



Posttraumatic stress symptoms and interpersonal processes in burn survivors and their partners

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ABSTRACT

Background: A burn event can elicit symptoms of posttraumatic stress disorder (PTSD) in survivors and their partners and may impact the way these couple members interact with each other. They may try to protect each other from further emotional distress by avoiding talking about the burn event, but they may also show concern towards each other.

Objective: The aim of this study was to investigate bidirectional relationships between survivor's and partner's PTSD symptoms and two interpersonal processes: partner-oriented 'self-regulation', which is avoidance-oriented, and 'expressed concern', which is approach-oriented.

Method: In this longitudinal multi-centre study, 119 burn survivors and their partners participated. Measures of PTSD symptoms, self-regulation, and expressed concern were administered in the acute phase following the burns, and follow-ups took place up to 18 months postburn. Intra- and interpersonal effects were examined in a random intercept cross-lagged panel model. Exploratory effects of burn severity were also investigated.

Results: Within individuals, survivor's expressed concern predicted later higher levels of survivor's PTSD symptoms. In their partners, self-regulation and PTSD symptoms reinforced each other in the early phase postburn. Between the two couple members, partner's expressed concern predicted later lower levels of survivor's PTSD symptoms. Exploratory regression analyses showed that burn severity moderated the effect of survivor's self-regulation on survivor's PTSD symptoms, indicating that self-regulation was continuously related to higher levels of PTSD symptoms over time within more severely burned survivors, but not in less severely burned survivors.

Conclusion: PTSD symptoms and self-regulation reinforced each other in partners and possibly also in more severely burned survivors. Partner's expressed concern was related to lower levels of survivor's PTSD symptoms, whereas survivor's expressed concern was related to higher levels of survivor's PTSD symptoms. These findings emphasize the importance of screening for and monitoring PTSD symptoms in burn survivors and their partner and of encouraging couple's self-disclosure.

Síntomas de estrés postraumático y procesos interpersonales en sobrevivientes a quemaduras y sus parejas

Antecedentes: Un incidente por quemadura puede provocar síntomas de trastorno de estrés postraumático (TEPT) en los sobrevivientes y en sus parejas, pudiendo también impactar la forma en la que ambos miembros de la pareja interactúan entre ellos. Pueden tratar de protegerse mutuamente de mayor angustia al evitar hablar del incidente, pero también pueden mostrar preocupación entre ellos.

Objetivo: El objetivo de este estudio fue el de investigar la relación bidireccional entre los síntomas del TEPT en el sobreviviente y en su pareja; y dos procesos interpersonales: 'la autorregulación' orientada a la pareja, la cual se basa en la evitación, y la 'expresión de preocupación', la cual se basa en el afrontamiento.

Método: En este estudio longitudinal multicéntrico, participaron 119 sobrevivientes a quemaduras y sus parejas. Se realizaron las mediciones de los síntomas del TEPT, de la autorregulación y de la expresión de preocupación en la fase aguda luego del incidente de quemadura. Las mediciones de seguimiento se realizaron hasta 18 meses luego del incidente. Se evaluaron los efectos intra e interpersonales mediante un modelo de panel con retraso cruzado. Asimismo, se investigaron de forma exploratoria los efectos de la severidad de la quemadura.

Resultados: Entre los participantes, la expresión de preocupación por parte del sobreviviente

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PALABRAS CLAVE

Quemaduras; trastorno de estrés postraumático; procesos interpersonales; parejas; afrontamiento diádico; autorregulación orientada a la pareja; expresión de preocupación

关键词

烧伤; 创伤后应激障碍; 人际交往过程; 伴侣; 二元应对; 伴侣导向的自我调节; 表达关注

HIGHLIGHTS

- PTSD symptoms in burn survivors and their partners are related to both avoidance- and approach-oriented interpersonal processes.
- In partners, higher levels of self-regulation were bidirectionally related to higher levels of posttraumatic stress symptoms.
- Concern expressed by partners may mitigate posttraumatic stress symptoms in burn survivors.

predijo niveles más altos de síntomas del TEPT en esta persona. En sus parejas, la autorregulación y los síntomas del TEPT se reforzaron mutuamente en la fase temprana luego de la quemadura. Entre ambos miembros de la pareja, la expresión de preocupación por parte de la pareja predijo menores niveles posteriores de síntomas del TEPT en los sobrevivientes. Los análisis de regresión exploratoria mostraron que la severidad de la quemadura moderó el efecto de la autorregulación del sobreviviente sobre sus propios síntomas del TEPT, indicando que la autorregulación estuvo relacionada a mayores síntomas del TEPT entre aquellos con las quemaduras más severas, pero no en aquellos con quemaduras de menor severidad.

Conclusión: Los síntomas del TEPT y la autorregulación se reforzaron mutuamente en las parejas y, posiblemente, también en los sobrevivientes con quemaduras más severas. La expresión de preocupación en las parejas estaba relacionada a niveles más bajos de síntomas del TEPT en los sobrevivientes, mientras que la expresión de preocupación del sobreviviente estuvo más relacionada a mayores síntomas del TEPT en ellos. Estos hallazgos enfatizan la importancia del tamizaje y supervisión de los síntomas del TEPT en sobrevivientes a incidentes de quemaduras y en sus parejas, así como en fomentar la expresión emocional de la pareja.

烧伤幸存者及其伴侣的创伤后应激症状和人际交往过程

背景: 烧伤事件会引发幸存者及其伴侣的创伤后应激障碍 (PTSD) 症状, 可能影响这些夫妻之间的互动方式。他们可能会通过回避谈论烧伤事件来试图保护彼此免受进一步的情绪困扰, 但他们也可能会表现出对彼此的关心。

目的: 本研究旨在考查幸存者和伴侣 PTSD 症状与两个人际交往过程之间的双向关系: 以伴侣为导向的‘自我调节’, 即回避导向, 以及‘表达关注’, 即接近导向。

方法: 119 名烧伤幸存者及其伴侣参与了这项纵向多中心研究。在烧伤后的急性期测量了 PTSD 症状、自我调节和表达关注, 并在烧伤后长达 18 个月内进行了随访。在随机截取交叉滞后面板模型中考查了个体内部和人际关系的影响。还考查了烧伤严重程度的探索性影响。

结果: 在个体中, 幸存者表达的担忧预测了幸存者之后更高的 PTSD 症状水平。在他们的伴侣中, 自我调节和 PTSD 症状在烧伤后的早期阶段相互加强。在夫妇中, 伴侣表达的担忧预测了幸存者之后更低的 PTSD 症状水平。探索性回归分析表明, 烧伤严重程度调节了幸存者自我调节对幸存者 PTSD 症状的影响, 表明自我调节与更严重烧伤幸存者中更高水平的 PTSD 症状有关, 但在烧伤较轻的幸存者则无关。

