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## Occupational burnout, fatigue and stress in professional rescuers in Kazakhstan

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Occupational burnout, fatigue and stress in professional rescuers in Kazakhstan

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Abstract

Objectives. To characterize fatigue, burnout and perceived stress in a cohort of rescuers and to find predictors of higher burnout in this specific population.

Design: cross-sectional study.

Setting: Republican Rescue Squad (RRS) (N=105) and Republican Mudslide Rescue Service under the Ministry of Emergency Situations (N=480) in Almaty, Kazakhstan.

Participants: In total we included 268 (80% men, median age 38 (interquartile range (IQR) 22) years) rescuers from both organisations.

Primary and secondary outcome measures: We offered a questionnaire to rescuers, which included Maslach Burnout Inventory, quantifying emotional exhaustion (EX), cynicism (CY) and professional efficacy (PE) along with fatigue, stress and health-related quality of life (HRQL) tools.

Results: Lower scores of HRQL (Physical Component Score (PCS) beta -0.04 (95% confidence interval (CI) -0.06;-0.02); Mental Component Score beta -0.03 (95% CI -0.05;-0.01)), higher fatigue (Fatigue Severity Scale score beta 0.03 (95% CI 0.03;0.04)) and stress (Perceived Stress Score-10 beta 0.04 (95% CI 0.02;0.06)) independently predicted greater EX. Lower PCS (beta -0.03 (95% CI -0.06;-0.01)) and FSS (beta 0.02 (95% CI 0.01;0.03)) could predict more CY burnout. In addition to stress, higher education (beta 0.86 (95% CI 0.40;1.32)) was positively associated with lower burnout severity in PE domain.

Conclusions. Fatigue, stress and the overall burnout were very low in rescuers. Addressing fatigue could guide further interventions to reduce occupational burnout.

Key words: stress; fatigue; adjusted modelling; occupational.
Strengths and limitations of this study

- The study of both fatigue, perceived stress and burnout together along with HRQL, almost never reported before in these groups in one questionnaire is a strength of this study.

- The most pronounced limitation of this analysis is the cross-sectional design, which does not allow to conclude on the direction of associations we have found.

- Another limitation is inability to reach regular rescuers working within the Provincial affiliations of the Ministry of Emergency Situations for comparison.

- Finally, we did not include the tools to verify work-family conflict and other potential sources of stress as confounders of occupational burnout.
Introduction

Occupational stress in first responders may be high due to frequent exposure to fatal accidents and emotional suffering of victims and their relatives [1]. In addition, permanent preparedness for immediate response may be associated with accelerated occupational burnout. Studies with quantitative description of burnout in these occupational groups are, however, sporadic and are usually limited to small samples [2] and linked to specific disasters, such as earthquakes [3], terrorist attacks or mass shootings. Selected reports usually demonstrate low levels of burnout in both heterogenous groups of responders, such as in a recent systematic review [4] or in the study of the earthquake responders [3], or in more homogenous groups, such as firefighters [5].

The systematic review concluded that such low prevalence of secondary traumatization may be explained by social desirability and job-loss concerns [4], thus, the overall prevalence of such traumatization may be underestimated. Burnout prevention is usually focused on the identification of risk and protective predictors, which include, but not limited to, sex, age, work duration, work-family conflict, and even health-related quality of life (HRQL), but the results across studies are inconsistent. In Kazakhstan firefighters, who are not in charge of medical evacuation and only deal with fire, age and work duration were not found to have an association with burnout, with the overall low level of all three domains [5]. However, other important risk factors should be considered and addressed in secondary burnout prevention, such as education, uniform discomfort and even intrinsic factors, such as blood testosterone [6].

Rescuers involved in the mitigation of natural and technogenic disasters, including those in the mountainous terrains, have been poorly described in the world literature with regard to burnout predictors. Because physical strain in mountainous rescue is enormous, fatigue and HRQL may be important in predicting burnout, but very little is known about such association from the very few published reports. Therefore, we aimed to characterize fatigue, burnout and
perceived stress in a cohort of rescuers and to find predictors of higher burnout in this specific population.

Materials and methods

All study participants signed written informed consent to participate. Two rescue organizations were included in this cross-sectional study of fatigue, stress and occupational burnout, stationed in Almaty, Kazakhstan, but performing their duty all over the country. The first group comprised qualified and trained rescuers from the Republican Rescue Squad (RRS), a military organization, existing within the Ministry of Emergency Situations of the Republic of Kazakhstan. The overall enlisted staff of the squad is 105 people. These rescuers are trained and usually called for complex emergency situations, such as natural disasters, including earthquakes, floods, large-scale technogenic catastrophes, which cannot be resolved by a local rescue team, affiliated with the Provincial Department of Emergency Situations. Of note, ambulance, fire service and police are separate divisions under different ministries, whereas local emergencies requiring rescue service are usually covered by the local Department of Emergency Situations rescue groups. We could only enroll 90 (86%) subjects from RRS, because the remaining 15 were either on a sick or maternity leave or on a permanent business trip outside Almaty Province.

