Association of trait resilience with peritraumatic and posttraumatic stress in patients with myocardial infarction

Meister, Rebecca Elisabeth ; Princip, Mary ; Schnyder, Ulrich ; Barth, Jürgen ; Znoj, Hansjörg ; Schmid, Jean-Paul ; Wittmann, Lutz ; von Känel, Roland

DOI: https://doi.org/10.1097/PSY.0000000000000278

Association of Trait Resilience With Peritraumatic and Posttraumatic Stress in Patients With Myocardial Infarction

Rebecca Elisabeth Meister, MSc, Mary Princip, MSc, Ulrich Schnyder, MD, Jürgen Barth, PhD, Hansjörg Znoj, PhD, Jean-Paul Schmid, MD, Lutz Wittmann, PhD, and Roland von Känel, MD

ABSTRACT

Objective: Acute myocardial infarction (MI) is a life-threatening condition, leading to immediate fear and distress in many patients. Approximately 18% of patients develop posttraumatic stress disorder in the aftermath of MI. Trait resilience has shown to be a protective factor for the development of posttraumatic stress disorder. However, whether this buffering effect has already an impact on peritraumatic distress and applies to patients with MI is elusive.

Methods: We investigated 98 consecutive patients with acute MI within 48 hours after having reached stable circulatory conditions and 3 months thereafter. Peritraumatic distress was assessed retrospectively with three single-item questions about pain, fear, and helplessness during MI. All patients completed the Posttraumatic Diagnostic Scale (PDS) and the Resilience Scale to self-rate posttraumatic stress and trait resilience.

Results: Multivariate models adjusting for sociodemographic and medical factors showed that trait resilience was not associated with peritraumatic distress, but significantly so with posttraumatic stress. Patients with greater trait resilience showed lower PDS scores ($b = -0.06$, $p < .001$). There was no significant relationship between peritraumatic distress scores and PDS scores; resilience did not emerge as a moderator of this relationship.

Conclusions: The findings suggest that trait resilience does not buffer the perception of acute MI as stressful *per se* but may enhance better coping with the traumatic experience in the longer term, thus preventing the development of MI-associated posttraumatic stress. Trait resilience may play an important role in posttraumatic stress symptoms triggered by medical diseases such as acute MI.

Key words: resilience, peritraumatic distress, posttraumatic stress disorder, cardiology, acute myocardial infarction.

INTRODUCTION

Acute myocardial infarction (MI) is a life-threatening and, therefore, potentially traumatic event. Approximately 70% of patients perceive peritraumatic distress during MI in the form, for instance, of intense fear (of dying) and stressful feelings (1,2). There are numerous predictors for increased peritraumatic distress, including female sex, lower education, emotional upset before MI, and pain intensity during MI (1). Furthermore, in the aftermath of MI, approximately 16% of patients go on to develop posttraumatic stress disorder (PTSD) (3,4). PTSD is characterized by symptoms of reexperiencing, avoidance, and hyperarousal, which must have lasted for at least 1 month with significant impairment in daily functioning (5). Research shows that PTSD after acute coronary syndromes is associated with cardiovascular morbidity and all-cause mortality (6,7).

MI = myocardial infarction, **PDS** = Posttraumatic Diagnostic Scale, **PTSD** = posttraumatic stress disorder, **RCT** = randomized controlled trial, **RES** = Resilience Scale, **STEMI** = ST-elevation myocardial infarction

SDC Supplemental Content

From the Department of Neurology (Meister, Princip, von Känel), Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland; Psychosomatic Research Group, Department of Clinical Research (Meister, Princip, von Känel) and Institute of Psychology (Meister, Princip, Znoj), Division of Clinical Psychology and Psychotherapy, University of Bern, Bern, Switzerland; Department of Psychiatry and Psychotherapy (Schnyder) and Institute for Complementary and Integrative Medicine (Barth), University Hospital Zurich, University of Zurich, Zurich, Switzerland; Department of Cardiology (Schmid), Bern University Hospital and Spital Netz Bern, Spital Tiefenau, Bern, Switzerland; International Psychoanalytic University (Wittmann), Berlin, Germany; and Department of Psychosomatic Medicine (von Känel), Clinic Barmelweid, Barmelweid, Switzerland.

Address correspondence and reprint requests to Rebecca Elisabeth Meister, MS, MSc, Department of Neurology, Inselspital, Bern University Hospital, CH-3010 Bern, Switzerland. E-mail: rebecca.meister@insel.ch

Received for publication April 9, 2015; revision received September 14, 2015.