结论: PTSD 症状和自我调节在伴侣中相互加强, 也可能在更严重的烧伤幸存者中相互加强。伴侣表达的担忧与较低的幸存者 PTSD 症状水平相关, 而幸存者表达的担忧与较高的幸存者 PTSD 症状水平相关。这些发现强调了筛查和监测烧伤幸存者及其伴侣 PTSD 症状以及鼓励夫妻自我表露的重要性。

1. Introduction

A burn event can be distressing for both the burn survivor and their partner. Given the potentially traumatic nature of the event, it may be unsurprising that elevated acute stress levels are found in about 30% of survivors and partners (Bond et al., 2017; Giannoni-Pastor et al., 2016). Also, posttraumatic stress disorder (PTSD) symptoms may develop, which may persist and have a long-term impact on quality of life (Spronk et al., 2018). Thus far, it is largely unknown how interpersonal processes and posttraumatic stress interact within couples after a burn event, and whether burn severity affects these processes. Burns often result in scarring and changes in the physical appearance or functioning, which may trigger intrusive recollections of the trauma and constitute a struggle with acceptance for both survivors and partners (Gullick et al., 2014; Phillips et al., 2007), thereby interfering with adequate (dyadic) coping (Ehlers & Clark, 2000; Falconier & Kuhn, 2019). A deeper understanding of these processes and contributing factors may inform health care practice to provide better support for burn survivors and their partners.

To cope with a distressing event, couples may engage in an *avoidance-oriented* interpersonal process (Stroebe et al., 2013). According to the cognitive-behavioural interpersonal model (Dekel & Monson, 2010; Monson et al., 2010), avoidance is one of the primary coping mechanisms that contributes to both the maintenance of PTSD symptoms and relationship difficulties. In an attempt to protect the survivor or the partner from further suffering, an avoidance-oriented interpersonal process manifests when one couple member tries to remain strong or holds negative feelings and thoughts from the other (Bäckström et al., 2018; Gullick et al., 2014), which may be triggered by seeing the scars (Macleod et al., 2016). Such an avoidance-oriented process was operationalized by Stroebe et al. (2013) as ‘partner-oriented self-regulation’ (hereafter referred to as ‘self-regulation’), and resembles concepts in the PTSD literature, such as protective buffering (Coyne & Smith, 1991), partner accommodation (Fredman et al., 2014), expressive suppression (Seligowski et al., 2015), holding back (Manne et al., 2015), or reluctance to talk (Pielmaier & Maercker, 2011). All these avoidance-oriented interpersonal processes have in common that they

require continuous efforts to regulate the self, a depleting capacity (Baumeister et al., 2018) that may interfere with processing, habituation, and reduction of threat perception, thereby maintaining PTSD symptoms (Ehlers & Clark, 2000; Seligowski et al., 2015).

Regardless of its specific form, the empirical literature shows support for an intrapersonal effect of avoidance-oriented interpersonal processes, increasing one's own distress (Chen et al., 2021; Langer et al., 2009; Manne et al., 2007; Manne et al., 2015; Stroebe et al., 2013) and PTSD symptoms (Pielmaier & Maercker, 2011). There is also support for an interpersonal effect, in which avoidance-oriented processes displayed by one couple member are related to higher levels of their partner's distress (Chen et al., 2021; Manne et al., 2007; Stroebe et al., 2013) and PTSD symptoms (Fredman et al., 2014; Pielmaier & Maercker, 2011). In burn research, avoidant coping (though not in an interpersonal context) has been related to higher levels of PTSD symptoms (Bosmans et al., 2015; Lawrence & Fauerbach, 2003; Su & Chow, 2020; Wiechman et al., 2020). Although the effect in the reverse direction, of PTSD symptoms on interpersonal avoidance, has been less intensively studied, it was found that interpersonally, PTSD symptoms and grief predict higher levels of interpersonal avoidance in one's partner over time (Allen et al., 2021; Stroebe et al., 2013). Moreover, a review shows that over time, PTSD symptoms appear to spur interpersonal difficulties rather than vice versa (Campbell & Renshaw, 2018).

Another interpersonal process is *approach-oriented* and may occur when a couple member expresses concern about the emotional well-being of their partner or encourages the partner to disclose feelings (Stroebe et al., 2013). By showing sensitivity, interest, acceptance and understanding one partner is responsive to the needs of the other (Maercker & Horn, 2013; Reis & Clark, 2013). Such responsivity can enhance emotional self-disclosure (Ruan et al., 2020), which may facilitate the processing of a traumatic event by promoting habituation and integration of trauma-related emotions and memories and challenging dysfunctional cognitions (see Frattaroli, 2006). Even the non-injured partner may feel supported when they can discuss strains with the burn survivor (Bäckström et al., 2018). This approach-oriented interpersonal process was operationalized by Stroebe et al. (2013) as 'expressed concern', and it comes close to concepts in the PTSD literature such as social (crisis) support (Engelhard et al., 2003; Wang et al., 2021; Zalta et al., 2021), intimacy (Leifker et al., 2015), and (perceived) partner responsiveness (Canevello et al., 2016). A partner's support and expressed concern may compensate for the depletion of self-regulatory strength through promoting adaptive processes like self-efficacy (Pietromonaco et al., 2022; Warner et al., 2015).

Research on approach-oriented interpersonal processes has primarily focused on the interpersonal effect of (perceived) social support on the survivor's well-being. Meta-analyses of risk factors for PTSD after other types of traumatic events, as well as burn research, showed that higher levels of social support are related to lower levels of PTSD symptoms (Brewin et al., 2000; Lawrence & Fauerbach, 2003; Ozer et al., 2003; Su & Chow, 2020; Sveen et al., 2011; Wang et al., 2021; Zalta et al., 2021). Furthermore, intrapersonally, a more complex relation between approach processes and PTSD symptoms is found. One study showed that higher levels of PTSD symptoms were related to *providing* less support to the partner (Hanley et al., 2013), and another study showed that veterans' tendency to experience concern towards others was related to their own higher levels of PTSD symptoms (Siegel et al., 2021).

Currently, few studies have examined the (bidirectional) effects of PTSD symptoms on both avoidance- and approach-oriented interpersonal processes, or included both intra- and interpersonal effects, and none have studied these effects in the burn population. Consequently, the general aim of this study was to investigate intra- and interpersonal bidirectional relations between an avoidance-oriented interpersonal process (i.e. self-regulation) and PTSD symptoms, and between an approach-oriented process (i.e. expressed concern) and PTSD symptoms in burn survivors and their partners over time. Specifically, we hypothesized bidirectional effects between self-regulation and expressed concern on the one hand and PTSD symptoms on the other hand, both within and between couple members. Furthermore, the possible effect of burn severity on these relationships was explored.

