)	8 (10.4%)	
ACS at admission or during baseline hospitalization			0.243
No ACS	513 (88.4%)	67 (11.6%)	
STEMI	105 (91.3%)	10 (8.7%)	
NSTEMI	139 (93.9%)	9 (6.1%)	
Unstable angina	95 (89.6%)	11 (10.4%)	
PCI at baseline			**0.007**
Yes	421 (92.5%)	34 (7.5%)	
No	431 (87.2%)	63 (12.8%)	
LVEF			0.428
< 45%	206 (88.4%)	27 (11.6%)	
≥45%	646 (90.2%)	70 (9.8%)	
Rehabilitation			0.227
No	686 (89.0%)	85 (11.0%)	
Outpatient	49 (94.2%)	3 (5.8%)	
Inpatient	117 (92.9%)	9 (7.1%)	
PHQ-9			0.950
< 7	521 (89.8%)	59 (10.2%)	
≥7	331 (89.7%)	38 (10.3%)	
PHQ-9 continuous score	6.2 (4.7)	6.5 (5.2)	0.490

(*continued on next page*)

Table 2 (*continued*)

Variable	Outpatient hospital visits (N = 769)			Outpatient physician visits (N = 769)				
	0 (N = 654; 85.0%)	≥1 (N = 115; 15.0%)		0 visits (N = 28; 3.6%)	1-2 visits (N = 275; 35.8%)	3-7 visits (N = 366; 47.6%)	≥8 visits (N = 100; 13.0%)	
	No. (%) or mean (SD)		P	No. (%) or mean (SD)				P
Gender			0.942					0.159
Female	127 (85.2%)	22 (14.8%)		5 (3.4%)	42 (28.2%)	82 (55.0%)	20 (13.4%)	
Male	527 (85.0%)	93 (15.0%)		23 (3.7%)	233 (37.6%)	284 (45.8%)	80 (12.9%)	
Age	63.9 (10.1)	64.8 (9.9)	0.398	65.3 (8.9)	63.9 (9.8)	64.1 (10.6)	64.2 (9.6)	0.905
Partner status (N = 759)			0.524					0.865
No partner	122 (83.6%)	24 (16.4%)		5 (3.4%)	56 (38.4%)	65 (44.5%)	20 (13.7%)	
Partner	525 (85.6%)	88 (14.4%)		23 (3.8%)	216 (35.2%)	295 (48.1%)	79 (12.9%)	
Housing situation			0.197					0.711
Private home	622 (85.2%)	108 (14.8%)		28 (3.8%)	259 (35.5%)	347 (47.5%)	96 (13.2%)	
Other private home	9 (100.0%)	0 (0.0%)		0 (0.0%)	5 (55.6%)	4 (44.4%)	0 (0.0%)	
Other	23 (76.7%)	7 (23.3%)		0 (0.0%)	11 (36.7%)	15 (50.0%)	4 (13.3%)	
Charlson comorbidity index			0.542					**0.039**
0	360 (86.1%)	58 (13.9%)		16 (3.8%)	159 (38.0%)	195 (46.7%)	48 (11.5%)	
1	165 (85.5%)	28 (14.5%)		8 (4.1%)	75 (38.9%)	87 (45.1%)	23 (11.9%)	
2	78 (80.4%)	19 (19.6%)		2 (2.1%)	27 (27.8%)	55 (56.7%)	13 (13.4%)	
≥3	51 (83.6%)	10 (16.4%)		2 (3.3%)	14 (23.0%)	29 (47.5%)	16 (26.2%)	
ACS at admission or during baseline hospitalization			0.891					0.082
No ACS	442 (84.4%)	82 (15.6%)		22 (4.2%)	191 (36.5%)	240 (45.8%)	71 (13.5%)	
STEMI	51 (86.4%)	8 (13.6%)		3 (5.1%)	23 (39.0%)	26 (44.1%)	7 (11.9%)	
NSTEMI	83 (86.5%)	13 (13.5%)		3 (3.1%)	26 (27.1%)	60 (62.5%)	7 (7.3%)	
Unstable angina	78 (86.7%)	12 (13.3%)		0 (0.0%)	35 (38.9%)	40 (44.4%)	15 (16.7%)	
PCI at baseline			0.124					**0.039**
Yes	295 (87.3%)	43 (12.7%)		14 (4.1%)	122 (36.1%)	171 (50.6%)	31 (9.2%)	
No	359 (83.3%)	72 (16.7%)		14 (3.2%)	153 (35.5%)	195 (45.2%)	69 (16.0%)	
LVEF			0.087					0.407
< 45%	161 (81.3%)	37 (18.7%)		6 (3.0%)	72 (36.4%)	88 (44.4%)	32 (16.2%)	
≥45%	493 (86.3%)	78 (13.7%)		22 (3.9%)	203 (35.6%)	278 (48.7%)	68 (11.9%)	
Outpatient rehabilitation			0.335					0.102
Yes	44 (89.8%)	5 (10.2%)		3 (6.1%)	24 (49.0%)	19 (38.8%)	3 (6.1%)	
No	610 (84.7%)	110 (15.3%)		25 (3.5%)	251 (34.9%)	347 (48.2%)	97 (13.5%)	
PHQ-9			**0.002**					< **0.001**
< 7	417 (88.2%)	56 (11.8%)		22 (4.7%)	200 (42.3%)	211 (44.6%)	40 (8.5%)	
≥7	237 (80.1%)	59 (19.9%)		6 (2.0%)	75 (25.3%)	155 (52.4%)	60 (20.3%)	
PHQ-9 continuous score	6.0 (4.8)	7.4 (4.8)	**0.004**	4.1 (3.3)	5.1 (4.3)	6.6 (4.7)	8.5 (5.6)	< **0.001**

