



Traumatic stress symptoms following a lower limb amputation in diabetic patients: a longitudinal study

Susana Pedras, Isabel Preto, Rui Carvalho & M. Graça Pereira

To cite this article: Susana Pedras, Isabel Preto, Rui Carvalho & M. Graça Pereira (2019) Traumatic stress symptoms following a lower limb amputation in diabetic patients: a longitudinal study, *Psychology & Health*, 34:5, 535-549, DOI: [10.1080/08870446.2018.1545907](https://doi.org/10.1080/08870446.2018.1545907)

To link to this article: <https://doi.org/10.1080/08870446.2018.1545907>



Published online: 11 Jan 2019.



Submit your article to this journal [↗](#)



Article views: 412



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 2 View citing articles [↗](#)



Traumatic stress symptoms following a lower limb amputation in diabetic patients: a longitudinal study

Susana Pedras^a, Isabel Preto^b, Rui Carvalho^c and M. Graça Pereira^a

^aSchool of Psychology, University of Minho, Braga, Portugal; ^bFaculty of Engineering, University of Porto, Porto, Portugal; ^cCentro Hospitalar do Porto, Porto, Portugal

ABSTRACT

Objective: Limited research has focussed on the development of traumatic stress symptoms following an amputation due to a chronic disease such as Diabetes. This study analysed whether coping strategies, anxiety and depression symptoms, sociodemographic and clinical variables were related to traumatic stress symptoms in a sample of patients who had undergone a lower limb amputation.

Design: A longitudinal design with three assessments, one month (T1), six (T2) and ten months after an amputation surgery (T3), included 144 patients.

Main outcome measures: IES-R, WOC and HADS.

Results: Traumatic stress symptoms were prevalent at T1 ($M = 15.65$, $SD = 15.40$) and probable PTSD was observed in 13.9% patients. Presence of pain, high level of anxiety symptoms and emotion-focused strategies contributed to traumatic stress symptoms, and the period between T1 and T2, was critical. Six to ten months ($\Lambda = 0.871$, $F(2,84) = 6.245$, $p = .003$), after surgery, symptoms tended to decrease 0.122 units ($SE = 0.032$, $p = 0.002$) per assessment.

Conclusions: Findings raise awareness to the need of urgent identification of traumatic stress symptoms in medically ill patients who underwent a lower limb amputation, given the prevalence of traumatic stress symptoms right after surgery and in the following six months.

ARTICLE HISTORY

Received 16 February 2018
Accepted 3 November 2018

KEYWORDS

Traumatic stress symptoms; anxiety symptoms; coping strategies; amputation; diabetes

Introduction

Diabetic Foot Ulcer (DFU) is the major cause of non-traumatic Lower Limb Amputation (LLA) (Armstrong et al., 2001) and may be perceived by patients as a loss experience with traumatic characteristics which, in turn, may have negative consequences in their mental and physical functioning (Cavanagh, Shin, Karamouz, & Rauch, 2006; de Godoy, Braile, Buzatto, Longo, & Fontes, 2002; Martz & Cook, 2001; Phelps et al., 2008).

According to the recent edition of the DSM-V (American Psychology Association, APA, 2013), LLA may be classified as a potential traumatic stressor since, in diseases

such as Diabetes and DFU, it is a therapeutic intervention that could be perceived as an invasive, threatening and adverse experience, given the number of procedures, cumulative stress, surgeries and the presence of pre-and post-surgery pain. Therefore, patients who have suffered a LLA are at risk of experiencing traumatic stress symptoms and/or a Posttraumatic Stress Disorder (PTSD), as they have been exposed to a threat to their physical integrity/life or a severe injury. Thus, the diagnosis of a chronic disease or a treatment for a medical condition may be perceived as a traumatic stressor and, consequently, trigger traumatic stress symptoms (Chalfant, Bryant, & Fulcher, 2004; Smith et al., 2011; Tulloch, Greenman, & Tassé, 2014; Van Loey, Maas, Faber, & Taal, 2003).

There is a growing body of literature indicating that specific events in the medical setting are related to the subsequent development of traumatic stress symptoms and PTSD. However, limited research has focused on the development of traumatic stress symptoms following a LLA due to a chronic disease such as Diabetes, and the majority, were developed in individuals submitted to traumatic LLA (Cavanagh et al., 2006; de Godoy et al., 2002; Desmond & MacLachlan, 2006a; Giummarra et al., 2015; Martz & Cook, 2001; Phelps et al., 2008; Wegener, Hofkamp, & Ehde, 2008). Cavanagh et al. (2006), in a sample of 23 individuals, found that only one patient had criteria for PTSD and that patients perceived the LLA as an urgent therapeutic intervention to stay alive. In turn, Copuroglu et al. (2010), in a sample of 22 patients, found that six months after LLA, 77% showed a probable PTSD diagnosis. Notwithstanding, in the only study, the authors are aware of, in a sample of 83 individuals submitted to a LLA, in which 61% was due to a chronic disease, Phelps et al. (2008), found that six months after LLA, 23% presented traumatic stress symptoms which increased to 26% after one year. Regarding the prevalence of traumatic stress symptoms and/or PTSD over time, studies suggest the presence of few symptoms after surgery increasing over time (Cavanagh et al., 2006; Phelps et al., 2008). Hence, according to the few studies, individuals submitted to a LLA, due to a chronic disease, may develop traumatic stress symptoms associated with learning about the need for amputation, with anxiety preceding the preparation for surgery or with waking up after surgery being confronted with the loss of a member as well as with post-surgery pain.

