

## Long-term posttraumatic stress disorder in mine workers after a coalmining disaster

MAKBULE NESLİSAH TAN<sup>1</sup><https://orcid.org/0000-0002-3262-7815>VILDAN MEVSİM<sup>1</sup><https://orcid.org/0000-0002-3546-9146>İSMAIL TOPAL<sup>2</sup><https://orcid.org/0000-0002-5483-4284>ÇİGDEM ALKAN<sup>1</sup><https://orcid.org/0000-0002-4369-6576>

Received: 02/13/2019 – Accepted: 09/02/2019

DOI: 10.1590/0101-60830000000223

<sup>1</sup> Dokuz Eylül Üniversitesi – Family Medicine İzmir, Turkey.<sup>2</sup> Tek İlke İş Sağlığı ve Güvenliği Eğitim Kurumu, İzmir, Turkey.

## Abstract

**Background:** A coalmine disaster has occurred in Turkey on 13 May 2014, which caused the death of 301 miners. **Objective:** This study aimed to determine the prevalence of posttraumatic stress disorder (PTSD) symptoms and the risk factors for PTSD among mine workers, 2 years after the coalmining disaster. **Methods:** This was a cross-sectional survey conducted between June 2016 and July 2016 among mine workers who were the employees of either the mine where the accident occurred or three other mines in the same area. Sociodemographic data form and PTSD Symptom-Scale Self-Report (PSS-SR) were used to collect data. **Results:** 672 mine workers participated in the study. At the time of the accident, 23.7% (n = 159) of them were in the mine where the accident occurred. The mean score on total PSS-SR was 4.27 (SD: ±4.49). Eighteen (2.7%) participants screened positive for PTSD. Logistic regression analysis revealed the significant risk factors for PTSD are: being single/divorced/widowed, having a chronic disease, having a family history of psychiatric illness and previously experiencing traumatic events more than one. **Discussion:** Coalmining workers have considerably high prevalence rate of PTSD symptoms after a coalmining disaster. Assessing PTSD and associated risks is important for preventive mental health services.

Tan MN et al. / Arch Clin Psychiatry. 2020;47(1):13-8

**Keywords:** Posttraumatic stress disorder, coalmining disaster, risk factors.

## Introduction

Occupational health and safety is a global concern, with millions of people getting injured or losing their lives owing to work accidents every year<sup>1</sup>. The rate of occupational accidents in Turkey is relatively high, although it has considerably decreased over the past four decades. According to the data of the International Labor Organization for Turkey (ILO), approximately 700-1,700 people have lost their lives every year since 1995 because of work accidents. Assessment of the distribution of the death rates according to the major sectors showed that the mining sector holds an important place among workplace deaths<sup>2</sup>, and the area within the mining sector that involves the highest risk is coal mining. Underground coal mining is among top-ranking occupations in terms of deaths and accidents per worker<sup>3</sup>. It is stated that, the fatal occupational injury rate in underground coal mining has been six times higher than that in all private industry<sup>4</sup>.

Mining accidents are potentially traumatic events (PTEs) that not only threaten the physical well-being of the individual but also have the potential to cause serious mental health problems such as posttraumatic stress disorder (PTSD)<sup>5</sup>. According to the DSM-IV, the core features of PTSD include a PTE and a configuration of symptoms. The disorder's criterion symptoms are defined as a state of increased alertness in a person, which emerges following a PTE, accompanied by the avoidance of stimuli reminding or evoking of the trauma, and the person reliving the PTE through dreams and flashbacks<sup>6</sup>. The duration of the symptoms presentation should be at least 1 month<sup>7</sup>. Symptoms may persist for more than 30 days after the PTE; alternatively, they can appear months or even years after the accident<sup>5,8</sup>. Surviving miners are not the only people affected

by mining accidents. Although the extent to which individuals are affected tends to differ, other people and groups impacted by these accidents are the family members, relatives, neighbors of the deceased, surviving workers, and even the citizens who follow the PTEs from the media<sup>9</sup>.

The results of studies on the prevalence of PTSD tend to vary depending on various factors such as the time period of the study, the nature of the trauma, the differences among the subjects, and the diagnostic tools used. A retrospective study on the mining industry in Africa conducted between 2006 and 2010 showed that the overall prevalence of PTSD was 0.09%<sup>5</sup>.

Studies investigating the relationship between PTEs and PTSD development indicate that old age, female sex, and being a member of a low social stratum are risk factors for PTSD development. In addition, psychological factors such as guilt, poor coping ability, and comorbid psychiatric conditions represent other risk factors for PTSD development<sup>10,11</sup>. The severity, duration, and proximity of an individual's exposure to a PTE are the most important factors affecting the likelihood of PTSD development<sup>5</sup>.

Although Turkey is a country that has frequently experienced mining accidents throughout its history, no studies have been conducted on the psychological impact of these accidents on people. In fact, these traumatic accidents can adversely affect the psychosocial well-being of mine workers, and consequently reduce their job performance and productivity<sup>2,5,12</sup>.

