Tilburg University

Tilburg University

Validity of a multidimensional comprehensive psychosocial screening instrument based on the ESC cardiovascular prevention guidelines

van den Houdt, S.; Albus, Chr.; Herrmann-Lingen, C.; Widdershoven, J.W.C.M.; Kupper, H.M.

Validity of a multidimensional comprehensive psychosocial screening instrument based on the ESC cardiovascular prevention guidelines – Evidence from the general and cardiovascular patient population

Sophie van den Houdt [a], Christian Albus [b], Christoph Herrmann-Lingen [c], Jos Widdershoven [a,d], Nina Kupper [a,*]

[a] Center of Research on Psychology in Somatic diseases (CoRPS), Department of Medical & Clinical Psychology, Tilburg University, the Netherlands
[b] Department of Psychosomatics and Psychotherapy, Medical Faculty and University Hospital of Cologne, Germany
[c] Department of Psychosomatic Medicine and Psychotherapy, University of Göttingen Medical Center and German Center for Cardiovascular Research (DZHK), partner site Göttingen, Germany
[d] Department of Cardiology, Elisabeth-TweeSteden Hospital, the Netherlands

ARTICLE INFO

ABSTRACT

Aim: To evaluate the psychometric properties and validity of the updated version of the Dutch multidimensional Comprehensive Psychosocial Screening Instrument in patients with coronary heart disease and the general population, based upon guideline recommendations from the European Society for Cardiology.

Method: 678 participants (M_{age} = 48.2, SD = 16.8; 46% male) of the Dutch general population and 312 cardiac patients (M_{age} = 65.9, SD = 9.9; 77% male) who recently received percutaneous coronary intervention completed the Comprehensive Psychosocial Screening Instrument and validated questionnaires for depression (PHQ-9), anxiety (GAD-7), Type D personality (DS14), hostility (CMHS), anger (STAS-T), trauma (SRIP), and chronic work and family stress (ERI, MMQ-6).

Results: Confirmatory factor analysis (CFA) confirmed that the eight screened risk factors were best measured as separate entities, rather than broader indications of distress. Inter-instrument agreement, assessed with the intraclass coefficient (ICC) and the screening accuracy indicators (receiving operator characteristic [ROC] curves, sensitivity, specificity, and the positive and negative predictive values [PPV; NPV]) were good for most screened risk factors. PPV was low in low prevalence risk factors like anxiety, trauma, and depression.

Conclusion: Overall, the current version of the Comprehensive Psychosocial Screening Instrument has an acceptable performance in both populations, with a fair to excellent level of agreement with established full questionnaires. Besides a few suggestions for further refinement, the screener may be implemented in primary care and cardiological practice.

1. Introduction

There is convincing evidence that various psychosocial factors contribute to both the risk of developing coronary heart disease (CHD), as well as worsening its progression and prognosis among patients with CHD [1,2], independent of classical cardiovascular risk factors such as smoking and hypertension. The European Society of Cardiology (ESC) 2016 guidelines on cardiovascular disease prevention in clinical practice [1] summarize these psychosocial risk factors, which include depression, anxiety, chronic stress (i.e., family, work), Type D personality, hostility, anger, low socio-economic status, lack of social support, post-traumatic stress/trauma, and a history of other psychiatric disorders.

Systematic screening for psychosocial risk factors could be of importance for both the general population (i.e., primary care

---

prevention) and for patients with established CHD (i.e., secondary prevention and clinical care), as psychosocial risk has proven relevant for the incidence and progression of distinct cardiovascular conditions [2–7]. Previous research findings have demonstrated that several psychosocial factors (e.g., depression, anxiety, anger) increase the risk of cardiovascular events in an apparently healthy population [8,9], supporting the causal effect of psychosocial risk factors on incident CHD [10]. These findings were corroborated in a sizeable longitudinal study among young Swedish men [11]. Moreover, psychosocial problems, such as distress, may be experienced years before the clinical presentation of cardiovascular events, setting the stage for continued adaptations in the cardiovascular system as a consequence of allostatic (over) load [10]. Systematic screening thus could identify apparently healthy individuals who are at risk of developing a cardiac condition, with primary care having a significant role in monitoring those individuals classified as high risk.

Patients with established CHD regularly report psychosocial problems such as anxiety, depression [12–14], post-traumatic stress disorder [10,12–14], and chronic stress [15]. Identification of risk profiles could aid individuals with getting appropriate counseling or care [7,16], which subsequently may improve their quality of life [1,17,18], and may negate future risk that comes with persistent distress. Several psychosocial interventions aimed at reducing the impact of psychosocial risk have proven useful [7,17]. To give a few examples, promising interventions may be collaborative care to treat depression and anxiety [19], nurse-led interventions on anxiety, general well-being, and depression [20,21], and group-based hostility-control interventions [22].

Taken together, systematic screening could provide an insight into patients' psychosocial risk profiles which eventually could initiate tailored psychological care, aiming to reduce the detrimental impact of the risk factors for individuals with and without established CHD. For example, a stepped-care approach could meet the patients' needs in terms of symptom severity and individual patient characteristics [23]. Furthermore, the ESC guidelines recommend considering the assessment of psychosocial risk factors (e.g., by standardized questionnaires) to identify potential barriers to treatment adherence and lifestyle change [1].

In a prior study [24], we examined the validity of the ESC guideline-based screening instrument as was proposed in the earlier 2012 guidelines on cardiovascular disease prevention in clinical practice [18], which was similarly recommended in the 2016 guidelines [1]. The instrument we first examined contained binary response categories for all items and reported on six risk factors (i.e., without anger and trauma) with one or two questions per construct. Our results showed that the screener in that format was not sufficiently valid to reliably detect all predefined psychosocial factors, though the screening items for anxiety and depression functioned well [24]. We concluded then that while the ESC guideline-based psychosocial screener is an easy to use, time-efficient, low-cost instrument, the screener needs psychometric improvement and more refinement. In the current, updated version of the Dutch Comprehensive Psychosocial Screening Instrument based on the 2016 ESC Prevention guidelines [1], we increased the detail in the answering scale (4-point Likert scale), added an item on energy/fatigue to gain information on somatic depression and included additional items to assess the personality constructs more extensively. Furthermore, we added items on trauma and anger following the renewed guidelines [1].

In sum, the current study aimed to evaluate the psychometric properties of an updated version of the Dutch Comprehensive Psychosocial Screening Instrument in two samples: one general population sample, and one real-world sample of patients with CHD. We hypothesized that the updated Comprehensive Psychosocial Screening Instrument is a valid representation of the validated scales with an adequate performance in terms of agreement and diagnostic accuracy indicators.

2. Methods

2.1. Participants and procedure (general population)

Participants belonging to the Southern Dutch general population were selected by convenience and invited to participate in the 2019 edition of the yearly psychological health survey by the Department of Medical & Clinical Psychology at Tilburg University. Research assistants got the instruction to each recruit 22 participants in person or by phone and apply quota sampling to reach an equal distribution of each age group across the adult life span (~18–85) and sex. Education and income levels were not taken into consideration in the quota. Participants received the survey in Qualtrics through e-mail or on paper, together with an information letter on the purpose of the study and an informed consent form. For those who received their questionnaire on paper, answers to the questionnaires were entered into the database by research assistants that were not related to the participant to protect their privacy. Each participant received a unique identifier to guarantee anonymity and ease data collection tracking. Ethical approval was granted by the Ethics Review Board of Tilburg University (protocol number: 2006/1101) [25–27].

