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34

The Open Psychology Journal

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RESEARCH ARTICLE

Resilience in Patients with Diabetes-Related Lower Limb Amputation

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Abstract:

Background:

Several factors may hinder postoperative rehabilitation following lower limb amputation. This study contributes to the existing knowledge of the impact of psychological factors on patients' successful adaptation.

Objective:

The study focused on the importance of resilience following lower limb amputation due to *diabetes mellitus*, especially on protective and risk factors potentially influencing adaptation to limb loss.

Method:

Patients (n=29) completed a test battery one and sixth months after amputation including the following questionnaires: Beck Depression Inventory (BDI-R), Hospital Anxiety and Depression Scale (HADS), Connor-Davidson Resilience Scale (CD-RISC), Medical Outcomes Study Social Support Survey (MOS-SSS), Sense of Coherence Scale (SOC), Positive and Negative Affect Schedule (PANAS).

Results:

Anxiety, depression and negative emotional states negatively correlated with resilience, suggesting to be risk factors hindering adaptation. Positive effects act as a protective factor, while negative emotions hinder coping with the trauma, particularly six months after limb loss. The overall score and all three subscales of the MOS-SSS correlated positively with resilience at both measurements, which suggests that social support has importance in successfully dealing with resilience. Patients' Sense Of Coherence (SOC) was found to be positively correlated with resilience six months after amputation suggesting it is also a protective factor.

Conclusion:

This study expands the limited empirical knowledge of patients with lower limb amputation due to *diabetes mellitus*. The study approached adaptation to limb loss from a new perspective focusing on protective and risk factors related to resilience. A complex test battery was compiled to implement the new approach to the essential protective factors in rehabilitation.

Keywords: Resilience, Diabetes-related lower limb amputation, Rehabilitation, Distress and depression, Protective and risk factors, SOC.

Article History	Received: November 20, 2018	Revised: January 12, 2019	Accepted: February 6, 2019

1. INTRODUCTION

Diabetes mellitus is a highly prevalent chronic disease with an estimated prevalence of 5 to 5.5% in the Hungarian population [1]. If left untreated, it leads to several complications such as conditions affecting the lower extremities, among others [2]. Most cases of non-traumatic lower limb amputation are due to vascular conditions caused by *diabetes mellitus*. In Hungary, 63 in 100,000 people undergo amputation in each year, of which 57 lose a lower limb [3]. There are only a few studies focusing on patients with lower limb amputation due to *diabetes mellitus*, while the number of amputation cases has increased globally over the past decade [4 - 6]. Findings of the related studies clearly show that amputation affects patients' quality of life and psychological well-being [7 - 10]. Although physical and psychological responses to amputation show great variability across individuals, certain psychological

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responses occur in almost all cases. The most typical responses are anxiety, depressed mood, difficulties with social interaction, reduced quality of life, and grief [11, 12]. Psychological responses are influenced by patients' age, gender, supportive social network, individual personality factors, coping capacity, phantom sensations, experience of pain, by the cause of amputation and the time elapsed since the intervention. These factors have an impact on patients' adaptation to altered life conditions during rehabilitation [9].

McDonald *et al.* [13] corroborated previous findings demonstrating that diabetic patients with amputation show significantly severer symptoms of depression as compared to non-amputee diabetic patients, and that amputation affects patients' adaptation through reduced physical activity, poorer quality of life and a negative body image. Furthermore, the authors' findings suggest that amputation itself is not the only cause of patients' poorer quality of life, difficulties with social interaction, dissatisfaction with their body image, and high levels of depression, but there also are other influencing factors such as patients' living conditions, previous and subsequent medical conditions, amputation-related complications, and patients' age and gender. The authors point out the relative lack of empirical research on the psychosocial impact of, besides psychological responses to, amputation. Previous studies primarily focused on the presence or absence of depression and anxiety [8, 14 - 16].

Amputation indisputably poses a serious challenge to patients, who have to deal with manifold changes in their physical, social and psychological conditions. The present study takes a novel approach to these difficulties focusing on resilience in order to reveal protective factors that facilitate trauma-related coping, postoperative adaptation and successful rehabilitation.

