The measure of psychological state and burnout level among the paramedics in the National Ambulance Services of Hungary

Ph.D. Thesis

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Szeged
2025

Introduction

Over the past decades, numerous studies aimed to understand and investigate the nature of burnout syndrome. Burnout syndrome is a complex phenomenon, that occurs when an individual is exposed to work stressors that simultaneously affect their mental, psychological, and somatic state as well as their overall performance (Aronsson et al., 2017). Burnout syndrome unfortunately has reached a relatively high prevalence in the modern society and thus a significant extent as negative cost in economy and public health. Currently the burnout syndrome is not classified or defined as a medical condition, rather it is an occupational phenomenon based on the World Health Organization (WHO), but it is included in the 11th Revision of the International Classification of Diseases (ICD-11). Even though almost all professions are affected differently, it is generally accepted that healthcare workers are at higher risk of the burnout syndrome (Bria et al., n.d.). Regarding the prevalence of burnout among health care workers, different studies reported a various range of it. Reardon and colleagues revealed that 16-56% of paramedic workers suffered from burnout syndrome (Reardon et al., 2020). Miller's work found a similar, 37.1% prevalence rate among emergency ambulance workers in the United Kingdom (Miller, 2021). Thyer and colleagues found that in total 55.9% of the Australian paramedics showed severe burnout symptoms (Thyer et al., 2018).

It is important to highlight that the exact definition of burnout is still being debated today. The signs of burnout can be described by a combination of three main symptoms: emotional exhaustion (EE), reduced or low personal accomplishment (PA) and depersonalization (DP). In emotional exhaustion, people feel emotionally drained, unable to cope, tired and enervated. The symptoms of emotional exhaustion are fatigue, weariness, weakening as well. The depersonalization is the interpersonal dimension of burnout syndrome which refers to response to detachment and indifference towards the work performance or towards the people who receive the work. It develops into negative attitudes or behavior, irritability and avoidance towards work or client. Due negative self-esteem reduced personal accomplishment occurs leading to decreased productivity and capabilities. It also results in reduced morale and coping skills. Burnout causes people to disengage from their work, as they experience it as stressful and frustrating, while their performance also decreases. They find it hard to concentrate and their creativity levels drop.

Another important consideration is how burnout is distinguished from depression. Although many symptoms overlap between the two conditions, such as fatigue, feelings of dejection and reduced performance, in most cases burnout symptoms are work-related, and the symptoms relieve when work stressors are removed whereas in depression, they are not exclusively work-related. However, burnout can develop into depression and lead to a range of symptoms, such as sleep disturbances, memory, attention and concentration problems, elevated cortisol levels (Bianchi et al., 2017; Khammissa et al., 2022).

Objectives

In Study One we investigated the degree of burnout among paramedics and how it differs from the original values in published in screening tools. Additionally, we aimed to reduce the length of the questionnaires used in Hungary for measurement of burnout and psychosomatic symptoms, while maintaining their high efficiency. We hypothesize that there are items in the surveys we use that allow for shortening, optimizing the measurement of burnout.

In Study Two we examined the interaction of demographic and work-related factors contributing to burnout and psychosomatic symptom severity. Even though numerous factors were already shown to be associated with symptom severity separately, we hypothesize that the exact pattern of these factors can be identified.

Methods

Participants

In Study One and Study Two, 815 paramedics were enrolled from the National Ambulance Service of Hungary as well (mean age: 40.02, male/female ration: 87.6% / 12.4%). Data were acquired as a final phase of a longitudinal study, conducted between 2016 and 2021 in Hungary. It is important to mention, that the researchers did not have an exact control over the response process.

In both study, batteries were sampled online via Google Survey and paper based as well. Even though no control over the response process were carried out; by completing and submission

the questionnaires, the subjects consented to the study in accordance with the Declaration of Helsinki. Both studies were approved by the Regional Medical and Research Ethical Committee of the University of Szeged (No.: 29640). Both samples consisted of people aged 18 or over, and all the participants were full-time employees of the National Ambulance Service of Hungary.