DOI: 10.1097/PSY.0000000000000278

Several risk factors for the development of PTSD have been identified, such as younger age, female sex, lower educational status, prior MI, previous traumatization, and lack of social support (8,9). MI-related peritraumatic distress has been shown to be a considerable risk factor for PTSD (10,11). Moreover, studies have consistently shown that the subjective experience of acute MI, but not objective markers of MI severity, such as left ventricular ejection fraction or cardiac enzyme levels, predicts posttraumatic stress after MI (9).

Psychological reactions to traumatic events may differ among individuals as a consequence or independently of the above-described risk factors. The observation that some people manage to stay well in the face of adversities is a key explanation for the rapidly growing interest in the resilience concept (12,13). However, the usage of the term resilience varies in the literature due to the complex and multidimensional structure of this concept (12,14). Some researchers consider resilience as a positive outcome after a traumatic event (15,16), whereas others see resilience more as a process variable, describing optimal adaption reactions to stressful events (17,18). According to Norris and colleagues (19), resilience corresponds to rising levels in stress followed by a fast recovery to normal levels after trauma cessation. This idea concurs with a study showing that fast recovery of post-MI stress is associated with greater quality of life in the long term (20). A third approach is to examine resilience as a personality trait characterized by a tendency to react with resistance and strength to adverse life events (14,21).

For this article, we focused on resilience as a positive personality characteristic that enhances adaptation to a sudden, life-threatening disease. Nonetheless, research definitions and measurements of resilience as a personality trait differ in the literature. Although some authorities explain resilience in terms of concepts related to hardiness or self-efficacy, others regard it as an independent concept (14,21,22). We rely here on the definition of resilience developed by Wagnild and Young (21), who draw a comprehensive and stable conceptualization of resilience. These authors combined qualitative data with previous concepts and findings from the literature and defined resilience on the basis of personal competence and acceptance of self and life. Personal competence refers to characteristics such as self-reliance, independence, determination, sense of invincibility, mastery, resourcefulness, and perseverance. Acceptance of self and life represents adaptability, balance, flexibility, and a balanced perspective of life. All of these dimensions have been identified as being associated with good adaptability to adverse events (14,21–23). Resilient persons seem to better identify situations as stressful and to appraise more realistically their capacity for effective means to reduce stress (21,23).

There are studies that demonstrate the predictive value of trait resilience for the development of PTSD (24–26). For instance, Ying and colleagues (24) showed that higher trait resilience was associated with less severe PTSD symptoms in adolescents 30 months after an earthquake. A study by Pietrzak and colleagues (25) revealed that veterans with PTSD had significantly lower trait resilience scores than those without PTSD, after an average of 27 months following deployment. In a sample of patients referred to an emergency center, Daniels and colleagues (26) found trait resilience to be significantly negatively related to the development of PTSD symptoms between 5 and 12 weeks after trauma. Overall, although empirical data support a link between resilience and posttraumatic stress, studies concerning whether trait resilience buffers peritraumatic distress are rare, particularly in the field of cardiovascular disease.

Therefore, the first aim of our study was to replicate that trait resilience is associated with reduced levels of posttraumatic stress, in a sample of acute MI patients assessed 3 months after hospitalization. The second aim was to examine the mechanisms underlying this relationship. On the assumption that peritraumatic distress has a direct association with posttraumatic stress, we specifically hypothesized that trait resilience would attenuate the link between peritraumatic distress and posttraumatic stress. Therefore, we explored the association between trait resilience and peritraumatic distress.

METHODS

Participants and Study Design

Data for the following analysis were collected in the context of the ongoing randomized controlled trial (RCT) Myocardial Infarction–Stress Prevention Intervention, which examines whether a psychological counseling intervention administered shortly after acute MI reduces posttraumatic stress (27). The research protocol was formally approved by the ethics committee of the State of Bern, Switzerland. All participants provided written informed consent to the study protocol. Data collection for the following analysis was performed between January 2013 and January 2015. Consecutive patients were recruited in the coronary care unit of the Bern University Hospital, Switzerland, after having experienced an acute ST-elevation (STEMI) or non–ST-elevation (non-STEMI) index MI. Inclusion criteria were as follows: age greater than 18 years, stable circulatory conditions, sufficient German language skills, and significant level of MI-triggered distress (cf. psychometric assessment). Specific exclusion criteria were cognitive impairment/disorientation, emergency coronary artery bypass graft, serious comorbid disease likely to cause death within 1 year, current severe depressive episode, suicidal ideations in the last 2 weeks, or participation in another RCT run by the Department of Cardiology.

Within 48 hours after having reached stable hemodynamic conditions, participants underwent a standardized interview to assess peritraumatic distress. Three months later, all participants were invited to fill in the Resilience Scale (RES) and the Posttraumatic Stress Diagnostic Scale (PDS).