Masten *et al.* [17] define resilience as the development, ability or outcome of successful adaptation in spite of challenging or threatening conditions. Reed-Victor [18] elaborates on this definition by distinguishing the role of individual characteristics such as one's resources, weaknesses and abilities from the importance of the goodness-of-fit between the individual and the environment. Few empirical findings have so far been published on the importance of resilience in patients with lower limb amputation [19, 20], therefore there is an urgent need for research on this field in order to gain better knowledge of this patient population in terms of adaptive trauma-related coping. Previous studies have already confirmed the basic tenet that individuals with higher levels of resilience are more likely to report positive emotions even under considerable distress, which results in more effective coping [21]. This finding was corroborated by Walsh *et al.* [20] in relation to patients with lower limb amputation, who found that although post-amputation physical pain, depression, and reduced activity were accompanied by less frequent positive emotional experiences, resilient patients were more likely to show proactive behavior, to set personally meaningful goals, and to actively engage with the environment.

With the aim of further elaboration on the above theoretical considerations and empirical findings, the present study focused on the importance of resilience following lower limb amputation due to *diabetes mellitus*, and especially on the protective and risk factors potentially influencing patients' adaptation to their altered physical condition.

2. MATERIALS AND METHODS

2.1. Participants and Procedures

All participants (n=29) were patients having undergone non-traumatic lower limb amputation due to *diabetes mellitus* at the Department of Rehabilitation of the Medical Centre of the Hungarian Defence Forces.

	N	Minimum	Maximum	Mean	Std. Dev.
Age	29	31	71	51.03	9.053

Gender	**Ratio**	**N**
Male	69.0%	20
Female	31.0%	9
Education	**Ratio**	**N**
Primary	13.8%	4
Vocational (secondary)	31.0%	9
Technical (secondary)	6.9%	2
Maturity (secondary)	27.6%	8
Tertiary	20.7%	6
Marital Status	**Ratio**	**N**
Single	10.3%	3
Married, shared household	44.8%	13
Divorced	10.3%	3
Widowed	20.7%	6
Domestic partnership	13.8%	4
Occupation	**Ratio**	**N**
Employee	3.4%	1
Self-employed	3.4%	1

Participants were involved in a follow-up study, in which data were collected on two occasions, one and six months after amputation (T1 and T2 measurements, respectively). This study was ethically approved and licensed by the Medical Research Council of Hungary. Besides health condition, participants were also selected according to their ability to write and read, since they completed the presented questionnaires on their own. Participation was voluntary and anonymous. Participants were informed on the aims of the study and gave informed consent prior to data collection. Participants were identified at the second measurement by aliases they chose for themselves at the first measurement. They did not receive any reward for participation. Correlation analysis was used to reveal the relationships between resilience and other studied factors, which enabled us to determine the strength of these relationships. That is, the data obtained with the test battery we compiled enabled us to clarify the specific effects of specific resilience-related psychological factors on traumatized patients' adaptation.

2.2. Measures

After providing sociodemographic data, participants completed a test battery compiled by the authors, which presented them with the Hungarian adaptations of the following self-report measures respectively:

Depression symptoms were in part measured by an abridged 9-item version of the Beck Depression Inventory, in which each Likert-item is rated on a 4-point scale (BDI-R) [22, 23]. The items tap symptoms such as social withdrawal, indecision, sleep disturbance, chronic fatigue, constant and irrational worry about physical symptoms, inability to work, pessimism, lack of satisfaction and pleasure, and guilt.

Another self-report measure of depression symptoms and a measure of anxiety were obtained by the Hospital Anxiety and Depression Scale (HADS) [24, 25]. Each of the 14 Likert-items is rated on a 4-point scale. Higher overall scores indicate a higher probability of depression and anxiety.

Resilience defined as successful coping with adversities was measured by a 10-item version of the Connor-Davidson Resilience Scale (CD-RISC) [26]. The 10-item version was developed by Campbell & Stein [27, 28]. Each Likert-item is rated on a 5-point scale ranging from 0 ("never true") to 4 ("very often true"). The overall score ranges from 0 to 40, where higher scores indicate higher levels of resilience.

