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Causal Attributions and Perceived Severity as Predictors of Posttraumatic Stress Symptoms after a First Myocardial Infarction

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A B S T R A C T

Recent meta-analyses have shown a significant link between symptoms of anxiety and depression, and cardiovascular diseases (CVDs). The presence of these symptoms has a direct impact on the course and the recovery from the CVDs. A less analyzed aspect is the role played by the stress induced by the onset of CVDs conditions and, especially, by acute myocardial infarction (AMI). In this study, we assessed posttraumatic stress symptoms (PTSS), emotional state, health habits, and subjective perception of the event and causal attributions regarding the infarct, in a sample of 76 patients who had suffered an AMI in the previous 48-72 hours. Structural equation analyses and path analyses showed that the severity of PTSS was predicted by the perceived severity of the AMI and by two specific beliefs (i.e., considering that the AMI is a hereditary condition and that the help of others will not be beneficial). The results suggest the possibility of early identification of patients with a higher risk of suffering a high level of stress derived from the AMI. Based on this evidence, we discuss the possibilities of making effective interventions to reduce these symptoms, often ignored in clinical practice, and improve the medical and psychological prognosis of people with AMI.

Atribuciones causales y gravedad percibida como predictores de síntomas de estrés post-traumático tras un primer infarto de miocardio

Palabras clave:
Infarto de miocardio
Afrontamiento
Estrés
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Atribuciones causales
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R E S U M E N

Metanálisis recientes han demostrado una asociación significativa entre los síntomas postraumáticos y las enfermedades cardiovasculares (ECV). La presencia de este tipo de síntomas psicopatológicos tiene un impacto directo en el curso y la recuperación de dichas enfermedades. Un aspecto menos estudiado es el papel que juega el estrés provocado por la vivencia de una enfermedad cardiovascular, y, en especial, por el infarto agudo de miocardio (IAM). En este estudio se evaluaron los síntomas postraumáticos, el estado emocional, los hábitos de salud, la percepción subjetiva del suceso y las atribuciones causales respecto al infarto, en una muestra de 76 pacientes que habían sufrido un IAM en las 48-72 horas previas. El análisis de ecuaciones estructurales y el análisis de sendero (path analysis) mostraron que tanto la gravedad percibida del IAM, como dos creencias concretas (considerar que el infarto es un problema hereditario y que la ayuda de otros no es beneficiosa), predecían la gravedad percibida de los síntomas postraumáticos. Los resultados sugieren la posibilidad de identificar precozmente a los pacientes con mayor riesgo de sufrir un alto nivel de estrés derivado del IAM, gracias a sus atribuciones y su percepción de la gravedad del infarto. En base a esta evidencia, se discuten las posibilidades de realizar intervenciones efectivas para reducir estos síntomas y mejorar el pronóstico de las personas que han sufrido un IAM.

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Introduction

The rapid increase in the prevalence of lifestyle and stress-related diseases has become one of the major public health problems in our society. Nowadays, despite the numerous deaths caused by COVID-19, cardiovascular diseases (CVDs) continue to be the leading cause of death in most developed countries. For example, according to the National Institute of Statistics (INE, 2020), almost 25% of total deaths in Spain are caused by CVDs, a figure that is increasing year after year.

Clinical and epidemiological investigations in recent decades have shown that diverse psychosocial factors (e.g., lifestyle stressors, work pressure, low socioeconomic status), personality (e.g., hostility, type D personality), and negative emotions (e.g., depression, anxiety), are associated with a higher risk of incidence of CVDs and have a significant impact on their prognosis (Jackson et al., 2018). The accumulated evidence regarding the influence of psychological factors on the course and prognosis of CVDs is not anecdotal but is derived from well-controlled cross-sectional and longitudinal studies, which already have been subjected to several meta-analyses. For example, Jacquet-Smailovic et al. (2022) found, in their meta-analysis, that posttraumatic stress disorder (PTSD) is associated with a significant increase in risk for subsequent onset of AMI, and hospitalizations for AMI, or cardiac mortality.