Moreover, traumatic stress symptoms are associated with depression and anxiety symptoms (Cavanagh et al., 2006; Phelps et al., 2008) as well as pain (Copuroglu et al., 2010; Desmond & MacLachlan, 2006a; Opalic & Lesic, 2002). Depression and anxiety symptoms are common and prevalent emotional reactions before and after a LLA. After surgery, symptoms as helplessness, sadness, loss of appetite and loneliness have been reported (Asano, Rushton, Miller, & Deathe, 2008; Desmond & MacLachlan, 2006a; Engstrom & Van de Ven, 2001; Livneh, Antonak, & Gerhardt, 1999; Schoppen et al., 2003). Anxiety symptoms are higher in pre-surgery compared with post-surgery, but still prevalent (Desmond & MacLachlan, 2006a; Hawamdeh, Othman, & Ibrahim, 2008; Machado Vaz, Roque, Pimentel, Rocha, & Duro, 2012) although decreasing over time (Horgan & MacLachlan, 2004). Pain, such as phantom limb pain (PLP) and residual limb pain (RLP), is common in individuals following a LLA (Ephraim, Wegener, MacKenzie, Dillingham, & Pezzin, 2005; Gallagher, Allen, & MacLachlan, 2001) and may exacerbate traumatic stress symptoms (Maes, 2000). For instance, vicarious sensations

were significantly more prevalent in amputees reporting PTSD, particularly symptoms of increased arousal and re-experiencing LLA (Giummarra et al., 2015). Consequently, traumatic stress symptoms have been associated with mental and physical health's deterioration and a poor psychological functioning (Mills, Teesson, Ross, & Peters, 2006).

Adjustment to a LLA is potentially disabling and requires high coping efforts. Coping strategies are considered time-dependent and situation-specific (Livneh, Antonak, & Gerhardt, 2000) and, after a LLA, patients often use different coping strategies at different stages of the rehabilitation process to deal with the trauma of the limb loss (Andersson, 2006; Couture, Desrosiers, & Caron, 2011; Couture, Desrosiers, & Caron, 2012). However, it is consensual that problem-focused strategies are more effective in promoting psychosocial adjustment to amputation (Desmond & MacLachlan, 2006b; Livneh et al., 1999). Strategies such as problem solving, seeking social support and perceiving control over the disability have been negatively associated with depression and anxiety symptoms, with anger and with a positive psychosocial adjustment (Desmond & MacLachlan, 2006b; Dunn, 1996; Livneh et al., 1999). In turn, emotion-focused strategies may be less adaptive (Lazarus, 1993; Lazarus & Folkman, 1984) and have been associated with poor psychosocial outcomes (Hill, Niven, Knussen, & McCreath, 1995; Lazarus, 1993; Livneh et al., 1999).

As far as the authors know, there are no studies addressing the relationship between coping strategies and traumatic stress symptoms, in patients who undergone a LLA, but, there is evidence that emotional-focused strategies have been related to more negative outcomes after a traumatic event than problem-focused strategies (Marmar, Weiss, & Metzler, 1996; Olf, Langeland, & Gersons, 2005). Likewise, coping styles have been highly correlated with the occurrence of PTSD rather than the extent of the LLA (Martini, Ryan, Nakayama, & Ramenofsky, 1990). In the case of individuals who are amputated due to a chronic disease, several demographic and clinical characteristics may play an important role as moderators in the individual's emotional response to the LLA. Therefore, the goals of this study were: 1) to find the prevalence of traumatic stress symptoms in a sample of adult patients who were submitted to a LLA due to DFU; 2) to study the trajectories of traumatic stress symptoms over time; 3) to analyse the influence of coping strategies, anxiety and depression symptoms, sociodemographic and clinical characteristics, on traumatic stress symptoms, after a LLA, over time. The results will be useful to guide psychotherapeutic intervention for this population in clinical practice, from the pre-surgery to ten months post-surgery.

Materials and methods

Sample

The study included participants who met the following inclusion criteria: having type 2 Diabetes Mellitus (T2DM) and DFU; be indicated for a LLA surgery; and being over 18 years old. Exclusion criteria included a diagnosis of dementia or a psychiatric disorder. In the larger study, a prospective cohort design was used, where participants completed questionnaires on admission to LLA, i.e., before the surgery (t0), one month after surgery (t1), six months (t2) and 10 months after LLA (t3). In this paper, the authors were only

Table 1. Sample sociodemographic and clinical characteristics at each assessment time.

Categorical variables	t1 (n = 144)		t2 (n = 107)		t3 (n = 96)		
	n	%	n	%	n	%	
Gender (male)	102	70.8	74	69.2	71	74.0	
Marital status (with partner)	97	67.4	69	64.5	66	68.8	
Professional status (retired)	110	76.4	77	72.0	66	68.8	
Presence of pain (yes)	86	59.7	49	45.8	51	53.1	
Previous amputation (yes)	75	52.1	59	55.1	51	53.1	
Level of index amputation (minor)	116	80.6	85	79.4	77	80.2	
Interval variables	M–Max	Mean	SD	Mean	SD	Mean	SD
Age	36–90	65.57	10.71	64.68	10.93	63.69	10.75
Education (years)	0–17	4.63	3.19	4.77	3.32	4.97	3.34
Number of complications	1–4	3.01	0.93	3.03	0.97	2.99	1.01

t1: one month after surgery; t2: six months after surgery; t3: ten months after surgery.

interested in the three post surgery assessments (t1 to t3) given that traumatic stress symptoms were assessed after the surgery which happened at t1. Therefore, only the t1, t2 and t3 assessments were included in the analysis. From the 239 identified patients, 206 participated at t0. When compared, participants who dropped out after t0 did not differ significantly from those who remained in the study in their sociodemographic and clinical characteristics, with the exception of ulcer duration ($t_{(204)} = .239$; $p \leq .05$, $d = .02$) and history of previous amputation ($\chi^2 = .348$; $p \leq .05$, $\phi = .130$), indicating that participants who withdrew were more likely to have a higher ulcer duration and had already been amputated before. Reasons for non-participation over time (t0 to t3) were: refusal to participate, cognitive impairment after surgery, cancelled surgeries, transference to a different hospital, death, losses during follow-up consultation and losses due to schedule mismatches. At t1, 144 patients participated and 107, at t2. The final sample, at t3, included 96 participants, although only 86 participated consecutively in all evaluations from t0 to t3. Table 1 shows patients' sociodemographic and clinical characteristics from t1 to t3 since this study included three assessments.

Procedure

This study was conducted in six hospitals, in northern Portugal, in the Multidisciplinary Diabetic Foot Clinics and/or Vascular Surgery Departments. Participants were invited by health professionals and assessed in the hospital after being informed they needed a LLA, during the inpatient stay (t0). T1 and t3 assessments occurred during routine hospital visits after a phone call to find out if patients were willing to participate in another study evaluation. Participation was voluntary and required the signing of a written informed consent in each assessment. The study was approved by the Hospital Research Ethics Committee from the six hospitals where the study was conducted.