On 13 May 2014, an occupational mining accident occurred in a mine located in the western region of Turkey, resulting in the death of 301 miners, which was the highest number of deaths in an occupational accident ever recorded in the country's history<sup>13</sup>. A review of PTSD studies reported in the literature showed that these studies



have heterogeneity in their sociodemographic variables<sup>14</sup>, and that they were mostly conducted without considering the trauma type and population<sup>5,10</sup>. This study aimed to determine the prevalence of PTSD symptoms and the risk factors for PTSD among mine workers working in mines located in an area that has previously experienced accidents.

## Methods

### Participants

This is a cross-sectional, descriptive and quantitative study. The study sample comprised trainees aged >18 years who had participated in the occupational health and safety training at the Occupational Health and Safety Training Center between June 2016 and July 2016, and who were among the employees of either the mine where the accident of 13 May 2014 occurred or three other mines in the same area. Written informed consent was obtained from the participants. Participants were included into the study on a voluntary basis and individuals who did not work as a mine worker for the located mines at “the time of the mining accident” were excluded. Illiterate participants were assisted by the researchers when filling their forms. No psychiatric interview was conducted with the participants.

### Ethical approval

The study was approved by the Dokuz Eylül University Faculty of Medicine’s Ethics Committee for Non-Interventional Studies on 12 May 2016, with the protocol number 2016/13-44.

### Data collection tools

**Sociodemographic and Clinical Data Collection Form:** This form was prepared by the researchers to collect information regarding the sociodemographic and clinical features of the participants. The form includes questions about participants’ age, marital status, education level, household income, presence of comorbid chronic diseases, current and past medical history of mental illness, family history of psychiatric illness, previous traumatic experience, occupational knowledge in the field of mining, and the outcomes of the accident. The participants were asked whether they are currently diagnosed with any chronic or psychiatric illness. They were asked to answer this question as “yes” or “no” and (if “yes”) to give the name of the diagnosis. These diagnoses are current condition diagnoses and do not include past diagnoses.

**Traumatic Experiences List:** The Traumatic Experiences List comprising 12 items was used to investigate PTEs experienced in the past. The trauma checklist is included in the Posttraumatic Diagnostic Scale developed by Foa *et al.*<sup>15</sup> and adapted for the Turkish sample<sup>16</sup>. The participants were asked whether they have experienced or witnessed each of these events.

**Posttraumatic Stress Disorder Symptoms Scale-Self-Reported (PSS-SR):** This scale was developed by Foa *et al.* (1993) to screen PTSD symptoms within the normal population in accordance with the criteria defined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)<sup>17</sup>. PSS-SR is a four-point Likert-type self-reported scale comprising 17 items. The Likert scale covers three aspects: reliving, avoidance, and arousal. Each item is scored between 0-3 (0: None, 3:  $\geq$  per week-almost always), and the total score is obtained by summing of item scores. The maximum score that can be obtained from the scale is 51. A cut-off value of 14 points on the PSS-SR was reported to have a sensitivity of 0.83 and a specificity of 0.71<sup>18</sup>. Moreover, different studies have determined the cut-off value to be 14<sup>19</sup>. A higher score indicates increased PTSD symptom severity. The Turkish validity and reliability study of the scale was conducted by Aydın *et al.* (2012), and the internal consistency coefficient was reported to be 0.90 for the entire scale<sup>20</sup>. Participants were asked to rate problems they were bothered by in the past month ‘in relation to the mine accident’ on the scale.

To address hazards and prevent injuries and illnesses among mine workers, The Regulations of the Ministry of Labour and Social Security of Turkey on occupational health and safety in mines were published on November 2013. The regulation issued mandatory safety and health training for any worker employed at a mine, to determine the minimum health and safety requirements for works related to mining<sup>21</sup>. The questionnaires were distributed to the participants during the training program, before starting training and collected when completed.

### Statistical analysis

The obtained data were evaluated using Statistical Package for Social Sciences for Windows 22.0 (IBM Corp.; Armonk, NY, USA). Quantitative variables were shown as mean  $\pm$  SD (standard deviation), whereas categorical variables were shown as numbers and percentages. Chi-square test was used to evaluate the relationships between categorical variables, and independent samples *t*-test was used to determine whether there was a significant difference between the mean scores of the groups. Variables were examined at 95% confidence interval, and  $P < 0.05$  was considered statistically significant. Risk factors for PTSD were examined initially using bivariate analysis based on socio-demographic characteristics, clinical characteristics and disaster experience. To further determine risk factors for PTSD, the variables that had *p* values  $< 0.05$  in bivariate analysis were further examined in logistic regression models and odds ratios (OR) with 95% confidence interval (95% CI) were obtained.

## Results

### Socio-demographical and clinical characteristics

Of 699 trainees participated in the occupational health and safety training, 27 were excluded: 23 trainees were not mine workers at each of the four mines at “the time of the mining accident”, 2 trainees declined to participate stating that they were “not interested”, 2 trainees had missing data points. Thus, a sample size of 672 trainees was used for analysis.

All of them were males, with the mean age of  $33,83 \pm 7,45$  years (range: 19-56 years). Table 1 shows a comparison of the prevalence of PTSD symptoms among the participants according to their sociodemographic and clinical characteristics.