Concerning negative emotions, sadness, anxiety, and posttraumatic symptoms have a frequent presence in patients who have suffered from heart disease (Iozzia et al., 2020). Although the existence of these psychological problems is associated with worse clinical results (Newman et al., 2011), in daily clinical practice they are neither frequently recognized nor treated (Edmondson et al., 2012) which increases the cost of health services, readmission to hospital and risk of fatal heart attacks in the future (Tsutsui et al., 2017). Thus, it is clear that healthcare providers need to know and recognize the psychological conditions associated with cardiac disease.

Beyond this general association between anxiety and stress, and coronary diseases, one aspect of great importance for health professionals is to consider the stressful and potentially traumatic character of some CVDs (Edmondson and Cohen, 2013). There is little doubt that acute cardiac events, like AMI, are sudden life-threatening experiences, which may easily meet the DSM-5 definition of a traumatic event -i.e., direct exposure to threatened death or serious injury (APA, 2013). So, if myocardial infarction is a potentially traumatic event (criterion A for stress disorders), it can induce significant PTSS in the first weeks (even reaching the threshold for Acute Stress Disorder), and if the symptoms persist for at least a month and are of sufficient magnitude and variety (i.e., intrusion symptoms, persistent avoidance, negative alterations in cognitions and mood, alterations in arousal and reactivity), the condition can lead to a full-blown PTSD. In support of this idea, the prevalence rate of PTSD related to acute coronary events is nearly twice as large as the rate in the general population (Jacquet-Smailovic et al., 2021).

Considering a time criterion, focused on early psychological symptoms after AMI, a systematic review by Jacquet-Smailovic et al. (2021) concluded that the prevalence rates for Acute Stress Disorder (ASD) range between 0 and 26%, with an average of 12% (e.g., Castilla & Vázquez, 2011). One month after the AMI it is possible to diagnose PTSD if significant PTSS symptoms are still present. The same study (Jacquet-Smailovic et al., 2021) found prevalence rates of PTSD from 0% to 38%, with an average of 4-16%, depending on the diagnostic tools used (Vilchinsky et al., 2017). These results confirmed previous meta-analytic evidence showing an average prevalence of 12% for the diagnosis of PTSD after an acute coronary syndrome (Edmondson et al., 2012).

In any case, assessing the presence of PTSS immediately after an AMI seems clinically relevant. There is evidence that the presence of PTSS a few days after the heart attack predicts adverse psychological reactions like major depression (Fortin et al., 2013) or PTSD (Wikman et al., 2012). Also, these symptoms are associated with a two-fold increase in mortality (risk ratio = 2.0) and/or AMI recurrence according to Edmondson et al.'s meta-analysis (2012). Similar findings have been found even when demographic and clinical co-variables and the severity of the cardiac episode were controlled (Tsutsui et al. (2017), which highlights the importance of PTSS symptoms as a prognostic risk factor in post-AMI patients (von Känel et al., 2011). Nevertheless, the exact psychobiological mechanisms involved in this increase in risk of poor health prognosis are not well known. There is some evidence related to increases in inflammation from the psychological stress after AMI (Fonkoue et al., 2020; Peruzzolo et al. 2022). Also, another type of evidence shows psychological distress symptoms (e.g., anxiety, depression, and stress) lead to poorer medication adherence and healthy habits (Fan et al., 2021).

Predictors of stress-related symptoms in coronary episodes

Extant research on the factors that predict the onset of significant PTSS induced by an acute coronary episode has identified several candidates. On one hand, there is a series of sociodemographic factors that are positively associated with these symptoms: being younger and with a lower socioeconomic level (Wikman et al., 2008) and female gender (Roberge et al., 2010). From a psychological point of view, factors such as intense fear after the episode (Bennett et al., 2002), feeling a loss of control (Doerfler et al., 2005), acute depression during hospitalization, or a history of previous psychiatric disorder (Roberge et al., 2010) are also predictors of a greater intensity of posttraumatic response (Edmonson et al., 2012). Social support may also contribute to a decreased risk of developing PTSD after AMI (Marke & Bennett, 2013). However, many studies found that the objective severity of the AMI event does not sufficiently explain the onset and maintenance of posttraumatic stress problems (e.g., von Känel et al., 2011; Wikman et al., 2012).