SD = Standard deviation. PHQ-9 = Patient health questionnaire. LVEF = Left ventricular ejection fraction. ACS = Acute coronary syndrome. STEMI = ST-segment elevation myocardial infarction. NSTEMI = non-ST-segment elevation myocardial infarction. Bold = p-value < 0.05.

re-hospitalized during the 30-day period. Median of hospital days in these patients was 5 days. Due to the small number of patients who were hospitalized, the number of hospital days was not included in further analyses.

In the sample for outpatient visits, 81.5% had visited their GP during the 30-day period. 91.3% had no contact to neuropsychiatrist, psychiatrist, neurologist, medical psychotherapist or psychological psychotherapist.

3.2. Health care service utilization

Table 2 shows participant characteristics according to the different health care service utilization measures.

There was no association between depressive symptoms and 30-day risk for re-hospitalization.

Depressive symptom scores were significantly associated with increased utilization of outpatient hospital services and outpatient physician visits (see Fig. 2).

Because outpatient physician visits comprised visits to psychiatrists, psychologists and neurologists, all of whom may treat depression, we analyzed the relation between visits to any of these specialties and depressive symptoms. 9.5% of patients with a PHQ-9 ≥7 had one outpatient visit to either a neuropsychiatrist, psychiatrist, neurologist, medical psychotherapist or psychological psychotherapist compared to 2.1% of patients with a PHQ-9 < 7 ($p < 0.001$). Furthermore, patients with one visit to either neuropsychiatrist, psychiatrist, neurologist, medical psychotherapist or psychological psychotherapist had a mean PHQ-9 score of 10.3 ($SD = 5.8$) compared to a mean PHQ-9 score of 5.8 ($SD = 4.5$) in patients with no visit to any of these specialists (patients with two or more visits to these specialists had a mean PHQ-9 score of 10.8; $SD = 5.3$; $p < 0.001$). However, when excluding those visits from the total number of outpatient physician visits, the results remained essentially unchanged. Therefore, further analyses of outpatient physician visits included all specialties. Due to the small number of patients in the groups with one or ≥2 visits to this provider group, we did not perform ordinal regression analyses to evaluate the covariable-adjusted association between depressive symptoms and visits to this provider group.

Table 3 shows the results of the unadjusted and adjusted regression models predicting different measures of health care utilization. In the sample for hospital re-admissions, depressive symptoms were not associated with 30-day re-hospitalization in the unadjusted or adjusted models.

In the sample for outpatient visits, patients with a PHQ-9 score ≥7 had an 85% increased risk for any outpatient hospital visit (OR = 1.85; 95% CI 1.24 – 2.76; $p = 0.002$). This finding remained statistically significant in the adjusted model (OR = 1.92; 95% CI 1.26 – 2.93; $p = 0.002$). In the unadjusted model that included the continuous measure of the PHQ-9, a one-point increase in the PHQ-9 lead to a 6% increase in the risk for any outpatient hospital visit (OR = 1.06; 95% CI 1.02 – 1.10; $p = 0.004$). This finding remained statistically significant in the adjusted model (OR 1.06; 95% CI 1.02 – 1.11; $p = 0.005$) (also see Fig. 2).

Patients with a PHQ-9 score ≥7 had a 146% increased risk for more outpatient physician visits (OR = 2.46; 95% CI 1.85 – 3.26; $p < 0.001$). This finding remained statistically significant in the adjusted model (OR = 2.36; 95% CI 1.75 – 3.18; $p < 0.001$). In the unadjusted model, a one-point increase in the continuous PHQ-9 score lead to a 10% increase in the risk for more outpatient physician visits (OR = 1.10; 95% CI 1.07 – 1.14; $p < 0.001$). This finding remained significant in the adjusted model (OR = 1.10; 95% CI 1.07 – 1.14; $p < 0.001$).