The extent of social support available to participants was assessed by the Medical Outcomes Study Social Support Survey (MOS-SSS) [29, 30]. The MOS-SSS consists of 20 items, the first of which assesses the number of close relationships, that is, the extent of the respondent's supportive social network, while the remaining 19 items tap various forms of social support provided for the respondent. Each Likert-item is rated on a 5-point scale according to the availability of the specific form of support.

Participants' sense of coherence was measured by a 13-item version of the Sense of Coherence Scale (SOC) [31, 32]. Each Likert-item is rated on a 7-point scale according to the extent of agreement with each. The scale comprises three subscales assessing Meaningfulness, Comprehensibility and Manageability.

Positive and negative emotional states were assessed by the Positive and Negative Affect Schedule (PANAS) [33, 34]. The scale consists of 20 items describing 10 positive (*e.g.* enthusiastic, attentive) and 10 negative emotional states (*e.g.* upset, irritable). Each Likert-item is rated on a 5-point scale.

3. RESULTS

This section presents the results on the revealed risk and protective factors influencing the coping capacity and resilience of patients with amputation due to *diabetes mellitus*. Prior to the data analysis, the statistical reliability of each measure was tested. All measures proved reliable according to the obtained Cronbach's alpha coefficients, which justify the subsequently conducted statistical tests involving the applied measures. The tables show those measures that correlated with resilience.

Table **1** summarizes the results obtained at the T1 measurement (one month after amputation). Table **2** shows the correlations obtained at the T2 measurement (six months after amputation), and reveals changes in the relationship between the studied factors and resilience.

Table 1. Correlations of the obtained measures with resilience one month after amputation (T1).

-	*r*	*p*
Depression (BDI-R)	-.560	.002**
Depression (HADS)	-.675	.000***
Anxiety (HADS)	-.645	.000***
Positive affect (PANAS)	.635	.000***
Negative affect (PANAS)	-.373	.046*
Social support (MOS-SSS) – Overall	.385	.039*
Social support (MOS-SSS) – Emotional/Informational	.426	.021*
Social support (MOS-SSS) – Positive social interaction	.397	.033*
Social support (MOS-SSS) – Tangible	.392	.035*
Sense of Coherence (SOC) – Meaningfulness	.288	.137
Sense of Coherence (SOC) – Comprehensibility	.210	.283
Sense of Coherence (SOC) – Manageability	.251	.198
Sense of Coherence (SOC) – Overall	.294	.129

Notes: BDI-R: Beck Depression Inventory; HADS: Hospital Anxiety and Depression Scale; PANAS: Positive and Negative Affect Schedule; MOS-SSS: Medical Outcomes Study Social Support Survey. * p<.05; ** p<.01; *** p<.001.

Table 2. Correlations of the obtained measures with resilience six month after amputation (T2).

	r	*p*
Depression (BDI-R)	-.811	.000***
Depression (HADS)	-.764	.000***
Anxiety (HADS)	-.653	.000***
Positive affect (PANAS)	.425	.022*
Negative affect (PANAS)	-.467	.011*
Social support (MOS-SSS) – Overall	.469	.010*
Social support (MOS-SSS) – Emotional/Informational	.442	.016*
Social support (MOS-SSS) – Positive social interaction	.488	.007**
Social support (MOS-SSS) – Tangible	.567	.001**
Sense of Coherence (SOC) – Overall	.554	.002**
Sense of Coherence (SOC) – Comprehensibility	.568	.001**
Sense of Coherence (SOC) – Meaningfulness	.566	.001**
Sense of Coherence (SOC) – Manageability	.357	.057^{+}

Notes: BDI-R: Beck Depression Inventory; HADS: Hospital Anxiety and Depression Scale; PANAS: Positive and Negative Affect Schedule; MOS-SSS: Medical Outcomes Study Social Support Survey; SOC: Sense of Coherence Scale. $^{+}$ p<.10; * p<.05; ** p<.01; *** p<.001.