Measures

Sociodemographic information was collected regarding age, education, professional (employed, unemployed/on sick leave or retired) and partner status (with and without a partner) through self-report.

Clinical information was gathered from the medical records: number of diabetes-related complications (nephropathy, retinopathy, neuropathy and peripheral arterial disease), history of previous amputation (yes/no), the level of index amputation (minor/major), and presence of pain (yes/no).

The measures which were completed at t1, t2 and t3 were the following:

The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983; Portuguese version of Pais-Ribeiro et al., 2007) is a 14-item measure of anxiety and depression symptoms severity. HADS-D is calculated summing the depression items (7 items) and HADS-A the anxiety items (7 items). Higher scores indicate greater symptoms of anxiety and depression, respectively. Cronbach's alpha was .88 and .86 for the HADS-D and HADS-A, respectively.

Ways of Coping Questionnaire (WOC, Folkman & Lazarus, 1998; Pais-Ribeiro & Santos, 2001). This scale assesses problem-focused (WOC-P) and emotion-focused coping strategies (WOC-E) and comprised 48 items. Higher scores indicate a higher use of coping strategies in each dimension. In this study, Cronbach's alpha was .90 and .77 respectively.

The Impact of Event Scale Revised (IES-R, Weiss & Marmar, 1997; Pereira, Figueiredo, & Fincham, 2012; Pereira & Pedras, 2016). This scale assesses traumatic stress symptoms after a potentially traumatic event through 21-item self-rating scale that assesses the frequency of each DSM-IV (APA, 2000) symptoms of PTSD included in three clusters: re-experiencing, avoidance and hyperarousal. Higher scores indicate higher number of traumatic stress symptoms. In this study, Cronbach's alpha was .94. The cut-off point of 33 has been used as an indicator of probable PTSD (Creamer, Bell, & Failla, 2003; Wang et al., 2011). IES-R has already been used in studies with medically ill populations such as cancer patients (O'Connor, Christensen, Jensen, Moller, & Zachariae, 2010) and in amputees (Desmond & MacLachlan, 2006b).

Data analysis

In order to characterize sociodemographic and clinical characteristics, data were summarised as means and SDs for continuous variables, or frequencies and percentages for categorical variables. Point-biserial and Pearson correlations were calculated to assess the associations between variables. In order to find differences between groups, independent samples *t*-test and χ^2 tests were performed. To test the differences in traumatic stress symptoms between assessments Repeated Measures were performed with pairwise comparisons. Cohen's *d* effect-sizes were calculated in order to assess the strength of the associations. According to Cohen (1969), the magnitude of the effect was classified as small (0.20–0.49), medium (0.50–0.79) or large (0.8). The effect size for Chi-square Test was reported by Phi ϕ value, where a value of 0.1 is considered a small effect, 0.3 a medium effect and 0.5 a large effect. The effect size of Repeated Measure was tested by Partial Eta Square (Partial η^2), where .02 is considered a small effect, 0.13 a medium effect, and 0.26 a large effect (Pierce, Block, & Aguinis, 2004).

Multilevel Models were used to estimate the growth trajectory of traumatic stress symptoms and to determine the effects of WOC-E and WOC-P, HADS-A, HADS-D, and

Table 2. Descriptive statistics for psychological variables at each assessment time.

Measures	Min–Max	t1(n = 144)		t2(n = 107)		t3(n = 96)	
		Mean	SD	Mean	SD	Mean	SD
HADS-A	0–21	9.24	5.42	8.39	5.36	7.74	4.91
HADS-D	0–21	9.82	5.79	8.07	5.69	7.85	6.13
WOC-P	0–71	30.85	15.31	35.47	114.61	38.22	14.36
WOC-E	5–41	15.36	8.34	17.60	7.57	18.41	12.06
IES-R	0–84	15.65	15.04	12.69	15.13	10.41	12.06

HADS-A = Anxiety Symptoms; HADS-D = Depression Symptoms; IES-R = Impact of Event Scale; SSSS = Social Support Scale; t1 = one month, t2 = six months; t3 = ten months after surgery; WOC-E = Emotion-Focused Coping; WOC-P = Problem Focused Coping.

sociodemographic and clinical variables, on rates of change over the time period. The Multilevel Models assume that the data structure in the population is hierarchical: there is one dependent variable (at the lowest level) and several independent variables (IV), at all levels. If the data structure involves repeated measurements on different units (persons, for example), like in this case, the measurements are clustered within persons, and predictors can be available in the measurement or personal level. Compared to other classical approaches, Multilevel Models have several advantages: 1) there is no assumption that each subject must be measured on the same number of occasions which allows incomplete data to be retained in the data set; 2) it is possible to include time-varying covariates in the model and 3) different subjects can have their own trajectory (Hox, 2010; Hox & Roberts, 2011; Singer & Willett, 2003). Other studies with similar samples have already used this methodology (Coffey, Gallagher, Desmond, Ryall, & Wegener, 2014; Fortington, Dijkstra, Bomans, Post, & Geertzen, 2013). Thus, Multilevel Models assuming unstructured variance-covariance were used, with patients at the highest level (level 2) and different evaluation timings as the lowest level (level 1). Variance components were estimated using the Restricted Maximum Likelihood method. The models were constructed according to the strategy recommended by Singer and Willett (2003). First, two unconditional models were created: a) an unconditional means model (a random intercept model, with no predictors) and b) an unconditional growth model (including time as the only predictor). The unconditional means model assesses if there is a systematic variation in the outcome that is worth to explore, allowing the calculation of the intraclass correlation coefficient (ICC) that represents the proportion of variance in the outcome attributable to between-person differences. The unconditional growth model informs whether there is a significant variation in both initial status and rate of change. Second, with time having a significant effect, different predictors were added stepwise: time-varying predictors like WOC-E and WOC-P, HADS-A, HADS-D and demographic and clinical variables (gender, education, marital and professional status, history of previous amputation, the level of index amputation, number of complications, presence of pain). Interaction effects of time with the predictors were also explored. Significance for all multilevel analyses was set at 0.05 (two-sided). Variables were centred. As Multilevel Models are tolerant of missing data, missing values in the data set were retained. Homoscedasticity and linearity assumptions were tested. Levene's test indicates, as described in Glaser (2006), that the assumption of homoscedasticity was not violated: $F = 4.5025$, $0.03456 > 0.1$. Linearity was checked graphically, plotting the model residuals and the