Of the originally 130 patients included in the study, data could be analyzed from 98 study participants. Reasons and numbers for dropout were as follows: inability to fill in questionnaires at admission due to

sudden referral to another hospital, medical conditions, or refusal (n = 9); lack of medical and demographic information (n = 1); death within the first 3 months after hospital admission (n = 6); loss to follow-up (n = 8); or refusal of further participation (n = 8) after 3 months.

Psychometric Assessment

Resilience Scale

Trait resilience was measured using the German version of the RES short form (21,28). This is an 11-item self-rating instrument scoring on a 7-point Likert scale (1 = "disagree," 7 = "agree"). Sum scores range between 11 and 77, with higher levels indicating higher resilience. The RES measures resilience as a continuously scaled stable personality factor, based on the two constructs *personal competence* and *acceptance of self and life*. Typical items are "I usually manage one way or another" and "I can usually look at a situation in a number of ways." Although not previously applied in cardiac patients, the RES is a widely used instrument in psychosomatic research (29). The RES short form shows a stable one-factorial structure with good internal consistency (Cronbach α = .91) (28), which was also found in our sample (Cronbach α = .93).

Peritraumatic Distress

Peritraumatic distress during MI was measured retrospectively with the three following single-item questions: a) "Please indicate how strong your pain was during the heart attack." (0 = "no pain at all," 10 = "intolerable pain"); b) "During my referral to the hospital, the emergency unit, or the intensive care unit, I was afraid I was dying." (0 = "absolutely not true," 10 = "absolutely true"); and c) "When the doctor told me I had a heart attack, I was frightened, felt helpless, and was afraid of losing control of the situation." (0 = "absolutely not true," 10 = "absolutely true"). Patients rated their answers on a numerical rating scale ranging from 0 to 10. Only patients scoring with at least 5 points for pain and 5 points for fear of dying and/or helplessness were included as they were considered to be at high risk for developing PTSD and to benefit from counseling. For further analysis, we calculated a sum score of the three items to assess the amount of MI-triggered peritraumatic distress. Very similar single-item questions have been used in previous studies. For example, a study by Wiedemar et al. (11) with 400 MI patients showed an association of peritraumatic distress measures with posttraumatic stress as rated by the PDS. Another study showed these peritraumatic distress measures to be associated with an increased risk of cardiovascular readmissions in a sample of 304 post-MI patients (2). Reliability has previously been shown to be acceptable (Cronbach α = .76) (7,30). In our sample, a similar internal consistency was found for the sum score (Cronbach α = .64).

Posttraumatic Diagnostic Scale

Posttraumatic stress was measured with the German version of the PDS (31,32), which is a self-rating instrument with 17 items. Patients rated on a 4-point Likert scale how often they had experienced each symptom during the past month (0 = "not at all," 3 = "often"). According to DSM-IV criteria for PTSD, the PDS consists of three subscales, namely, reexperiencing, avoidance, and arousal (5). We calculated a sum score (range, 0-51) for assessing the level of posttraumatic stress 3 months post-MI. In the questionnaire, we replaced the term "event" with the term "heart attack". Internal consistency was considered to be good in a cardiac sample (Cronbach α sum score = .91) (7). We also found good reliability in the current sample (Cronbach α sum score = .89). As the study started before DSM-5 had been issued, our measurement of PTSD symptom levels is based on DSM-IV criteria. The two main changes in the new diagnostic manual concern the omission of the trauma criterion A2 and the differentiation of the symptom cluster avoidance/numbing into the two groups avoidance and negative alterations in cognitions and mood (5,33).

Demographic and Medical Factors

We obtained information about age, education, medical history, smoking, height/weight, and cardiac rehabilitation by standardized interview questions or from medical charts. Information about the acute MI (i.e., STEMI/non-STEMI, number of diseased vessels with coronary lumen stenosis >50%, Killip class, troponin T peak levels, and left ventricular ejection fraction) was abstracted from hospital charts.

Statistical Analysis

Data were analyzed using PASW 21.0 statistical software package (SPSS Inc, Chicago, IL). Level of significance was set at $p < .05$ (two tailed). Missing items were replaced using the expectation-maximization algorithm if at least 70% of the items of that questionnaire were answered (34). Normal distribution of variables was verified by the Kolmogorov-Smirnov test. The PDS score was square root transformed to approximate a normal distribution. To demonstrate patients' characteristics, we conducted a median split on resilience scores. To compare the two groups with high versus low resilience, we used Pearson χ^2 and independent-samples t test for categorical and continuous variables, respectively.