### Physical proximity to PTE and physical consequences of trauma

All the participants ( $n = 672$ ) were working at four different mines within the area of the accident. At the time of the accident, 41.2% (277) of the participants were in the town where the mine is located, 37.4% (251) were working for the mining company where the accident occurred, and 63.3% (159) of these 251 participants were inside the mine when the accident occurred. Table 2 shows a comparison of the prevalence of PTSD symptoms among the participants according to their physical proximity to the PTE and the physical consequences of trauma.

### The prevalence of PTSD symptoms and risk factors

The mean score on total PSS-SR was 4.27 (SD:  $\pm 4.49$ ). Of the 672 participants, 18 (2.7%) who were evaluated two years after the accident were screened positive for PTSD symptoms by PSS-SR with a cut-off value of 14.

Factors such as not being married (66.7%), having a chronic illness (50%), having a comorbid psychiatric illness (22.2%), having a family history of psychiatric illness (27.8%), having more than one traumatic experience in the past (61.1%), working for the mine where the accident occurred (61.1%), being inside the disaster mine when the accident occurred (44.4%), and being injured (44.4%) were found

**Table 1.** Comparison of the prevalence of PTSD symptoms among the participants according to their sociodemographic and clinical characteristics

	n (%)	PTSD negative <sup>α</sup> n = 654	PTSD positive <sup>β</sup> n = 18	p
Age, years (mean±SD)**	672 (100)	33.80±7.48	35.11±6.24	0.461
Age groups*				0.099
19-35	423 (62.9)	415 (63.5)	8 (44.4)	
>35	249 (37.1)	239 (36.5)	10 (55.6)	
Marital status*				<b>0.005</b>
Married	432 (64.3)	426 (65.1)	6 (33.3)	
Single/Divorced/Widowed	240 (35.7)	228 (34.9)	12 (66.7)	
Education status*				0.952
No high school degree	378 (56.3)	368 (56.3)	10 (55.6)	
High school graduate or above	294 (43.8)	286 (43.7)	8 (44.4)	
Household income*				0.333
High	55 (8.2)	52 (8.0)	3 (16.7)	
Average	401 (59.7)	390 (59.6)	11 (61.1)	
Low	216 (32.1)	212 (32.4)	4 (22.2)	
Chronic illness*				<b>0.040</b>
Yes	191 (28.4)	182 (27.8)	9 (50.0)	
No	481 (71.6)	472 (72.2)	9 (50.0)	
Comorbid psychiatric illness*				<b>0.017</b>
Yes	51 (7.6)	47 (7.2)	4 (22.2)	
No	621 (92.4)	607 (92.8)	14 (77.8)	
History of psychiatric illness*				0.435
Yes	105 (15.6)	101 (15.4)	4 (22.2)	
No	567 (84.4)	553 (84.6)	14 (77.8)	
Family history of psychiatric illness*				<b>0.002</b>
Yes	55 (8.2)	50 (7.6)	5 (27.8)	
No	617 (91.8)	604 (92.4)	13 (72.2)	
Previous traumatic experience*				<b>0.000</b>
No traumatic experience or one	579 (86.2)	572 (87.5)	7 (38.9)	
More than one traumatic experience	93 (13.8)	82 (12.5)	11 (61.1)	
PSS-SR score (mean±SD)**	672 (100)	3.81±3.48	20.94±5.51	<b>0.000</b>

Results shown in parenthesis are percentages unless stated otherwise. Statistical significance is highlighted as bold fonts. PTSD, Post-Traumatic Stress Disorder. PSS-SR, PTSD Symptom Scale-Self Report. <sup>α</sup> PTSD negative: Represents individuals who scored <14 on the PSS-SR. <sup>β</sup> PTSD positive: Represents individuals who scored ≥ 14 on the PSS-SR. \* Chi-square test. \*\* Independent samples test.

**Table 2.** Comparison of the prevalence of PTSD symptoms among the participants according to their physical proximity to the potentially traumatic event and the physical consequences of trauma

	n (%)	PTSD negative <sup>α</sup> n = 654	PTSD positive <sup>β</sup> n = 18	p
At the time of the accident, being in the town where the accident occurred*				0.082
Yes	277 (41.2)	266 (40.7)	11 (61.1)	
No	395 (58.8)	388 (59.3)	7 (38.9)	
Working for the mine where the accident occurred*				<b>0.035</b>
Yes	251 (37.4)	240 (36.7)	11 (61.1)	
No	421 (62.6)	414 (63.3)	7 (38.9)	
Being inside the disaster mine when the accident occurred*				<b>0.035</b>
Yes	159 (23.7)	151 (23.1)	8 (44.4)	
No	513 (76.3)	503 (76.9)	10 (55.6)	
Physical injury*				<b>0.029</b>
Yes	155 (23.1)	147 (22.5)	8 (44.4)	
No	517 (76.9)	507 (77.55)	10 (55.6)	
Physical injury/death of one of the family members or relatives*				0.251
Yes	457 (68.0)	447 (68.3)	10 (55.6)	
No	215 (32.0)	207 (31.7)	8 (44.4)	

Results shown in parenthesis are percentages unless stated otherwise. Statistical significance is highlighted as bold fonts. PTSD, Post-Traumatic Stress Disorder. <sup>α</sup> PTSD negative: Represents individuals who scored < 14 on the PSS-SR. <sup>β</sup> PTSD positive: Represents individuals who scored ≥ 14 on the PSS-SR. \* Chi-square test.

to be significantly higher in participants who screened positive for PTSD symptoms than in those who screened negative (all  $p$  values  $< 0.05$ ) (Table 1, Table 2).

