



Posttraumatic Stress, physical Health and chronic Pain: The Role of Hyperarousal and depressive Symptoms

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Abstract

Background

This cross-sectional study aimed to examine the association of posttraumatic stress symptoms (PTSS; i.e., re-experiencing, avoidance/numbing, and hyperarousal) and depressive symptoms with: (a) physical health symptoms, (b) pain symptoms, (c) and the presence of chronic pain among trauma-exposed individuals. The mediational role of depressive symptoms in the relationship between each PTSS cluster and physical health symptoms, pain symptoms, or presence of chronic pain was also tested.

Method

Individuals who reported to have suffered a traumatic experience (N = 100) participated in the study. They were recruited through organizations offering services for victims of violence, self-help groups, newspaper announcements, and the outpatient clinic. Participants were interviewed with the Diagnostic and Statistical Manual for DSM-IV and the German versions of the Clinician-Administered PTSD Scale, the Beck Depression Inventory, and the Freiburg Complaints Scale.

Results

Regression analysis showed that both hyperarousal and depressive symptoms accounted for unique variances of physical health symptoms (partial r^2 were .03 and .11, respectively). Bootstrap analysis indicated that whereas hyperarousal was both directly and indirectly (through depressive symptoms) related to physical health symptoms, avoidance/numbing and re-experience were only indirectly related with physical health symptoms via depressive symptoms. For pain symptoms, only depressive symptoms were uniquely related with this variable (partial r^2 was .05). Depressive symptoms mediated the relationship between the three PTSS clusters and pain symptoms, but not the relationship between the clusters and the presence of chronic pain. Hyperarousal was the only variable uniquely and directly related with the presence of chronic pain ($OR = 3.01$; $p < .05$).

Conclusions

These data highlight the importance of treating depressive and hyperarousal symptoms in order to improve physical health and pain in trauma-exposed individuals.

Keywords

Mediation analysis; Re-experiencing; avoidance/numbing; bootstrap analysis; Trauma exposure; chronic pain

Introduction

Extant evidence supports a negative relationship between both posttraumatic stress symptoms (PTSS) and depressive symptoms with physical health symptoms [1,2]. For instance, both PTSS and depressive symptoms accounted for unique proportion of variance (variability of the dependent variable that is accounted only by one of the independent variables) in physical health symptoms among U.S. soldiers who had been deployed in Irak [2]. However, not all PTSS clusters seem to be equally related to physical health symptoms. Two studies pointed to hyperarousal as the only PTSS cluster explaining unique physical health symptoms variance even after controlling for depressive symptoms. Miranda et al. found that both hyperarousal and depressive symptoms uniquely mediated the relationship between trauma exposure and physical health symptoms among female undergraduate students with a history of trauma [3,4,5,6]. Conversely, Zoellner, Goodwin, and Foa [7] found that re-experiencing, but not hyperarousal or avoidance, were associated with self-reported physical health symptoms. By contrast, only avoidance/numbing accounted for unique physical health symptoms variance among intimate partner violence victims [8]. Finally, in a recent study only depressive symptoms but not PTSS accounted for unique physical health symptoms variance among female sexual assault survivors with PTSD [9]. Further investigation about the relationship between each of the specific PTSS clusters and physical health symptoms – in which depressive symptoms are also considered as predictors – is needed. Knowing which specific aspects of the posttraumatic stress disorder (PTSD) phenotype related with physical health is important to clarify over which aspects of mental health to intervene in order to prevent negative health consequences. This research may also contribute to understand the nature of PTSD, and provide construct validity to its symptoms clusters, which have been recently questioned [10]. It may also help to clarify whether the interventions aimed to protect physical health among trauma-exposed individuals must emphasize the treatment of PTSS or the treatment of depressive symptoms. Therefore, our first aim was to examine the association of each PTSS clusters (i.e., re-experiencing, avoidance/numbing, and hyperarousal) and depressive symptoms – considered concurrently as independent variables in a regression analysis – and physical health symptoms among trauma-exposed individuals. We were interested in elucidating which symptoms accounted for unique physical health symptoms variance. We hypothesized that both hyperarousal and depressive symptoms would account for unique physical health symptom variance. Individuals with higher hyperarousal and depressive symptoms scores would report more severe physical health symptoms.