2.2. Participants and procedure (patient population)

The Tilburg Health Outcomes Registry of Emotional Stress after Coronary Intervention (THORESCI) is a longitudinal observational cohort study on patients who received either an acute (i.e., urgent) or elective (i.e., planned) percutaneous coronary intervention (PCI) treatment for CHD at the Elisabeth-TweeSteden Hospital in Tilburg, the Netherlands. The THORESCI study started with inclusion in 2013 and both inclusion and data collection are currently ongoing. The updated version of the screener was implemented in May 2018. Consequently, the current sample only includes patients who completed the updated screening interview. Up until five days after PCI, patients were approached at the bedside or by phone (in case they had left the hospital already, as elective PCI is a day treatment) to take part in the study by a member of the research team, who further explained the aim and content of participation. After agreeing on participation and providing written consent, patients were given their first questionnaire and were called after 2 weeks to administer the Comprehensive Psychosocial Screening interview. Over the course of two years, participants were sent five surveys, of which the current study uses baseline and 1-month follow-up data unless mentioned otherwise. Inclusion criteria were being over 18 years of age and having a sufficient understanding of the Dutch language (i.e., both written and spoken). Patients with cognitive disabilities (e.g., dementia) or life-threatening comorbidity (e.g., metastasized cancer) were excluded. The study protocol and its amendments are in accordance with the Declaration of Helsinki and approved by the institutional Medical Ethical Review Board (METC Brabant). The current data analysis plan has been pre-registered on Open Science Framework (https://osf.io/5scqp/) for both the general and the patient population.

2.3. Materials

2.3.1. Comprehensive psychosocial screening instrument

The Comprehensive Psychosocial Screening Instrument (see Appendix) consists of 19 items that measure psychosocial problems. It serves as a quick assessment of psychosocial problems recommended to screen for according to the 2016 ESC prevention guidelines [1]. The general population received a version of the screening instrument as part of the larger survey. The items of the screening instrument are divided over eight components and assess depression, anxiety, work stress, family stress, Type D personality (i.e., social inhibition [SI] and negative affectivity [NA]), anger, hostility, and trauma. The Comprehensive Psychosocial Screening interview in the cardiac patient population did

not include one hostile attribution item, thus making the analysis slightly different from those of the general population.

The items on depression and anxiety are based on the PHQ-2 [28] and GAD-2 [29] respectively, with the first-mentioned being expanded in comparison to the original screener [24] with the PHQ-9 item on energy/fatigue to measure the somatic aspect of depression. Further, the screener addressed socioeconomic status, having experienced a traumatic event, and receiving treatment by a psychologist or psychiatrist. However, these items were left out for the analyses in the current study, as we labeled these as important contextual risk factors (e.g., an individual either has or has not experienced a traumatic event), rather than psychosocial risk factors on their own. Moreover, there are no specific tools to validate these items. Social support, or rather the lack thereof, was operationalized by the item 'Do you have someone you can confide in?'. We combined this item with the family stress item to be validated against the family stress scale (i.e., MMQ-6). When designing the screener improvements for the current screener version, we chose the items that best represented the construct (item-total correlation), and we held an expert meeting to choose the appropriate items and modify them if deemed appropriate. The items were answered on a 4-point Likert scale ranging from 'Not at all' [1] to 'Very much (so)' [4] and were already available in Dutch.

2.3.2. Validated scales

The scales from the Comprehensive Psychosocial Screening Instrument were compared to valid, established full-scale questionnaires for depression (PHQ-9 [30]), anxiety (GAD-7 [31]), Type D personality (DS14 [32]), effort-reward imbalance (ERI [33]), family stress (MMQ-6 [34]), hostility (CMHS-Williams subscale [35]), PTSD symptoms (SRIP [36]), and anger (STAS-T [37]). A full description of these questionnaires and their established clinical cutoffs (if available) are presented in the online methods supplement. All validated scales that were used in the general population were also used in the cardiac patient population. Some questionnaires, such as the PHQ-9 and GAD-7, were measured at multiple time points (baseline, 1-month follow-up). These time points were combined in such a way that one timepoint would be selected if the other one was missing. If both time points were available, T1 (1-month follow-up) was taken for analysis. The previously validated CMHS-Williams subscale to measure hostility was implemented in the study at a later timepoint and was for that reason not filled out by some participants (ongoing study). For a part of the screening items and validated questionnaires of family and work stress, items were missing not at random. As the MMQ-6 measures the quality of a romantic relationship, we only selected participants that had a partner for further analysis of the family stress items. We took a similar approach for the work stress items, as not all participants were employed due to retirement or educational reasons. Additionally, after careful examination of the ERI scale, we noticed that some participants did not answer all items as some of these items were not applicable given their career stage (e.g., not being considered for a promotion due to being close to retirement), which was corrected for by requiring at least 15 out of 18 answers given that three items contained a large number of missing values, due to above-stated reasons. In this case, we imputed the mean of the other items.

2.3.3. Demographic and clinical variables

Demographic variables were obtained from self-report and included sex, age, educational level, relationship status, and employment status. We obtained information on biomedical risk factors (e.g., diabetes, hypertension, smoking) and previous cardiac history by self-report in the general population by asking whether there were any rhythm or ischemic diagnoses made by a cardiologist previously. For the patient population, clinical variables and information on cardiac history were derived from the medical records. Clinical variables included diagnosis, indication for PCI (i.e., elective or acute), and biomedical risk factors (i. e., family history, hypercholesterolemia, diabetes mellitus type 2,

smoking, depression, and hypertension).

2.4. Statistical analysis

Confirmatory factor analysis – We assessed whether the items of the Comprehensive Psychosocial Screening Instrument loaded on the corresponding factors by confirmatory factor analysis (CFA) in R, using the packages 'lavaan' [38], 'psych' [39], and 'haven' [40]. Four models were compared: first, an eight-factor model, comprising all psychosocial constructs of the current screening instrument (model 1). Then, a three-factor model, i.e., emotion, personality, and stress (model 2a) was tested, followed by a model that divided the stress component in work stress and family stress (model 2b). Lastly, a one-factor model with all items loading on one factor (model 3) was fit. Model fit was compared with Chi-square Difference Tests (CSDT).

Agreement – Two-way mixed reliability analyses were performed in SPSS 24.0 [41] to calculate Intraclass Correlation Coefficients (ICC) based on consistency and absolute agreement between the standardized total scores of the validated scales and the corresponding items per construct (average measures). Values below 0.5 indicate a poor level of reliability, values between 0.5 and 0.75 a sufficient reliability, values between 0.75 and 0.9 a good reliability, and ICCs above 0.9 an excellent level of reliability [42].

Screening accuracy – Cross tables examined the relationships between screening scores and validated scale scores. Dichotomized scores based on standardized (i.e., tertile and quartile) and validated cut-offs of the validated scales were used to determine the optimal cut-off score for the screening items by calculating the Receiver Operating Characteristic (ROC) curves for each construct, of which an Area Under the Curve (AUC) larger than 0.6 indicates sufficient diagnostic ability [43]. Consequently, the ROC curves determined the optimal levels of sensitivity (i.e., the ability of the screening instrument to accurately indicate the existence of psychosocial problems as compared to the validated questionnaires) and specificity (i.e., the ability of the screening instrument to accurately indicate the absence of psychosocial problems as compared to the validated questionnaires). The positive predictive value (PPV) and negative predictive value (NPV) were calculated to obtain the percentage of participants who had a positive or negative score respectively on both the screener as well as the validated instrument. To ensure an easier textual interpretation, we described the sensitivity, specificity, PPV and NPV results in categories, i.e., low (<50%), moderate (50–74%), good (75–89%), and excellent (90%), while the respective tables hold the exact numbers.

Because the screening instrument is supposed to serve as a screening tool rather than a diagnostic tool, we assessed the most optimal cut-off scores for each risk factor (if applicable) to implement in a stepped care approach. Furthermore, we preferred using a stricter approach in such a way that we limit the risk of not detecting people who would benefit from receiving additional care. For depression (PHQ-9) and anxiety (GAD-7), two cut-off points have been clinically validated to classify symptoms as either mild (score of 5) or moderate to severe (score of at least 10). The scales for chronic stress (i.e., MMQ-6 and ERI), anger (STAS-T), and hostility (CMHS) did not have an established cut-off point, thus we studied the screening accuracy based on the cut-off points derived from both the upper quartile and tertile for these scales. The DS14 for Type D personality [44] and SRIP for trauma [36] have only one determined clinical cut-off score to classify someone as either having or not having Type D personality or PTSD symptoms, respectively. The optimal cut-off score for the screener scales was based on both the ROC curve (i.e., optimal levels of sensitivity and specificity), as well as the PPV and NPV. Table S1 in the online supplement provides an overview of the cut-off values for each subscale of the screening instrument and ROC curves per cut-off value for each validated scale.