We applied two hierarchical regression analyses with forced entry of covariates to test the independent contribution of resilience to peritraumatic and posttraumatic stress. In the first regression model, the peritraumatic distress score was the outcome variable. We entered in a first step the a priori defined control variables (age, sex, and education) into the equation. In the second step, objective measures of MI severity (i.e., troponin T peak level) and medical history (previous MI, history of depression) were added. Resilience was entered in a third step. In the second regression model, the PDS score was our outcome variable. We again entered in the first step the control variables (sex, age, and education), in the second step objective and subjective characteristics of the traumatic situation (i.e., troponin T peak level, distress score) and medical history (previous MI, history of depression), followed by resilience that was added in a third step.

To test for a moderator effect of resilience on the relation of peritraumatic distress with PTSD symptoms, we additionally entered the interaction between resilience and peritraumatic distress score as a last analytic step into the second model. We centered the variables to the mean before multiplication to reduce problems with multicollinearity.

Linearity, homoscedasticity, and absence of multicollinearity were tested by scatterplot and curve estimation. Durbin Watson statistic assured exclusion of autocorrelation. Results are expressed as unstandardized b coefficients, standard errors of the mean and changes in R^2 of each step with p values.

RESULTS

Patient Characteristics

Table 1 shows patient characteristics for the total sample and stratified by resilience level. The sample comprised mainly men (83%) and had a mean age of 59 years. Most participants' highest level of education was vocational school. More patients had an STEMI (72%) than a non-STEMI (28%). Most patients had attended cardiac rehabilitation (81%). The "low resilience" group reported significantly more frequently a history of depression (p = .046). There were no statistically significant group differences in any other biomedical variable.

TABLE 1. Characteristics of All Patients (n = 98) and Per High and Low Resilience

Variables	Total (n = 98)	Low Resilience (n = 48)	High Resilience (n = 50)	p
Age, y	58.9 (9.6)	59.0 (9.2)	58.9 (10.0)	.93
Male sex, %	82.7	81.3	84.0	.72
Highest level of education, %				.96
Primary school	10.2	10.4	10.0	
Vocational school	72.4	72.9	72.0	
College	3.1	2.1	4.0	
University	14.3	14.6	14.0	
Body mass index, kg/m^2	27.7 (4.7)	27.9 (5.2)	27.5 (4.3)	.68
Hypertension, %	53.1	52.1	54.0	.85
Hypercholesterolemia, %	53.1	50.0	56.0	.52
Diabetes, %	15.3	16.7	14.0	.71
Smoking, %	42.9	41.7	44.0	.81
Previous MI, %	7.1	6.3	8.0	.74
Positive family history of coronary artery disease, %	29.6	37.5	22.0	.09
History of depression, %	24.5	33.3	16.0	.05*
Myocardial infarction, %				.16
STEMI	72.2	78.7	66.0	
Non-STEMI	27.8	21.3	34.0	
No. diseased vessels, %				.20
0 vessel	2.0	0.0	4.0	
1 vessel	38.8	33.3	44.0	
2 vessel	29.6	37.5	22.0	
3 vessel	29.6	29.2	30.0	
Killip classification, %				.75
Killip I	82.7	83.3	82.0	
Killip II	9.2	10.4	8.0	
Killip III	1.0	0.0	2.0	
Killip IV	7.1	6.3	8.0	
Troponin T peak, µg/l	4.1 (4.5)	4.7 (5.3)	3.5 (3.7)	.19
LVEF, %	47.9 (12.8)	48.8 (13.0)	47.0 (12.7)	.49
Cardiac rehabilitation, %	80.6	85.4	76.0	.24

MI = myocardial infarction; STEMI = ST-segment elevation myocardial infarction; LVEF = left ventricular ejection fraction; SD = standard deviation.
Data are shown as mean (SD) or percentage.
Significance level for p values: *p < .05, **p < .01, ***p < .001.

Regression Analysis for Peritraumatic Distress

The correlations between resilience, peritraumatic, and posttraumatic stress are shown in Table S1 (Supplemental Digital Content 1, http://links.lww.com/PSYMED/A258). There were significant associations between resilience and posttraumatic stress and between peritraumatic distress and posttraumatic stress, but not between resilience and peritraumatic distress. Table 2 shows that in the first hierarchical linear regression, there emerged no significant association between any covariate and peritraumatic distress as the outcome variable, except previous MI. Patients with a first-time MI had higher levels of peritraumatic distress compared with those with a previous MI (b = −3.2, p = .044).