Resilience showed significant negative correlations with the Beck Depression Inventory (r = -.560, p=.002) and with the HADS Depression (r = -.675, p<.000) and Anxiety subscales (r = -.645, p=<.000) at the T1 measurement. These negative correlations were even higher at the T2 measurement (BDI-R: r = -.811, p<.000; HADS Depression: r = -.764, p<.000; HADS Anxiety: r = -.653, p<.000).

Both subscales of the Positive and Negative Affect Schedule correlated significantly with resilience at both measurements. The positive subscale correlated positively (T1: r = .635, p<.000; T2 r = .425, p=.022), while the negative subscale correlated negatively with resilience (T1: r = -.373, p=.046; T2: r = -.467, p=.011).

All three subscales of the MOS-SSS showed a significant positive relationship with resilience. The level of correlation of

the Emotional/Informational subscale practically remained the same across the two measurements (T1: r = .426, p=.021; T2: r = .442, p=.016), while an increase was shown by the Positive Social Interaction subscale (T1: r = .397, p=.033; T2: r = .488 p=.007) and by the Tangible subscale (T1: r = .392, p=.035; T2: r = .567, p=.001) Correlation of the overall score of the MOS-SSS also increased (T1: r = .385, p=.039; T2: r = .469, p=.010).

The Sense of Coherence Scale (SOC) correlated positively with resilience at the T2 measurement, including the overall SOC score (r = .554, p=.002) as well as all three subscales (Comprehensibility: r = .568, p=.001; Manageability: r = .566, p=.001; Meaningfulness: r = .357, p=.057).

4. DISCUSSION

The obtained results may be summarized as follows. One of the highest positive correlations with resilience, and a protective factor supporting adaptation, was shown by the PANAS Positive subscale one month after amputation see (Table **1**). This subscale provides a measure of positive affectivity (*e.g.* enthusiasm, activity, responsiveness). That is, this finding confirms the hypothesis that the dominance of positive affect is closely related to resilience. As previously mentioned, positive affectivity has an impact on self-esteem and facilitates coping with situations involving prolonged negative mental states [21]. Furthermore, this finding is consistent with those suggesting that positive emotional experiences such as openness, vigour, hope and optimism are generally closely associated with higher levels of resilience [17, 35 - 38]. As expected, a negative relationship was found between negative emotional states (*e.g.* upset, irritable) and resilience as revealed by the Negative subscale of the PANAS. That is, lower-limb amputees dominantly characterized by negative affect showed lower levels of resilience. It is worth noting that while an increase in negative affectivity across the two measurements had an unfavourable impact on resilience showing that negative affect hindered patients' adaptation to their altered physical condition, positive emotional experiences still supported adaptation and rehabilitation.

The overall availability of social support (MOS-SSS) was positively associated with resilience, and an even closer positive association was found six months after the intervention. Similarly, all three subscales including Emotional/ Informational support, Positive Social Interactions and Tangible support were positively related to resilience at both measurements, suggesting that these factors are protective in terms of adaptation.

The results also revealed that higher levels of social support were associated with higher levels of positive affectivity and lower levels of depression and anxiety symptoms and negative affect. These findings are in line with those pointing out the positive relationship between social support and mental health [39 - 42].

As reported by Rajiv *et al.* [43], amputees who live alone and have less social support show severer symptoms of depression and anxiety, and these patients remain in institutional rehabilitation care for significantly longer periods. Furthermore, other authors point out that a lack of social integration also has indirect negative effects on patients' health through adverse health behavior (alcohol consumption, smoking, ignoring medical checkups) [44]. Consequently, it is vitally important that amputees receive continuous support from their social network, family environment and friends beyond institutional health care, who help them adapt to their altered physical condition and support rehabilitation.