Because visits to GPs may have included depression treatment, we performed a sensitivity analysis for all outpatient physician visits excluding the GP visits. Again, depression was associated with a higher number of visits, in unadjusted and adjusted analyses (see eTable 1 and eTable 2).

4. Discussion

The present study analysed the effect of depressive symptoms on the utilization of health care services during the 30 days following a cardiac-related hospitalization. The results provide evidence that depressive symptoms lead to higher utilization of outpatient health care services.

Specifically, CHD patients with elevated depressive symptoms had more outpatient hospital visits and physician visits than non-depressed patients. These findings are consistent with previous studies which also showed more emergency department visits and more visits to doctors in depressed patients but which focused on a 12-month period or included only patients after myocardial infarction [21–23]. It is an important finding that after a cardiac-related hospitalization, short-term outpatient use is also increased because the majority of patients have at least one ambulatory care visit shortly after discharge. Consistent with this practice, over 95% of patients in our sample had at least one visit, and over 80% had visited their GP within the first 30 days. Despite this continuity in care, patients with depressive symptoms had an increased number of visits, irrespective of medical comorbidities.

In contrast, we did not find that depressive symptoms were associated with more hospitalizations as reported by previous studies that focused on long-term re-hospitalization [21–23]. Given the rather chronic than acute course of depression, its effect on short-term re-hospitalization might not be as strong as on long-term re-hospitalization.

As proposed by other authors, the main reason for higher utilization

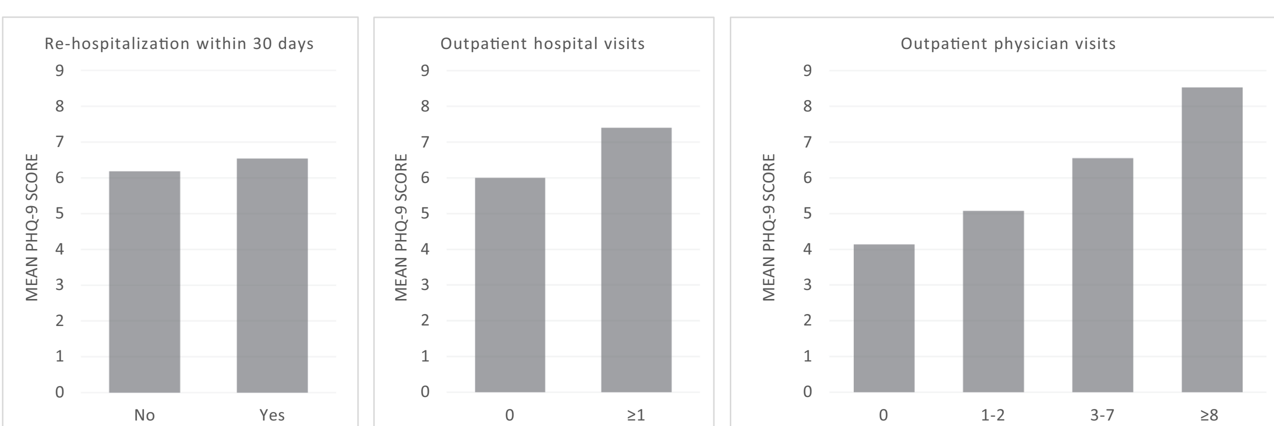

Fig. 2. Depressive symptom severity and health care utilization within 30 days post-discharge.

Table 3
Regression models for measures of 30-day in- and outpatient health care utilization. Binary logistic regression was performed for hospitalization (no/yes) and outpatient hospital visits (0/≥1 visits). Ordinal logistic regression was performed for outpatient physician visits (0/1-2/3-7/≥8 visits).

	Hospitalization[a]			Outpatient hospital visits[b]			Outpatient physician visits[b]		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
PHQ-9 ≥7 (vs. < 7)									
Unadjusted	1.01	0.66 – 1.56	0.950	1.85	1.24 – 2.76	**0.002**	2.46	1.85 – 3.26	< **0.001**
Adjusted	0.92	0.58 – 1.46	0.727	1.92	1.26 – 2.93	**0.002**	2.36	1.75 – 3.18	< **0.001**
PHQ-9 continuous score									
Unadjusted	1.02	0.97 – 1.06	0.489	1.06	1.02 – 1.10	**0.004**	1.10	1.07 – 1.14	< **0.001**
Adjusted	1.00	0.96 – 1.05	0.954	1.06	1.02 – 1.11	**0.005**	1.10	1.07 – 1.14	< **0.001**