The second group in this analysis were trained rescuers from the Republican Mudslide Rescue Service under the Ministry of Emergency Situations. This organization employs 480 staff in six provinces of the country and offers a wide range of service aiming to control and prevent the consequences of mudslide. The terms of references include, but not limited to, design and construction of mudslide control engineering means; exploration, research and monitoring of mudslide control structures; immediate response to mudslide events; setting up communication means for the population and response teams and other. Mudslide rescuers are usually stationed in the mountainous terrains away from the cities and other residence areas.
We offered a self-administered structured questionnaire in either Russian or Kazakh depending on a personal preference to all study participants. The overall number of questions was 68, whereas the questionnaire comprised demographic section, occupational and lifestyle history, general health-related quality of life (HRQL) tool, followed by nine questions of fatigue, sixteen questions on burnout, a question on subjective discomfort from the uniform and one more question on difficulty in communication because of language. In addition, we also offered 10 questions to assess occupational stress. In the demographic part, we collected information on sex, date of birth, marital status and the highest attained education. In an occupational and lifestyle history section, we ascertained the overall and in current position years in service, shift length in hours, number of shifts a month, the current and the last four positions held, followed by cigarette smoking history, stratifying subjects to never-, former and current daily smokers; the total hours of recreational physical activity per week, and the frequency of alcohol consumption (never, small amounts seldom; large amounts seldom and the use at least once a week).

HRQL was quantified using an 8-item general HRQL SF-8 tool, which produced the scores of physical and social functioning, role physical and role emotional, mental health, vitality, bodily pain and general health. In the current analysis, we used two component scores, Physical Component Score (PCS) and Mental Component Score (MCS) as the summary estimates of two HRQL components. Fatigue was measured using nine questions of Fatigue Severity Scale, with the summary score ranging from 0 to 63, and the score above 36 was indicative of high fatigue level. Burnout was measured with a 16-item Maslach Burnout Inventory (MBI) General (MBI-GS) tool, producing the mean scores of three dimensions, including emotional exhaustion (EX), cynicism (CY) and professional efficacy (PE). Higher EX and CY scores assumed greater burnout with the reverse dependence of PE. Stress was measured with a 10-item PSS-10 questionnaire, in which each of 10 included questions ranged from 1 to 5, with inverted scores of four questions of “stress counteraction” domain. Finally, the overall scores ranged from 10 to 50.
When tested for normality, most variables were non-normally distributed, therefore, we used and reported non-parametric tests in this presentation. Means are presented as medians with the corresponding interquartile ranges (IQR), unless otherwise stated. The medians of two groups were compared using Mann-Whitney U-test. Binary variables’ frequencies were compared between two or more groups using χ² test from contingency tables. We analyzed selected variables both as continuous and binary, such as fatigue scores. FSS, PSS-10 and all three scores of burnout were tested as dependent variables in simple regression models first, which included selected predictors depending on the model. Those found significantly associated with the outcome were then included in adjusted models, in which we first assessed collinearity with correlation matrix and inflation factor. Such crude and adjusted models yielded beta coefficients with their 95% confidence intervals (CI). In addition to beta coefficients, we also report R² for each model of burnout domain prediction, indicative of the fraction of the overall variability explained by the pool of included predictors. All tests were considered significant when p was below 0.05, where NCSS 2020 (Utah, USA) was the statistical package to run all tests.

**Results**

One-third of the sample were rescuers from RRS. Age ranged from 21 to 73 years, and the median age of included subjects was 38 (IQR 22) years, whereas the majority were men (Table 1). Study participants worked in rescue system for 5 years on average (from 0.2 to 41 years), 40% worked 24-hour shifts, and the majority (78%) were married. Almost half of the sample had a university degree, and never smoked cigarettes. Fifty-four percent exercised off work regularly, with the median of 4 times a week. Two study groups comprising the current sample, were different with regard to age, shifts worked, cigarette smoking and exercising profile. Group 1 were significantly younger and the majority worked 24-hour shifts. Furthermore, there were significantly more former cigarette smokers and daily off-work exercisers in rescuers compared to mudslide prevention personnel.
Table 1. Demographic and lifestyle profile of the sample

|                          | Overall | RRS Rescuers | Mudslide rescuers | p     |
|--------------------------|---------|--------------|------------------|-------|
| N (%)                    | 268 (100)| 90 (34)      | 178 (66)         | -     |
| Age, years               | 38 (22) | 33 (10.3)    | 45 (21)          | <0.001|
| Men, N (%)               | 214 (80)| 78 (87)      | 136 (76)         | 0.048 |
| Shifts, N (%)            |         |              |                  |       |
| 8-hour                   | 140 (52)| 16 (18)      | 124 (70)         | <0.001|
| 12-hour                  | 20 (8)  | 0 (0)        | 20 (11)          |       |
| 24-hour                  | 108 (40)| 74 (82)      | 34 (19)          |       |
| Years of work in the rescue | 5 (9.8) | 5 (8)        | 5 (10)           | 0.82  |
| Marital status           |         |              |                  |       |
| Single                   | 39 (15) | 7 (8)        | 32 (18)          | 0.07  |
| Married                  | 208 (78)| 76 (84)      | 132 (74)         |       |
| Divorced                 | 21 (7)  | 7 (8)        | 14 (8)           |       |
| Education                |         |              |                  |       |
| Secondary school         | 7 (3)   | 2 (2)        | 5 (3)            | 0.34  |
| High school              | 68 (25) | 17 (19)      | 51 (29)          |       |
| College                  | 65 (24) | 25 (28)      | 40 (22)          |       |
| University               | 128 (48)| 46 (51)      | 82 (46)          |       |
| Cigarette smoking        |         |              |                  |       |
| Never                    | 127 (48)| 29 (32)      | 98 (55)          | <0.001|
| Former                   | 52 (19) | 34 (38)      | 19 (11)          |       |
| Current daily            | 89 (33) | 27 (30)      | 61 (34)          |       |
| Exercising regularly, N (%) | 145 (54)| 58 (64)      | 87 (49)          | 0.02  |
| Hours per week exercised | 4 (4) | 5 (3.4) | 3 (4.8) | <0.001 |
|--------------------------|-------|---------|---------|--------|
| Never-alcohol users, N (%) | 157 (59) | 48 (53) | 109 (61) | 0.21 |