Regression Analysis for Posttraumatic Stress

Table 3 presents the second hierarchical linear regression analysis with the PDS score as the outcome. None of the demographic variables (i.e., age, sex, educational level) entered in step 1 showed a significant association with posttraumatic stress levels. In step 2, troponin T peak level (b = 0.07, p = .021) and history of depression (b = 0.68,

TABLE 2. Hierarchical Regression Analysis With Peritraumatic Distress Score as the Outcome Variable

Variables Entered	Step 1	Step 2	Step 3
Model statistics (n = 85)	ΔR^2 = 0.028	ΔR^2 = 0.070	ΔR^2 = 0.004
	p = .44	p = .15	p = .19
Age	−0.06 ± 0.04	−0.06 ± 0.04	−0.05 ± 0.04
Sex	0.60 ± 1.10	0.81 ± 1.14	0.86 ± 1.14
Educational level	−0.35 ± 0.51	−0.31 ± 0.50	−0.25 ± 0.51
Troponin T peak		0.15 ± 0.09	0.14 ± 0.09
Previous MI		−3.20 ± 1.57*	−3.15 ± 1.57*
History of depression		0.51 ± 0.97	0.42 ± 0.98
Resilience			−0.02 ± 0.03

MI = myocardial infarction; SEM = standard errors of the mean.

Data are shown as unstandardized b coefficients ± SEM.

Significance level for p values: *p < .05, **p < .01, ***p < .001.

p = .026) were both significantly related to posttraumatic stress. Although showing a significant relation in the bivariate correlation analysis (r = 0.261, p = .010), peritraumatic distress was no longer associated with posttraumatic stress after adjusting for covariates. In Step 3, greater trait resilience was significantly associated with lower levels of posttraumatic stress (b = −0.06, p < .001). Resilience explained an additional 29% of the variance in posttraumatic stress, independently of all other covariates in the model. After resilience was entered into the equation, sex (b = 0.72, p = .012), but no longer a history of depression, became a significant predictor, with women showing more posttraumatic stress than men.

Considering the RCT nature of the study, we conducted a sensitivity analysis for both treatment arms separately. For this purpose, we reran the regression analysis described earlier with the same covariates for each of the treatment groups. This revealed similar b coefficients and p values for resilience in both the intervention group (n = 50, b = −0.057, p < .001) and the control group (n = 48, b = −0.064, p < .001).

Moderation Analysis for Resilience

A moderator analysis was conducted whereby the resilience by peritraumatic distress interaction was entered into the model in a fourth and last analytic step. As shown in Table 3, the interaction term turned out to be nonsignificant, indicating that the link between peritraumatic distress and posttraumatic stress was not moderated by resilience.

DISCUSSION

We found trait resilience to be significantly and inversely associated with the PDS score assessed at 3 months after MI. Resilience explained almost an additional 30% of the

TABLE 3. Hierarchical Regression Analysis With Posttraumatic Diagnostic Scale Score as the Outcome Variable

Variables Entered	Step 1	Step 2	Step 3	Step 4
Model statistics (n = 98)	ΔR^2 = 0.056	ΔR^2 = 0.166	ΔR^2 = 0.291	ΔR^2 = 0.005
	p = .140	p = .002	p < .001	p < .001
Age	−0.02 ± 0.01	−0.01 ± 0.01	−0.01 ± 0.01	−0.01 ± 0.01
Sex	0.62 ± 0.36	0.57 ± 0.35	0.72 ± 0.28*	0.70 ± 0.28*
Educational level	−0.18 ± 0.17	−0.16 ± 0.15	0.01 ± 0.13	−0.10 ± 0.13
Troponin T peak		0.07 ± 0.03*	0.05 ± 0.02*	0.05 ± 0.02*
Peritraumatic distress		0.05 ± 0.03	0.04 ± 0.03	0.04 ± 0.03
Previous MI		−0.80 ± 0.50	−0.73 ± 0.40	−0.69 ± 0.40
History of depression		0.68 ± 0.30*	0.45 ± 0.24	0.45 ± 0.24
Resilience			−0.06 ± 0.01***	−0.06 ± 0.01***
Resilience by distress score				−0.00 ± 0.00

MI = myocardial infarction; SEM = standard errors of the mean.

Data are shown as unstandardized b coefficients ± SEM.

Significance level for p values: *p < .05, **p < .01, ***p < .001.

variance in posttraumatic stress, after adjusting for demographic, trauma-specific, and biomedical factors. This result indicates that trait resilience might attenuate the development of posttraumatic stress after MI; moreover, this finding confirms previous research reporting a relation between trait resilience and PTSD that had developed after different traumatic situations (e.g. Ref. (26)). To our knowledge, the finding that greater trait resilience was associated with lower levels of posttraumatic stress triggered by acute MI is novel. According to the definition of trait resilience of Wagnild and Young (21), our findings suggest that patients with high personal competences like self-reliance, independence, or perseverance and with high levels of acceptance of self and life like balance and flexibility are able to better adapt to acute MI and its consequences. Possibly, these patients have more faith in their capacities, while also recognizing their limits in a realistic manner, which enables them to seek and accept external help when needed (21,23). A more detailed examination of the mechanism underlying the attenuating effect of resilience on posttraumatic stress is highly warranted in future studies.