Screening tools

Beside sociodemographic questions, in both studies The Burnout Measure (BM) and Psychosomatic Symptom Scale (PSS) questionnaires were used. The sociodemographic questions consisted of factors as follows: age, gender, highest level of education (primary education, high school education or university), status within the paramedic workforce, years in of work, marital status, shifts, side jobs.

To assess the level of burnout, The Burnout Measure (Malakh-Pines, 1981). was used, that is originally developed by Pines and Aronson back in 1981. The questionnaire focuses on items identified in previous research on burnout syndrome. Each item was scored on a seven-point Likert scale (1=never, 2=once or twice, 3=rarely, 4=sometimes, 5=often, 6=usually 7=always), rating symptoms that have occurred in the past 12 months. Answers were then categorized the following way: between 1-2 points state of constant euphoria; between 2-3 points no intervention needed; between 3-4 points need for change; above 4 points requires intervention. After calculating burnout score (after recoding the positively phrased items), emotional (items 2, 5, 8, 12, 14, 17,21), mental (items 3, 6, 9, 11, 15, 18, 19), and physical exhaustion (items 1, 4, 7, 10, 13, 16, 20) rates were calculated using the listed items in the brackets.

To determine the level of the somatic background of burnout, the Hungarian-validated version of the Psychosomatic Symptom Scale was used. Each symptom is scored on a scale from 0 to 3 (0=never, 1=rarely, 2=occasionally, and 3=often). According to the original validation in a standard sample, from a total of 21 points, women scored an average of 6.1 points and men 5.0 points (Pik et al., 1997).

Statistical analysis

In Study One, data were analyzed using the Statistical Package for Social Sciences (SPSS 25.0 for Windows, IBM Corporation, USA), and the significance level was set at 0.05. We used

descriptive statistics to determine the characteristics of the sample. First, the normality was tested in all variables using the Shapiro-Wilk test. Due to non-normal distributions, non-parametric tests were performed. Reliability was determined by calculating Cronbach's alpha. Mann-Whitney, Kruskal-Wallis and Chi-squared tests were used for between-group comparisons. During the analysis, we first filtered for the role in the paramedic workforce, excluding respondents who gave the status 'OTHER'. We then examined the reliability of the questionnaires taken. In this case, we only went further in the analysis if Cronbach's alpha indicators were adequate. We then calculated the Burnout Index (BI) of BM to determine the degree of burnout by summing up the 21 items, after recoding the positively phrased items (Enzmann et al., 1998; Malakh-Pines, 1981). Finally, we categorized the participants into predefined categories in the questionnaire (Tamás et al., 2017, 2018). While the original instrument discriminates four categories, we only distinguished between low-risk (0-3 points) and high-risk (above 3 points) groups. We then determined which of the items of BM and PSS correlated best with the BI. The methodological consideration was to find the most relevant and well-differentiating items. The two questionnaires contain 29 items (BM: 21; PSS: 8) that we correlated with the BI using Spearman correlation (Howard & Forehand, 1962). The results were ranked according to Spearman's rho, and the 5-5 items considered the most significant are used as one of the bases for the subsequent analysis. The classification reliability of the selected items was later tested by binary logistic regression (using "enter" and "forward conditional" methods) between the two risk groups. In choosing the most optimal model, we considered the number of items and the percentage of correct classification. On this basis, we determined the most effective model, defined as the ratio of the classification percentage and the number of items. Here, the model with the highest index was chosen for further analysis. Based on the elements of the selected model, a shortened burnout index (SBMI) was created, and its correlation with the BI was examined. Subsequently, we also determined Cronbach's alpha and sensitivity (ROC analysis) of the SBMI. Then we used Two-Step cluster analysis (automatic, BIC model) to examine the characteristics of the categories created by the SBMI. The cut-off scores for the categories were determined using the Youden Index, calculated using the formula: [(Sensitivity+Specificity)-1] (Habibzadeh et al., 2016). If no psychosomatic complaints appear within the most effective model, it is abbreviated separately and appended to the items that primarily examine burnout.