Logistic regression analysis further showed that significant risk factors for PTSD included: being single/divorced/widowed compared to being married (OR = 3.53, 95% CI, 1.21-10.28;  $p = 0.021$ ), having a chronic illness compared to have not (OR = 6.73, 95% CI, 2.06-21.93;  $p = 0.002$ ), having a family history of psychiatric illness compared to have not (OR = 7.48, 95% CI, 2.01-27.81;  $p = 0.003$ ) and previously experiencing PTEs more than one compared to have no or one experience (OR = 24.56, 95% CI, 7.03-85.77;  $p = 0.000$ ).

## Discussion

The mining sector is of critical importance for countries in terms of its contribution to employment and economic development<sup>22</sup>. However, mining is also considered to be the most risky sector in the world in terms of occupational health and safety<sup>23</sup>. The accident of 13 May 2014 that occurred in a major mining area in Turkey had crucial psychological effects on its victims.

In our study, the mean PSS-SR score was significantly higher in patients with a positive PTSD screen than in those with a negative PTSD screen. The obtained results support the discriminant validity of the scale. The internal consistency coefficient (Cronbach's alpha) of the entire scale was found to be 0.79, which is an acceptable value in terms of the scale's reliability. These results are consistent with those of another study investigating the psychometric properties of the PSS-SR in a Turkish sample<sup>20</sup>.

The prevalence of PTSD symptoms, as determined by the PSS-SR, in our sample population (2.7%) far exceeds the estimated overall prevalence of PTSD which was reported by Li for the mining sector in South Africa (0.09%)<sup>5</sup>. The prevalence rate of PTSD symptoms observed after a coalmining disaster seems higher than overall prevalence suggesting that psychological impairments caused by traumatic exposure in coalmining disaster appear to be more profound than mining sector routine. Given that coal mine disasters occur owing to foreseeable and preventable reasons compared with other disasters, occupational safety education can be an effective method to prevent the resulting psychopathologies.

In our study, the participants were evaluated for PTSD symptoms at the end of the second year after the accident. Reviewing other similar disasters reported in the literature, it can be observed that at 3 and 6 months after a coal mining disaster in China, the prevalence of PTSD was 35.4% and 31.3%, respectively<sup>24</sup>. Another coalmining disaster in China, showed 50% of survivors had as PTSD at 2 months and 31% at 10 months post-disaster<sup>25</sup>. The rates obtained in the present study for this disaster seem to be low compared with the rates reported in the literature. However, this difference seems to be related with the time passed after trauma. We noted that the prevalence of PTSD seemed to decrease over time after the PTEs. The declining prevalence may be attributable to social support<sup>26</sup>. Social ties are shown to be associated with reduced stress caused by the feeling of threat in mine rescuers<sup>27</sup>. It is important to note that these studies all evaluated PTSD according to DSM-IV. It is possible that screening instruments based on DSM-5 criteria for PTSD, such as the PCL-5 would have given different prevalence rates<sup>28</sup>.

In our study, there was no significant difference between participants who screened positive for PTSD symptoms and those who screened negative in terms of age, educational status, household income, and history of psychiatric illness before the accident. More experience in working underground and less PTSD are expected with increasing age<sup>25</sup>; however, in our study, no significant difference was observed between the groups according to age same as other studies<sup>24,29,30</sup>. The results of our study are consistent with the findings of other studies concluding that educational status is not an effective factor among those who developed PTSD<sup>24,29-31</sup>. Njenga *et al.*<sup>30</sup> showed that having current financial difficulties was associated with the emergence of PTSD symptoms; however, similar to other studies<sup>24,32</sup>, there was no relationship between income level

and PTSD in our study. Having a history of psychiatric illness has been shown to be a strong risk factor in the development of PTSD in the first three months following a trauma<sup>29,32</sup>. However, in our study, history of psychiatric illness before the accident did not show a significant difference between the groups of positive and negative PTSD screens. In their study on people who were directly exposed to terrorist bombing attacks, Verger *et al.*<sup>31</sup> found that having a history of psychiatric disorder before the explosion was not a risk factor within an average period of 2.6 years after the explosion. In the long term, the relevance of being previously diagnosed with a psychiatric disorder was not statistically significant.