Statistical power – Based on previous recommendations, larger sample sizes (N > 200) are preferred as they provide more precision and stability regarding the factor loadings [45]. There is no specific rule on the

sample/power ratio because both over-determination and communalities can affect the required sample size greatly. Given that the data used in the current study were already collected in the light of other research aims, we made use of it in the form in which it was accessible to us. This effort resulted in the observed sample sizes ($N > 300$ for both samples).

3. Results

3.1. Results general population

3.1.1. Sample characteristics

In the general population, an equal representation of age was ensured among 678 participants (54% female), with age groups ranging from 18 to 85 ($M = 48.18$, $SD = 16.80$). Participant characteristics are displayed in Table 1.

3.1.2. Confirmatory factor analysis

CFA initially revealed an issue regarding the structure of the model after which secondary analysis was done to assess the nature of the issue, which is explained in more detail in the online results supplement. After careful consideration of the aforementioned issue, results demonstrated the eight-factor model to have a fair (CFI = 0.829) to good (RMSEA = 0.051, SRMR = 0.051) model fit. Results of the CSDTs revealed that the fit of the eight-factor model was significantly better than the three-factor model ($\Delta \chi^2 = 122.53$; $\Delta df = 24$; $p < .05$), four-factor model ($\Delta \chi^2 = 45.809$; $\Delta df = 21$; $p < .05$) and one-factor model ($\Delta \chi^2 = 199.7$; $\Delta df = 27$; $p < .05$). Additionally, inspection of the fit indices (i.e., CFI, RMSEA, and SRMR) similarly indicated that overall, the eight-factor model had the best values. All results are displayed in Table 2.

3.1.3. Agreement and screening accuracy

The results of the descriptive analyses and the results of the cross-tabulation analyses and on the agreement for the general population are displayed in Table 3 and Table 4, respectively. The ROC curves demonstrated sufficient screening accuracy, evident in higher AUC levels (CI 95% upper bound AUC > 0.6; Table S1) for all constructs, with excellent levels (upper bound >0.9) for depression, anxiety, and Type D personality. Further results on screening accuracy are discussed below

Table 1
Participant characteristics for the general and patient population.

	General population	Patient population
Demographics		
Sex, men	312 (46%)	239 (77%)
Age, *M(SD)*	48.18 (16.80)	65.85 (9.89)
Employed	460 (68%)	108 (42%)
Having a partner	513 (78%)	233 (83%)
Medical history		
Risk factors		
Family history of cardiovascular disease <60	–	137 (49%)
Hypercholesterolemia	29 (4%)	99 (35%)
Hypertension	73 (10%)*	127 (45%)
Diabetes mellitus type 2	18 (3%)*	33 (12%)
Smoking	105 (16%)	48 (17%)
Obesity	83 (11%)**	70 (26%)
Cardiac history	45 (6%)***	88 (32%)****
CABG	–	27 (10%)
MI	–	57 (21%)
PCI	–	60 (22%)
Anxiety and/or depression diagnosis	56 (8%)	–

Data are presented as n(%) unless otherwise indicated. M (SD) = mean (standard deviation).

* Self-reported in general population (measured in the past 3 months and was too high, or doctor diagnosed me with…)
** based on self-report weight and height
*** self-report: doctor diagnosed me with heart disease (rhythm or ischemic)
**** cardiac history before the PCI that led to enrollment in the current study.

Table 2
Results of the confirmatory factor analysis and Chi-Squared Difference Tests (CSDT) in the general population and patient population.

Model	Fit Indices			CSDT[a]
General population	CFI	RMSEA	SRMR	
1: Eight-factor Model	0.829	0.051	0.051	–
2a: Three-factor Model (stress, emotion, personality)	0.726	0.056	0.063	$\Delta \chi^2 = 122.53$ ($\Delta df = 24$)*
2b: Four-factor model (work stress, social stress, emotion, personality)	0.823	0.049	0.056	$\Delta \chi^2 = 45.809$ ($\Delta df = 21$)*
3: One-factor Model	0.707	0.053	0.070	$\Delta \chi^2 = 199.730$ ($\Delta df = 27$)*
Patient Population				
1: Eight-factor Model	0.825	0.052	0.067	
2a: Three-factor Model (stress, emotion, personality)	0.803	0.049	0.075	$\Delta \chi^2 = 36.974$ ($\Delta df = 22$)*
2b: Four-factor model (work stress, social stress, emotion, personality)	0.799	0.050	0.075	$\Delta \chi^2 = 36.753$ ($\Delta df = 20$)*
3: One-factor Model	0.766	0.052	0.079	$\Delta \chi^2 = 56.565$ ($\Delta df = 25$)*

CFI = Comparative Fit Index, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardized Root Mean Squared Residual.
* $p < .05$ favoring the eight-factor model.
[a] Based on CSDT when compared to the first model.

Table 3
Numbers (percentages) of positive scores of the Comprehensive Psychosocial Screening instrument versus validated instruments and final cut-off scores.

General components	Positive Scores General Population (GP)	Positive Scores Patient Population (PP)	Cut-offs used for screener scales
	S | V, n/total (%)	S| V, n/total(%)	
Depression (PHQ-9)	95/659 (14) | 58/657 (9)	104/309 (34) | 24/265 (9)	6.5 (GP), 5.5 (PP)
Anxiety (GAD-7)	123/656 (19) | 42/654 (6)	69/305 (23) | 24/265 (9)	3.5
Type D (DS14)	181/661 (27) | 142/638 (22)	68/310 (22) | 45/263 (17)	9
(NA)	270/660 (41) | 216/638 (34)	114/309 (37) | 79/263 (30)	2.5
(SI)	340/662 (51) | 268/638 (42)	145/310 (47) | 93/263 (35)	2.5
Work stress[a] (ERI)	185/446 (42) | 96/381 (25)	29/105 (28) | 24/71 (34)*	3.5
Family stress[b] (MMQ)	124/498 (25) | 158/456 (35)*	44/233 (19) | 68/195 (35)*	1.5
Hostility (CMHS)	270/656 (41) | 256/634 (40)*	45/129 (35) | 61/127 (48)*	4.5 (GP), 2.5 (PP)[c]
Trauma (SRIP cut-off 1); (cut-off 2)	142/653 (22) | 26/641 (4); 142/653 (22) | 38/678 (6)	63/309 (20) | 6/216 (3); N/A | N/A	1.5; –
Anger (STAS-T)	182/661 (28) | 173/640 (27)	91/309 (29) | 63/218 (29)	3.5

S = Screener, V = Validated instrument, PHQ-9 = Patient Health Questionnaire-9, GAD-7 = Generalized Anxiety Questionnaire 7, DS14 = Type D Scale 14, NA = Negative Affectivity, SI = Social Inhibition, ERI = Effort-Reward Imbalance Scale, MMQ-6 = Maudsley Marital Questionnaire 6, CMHS = Cook Medley Hostility Scale, SRIP/SRIP = Self-Rating Inventory (1 and 2 refers to cut-offs), STAS-T = State-Trait Anger Scale (Trait subscale).
* Mild (i.e., tertile) cut-offs,
[a] Only participants with a job,
[b] Only participants with a partner,
[c] The scale consisted of two hostility items in patient population and three hostility items in general population.

Table 4
Cross tabulation analysis of Comprehensive Psychosocial Screening constructs (vertical) versus validated instruments (horizontal) in the general population.