In Study Two, we have used partial least squares (PLS) regression to examine how different sociodemographic and work-related factors contribute to the degree of burnout (total burnout

score, emotional exhaustion, physical exhaustion and mental exhaustion aspects, separately) and to the degree of psychosomatic symptoms in the Hungarian paramedics. In this framework, the outcome variables are represented by an $n \times q$ matrix Y, and the predictors by an $n \times p$matrix X, with n being the number of subjects. PLS iteratively extracts latent variables from both X and Y in a way that maximizes the covariance between them. This procedure reduces the dimensionality of the predictor space by constructing weighted linear combinations of the X variables that form orthogonal components optimized for predicting Y. Formally, the decomposition is expressed as:

$$X=TP^{\top}+E,\ Y=UQ^{\top}+F,$$

where T ($n \times r$) and U ($n \times r$) are the score matrices, P ($p \times r$) and Q ($q \times r$) are the loading matrices, E and F are the residual terms, and r is the number of latent variables. The method ensures that the covariance between the score matrices T and U is maximized. To assess statistical significance, permutation testing was performed on the singular values of the decomposition. Specifically, the rows of the dependent variable matrix were randomly permuted 5,000 times, and the singular values recalculated to generate a null distribution. Variable contributions were summarized using Variable Importance in the Projection (VIP) scores. Since the mean of the squared VIP scores equals 1, variables with VIP values greater than 1 were considered to be of high importance(Abdi & Williams, 2013; Wold et al., 1993).

RESULTS

Sample characteristics

The questionnaire was completed by a total N=727 respondents from the 815 total respondents after pre-screening. A total of 637 men and 90 women remained in the sample. Age mean of the total sample was 40.02 years, 40.77 years for men and 34.69 years for women. Most of the respondents (62,17%) had completed secondary school education. The BI has a median of 2.33 points, with 2.33 points for men and 2.35 points for women. The sample was homogeneous in this respect, with no significant difference according to the Mann-Whitney test performed (Z=-1.292, U=26255.0, p=.196). For PSS, the average score was 9.04, 8.88 for men and 1.14 for women. These scores were significantly higher than the mean scores of the originally validated

test. In addition, the correlation between the burnout index and the psychosomatic index was found to be strong (rho=.735; p<.0001).

Results in Study One

Before correlation analysis, we first examined the normality and reliability of each item in the questionnaire. The BM had a Cronbach's alpha of 0.813, and the PSS had a Cronbach's alpha of 0.898. Without exception, the items deviated from the normal distribution. Subsequent tests revealed that the following five items were found to be the most significantly correlated with the BI: being emotionally exhausted (rho=0.833, p<0.001); being 'wiped out' (rho=0.831, p<0.001); feeling rundown (rho=0.822, p<0.001); feeling hopeless (rho=0.777, p<0.001); feeling 'burned out' (rho=0.766, p<0.001). The Cronbach's alpha coefficients for the selected five items were re-examined and were found to be 0.920, meaning high reliability. The items of the PSS also showed a correlation with BI: feeling weak and tired (rho=0.649, p<0.001); sleeping problems (rho=0.595, p<0.001); stress diarrhea (rho=0.490, p<0.001); palpitation (rho=0.461, p<0.001); backache (rho=0.439, p<0.001). For somatic problems, Cronbach's alpha was 0.748, assuming good reliability. The psychological and somatic items were combined, giving a total of 10 items, and then the reliability indicators were re-tested here, with a value of 0.901.