Identification of another psychiatric condition concurrent with PTSD is not rare<sup>33-36</sup>. In our study, the rate of presence of comorbid psychiatric disease was found to be significantly higher in participants with a positive PTSD screen than in those with a negative PTSD screen; however, this was not found to be a risk factor for PTSD. PTSD may be a causal risk factor for other psychiatric disorders. Comorbid psychiatric disorders may develop as a complication of PTSD and its associated impairment<sup>37,38</sup>.

In our study, not being married, having a comorbid chronic illness, having a family history of psychiatric illness, and having a history of more than one traumatic experience were identified as risk factors for PTSD by logistic regression analysis. Previous studies reported that PTSD developed at higher rates among single people or people living alone than in married people<sup>30,35</sup>. Similarly, in our study, not being married was determined as a risk factor for PTSD. Lack of social support after trauma can increase the likelihood of mental disorders<sup>39,40</sup>. Consistent with the study of Husky *et al.*<sup>35</sup>, which emphasized the burden of comorbid medical conditions in PTSD, we also observed in our study that PTSD is associated with a significantly higher probability of chronic diseases. Tsujiuchi *et al.*<sup>41</sup> reported that significant predictors of probable PTSD were chronic physical diseases such as hypertension, hyperlipidemia, obesity, and coronary heart disease. Previous research in the general population found that PTSD respondents were 3 times more likely to report a family history of mental illness<sup>42</sup>, in contrast, in another study, patients with PTSD did not differ from nonpsychiatric controls on the basis of family history<sup>43</sup>. Similar to our study, a meta-analysis by Brewin *et al.*<sup>44</sup> revealed that one of the risk factors for PTSD was family history of psychiatric disease. In the present study, we demonstrated that the participants who had more than one traumatic experience were 24 times more likely to be positive for PTSD symptoms compared to those without these experiences. Similar results of traumatic experience also have been observed in victims of terrorist attacks<sup>45</sup> and mineworkers who were involved in earth-fall mine accidents<sup>46</sup>. Multiple previous events had a stronger effect than a single previous event<sup>47</sup>. These results are consistent with a sensitization hypothesis, that is, early stressors producing greater responsiveness to subsequent stressors.

There is some evidence that proximity to a terror scene may increase the risk of PTSD symptoms<sup>48,49</sup> and that the closer one is to the terror scene, the greater is the PTSD symptoms level. However, Eşsizoğlu *et al.*<sup>29</sup> found that after a terrorist attack, proximity to the explosion was significantly higher among participants with PTSD at one month after the explosion, but not significantly different at the end of the third month. In our study, due to two years passing after the trauma, it is possible that the ratio of those located, at the time of the accident, in the town where the accident occurred among participants with a positive PTSD screen could not be obtained at a significantly high level. Paired analyses conducted with the data obtained in the present study revealed that, among those who screened positive for PTSD symptoms, there was no difference associated with physical injury or death of one of the family members or relatives. In a study conducted in Turkey after an industrial explosion, loss or injury of an acquaintance was found to be a risk factor for PTSD development<sup>32</sup>. In another study conducted after a terrorist bombing attack, the ratio of injury and mortality among acquaintances/relatives was found to be significantly higher in patients with PTSD, but this was not identified as a risk factor for PTSD development at 1<sup>st</sup> and 3<sup>rd</sup> months after the trauma<sup>29</sup>.

When two groups with and without PTSD symptoms were compared, it was observed that the ratio of participants who worked for the mining company where the accident happened, who were exposed to a PTE in the mine at the time of the accident, and who survived the accident with a physical injury was significantly higher among those who screened positive for PTSD symptoms ( $p < 0.05$ ), suggesting that these parameters could have an effect on PTSD symptoms. However, none of these parameters were detected to be a risk factor for PTSD: In a study conducted after a terrorist bombing attack in Kenya, mourning the death of a relative or acquaintance due to the explosion was found to be associated with PTSD development<sup>30</sup>. In our study, one-third of the participants working for the mining company where the accident occurred had colleagues or relatives inside the mine when the accident occurred (while they themselves were not in the mine at the time of the accident), and these participants mourned the loss of these 301 people after the accident. However, working for the mining company where the accident took place was not identified as a risk factor for PTSD, possibly because the time that elapsed after the accident was enough to allow these individuals to cope up with the mourning. As our study, similar studies have reported that the proximity of survivors to exposure to PTEs predicted the occurrence of PTSD<sup>5,32</sup>. In contrast, another study reported neither exposure to noninterpersonal events, (i.e., accidents, fire, and disaster) nor community violence (i.e., witnessing community violence or being the victim of community violence) was significantly associated with PTSD, only interpersonally PTEs (i.e., experiencing physical abuse, sexual abuse, and domestic violence) were significantly associated with PTSD<sup>50</sup>. People in our sample may have been exposed to various types of mining accident on a regular basis and may therefore have become desensitized and less distressed because of this type of trauma exposure. In the studies conducted after terrorist bombing attacks, physical injury sustained in the explosion was reported to be a risk factor for PTSD development<sup>30,31</sup>. This supports other studies that linked injury and the risk for PTSD<sup>32,46</sup>. But Green *et al.*<sup>51</sup> suggest PTSD was associated with work-related dysfunction equal to that associated with severe physical handicap. Among the participants, the fact that physical injury resulting from the accident did not prevent the person from working could be a reason why physical injury was not identified as a risk factor affecting the presence of PTSD symptoms.