Note: RRS - Republican Rescue Squad; data are presented either as medians (IQR), assuming non-normal distribution for continuous variables or as N (%) for binary variables. P-values were calculated using Mann-Whitney U-test or, alternatively, \( \chi^2 \) test from contingency tables.

There were 12 (13.3%) subjects with fatigue (FSS more than 36) among RRS rescuers and 13 (7.3%) among mudslide rescuers, with non-significant difference between these groups. Despite being significantly younger, rescuers in group 1 showed higher scores of fatigue (Table 2). Working 24-hours shifts, age, sex, years in rescue, being married, higher education, current cigarette smoking were not associated with FSS, in contrast with regular exercise, which was negatively associated with FSS. In addition, both physical (beta -0.41 (95% CI -0.69;-0.12)) and mental (beta -0.50 (95% CI 0.74;-0.27)) component scores of HRQL showed negative and PSS-10 positive (beta 0.48 (95% CI 0.18;0.82)) association with FSS, independent of each other in an adjusted model. These three predictors explained 22% of the overall FSS variability. Obviously, greater FSS score in younger rescuers from group 1 may be explained by specific job tasks.

Table 2. Median and interquartile scores of fatigue, burnout and stress in two studied groups

|                      | RRS Rescuers | Mudslide rescuers | p   |
|----------------------|--------------|-------------------|-----|
| FSS (0-63)           | 16 (21)      | 12 (19)           | 0.02|
| Burnout              |              |                   |     |
| EX (0-6)             | 0.6 (1.7)    | 0.8 (1.2)         | 0.18|
| CY (0-6)             | 1.5 (2.1)    | 1.6 (1.4)         | 0.15|
| PE (0-5)             | 4.9 (2.4)    | 4.7 (3)           | 0.24|
| PSS-10 (10-50)       | 22.5±6.2     | 23 (7)            | 0.90|
Note: all p-values from Mann-Whitney U-test; RRS - Republican Rescue Squad; EX – Emotional Exhaustion; CY – Cynicism; PE – Professional Efficacy; FSS – Fatigue Severity Scale; PSS – Perceived Stress Scale

In both RRS rescuers and mudslide rescuers, as well as in the whole cohort, all three studied burnout domain levels were low and very low. The overall EX score was 0.8 (IQR 0.2; 1.6), CY 1.6 (IQR 0.8; 2.4), PE 4.7 (IQR 3; 5.8), with no differences between RRS rescuers and mudslide rescuers. We found moderate correlation between EX and FSS (r=0.61) and CY (r=0.54). No differences were found between groups with regard to stress level. The overall PSS-10 score was 23 (IQR 8), which corresponded to its low level. In the univariate analyses, age, sex, working 24-hour shifts, marital status, cigarette smoking, were not associated with higher PSS-10. However, FSS, exercising regularly, higher education and HRQL could predict stress score. When adjusted for each other, both HRQL components (PCS beta -0.27, p<0.001; MCS beta -0.25, p<0.001), fatigue (FSS beta 0.07, p<0.01) and higher education (beta 1.44, p<0.05) still remained significantly associated with PSS-10 score.

In testing candidate variables to predict burnout domains in simple univariate regression models, neither age, nor sex, working 24-hour shifts, years in rescue, marital status or cigarette smoking were associated with any burnout domain. In a multivariate regression model of predicting EX, regular exercise, PCS, MCS, FSS and PSS-10 were included, and this model yielded the higher power among three domains, in which these five variables explained 52% EX variability. As Table 3 shows, lower scores of both domains of HRQL, higher fatigue and stress scores independently predicted greater EX. The model of predicting CY only included 4 variables, of which two (MCS and PSS-10) did not show an association in an adjusted model, and R² for the model was 0.13. With regard to CY, only lower PCS and FSS, independent of each other, could predict more burnout. Finally, adjusted model for PE had even smaller R² (0.10) with four variables included, of which both domains of HRQL did not yield an association.
with PE. In addition to FSS-10, higher education was positively associated with higher PE burnout score (beta 0.86 (95% CI 0.40;1.32)), thus, lower burnout severity.