Binary logistic regression was used to test the predictive accuracy of the selected items between the low and high-risk groups. First, the five BM items were examined from the point of view of classification. Using the Enter method, efficacy was found to be 93.8% with a significant model (χ2 (df 5, Ntotal: 727, low-risk group: 466, high-risk group: 216) = 708.576 p<.0001). Applying the forward conditional method, the efficiency was 93.5%, and one item (*Feeling 'burned out'*) was not required in the model (χ2 (df 4, Ntotal: 727, low-risk group: 465, high-risk group: 215) = 705,173 p<.0001). For PPS, using the enter method, an accuracy of 81.6% is obtained (χ2 (df 5, Ntotal: 727, low-risk group: 436, high-risk group: 157) = 334,401 p<. 001), also for the forward conditional method (χ2 (df 5, Ntotal: 727, low-risk group: 436, high-risk group: 157) = 334,401 p<.0001). In the case of 10 items, using the enter method, we obtained an accuracy of 94.5% (χ2 (df 10, Ntotal: 727, low-risk group: 469, high-risk group: 218) = 731,359 p<. 001), while the forward conditional method yielded 93.9% (χ2 (df 10, Ntotal: 727, low-risk group: 464, high-risk group: 219) = 726,346 p<.0001). Therefore, the four-batch BM model seems to be the optimal choice based on the given ratio. Combining the four items created a new burnout

index for further analysis (SBMI). The Cronbach's alpha for the four selected items was excellent (0.905) and correlated well with the BM (rho=0.936) and PSS (rho=0.683). The ROC curve was calculated to confirm the sensitivity and specificity tradeoff further. The analysis also shows that SBMI has an excellent separation ability concerning the assessment of the original risk groups (AUC_{SBMI} =. 979; 95% CI: 0.971 - 0.988). We also examined whether the SBMI can distinguish between different risk groups. Using the Two-Step clustering method (BIC, automatically determined clusters), we obtained three well-distinguishable groups [High risk (M=21.18, SD=2.91); Moderate risk (M=13.42, SD=2.19); Low risk (M=5.81, SD=1.72)]. For the low and moderate risk and the moderate and high-risk categories, the most optimal cut-off values would be 9.5 and 17.5 points respectively, but the test results are calculated with whole points. Thus, the Youden-index of the two closest integer scores *Howard et al. (1962)*) was determined, and the score with the better indicator was chosen as the cut-off value (J_{10}=0.704 vs J_9=0.679; J_{18}=0.964 J_{17}=0.798).Since the items of PSS did not appear in the current model, the selected five items were used to differentiate burnout levels. In this case, we also examined Cronbach's alpha values of the shortened PSS index (SPSSI) (0.748) and the correlation between BI (rho=0.744) and SBMI (rho=0.698). Furthermore, the ROC analysis results show that SPSSI has good sensitivity and specificity (AUC_{SPSSI} =0. 871; 95% CI: 0.845 - 0.897).

Results in Study Two

In the first PLS analysis, the dependent variables were the total burnout score, the rate of emotional, mental and physical exhaustion. As the second latent variable interpreted only a small part of the variance of the dependent measure (<5%) and the permutation test indicated a non-significant latent variable, only the first latent variable was evaluated. The permutation test showed that the first latent variable was significant ($p < 0.001$) and responsible for 34.6% of the variation of the dependent variable. The *X* loadings and the corresponding VIP scores in regard of the total burnout score indicated that job description (VIP score: 1.258), level of education (VIP score: 1.225), gender (VIP score: 1.21) and age (VIP score: 1.029) were the significant contributors in ascending order.