2. Methods

2.1. Inclusion

Data from this study were part of a larger project in three Dutch and three Belgian burn centres that focused on the social impact of burns. Previous work described burn survivor's quality of life in relation to PTSD symptoms and described partner's PTSD symptoms (Boersma-van Dam et al., 2020; Boersma-van Dam et al., 2021). Survivors and their partners were recruited between October 2013 and October 2015 and were followed for 18 months. Inclusion criteria for survivors were: hospital stay of >24 h following the burn event, age of 18 years or older, and proficiency in Dutch. The last two criteria also applied to partners. Exclusion criteria were: psychiatric problems that interfere with the comprehension of questionnaires (e.g. psychosis, cognitive problems).

2.2. Procedure

The study was approved by ethics boards in the Netherlands and Belgium. Survivors and their partners were invited to participate in the study by a local researcher during hospitalization. After receiving oral and written study information, they provided written informed consent and completed the first measurement (T1; $M_{\text{survivor}} = 22$ days postburn, $SD = 22.8$; $M_{\text{partner}} = 24$ days, $SD = 24.0$ days postburn). Follow-up measures were sent at 3 (T2), 6 (T3), 12 (T4), and 18 (T5) months postburn by postal mail.

2.3. Sample and missing data

In this cohort study, 187 survivors (out of a total of 266 patients) indicated they were involved in a romantic relationship, 120 of whom had partners who agreed to participate in the study. One survivor did not complete any measure. For the 119 couples comprising the final sample, each member had completed at least one measurement of PTSD symptoms and one measurement of either self-regulation ($n = 118$) or expressed concern ($n = 117$). Using *t*-tests and chi-square difference tests, no statistically significant differences emerged between the 119 participating couples and the 68 not participating couples, with respect to T1 measures of survivors' PTSD symptoms, self-regulation, expressed concern, TBSA burned, number of surgeries, gender and age (p 's $> .05$).

The number of couples for which at least one of the members completed a measure of PTSD, self-regulation or expressed concern was 119 (100%) at T1, 107 (89.9%) at T2, 102 (85.7%) at T3, and 90 (75.6%) at both T4 and T5. In total, 38 couples (31.9%) had complete data for all measurements of PTSD symptoms, self-regulation and expressed concern, 35 (29.4%) had missing data for one dyad member, and 46 (38.7%) had missing data for both dyad members. Comparing specifically survivors with complete ($n = 57$) and incomplete ($n = 62$) data yielded no significant differences with regard to T1 measures of PTSD symptoms, self-regulation, expressed concern, TBSA burned, number of surgeries, partner's presence at the burn event, gender and age (p 's $> .05$). However, comparing specifically partners with complete ($n = 54$) and incomplete ($n = 65$) data showed significantly higher levels of survivor's self-regulation (T1) for partners with incomplete data ($M = 6.25$, $SD = 2.78$) than for partners with complete data ($M = 5.15$, $SD = 1.90$), $t(109.5) = 2.53$, $p = .01$.

2.4. Measures

2.4.1. Posttraumatic stress disorder symptoms

The Impact of Event Scale-Revised (IES-R; Weiss & Marmar, 1997) was used to assess PTSD symptoms.

It is a 22-item self-report questionnaire that measures three symptom clusters of PTSD symptoms in the past week: intrusions, avoidance, and hyper-arousal. Answers were given on a 0–4 Likert scale and summed to obtain a total score, with scores ≥ 33 indicating a possible diagnosis of PTSD (Creamer et al., 2003). If at least 19 of the 22 items were completed, sum scores were calculated based on the mean of the completed items. The IES-R was validated in Dutch trauma populations and showed good psychometric properties (Olde et al., 2006). The reliability of the IES-R in the current study was excellent at the five measurements, with Cronbach's alphas ranging from .95 to .97 for survivors and .93 to .97 for partners.

2.4.2. Partner-oriented self-regulation

The partner-oriented self-regulation scale (Stroebe et al., 2013) was designed to examine self-regulation of feelings in order to protect a partner in a bereavement situation, but we applied it to the burn event. It consists of three items: 'I stay strong for my partner', 'I try to spare my partner's feelings', and 'I hide my feelings for the sake of my partner'. Answers were rated on a 5-point Likert scale ranging from 1 'not at all' to 5 'very much' by both partners. The scale has not been validated in the burn population, but in line with Stroebe et al. (2013), Cronbach's alphas ranged from .69 to .76 for survivors and from .72 to .84 in partners over time.

2.4.3. Expressed concern

Expressed concern was measured with the 'concern for the partner' scale (Stroebe et al., 2013), that was designed to measure approach-oriented behaviour in the bereavement situation, but we applied it to the burn event. Expressed concern was measured with three items: 'I encourage my partner to talk about his/her feelings', 'I ask my partner how he/she feels', and 'I show interest in what my partner is going through'. Answers were rated on a 5-point Likert scale ranging from 1 'not at all' to 5 'very much' by both partners. The scale has not been validated in the burn population, but in line with Stroebe et al. (2013), Cronbach's alphas ranged from .84 to .88 in survivors and from .81 to .87 in partners over time.

2.4.4. Burn characteristics

The number of surgeries, total body surface area (TBSA) burned, length of stay in the hospital, and mechanical ventilation (yes/no) were recorded from the survivor's medical file. Presence at the burn event was self-reported by the partner. The number of surgeries indicates the number of skin graft procedures required to cover the wounds and is considered an indicator of burn severity. TBSA burned is the estimated percentage of the body covered with partial and full-thickness burns.

2.5. Statistical analyses

Descriptive analyses were conducted in IBM SPSS v28. To analyse missing data patterns, t-tests and chi-square difference tests were performed. Longitudinally, intra- and interpersonal effects between self-regulation and PTSD symptoms, and between expressed concern and PTSD symptoms, were examined in two random intercept cross-lagged panel models (RI-CLPM; Hamaker et al., 2015) in Mplus 8 (Muthén & Muthén, 1998–2017). Full Information Maximum Likelihood (FIML) was used to handle missing data in SEM. To account for the non-normality of some of the variables, Robust Maximum Likelihood (MLR) was used.

Unlike the traditional CLPM, the RI-CLPM separates the *within*-dyad level from the *between*-dyad level by including a random intercept, thereby accounting for time-invariant, trait-like stability between dyads (Hamaker et al., 2015). Figure 1 displays the RI-CLMP model for self-regulation, but an identical model was tested for expressed concern. On the between-level, correlations between the random intercepts represent overall between-couple

effects (Figure 1(a)). On the within-level, positive cross-lagged regression paths indicate, for example, that time points when a survivor scored above their expected score on PTSD symptoms were followed by time points when this survivor scored above their expected score on self-regulation (Figure 1(b)).

A RI-CLPM with time-varying estimates was too complex for the data. Therefore, the parameters in each model were constrained to be equal across time points without evaluation of this assumption with a formal chi-square difference test. Next, in a stepwise procedure, it was tested whether the paths for survivors and partners could be constrained to be equal, resulting in two identical final models, one for self-regulation and one for expressed concern. Model fit of these models was evaluated with the comparative fit index (CFI), the Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA). TLI and CFI > .90 and RMSEA < .08 indicated an acceptable model fit (Kline, 2011).