Table 3. Beta coefficients with the corresponding 95% confidence intervals of selected predictors of emotional exhaustion, cynicism and professional efficacy in fully adjusted regression models

| Predictor | EX        | CY        | PE          |
|-----------|-----------|-----------|-------------|
| PCS       | -0.04 (-0.06; -0.02) | -0.03 (-0.06; -0.01) | NS          |
| MCS       | -0.03 (-0.05; -0.01) | NS         | NS          |
| FSS       | 0.03 (0.03;0.04) | 0.02 (0.01;0.03) | -           |
| PSS-10    | 0.04 (0.02;0.06) | NS         | -0.06 (-0.10; -0.02) |

Note: NS – non-significant; EX – Emotional Exhaustion; CY – Cynicism; PE – Professional Efficacy; PCS – Physical Component Score; MCS – Mental Component Score; FSS – Fatigue Severity Scale; PSS – Perceived Stress Scale

Discussion

In this first presentation of the occupational burnout, stress and fatigue in rescuers, including mudslide rescuers, from Kazakhstan, we found that the overall prevalence of high burnout scores in any three studied dimensions, including EX, CY and PE, was low. Using multivariate modelling, we showed that higher EX burnout in this group was associated with lower HRQL, greater fatigue and stress, whereas CY burnout could be predicted by more fatigue and poorer physical component of HRQL. Finally, PE burnout was associated with stress and education. We consider these findings important to plan early prevention of burnout in rescuers; thus, potentially affecting survival rates in natural disaster victims through high professional efficacy.
Occupational burnout is widely reported in different occupational groups, mostly medical professionals, such as nurses, but studies in rescuers do not often take occupational burnout into account. In Kazakhstan, medical ambulance, fire departments and rescuers do not function together and are usually attributed to separate organizations. We earlier reported that occupational burnout in firefighters was generally low and its predictors in multivariate models were HRQL, uniform discomfort, language barrier, sex and education, depending on a specific domain [5]. The terms of reference of firefighters and rescuers in Kazakhstan are different, and we therefore aimed to now detect burnout predictors in the latter. We found common burnout predictors with firefighters, such as HRQL and education (with regard to PE), indicative of potentially similar mechanisms of burnout development and progression in these groups.

Burnout in rescuers most likely develops as a result of secondary traumatization, that is a stress that develops in those who contacted and assisted others experiencing direct stress. As opposed to burnout, such secondary traumatization has been widely reported in responders, including police officers, firefighters and paramedics. In group comparisons, the findings of studies have not been consistent. Thus, more compassion fatigue in firefighters in one report [7] contradicted less traumatization in firefighters compared to rescue personnel in another [8]. In addition, risk factors for occupational burnout in rescuers have been very poorly described, and included the experience of feeling threatened, the experience of being jailed or insulted and the number of years of service in one study in paramedics [9]; self-efficacy, collective efficacy and sense of community in another study in first responders [10]; and a 4-year follow-up study of medical rescue workers during the Great East Japan Earthquake showed that stress before deployment was a significant predictor of burnout [11]. None of these and other published studies examined HRQL, and the association of HRQL with burnout we ascertained is a novel finding in the field.

The overall low prevalence of high burnout in rescuers in Kazakhstan may result from a well-set system of psychological aid and consultations with regularly trained psychologists in the
staff. These psychologists operate 8-hour daily shifts and are in charge of daily monitoring of the
so-called psychological climate. They disseminate and analyze the questionnaires to the duty
personnel on a monthly basis and get regular training on the ways to consult rescuers how to
mitigate occupational stress. The efficacy of these interventions is also assessed regularly, but we
have found no reports disclosing the effect of such interventions in the published literature.

We believe that the study of both fatigue, perceived stress and burnout together along
with HRQL, almost never reported before in these groups in one questionnaire is a strength of
this study. The most pronounced limitation of this analysis is the cross-sectional design, which
does not allow to conclude on the direction of associations we have found. Another limitation is
inability to reach regular rescuers working within the Provincial affiliations of the Ministry of
Emergency Situations for comparison. Furthermore, we did not include the tools to verify work-
family conflict and other potential sources of stress as confounders of occupational burnout.

Conclusions

To conclude, this is the first presentation of the occupational burnout, fatigue and stress
in a large sample of professional rescuers of Kazakhstan, which showed that fatigue was an
independent predictor of generally low burnout in this group. Because HRQL was also an
important predictor of EX and even CY, primary burnout prevention should consider general
health status and HRQL and aim to support better physical health though efficient health
interventions and exercise and health surveillance as mandated by the local regulations. Burnout
prevention in rescuers should focus on fatigue reduction through better worktime and shift
planning.

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Competing interests

Authors declare no competing interests.

Author contributions

DV and GK designed the study, analysed study results and drafted the manuscript; ZR, IK, SK and ZT collected data and approved the final version; AU, KB and DO analysed data and approved the final version.

Ethics Approval

This study was approved by the Committee on Bioethics of the al-Farabi Kazakh National University (approval #35/2021).

Data statement

All datasets generated in this study are included in the manuscript.