According to the theory of Schnurr and Green [11], depressive symptoms may affect physical health not only as a primary reaction to trauma exposure but also as a consequence of PTSD. In fact, some evidence supports the mediational role of depressive symptoms in the relationship between PTSD and physical health symptoms. Namely,

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depressive symptoms fully mediated the relationship between PTSS and health complaints in two studies conducted with patients with PTSD [6,12]. By contrast, the results of one study conducted with deployed and non-deployed peace keepers showed that PTSD symptoms had both a direct and an indirect influence on health through depressive symptoms [5]. A limitation of these studies was that only the participant's total PTSS score – and not the scores in the specific symptom clusters that shape PTSD – was considered. Depressive symptoms may only mediate the influence of some of the PTSS clusters (but not all of them) over physical health symptoms, but this hypothesis has never been tested. Therefore, our second objective was to examine whether depressive symptoms mediated the relationship between each of the PTSS clusters and physical health symptoms. We hypothesized that, whereas avoidance/numbing and re-experiencing would be indirectly related with physical health symptoms via depressive symptoms, hyperarousal would be both directly and indirectly related (via depressive symptoms) with physical health symptoms.

physical health is a multidimensional construct [11] including pain as one component, and PTSD and pain – and even chronic pain syndromes – often co-occur [13]. As in the case of physical health symptoms, not all the PTSD symptoms clusters seem to be related with pain symptoms in the same way. For instance, among people with chronic pain, Beckham et al. [14] found that re-experiencing was related to pain disability, overall pain index, and current pain level. Re-experience has also been found to relate to migraine episodes frequency [15]. In fact, according to the literature, pain may trigger re-experience symptoms, because it may work as a remainder of the trauma [16]. By contrast, López-Martínez, Ramírez-Maestre, and Esteve [17] found that emotional numbing and hyperarousal were related with chronic pain outcomes; whereas Cyders, Burris, and Carlson [18] found that only hyperarousal predicted pain severity among patients with chronic pain. More research investigating the particular role of each of the PTSD clusters and pain appears desirable. Therefore, our third objective was to examine which of the PTSS clusters was uniquely related with pain symptoms – as well as with the presence of chronic pain – when considered concurrently with depressive symptoms as independent variables in a regression analysis. We hypothesized that re-experiencing, hyperarousal, and depressive symptoms – but not avoidance/numbing – would be uniquely related with pain symptoms – as well as with the presence of chronic pain. Individuals with higher re-experiencing, hyperarousal, and depressive symptoms scores would report more pain symptoms and would have greater probability of presenting chronic pain.

As in the case of physical health symptoms, some authors consider depressive symptoms to mediate the PTSD and pain relationship. Poundja et al. [19] found depression fully mediated the relationship between PTSD and pain severity among male veterans with PTSD; whereas Roth, Geisser, and Bates [20] found PTSS were directly related to depressive symptoms and that depressive symptoms were directly and indirectly related to pain among patients with accident-related chronic pain. However, these authors did not consider the influence of each PTSS clusters separately. Therefore, our fourth objective was to examine whether depressive symptoms mediated the relationship between each PTSS cluster and two dependent variables: pain symptoms and presence of chronic pain. We expected to find that avoidance/numbing will be indirectly related with both pain symptoms and presence of chronic pain, via depressive symptoms. Regarding re-experiencing and hyperarousal, these two variables were expected to be directly as well as indirectly related (via depressive symptoms) with pain symptoms and presence of chronic pain.