General construct	Mean (SD) Validated	Mean (SD) Screener	Cross Tables				
Depression (PHQ9)	3.50 (4.29)	4.82 (1.86)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.881	95% CI [0.861, 0.898]	**No**	551	8	86.2%	92.7%
			Yes	43	50	**PPV**	**NPV**
						53.8%	98.6%
Anxiety (GAD7)	2.80 (3.66)	2.72 (1.11)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.760	95% CI [0.720, 0.795]	**No**	517	7	83.3%	85.6%
			Yes	87	35	**PPV**	**NPV**
						28.7%	98.7%
Type D (DS14)	16.88 (9.09)	8.62 (7.14)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.817	95% CI [0.786, 0.844]	**No**	426	39	72.3%	86.2%
			Yes	68	102	**PPV**	**NPV**
						60.0%	91.6%
NA (Type D)	7.82 (5.03)	2.75(0.75)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.795	95% CI [0.760, 0.824]	**No**	330	50	76.7%	78.8%
			Yes	89	165	**PPV**	**NPV**
						65.0%	86.8%
SI (Type D)	9.05 (5.36)	2.94 (1.21)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.828	95% CI [0.799, 0.853]	**No**	269	43	83.9%	72.9%
			Yes	100	224	PPV	NPV
						69.1%	86.2%
Work Stress (ERI)	35.24 (8.16)	3.45 (1.36)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.685	95% CI [0.615, 0.743]	**No**	196	24	75.0%	69.0%
			Yes	88	72	**PPV**	**NPV**
						45.0%	89.1%
Family Stress*(MMQ-6)	4.43 (5.55)	1.33 (0.66)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.480	95% CI [0.374, 0.568]	**No**	246	90	41.6%	83.3%
			Yes	49	64	**PPV**	**NPV**
						56.6%	73.2%
Hostility*(CMHS)	9.25 (1.77)	4.53 (1.50)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.528	95% CI [0.448, 0.598]	**No**	264	109	56.7%	70.6%
			Yes	110	143	**PPV**	**NPV**
						56.5%	70.8%
Trauma (SRIP)	30.05 (8.82)	1.28 (0.62)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.712	95% CI [0.663, 0.754]	**No**	489|502	7|9	73.1% |76.3%	81.0% | 81.6%
			Yes	115|113	19|29	**PPV**	**NPV**
						14.2% | 20.4%	98.6% | 98.2%
Anger (STAS-T)	14.12 (4.15)	3.02 (1.21)		**No**	**Yes**	**Sensitivity**	**Specificity**
	ICC = 0.681	95% CI [0.628, 0.728]	**No**	385	77	53.9%	82.3%
			Yes	83	90	**PPV**	**NPV**
						50.6%	83.3%

ICC = Intraclass Correlation, PHQ-9 = Patient Health Questionnaire-9, GAD-7 = Generalized Anxiety Questionnaire 7, DS14 = Type D Scale 14, NA = Negative Affectivity, SI = Social Inhibition, ERI = Effort-Reward Imbalance Scale, MMQ-6 = Maudsley Marital Questionnaire 6, CMHS = Cook Medley Hostility Scale, SRIP = Self-Rating Inventory (1 and 2 refers to set cut-off and DSM-IV cut-off, respectively), STAS-T = State-Trait Anger Scale (Trait subscale); PPV = Positive Predictive Value; NPV = Negative Predictive Value.

* Mild (i.e., tertile) cut-offs.

and are displayed in Table 4.

Depression and Anxiety. The *moderate to severe* clinical cut-off point led to the most optimal levels of screening accuracy. The ICCs (NB. Because consistency and absolute agreement ICCs were equal, with 0.001 difference, we only report one) indicated a good agreement between the depression screening scale and the PHQ-9, which did not surprise as two out of the three screening items were based on the PHQ-2 [28], with the additional screening item on fatigue distinctively adding to the screening scale. Cross-table analysis showed that for depression the specificity, sensitivity, and NPV were good to excellent, and the PPV moderate. Similarly, for anxiety, a good agreement between the Comprehensive Psychosocial Screening Instrument and the GAD-7 was found, with good levels of sensitivity and specificity, and an excellent level for the NPV, whereas the PPV was rather low (Table 4).

Type D personality. Agreement in rank association (i.e., ICC) between the DS14 and Type D screening items was good for both the overall scale and the subscales (i.e., NA and SI). The Type D screening items (overall and subscales) showed satisfying screening accuracy parameters ranging from moderate to good, with an excellent NPV for the overall scale (Table 4).

Stress. For work stress, the strict (quartile) cut-off provided the best results, whereas for family stress the mild (tertile) cut-off led to more optimal levels. ICCs indicated sufficient agreement between the work

stress items and the ERI, and poor agreement for the family stress items with the MMQ-6. The work stress items revealed that specificity and sensitivity were moderate and good, respectively, with a good NPV and a low PPV. For family stress, the cross-tables revealed that the specificity was good, the predictive values moderate, and the sensitivity was low (Table 4).

Hostility, Anger and Trauma. For hostility, both the strict (quartile) and mild (tertile) cut-off score on the validated scale for hostility (CMHS) yielded the same results regarding the most optimal levels for the screening accuracy indicators. The ICC demonstrated a sufficient level of agreement between the hostility screening scale and the CMHS. Cross-table analysis revealed moderate screening accuracy parameters. For anger, the strict cut-off score indicated the best screening accuracy with sufficient agreement between the validated anger scale (STAS-T) and the screening items. The NPV and specificity were good, whereas the sensitivity and PPV were moderate. Finally, with respect to the trauma screening item, the ICC indicated a sufficient agreement between the validated SRIP and the trauma screening item. Cross-table results indicated that the specificity was good, and the NPV excellent, with sufficient to good sensitivity and a low PPV (Table 4).

Taken together, the screening items for depression, anxiety, Type D personality (NA and SI included) and trauma functioned well in the general population, whereas the stress, anger, and hostility items

showed an overall moderate but sufficient screening accuracy. It is of note that positive cases obtained by the Comprehensive Psychosocial Screening Instrument were higher for the majority of the screening constructs, as compared to the validated scales (see Table 3).

3.2. Results patient population

3.2.1. Sample characteristics

In total, 312 participants were included in this sample (77% male; 51% elective PCI; Mean age 65.85 (SD = 9.89)). Baseline patient characteristics are displayed in Table 1.

3.2.2. Confirmatory factor analysis

The CFA of the patient population likewise revealed a technical issue, which is explained in detail in the online results supplement. After careful consideration of the model, the adjusted eight-factor model revealed similar conclusions as those of the general population with a fair (CFI = 0.825) to good (RMSEA = 0.052; SRMR = 0.067) fit to the data. Results of the CSDTs demonstrated that the fit of the eight-factor model was significantly better than the three-factor model ($\Delta \chi^2$ = 36.974; Δdf = 22; p < .05), four-factor model ($\Delta \chi^2$ = 36.753; Δdf = 20; p < .05) and one-factor model ($\Delta \chi^2$ = 56.565; Δdf = 25; p < .05). Overall, the CFI and SRMR fit indices were better for the eight-factor model when compared to the other three models, whereas the RMSEA

was comparable to the one-factor model (0.052) and somewhat less desirable than the three-factor (0.049) and four-factor (0.050). All results of the CFA and the CSDT are displayed in Table 2.

3.2.3. Agreement and screening accuracy

Positive results on both the screening scales and the validated scales are displayed in Table 3. All cut-off scores of the screening instrument were established in the same way as was done in the general population and led to the same decisions based on the cut-off scores on the validated scales except for depression: a cut-off point of 5.5 on the screening scale was found to be most optimal in the cardiac patient population instead of a score of 6.5 as retrieved in the general population (see Table S1). The results indicated that for most of the constructs, the screener more often classified individuals as positive when compared to validated scales. The ROC curves indicated sufficient to good screening accuracy as indicated by the area under the curve measures (95% CI upper bound AUC > 0.6; S2). Further results on screening accuracy are discussed below and displayed in Table 5.

Depression and Anxiety. For depression, sufficient agreement between the screening items and the PHQ-9 was found based on the moderate to severe cut-off score (i.e., at least 10) leading to a screener cut-off point of 5.5. Cross-table analysis showed that specificity and sensitivity were good and the NPV excellent, whereas the PPV was low. Based on this cut-off score, we observed that for depression the

Table 5

Cross tabulation analysis of Comprehensive Psychosocial Screening constructs (vertical) versus validated instruments (horizontal) in the patient population.