Patient and Public Involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

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Statistical methods #12c Explain how missing data were addressed

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Statistical methods #12e Describe any sensitivity analyses

Results

Participants #13a Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for exposed and unexposed groups if applicable.

Participants #13b Give reasons for non-participation at each stage

Participants #13c Consider use of a flow diagram

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Descriptive data #14a Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.

Descriptive data #14b Indicate number of participants with missing data for each variable of interest

Outcome data #15 Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.

Main results #16a Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

Main results #16b Report category boundaries when continuous variables were categorized

Main results #16c If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

Other analyses #17 Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results #18 Summarise key results with reference to study objectives

Limitations #19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.

Interpretation #20 Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.

Generalisability #21 Discuss the generalisability (external validity) of the study results

Other Information

Funding #22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

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### Occupational burnout, fatigue and stress in professional rescuers: a cross-sectional study in Kazakhstan

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Occupational burnout, fatigue and stress in professional rescuers: a cross-sectional study in Kazakhstan

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Abstract

Objectives. To characterize fatigue, burnout and perceived stress in a cohort of rescuers and to find predictors of higher burnout in this specific population.

Design: cross-sectional study.

Setting: Republican Rescue Squad (RRS) (N=105) and Republican Mudslide Rescue Service under the Ministry of Emergency Situations (N=480) in Almaty, Kazakhstan.

Participants: In total we included 268 (80% men, median age 38 (interquartile range (IQR) 22) years) rescuers from both organisations.

Primary and secondary outcome measures: We offered a questionnaire to rescuers, which included Maslach Burnout Inventory, quantifying emotional exhaustion (EX), cynicism (CY) and professional efficacy (PE) along with fatigue, stress and health-related quality of life (HRQL) tools.

Results: Lower scores of HRQL (Physical Component Score (PCS) beta -0.04 (95% confidence interval (CI) -0.06;-0.02); Mental Component Score beta -0.03 (95% CI -0.05;-0.01)), higher fatigue (Fatigue Severity Scale (FSS) score beta 0.03 (95% CI 0.03;0.04)) and stress (Perceived Stress Score-10 beta 0.04 (95% CI 0.02;0.06)) independently predicted greater EX. Lower PCS (beta -0.03 (95% CI -0.06;-0.01)) and FSS (beta 0.02 (95% CI 0.01;0.03)) could predict more CY burnout. In addition to stress, higher education (beta 0.86 (95% CI 0.40;1.32)) was positively associated with lower burnout severity in PE domain.

Conclusions. Fatigue, stress and health-related quality of life were associated with burnout in rescuers. Addressing these predictors may help guide further interventions to reduce occupational burnout.

Key words: stress; fatigue; adjusted modelling; occupational.
Strengths and limitations of this study

- The study of both fatigue, perceived stress and burnout together along with HRQL, almost never reported before in these groups in one questionnaire is a strength of this study.

- The most pronounced limitation of this analysis is the cross-sectional design, which does not allow to conclude on the direction of associations we have found.

- Another limitation is inability to reach regular rescuers working within the Provincial affiliations of the Ministry of Emergency Situations for comparison.

- Finally, we did not include the tools to verify work-family conflict and other potential sources of stress as confounders of occupational burnout.
Introduction

Occupational stress in first responders may be high due to frequent exposure to fatal accidents and emotional suffering of victims and their relatives [1]. In addition, permanent preparedness for immediate response may be associated with accelerated occupational burnout. However, studies with quantitative description of burnout in these occupational groups are, usually limited to small samples [2] and linked to specific disasters, such as earthquakes [3], terrorist attacks or mass shootings. Selected reports usually demonstrate low levels of burnout in both heterogenous groups of responders [4–6], such as in a recent systematic review [7] or in the study of the earthquake responders [3], or in more homogenous groups, such as firefighters [8].

The systematic review concluded that such low prevalence of secondary traumatization may be explained by social desirability and job-loss concerns [7], thus, the overall prevalence of such traumatization may be underestimated. Burnout prevention is usually focused on the identification of risk and protective predictors, which include, but not limited to, sex, age, work duration, work-family conflict, and even health-related quality of life (HRQL). However, the outcomes in such studies were inconsistent. In Kazakhstan firefighters, who are not in charge of medical evacuation and only deal with fire, age and work duration were not found to have an association with burnout, whereas the overall scores of all three domains were low [8]. However, other important risk factors should be considered and addressed in secondary burnout prevention, such as education, uniform discomfort and even intrinsic factors, such as blood testosterone [9].

The overall levels of fatigue and occupational stress in this specific occupation remain poorly characterized. Furthermore, burnout domains have not been properly characterized in this occupational group before, whereas rescuers involved in the mitigation of natural and technogenic disasters, including those in the mountainous terrains, have been poorly described in the world literature with regard to burnout predictors. Because physical strain in mountainous rescue is enormous [10,11], fatigue and HRQL may be important burnout predictors, but very little is known about such association. More evidence is needed to understand how stress, HRQL
and fatigue in the workplace can affect specific burnout domains. Therefore, we aimed to characterize fatigue, burnout and perceived stress in a cohort of rescuers and to find predictors of higher burnout in this specific population.