Materials and Methods

Participants and procedure

One-hundred trauma-exposed individuals (35 men and 65 women) were recruited through organizations offering services for victims of violence, self-help groups, newspaper announcements, and the outpatient clinic. We selected persons who had had a traumatic event of any kind other than childhood trauma with or without adverse consequences. Two participants were removed from the sample because they were identified as multivariate outliers through Mahalanobis distance [21]. Critical χ^2 calculate at $\alpha = .001$ for seven variables (age, sex, re-experiencing, avoidance/numbing, hyperarousal, depressive symptoms, and physical health symptoms) was 24.322. One of these participants was a multivariate outlier because he reported no re-experiencing symptoms at all, low physical health symptom scores, and extremely high depressive symptom scores. The other outlier was a person that had very high scores in avoidance, but average scores in re-experiencing and physical health symptoms. Therefore, data analysis were conducted with 98 participants (65 women, 33 men; mean age 44.88 years, SD = 13.52, range 16-68). Fifty-six per cent of them indicated their worst traumatic experience was an accident, 15.3% being victim of violence perpetrated by a friend, 9.2% being victim a sexual abuse perpetrated by a close one, 5.1% being victim of violence perpetrated by a family member, 4% having suffered a life-threatening illness, and 1% experiencing a natural disaster. "Other" was indicated as the worst trauma category by 9.2%. Whereas 70.4% were exposed to a traumatic event produce by chance, 29.6% experienced an event caused intentionally by another human being. Time of trauma occurrence was more than 5 years ago in 61%, between three and five years ago in 9.1%, between six months and three years in 21.6%, and less than six months ago in 7.9%. Fifty-two per cent were diagnosed with current PTSD, 21.4% with current major depression, and 18.4% with lifetime chronic pain according to DSM-IV [22]. Comorbid major depression was present in 34.6% and comorbid pain in 27.5% of the patients with PTSD. Participants with a current or past alcohol or drug dependence or psychotic disorder were excluded from the study. The Ethics Committee of the Medical Faculty Mannheim, Heidelberg University approved this study. We informed participants about the purpose of the study, which was part of a larger investigation on the psychobiology of PTSD, and they gave written informed consent. All participants were interviewed by a trained clinical psychologist to determine the presence of mental disorder and then completed the questionnaires described below.

Measures

PTSD was assessed using the German version of the Clinician-Administered PTSD Scale (CAPS) [23]. Participants reported the PTSD symptoms experienced during the past month. The CAPS is one of the most widely employed PTSD interviews and presents excellent psychometric properties [24]. Its scores for the three PTSD symptoms clusters (re-experiencing, hyperarousal, and avoidance/numbing) were used. Cronbach's alpha for the subscales were .85, .87, and .84, respectively in the present sample. The Freiburg Complaints Scale (FCS) was employed to assess physical health symptoms and pain symptoms [25]. It comprises 80 items organized in nine subscales: general well-being, fatigue, cardiovascular complaints, gastro-intestinal complaints, neck problems, tension, emotional reactivity, pain, and hypersensitivity. Participants indicated whether they experience their symptoms *never, approximately twice per year,*

approximately twice per month, three times per week, or almost every day. The FCS presents adequate psychometric properties. The total score of these questionnaire has Cronbach’s alpha levels between 0.95-0.97, and was positively associated with physician visits [26,27]. In our sample, Cronbach’s alpha coefficients were .97 for the total physical health symptoms score and .76 for the pain symptoms subscale. The Structured Clinical Interview for DSM-IV (SCID) was used to assess the presence of comorbid mental disorders (e.g. depression, chronic pain disorder) [28]. The German version of the Beck Depression Inventory (BDI) was used in order to assess depressive symptoms [29]. Participants rated their feelings during the past two weeks. Cronbach’s alpha for this scale was .83 in our sample.

Data analysis

To examine the association of the three PTSD clusters (re-experiencing, avoidance/numbing, and hyperarousal) and depressive symptoms with physical health symptoms (Aim 1) and pain symptoms (Aim 3), we conducted two hierarchical multiple regression analysis. We reported R^2 and partial r^2 as effect size indices. According to Cohen, the values for small, medium, and large R^2 (or partial r^2) are .0196, .1304, and .2592, respectively [30].

To examine the association of the three PTSD symptom clusters and depressive symptoms and the presence of chronic pain (Aim 5), we performed a hierarchical logistic regression analysis. We introduced age and sex in the first step of all analysis; re-experiencing, avoidance/numbing, and hyperarousal in the second step; and depressive symptoms in the third step. Sex was coded with 0 for women and 1 for men. The category of reference was women. As an indicator of the effect size sizes we have reported Cohen’s d. The effect sizes were calculated by using the following formula $\ln(\text{Odds ratio})/1.81$ [21]. The values for small, medium, and large Cohen’s d are .20, .50, and .80, respectively [30].