In addition to these clinical and sociodemographic factors, two cognitive factors also seem relevant: the subjective perception of the seriousness of the episode and the explanation given by the patient for the causes of the event (causal attributions). In a study with 172 patients with cardiovascular illness (Steca et al., 2013), it was concluded that the perception of the severity of the heart attack and the beliefs that one can control the situation (i.e., self-efficacy mediated the relation between the objective severity of the illness and the dependent variables included in the study (depression, health satisfaction and life satisfaction). Moreover, there is evidence that perceiving the heart attack as less serious leads to a better recovery (Petrie et al., 1996) and a faster one (Johnson & King, 1995), as well as starting and maintaining a long-term healthy lifestyle (Lau-Walker, 2007; Scharloo et al., 1998). On the other hand, greater threat perceptions in patients with an acute coronary syndrome, predicted greater posttraumatic stress symptoms (Meli et al., 2018) and higher levels of rehospitalization and mortality a year after the event (Whitmarsh et al. 2003). In a meta-analysis on the perception of illness in patients with AMI, French et al. (2006) found that perceiving the condition as controllable, was a significant predictor of attendance at cardiac rehabilitation.

Causal attributions are also a relevant factor. In a pioneering study by Affleck et al. (1987), 287 patients who had suffered a heart attack were interviewed seven weeks after the event and eight years later. Amongst the included variables were the causal attributions of the heart attack (i.e., the explanations that the patient gave for the cause of the coronary episode), the recuperation of the survivor and the repetition of the attack. Independently of the sociodemographic characteristics, they observed that those who attributed the attack

to "internal" factors such as worries or nervousness, showed a worse recovery after eight years. This was one of the first studies which suggested the possibility that beliefs about the cause of the illness, could have a predictive role on the course of the illness.

Perkins-Porras et al. (2006) studied the causal attributions for the illness in 171 patients with acute coronary syndrome in the first five days of the hospital admission. They found a strong relationship between causal attributions and the specific risk factors that the people were experiencing. For example, 90% of smokers attributed their heart attack to smoking and 72% of people with a family history of cardiac illness attributed their heart attack to hereditary factors. These authors pointed out the need of giving adequate information about modifiable risk factors to influence these beliefs that could promote changes in their lifestyle.

Therefore, both the existence of a negative affective state and a series of beliefs about the seriousness, cause and circumstances of the coronary episode can affect the presence of symptoms of posttraumatic stress induced by the event as well as the level of adherence to treatment (Fan et al., 2021). Yet, the specific relationships among these factors are still unknown. This study aimed to construct and contrast, using structural equations, an explanatory model of the relations between some of the relevant variables identified in previous research (i.e., the severity of the episode, causal attributions, psychological distress, and stress-related symptoms). We also included variables related to health-related behaviors and sociodemographic information. Based on the revised literature, we hypothesized that the perception of the seriousness of the heart attack would mediate the relation between beliefs about the event, negative mood and the appearance of posttraumatic symptoms induced by the AMI.

Method

Participants

The sample consisted of 76 participants who had suffered an AMI in the previous 48 to 72 hours and were hospitalized in the Coronary Unit of the Getafe University Hospital (Madrid). Patients who had suffered a previous heart attack were not included, since that experience may have changed their way of life and way of dealing with the event and could therefore affect the results.

Materials

Socio-demographic information. It included items referring to age, gender, civil status, level of studies and occupation. Medical history was also included, such as the use of medication, previous coronary problems, and previous health problems (i.e., hypertension, high cholesterol, diabetes, and circulation problems).

The Lifestyle Appraisal Questionnaire (LAQ, Craig et al., 1996). This questionnaire is comprised of two parts. The first one (LAQ-I) has 21 items and assesses life style risk factors presents in the previous weeks of de AMI (e.g. smoking, sedentary lifestyle, eating habits, obesity…). We used the total score (between 0-73), where higher scores reflect higher risks of disease and lower quality of life (α = .59). The second part (LAQ-II), assesses perceived stress (i.e., beliefs about life stressors and life demands) over the weeks before AMI. This four-point Likert scale, consists of 25 items (scores between 0-75) and high scores indicate higher perceived levels of stress (α = .69).