Materials and methods

Two rescue organizations were included in this cross-sectional study of fatigue, stress and occupational burnout, stationed in Almaty, Kazakhstan, but performing their duty all over the country. The first group comprised qualified and trained rescuers from the Republican Rescue Squad (RRS), a military organization, which exists within the Ministry of Emergency Situations of the Republic of Kazakhstan. The overall enlisted staff of the squad is 105 people. These rescuers are trained and usually called for complex emergency situations, such as natural disasters, including earthquakes, floods, large-scale technogenic catastrophes, which cannot be resolved by a local rescue team, affiliated with the Provincial Department of Emergency Situations. Of note, ambulance, fire service and police are separate divisions under different ministries, whereas local emergencies requiring rescue service are usually covered by the local Department of Emergency Situations rescue groups. We could only enroll 90 (86%) subjects from RRS, because the remaining 15 were either on a sick or maternity leave or on a permanent business trip outside Almaty Province.

The second group in this analysis were trained rescuers from the Republican Mudslide Rescue Service under the Ministry of Emergency Situations. This organization employs 480 people in six provinces of the country and offers a wide range of service aiming to control and prevent the mudslide consequences. The terms of references include, but not limited to, design and construction of mudslide control engineering means; exploration, research and monitoring of mudslide control structures; immediate response to mudslide events; setting up communication means for the population and response teams and other. Mudslide rescuers are usually stationed in the mountainous terrains away from the cities and other residence areas.
We offered a self-administered structured questionnaire in either Russian of Kazakh depending on a personal preference to all study participants. The overall number of questions was 68, whereas the questionnaire comprised demographic section, occupational and lifestyle history, general HRQL tool, followed by nine questions on fatigue, sixteen questions on burnout, a question on subjective discomfort from the uniform and one more question on difficulty in communication because of language. In addition, we offered 10 questions to assess occupational stress. In the demographic part, we collected information on sex, date of birth, marital status and the highest attained education. In an occupational and lifestyle history section, we ascertained the overall years in service and years in current position, shift length in hours, number of shifts per month, the current and the last four positions held. This was followed by cigarette smoking history, stratifying subjects to never-, former and current daily smokers; the total hours of recreational physical activity per week, and the frequency of alcohol consumption (never, small amounts seldom; large amounts seldom and the use at least once a week).

HRQL was quantified using an 8-item general SF-8 tool, which produced the scores of physical and social functioning, role physical and role emotional, mental health, vitality, bodily pain and general health. In the current analysis, we used two component scores, Physical Component Score (PCS) and Mental Component Score (MCS) as the summary estimates of two HRQL components. Fatigue was measured using nine questions of Fatigue Severity Scale (FSS), with the summary score ranging from 0 to 63, whereas the score above 36 was indicative of high fatigue level. Burnout was measured with a 16-item Maslach Burnout Inventory (MBI) General (MBI-GS) tool, producing the mean scores of three dimensions, including emotional exhaustion (EX), cynicism (CY) and professional efficacy (PE). Higher EX and CY scores assumed greater burnout with the reverse dependence for PE. Stress was measured with a 10-item PSS-10 questionnaire, in which each of 10 included questions ranged from 1 to 5, with inverted scores of four questions of “stress counteraction” domain. Finally, the overall score ranged from 10 to 50.
When tested for normality, most variables were non-normally distributed; therefore, we used and reported non-parametric tests in this presentation. Means are presented as medians with the corresponding interquartile ranges (IQR), unless otherwise stated. The medians of two groups were compared using Mann-Whitney U-test. Binary variables’ frequencies were compared between two or more groups using $\chi^2$ test from contingency tables. We analyzed selected variables both as continuous and binary, such as fatigue scores. FSS, PSS-10 and all three scores of burnout were tested as dependent variables in simple regression models first, which included selected predictors depending on the model. Those found significantly associated with the outcome were then included in adjusted models, in which we first assessed collinearity by means of correlation matrix and inflation factor. Such crude and adjusted models yielded beta coefficients with their 95% confidence intervals (CI). In addition to beta coefficients, we also report $R^2$ for each model of burnout domain prediction, reflecting the fraction of the overall variability explained by the pool of included predictors. All tests were considered significant when $p$ was below 0.05, where NCSS 2020 (Utah, USA) was the statistical package to run all tests.

**Results**

One-third of the sample were rescuers from RRS. Age ranged from 21 to 73 years, and the median age of included subjects was 38 (IQR 22) years, whereas the majority were men (Table 1). Study participants worked in rescue system for 5 years on average (from 0.2 to 41 years), 40% worked 24-hour shifts, and the majority (78%) were married. Almost half of the sample had a university degree and never smoked cigarettes. Fifty-four percent exercised off work regularly, with the median of four times a week. Two study groups were different with regard to age, shifts worked, cigarette smoking and exercising profile. Group 1 was significantly younger and the majority worked 24-hour shifts. Furthermore, there were significantly more former cigarette smokers and daily off-work exercisers in rescuers compared to mudslide prevention personnel.
Table 1. Demographic and lifestyle profile of the sample