Following the PLS regression analysis, descriptive statistics were computed for each significant sociodemographic and work-related predictor of burnout scores (VIP > 1). This allowed for a clearer interpretation of the direction and variability of the observed effects. Beside younger

age, physician position, university degree and female gender showed the highest contribution to burnout score among paramedics. In regards of the physical exhaustion, level of education (VIP score: 1.327), gender (VIP score: 1.308) and job description (VIP score: 1.28) were the significant contributors in ascending order. The descriptive statistics showed that university degree, female gender and physician position showed together showed the highest contribution to the physical exhaustion aspect of burnout syndrome among paramedics. However, age (VIP score: 1.37), side job (VIP score: 1.261) and level of education (VIP score: 1.246) contributed most to the level of mental exhaustion aspect of burnout syndrome in ascending order. The descriptive statistics showed that older age, primary education and the presence of side job showed together the highest contribution to the mental exhaustion aspect of burnout syndrome among paramedics. Furthermore, contributors of emotional exhaustion were age (VIP score: 1.57), job description (VIP score: 1.213) and gender (VIP score: 1.092) in ascending order. The descriptive statistics showed that younger age physician position and female gender showed together the highest contribution to the emotional exhaustion aspect of burnout syndrome among paramedics.

Finally, in the second PLS analysis, the dependent variable was the psychosomatic symptom scale score. As in the first PLS, the second latent variable interpreted only a small part of the variance of the dependent measure (<5%) and the permutation test indicated a non-significant latent variable, only the first latent variable was evaluated here as well. The permutation test showed that the first latent variable was significant ($p < 0.001$) and responsible for 32.41% of the variation of the dependent variable. The *X* loadings and the corresponding VIP scores in regard of the psychosomatic symptom scale scores indicated that only gender (VIP score: 1.739) and age (VIP score: 1.562) were the significant contributors in ascending order. The descriptive statistics showed that younger age and female gender showed together the highest contribution to the psychosomatic symptoms among paramedics.

Conclusion

Based on our studies discussed in this thesis, uniquely in the literature we identified several factor patterns that contribute to burnout syndrome and psychosomatic symptoms among paramedics working in the National Ambulance Service of Hungary. In our first research we have constructed a short questionnaire with a classification efficiency of 81.6% to perform an effective

classification even based on physical symptoms. The reliability indicators of the generated inquiries are excellent, and they also show a high correlation with the original questionnaires. These features allow for an efficient and quick self-assessment, convenient for paramedics. Our results in the second research showed that with exact patterns of socio-demographic and work-related factors, we are able to identify paramedics with higher possibility of more severe burnout.

Thesis points

Enrolling 727 members of the National Ambulance Service of Hungary, in our two studies we aimed to demonstrate that (i) we are able to reduce the length of the questionnaires used in Hungary for measurement of burnout and psychosomatic symptoms, while maintaining their high efficiency (ii) there are items in the surveys we use, that allow for shortening, optimizing the measurement of burnout, thus (iii) with the shortened questionnaire we are able to classify paramedics into well-defined risk categories. Furthermore, we have aimed to demonstrate (iv) using model free approach we could identify patterns in socio-demographic and work-related factors that contribute to the severity of burnout and psychosomatic symptoms.

The most important results of our studies can be summarized as follows:

(1) In Study One we found strong correlation between the burnout and psychosomatic symptoms scores.

(2) In Study One we were able to shorten the original Burnout Measure questionnaire to a new Shortened Burnout Measure Instrument including 4 items from the original Burnout Measure.

(3) In Study One using model free clustering method we could determine three well-distinguishable groups regarding the risk of burnout development. The Shortened Burnout Measure Instrument had excellent separation ability in relation of the risk groups.

(4) In Study One we were able to determine precise cut-off values between the high, medium, and low risk group in relation of burnout.

(5) In Study Two we identified that younger age, physician position, university degree and female gender were the most significant contributors together to the degree of burnout syndrome.

(6) In Study Two we identified that university degree, female gender and physician position were the most significant contributors together to the degree of physical exhaustion aspect of burnout syndrome.

(7) In Study Two we identified that older age, presence of side job and primary education were the most significant contributors together to the degree of mental exhaustion aspect of burnout syndrome.

(8) In Study Two we identified that younger age, physician position and female gender were the most significant contributors together to the degree of emotional exhaustion aspect of burnout syndrome.

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