General Health Questionnaire (GHQ-12) (Goldberg & Williams, 1996) is a screening instrument for common mental disorders. It consists of 12 items, each one assessing the severity of a mental problem over the past few weeks using a four point Likert scale (from 0= never, to 3=always). The Spanish version (Lobo & Muñoz, 1996) was used in the study.

We used the total score, which varies between 0 and 36, with higher scores representing worse health. Two factors are differentiated: Social dysfunction or the incapacity to follow a normal "healthy" lifestyle, and Anxiety/depression that corresponds to general distress. In this study was obtained an adequate internal consistency for anxiety/depression (α = .85) and inadequate for social dysfunction (α = .46).

Perception of the severity of the AMI (PS-AMI). We created a 3-item questionnaire covering: a) perception of danger, b) perception of whether it was experienced as a traumatic situation and c) perception of the seriousness of the event. Participants responded on one scale from 1 ("not at all") to 10 ("very much"). High scores indicate higher perception of trauma severity (α = .65).

Causal Beliefs Questionnaire (Perkins-Porras et al., 2006). It consists of 16 statements about attributional beliefs regarding the cause of the heart attack (e.g., "My illness is hereditary, it runs in my family"; "Stress has been the main cause of my illness"). Each item is answered on a scale of 3 points (0= no, 1= perhaps, 2=yes).

Positive and Negative Affective Schedules (PANAS) (Watson et al., 1988). The Spanish version of this instrument (López-Gómez et al., (2015) it was used to measure patients' emotional states at the time of the interview. It includes 10 positive emotions (e.g., hope, strength) and 10 negative ones (e.g., nervousness, fear) of high arousal. The responses are in a range from 1 ("very slightly or not at all") to 5 ("extremely") according to the intensity of the emotion at the time of evaluation. We used the separate total scores (from 10 to 50) for positive and negative emotions. In this study, was obtained an adequate internal consistency for positive affective (α = .85) and negative affective (α = .91).

Posttraumatic Civilian Checklist (PCL, Weathers et al., 1993). It was used to evaluate posttraumatic symptomology (PTS). The PCL is an inventory that evaluates on a scale from 1("not at all") to 5 ("extremely") the seriousness of each of the 17 symptoms that cover criteria B (re-experiencing), C (avoidance) and D (hyperactivity) of the DSM-IV-TR (APA, 2000) criteria for PTSD. For this study, the total score (from 17 to 85) was used (Castilla and Vázquez, 2011), which obtained a Cronbach's α = .77.

Procedure

Consecutive patients in the Coronary Unit were individually interviewed by Master and PhD Psychology candidates 48-72 hours after their admission to the hospital. All patients signed a consent form for participating in the study (approved by the Ethical Committee of the hospital). The collection of data lasted approximately an hour.

Data analyses

Regression equations were used to determine the most relevant relations among the variables included in the study. Then, path models were used to evaluate which of them presented a better fit, by using path analyses via a structural equation modeling.

The AMOS v18.0 of the SPSS program was used for the analyses, using the method of maximum likelihood estimation, since the Mardia index (1970) obtained a point of 4.99, which supports the assumption of multivariate normality (Bentler, 2005). Given that the size of the sample was relatively small, the bootstrap method was used to test the significance of the regression weights (Gil, 2005; West et al., 1995). The fitting indices were the following: a) $\chi 2$: a perfect fit is indicated by a non-significant value; b) $\chi 2$/df: a good fit is indicated by a value lower than 2; c) TLI and CFI: an acceptable fit is indicated by a value ≥ 0.90, whereas a good fit is indicated by

a value ≥ 0.95; d) RMSEA: an acceptable fit is indicated by an RMSEA value ≤ 0.08 (90% CI ≤ 0.10), whereas a good fit is indicated by an RMSEA ≤ 0.05 (90% CI ≤ 0.08). e) AIC: is a comparative indicator, where lower values favor the choice of model.

Results

Table 1 summarizes the sociodemographic characteristics of the sample and lifestyle risk factors results (LAQ-I).