To test mediation (Aims 2, 4, and 5), regression models with bootstrapping were conducted using a SPSS macro (“INDIRECT”;) that generated 5000 bootstrap samples to calculate 95% bias-corrected confidence intervals [31]. Bootstrapping has demonstrated numerous advantages over classical methods to test for mediation [32]. According to this procedure, the only condition for mediation is finding a statistically significant indirect effect [31,32]. The specific indirect effect of a predictor (e.g., hyperarousal) on a dependent variable (e.g., physical health symptoms) via a particular mediator (depressive symptoms in our case) is defined as the product of the unstandardized regression coefficient of the path linking the predictor and the mediator (a) and the unstandardized regression coefficient of the path linking the mediator and the dependent variable (b). To bootstrap the sampling distribution of the indirect effect, a sample of size n cases is taken from the original sample. Using this new resample size (n) a and b values for the mediator are estimated, and

ab (the indirect effect) calculated. This process is repeated k times (5,000 in our analysis) yielding 5,000 estimates of the indirect effect of the predictor on the dependent variable. The distributions of these 5,000 estimates serve as empirical, nonparametric approximations of the sampling distributions of the indirect effect of interest. The bootstrap confidence interval (CI) for the population-specific indirect effect of this mediator is derived by sorting the 5,000 indirect effect values from low to high. Values defining the lower and upper 100% ($\alpha/2$) of the indirect effect distribution are then found and taken as the lower and upper limits of the 100% CI (1 – α) for the population indirect effect, where α is the desired nominal type I error rate. When CIs of the indirect effect do not include 0, this effect is considered statistically significant.

Three bootstrapping procedure were conducted considering physical health symptoms as the dependent variable. In each of these procedures one of the PTSS clusters (re-experiencing, avoidance/numbing, or hyperarousal) was considered the predictor and depressive symptoms the mediator. That is, the indirect effects of higher scores in the PTSS cluster on more severe physical health symptoms via higher depressive symptoms were examined. In addition, other additional six bootstrapping procedures – similar to the previous ones – were employed (three using pain symptoms as the dependent variable and other three considering chronic pain as the dependent variable). In all these analysis, age and sex were included as covariates.

No missing data were detected. Preliminary analysis showed all the variables approximated a normal distribution. Descriptive statistics and correlations among the variables are presented in Table 1. Regarding multicollinearity, the variance inflation factor (VIF) was lower than 10 in all the steps of the regression analysis (values ranged from 1.05 to 2.58) indicating that multicollinearity was not a problem [33].

Results

Relationship between PTSS and physical health symptoms

A regression model including age and sex significantly accounted for 5.4% of the physical health symptoms variance, $F [2, 95] = 3.74, p < .05$, with age being the only variable significantly contributing to the model (Table 2). A second model adding the PTSS clusters significantly explained 32.3% of the physical health symptoms variance, $F [5, 92] = 10.27, p < .001$. In this model, only hyperarousal was statistically significant. When depressive symptoms were added to this model, the proportion of physical health symptoms variance explained by the model significantly increased to 43.6%, $F [6, 91] = 13.482, p < .001$. Adjusted R^2 for this final model was .44, what – according to Cohen’s criteria – is indicative of a large effect size [30]. Hyperarousal and depressive symptoms were the only significant variables in this model. They accounted for a large proportion of the variance (27.6 % and 47.9%, respectively). However, the effect sizes

Table 1: Means, standard deviation and Pearson correlations for age, depressive symptoms, PTSD symptoms clusters, physical health symptoms, and pain symptoms

	N	M	SD	1	2	3	4	5	6	7
1. Age	98	41.88	13.52	--						
2. depressive symptoms	98	17.00	11.41	.17	--					
3. Reexperiencing	98	1.40	0.96	** .29	*** .58	--				
4. Avoidance/numbing	98	1.08	0.85	.14	*** .67	*** .64	--			
5. Hyperarousal	98	1.39	0.96	* .23	*** .64	*** .70	*** .69	--		
6. physical health symptoms	98	183.34	52.10	** .27	*** .61	** .49	*** .41	*** .56	--	
7. Pain symptoms	98	22.15	9.70	.18	*** .52	*** .45	*** .36	*** .46	*** .82	--

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2: Hierarchical regression predicting physical health symptoms considering the PTSD symptoms clusters and depressive symptoms as predictors, and controlling for age and sex (N = 98)

Variables	Adjusted R ²	Change R ²	β	Square Partial Correlations
Step 1	*.054			
Age			** .28	.07
Sex (reference category women)			-.03	.00
Step 2	***.32	***.29		
Age			.15	.02
Sex			-.12	.01
Re-experiencing			.17	.01
Avoidance/numbing			.03	.00
Hyperarousal			** .41	.07
Step 3	***.44	***.11		
Age			.15	.02
Sex			-.14	.02
Re-experiencing			.10	.00
Avoidance/numbing			-.14	.01
Hyperarousal			*.28	.03
depressive symptoms			***.48	.11