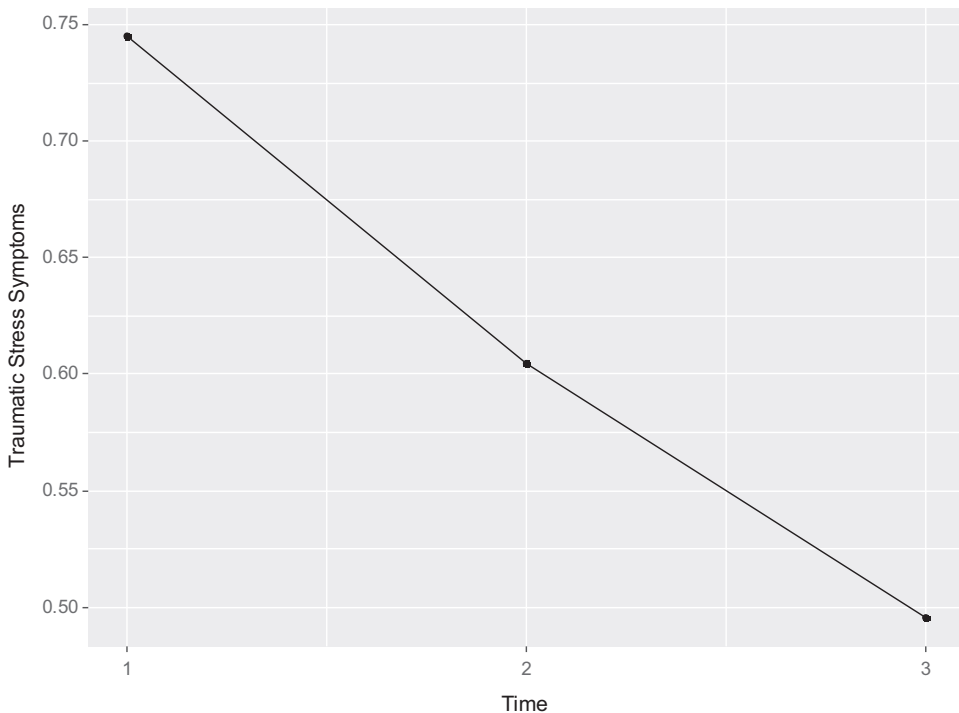


Figure 1. Trajectories of traumatic stress symptoms over time.

outcome variable. The result looked reasonably random, allowing to assume that this assumption was not violated. Statistical analyses were performed using the SPSS 24.0 (IBM, 2013).

Results

Prevalence of traumatic stress symptoms

Table 2 shows the descriptive statistics of all the psychological variables at t1, t2 and t3.

Traumatic stress symptoms decreased from t1 to t3. According to the cut-off point of IES-R, probable PTSD was observed, at t1, in 13.9% patients ($n = 20$), at t2, in 12.1% ($n = 13$) and at t3, in 6.3% ($n = 6$) patients.

Trajectories of traumatic stress symptoms over time

The unconditional means model (without predictors) which allowed the calculation of the intraclass correlation coefficients indicated that 49.5% of total variation in traumatic stress symptoms were attributable to differences between patients.

The unconditional growth model for traumatic stress symptoms with time as the only predictor, revealed an average initial status of 0.729 ($SE = 0.056$, $p < .001$). The average growth trajectory was negative, indicating a decrease of 0.122 units ($SE = 0.032$, $p = .002$) in traumatic stress symptoms per assessment (Figure 1). A

Table 3. Estimates of fixed effects for mixed model predicting traumatic stress symptoms.

Parameters	Estimate	Std. Error
Intercept, γ_{00}	.613221***	.060689
Time, γ_{10}	-.090591**	.032524
HADS-A, γ_{20}	.055607***	.005915
WOC-E, γ_{30}	.007448	.003781
Pain, γ_{40}	.168961**	.057381

HADS-A = Anxiety Symptoms; WOC-E = Emotion-Focused Coping;

* $p < .05$

** $p < .01$

*** $p < .001$.

statistically significant difference in traumatic stress symptoms between assessments was found, Wilks Lambda = 0.871, $F(2,84) = 6.245$, $p = .003$, $\eta^2 = .13$. Pairwise comparisons showed a significant improvement in mean score of traumatic stress symptoms from t2 to t3.

Influence of time-varying predictors

In the final model, a positive association between the initial status of traumatic stress symptoms and HADS-A, WOC-E and presence of pain was found, i.e. patients with more anxiety symptoms, more use of emotion-focused strategies and reported pain showed a higher number of traumatic stress symptoms (Table 3). Results indicated that traumatic stress symptoms decreased on average 0.091 per assessment. For every one unit increase, in a patient's anxiety score, there was a 0.556 increase in their IES-R score. Also, for every one unit increase in a patient's WOC-E score, there was a 0.007 increase in their IES-R score. Finally, patients with reported pain showed a value of 0.169 of the IES-R higher than patients without pain.

$$\text{Traumatic Stress Symptoms}_{ij} = \gamma_{00} + \gamma_{10} \times \text{Time}_{ij} + \gamma_{20} \times \text{HADS-A}_{ij} + \gamma_{30} \times \text{WOC-E}_{ij} + \gamma_{40} \times \text{Pain}_{ij} + \varepsilon_{ij} + \zeta_{0i} + \zeta_{1i} \times \text{Time}_{ij} + \zeta_{3i} \times \text{WOC-E}_{ij}$$

$$\text{assuming } \varepsilon_{ij} \sim N(0, \sigma_{\varepsilon}^2) \text{ and } \begin{bmatrix} \zeta_{0i} \\ \zeta_{1i} \\ \zeta_{3i} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_{\varepsilon}^2 & \sigma_{01} & \sigma_{03} \\ \sigma_{10} & \sigma_1^2 & \sigma_{13} \\ \sigma_{30} & \sigma_{31} & \sigma_3^2 \end{bmatrix}\right)$$