General construct	Mean (SD) Validated	Mean (SD) Screener	Cross Tables		No	Yes		
Depression (PHQ9)	4.58 (4.39)	4.93 (1.73)			No	Yes	Sensitivity	Specificity
	ICC = 0.718	95% CI [0.640, 0.779]	No		179	4	83.3%	75.2%
			Yes		59	20	PPV	NPV
							25.3%	97.8%
Anxiety (GAD7)	3.75 (3.83)	2.82 (1.17)			No	Yes	Sensitivity	Specificity
	ICC = 0.676	95% CI [0.586, 0.746]	No		197	7	68.2%	83.1%
			Yes		40	15	PPV	NPV
							27.3%	96.6%
Type D (DS14)	14.65 (10.38)	7.93 (5.28)			No	Yes	Sensitivity	Specificity
	ICC = 0.735	95% CI [0.690, 0.810]	No		189	17	62.2%	87.1%
			Yes		28	28	PPV	NPV
							50.0%	91.7%
NA (Type D)	7.12 (5.93)	2.64 (1.02)			No	Yes	Sensitivity	Specificity
	ICC = 0.765	95% CI [0.662, 0.793]	No		144	25	68.4%	79.1%
			Yes		38	54	PPV	NPV
							58.7%	85.2%
SI (Type D)	7.53 (6.31)	2.91 (1.25)			No	Yes	Sensitivity	Specificity
	ICC = 0.757	95% CI [0.701, 0.816]	No		119	18	70.8%	80.6%
			Yes		49	75	PPV	NPV
							60.5%	86.9%
Work Stress (ERI)*	37.14 (7.51)	2.98 (1.16)			No	Yes	Sensitivity	Specificity
	ICC = 0.580	95% CI [0.316, 0.738]	No		40	12	50.0%	88.9%
			Yes		5	12	PPV	NPV
							70.6%	76.9%
Family Stress (MMQ-6)	3.36 (4.71)	1.23 (0.50)			No	Yes	Sensitivity	Specificity
	ICC = 0.398	95% CI [0.200, 0.547]	No		110	52	23.5%	88.7%
			Yes		14	16	PPV	NPV
							53.3%	67.9%
Hostility (CMHS)	8.97 (1.71)	2.95 (1.20)			No	Yes	Sensitivity	Specificity
	ICC = 0.484	95% CI [0.268, 0.638]	No		51	15	65.1%	60.7%
			Yes		33	28	PPV	NPV
							45.9%	77.3%
Trauma (SRIP)	30.15 (8.61)	1.25 (0.54)			No	Yes	Sensitivity	Specificity
	ICC = 0.481	95% CI [0.321, 0.603]	No		175	4	33.3%	83.4%
			Yes		34	2	PPV	NPV
							5.6%	97.8%
Anger (STAS-T)	13.89 (4.12)	3.06 (1.34)			No	Yes	Sensitivity	Specificity
	ICC = 0.539	95% CI [0.397, 0.647]	No		124	34	46.0%	81.0%
			Yes		29	29	PPV	NPV
							50.0%	78.5%

ICC = Intraclass Correlation, PHQ-9 = Patient Health Questionnaire-9, GAD-7 = Generalized Anxiety Questionnaire 7, DS14 = Type D Scale 14, NA = Negative Affectivity, SI = Social Inhibition, ERI = Effort-Reward Imbalance Scale, MMQ-6 = Maudsley Marital Questionnaire 6, CMHS = Cook Medley Hostility Scale, SRIP = Self-Rating Inventory for PTSD, STAS-T = State-Trait Anger Scale (Trait subscale); PPV = Positive Predictive Value; NPV = Negative Predictive Value

*   Mild (i.e., tertile) cut-offs.

Comprehensive Psychosocial Screening Instrument indicated a much higher prevalence as compared to the PHQ-9 (34% vs. 9% respectively; Table 2). However, increasing the cut-off point to 6.5 or 7.5 to match prevalence levels drastically decreased sensitivity levels (i.e., 50% and 46% respectively) with low (34%) to moderate (50%) levels for the PPV. We thus stuck with the 5.5 cut-off score based on the most optimal test statistics given our aim to implement the screener in a stepped care approach. For anxiety, the ICC revealed a sufficient agreement between the screening scale and the GAD-7, which was based on the moderate to severe cut-off (i.e., 10). Like the depression items, differences in prevalence were observed (Table 3). Increasing the cut-off score would lead to sensitivity decreasing to moderate (55%) and low (23%) levels for cut-off scores of 4.5 and 5.5, respectively. PPV levels revealed an opposite pattern increasing to moderate to sufficient levels (50% and 63% respectively). Like the depression scale, we based our decisions on the test statistics which favored the 3.5 screening cut-off score. Results of the cross-tabulation analysis showed that for this cut-off score the specificity was good, the NPV excellent, sensitivity moderate, and the PPV low (Table 5).

Type D personality. The ICCs for Type D personality indicated a sufficient agreement with the 4-item scale and good agreement with the two 2-item subscales (NA and SI) of the screening scale with the DS14. Both the full screening scale, as well as NA and SI separately indicated moderate sensitivity levels and PPVs, and good to excellent NPVs. Specificity levels were good (Table 5).

Stress. For the stress scales, tertile cut-off scores were most optimal (Table S1). The ICC indicated a sufficient level of agreement between the ERI and the work stress screening items. The sensitivity and PPV were moderate, and the specificity and NPV were good. For family stress, a low agreement between the MMQ-6 and the Comprehensive Psychosocial Screening Instrument was found. The results of the cross-table analysis showed a low sensitivity but a good specificity. The PPV and NPV were both moderate (Table 5).

Hostility, Trauma, and Anger. The agreement between the validated scales and their corresponding screener items was found to be low for hostility and trauma, and sufficient for anger. Like the general population, the mild and strict cut-off scores for the validated hostility scale (CMHS) led to the same cut-off for the hostility screening items. Cross-table analysis results indicated that sensitivity and specificity were moderate, the NPV was deemed good, and the PPV was low. Cross-table analysis for trauma showed a low sensitivity and low PPV, while the specificity and NPV were found to be good to excellent, respectively. For anger, the strict cut-off on the validation scale STAS-T was found to be most optimal, leading to low sensitivity, a moderate PPV, and good levels for the NPV and specificity (Table 5).

Taken together, the screener items on depression functioned well, and items on anxiety and Type D personality functioned sufficiently with good levels of specificity and NPV, whereas the sensitivity could be improved. For low prevalence constructs like anxiety, trauma, and depression, the PPV was directly negatively influenced which was partly based on our decision for the cut-off scores for anxiety and depression. Work stress, trauma, anger, and hostility screening scales showed mixed, but overall sufficient results with differences in levels for the screening accuracy indicators. Family stress functioned the least optimal with low sensitivity and a moderate PPV.

4. Discussion

The current study tested the validity of a second, updated, version of a Comprehensive Psychosocial Screening Instrument, among a general population and a patient population with CHD. Results showed similar findings in both populations: the screener assesses the eight psychosocial factors validly and with sufficient to good diagnostic accuracy, showing better performance than the previous version of the screening instrument [24].

Factor structure - The validity of the eight-factor model was confirmed by the results of the confirmatory factor analysis in both populations, suggesting the psychological risk factors were best measured as separate constructs, rather than broader indications of distress [1]. This finding is not in concordance with our previous publication on an earlier version of the psychosocial screener [24]. The current approach differed though, in that we explicitly compared the fit of several models in confirmatory factor analysis, instead of exploratory factor analysis. Moreover, socio-economic status, negative life events, and psychiatric history were left out of the validation. While these are important contextual factors, they do not represent true psychosocial constructs. The *lack of a close confidant* item did not have an optimal performance in the patient population and therefore was excluded from the validation. While this is a limitation of the current study, future analysis should examine whether items focusing on other forms of social support need to be added to the screener.

Construct validity & screening accuracy - The current screener outperformed its previous version [24] in terms of inter-instrument agreement, improved balance between sensitivity and specificity, and improved NPVs for all constructs. Screening accuracy was best for depression, anxiety, and Type D personality, owing to the implemented scale improvements, following foregoing recommendations and our expert meeting [24,47]. The PPVs were low in low-prevalence constructs, which did not come as a surprise given the direct influence of prevalence on the PPV [48]. Another reason for the low agreement in positive cases can be that the first month post-PCI is a relatively volatile period, in which emotional stress may fluctuate from one moment to the next.