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3: Indirect effect (IE) of re-experience, avoidance/numbing, and hyperarousal o through depressive symptoms on PHS, pain symptoms, and presence of CP (bootstrap analysis; N = 98)

	IE	SE	BCa 95% CI
VD: PHS			
Re-experiencing	16.98	4.57	[9.27, 27.08]
Avoidance/numbing	23.04	6.49	[10.51, 34.88]
Hyperarousal	19.79	4.65	[10.97, 29.18]
VD: pain symptoms			
Re-experience	2.55	.75	[1.26, 4.21]
Avoidance/numbing	3.69	1.06	[1.82, 5.88]
Hyperarousal	2.53	.77	[1.11, 4.10]
VD: Presence of CP			
Re-experience	0.13	0.28	[-0.44, 0.65]
Avoidance/numbing	0.05	0.40	[-0.90, 0.69]
Hyperarousal	-0.08	0.32	[-0.77, 0.52]

Notes: BCa- Bias corrected and accelerated; 5,000 bootstrap samples. Abbreviations: VD = Dependent variable; PHS = physical Health Symptoms; CP = chronic pain.

of the unique influence of hyperarousal and depressive symptoms in physical health symptoms were small (Partial r^2 were .03 and .11, for hyperarousal and depressive symptoms, respectively). Please see Table 2 for additional statistics for these regression analysis.

The results of the bootstrap analysis are reported in Table 3. Both the direct effect of hyperarousal on physical health symptoms and its indirect effect through depressive symptoms were statistically significant, $DE=33.38$; $SE=6.38$; $t=2.13$; $p < .05$. Regarding re-experience, its indirect effect through depressive symptoms was statistically significant but not its direct effect, $DE=10.28$; $SE =5.49$; $t=1.78$; $p=.078$. Similarly, the indirect effect of avoidance/numbing on physical health symptoms through depressive symptoms was significant, but not its direct effect, $DE=1.74$; $SE=6.48$; $t=0.27$; $p=.789$.

Relationship between PTSS and pain symptoms

The results of the regression analysis are reported in Table 4. The first regression model including age and sex as independent variables was not significant, $F [2, 95]=1.68$, $p =.193$. A second model adding the PTSS clusters was statistically significant, $F [2, 92]=6.48$, $p < .001$, and accounted for 22% of the pain symptoms variance. Only hyperarousal significantly contributed to the model. Including

depressive symptoms significantly improved the model, $Change F [1, 91] = 11.34$, $p < .01$, which now accounted for the 30% of the pain symptoms variance, $F [2, 91]=7.89$, $p < .001$. Adjusted R^2 for this final model was .21, indicating a medium size effect. Only depressive symptoms (and no longer hyperarousal) significantly contributed to this model (Table 4). Partial r^2 for depressive symptoms was .05, indicating that depressive symptoms accounted for a unique but small proportion of the variance of pain symptoms.

The indirect effect of re-experiencing, avoidance/numbing, and hyperarousal through depressive symptoms on pain symptoms are reported in Table 3. Hyperarousal was not directly but indirectly related to pain symptoms via depressive symptoms, $\beta_{DE} = 2.08$; $SE = 1.13$; $p = .069$. Re-experiencing was shown to be directly, $\beta_{DE} = 2.38$; $SE = 1.17$; $p < .05$, and indirectly related with pain symptoms through depressive symptoms. Finally, avoidance/numbing was not directly related with pain symptoms, $\beta_{DE} = .43$; $SE = 1.32$; $p = .747$. However, it was indirectly related to pain symptoms via depressive symptoms (Table 3). According to our previous analysis, re-experiencing was not uniquely related with pain symptoms when the other PTSS clusters were concurrently considered. In spite of this, we found that the direct effect of re-experiencing on pain symptoms was statistically

significant. As such, we decided to repeat these mediational analysis controlling for hyperarousal symptoms. The direct effect of re-experience became non-significant when hyperarousal symptoms were controlled for. In the light of these results hyperarousal might partially mediate the effect of re-experience. We conducted a bootstrap analysis considering both depressive symptoms and hyperarousal as mediators. The results of these analysis showed that only depressive symptoms and not hyperarousal mediated the effect of re-experiencing on pain symptoms (the indirect effect of hyperarousal was .92, SE = .92, CI [-.88, 2.84]).