Discussion

One of the goals of this study was to find the prevalence of traumatic stress symptoms in a sample of patients who were submitted to a LLA due to DFU, as other studies with other medically ill samples have explored (Chalfant et al., 2004; Smith et al., 2011; Tulloch et al., 2014; Van Loey et al., 2003). Results showed that traumatic stress symptoms after LLA were prevalent, especially at t1, decreasing over time. Contrarily to the few existing studies, that found few symptoms after surgery with a tendency to increase (Cavanagh et al., 2006; Phelps et al., 2008). Also, a probable PTSD was observed in 13.9% patients. This result raises awareness to the need of urgent identification of traumatic stress symptoms, in this population, and the need for an adequate psychological intervention. Until now, the diagnosis of a chronic disease or a treatment for a medical condition was perceived as traumatic stressor potentially triggering traumatic stress symptoms in diseases such as cancer, multiple sclerosis, following a cardiovascular event

and brain injury (Chalfant et al., 2004; Pereira et al., 2012; Tulloch et al., 2014; Van Loey et al., 2003) and in patients who had undergone a traumatic amputation (Cavanagh et al., 2006; de Godoy et al., 2002; Desmond & MacLachlan, 2006a; Giummarra et al., 2015; Martz & Cook, 2001; Phelps et al., 2008; Wegener et al., 2008) but not in amputations due to DFU. In view of this result, efforts should be made to better address the psychological needs of patients indicated for a LLA surgery.

Another goal of this study was to analyse the trajectories of traumatic stress symptoms over time. As already mentioned, the traumatic stress symptoms were prevalent after LLA, although they tended to decrease over time, and the decrease was significant only from t2 to t3. As far as the authors know, this is the first study to show that patients who underwent a LLA, due to diabetes-related complications, such as DFU, are prone to traumatic stress symptoms suggesting the best time period that psychotherapeutic intervention should be offered to patients.

The final goal of this study was to know the influence of coping strategies, anxiety and depression symptoms, sociodemographic and clinical characteristics, on traumatic stress symptoms, after a LLA, over time. The results highlight the contribution of emotional-focused strategies, anxiety symptoms and the presence of pain on traumatic stress symptoms, after a LLA.

Research has shown substantial overlap of PTSD symptoms with depression and anxiety disorders (Pai, Suris, & North, 2017). It is a well-known fact that anxiety symptoms are associated with traumatic stress symptoms (Cavanagh et al., 2006; Phelps et al., 2008) and, although some studies had reported a high prevalence at pre-surgery than at post-surgery (Desmond & MacLachlan, 2006a; Hawamdeh et al., 2008; Machado Vaz et al., 2012), actually, it seems that anxiety symptoms after surgery, prevalent or not, may have a detrimental impact, potentiating traumatic stress symptoms. The source of anxiety may start on the preoperative period, when it was necessary for the patient to learn and process the need for a LLA; in the period that precedes the preparation for surgery or in the awakening after the surgery, when the individual is confronted with the loss of a limb and with post-surgery pain. In fact, there is a significant degree of overlap in the symptoms of traumatic stress disorder and anxiety. For instance, worry and anxiety are common experiences in both disorders and although, traumatic stress symptoms are thought as the psychological disorder most commonly triggered by a traumatic event, few of those individuals will develop PTSD (Breslau, Davis, Andreski, & Peterson, 1991; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995) and a high proportion will develop anxiety symptoms and a generalised anxiety disorder (Martin, Preedy, & Patel, 2016). In turn, depression symptoms did not play a significant role in the change of traumatic stress symptoms, which was not expected. However, this sample presented a lower prevalence of depression symptoms (Pedras, Carvalho, & Pereira, 2017), that may explain the non-significant result, this study.

Regarding the contribution of coping strategies, as the literature has been suggesting (Hill et al., 1995; Livneh et al., 1999), emotional-focused strategies were associated with traumatic stress symptoms being therefore, less adaptive. Cognitive disengagement, catastrophizing, avoidance and wishful thinking are an attempt to manage the emotional responses induced by the LLA and are associated with more negative outcomes after a traumatic event than problem-focused strategies (Lazarus, 1993; Marmar

et al., 1996; Olf et al., 2005). In addition, as coping strategies are considered time-dependent and situation-specific (Livneh et al., 2000), this result may be related to the follow-up period (10 months).

Although, the literature has shown the differential impact of some sociodemographic and clinical characteristics in the development of traumatic stress symptoms and PTSD (Breslau, & Anthony, 2007; Foa, Keane, Friedman, & Cohen, 2008; Sadat, Abdi, & Aghajani, 2015), in this sample, those results were not confirmed. In fact, only pain was a significant predictor of traumatic stress symptoms after LLA. PLP and RLP are common in individuals following a LLA (Ephraim et al., 2005; Gallagher et al., 2001) and may exacerbate traumatic stress symptoms (Maes, 2000). In fact, in Liedl, O'Donnell, Creamer, & Silova's study (2010), the relationship between acute pain and 12-month pain was mediated by arousal symptoms at 3 months, and the relationship between baseline arousal and re-experiencing symptoms, and later 12-month arousal and re-experiencing symptoms, was mediated by 3-month pain levels, evidencing the mutual maintenance between pain and traumatic stress symptoms.

The findings have implications for clinical practice and future research. The prevalence rate, the trajectory over time and the variables associated with traumatic stress symptoms following LLA, are useful to tailor specific psychotherapeutic intervention for this population in clinical practice, especially in the period between t1 and t2, although only approximately 13% of the variance was explained by time. Patients should be assessed through a brief emotional reaction measure (e.g. HADS), and those with high level of anxiety symptoms should be referred for an early psycho-educational intervention, ideally at pre-surgery (focused on surgery and procedures, sensations and fears, post-surgery normal emotional reactions, post-discharge concerns, physical limitations, usual coping strategies, ...). Individual trauma-focused cognitive-behavioral interventions, when compared with counselling support or a waiting list, have been effective, although it is not known whether these interventions are effective in preventing the development of PTSD, in the long term (Roberts, Kitchiner, Kenardy, & Bisson, 2010). In addition, the intervention should focus on the **low effectiveness** of emotion-focused strategies after LLA.