In the patient population, the sensitivity of the anxiety scale might still be improved: one way to do that is to add more items like we successfully did for depression and Type D personality. In these cardiac patients, anxiety is often heart-focused, including avoidance of physical activity [49] which we recommend adding in a future version. Furthermore, it should be emphasized that the anxiety screening items ask for symptoms of different anxiety disorders (e.g., general anxiety and panic), whereas we validated these items against the GAD-7, which is an established screening instrument in cardiac rehabilitation, while it simultaneously solely focuses on generalized anxiety. Besides generalized anxiety, other anxiety disorders such as panic disorder and phobias are also common in CHD patients [50]. This suboptimal external criterion may also have accounted for the observed low PPV.

Furthermore, we observed large differences between the prevalences for depression and anxiety, comparing screening scores with full instrument scores, leading to further scrutiny of the most optimal test statistics. However, increasing the cut-off score to match the prevalences according to the validated scales led to less optimal sensitivity levels which eventually could cause more false negatives. The more lenient cut-off test statistics thus perform better which subsequently could lead to a better performance in a stepped care protocol. Additionally, follow-up (e.g., clinical interviews) based on the increased cut-off scores might miss individuals who would benefit from interventions that target depression and/or anxiety. Those who use the screening instrument professionally could ultimately decide which cut-off score matches best with their target audience and available follow-up methods.

Trauma had the lowest PPV, likely because of the low prevalence of trauma in the current samples [48]. Additionally, the sensitivity of the trauma item was low in the patient population. In the current screening instrument trauma was assessed with an item on re-experience only, whereas both the clinical manifestation of PTSD [51] and the validation scale SRIP [36] are based on re-experience, avoidance, and hyperarousal. Previous research suggests cardiac patients may be prone to the development of all three dimensions of PTSD [52]. As PTSD symptoms may importantly contribute to higher cardiometabolic risk [13,14], we recommend expanding the Comprehensive Psychosocial Screening Instrument with two additional items that cover the remaining symptom dimensions, which could simultaneously improve screening accuracy.

The screening for hostility had a moderate to sufficient performance.

The Williams subscale of the CMHS [35], chosen for its predictive qualities [53], taps into multiple domains of hostility. Based on the criticism of the first screener [24], items on mistrust and cynicism were assessed in the current screening instrument next to a general item on hostile attribution, which led to improved performance in comparison to the previous version [24]. While the screening instrument expanded its answer options from two to four, the items in the Williams hostility subscale still have a binary character, which likely may have resulted in a limited variance in the hostility full-scale score [53].

The items of work stress similarly indicated mixed, but sufficiently sound results, which may be explained by an increased number of missing values on the full- scale (ERI): in the older aged working population, getting a promotion may be less relevant, and such items were more often left unanswered. Nevertheless, compared to the previous screener [24] the items improved on most of the screening accuracy indicators and still perform sufficiently.

The family stress screening component had the least desirable performance, although it performed better than in the previous screening instrument. The comparison instrument MMQ-6 assesses the quality of the relationship with a partner which could lead to inconsistencies when there is social stress within the family but not in the partner relationship. Social desirability may also have played a role in the cardiac patient population, as the screening instrument was administered by an interviewer. Lastly, chronic family stress can be characterized by multiple components, such as psychological abuse [54] or a lack of family cohesion [55]. More insight into the most important contributors of family stress is thus needed, which could be examined by an in-depth qualitative exploration.

The results of decades of work on the effects of psychosocial on the incidence and prognosis of heart disease, and their intermediate mechanisms abundantly show that cardiovascular risk is increased not only with the presence of depression, or anxiety, but also with the presence of chronic stress, lack of social support, and certain aspects of personality that put a burden on allostasis (e.g., 2, 3, 4–15). While the most recent ESC prevention guidelines [56] acknowledge the role of a broad spectrum of psychosocial risk factors, it differs from previous guidelines [1] in their recommendations for self-rating instruments. The currently validated Comprehensive Psychosocial Screening Instrument could fill the gap between the acknowledgment of the importance of screening for multiple risk factors on the one hand, and the limited amount of research and the lack of a multidimensional screening instrument on the other hand.

4.1. Clinical implications

*4.1***Clinicalimplications**- The ultimate value of a psychosocial screening tool depends on a clinician's willingness, i.e., cardiologists, cardiac rehabilitation nurses, medical psychologists, and general practitioners, to use it in clinical practice. Other self-reported screening tools are available, like for example the full-size instruments we used for validation purposes, but these are screening for one psychological risk factor only, and their (combined) length poses obstacles for implementation in clinical practice. The currently validated psychosocial screening tool involves the assessment of eight constructs, plus socioeconomic factors, social isolation, and psychiatric history on one page (23 items). The next step is to examine the willingness of physicians and nurses to implement the screening tool in their clinical practice, and to involve patients in issues related to privacy (i.e., who should be allowed to view results in the electronic medical records), rate of administration, and look and feel of the tool. For the patient population, the course and prognosis of the heart condition could be improved by offering psychosocial interventions tailored to their psychosocial problems [1,17] using a stepped care approach [23]. Once screening results indicate there is an elevated or high risk, further action could be taken by offering interventions tailored to profiles of risk factors to reduce its negative impact. This may not only be standard depression or anxiety treatment

but might also include a psychosocial skills training workshop [22], aiming to reduce anger, hostility, maladaptive responses to stressors, and low social support, which has been shown to successfully reduce those psychosocial risk factors [22]. In the general population, screening is advisable in primary care settings where it may function as a component of cardiovascular risk management given the predictive value of psychosocial risk factors for incident CHD [8,10].

4.2. Limitations & strengths

The current study was not without limitations. First, most assessments were conducted through self-report, rather than structured clinical interviews to obtain a gold standard diagnosis. Nevertheless, all questionnaires were widely used as valid predictors of prognosis in heart disease. Moreover, the absence of official diagnostic cut-offs hampered optimal validation of some of the constructs (e.g., work stress, family stress). The current study made use of both the upper quartile and upper tertile to establish the best performing cut-off values. Two limitations concern the samples of the two populations. Firstly, we made use of a conventional convenience sample for the general population which could reduce the generalizability. However, some convenience samples have higher levels of generalizability than others, and the quota convenience sampling strategy we applied is typically viewed as more advantageous regarding generalizability as compared to general convenience sampling (57). Another limitation concerns the generalizability regarding other patients with cardiovascular disease. Notably, it is important to consider the psychosocial risk status for all patients with cardiovascular disease. Future studies might want to expand to other patient groups for generalizability purposes. Lastly, the items on socioeconomic status, traumatic experiences, psychiatric history, and lack of a close confidant were not (properly) validated in the current study, as these items rather refer to the presence or absence of the construct and thus serve more as contextual factors which cannot be validated. For lack of social support, results confirmed this when we included the item *lack of a close confidant*: CFA revealed that the item did not fit very well in the patient population which led to removal from further validation. Additionally, removal of the item improved the scale. However, we recognize the importance of *the lack of a close confidant* item and its predictive role in cardiac events [46], hence, we decided to keep the item but with a different scale (i.e., binary). Further research should provide a better insight into adding other forms of social support to the screener. The current screener is valid for the general, primary care population, as well as for patients with CHD. Its explicit connection with the ESC guidelines and its inherent multidimensionality are strengths of the current study. The current study contributes to the ESC guidelines [1] and provides insight into the validity of the psychosocial screening instrument.

4.3. Conclusion

In conclusion, the updated version of the Comprehensive Psychosocial Screening instrument assesses eight separate risk factors and performed adequately in terms of screening accuracy. Future research may want to finetune the screening accuracy of constructs without a clear diagnostic cut-off. The current screener serves as a quick and reliable tool offering screening for a broad spectrum of psychosocial risk factors, which may be the first step in a primary care prevention program, offering e.g., stress-reduction and anger management training to at-risk individuals, or may serve as the first indication of risk in a stepped psychosocial care approach in the context of cardiac rehabilitation, and medical psychological care.