Relationship between PTSS and chronic pain

The results of the hierarchical logistic regression analysis predicting presence of chronic pain are shown in Table 5. The first model including age and sex was not statistically significant, $\chi^2 [2, N=98] = 2.35; p=.309$. The second model including the PTSS clusters was statistically significant, $\chi^2 [5, N=98] = 13.74; p<.01$. Only hyperarousal

significantly contributed to the model predicting chronic pain (Table 5). The third model, in which depressive symptoms were included was also statistically significant, $\chi^2 [6, N=98] = 16.09; p<.01$. Nonetheless, introducing depressive symptoms did not significantly improve the model. Again, only hyperarousal significantly contributed to the model. The effect size of the relationship between hyperarousal and presence of chronic pain was medium ($d = .61$).

The indirect effect of re-experiencing, avoidance/numbing, and hyperarousal through depressive symptoms on chronic pain are reported in Table 3. The direct effect of hyperarousal on presence of chronic pain was statistically significant ($\beta_{DE} = 1.18, SE: 0.40, p < .01, Wald = 8.67$), but not its indirect effect (Table 3). Re-experiencing was not directly or indirectly (via depressive symptoms) related to presence of chronic pain, $\beta_{DE} = 0.53, SE: 0.38, p = .159, Wald = 1.98$. Finally, the direct effect of avoidance/numbing was statistically significant ($\beta_{DE} = 1.04, SE: 0.45, p <.05, Wald = 5.29$), but not its indirect effect via depressive symptoms.

Table 4: Hierarchical regression predicting pain symptoms considering the PTSD symptoms clusters and depressive symptoms as predictors, and controlling for age and sex (N = 98).

Variables	Adjusted R ²	Change R ²	β	Square Partial Correlations
Step 1	.034			
Age			.19	.000
Sex (reference category women)			-.05	.000
Step 2	** .14	*** .18		
Age			-.15	.020
Sex			-.06	.004
Re-experiencing			.17	.015
Avoidance/numbing			.02	.000
Hyperarousal			*.31	.046
Step3	***.21	** .07		
Age			-.15	.027
Sex			-.08	.007
Re-experiencing			.11	.007
Avoidance/numbing			-.12	.009
Hyperarousal			.20	.021
depressive symptoms			** .38	.046

Note: * $p <.05$, ** $p < .01$, *** $p < .001$.

Table 5: Hierarchical logistic regression predicting chronic pain, considering PTSD symptom clusters and depressive symptoms as predictors, and controlling for age and sex

Variables	B	SE	Wald	OR	95.0% CI for OR	d
Step 1						
Age	0.03	0.02	1.89	1.03	[0.99, 1.07]	.02
Sex (reference category women)	0.52	0.60	0.76	1.568	[0.52, 5.41]	.25
Step2						
Age	0.03	0.03	1.25	1.03	[0.98, 1.08]	.02
Sex	0.90	0.65	1.92	2.46	[0.69, 9.82]	.50
Reexperiencing	-0.30	0.45	0.45	0.74	[0.31, 1.78]	-.17
Avoidance	0.57	0.49	1.39	1.77	[0.69, 4.58]	.32
Hyperarousal	1.03	0.46	*4.93	2.79	[1.13, 6.89]	.57
Step 3						
Age	0.28	0.03	1.16	1.03	[0.98, 1.08]	.02
Sex	0.87	0.66	1.77	2.40	[0.66, 8.67]	.48
Reexperiencing	-0.29	0.45	0.41	0.75	[0.31, 1.82]	-.16
Avoidance	1.10	0.53	1.80	2.03	[0.72, 5.73]	.39
Hyperarousal	0.25	0.48	*5.30	3.01	[1.18, 7.71]	.61
depressive symptoms	-0.03	0.04	0.53	0.98	[0.91, 1.04]	-.01

Note: * $p <.05$

As according to our previous analysis, avoidance/numbing was not uniquely related with presence of chronic pain when the other PTSD symptoms clusters were concurrently considered, we decided to repeat these mediational analysis controlling for hyperarousal symptoms. When controlling for hyperarousal, the direct effect of avoidance-numbing was not statistically significant. In the light of these results, hyperarousal might partially mediate the effect of avoidance. We conducted bootstrap analysis considering hyperarousal as a mediator. The results of these analysis showed that only depressive symptoms and not hyperarousal mediated the effect of avoidance on the presence of chronic pain (the indirect effect via hyperarousal was .67, SE = .43, [-.12, 1.38]).