|                        | Overall  | RRS Rescuers | Mudslide rescuers | p       |
|------------------------|----------|--------------|-------------------|---------|
| N (%)                  | 268 (100)| 90 (34)      | 178 (66)          | -       |
| Age, years             | 38 (22)  | 33 (10.3)    | 45 (21)           | <0.001  |
| Men, N (%)             | 214 (80) | 78 (87)      | 136 (76)          | 0.048   |
| Shifts, N (%)          |          |              |                   |         |
| 8-hour                 | 140 (52) | 16 (18)      | 124 (70)          | <0.001  |
| 12-hour                | 20 (8)   | 0 (0)        | 20 (11)           |         |
| 24-hour                | 108 (40) | 74 (82)      | 34 (19)           |         |
| Years of work in the rescue | 5 (9.8)  | 5 (8)        | 5 (10)            | 0.82    |
| Marital status         |          |              |                   |         |
| Single                 | 39 (15)  | 7 (8)        | 32 (18)           | 0.07    |
| Married                | 208 (78) | 76 (84)      | 132 (74)          |         |
| Divorced               | 21 (7)   | 7 (8)        | 14 (8)            |         |
| Education              |          |              |                   |         |
| Secondary school       | 7 (3)    | 2 (2)        | 5 (3)             | 0.34    |
| High school            | 68 (25)  | 17 (19)      | 51 (29)           |         |
| College                | 65 (24)  | 25 (28)      | 40 (22)           |         |
| University             | 128 (48) | 46 (51)      | 82 (46)           |         |
| Cigarette smoking      |          |              |                   |         |
| Never                  | 127 (48) | 29 (32)      | 98 (55)           | <0.001  |
| Former                 | 52 (19)  | 34 (38)      | 19 (11)           |         |
| Current daily          | 89 (33)  | 27 (30)      | 61 (34)           |         |
| Exercising regularly, N (%) | 145 (54) | 58 (64)      | 87 (49)           | 0.02    |
| Hours per week exercised | 4 (4) | 5 (3.4) | 3 (4.8) | <0.001 |
|--------------------------|-------|--------|--------|--------|
| Never-alcohol users, N (%) | 157 (59) | 48 (53) | 109 (61) | 0.21 |

Note: RRS - Republican Rescue Squad; data are presented either as medians (IQR), assuming non-normal distribution for continuous variables or as N (%) for binary variables. P-values were calculated using Mann-Whitney U-test or, alternatively, $\chi^2$ test from contingency tables.

There were 12 (13.3%) subjects with fatigue (FSS more than 36) among RRS rescuers and 13 (7.3%) among mudslide rescuers, with non-significant difference between these groups. Despite being significantly younger, rescuers in group 1 showed higher scores of fatigue (Table 2). Working 24-hours shifts, age, sex, years in rescue, being married, higher education, current cigarette smoking were not associated with FSS, in contrast with regular exercise, which was negatively associated with FSS. In addition, both physical (beta -0.41 (95% CI -0.69,-0.12)) and mental (beta -0.50 (95% CI -0.74,-0.27)) component scores of HRQL showed negative and PSS-10 positive (beta 0.48 (95% CI 0.18;0.82)) association with FSS, independent of each other in an adjusted model. These three predictors explained 22% of the overall FSS variability. Obviously, greater FSS score in younger rescuers from group 1 may be explained by specific job tasks.

Table 2. Median and interquartile scores of fatigue, burnout and stress in two studied groups

|                      | RRS Rescuers | Mudslide rescuers | p   |
|----------------------|--------------|-------------------|-----|
| FSS (0-63)           | 16 (21)      | 12 (19)           | 0.02|
| Burnout              |              |                   |     |
| EX (0-6)             | 0.6 (1.7)    | 0.8 (1.2)         | 0.18|
| CY (0-6)             | 1.5 (2.1)    | 1.6 (1.4)         | 0.15|
| PE (0-5)             | 4.9 (2.4)    | 4.7 (3)           | 0.24|
| PSS-10 (10-50)       | 22.5±6.2     | 23 (7)            | 0.90|
Note: all p-values from Mann-Whitney U-test; RRS - Republican Rescue Squad; EX – Emotional Exhaustion; CY – Cynicism; PE – Professional Efficacy; FSS – Fatigue Severity Scale; PSS – Perceived Stress Scale

In both RRS rescuers and mudslide rescuers, as well as in the whole cohort, all three studied burnout domain levels were either low or very low. The overall EX score was 0.8 (IQR 0.2; 1.6), CY 1.6 (IQR 0.8; 2.4), PE 4.7 (IQR 3; 5.8), with no differences between RRS rescuers and mudslide rescuers. We found moderate correlation between EX and FSS (r=0.61) and CY (r=0.54). No differences were found between groups with regard to stress level. The overall PSS-10 score was 23 (IQR 8), which corresponded to its low level. In the univariate analyses, age, sex, working 24-hour shifts, marital status, cigarette smoking, were not associated with higher PSS-10. However, FSS, exercising regularly, higher education and HRQL could predict stress score. When adjusted for each other, both HRQL components (PCS beta -0.27, p<0.001; MCS beta -0.25, p<0.001), fatigue (FSS beta 0.07, p<0.01) and higher education (beta 1.44, p<0.05) still remained significantly associated with PSS-10 score.