An additional aim of the study was to explore the effect of burn severity on the above relations. However, model complexity in relation to the sample size

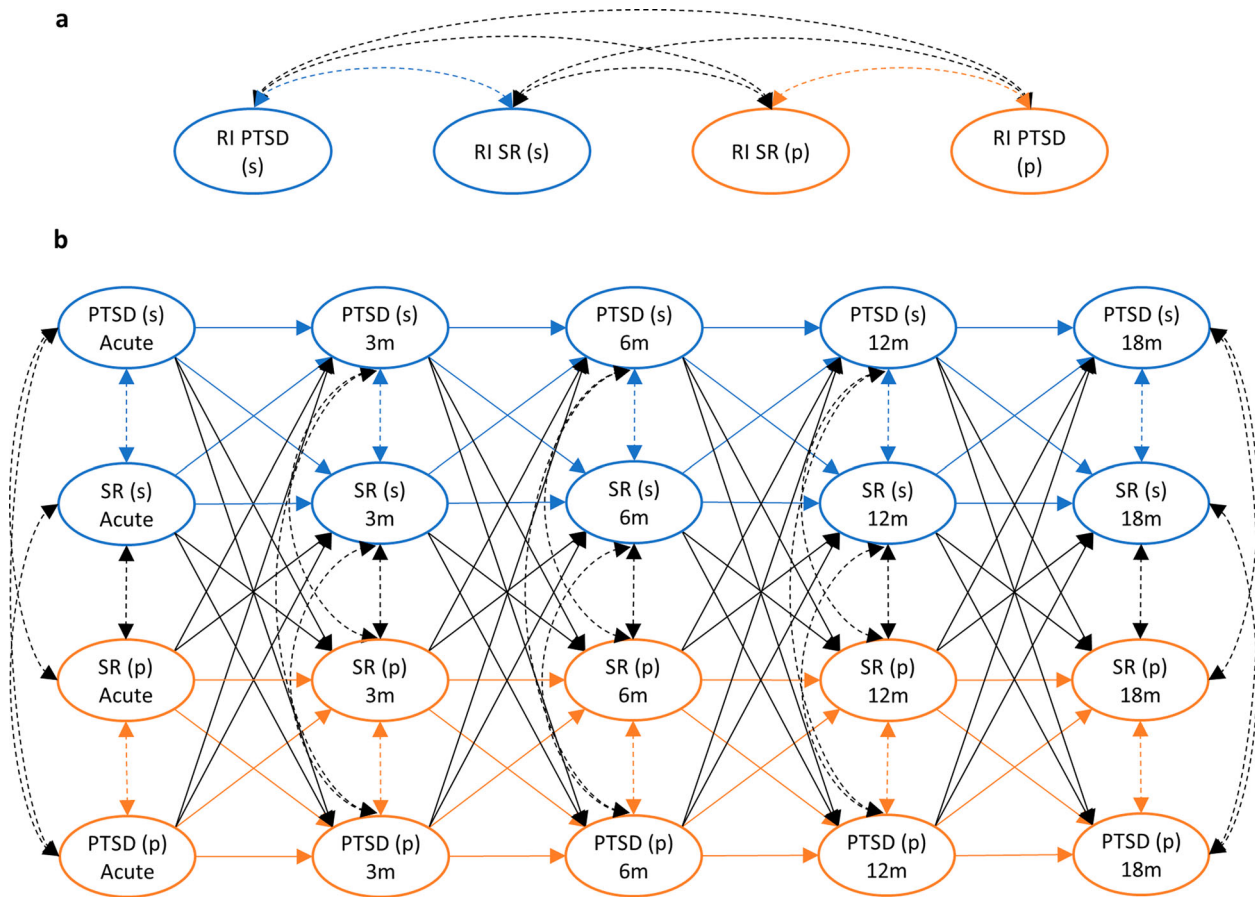


Figure 1. Simplified path model of the random-intercept cross-lagged panel model without estimates, with (a) representing the correlations between the four random intercepts and with (b) representing the relations between the person-mean centred variables over time. One-sided arrows represent regression coefficients; Two sided arrows represent correlations; Blue colours represent effects within survivors; Orange colours represent effects within partners; Black colours represent interpersonal effects between survivors and partners; RI = random intercept; PTSD = post-traumatic stress disorder symptoms; SR = partner-oriented self-regulation; s = survivor; p = partner; m = months postburn.

prevented to add this variable as a moderator to the RI-CLPM. Therefore, cross-sectional multiple regression analyses were performed within survivors and within partners at each time point. Specifically, the survivor's PTSD symptoms were cross-sectionally predicted by the survivor's self-regulation, number of surgeries, and the interaction between these variables. This analysis was repeated using expressed concern as a predictor instead of self-regulation. Similarly, survivor's self-regulation and expressed concern were each regressed on number of surgeries, survivor's PTSD symptoms, and the interaction term. These analyses were repeated for the partner, resulting in a large number of analyses. To correct for multiple-testing in all analyses, only p -values $\leq .01$ were deemed significant in all analyses.

3. Results

3.1. Descriptive analyses

The 119 couples consisted of 92 (77.3%) male burn survivors with a female partner and 27 (22.7%) female survivors with a male partner. The mean age was 45.7 (SD = 15.1, range 18–77) in survivors, and 44.5 (SD = 14.5, range 19–78) in partners. The burn survivor's mean TBSA burned was 10.3% (SD = 11.1, range: 1–75) and the median number of surgeries was 1 (range 0–14). For further analyses, this variable was recoded into 'no surgeries' ($n = 53$; 44.5%), and 'one or more surgeries' ($n = 66$; 55.5%). Among the partners, 44 (39.6%) were present at the burn event, 67 (60.4%) were not present, and 8 had missing data.

Figure 2 depicts the mean scores for total PTSD symptoms, self-regulation, and expressed concern of burn survivors and partners over time (see also Appendix 1 in the Supplementary material). PTSD

symptom levels of both survivors and partners decreased over time, and the percentage that showed clinically high levels of PTSD symptoms decreased from 18% (acute) to 6% (18 months) in survivors and from 30% (acute) to 5% (12/18 months) in partners. Levels of self-regulation and expressed concern were approximately stable in survivors but decreased over time in partners. In the acute phase, partner's PTSD symptoms, self-regulation, and expressed concern were significantly higher than those of survivors, and at 18 months postburn expressed concern was significantly higher in survivors than in partners.