Discussion

This research was aimed to examine the associations of each PTSD cluster (i.e., re-experiencing, avoidance/numbing, and hyperarousal) and depressive symptoms with: (1) physical health symptoms, (2) pain symptoms, (3) and presence of chronic pain among trauma-exposed individuals. Furthermore, we examined the mediational role of depressive symptoms in the relationships between each of the PTSD clusters and the three dependent variables.

Both hyperarousal and depressive symptoms were uniquely related with physical health symptoms. These results on a civilian sample are similar to those recently found by Quartana et al. in U.S. soldiers. Hyperarousal was the only PTSD symptom cluster accounting for unique physical health symptoms variance, being directly and indirectly related to this variable through depressive symptoms [2]. Depressive symptoms showed a stronger relationship with physical health symptoms than hyperarousal (uniquely explaining 11.2% vs 3% of the variance). According to these results treating depressive symptoms may help to influence severe physical health problems in trauma-exposed individuals with and without PTSD.

In line with the statement that depression may affect physical health both as a reaction to trauma and as a consequence of PTSD [11], depressive symptoms not only were independently related to physical health symptoms but also mediated the relationship between each PTSD symptom cluster and physical health symptoms. This is coherent with the results reported by Asmundson et al. [5], et al., who found both a direct and an indirect effect of PTSS (through depression) on male veterans' general health status [5]. In addition, our study extend the findings of previous studies conducted with treatment-seeking female sexual assault victims and female war veterans regarding the unique contribution of depressive symptoms and hyperarousal on physical health by observing these effects in a German heterogeneous sample of trauma-exposed individuals [3,4,5,34]. Our and previous findings thus suggest that, independent of the type of traumatic experience, hyperarousal and comorbid depressive symptoms may be the mechanism linking PTSD and physical health.

The important role hyperarousal seems to be playing in relation to physical health symptoms might have several explanations. First, the persistent over-activation of the stress system over time and the subsequent strain on bodily functions may produce changes in the body (e.g. immune system alterations) that, depending on a person's vulnerability, could contribute to the development of different types of health problems. Second, hyperarousal might motivate individuals to engage in negative health behaviors (e.g., using drugs) contributing to health status impairment [1]. Studies investigating

the association between hyperarousal and negative health behaviors as well as the role of hyperarousal in the epigenetic changes and neuroimmunoendocrine alterations reported in PTSD individuals are desirable [35,36].

Our findings did not support the unique relationship between avoidance and physical health symptoms reported by Woods et al. [8]. Their study was conducted with victims of intimate partner violence, a long lasting type of trauma which may imply current real risk for one's life, what may have explained these discrepancies. Further research is needed to clarify if the mechanisms relating PTSD and health are the same in chronic traumatization and single Type-I-trauma. Similarly, the unique relationship between re-experiencing and physical health symptoms reported by Zoellner et al. was not supported [7]. The fact that in their study only individuals with a PTSD diagnoses were considered, whereas both trauma-exposed individuals with and without PTSD were included in the present investigation, may explain this inconsistency.

It is important to consider that, according to the literature, not only depressive symptoms seems to affect physical health, but physical health problems (especially chronic illnesses) seem to exacerbate depressive symptoms [37]). For example, according to the results of a meta-analysis [38], some chronic diseases (such as stroke, poor hearing, poor vision, cardiac disease, and chronic lung disease) are risk factors for depression in old age. In spite of this, the influence of physical health symptoms on depressive symptoms was not taken into account in the present research. Longitudinal studies in which the reciprocal influence of physical health and depressive symptoms is examined are indeed needed.

Hyperarousal was not only directly related to physical health symptoms but also with the presence of chronic pain. This is congruent with López-Martínez et al. who found that hyperarousal was related with pain outcomes among patients with chronic pain; as well as with the results of Cyders et al. who found that hyperarousal was associated with pain severity among patients with orofacial chronic pain [17,18]. Nonetheless, the relationship between hyperarousal and pain symptoms was completely mediated by depressive symptoms, suggesting that the pathway linking hyperarousal and presence of chronic pain is not the same as the one linking hyperarousal and pain symptoms in general. Depressive symptoms did not uniquely relate to the presence of chronic pain nor mediated the relationship between the PTSD symptoms clusters and the presence of chronic pain; however it was uniquely related to pain symptoms and mediated the relationship between each of the PTSS clusters and pain symptoms. These findings partially match previous results found in a sample of patients with chronic pain resulting from traumatic injury, in that depressive symptoms, but not PTSD symptoms, were directly related to pain severity [20]. In addition, they agree with the results reported by Poundja et al., who observed depression fully mediated the relationship between PTSD symptoms and a measure of current pain, in a sample of male veterans seeking treatment for deployment-related PTSD [19]. The pathways leading to chronic pain may not be the same one as the pathway leading to other pain complaints. In the case of chronic pain, hyperarousal (and not depressive symptoms) seems to be the key symptom; whereas in the case of pain symptoms in general depressive symptoms seems to have a more important role than hyperarousal.