Table 1
Sample sociodemographic characteristics and lifestyle risk factors (LAQ-I)

Sociodemographic Characteristics		M (SD) / N (%)
Age (between 35 and 87)		M=60.32 (SD=12.73)
Gender (male)		55 (72,4%)
Civil Status	Single	3 (3.9%)
	Married or lived with their partner	58 (76.3%)
	Widowed	6 (11.8%)
	Divorced or separated	9 (7.9%)
Employment status (unemployed or retired)		33 (43.4%)
Completed education	None	10 (13.2%)
	Primary	42 (55,2%)
	Secondary	18 23.6%)
	Superior	6 (7.8%)
Lifestyle risk factors		N (%)
Previous risk factors: Hypertension (Yes)		27 (35.5%)
Previous risk factors: High cholesterol (Yes)		20 (26.3%)
Previous risk factors: Diabetes (Yes)		7 (9.2%)
Previous risk factors: Circulation problems (Yes)		14 (18.4%)
Have ever smoked (Yes)		50 (65.8%)
Currently smoke (Yes)		35 (46.1%)
Smoking frequency (≥10 cigarettes per day)		28 (36.8%)
Arterial pressure (≥130 systolic)		10 (13.9%)
Body mass index: overweight (25-29)		36 (47.4%)
Body mass index: obese (≥30)		19 (25%)
Frequency of alcohol consumption (≥3 drinks/day)		6 (7.9%)
Consumption of analgesics, ansiolitics, etc. (Every day)		18 (23.7%)
Family history of heart attack (Yes)		39 (51.3%)
Family history of cancer (Yes)		33 (43.4%)
Family history of high blood pressure (Yes)		34 (44.7%)
Frequency of physical exercise (never)		21 (27,6%)
Frequency of leisure activities (never)		15 (19.7%)
Frequency of relaxing exercises (never)		60 (78.9%)
Frequency of consumption of unhealthy food (≥1 time per day)		26 (34.2%)
Friends and relatives that help out (always available)		53 (69.7%)
Stressful events in the past 6 months (≥1)		39 (51.3%)
Any chronic illness or disease (Yes)		25 (32.9%)
Frequency of physical symptoms: fatigue, headache (≥1 time/year)		40 (52.6%)
Frequency of good sleep (most times)		57 (75.0%)
Frequency of consumption of coffee or tea (≥4 cups/day)		17 (22.3%)

None of the sociodemographic conditions (gender, age, civil status, occupation) nor the medical conditions (previously having taken medication, other health problems, hypertension, diabetes, high cholesterol, circulation problems) included in the study, showed a significant association with the main dependent variable (i.e., PTSS), except for the level of education; an ANOVA with the levels of education ($F(5,70)=3.411$; $p=0.008$; partial eta squared=0.20) revealed significantly higher PTSS scores in people with no studies than in the rest of educational levels (M=30.98; SD=14.79), with no differences between the other levels.

No significant relations were found between PTSS and health habits (LAQ-I), positive affectivity (PANAS) or social dysfunction (GHQ-12). Thereafter, an analysis of the correlation of zero-order of the variables included in the study was made. The results are shown in Table 2.

Table 2
Mean Scores and Pearson's correlations between health-related habits, emotional state, perceived severity, psychological distress and trauma-related symptoms (N=76)

	Positive emotions (PANAS)	Negative emotions (PANAS)	Anxiety-depression (GHQ-12)	Social dysfunction (GHQ-12)	PS-AMI	PTSS
Mean Score (SD)	28.5 (8.8)	17.4 (6.8)	5 (3.9)	6.6 (2.1)	16.4 (6.8)	23.2 (7.4)
Min/Max	10-50	10-50	0-18	0-18	3-30	17-85
Lifestyle (LAQ I)	-.19	.11	.04	-.07	.17	.21
Positive emotions (PANAS)		.11	-.08	-.23	-.04	-.03
Negative emotions (PANAS)			.61***	.18	.32**	.37**
Anxiety-depression (GHQ-12)				.48***	.25*	.31**
Social dysfunction (GHQ-12)					-.01	.16
PS-AMI						.25*

GHQ-12=Goldberg Health Questionnaire-12; PS-AMI= Perception of the severity of the AMI (acute myocardial infarction); PTSS=Posttraumatic Stress Symptoms.
*<0.05; **<0.01; ***<0.001

In multiple linear regression analyses including predictors of life habits (LAQ-I) and the questionnaire of causal attributions and the perception of the seriousness of the episode (PS-AMI) and PTSS as outcomes, only two predictors were found to be significant: “Other people cannot help me manage my stress” (item 23 from the LAQ-II) for PS-AMI, and “My illness is hereditary, this runs in my family” for PTSS.