Tables 1 and 2 present the bivariate correlations of respectively self-regulation and expressed concern with the study variables. Within individuals, associations between PTSD symptoms and self-regulation were, generally, moderately-strong over time, whereas associations between expressed concern and PTSD relations were small-moderate in partners, and unrelated or small in survivors. Interpersonally, associations between self-regulation of one dyad member and PTSD symptoms of the other were not consistently found across all time points, and were weaker for expressed concern with PTSD symptoms. Remarkably, all significant correlations between expressed concern and PTSD symptoms were positive. Burn severity was significantly related to PTSD symptoms of both dyad members, but not to self-regulation and expressed concern.

3.2. RI-CLPM

A stepwise method was used to arrive at the most parsimonious RI-CLPM by testing whether identical paths between survivors and partners could be constrained to be equal (see Appendix 2 in the supplementary material). In the within-part of the final

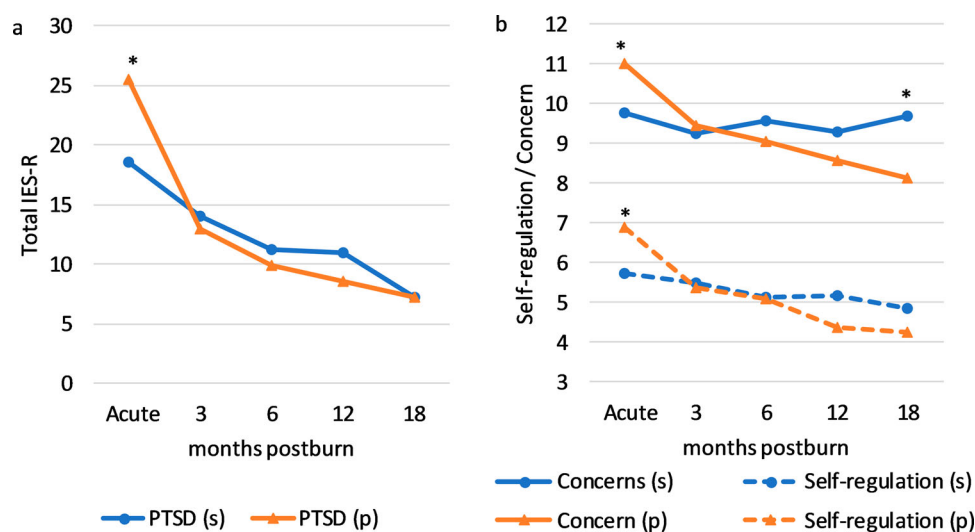


Figure 2. Survivors' and partners' levels of PTSD symptoms (a), self-regulation (b), and concern (b) over time. PTSD = Posttraumatic stress symptoms; s = survivor; p = partner. *At this measurement time, the means of survivors and partners differ significantly with $p \leq .01$.

Table 1. Pearson correlations for PTSD symptoms and self-regulation in survivors and partners over time.

	Survivors										Partners									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Survivors																				
1 PTSDs Acute																				
2 PTSDs 3m	.72*																			
3 PTSDs 6m	.68*	.73*																		
4 PTSDs 12m	.61*	.62*	.82*																	
5 PTSDs 18m	.48*	.65*	.68*	.87*																
6 SRs Acute	.34*	.39*	.27*	.41*	.20															
7 SRs 3m	.34*	.53*	.39*	.40*	.26*	.55*														
8 SRs 6m	.37*	.49*	.59*	.58*	.55*	.41*	.55*													
9 SRs 12m	.29*	.43*	.49*	.55*	.44*	.57*	.58*	.76*												
10 SRs 18m	.28*	.40*	.47*	.53*	.48*	.48*	.48*	.67*	.80*											
Partners																				
11 PTSDp Acute	.24*	.38*	.33*	.29*	.38*	.22*	.19*	.24*	.21	.31*										
12 PTSDp 3m	.27*	.47*	.35*	.24*	.42*	.36*	.26*	.42*	.35*	.41*	.72*									
13 PTSDp 6m	.31*	.37*	.41*	.34*	.43*	.23*	.16	.36*	.33*	.38*	.57*	.72*								
14 PTSDp 12m	.24*	.31*	.36*	.33*	.51*	.22*	.14	.30*	.29*	.37*	.46*	.64*	.72*							
15 PTSDp 18m	.30*	.53*	.50*	.53*	.68*	.31*	.27*	.44*	.46*	.48*	.54*	.66*	.67*	.78*						
16 SRp Acute	.22*	.19	-.05	-.07	-.03	.13	.19	-.05	-.05	.02	.25*	.29*	.18	.08	.03					
17 SRp 3m	.19	.17	.11	.02	.10	.21*	.18	.23*	.13	.24*	.30*	.52*	.52*	.48*	.31*	.44*				
18 SRp 6m	.22*	.33*	.32*	.25*	.38*	.28*	.23*	.45*	.28*	.33*	.49*	.66*	.68*	.76*	.71*	.36*	.65*			
19 SRp 12m	.27*	.40*	.30*	.36*	.36*	.24*	.22*	.38*	.38*	.45*	.40*	.52*	.65*	.62*	.61*	.21	.38*	.65*		
20 SRp 18m	.23*	.28*	.19	.24*	.32*	.21	.11	.24*	.15	.31*	.41*	.38*	.47*	.64*	.51*	.32*	.47*	.67*	.68*	
Burn severity																				
21 Surgeries	.15	.24	.26*	.32*	.32*	.00	.11	.18	.19	.23	.23	.32*	.18	.27*	.36*	-.07	.07	.18	.26	.21

Note: PTSD = Posttraumatic stress symptoms; SR = self-regulation; m = months postburn; p = partner; s = survivor; * $p < .01$.

Table 2. Pearson correlations for PTSD symptoms and concern in survivors and partners over time.

	Survivors										Partners									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Survivors																				
1 PTSDs Acute	–																			
2 PTSDs 3m	.72*	–																		
3 PTSDs 6m	.68*	.73*	–																	
4 PTSDs 12m	.61*	.62*	.82*	–																
5 PTSDs 18m	.48*	.65*	.68*	.87*	–															
6 CONCs Acute	.05	.00	.11	.19	.12	–														
7 CONCs 3m	.18	.07	.26	.26	.14	.40*	–													
8 CONCs 6m	.05	–.11	.00	.13	–.11	.47*	.57*	–												
9 CONCs 12m	.16	.16	.15	.16	.18	.63*	.49*	.67*	–											
10 CONCs 18m	.09	.09	.02	.02	.00	.46*	.48*	.68*	.64*	–										
Partners																				
11 PTSDp Acute	.24*	.38*	.33*	.29*	.38*	.09	–.04	–.07	.08	.04	–									
12 PTSDp 3m	.27*	.47*	.35*	.24	.42*	–.01	–.13	–.10	.07	–.01	.72*	–								
13 PTSDp 6m	.31*	.37*	.41*	.34*	.43*	.00	–.10	–.09	.09	.06	.57*	.72*	–							
14 PTSDp 12m	.24	.31*	.36*	.33*	.51*	.15	.12	.05	.22	.13	.46*	.64*	.72*	–						
15 PTSDp 18m	.30*	.53*	.50*	.53*	.68*	.06	.09	–.06	.18	.04	.54*	.66*	.67*	.78*	–					
16 CONCp Acute	.09	.11	.06	.07	.18	.27*	–.06	–.11	.08	–.01	.27*	.22	.21	.31	.25	–				
17 CONCp 3m	.19	.22	.11	.11	.11	.23	.24	.17	.16	.21	.31*	.24	.24	.32*	.18	.50*	–			
18 CONCp 6m	.24	.31*	.33*	.16	.33*	.22	.20	.00	.31*	.17	.30*	.38*	.42*	.39*	.32*	.40*	.47*	–		
19 CONCp 12m	.11	.22	.13	.07	.08	.09	.27	.13	.28	.31*	.23	.18	.30*	.35*	.23	.50*	.61*	.60*	–	
20 CONCp 18m	.16	.08	.09	.01	.03	.17	.38*	.29*	.35*	.44*	.14	.13	.28	.28	.18	.23	.41*	.63*	.78*	–
Burn severity																				
21 Surgeries	.15	.24	.26*	.32*	.32*	.03	.09	–.02	–.03	–.03	.23	.32*	.18	.27	.36*	.07	.11	.15	.22	.05