We did not find an association of resilience with peritraumatic distress during MI. It seems that although trait resilience enhances adaptation to the traumatic sequelae of the MI experience, it may not attenuate the distress evoked during MI per se. Although the literature on an association of trait resilience with peritraumatic distress is scarce, our observation concurs with the resilience concept at large. According to the model of Norris and colleagues (19), resilience describes a reaction pattern with moderate distress scores during a traumatic event and fast return to normal stress levels after the trauma. Similarly, Ginzburg and Ein-Dor (20) found that a decrease in stress from the hospital stay to approximately 7 months and 8 years after MI was associated with a better quality of life after 8 years. Both these studies referred to resilience as a process variable, namely, a healthy adaptation to a stressful situation. Our results might support a resilient personality pattern to be beneficial for both a positive outcome (i.e., lower posttraumatic stress) and processing of a stressful situation; therefore, the findings of our study may help to bridge some of the differing perspectives on resilience in previous research (17,19,20).

We could not replicate previous findings of a direct association between peritraumatic distress and posttraumatic stress (10,11), and moreover, resilience did not emerge as a moderating factor of this association. We assumed that trait resilience might affect the increase in peritraumatic distress, facilitating gradual coping with the distressing situation and thereby preventing the development of PTSD symptoms. Not being able to show this might be explained by the fact that our patients were required to have experienced a certain amount of distress to be included in the study. Therefore, the specific nature of the measurement of peritraumatic distress with its limited variance needs to be considered.

We further found that female sex emerged as a significant predictor of posttraumatic stress, but not of peritraumatic distress, after adjusting for covariates. Women had higher PDS scores than did men. This is in agreement with previous studies indicating that women are at higher risk for developing PTSD in the aftermath of MI (9). The other sociodemographic characteristics, namely, age and educational level, showed no significant association with peritraumatic and PTSD stress. However, because most patients in our sample were older men with an average educational level, generalization of these findings is limited.

Among the trauma-specific variables, troponin T peak level was not significantly associated with peritraumatic distress, which is in agreement with previous studies (2). In contrast, the direct association between peak troponin T level and the PDS score was an unexpected finding. Several previous studies have reported that the subjective perception of the traumatic situation as distressful, but not objective markers of MI severity, is predictive for the development of PTSD (2,9). One explanation for our finding could be that most of our participants attended cardiac rehabilitation, where they were confronted with the severity of their illness. Patients who realize that objectively they have more severe heart muscle damage than their peers might feel less secure, which might compromise their ability for emotional adaptation to the disease. Further studies seem warranted to investigate this assumption.

We found prior MI to be a significant predictor for peritraumatic distress, but not PDS score, with patients who experienced their first MI reporting higher levels of peritraumatic distress. This finding is in contrast to some previous studies showing prior MI puts patients at risk for developing PTSD (35). It may be that patients who have previously survived an MI feel less overwhelmed by the medical situation as they are already "familiar" with the procedures in the clinical setting of a coronary care unit. A history of depression was unrelated to the outcomes. There is evidence that depression predicts PTSD after MI (9). One possible reason why we could not replicate this finding may be that we excluded patients with a current severe depressive episode.

Our study has several limitations. Because of the study design, we assessed peritraumatic stress retrospectively only when patients were hemodynamically stable, so a recall bias cannot be excluded. Furthermore, we assessed resilience at the 3-month follow-up so as to limit burden for patients in the acute hospital situation. Even if trait resilience is deemed to be stable over time, it might be influenced by emotional and cognitive processes after the traumatic event. Therefore, although the study applied a prospective design, causal inferences cannot be drawn from our study findings. According to our study design,

we included patients with sufficiently high levels of peritraumatic distress to select patients who were at higher risk for developing post-MI PTSD. Patients with low peritraumatic distress were therefore excluded from the study, limiting the range of values and generalizability of our findings. Our project started before the release of DSM-5 in May 2013 (33); therefore, psychometric assessment in our study is based on DSM-IV criteria. Whether our findings will hold when applying DSM-5 needs to be tested in future studies.