Based on the significant variables found, a structural model was proposed including the variables that had shown a significant relation with the main outcome (i.e. posttraumatic stress symptoms): negative emotions (PANAS total negative affect), anxiety/depression (GHQ total score), beliefs related to stress (“Other peo-

ple can't help me manage my stress", item 23 from the LAQ-II), the item number one the Causal Beliefs Questionnaire ("My illness is hereditary, this runs in my family"), and the perception of the severity of AMI. Four distinct plausible models which had sufficient theoretical support were tested, which are shown in Figures 1, 2, 3 and 4.

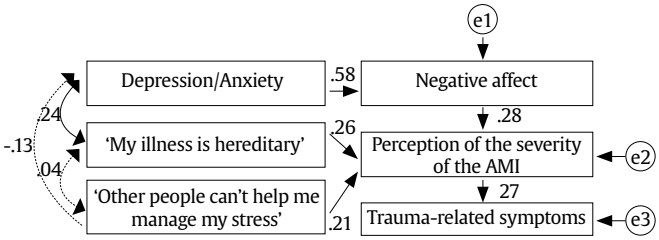

Figure 1.
Model 1.

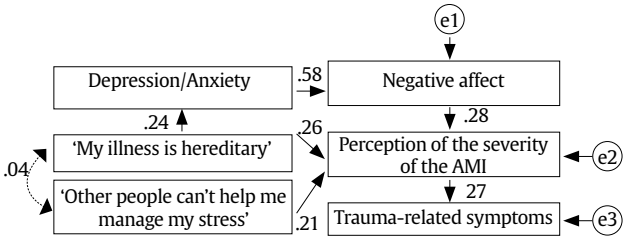

Figure 2.
Model 2.

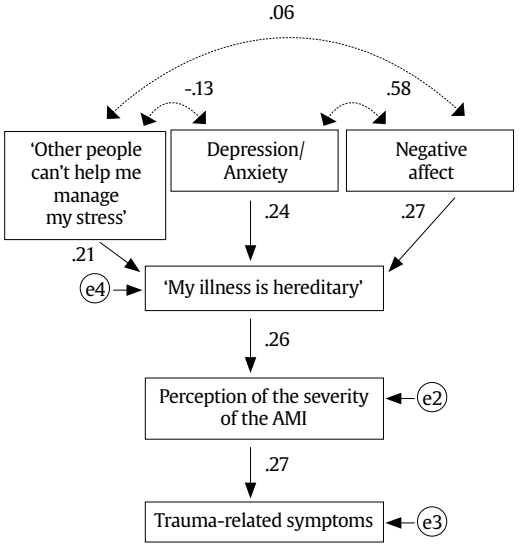

Figure 3.
Model 3: Model with the best fit.

All models considered full mediation of the perception of the severity of the heart attack between the rest of the variables and the PTSS. Yet, the models varied regarding the relationship between these variables and the mediator. In model 1, negative affect fully mediates the relationship between depression/anxiety and the perception of the severity. In model 2, depression/anxiety fully mediates the relation between beliefs considering the heart attack as a hereditary illness and negative affect. In model 3 beliefs on the hereditability of the illness fully mediate the relation between depression/anxiety mental health and the perception of severity. In model 4 negative affect and heritability beliefs fully mediate the relation between depression/anxiety mental health and the perception of severity. Goodness of fit indicators are shown in Table 3.