Funding

Appendix A. Appendix

Comprehensive Psychosocial Screening interview and scoring rules for the Cardiopsychology practice (English). A Dutch and German translation of the Comprehensive Psychosocial Screening Instrument, as well as download options for the English, Dutch and German screener are available at www.tilburguniversity.edu/corps (resources) and at dr. Kupper's OSF page: https://osf.io/szq6h/

General questions

A. What is your highest completed education?

☐ Primary school or less
☐ Tertiary school or Bachelor's
☐ Secondary school
☐ Master's or higher

B. What is your relationship status?

☐ Living with partner
☐ Single, living alone
☐ with partner, living alone
☐ Divorced, widowed, living alone

C. Do you lack someone to confide in?

☐ Yes
☐ No

D. What is your work status?

☐ Employed
☐ Pension, on benefits
☐ Unemployed/in training
☐ Household work only

Mood

Over the last two weeks, how often have you been bothered by any of the following problems?

		Not at all	Somewhat	Substantially	Very much so
1	Do you feel down, depressed, or hopeless?	☐	☐	☐	☐
2	Do you have little interest and pleasure in life?	☐	☐	☐	☐
3	Do you sometimes feel sudden anxiety or panic?	☐	☐	☐	☐
4	Are you frequently unable to stop worrying?	☐	☐	☐	☐
5	Do you feel fatigued, or do you experience a lack of energy?	☐	☐	☐	☐

Stress

Have you experienced one or more of the following stressors lately?

		Not at all	Somewhat	Substantially	Very much so
6	Do you feel burdened by your work?	☐	☐	☐	☐
7	Is **the reward for** your **work** inappropriate for your effort?	☐	☐	☐	☐
8	Do you experience problems within your family or with your spouse/partner?	☐	☐	☐	☐
9	Do you suffer from nightmares or recurring unpleasant memories?	☐	☐	☐	☐

Personality

How would you describe yourself in general?

		Not at all	Somewhat	Substantially	Very much so
10	Do you often feel anxious, irritable, or depressed?	☐	☐	☐	☐
11	Do you tend to have a dark outlook on things?	☐	☐	☐	☐
12	Do you find it difficult to start a conversation because you do not know what to talk about?	☐	☐	☐	☐
13	Do you view yourself as a closed person?	☐	☐	☐	☐
14	Do you tend to bottle up your anger?	☐	☐	☐	☐
15	Do you experience outbursts of anger?	☐	☐	☐	☐
16	Do you find it difficult to trust other people?	☐	☐	☐	☐
17	Do you have the feeling that people who know less than you tell you what to do?	☐	☐	☐	☐

Experiences

18. Did you experience one or more events in your life that still evoke strong and negative feelings?
☐ Yes, namely……..
☐ No.
19. Have you ever been in treatment with a psychologist or psychiatrist?
☐ Yes, namely ……

Scoring rules for patients with heart disease*

Below we describe which items belong to which construct, and at what threshold a person is screens either negative or positive. If a person screens positive, we advise having them fill out the full instrument and plan a consultation with a professional involved in psychosocial care.

Values:

Not at all = 1.

Somewhat = 2.

Substantially = 3.

Very much so = 4.

Depression:

Add up scores of items 1, 2, and 5. If the score is higher than 5.5, the patient scores positive for depression.

Anxiety:

Add up scores of items 3 and 4. If the score is higher than 3.5, the patient scores positive for anxiety.

Work stress:

Add up scores of items 6 and 7. If the score is higher than 3.5, the patient scores positive for chronic stress.

Social/Relational Stress/lack of social support:

This reflects the score on item 8, or a confirmation of item C.

If C = Yes, there is low social support.

If there is a score on item 8 that is higher than 1, the patient scores positive for chronic stress.

Type D personality:

Add up scores of items 10 and 11 to get the NA score.

Add up scores on items 12 and 13 to get the SI score.

If the NA score is higher than 3, and the SI score is higher than 3 the patient scores positive for Type D personality.

Hostility:

Add up scores of items 16 and 17. If the score is higher than 2.5, the patient scores positive for hostility.

Trauma:

Reflected by item 9 and a Yes on 19. If the score is higher than 1.5, and there is a yes, the patient scores positive for trauma.

Anger:

Add up scores of items 14 and 15. If the score is higher than 3.5, the patient scores positive for anger.

*For cut-offs in the general population we refer to the results supplement of this current paper.

☐ No.

Copyright Tilburg University, Dr. Nina Kupper, h.m.kupper@tilburguniversity.edu

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychores.2022.110791.

References

[1] M.F. Piepoli, A.W. Hoes, S. Agewall, C. Albus, C. Brotons, A.L. Catapano, et al., 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts)Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR), Eur. Heart J. 37 (29) (2016) 2315–2381.

[2] C. Albus, C. Waller, K. Fritzsche, H. Gunold, M. Haass, B. Hamann, et al., Significance of psychosocial factors in cardiology: update 2018: Position paper of the German Cardiac Society, Clin. Res. Cardiol. 108 (11) (2019) 1175–1196.

[3] R. von Känel, Psychosocial stress and cardiovascular risk: current opinion, Swiss Med. Wkly. 142 (2012).

[4] A. Steptoe, M. Kivimäki, Stress and cardiovascular disease: an update on current knowledge, Annu. Rev. Public Health 34 (2013) 337–354.

[5] N. Glozier, H. Christensen, S. Naismith, N. Cockayne, L. Donkin, B. Neal, et al., Internet-delivered cognitive behavioural therapy for adults with mild to moderate depression and high cardiovascular disease risks: a randomised attention-controlled trial, PLoS One 8 (3) (2013).

[6] C. Albus, Psychological and social factors in coronary heart disease, Ann. Med. 42 (7) (2010) 487–494.

[7] C. Albus, J. Jordan, C. Herrmann-Lingen, Screening for psychosocial risk factors in patients with coronary heart disease-recommendations for clinical practice, Eur. J. Cardiovasc. Prev. Rehabil. 11 (1) (2004) 75–79.

[8] A. Rozanski, Behavioral cardiology: current advances and future directions, J. Am. Coll. Cardiol. 8 (64) (2014) 100–110.

[9] G.N. Levine, B.E. Cohen, Y. Commodore-Mensah, J. Fleury, J.C. Hufman, U. Khalid, et al., Psychological health, well-being, and the mind-heart-body connection: a scientific statement from the American Heart Association, Circulation. 143 (10) (2021).

[10] S.S. Pedersen, R. von Känel, P.J. Tully, J. Denollet, Psychosocial perspectives in cardiovascular disease, Eur. J. Prev. Cardiol. 24 (3) (2017) 108–115.

[11] C.R. Gale, G.D. Batty, D.P.J. Osborn, P. Tynelius, F. Rasmussen, Mental disorders across the adult life course and future coronary heart disease: evidence for general susceptibility, Circulation. 129 (2) (2014) 186–193.

[12] E. Guler, J.-P. Schmid, L. Wiedemar, H. Saner, U. Schnyder, R. von Kanel, Clinical diagnosis of posttraumatic stress disorder after myocardial infarction, Clin. Cardiol. 32 (3) (2009) 125–129.

[13] D. Forbes, E. Lockwood, J. Elhai, M. Creamer, M. O'Donnell, R. Bryant, et al., An examination of the structure of posttraumatic stress disorder in relation to the anxiety and depressive disorders, J. Affect. Disord. 132 (2011) 165–172.

[14] L.A. Zoellner, L.D. Pruitt, F.J. Farach, J.J. Jun, Understanding heterogeneity in PTSD: fear, dysphoria, and distress, Depress. Anxiety 31 (2014) 97–106.

[15] R. von Känel, R. Hari, J.-P. Schmid, H. Saner, S. Bergé, Distress related to myocardial infarction and cardiovascular outcome: a retrospective observational study, BMC Psychiatry. 98 (2011).

[16] A. Rozanski, Psychosocial risk factors and cardiovascular disease: epidemiology, screening, and treatment considerations, Cardiovasc. Innov. Appl. 1 (4) (2016) 417–431.

[17] K. Ladwig, F. Lederbogen, C. Albus, C.E. Angermann, M. Borggrefe, D. Fischer, et al., Position paper on the importance of psychosocial factors in cardiology: update 2013, Ger. Med. Sci. 7 (12) (2014).

[18] J. Perk, G. De Backer, H. Gohlke, I. Graham, Z. Reiner, M. Verschuren, et al., European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts), Eur. Heart J. 33 (13) (2012) 1635–1701.