There were certain limitations to our study. Although PSS-SR has been demonstrated to have good sensitivity and specificity, the Clinician-Administered Posttraumatic Stress Disorder Scale (CAPS) is considered the gold standard measurement tool for PTSD diagnosis. However, owing to the lack of trained clinicians to conduct psychiatric interviews and the time constraints, CAPS was not applied in our study. Another limitation of our study was that the DSM-5 criteria were not used for PTSD diagnosis. However, we could not find a self-report scale validated for DSM-5 criteria in the literature, which could have been used for screening PTSD.

Another limitation of this study is its retrospective design. The psychological consequences of the coalmining disaster were assessed through retrospective self-reports.

Despite these limitations, to the best of our knowledge, the current study is one of the very few research efforts to examine the long-term prevalence of PTSD symptoms several years after coalmining disaster. We surveyed a large sample of victims ( $N = 672$ ), evaluated psychological outcomes 2 years after the coalmining disaster, and found a high prevalence of PTSD symptoms among mine workers. Our findings suggest that psychological care for some victims may have been inadequate in the 2-3 year period after the event and thus highlights the need for improved health services to address the intermediate and long-term physical, psychological, and social consequences of disasters. In view of the fact that a large portion of PTSD data were obtained from traumatic victims who generally had considerable heterogeneity in demographic characteristics, the present study represents high homogeneity in demographic background.

## Conclusion

PTSD is a common mental health problem that has a substantial impact on the individual and society. The present study suggests that coalmining workers have considerably high prevalence rate of PTSD symptoms after a coalmining disaster. Not being married, having a chronic disease, having a family history of psychiatric illness, and having more than one traumatic experience are the risk factors that predict the presence of PTSD symptoms. Assessing PTSD and its associated symptoms is important from the standpoint of preventive mental health services. Early detection of traumatic stress and associated symptoms will facilitate the development of protective mental health and post-disaster mental health services in primary healthcare and prevention of the diseases from becoming chronic. For these reasons, the ability to identify and evaluate PTSD is of crucial importance.

## Conflict of interests

The authors declare that they have no competing interest.

## References

1. Safety and Health at Work: A Vision for Sustainable Prevention [Internet]. XX World Congress on Safety and Health at Work 2014: Global Forum for Prevention, 24 - 27 August 2014, Frankfurt, Germany/International Labour Office, Geneva: ILO; 2014. Available from: [http://www.ilo.org/wcmsp5/groups/public/---ed\\_protect/---protrav/---safework/documents/publication/wcms\\_301214.pdf](http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_301214.pdf). Accessed on: Jan 10, 2020.
2. Bilir N. Occupational health and safety profile [Internet]. International Labor Organization. Ankara: ILO Turkey Office; 2016. 124p. Available from: [http://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-ankara/documents/publication/wcms\\_498829.pdf](http://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-ankara/documents/publication/wcms_498829.pdf). Accessed on: Jan 10, 2020.
3. TMMOB Maden Mühendisleri Odası Yönetim Kurulu. Madencilikte yaşanan iş kazaları raporu [Internet]. TMMOB Maden Mühendisleri Odası; 2010. 52p. Available from: <http://www.maden.org.tr/resimler/ekler/9bd3e8809c72d94>.
4. Asfaw A, Mark C, Pana-Cryan R. Profitability and occupational injuries in U.S. underground coal mines. *Accid Anal Prev*. 2013;50:778-86.
5. Li Z. Prevalence of post-traumatic stress disorder in the South African mining industry and outcomes of liability claims submitted to Rand Mutual Assurance Company. *Occupational Health Southern Africa*. 2013;19(2):22-6.
6. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington, DC: APA; 2013.
7. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Washington, DC: APA; 1994.
8. Nally RJ. Posttraumatic stress disorder. In: Blaney PH, Millon T, eds. *Oxford Textbook of Psychopathology*. 2nd ed. New York: Oxford University Press; 2009. p. 178-90.
9. Kahil A. Investigation of secondary traumatic stress levels of professional and volunteers in assisting individuals with traumatic experiences. Ankara: Ufuk University; 2016. [cited 2019 Feb 11]. Available from: [https://www.researchgate.net/publication/314177548\\_Travmatik\\_Yasantilari\\_Olan\\_Bireylere\\_Yardim\\_Davranisinda\\_Bulunan\\_Profesyonel\\_ve\\_Gonullulerin\\_Ikincil\\_Travmatik\\_Stres\\_Duzeylerinin\\_Incelenmesi](https://www.researchgate.net/publication/314177548_Travmatik_Yasantilari_Olan_Bireylere_Yardim_Davranisinda_Bulunan_Profesyonel_ve_Gonullulerin_Ikincil_Travmatik_Stres_Duzeylerinin_Incelenmesi). Accessed on: Jan 10, 2020.
10. Perkonig A, Kessler RC, Storz S, Wittchen HU. Traumatic events and post-traumatic stress disorder in the community: prevalence, risk factors and comorbidity. *Acta Psychiatr Scand*. 2000;101(1):46-59.
11. Galea S, Nandi A, Vlahov D. The epidemiology of post-traumatic stress disorder after disasters. *Epidemiol Rev*. 2005;27:78-91.
12. Carlisle KN, Parker AW. Psychological distress and pain reporting in Australian coal miners. *Saf Health Work*. 2014;5(4):203-9.
13. Over 200 dead, many trapped in Turkish coal mine. *USA Today News*; 2014. Available from: <https://www.usatoday.com/story/news/world/2014/05/13/turkey-coal-mine-disaster/9047103/>. Accessed on: Jan 10, 2020.