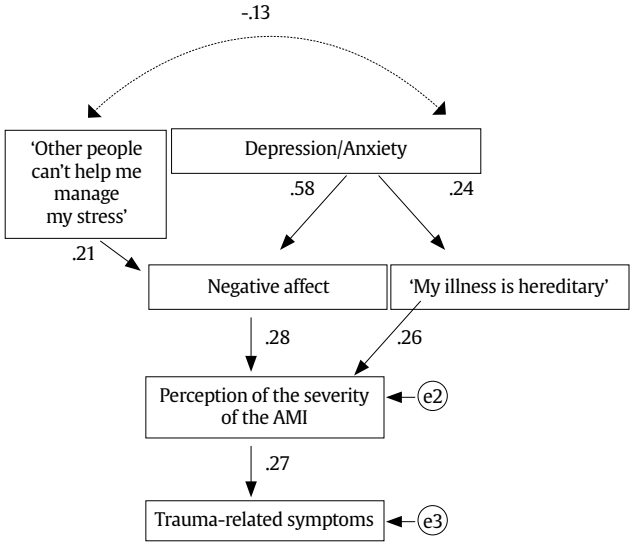

Figure 4.
Model 4.

Table 3
Models and Goodness of Fit Indices

Models	$\chi 2$	*p*	$\chi 2/gl$	TLI	CFI	AIC	RMSEA	IC 90%
Model 1	10.063	0.185	1.43	0.88	0.95	50.06	0.08	0.00-0.17
Model 2	11.558	0.172	1.45	0.88	0.94	49.56	0.08	0.00-0.17
Model 3	8.305	0.306	1.19	0.95	0.98	48.31	0.05	0.02-0.16
Model 4	10.458	0.234	1.31	0.92	0.96	48.46	0.06	0.02-0.16

Model 3 showed the best fit according to the aforementioned best-fit criteria. These models show a direct effect of anxiety/depression on the belief "My illness is hereditary, this runs in my family"; a direct effect on the beliefs "Other people can't help me manage my stress" and "My illness is hereditary, this runs in my family" and of the negative affectivity on the perception of the severity of the AMI, and a direct effect on the perception of the severity of the heart attack on PTSS. A bias-corrected bootstrap estimation with 10,000 samples with a 95% confidence interval was performed to determine if the indirect effects were significant (MacKinnon et al., 2004). A mediating effect exists as long as the zero is not included in the confidence interval in the bootstrap analyses. The results indicated that all the observed indirect effects were significant, except for the indirect effect of the belief "Other people can't help me manage my stress" concerning PTSS. This result shows that the perception of the severity of the AMI totally mediates the effect of anxiety-depression mental health, negative affect, and the belief "My illness is hereditary, it runs in my family" over PTSS, but does not fulfill a mediating role of the belief "Other people can't help me manage my stress" over PTSS.

Discussion

The results of this study confirm that the subjective perception of the seriousness of the heart attack has a direct relation with the seriousness of posttraumatic symptoms associated with the coronary episode. This result is in line with the findings that there is no relation between the objective seriousness of AMI, measured by the fraction of the ejection of the left ventricle, and other parameters, and the psychological symptoms of stress (Roberge et al, 2010). In a similar vein, the literature concerning posttraumatic stress equally reveals that the seriousness of the psychological response does not have a direct relation with the objective intensity of the stressor, but does with the perceived seriousness (Gabert-Quillen et al., 2011; Steca et al., 2013).

Regarding the antecedents of the perception of the seriousness of the AMI, our results revealed that negative affect has a direct predictive role on said perception. In our case, two emotional factors are relevant. On the one hand, the factor of Anxiety/depression of the GHQ-12 has an indirect effect via the belief that the disease is hereditary, and, on the other hand, a negative affective state directly affects the perception of severity. This matches the existing literature on the psychological impact of AMIs, which states that a negative emotional state is a predictor of posttraumatic symptoms after an AMI (Pedersen et al, 2011).

Finally, two beliefs contribute directly to the perception of seriousness. Firstly, the idea that the illness is hereditary could lead to a perception of lack of control or helplessness against the situation (Rosengren et al, 2004). Interestingly, some studies have found that attributing the cardiac episode to non-modifiable factors is associated with non-attendance to cardiac rehabilitation services (Blair et al., 2014). Secondly, the idea that nobody can help to reduce the stress, which reflects a negative belief on the efficacy of social support, appears to be a predictor of posttraumatic symptoms after an AMI (Bennet et al, 2002). It is possible that people with these beliefs are more likely to use coping strategies without considering the help of others, and therefore less efficient; consistent with the idea discussed above that social support decreases the occurrence of PTSD (Marke & Bennet, 2013).