Overall, the findings of this study suggest that the impact of trait resilience must also be taken into consideration in medical settings, where it is increasingly acknowledged that various somatic diseases and related diagnostic and treatment procedures may be experienced as traumatic, thus potentially leading to PTSD (36,37). Because PTSD is associated with negative psychological and physiological outcomes (6,7), an important clinical implication of our study is that patients with low resilience could be identified to be offered psychological support post-MI so as to possibly reduce their level of PTSD symptoms. For instance, psychological interventions might aim at improving coping with the MI experience.

In sum, our study showed that greater trait resilience was associated with lower posttraumatic stress levels 3 months post-MI but not with immediate distress during MI. Our results suggest that resilient persons are able to better cope with a stressful medical event, rather than experiencing the event as less stressful per se. However, further research is warranted to elucidate the underlying mechanism of resilience. It seems important to identify patients with low resilience in acute coronary care and perhaps also other medical settings to offer them support in coping with the disease. This study is an essential step toward a better understanding of the role of trait resilience in posttraumatic stress triggered by medical diseases like acute MI.

The authors wish to thank Annette Kocher for editorial assistance, and Tania Weber, Miriam Koemeda, Christina Gattlen, Marco Scholz, and Laurin Imholz for their help in data collection.

Contributors: R.v.K., J.P.S., U.S., J.B., and H.Z. designed the study. L.W. trained the study therapists. R.M. and M.P. supervised the data collection and collected data. R.M., M.P., and R.v.K. performed the statistical analysis. R.M. wrote the first draft of the manuscript. All authors critically revised and approved the final manuscript. R.v.K. is the guarantor for the study.

Source of Funding and Conflicts of Interest: This research was supported by Grant 140960 from the Swiss National Science Foundation to R.v.K. (principal investigator), J.P.S., U.S., H.Z., and J.B. The authors declare that there is no conflict of interest.

REFERENCES

1. Whitehead DL, Strike P, Perkins-Porras L, Steptoe A. Frequency of distress and fear of dying during acute coronary syndromes and consequences for adaptation. Am J Cardiol 2005;96:1512–6.
2. von Känel R, Hari R, Schmid JP, Saner H, Begré S. Distress related to myocardial infarction and cardiovascular outcome: a retrospective observational study. BMC Psychiatry 2011; 11:98.
3. Edmondson D, Richardson S, Falzon L, Davidson KW, Mills MA, Neria Y. Posttraumatic stress disorder prevalence and risk of recurrence in acute coronary syndrome patients: a meta-analytic review. PLoS One 2012;7:e38915.
4. Ginzburg K, Solomon Z, Koifman B, Keren G, Roth A, Kriwisky M, Kutz I, David D, Bleich A. Trajectories of posttraumatic stress disorder following myocardial infarction: a prospective study. J Clin Psychiatry 2003;64:1217–23.
5. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994.
6. Edmondson D, Rieckmann N, Shaffer JA, Schwartz JE, Burg MM, Davidson KW, Clemow L, Shimbo D, Kronish IM. Posttraumatic stress due to an acute coronary syndrome increases risk of 42-month major adverse cardiac events and all-cause mortality. J Psychiatr Res 2011;45: 1621–6.
7. von Känel R, Hari R, Schmid JP, Wiedemar L, Guler E, Barth J, Saner H, Schnyder U, Begré S. Non-fatal cardiovascular outcome in patients with posttraumatic stress symptoms caused by myocardial infarction. J Cardiol 2011;58:61–8.
8. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. J Consult Clin Psychol 2000;68:748–66.
9. von Känel R, Gander ML. Post-traumatic stress disorder: emerging risk factor and mechanisms. In: Hjemdahl P, Rosengren A, Steptoe A, eds. Stress and Cardiovascular Disease. London: Springer; 2012;235–56.
10. Whitehead DL, Perkins-Porras L, Strike PC, Steptoe A. Posttraumatic stress disorder in patients with cardiac disease: predicting vulnerability from emotional responses during admission for acute coronary syndromes. Heart 2006;92: 1225–9.
11. Wiedemar L, Schmid JP, Müller J, Wittmann L, Schnyder U, Saner H, von Känel R. Prevalence and predictors of posttraumatic stress disorder in patients with acute myocardial infarction. Heart Lung 2008;37:113–21.
12. Luthar SS, Cicchetti D, Becker B. The construct of resilience: a critical evaluation and guidelines for future work. Child Dev 2000;71:543–62.
13. Masten AS, Best KM, Garmezy N. Resilience and development: contributions from the study of children who overcome adversity. Dev Psychopathol 1990;2:425–44.
14. Southwick SM, Bonanno GA, Masten AS, Panter-Brick C, Yehuda R. Resilience definitions, theory, and challenges: interdisciplinary perspectives. Eur J Psychotraumatol 2014;5.
15. Rutter M. Resilience in the face of adversity. Protective factors and resistance to psychiatric disorder. Br J Psychiatry 1985; 147:598–611.
16. Bonanno GA, Westphal M, Mancini AD. Resilience to loss and potential trauma. Annu Rev Clin Psychol 2011; 7:511–35.
17. Karatsoreos IN, McEwen B. Psychobiological allostatis: resistance, resilience and vulnerability. Trends Cogn Sci 2011; 15:576–84.