Finally, the results highlight that a post-discharge follow-up care should be arranged in order to identify and follow patients at risk of re-amputation as well as those with traumatic stress symptoms and refer them to a formal and structured psychotherapeutic intervention. Several randomised controlled trials of psychological interventions suggest that individual cognitive-behavioral therapy, exposure therapy (CBT/ET) and eye movement desensitisation and reprocessing (EMDR), as well as a group CBT/ET, have shown to be effective in the treatment of PTSD (Bisson & Andrew, 2009). As traumatic stress symptoms are associated with mental and physical health deterioration and with a poor psychological functioning (Mills et al., 2006), tailored interventions should be offered to patients, in order to promote a better adjustment to LLA, later on. Unexpectedly, no sociodemographic and clinical variables were associated with traumatic stress symptoms. One may hypothesise that other clinical, emotional and cognitive factors may be involved in the development of traumatic stress symptoms following a LLA, such as psychopathology, previous traumatic experiences, subjective sense of life threat and benzodiazepine use after the traumatic event

(Davydow, Katon, & Zatzick, 2009). Future studies should address these factors as well as premorbid personality traits influencing the development of traumatic stress symptoms after LLA, in this population.

Although the present findings are promising, there are limitations that need to be addressed such as the sample size and the use of only self-report measures that precluded a PTSD clinical diagnosis, allowing only for probable PTSD. Also, the majority of patients underwent a minor amputation thus, generalisation of these findings to limb loss samples that include patients with major amputations (above and below knee) should be carefully considered.

Conclusions

The results have significant implications for understanding the development of traumatic stress symptoms in a sample of patients with Diabetes and DFU who underwent a LLA, shedding light on the symptoms trajectories over time and on the variables influencing traumatic stress symptoms. Taken together, the findings suggest that patients who underwent a minor LLA due to DFU are prone to develop traumatic stress symptoms, particularly a subset of patients who report pain, present a high level of anxiety symptoms and use emotion-focused strategies between one and six months, after LLA. Patients submitted to major LLA may be affected differently, requiring further research.

Acknowledgements

The authors gratefully acknowledge the contributions of the Multidisciplinary Diabetic Foot Clinics of the following hospitals: CHP, CHSJ, CHVNG/E, CHTS, ULSAM and the Vascular Surgery Departments in Braga and CHSJ Hospitals. The authors also wish to thank all patients who agreed to participate in this study.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This study was conducted at Psychology Research Centre (PSI/01662), University of Minho, and supported by the Portuguese Foundation for Science and Technology and the Portuguese Ministry of Science, Technology and Higher Education through national funds and co-financed by FEDER through COMPETE2020 under the PT2020 Partnership Agreement (POCI-01-0145-FEDER-007653). This work was supported by a grant (SFRH/BD/87704/2012) from the Portuguese Foundation for Science and Technology.

References

American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)*. Washington, DC: American Psychiatric Association.

- American Psychiatric Association (APA, 2013). *Diagnostic and statistical manual of mental disorders: DSM-V*. Washington, DC: American Psychiatric Association.
- Andersson, M. (2006). *Coping Strategies in Conjunction with Amputation: A literature study*. Division for Health and Caring Sciences, Karlstads University. C-level thesis 10 points The Nursing programme. Retrieved from <http://www.diva-portal.org/smash/get/diva2:5930/fulltext01>.
- Armstrong, D. G., Nguyen, H. C., Lavery, L. A., van Schie, C. H., Boulton, A. J., & Harkless, L. B. (2001). Off-loading the diabetic foot wound: A randomized clinical trial. *Diabetes Care*, 24, 1019–1022.
- Asano, M., Rushton, P., Miller, W. C., & Deathe, B. A. (2008). Predictors of quality of life among individuals who have a lower limb amputation. *Prosthetics & Orthotics International*, 32, 231–243. doi: 10.1080/03093640802024955.
- Bisson, J., & Andrew, M. (2009). Psychological treatment of post-traumatic stress disorder (PTSD). *Cochrane Database of Systematic Reviews*, 3, CD003388. doi: 10.1002/14651858.CD003388.
- Breslau, N., & Anthony, J. C. (2007). Gender differences in the sensitivity to posttraumatic stress disorder: An epidemiological study of urban young adults. *Journal of Abnormal Psychology*, 116, 607–611.
- Breslau, N., Davis, G. C., Andreski, P., & Peterson, E. (1991) Traumatic events and posttraumatic stress disorder in an urban population of young adults. *Archives of General Psychiatry*, 48, 216–222.
- Cavanagh, S. R., Shin, L. M., Karamouz, N., & Rauch, S. R. (2006). Psychiatric and emotional sequelae of surgical amputation. *Psychosomatics*, 47, 459–464.
- Chalfant, A. M., Bryant, R. A., & Fulcher, G. (2004). Posttraumatic Stress Disorder following diagnosis of Multiple Sclerosis. *Journal of Traumatic Stress*, 17, 423–428.
- Coffey, L., Gallagher, P., Desmond, D., Ryall, N., & Wegener, S. T. (2014). Goal management tendencies predict trajectories of adjustment to lower limb amputation up to 15 months post rehabilitation discharge. *Archives of Physical and Medicine Rehabilitation*, 95, 1895–1902.
- Cohen, J. (1969). *Statistical power analysis for the behavioral sciences*. Academic: New York.
- Copuroglu, C., Ozcan, M., Yilmaz, B., Gorgulu, Y., Abay, E., & Yalniz, E. (2010). Acute stress disorder and post-traumatic stress disorder following amputation. *Acta Orthopaedica Belgica*, 76, 90–93.
- Couture, M., Desrosiers, J., & Caron, C.D. (2011). Cognitive appraisal and perceived benefits of dysvascular lower limb amputation: A longitudinal study. *Archives of Gerontology and Geriatrics*, 52(1), 5–11.
- Couture, M., Desrosiers, J., & Caron, C.D. (2012). Coping with a lower limb amputation due to vascular disease in the hospital, rehabilitation and home setting. *International Scholarly Research Network Rehabilitation, 2012*, 1–9.
- Creamer, M., Bell, R., & Failla, S. (2003). Psychometric properties of the Impact of Event Scale - Revised. *Behaviour Research and Therapy*, 41, 1489–1496.
- Davydow, D. S., Katon, W. J., & Zatzick, D. F. (2009). Psychiatric morbidity and functional impairments in survivors of burns, traumatic injuries, and ICU stays for other critical illnesses: A review of the literature. *International Review of Psychiatry*, 21, 531–538.
- de Godoy, J. M. P., Braile, D. M., Buzatto, S. H. G., Longo, O., & Fontes, O. A. (2002). Quality of life after amputation. *Psychology and Health Medicine*, 4, 397–400.
- Desmond, D. M., & MacLachlan, M. (2006a). Affective distress and amputation-related pain among older men with long term, traumatic limb amputations. *Journal of Pain and Symptom Management*, 31, 362–368.
- Desmond, D. M., & MacLachlan, M. (2006b). Coping strategies as predictors of psychosocial adaptation in a sample of elderly veterans with acquired lower limb amputations. *Social Science and Medicine*, 62, 208–216.
- Dunn, D. S. (1996). Well-being following amputation: salutary effects of positive meaning, optimism, and control. *Rehabilitation Psychology*, 41, 285–302.
- Engstrom, B. & Van de Ven, C. (2001). *Therapy for amputees* (3rd ed.). Edinburgh: Churchill Livingstone.