Even though there was already evidence that some of these factors have a relevant role in stress symptoms after an AMI, our study used techniques of structural equations to reveal a hypothetical causal model between those factors. According to our hypothesis, this model (Figure 3) links the stress symptoms induced by the coronary episode with the perception of seriousness, and the negative emotional state of the patient, also including a specific set of negative beliefs about the illness and its circumstances. In this lines, recent research on posttraumatic growth has shown that core beliefs (e.g., general ideas about being part of the humanity) have a mediator role in the development of growth-related feelings and beliefs (Vázquez et al., 2021).

Our study has some limitations. Firstly, the size of the sample is relatively small; nevertheless, despite that limited size, our statistical models used are robust, as shown by the results on multivariate normality. Underpowered studies is a common limitation in psychology research (Anderson et al., 2017) and this also affects the studies in this field. In fact, Edmonson et al (2012) observed in their meta-analysis that this a typical limitation problem in the published literature about stress-related symptoms and cardiac episodes and, therefore, future studies should increase the number of participants. Secondly, although this study evaluates models that establish causal or temporal relations through a structural equation model, its design was correlational and cross-sectional. Therefore, the validity of the model must be corroborated by further longitudinal studies assessing causal relations between variables. Thirdly, there are some potential mediating variables that were not considered in the study (e.g., the intensity and type of critical care given to the patient), which could affect the results. In effect, there is evidence that the number of invasive medical interventions used on these patients can have a cumulative effect on the amount of stress that they can efficiently support (Griffiths et al., 2007). Another limitation is that the study could not include other relevant predictive variables of stress symptoms in patients with AMI, such as a previous history of PTSD or substance abuse (Roberge et al., 2010) or some other relevant psychosocial risk factors like personality patterns or social isolation (Mesa-Vieira et al., 2021). Finally, the study was designed before there were assessment instruments related to the DSM-5 (APA, 2013). Therefore, we used the PCL-C to assess PTSS, which does not include the new domain of problems (i.e., negative alterations in cognitions and mood associated with the traumatic event) included in the criteria of PTSD symptoms. Despite this new domain of symptoms also includes attributional symptoms (e.g., distorted cognitions about the cause or consequences of the traumatic event that lead the individual to blame himself/herself or others), we believe that the rationale of our model (i.e., considering that attributions may play a causal role in relation to PTSS) is still psychologically and theoretically meaningful. Finally, it should also be noted the limited reliability of some the scales (e.g., PS-AMI and GHQ-12) used in the study.

Our results may have some significant implications for routine clinical practice. They support the idea that a relatively simple way of screening, including psychological symptoms, the perception of seriousness the AMI (Baxter & Allmark, 2013) and some attributional beliefs on the cardiac episode (Perkins-Porras et al, 2006), could be useful in detecting patients at possible risk of developing acute or posttraumatic stress syndromes or even later clinical cases of PTSD, with potential serious consequences in their recovery (e.g., attendance to cardiac rehabilitation services).

Some studies have shown that psychological intervention significantly psychological symptoms and reduced cardiac mortality for people with CHD (Richards et al., 2018). Specifically, Birk et al. (2019) in their systematic review, found that cognitive behavioral therapy or meaning-making, were more efficacious at reducing PTSD symptoms in survivors of life-threatening medical events, than hospital counseling intervention. Furthermore, in a recent meta-analysis of randomized controlled studies (Shi et al., 2022), the authors found that patient education, which is key component of cardiac rehabilitation, significantly reduces the risk for having clinical symptoms of anxiety or depression at the end of the interventions and at 6-12 months follow-ups. In general, all this evidence converges on the idea that psychological interventions related to the beliefs about the AMI and the perception of the event, most probably reduces the risk of developing emotional distress after the AMI, and indirectly, also reduces morbidity and mortality.

Further research should address whether modifying the emotional and cognitive factors found to be associated with the stress-related responses in patients suffering an AMI could improve recovery and prevent possible relapses. If these results are confirmed in further studies, we could contribute to saving economic and human resources and provide better care and attention for the patient.

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