Bold = p-value < 0.05.
[a] For hospitalization, the adjustment was for gender, age, partner status, Charlson comorbidity index, left ventricular ejection fraction, percutaneous coronary intervention at baseline, presence and type of acute coronary syndrome at baseline and any rehabilitation.
[b] For outpatient hospital visits and physician visits, the adjustment was for gender, age, partner status, Charlson comorbidity index, left ventricular ejection fraction, percutaneous coronary intervention at baseline, presence and type of acute coronary syndrome at baseline and outpatient rehabilitation.

of health care services among depressed patients might be the effect of depression on somatic symptoms [33]. Therefore, depressed patients might not have an objective need for the high amount of health care services they consume [23]. In fact, a recent study showed that when depressed patients receive diagnostic feedback and information on depression screening they tend to visit their GP less often than patients who receive no feedback or information on their screening result; the authors propose that this might be because informed patients attribute somatic symptoms to depression rather than to somatic diseases [34]. Another study showed that increased health care utilization and costs in depressed patients are mainly due to increased general health service utilization rather than due to depression treatment [35]. Therefore, from an economic perspective, it appears important to reduce general health care utilization in depressed patients. Of note, depression has been shown to increase costs in several other health care sectors, including nursing care and pharmaceuticals [36]. Treating depression typically results in additional healthcare costs from depression treatment but has been shown to potentially be cost-effective over time [37].

The prevalence of depressive symptoms of 38.8% in this sample is in line with previous studies that reported similar rates in CHD patients [38]. Interestingly, the Charlson Comorbidity Index was not a significant predictor of re-hospitalization which is consistent with a similar study by Edmondson et al [39]. On an additional note, patients who had received PCI at baseline were less often re-hospitalized than those who had not. However, in this study this finding did not remain significant after adjusting for age, gender and type of ACS at baseline. Participation in any rehabilitation was not significantly associated with the odds for re-hospitalization, and participation in outpatient rehabilitation was not associated with other outpatient healthcare utilization. However, less than 20% of patients in this sample participated in any kind of rehabilitation in this time frame and it is possible that participation in rehabilitation may impact subsequent healthcare utilization, potentially through improved adherence to secondary prevention.

Several limitations have to be noted. First, no distinction between cardiac and non-cardiac or depression and non-depression visits to doctors was made. Therefore, it is not possible to know what reasons patients visited their GP for. Since a lot of patients turn to their GP when experiencing depressive symptoms this distinction would have been valuable [34,40]. Second, the duration of depressive symptoms was not assessed. A study that focused on help-seeking behavior for mental health problems showed that the duration of depressive symptoms and personal stigma are also associated with higher health care utilization [41].Third, hospital re-admissions outside of the hospitals where the baseline hospitalization had occurred were only detected if patients reported on these hospitalizations (which were then subsequently verified by requesting discharge hospital records). Thus, the rate of re-hospitalizations may have been underestimated. However, it is unlikely that this would have caused a spurious relation between depressive symptoms and re-hospitalization. Lastly, depressed patients may have over- or underreported outpatient physician visits as those were not verified by medical records. Self-reports of healthcare utilization have been found to be fairly accurate for the time period of one month [42]. One study with elderly patients who had been discharged from hospitalization for depression showed that higher depressive symptoms were associated with a tendency for underreporting of subsequent outpatient visits [43]. If that was the case in our study also, depressed patients would have had a higher number of actual outpatient physician visits than reported and the association between depressive symptom level and healthcare utilization may have been stronger.

This study has several noteworthy implications. Depressed patients present a large group in CHD patients [38]. Depression has a significant impact on the outcome of CHD patients as it increases their risk for further cardiovascular events and mortality [1–3]. This study supports existing evidence that depression also leads to increased utilization of outpatient health care services independent of medical comorbidities, even in the first 30 days after discharge from hospitalization.

Declaration of Interest

Jakob Hornung: No conflict of interest.
Stella Linnea Kuhlmann: No conflict of interest.
Maria Radzimanowski: No conflict of interest.
Silke Jörgens: No conflict of interest.
Wilhelm Haverkamp has been a member of the advisory boards of or has given presentations on behalf of the following companies: AstraZeneca, Bayer, Boehringer Ingelheim, Daiichi Sankyo, Eli Lilly, Grünenthal, GlaxoSmithKline, Lundbeck, Medicines Company, MSD, Novartis, Pfizer, Trommsdorff and Servier.
Peter Martus: No conflict of interest.
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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.genhosppsych.2018.10.001.

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