18. Agaibi CE, Wilson JP. Trauma, PTSD, and resilience: a review of the literature. Trauma Violence Abuse 2005;6: 195–216.
19. Norris FH, Tracy M, Galea S. Looking for resilience: understanding the longitudinal trajectories of responses to stress. Soc Sci Med 2009;68:2190–8.
20. Ginzburg K, Ein-Dor T. Posttraumatic stress syndromes and health-related quality of life following myocardial infarction: 8-year follow-up. Gen Hosp Psychiatry 2011;33:565–71.
21. Wagnild GM, Young HM. Development and psychometric evaluation of the resilience scale. J Nurs Meas 1993; 1:165–78.
22. Connor KM, Davidson JR. Development of a new resilience scale: The Connor-Davidson Resilience Scale (CD-RISC). Depress Anxiety 2003;18:76–82.
23. Beardslee WR. The role of self-understanding in resilient individuals: the development of a perspective. Am J Orthopsychiatry 1989;59:266–78.
24. Ying L, Wu X, Lin C, Jiang L. Traumatic severity and trait resilience as predictors of posttraumatic stress disorder and depressive symptoms among adolescent survivors of the Wenchuan earthquake. PLoS One 2014;9:e89401.
25. Pietrzak RH, Johnson DC, Goldstein MB, Malley JC, Southwick SM. Psychological resilience and postdeployment social support protect against traumatic stress and depressive symptoms in soldiers returning from Operations Enduring Freedom and Iraqi Freedom. Depress Anxiety 2009;26:745–51.
26. Daniels JK, Hegadoren KM, Coupland NJ, Rowe BH, Densmore M, Neufeld RWJ, Lanius RA. Neural correlates and predictive power of trait resilience in an acutely traumatized sample: a pilot investigation. J Clin Psychiatry 2012; 73:327–32.
27. Meister R, Princip M, Schmid JP, Schnyder U, Barth J, Znoj H, Herbert C, von Känel R. Myocardial Infarction–Stress PRevention INTervention (MI-SPRINT) to reduce the incidence of posttraumatic stress after acute myocardial infarction through trauma-focused psychological counseling: study protocol for a randomized controlled trial. Trials 2013;14:329.
28. Schumacher J, Leppert K, Gunzelmann T, Strauss B, Brähler E. Die Resilienzskala–Ein Fragebogen zur Erfassung der psychischen Widerstandsfähigkeit als Personmerkmal. Z Klin Psychol Psychiatr Psychother 2005;53:16–39.
29. Wallhäusser-Franke E, Delb W, Balkenhol T, Hiller W, Hörmann K. Tinnitus-related distress and the personality characteristic resilience. Neural Plast 2014;2014:370307.
30. Guler E, Schmid JP, Wiedemar L, Saner H, Schnyder U, von Känel R. Clinical diagnosis of posttraumatic stress disorder after myocardial infarction. Clin Cardiol 2009;32:125–9.
31. Ehlers A, Steil R, Winter H, Foa EB. German translation of the Posttraumatic Diagnostic Scale by Foa. Oxford: Department of Psychiatry, Warneford Hospital; 1996.
32. Foa EB, Cashman L, Jaycox L, Perry K. The validation of a self-report measure of posttraumatic stress disorder: the posttraumatic diagnostic scale. Psychol Assess 1997;9:445–51.
33. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington, DC: American Psychiatric Association; 2013.
34. Do CB, Batzoglou S. What is the expectation maximization algorithm? Nat Biotechnol 2008;26:897–9.
35. Kutz I, Shabtai H, Solomon Z, Neumann M, David D. Posttraumatic stress disorder in myocardial infarction patients: prevalence study. Isr J Psychiatry Relat Sci 1994;31:48–56.
36. Cámara RJ, Gander ML, Begré S, von Känel R, Swiss Inflammatory Bowel Disease Cohort Study Group. Post-traumatic stress in Crohn's disease and its association with disease activity. Frontline Gastroenterol 2011;2:2–9.
37. Moye J, Rouse SJ. Posttraumatic stress in older adults: when medical diagnoses or treatments cause traumatic stress. Psychiatr Clin North Am 2015;38:45–57.