A further protective factor revealed by the present study is patients' sense of coherence. Antonovsky [31, 45, 46] describes one's sense of coherence as one's general attitude towards, and general experience of, the world, as the awareness that one's external and internal world is predictable, comprehensible, and that events in the environment can be controlled. Accordingly, one's sense of coherence includes comp-rehensibility (differentiated and integrated perception of events in the external environment and internal milieu), manageability (search and utilization) of resources, and meaningfulness (belief in a meaningful life). The overall SOC score and all three subscales (Comprehensibility, Manage-ability, Meaningfulness) showed a significant positive relationship with resilience six months after the intervention, suggesting that amputees' sense of coherence along with resilience has a positive long-term effect on patients' adaptation to amputation. The present study corroborated previous findings on the importance of these factors in adaptation. Namely, it also holds true for diabetic lower-limb amputees that a stronger sense of coherence enables them to face their altered life conditions as a challenge, and they are able to gain support from their belief and trust in a meaningful life.

Summarizing the latter findings, both higher levels of social support and a stronger sense of coherence proved protective factors six months after the intervention, and the strength of their relationship increased over time. However, the follow-up data also point out the impact of risk factors such as negative affectivity and increased distress and depression symptoms (as indicated by the Beck Depression Inventory, the HADS Depression and Anxiety subscales, and the PANAS Negative subscale). Data obtained at the two measurements show differences in the strength of correlations. Namely, severer depression and anxiety symptoms are more closely associated with lower levels of resilience six months after the amputation, which points to an increased risk of maladaptive coping.

4.1. Limitations

Data were collected from participants in a follow-up study, one and six months after amputation. The study revealed several important factors that have a positive or negative impact on patients in terms of resilience. However, a limitation of the study is that amputees' adaptation to their altered physical and life conditions takes more time than six months, therefore further follow-up measurements should be conducted one and two years after the intervention.

The small sample size only enabled a correlation analysis but we are planning to continue data collection and to build a structural equation model based on a larger sample, which enables us to elaborate a more complex explanation for the

importance of resilience-related protective and risk factors.

CONCLUSION

Masten and Powell point out that the most important findings of early research on resilience is that people adequately perceive how they can successfully adapt to the environment in spite of threatening conditions.

This study expands the limited empirical knowledge of patients with lower limb amputation due to *diabetes mellitus*. The study takes a novel approach based on resilience to the protective and risk factors influencing the outcome of traumatized patients' adaptation to their altered physical condition. Depression and anxiety proved risk factors at both follow-up measurements, while protective factors such as positive affectivity, social support and a sense of coherence were positively related to resilience, which points out their important role in successful adaptation. The importance of these protective factors in terms of resilience was found to increase six months after the intervention.

These findings revealing the importance of several protective and risk factors will contribute to amputees' successful coping with their physical and psychological traumas. Successful coping is one of the most important objectives of rehabilitation, which serves to ensure that patients may not only begin a "new life" in a physical sense, but they also successfully cope with psychological losses and adapt to altered life conditions.

We have the long-term plan of turning the findings of our study into practice through resilience training for patients and through the education of the healthcare staff and family members. Ideally, psychologists' work is not confined to diagnostic procedures; they also engage in important development activities. Targeted activities requiring expertise such as resilience training may contribute to the improvement of amputees' competencies, to the compensation for their disabilities, to their more efficient learning and more successful reintegration. Although such development is rarely or never set as an objective in amputee rehabilitation, resilience training in itself may provide some protection against risk factors. The provision of psychological support has been adopted as a specific objective by our rehabilitation team: resilience training may be targeted at enhancing patients' positive affectivity and their awareness that a positive affective orientation is closely associated with resilience. Providing healthcare for amputees' may never be too early. We believe that timely healthcare provision may significantly improve the efficiency of rehabilitation, and thus it may reduce the frequency and severity of subsequent complications. Identifying the protective and risk factors and a custom-tailored resilience training may set a better course for patients' development and coping than that achievable without a development programme.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was ethically approved and licensed by the Medical Research Council of Hungary.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are the basis of this research.

CONSENT FOR PUBLICATION

Participants were informed on the aims of the study and gave informed consent prior to data collection.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest with respect to their authorship or the publication of this article.

ACKNOWLEDGEMENTS

Declared none.

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