Note: PTSD = Posttraumatic stress symptoms; CONC = expressed concern; m = months postburn; p = partner; s = survivor; * $p < .01$.

models, identical autoregressive paths and correlations were constrained to be equal, while the paths of most interest, the cross-lagged effects, could not be constrained and were estimated freely in survivors and partners. The model fit of the final models was acceptable for self-regulation, $\chi^2(158) = 244.29$, $p < .001$, RMSEA = .07, CFI = .91, TLI = .90, and expressed concern, $\chi^2(158) = 229.90$, $p < .001$, RMSEA = .06, CFI = .93, TLI = .91.

Table 3 presents the standardized estimates for the RI-CLPMs for self-regulation and expressed concern and Figure 3 presents a graphical display of the significant cross-lagged paths in both models. In general, levels of self-regulation and PTSD showed significant within-person stability over time, whereas levels of expressed concern did not. Couple members' levels of PTSD symptoms were significantly correlated over time, both at the within-couple and the between-couple levels.

The results for self-regulation showed that, only within partners, PTSD symptoms predicted higher levels of later self-regulation. And, self-regulation predicted higher levels of later PTSD symptoms, although this trend was not significant after 3 months postburn (p -value ranged between .02 and .05). Between the two members of a couple, no significant effects emerged. At the between-couple level, a number of significant

correlations between the random intercepts emerged, indicating that stable differences between couples were present.

With regard to expressed concern it was found that, within survivors, expressed concern predicted higher levels of later PTSD. In partners, we found a non-significant trend with higher PTSD symptoms predicted higher levels of later expressed concern (p -values ranged between .04 and .06). Between couple members, higher levels of expressed concern in partners were related to lower levels of later PTSD in survivors. At the between-couple level, significant correlations were found between partner's PTSD and expressed concern, and between both couple members' expressed concern.

To explore the effect of number of surgeries on the above within-person relationships, cross-sectional interaction effects were evaluated at each measurement point. A significant interaction effect of number of surgeries with survivor's self-regulation on survivor's PTSD symptoms emerged. Figure 4 shows that the effect of self-regulation on PTSD symptoms remained from the acute phase until 18 months postburn in survivors who needed 1 or more surgeries (3b), but it diminished over time in survivors who did not need acute surgery (3a), with differences reaching significance from 12 months onward. A

Table 3. Standardized path coefficients for the random-intercept cross-lagged panel model.

Parameter	Self-regulation (n = 118)					Expressed concern (n = 117)				
	Acute	3 m	6 m	12 m	18 m	Acute	3 m	6 m	12 m	18 m
Within-couple effects										
Survivor → Survivor										
PTSDs → PTSDs		.50**	.41**	.53**	.55**	.49**	.41**	.55**	.59**	
IPs → IPs		.24**	.23**	.26**	.21**	.09	.16	.12	.11	
IPs → PTSDs		-.04	-.04	-.05	-.06	.14**	.17**	.17**	.24**	
PTSDs → IPs		.11	.09	.10	.08	-.01	-.01	-.01	-.01	
Partner → Survivor										
PTSDp → PTSDs		-.11	-.10	-.10	-.11	.15	.11	.12	.17	
IPp → IPs		.12	.09	.09	.08	.08	.11	.11	.09	
IPp → PTSDs		.17	.12	.14	.19	-.14**	-.15**	-.19**	-.24**	
PTSDp → IPs		.10	.09	.09	.07	-.10	-.10	-.09	-.09	
Partner → Partner										
PTSDp → PTSDp		.56**	.47**	.41**	.47**	.57**	.49**	.40**	.48**	
IPp → IPp		.23**	.30**	.29**	.24**	.11	.12	.13	.11	
IPp → PTSDp		.21**	.24	.18	.16	-.05	-.06	-.06	-.06	
PTSDp → IPp		.30**	.28**	.31**	.33**	.23	.17	.16	.16	
Survivor → Partner										
PTSDs → PTSDp		.07	.07	.07	.07	.03	.03	.03	.02	
IPs → IPp		.01	.02	.02	.02	.05	.07	.06	.05	
IPs → PTSDp		-.01	-.01	-.01	-.01	-.02	-.03	-.02	-.03	
PTSDs → IPp		-.01	-.02	-.02	-.02	.04	.03	.04	.03	
Correlations										
PTSDs ↔ IPs	.17	.13	.13	.21	.29	.02	.05	.06	.10	.16
PTSDp ↔ IPp	.11	.10	.16	.19	.24	.02	.06	.07	.08	.09
PTSDp ↔ IPs	.17	.08	.09	.10	.11	.03	-.01	-.02	-.01	-.02
PTSDs ↔ IPp	.15	.05	.07	.13	.20	.04	-.01	-.01	-.02	-.03
PTSDs ↔ PTSDp	.12	.20**	.22**	.29**	.50**	.10	.15**	.17	.23**	.47**
IPs ↔ IPp	.14	.13	.18	.28	.27	.41**	.06	.09	.10	.10
Between-couple effects										
RI PTSDs ↔ RI IPs			.69**					.02		
RI PTSDp ↔ RI IPp			.75**					.36**		
RI PTSDp ↔ RI IPs			.51					-.01		
RI PTSDs ↔ RI IPp			.47**					.23		
RI PTSDs ↔ RI PTSDp			.68**					.63**		
RI IPs ↔ RI IPp			.39					.32**		

Note: * $p \leq .01$; PTSD = Posttraumatic stress symptoms; IP = Interpersonal process; m = months postburn; RI = Random Intercept; p = partner; s = survivor.