[19] J.C. Huffman, C.A. Mastromauro, S.R. Beach, C.M. Celano, C.M. DuBois, B.C. Healy, et al., Collaborative care for depression and anxiety disorders in patients with recent cardiac events: the Management of Sadness and Anxiety in Cardiology (MOSAIC) randomized clinical trial, JAMA Intern. Med. 174 (2014) 411–418.

[20] I. Lie, H. Arnesen, L. Sandvik, G. Hamilton, E.H. Bunch, Effects of a home-based intervention program on anxiety and depression 6 months after coronary artery bypass grafting: a randomized controlled trial, J. Psychosom. Res. 62 (2007) 411–418.

[21] T. Page, C. Lockwood, T. Conroy-Hiller, Effectiveness of nurse-led cardiac clinics in adult patients with a diagnosis of coronary heart disease, Int. J. Evid. Based Healthcare 3 (2005) 2–26.

[22] G.D. Bishop, D. Kaur, V.L. Tan, Y.L. Chua, S.M. Liew, K.H. Mak, Effects of a psychosocial skills training workshop on psychophysiological and psychosocial risk in patients undergoing coronary artery bypass grafting, Am. Heart J. 150 (3) (2005) 602–609.

[23] J.A.C. Meeuwissen, C.M. van der Feltz-Corneles, H.W.J. van Marwijk, P.B. M. Rijnders, M.C.H. Donker, A stepped care programme for depression management: an uncontrolled pre-post study in primary and secondary care in the Netherlands, Int. J. Integr. Care 8 (2008).

[24] E. van Montfort, J. Denollet, J. Widdershoven, N. Kupper, Validity of the European Society of Cardiology's psychosocial screening interview in patients with coronary artery disease-the THORESCI study, Psychosom. Med. 79 (4) (2017) 404–415.

[25] P.M.C. Mommersteeg, N. Kupper, J. Denollet, Type D personality is associated with increased metabolic syndrome prevalence and an unhealthy lifestyle in a cross-sectional Dutch community sample, BMC Public Health 10 (2010) 714.

[26] E. Van Montfort, P.M.C. Mommersteeg, V. Spek, N. Kupper, Latent profiles of early trauma & Type D personality: sex differences in cardiovascular risk markers, Compr. Psychiatry 83 (2018) 38–45.

[27] F. Mols, A.J. Pelle, N. Kupper, Normative data of the SF-12 health survey with validation using postmyocardial infarction patients in the Dutch population, Qual. Life Res. 18 (4) (2009) 403–414.

[28] K. Kroenke, R.L. Spitzer, J.B. Williams, The patient health Questionnaire-2: validity of a two-item depression screener, Med. Care 41 (2003) 1284–1292.

[29] K. Kroenke, R.L. Spitzer, J.B. Williams, P.O. Monahan, B. Lowe, Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection, Ann. Intern. Med. 146 (2007) 317–325.

[30] K. Kroenke, R.L. Spitzer, J.B.W. Williams, The PHQ-9 - validity of a brief depression severity measure, J. Gen. Intern. Med. 16 (9) (2001) 606–613.

[31] R.L. Spitzer, K. Kroenke, J.B. Williams, B. Löwe, A brief measure for assessing generalized anxiety disorder: the GAD-7, Arch. Intern. Med. 166 (10) (2006).

[32] J. Denollet, DS14: standard assessment of negative affectivity, social inhibition, and Type D personality, Psychosom. Med. 67 (1) (2005) 89–97.

[33] E.K.S. Hanson, W. Schaufeli, T. Vrijkotte, N.H. Plomp, G.L.R. Godaert, The validity and reliability of the Dutch Effort–Reward Imbalance Questionnaire, J. Occup. Health Psychol. 5 (1) (2000) 142–155.

[34] J. Orathinkal, A. Vansteenwegen, R. Stroobants, Further validation of the Maudsley Marital Questionnaire (MMQ), Psychol. Health Med. 12 (3) (2007) 346–352.

[35] J.C. Barefoot, K.A. Dodge, B.L. Peterson, W.G. Dahlstrom, Williams RBj., The Cook-Medley Hostility Scale: item content and ability to predict survival, Psychosom. Med. 51 (1989) 414–418.

[36] J.E. Hovens, H.M. van der Ploeg, E. Bramsen, M.T.A. Klaarenbeek, J.N. Schreuder, V.V. Rivero, The development of the self-rating inventory for posttraumatic stress disorder, Acta Psychiatr. Scand. 90 (1994) 172–183.

[37] D.G. Kroner, J.R. Reddon, The Anger Expression Scale and State Trait Anger Scale: stability, reliability and factor structure in an inmate sample, Crim. Justice Behav. 19 (1992) 379–408.

[38] Y. Rosseel, Lavaan: an R package for structural equation modeling, J. Stat. Softw. 48 (2) (2012) 1–36.

[39] W. Revelle, psych: Procedures for Psychological, Psychometric, and Personality Research, 2020.

[40] H. Wickham, E. Miller, Haven: Import and Export 'SPSS', 'Stata' and 'SAS' Files, 2020.

[41] IBM, IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY, 2018.

[42] T.K. Koo, M.Y. Li, A guideline of selecting and reporting intraclass correlation coefficients for reliability research, J. Chiropr. Med. 15 (2) (2016) 155–163.

[43] A.-M. Šimundić, Measures of diagnostic accuracy: basic definitions, EJIFCC. 19 (4) (2009) 203–211.

[44] W. Emons, R.R. Meijer, J. Denollet, Negative affectivity and social inhibition in cardiovascular disease: evaluating Type-D personality and its assessment using item response theory, J. Psychosom. Res. 63 (1) (2007) 27–39.

[45] R.C. MacCallum, K.F. Widaman, K.J. Preacher, S. Hong, Sample size in factor analysis: the role of model error, Multivar. Behav. Res. 36 (4) (2001) 611–637.

[46] C. Dickens, L. McGowan, C. Percival, Lack of close confidant, but not depression, predicts further cardiac events after myocardial infarction, Heart 90 (5) (2004) 518–522.

[47] L.L. Watkins, N. Schneiderman, J.A. Blumenthal, D.S. Sheps, D. Catellier, C.B. Taylor, et al., Cognitive and somatic symptoms of depression are associated with medical comorbidity in patients, Am. Heart J. 146 (1) (2003) 48–54.

[48] S. Tenny, M.R. Hoffman, StatPearls[Internet]: Prevalance, StatPearls Publishing, Treasure Island, FL, 2020.

[49] M.H.C.T. Van Beek, M. Zuidersma, M. Lappenschaar, G. Pop, A.M. Roest, A.J.L. M. Van Balkom, et al., Prognostic association of cardiac anxiety with new cardiac events and mortality following myocardial infarction, Br. J. Psychiatry 209 (5) (2016) 400–406.

[50] C.M. Celano, D.J. Daunis, H.N. Lokko, K.A. Campbell, Anxiety disorders and cardiovascular disease, Current Psychiatry Rep. 18 (11) (2016), 101.

[51] Association AP, Diagnostic and Statistical Manual of Mental Disorders, 5th ed., Author, Washington, DC, 2013.

[52] H. Tulloch, P.S. Greenman, V. Tasse, Post-traumatic stress disorder among cardiac patients: prevalence, risk factors, and considerations for assessment and treatment, Behav. Sci. (Basel) 5 (1) (2015) 27–40.

[53] J.M. Wong, N.L. Sin, M.A. Whooley, A comparison of cook-medley hostility subscales and mortality in patients with coronary heart disease: data from the heart and soul study, Psychosom. Med. 76 (4) (2014) 311–317.

[54] S.K. Wood, S. Bhatnagar, Resilience to the effects of social stress: evidence from clinical and preclinical studies on the role of coping strategies, Neurobiol Stress. 1 (2015) 164–173.

[55] A.J. Sheidow, D.B. Henry, P.H. Tolan, M.K. Strachan, The role of stress exposure and family functioning in internalizing outcomes of urban families, J. Child Fam. Stud. 23 (8) (2015) 1351–1365.

[56] F.L.J. Visseren, F. Mach, Y.M. Smulders, D. Carballo, K.C. Koskinas, M. Bäck, et al., 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice, Eur. Heart J. 42 (34) (2021) 3227–3337.