- Ephraim, P. L., Wegener, S. T., MacKenzie, E. J., Dillingham, T. R., & Pezzin, L. E. (2005). Phantom pain, residual limb pain, and back pain in amputees: Results of a national survey. *Archives of Physical Medicine and Rehabilitation*, *86*, 1910–1919. doi: 10.1016/j.apmr.2005.03.031
- Foa, E. B., Keane, T. M., Friedman, M. J., & Cohen, J. A. (2008). *Effective treatments for PTSD: practice guidelines from the International Society for Traumatic Stress Studies*. USA: Guilford Press.
- Folkman, S., & Lazarus, R. S. (1998). *Manual for the Ways of Coping Questionnaire*. California: Consulting Psychologists Press.
- Fortington, L. V., Dijkstra, P. U., Bomans, J. C., Post, W. J., & Geertzen, J. H. (2013). Change in health-related quality of life in the first 18 months after lower limb amputation: A prospective, longitudinal study. *Journal of Rehabilitation Medicine*, *45*, 587–594. doi: 10.2340/16501977-1146.
- Gallagher, P., Allen, D., & MacLachlan, M. (2001). Phantom limb pain and residual limb pain following lower limb amputation: A descriptive analysis. *Disability and Rehabilitation*, *23*, 522–530.
- Giummarra, M. J., Fitzgibbon, B. M., Tsao, J. W., Gibson, S. J., Rich, A. N., Georgiou-Karistianis, N., ... Enticott, P. G. (2015). Symptoms of PTSD associated with painful and nonpainful vicarious reactivity following amputation. *Journal of Traumatic Stress*, *28*, 330–338.
- Glaser, R. E. (2006). Levene's robust test of homogeneity of variances. In S. Kotz, C. B. Read, N. Balakrishnan, B. Vidakovic and N. L. Johnson (Eds.), *Encyclopedia of Statistical Sciences*. New York: John Wiley & Sons.
- Hawamdeh, Z. M., Othman, Y. S., & Ibrahim, A. I. (2008). Assessment of anxiety and depression after lower limb amputation in Jordanian patients. *Neuropsychiatric Disease and Treatment*, *4*, 627–633.
- Hill, A., Niven, C. A., Knussen, C., & McCreath, S. W. (1995). Rehabilitation outcome in long-term amputees. *British Journal of Therapy & Rehabilitation*, *2*, 593–598.
- Horgan, O., & MacLachlan, M. (2004). Psychosocial adjustment to lower-limb amputation: a review. *Disability and Rehabilitation*, *26*, 837–850.
- Hox, J. J. (2010). *Multilevel analysis techniques and applications*. Boca Raton, FL: Routledge.
- Hox, J. J. & Roberts, K. (2011). *Handbook of advanced multilevel analysis*. Boca Raton, FL: Taylor and Francis Group, LLC
- IBM Corporation. (2013). *IBM SPSS Statistics for Windows, Version 22.0 [Computer software]*. Armonk, NY: IBM Corporation.
- Kessler, R. C., Sonnega, A., Bromet, E., Hughes, M., & Nelson, C.B. (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry*, *52*, 1048–1060.
- Lazarus, R. (1993). Coping with the stress of illness. In A. Kaplun (Ed.), *Health promotion and chronic illness: Discovering a new quality of health* (pp. 11–29). Copenhagen: WHO Regional Office for Europe.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.
- Liedl, A., O'Donnel, M., Creamer, M., & Silova, D. (2010). Support for the mutual maintenance of pain and post-traumatic stress disorder symptoms. *Psychological Medicine*, *40*, 1215–1223.
- Livneh, H., Antonak, R. F., & Gerhardt, J. (1999). Psychosocial adaptation to amputation: The role of sociodemographic variables, disability related factors and coping strategies. *International Journal of Rehabilitation Research*, *22*, 21–31.
- Livneh, H., Antonak, R. F., & Gerhardt, J. (2000). Multidimensional investigation of the structure of coping among people with amputations. *Psychosomatics*, *41*, 235–244.
- Machado-Vaz, I., Roque, V., Pimentel, S., Rocha, A., & Duro, H. (2012). Caracterização psicossocial de uma população portuguesa de amputados do membro inferior. [Psychosocial characterization of a Portuguese sample of lower limb amputees]. *Acta Medica Portuguesa*, *25*, 77–82.
- Maes, M. (2000). Risk and preventive factors of posttraumatic stress disorder and its co-morbid disorders. *Current Opinion in Psychiatry* *13*, 587–589.
- Marmar, C. R., Weiss, D. S., & Metzler, T. J. (1996). The relationship of peritraumatic dissociation and posttraumatic stress: findings in female Vietnam theatre veterans. *Journal of Consulting and Clinical Psychology*, *64*, 1054–1059.