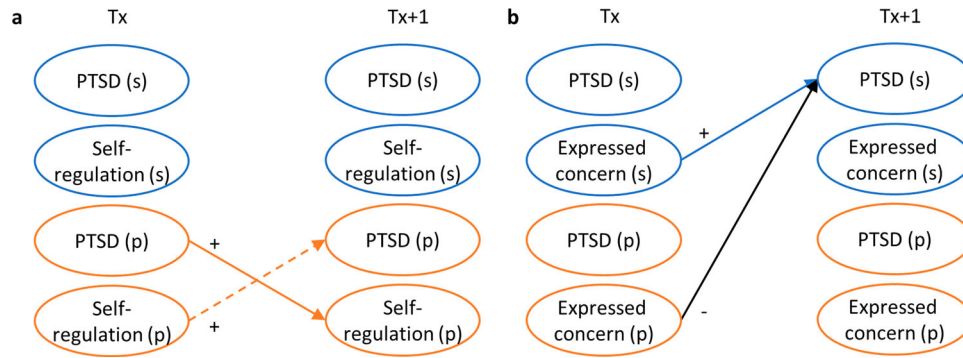


Figure 3. Visual presentation of the statistically significant within-couple results ($p \leq .01$) in a simplified path model for (a) self-regulation and (b) expressed concern. The full lines represent repeated significant effects over time, the dashed line represents a significant effect from T1 to T2. Blue colours indicate effects within survivors; Orange colours indicate effects within partners; Black colours indicate interpersonal effects between survivors and partners; PTSD = post-traumatic stress disorder symptoms; s = survivor; p = partner; Tx represents T1-T4.

similar trend, though not significant, was found for the reverse effect of survivor’s PTSD symptoms on survivor’s self-regulation. In partners, the effect of PTSD symptoms on self-regulation was stronger if no surgeries were needed than if one or more surgeries were needed, up until 3 months postburn (Figure 5). For the other effects concerning self-regulation and expressed concern, no repeating significant interaction effects were found (see Appendix 3 for self-regulation and Appendix 4 for expressed concern in the Supplementary material).

4. Discussion

This study examined the relationship between PTSD symptoms and the interpersonal processes of avoidance and approach in burn survivors and their partners from the acute phase until 18 months postburn. Levels of self-regulation (an avoidant interpersonal process), expressed concern (an approach

interpersonal process) and PTSD symptoms of both survivors and partners were highest in the acute phase and decreased afterwards, specifically in partners. This study showed that only in partners, PTSD symptoms and self-regulation were intertwined in the subacute phase, and PTSD symptoms seemed to thrive self-regulation in the long term. In burn survivors, expressing concern was related to an increase in PTSD symptoms over time. Between couple members, we found that more concern expressed by the partner was related to a decrease in PTSD symptom levels in the survivor.

Results regarding ‘self-regulation’, which is an avoidance-oriented interpersonal process, demonstrated that in partners, PTSD symptoms and self-regulation reinforced each other in the first three months, after which PTSD symptoms continued to predict self-regulation, supporting the idea that avoidant self-regulation and PTSD symptoms may form a maintaining cycle (Ehlers & Clark, 2000; Monson

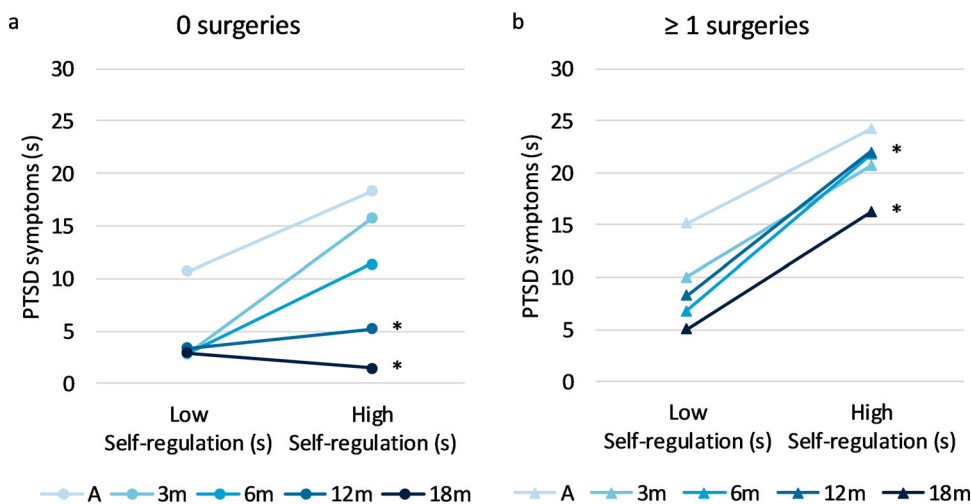


Figure 4. Cross-sectional interaction effects of number of surgeries with self-regulation on PTSD symptoms of the survivor at each of the five measurement times. Predicted values for survivors without acute surgeries (a) and with at least 1 surgery (b) are shown. The ‘low’ and ‘high’ split for self-regulation was defined by the average median of the five measurement points. PTSD = Posttraumatic stress symptoms; A = Acute phase; m = months postburn; s = survivor; * $p \leq .01$ for the interaction effect.

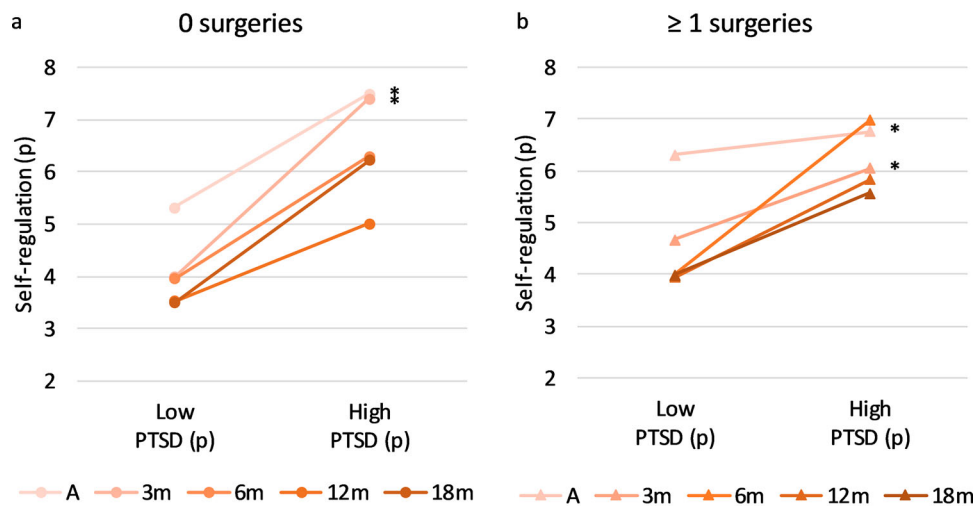


Figure 5. Cross-sectional interaction effects of number of surgeries with PTSD symptoms on self-regulation of the partner at each of the five measurement times. Predicted values for partners of survivors without acute surgeries (a) and with at least 1 surgery (b) are shown. The 'low' and 'high' split for PTSD symptoms was defined by the average median of the five measurement points. PTSD = Posttraumatic stress symptoms; A = Acute phase; m = months postburn; s = survivor; p = partner; * $p \leq .01$ for the interaction effect.