14. Tokgünaydın S, Sütcü ST. Effectiveness of Cognitive Behavioral Group Therapy for Treatment of Posttraumatic Stress Disorder: A Systematic Review. *Psikiyatride Güncel Yaklaşımlar*. 2016;8:95-107.
15. Foa EB, Cashman L, Jaycox L, Perry K. The Validation of a Self-Report Measure of Posttraumatic Stress Disorder: The Posttraumatic Diagnostic Scale. *Psychol Assessment*. 1997;9(4):445-51.
16. Işıklı S. Travma Sonrası Stres Belirtileri Olan Bireylerde Olaya İlişkin Dikkat Yanlılığı, Ayrışma Düzeyi ve Çalışma Belleği Uzamı Arasındaki İlişkiler [dissertation]. Ankara: Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü; 2006.
17. Foa EB, Riggs DS, Dancu CV, Rothbaum BO. Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *J Trauma Stress*. 1993;6(4):459-74.
18. Sin GL, Abidin E, Lee J, Poon LY, Verma S, Chong SA. Prevalence of post-traumatic stress disorder in first-episode psychosis. *Early Interv Psychiatry*. 2010;4(4):299-304.
19. Coffey SF, Gudmundsdottir B, Beck G, Palyo SA, Miller L. Screening for PTSD in motor vehicle accident survivors using the PSS-SR and IES. *J Trauma Stress*. 2006;19(1):119-28.
20. Aydın A, Barut Y, Kalafat T, Boysan M, Beşiroğlu L. Posttraumatic stress disorder symptoms scale, self-assessment, psychometric properties of Turkish form. *Anadolu Psikiyatri Dergisi*. 2012;13(2):125-30.
21. Turkey – Occupational safety and health [Internet]. International Labor Organization (ILO). Available from: [https://www.ilo.org/dyn/natlex/natlex4.detail?p\\_lang=en&p\\_isn=94667&p\\_country=TUR&p\\_count=778&p\\_classification=14&p\\_classcount=103](https://www.ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=94667&p_country=TUR&p_count=778&p_classification=14&p_classcount=103). Accessed on: Jan 10, 2020.
22. The role of mining in national economies. Report [Internet]. ICMM (International Council on Mining and Metals). Available from: [https://www.icmm.com/website/publications/pdfs/social-and-economic-development/romine\\_2nd-edition](https://www.icmm.com/website/publications/pdfs/social-and-economic-development/romine_2nd-edition). Accessed on: Jan 10, 2020.
23. Mining: a hazardous work [Internet]. International Labour Organization (ILO) home, 2015. Available from: [https://www.ilo.org/safework/areasofwork/hazardous-work/WCMS\\_356567/lang--en/index.htm](https://www.ilo.org/safework/areasofwork/hazardous-work/WCMS_356567/lang--en/index.htm). Accessed on: Jan 10, 2020.
24. Wang HH, Zhang J, Tan QR, Yin H, Chen YC, Wang HN, et al. Psychopathological, biological, and neuroimaging characterization of post-traumatic stress disorder in survivors of a severe coalmining disaster in China. *J Psychiatr Res*. 2010;44(6):385-92.
25. Hou CL, Li LJ, Zhang Y, Li WH, Li ZX, Yang JL, et al. [Prevalence and risk factors for posttraumatic stress disorder among survivors from a coal mining accident after 2 and 10 months]. *Zhong Nan Da Xue Xue Bao Yi Xue Ban*. 2008;33(4):279-83.
26. Jia X, Ying L, Zhou X, Wu X, Lin C. The effects of extraversion, social support on the posttraumatic stress disorder and posttraumatic growth of adolescent survivors of the Wenchuan earthquake. *PLoS One*. 2015;10(3):e0121480.
27. Stasiła-Sieradzka M, Turska E. The feeling of threat and stress: the mediating role of social ties in the workplace on the example of the mine rescuer occupation. *Medycyna Pracy*. 2019;70(3):295-304.
28. Hoge CW, Riviere LA, Wilk JE, Herrrell RK, Weathers FW. The prevalence of post-traumatic stress disorder (PTSD) in US combat soldiers: a head-to-head comparison of DSM-5 versus DSM-IV-TR symptom criteria with the PTSD checklist. *Lancet Psychiatry*. 2014;1(4):269-77.
29. Eşizoğlu A, Yaşan A, Bülbül İ, Önal S, Yildirim EA, Aker T. Risk factors affecting post traumatic stress disorder after a terrorist attack. *Türk Psikiyatri Dergisi*. 2009;20(2):118-26.
30. Njenga FG, Nicholls PJ, Nyamai C, Kigamwa P, Davidson JR. Post-traumatic stress after terrorist attack: psychological reactions following the US embassy bombing in Nairobi: Naturalistic study. *Br J Psychiatry*. 2004;185:328-33.