Finally, our result consistent with findings indicating that each PTSS clusters is related with a different health outcome, providing with

discriminant validity for them [10]. It is also worth mentioning that in DSM-5, a new symptom cluster characterized by negative mood and cognitions is included [39]. In our study, this new PTSS cluster may have overlapped with depressive symptoms, and depressive symptoms may therefore indeed be part of the PTSD syndrome itself. This new symptom cluster (together with hyperarousal and depressive symptoms) may be related with physical health symptoms. For research assessing the relationship between the different PTSS clusters and physical health, instruments for the PTSD assessment adjusted to the changes that occurred in the DSM-5 are indeed needed.

Our findings must be interpreted in the light of some limitations. First, we used self-report measures of physical health symptoms and pain symptoms which could themselves have been affected by depression. Moreover, the scale we employed to measure physical health symptoms includes some items which assess various somatic reactions in aroused states [27]. This may raise the question whether we might have found lower correlations between depressive symptoms (and hyperarousal symptoms) and physical health symptoms if we had instead used a scale excluding this type of symptoms (e.g., the PHQ-15). However, in support of our results, in a previous study using the PHQ-15 a relationship among hyperarousal, depressive symptoms, and physical health symptoms was also found, suggesting the items assessing somatic reactions in aroused states were not solely responsible for our findings [33]. Future studies incorporating multiple measures of health and pain symptoms, as well as more objective medical examinations, are needed. Third, we used a cross-sectional design and consequently a causal relationship cannot be established. Therefore, our findings should be considered as preliminary, as proper mediation can only be tested with longitudinal designs. Furthermore, there is evidence suggesting that the relationship between physical health symptoms and depressive symptoms is bidirectional and that more severe physical health problems may exacerbate depressive symptoms [37,38]. This raises the need for longitudinal studies, in which the directionality of this relationship is tested and proper mediation is examined. In fact, in some cases depression or pain diagnoses may have preceded PTSD diagnoses and this could have affected our results. We cannot determine this because data about the onset of each disorder were not collected. Fourth, the critical p-value for the analysis was set to .05 and corrections for multiple tests were not conducted, what may have increase type I error. Nonetheless, correction for multiple tests has been criticized by some authors, because they reduce the power of the study and increase type II error [39,40]. Fifth, participants with a current or past alcohol or drug dependence or psychotic disorder were excluded from the study and, therefore, our results are limited to those individuals with PTSD without these disorders. Sixth, the sample size considered was small. Finally, the data included individuals with and without PTSD, with and without depression, and with and without chronic pain, as well as individuals that may have had two or more comorbid diagnoses. The mechanisms leading to poorer health may not be exactly the same in all these groups of individuals; in fact the type of sample may be explaining why conflicting results have been found in this regard. The symptoms of the different disorders may interact leading to differential outcomes. Research analyzing these issues in separate samples with different combinations of diagnoses is needed. In addition, it may be possible that physical and mental health symptoms do not interact in the same way among trauma-exposed individuals with PTSD and those without PTSD. Nonetheless, the existing research either combines both types of sample or analysis

these issues only in PTSD individuals. Studies in which the results of both samples are compared may be helpful to understand the interaction between physical and mental health.

Despite these limitations, our study added to the literature by examining the role of depressive symptoms in the particular relationship between each PTSS cluster and physical health symptoms. Furthermore, our study is novel in investigating the relationship between each PTSD cluster and a chronic pain diagnosis while considering the role of depressive symptoms. Moreover, it overcame some of the limitations of preceding investigations studying the relationship between PTSD and health. First, we assessed a heterogeneous sample of both men and women who have experienced different kinds of traumatic events, allowing a better generalization of results. Second, by conducting bootstrap analysis instead of the more commonly used and often criticized Baron and Kenny's procedure, we overcame the significant criticism made in regards to existing mediational studies in this field [32,41].

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