et al., 2010). That the effect from PTSD symptoms to later self-regulation lasted longer than the effect in the opposite direction is in line with the general literature (Campbell & Renshaw, 2018). Perhaps we only observed this effect in partners and not in survivors because the patient-supporter relationship after the burn event may make partners especially inclined to stay strong (Bäckström et al., 2018; Gullick et al., 2014). In survivors, additional exploratory analyses showed a probable moderation effect of burn severity in survivors. In more severely burned survivors, self-regulation was related to higher levels of PTSD symptoms throughout the study period, whereas in less severely burned survivors, this effect ceased after the first few months. Indeed, burn severity has been linked to PTSD-related avoidance processes, by showing that scars may form a constant reminder of the trauma and triggers avoidance-oriented processes (Macleod et al., 2016). Relations between avoidance and PTSD symptoms in both couple members are in line with previous research (Manne et al., 2021; Pielmaier & Maercker, 2011), supporting the idea that efforts to regulate the self may have deleterious consequences for one's well-being (Ehlers & Clark, 2000; Seligowski et al., 2015).

No interpersonal effects were found between one member's self-regulation and the other member's PTSD symptoms, in contrast to previous studies (Allen et al., 2021; Fredman et al., 2014; Pielmaier & Maercker, 2011), although some associations were demonstrated at the *between*-couple level. Differences in, for example, operationalization of interpersonal avoidance, sample (size) and statistical models make it difficult to interpret the cause of the difference in results with these studies. Notably, survivors' higher self-regulation in the acute phase predicted the partner dropping out during the study, suggesting that

survivor's self-regulation impacts partners in at least some way, for example, it may cause the partner to think the burn event is no longer an issue, and study participation is no longer relevant.

With regard to the approach-oriented process 'expressed concern', findings showed that survivors' expressed concern predicted increased levels of PTSD symptoms over time, which contradicts the beneficial effects that were hypothesized, but have been found before (Siegel et al., 2021). This might be related to feelings of guilt of being a burden for the partner. Also, it may demonstrate emotional contagion, given that showing empathy for one's partner has been related to developing PTSD symptoms oneself (Gouin & Kiecolt-Glaser, 2012). In contrast, partners expressed concern predicted lower levels of survivors' PTSD symptoms over time, supporting the general literature that approach oriented processes can mitigate PTSD symptoms (Brewin et al., 2000; Ozer et al., 2003; Pielmaier & Maercker, 2011; Su, 2018; Wang et al., 2021; Weinberg, 2013; Zalta et al., 2021) which is likely achieved through modification of posttraumatic negative appraisals (Robinaugh et al., 2011; Woodward et al., 2015). In sum, our results suggest that when a partner expresses empathic concerns this may enhance their role as supporter and have beneficial effects on the survivor's PTSD symptoms. Contrary, a survivor expressing empathic concerns about the impact of the burn event on the partner's well-being may contribute to the maintenance of their own PTSD symptoms.

Overall, this study indicated two different adverse intra-personal processes. In partners, self-regulation and PTSD symptoms are mutually exacerbating, whereas in survivors, expressed concern was related to higher levels of PTSD symptoms. Only for the

survivor, a potential beneficial interpersonal effect was established, as partner's expressed concern was associated with lower subsequent PTSD symptoms in survivors. This is in line with a review in cancer populations, stating that patients were more affected by supportive communication than partners (Chen et al., 2021). Previous research with similar results in traumatic brain injury survivors and proxies (Pielmayer & Maercker, 2011) suggested that survivors often encounter a period of decreased social contacts due to their impairment, causing a stronger dependency on their partner for support, whereas partners can more easily turn to additional sources for support, making them less dependent on the survivor (see also Weinberg, 2013).

The strengths of this study included the use of dyadic longitudinal data, analysed to differentiate between within-couple effects and stable between-couple differences, providing unique insight into the dynamics of interpersonal processes and PTSD symptoms in burn survivors and partners. However, a number of limitations should be noted. First, the majority of the couples in the sample comprised of a male survivor with a female partner, which may have led to spurious survivor-partner differences that may actually reflect gender differences. Second, the limited number of couples in relation to the complex statistical model, prevented testing the model's assumption that effects were equal over time, and prevented the inclusion of gender and burn severity as moderators in the larger model. It may also have reduced the power to detect smaller effects. Third, no information was available on the quality of the couples' relationship, which may play a role in the effects between PTSD symptoms and interpersonal processes in couples (Lambert et al., 2015; LeBlanc et al., 2016). Fourth, the measures for self-regulation and expressed concern have not been validated, and need specific validation in the burn population. Also, these scales were self-reported from the actor's point of view, while *perceived* partner support is more relevant for one's wellbeing (Fekete et al., 2007; Maercker & Horn, 2013; Reis & Shaver, 1988). Alternatively, the use of directly observed partner behaviours has been advocated (Maisel et al., 2008).

Future research in larger samples and with an alternative operationalization of interpersonal processes, such as accommodation, protective buffering, and actual or perceived social support, is needed to further shape our ideas about how PTSD symptoms and the regulation of behaviour, thoughts and feelings towards partners are related. Examining possible moderators, such as burn severity, and possible mediators, such as disclosure, may elicit specific conditions or mechanisms that strengthen or attenuate the relations.

This study has potential clinical implications. Health care providers in burn care are advised to assess the mental and emotional impact of the burn event on both survivors and partners in the acute phase as well as in the aftercare phase, given that the effects seem to persist. Specific attention may be needed for the survivor's concerns for their family and for their partner's use of self-regulation. Before discharge, a joint and open discussion about fears and worries may pave the way to more openness between partners. Partners may be encouraged to express their thoughts and feelings, for the sake of their own well-being. Special attention to the survivors' romantic relationship may continue during follow-up visits to support survivor and partner to continue their mutual openness about their feelings.

In conclusion, PTSD symptoms and interpersonal avoidance may mutually enforce each other, especially within partners of trauma survivors, who, although with altruistic intentions, may harm their own well-being. On the other hand, partner's expression of concern may enhance the survivor's processing of the traumatic event and mitigate PTSD symptoms.

Ethics approval and consent to participate

All participants in the study provided written informed consent. The study was approved by ethics boards 'METC Noord-Holland' in the Netherlands (NL44682.094.13) and 'Commissie voor Medische Ethiek Universiteit Gent' in Belgium (B670201420373).

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Data availability statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to them containing information that could compromise participant privacy.

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