- Martin, C. R., Preedy, V. R., & Patel, V. B. (2016). *Comprehensive Guide to Post-Traumatic Stress Disorders*. New York: Springer.
- Martini, D. R., Ryan, C., Nakayama, D., & Ramenofsky, M. (1990) Psychiatric sequelae after traumatic injury: the Pittsburgh Regatta accident. *Journal of the American Academy of Child and Adolescence Psychiatry*, 29, 70–75.
- Martz, E., & Cook, D.W. (2001). Physical impairments as risk factors for the development of post-traumatic stress disorder. *Rehabilitation Counselling Bulletin*, 44, 217–221.
- Mills, K. L., Teesson, M., Ross, J., & Peters, L. (2006). Trauma, PTSD, and substance use disorders: Findings from the Australian National Survey of Mental Health and Well-Being. *American Journal Psychiatry*, 163, 651–658.
- O'Connor, M., Christensen, S., Jensen, A.B., Moller, S., & Zachariae, R. (2010). How traumatic is breast cancer? Post-traumatic stress symptoms (PTSS) and risk factors for severe PTSS at 3 and 15 months after surgery in a nationwide cohort of Danish women treated for primary breast cancer. *British Journal of Cancer*, 104, 419–426.
- Olf, M., Langeland, W., & Gersons, B. (2005). The psychobiology of PTSD: coping with trauma. *Psychoneuroendocrinology*, 30, 974–982.
- Opalic, P., & Lesic, A. (2002). Investigation of psychopathological state of patients depending on specific clinical characteristics of physical trauma. *Panminerva Medicine*, 44, 11–17.
- Pai, A., Suris, A. M., & North, C. S. (2017). Posttraumatic Stress Disorder in the DSM-5: Controversy, Change, and Conceptual Considerations. *Behavioral Sciences*, 7, 1–7.
- Pais-Ribeiro, J. L., & Santos, C. (2001). Estudo conservador de adaptação do Ways of Coping Questionnaire a uma amostra e contexto portugueses. [Conservative study of adaptation of the Ways of Coping Questionnaire to a Portuguese sample and context]. *Análise Psicológica*, 4, 491–502.
- Pais-Ribeiro, J. L., Silva, I., Ferreira, T., Martins, A., Meneses, R., & Baltar, M. (2007). Validation study of a Portuguese version of the Hospital Anxiety and Depression Scale. *Psychology, Health & Medicine*, 12, 225–237.
- Pedras, S., Carvalho, R., & Pereira, M. G. (2017). A predictive model of anxiety and depression symptoms after a lower limb amputation. *Disability and Health Journal*, 11, 79–85.
- Pereira, M. G., Figueiredo, A. P., & Fincham, F. D. (2012). Anxiety, depression, traumatic stress and quality of life in colorectal cancer after different treatments: A study with Portuguese patients and their partners. *European Journal of Oncology Nursing*, 16, 227–232.
- Pereira, M. G., & Pedras, S. (2016). *Versão do IES-R adaptada à amputação [IES-R version adapted to amputation]. Versão do Grupo de Investigação em Saúde Familiar e Doença*. Braga, Portugal: Escola de Psicologia, Universidade do Minho.
- Phelps, L. F., Williams, R. M., Raichle, K. A., Turner, A. P., & Ehde, D. M. (2008). The importance of cognitive processing to adjustment in the 1st year following amputation. *Rehabilitation Psychology*, 53, 28–38.
- Pierce C.A., Block, C.A., & Aguinis, H. (2004). Cautionary note on reporting eta-squared values from multifactor anova designs. *Educational and Psychological Measurement*, 64(6), 916–924.
- Roberts, N. P., Kitchiner, N. J., Kenardy, J., & Bisson, J. I. (2010). Early psychological interventions to treat acute traumatic stress symptoms. *Cochrane Database of Systematic Reviews*, 3, CD007944.
- Sadat, Z., Abdi, M., & Aghajani, M. (2015). Prevalence of Posttraumatic Stress Disorder and related factors among patients discharged from critical care units in Kashan, Iran. *Archives of Trauma Research*, 4, e28466.
- Schoppen, T., Boonstra, A., Groothoff, J. W., de Vries, J., Goeken, L. N., & Eisma, W. H. (2003). Physical, mental, and social predictors of functional outcome in unilateral lower-limb amputees. *Archives of Physical Medicine and Rehabilitation*, 84, 803–811.
- Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis*. New York: Oxford University Press.
- Smith, S. K., Zimmerman, S., Williams, C. S., Benecha, H., Abernethy, A. P., Mayer, D. K., ... Ganz, P. A. (2011). Post-Traumatic Stress Symptoms in long-term Non-Hodgkin's Lymphoma survivors: does time heal? *Journal of Clinical Oncology*, 29, 4526–4533.

- Tulloch, H., Greenman, P. S., & Tassé, V. (2014). Post-Traumatic Stress Disorder among cardiac patients: prevalence, risk factors, and considerations for assessment and treatment. *Behavioral Sciences, 5*, 27–40.
- Van Loey, N. E., Maas, C. J., Faber, A. W., & Taal, L. A. (2003). Predictors of chronic posttraumatic stress symptoms following burn injury: results of a longitudinal study. *Journal of Traumatic Stress, 16*, 361–369.
- Wang, L., Zhang, J., Shi, Z., Zhou, M., Huang, D., & Liu, P. (2011). Confirmatory factor analysis of posttraumatic stress symptoms assessed by the Impact of Event Scale-Revised in Chinese earthquake victims: Examining factor structure and its stability across sex. *Journal of Anxiety Disorders, 25*, 369–375.
- Wegener, S. T., Hofkamp, S. E., & Ehde, D. M. (2008). Interventions for psychological issues in amputation. In P. Gallagher, D. M. Desmond, & M. MacLachlan (Eds.), *Psychoprosthetics: State of the Knowledge* (pp. 91–105). London: Springer-Verlag.
- Weiss, D. S., & Marmar, C. R. (1997). The Impact of Event Scale - Revised. In J. Peterson, & M. Teerence (Eds.), *Assessing psychological trauma and PTSD* (pp. 399–411). New York: Guilford.
- Zigmond, A. S., & Snaith, R. P. (1983). Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica, 67*, 361–370. doi: [10.1111/j.1600-0447.1983.tb09716.x](https://doi.org/10.1111/j.1600-0447.1983.tb09716.x)