31. Verger P, Dab W, Lamping DL, Loze JY, Deschaseaux-Voinet C, Abenhaim L, et al. The Psychological impact of terrorism: an epidemiologic study of posttraumatic stress disorder and associated factors in victims of the 1995-1996 bombings in France. *Am J Psychiatry*. 2004;161(8):1384-9.
32. Taymur İ, Sargin AE, Özdel K, Türkçapar HM, Çalışgan L, Zamki E, et al. Possible risk factors for acute stress disorder and post-traumatic stress disorder after an industrial explosion. *Noro Psikiyatr Ars*. 2014;51(1):23-29.
33. Woudenberg VC, Voorendonk EM, Bongaerts H, Zoet HA, Verhagen M, Lee CW, et al. Effectiveness of an intensive treatment programme combining prolonged exposure and eye movement desensitization and reprocessing for severe post-traumatic stress disorder. *Eur J Psychotraumatol*. 2018;9(1):1487225.
34. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the national comorbidity survey. *Arch Gen Psychiatry*. 1995;52(12):1048-60.
35. Husky MM, Mazure CM, Kovess MV. Gender differences in psychiatric and medical comorbidity with post-traumatic stress disorder. *Compr Psychiatry*. 2018;84:75-81.
36. Brady KT. Posttraumatic stress disorder and comorbidity: recognizing the many faces of PTSD. *J Clin Psychiatry*. 1997;58(9):12-5.
37. Keane TM, Kaloupek DG, Ann NY. Comorbid psychiatric disorders in PTSD. Implications For Research. *Ann N Y Acad Sci*. 1997;821:24-34.
38. Breslau N. Epidemiologic studies of trauma, posttraumatic stress disorder, and other psychiatric disorders. *Can J Psychiatry*. 2002;47(10):923-9.
39. Solomon Z, Mikulincer M, Hobfoll SE. Objective versus subjective measurement of stress and social support: combat related reactions. *J Consult Clin Psychol*. 1985;55(4):577-83.
40. Özaltın M, Kaptanoğlu C, Aksaray G. Acute stress disorder and post-traumatic stress disorder after motor vehicle accidents. *Türk Psikiyatri Dergisi*. 2004;15:16-25.
41. Tsujuchi T, Yamaguchi M, Masuda K, Tsuchida M, Inomata T, Kumano H, et al. High prevalence of post-traumatic stress symptoms in relation to social factors in affected population one year after the Fukushima Nuclear Disaster. *PLoS One*. 2016;11(3):e0151807.
42. Davidson JR, Hughes D, Blazer DG, George LK. Post-traumatic stress disorder in the community: an epidemiological study. *Psychol. Med*. 1991;21(3):713-21.
43. Davidson J, Smith R, Kudler H. Familial psychiatric illness in chronic posttraumatic stress disorder. *Compr Psychiatry*. 1989;30(4):339-45.
44. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Consult Clin Psychol*. 2000;68(5):748-66.
45. Galea S, Ahern J, Resnick H, Kilpatrick D, Bucuvalas M, Gold J, et al. Psychological sequelae of the September 11 terrorist attacks in New York City. *N Engl J Med*. 2002;346(13):982-7.
46. Stevens JL, Calitz FJW, Joubert G, Gagiano CA, Nel M. Trauma-related risk factors in mine workers with PTSD: a prospective follow-up study. *South Afr J Psychol*. 2006;36(2):425-45.
47. Breslau N, Chilcoat HD, Kessler RC, Davis GC. Previous exposure to trauma and PTSD effects of subsequent trauma: results from the Detroit Area Survey of Trauma. *Am J Psychiatry*. 1999;156(6):902-7.
48. Grieger TA, Waldrep DA, Lovasz MM, Ursano RJ. Follow-up of pentagon employees two years after the terrorist attack of September 11, 2001. *Psychiatr Serv*. 2005;56:1378-4.
49. Mahat-Shamir M, Ring L, Hamama-Raz Y, Ben-Ezra M, Pithco-Prelourentzos S, David UY, et al. Do previous experience and geographic proximity matter? Possible predictors for diagnosing Adjustment disorder vs. PTSD. *Psychiatry Res*. 2017;258:438-43.
50. Luthra R, Abramovitz R, Greenberg R, Schoor A, Newcorn J, Schmeidler J, et al. Relationship between type of trauma exposure and posttraumatic stress disorder among urban children and adolescents. *J Interpers Violence*. 2009;24(11):1919-27.
51. Green MM, McFarlane AC, Hunter CE, Griggs WM. Undiagnosed post-traumatic stress disorder following motor vehicle accidents. *Med J Aust*. 1993;159(8):529-34.