In testing candidate variables to predict burnout domains in simple univariate regression models, age, sex, working 24-hour shifts, years in rescue, marital status or cigarette smoking were not associated with any burnout domain. In a multivariate regression model of predicting EX, regular exercise, PCS, MCS, FSS and PSS-10 were included, and this model yielded the highest power among three domains, in which these five variables explained 52% of EX variability. As Table 3 shows, lower scores of both domains of HRQL, higher fatigue and stress scores independently predicted greater EX. The model of predicting CY only included 4 variables, of which two (MCS and PSS-10) did not show an association in an adjusted model, and R² for the model was 0.13. With regard to CY, only lower PCS and FSS scores, independent of each other, could predict more burnout. Finally, adjusted model for PE had even smaller R² (0.10) with four variables included, of which both domains of HRQL did not yield an association.
with PE. In addition to FSS-10, higher education was positively associated with higher PE burnout score (beta 0.86 (95% CI 0.40;1.32)), thus, lower burnout severity.

Table 3. Beta coefficients with the corresponding 95% confidence intervals of selected predictors of emotional exhaustion, cynicism and professional efficacy in fully adjusted regression models

| Predictor | EX          | CY          | PE          |
|----------|-------------|-------------|-------------|
| PCS      | -0.04 (-0.06;-0.02) | -0.03 (-0.06;-0.01) | NS          |
| MCS      | -0.03 (-0.05;-0.01) | NS          | NS          |
| FSS      | 0.03 (0.03;0.04) | 0.02 (0.01;0.03) | -           |
| PSS-10   | 0.04 (0.02;0.06) | NS          | -0.06 (-0.10;-0.02) |

Note: NS – non-significant; EX – Emotional Exhaustion; CY – Cynicism; PE – Professional Efficacy; PCS – Physical Component Score; MCS – Mental Component Score; FSS – Fatigue Severity Scale; PSS – Perceived Stress Scale

Discussion

In this first presentation of the occupational burnout, stress and fatigue in rescuers from Kazakhstan, we found that the overall prevalence of high burnout scores in any three studied dimensions, including EX, CY and PE, was low. Using multivariate modelling, we showed that higher EX burnout in this group was associated with lower HRQL, greater fatigue and stress, whereas CY burnout could be predicted by more fatigue and poorer physical component of HRQL. Finally, PE burnout was associated with stress and education. We consider these findings important to plan early prevention of burnout in rescuers; thus, potentially affecting survival rates in natural disaster victims through high professional efficacy.
Occupational burnout is widely reported in different occupational groups, mostly medical professionals, such as nurses, but studies in rescuers do not often take occupational burnout into account. In Kazakhstan, medical ambulance, fire departments and rescuers do not function together and are usually attributed to separate organizations. We earlier reported that occupational burnout in firefighters was generally low and its predictors in multivariate models included HRQL, uniform discomfort, language barrier, sex and education, depending on a specific domain [8]. The terms of reference of firefighters and rescuers in Kazakhstan were different, and we therefore aimed to now detect burnout predictors in the latter. We found common burnout predictors with firefighters, such as HRQL and education (with regard to PE), indicative of potentially similar mechanisms of burnout development and progression in these groups.

Burnout in rescuers most likely develops as a result of secondary traumatization, that is a stress that develops in those who contacted and assisted others experiencing direct stress. As opposed to burnout, such secondary traumatization has been widely reported in responders, including police officers, firefighters and paramedics. In group comparisons, the findings of studies have not been consistent. Thus, more compassion fatigue in firefighters in one report [12] contradicted less traumatization in firefighters compared to rescue personnel in another presentation [13]. In addition, risk factors for occupational burnout in rescuers have been very poorly described and included the experience of feeling threatened, the experience of being jailed or insulted and the number of years of service in one study in paramedics [14]; self-efficacy, collective efficacy and sense of community in another study in first responders [15]. Furthermore, a 4-year follow-up study of medical rescue workers during the Great East Japan Earthquake showed that stress before deployment was a significant predictor of burnout [16]. None of these and other published studies examined HRQL, and the association of HRQL with burnout we detected was a novel finding in the field.
The overall low prevalence of high burnout in rescuers in Kazakhstan may result from a well-set system of psychological aid and consultations with regularly trained psychologists in the staff. These psychologists operate 8-hour daily shifts and are in charge of daily monitoring of the so-called psychological climate. They disseminate and analyze the questionnaires to the duty personnel on a monthly basis and complete regular training on the ways to consult rescuers how to mitigate occupational stress. The efficacy of these interventions is also assessed regularly, but we have found no reports disclosing the effect of such interventions in the published literature.

The analysis of both fatigue, perceived stress, burnout and HRQL is a strength of this study, because the association of these in such occupational groups has never been reported before. The most pronounced limitation of this analysis is the cross-sectional design, which does not allow to conclude on the direction of associations we have found. Another limitation is inability to reach regular rescuers working within the Provincial affiliations of the Ministry of Emergency Situations for comparison. Furthermore, we did not include the tools to verify work-family conflict and other potential sources of stress as confounders of occupational burnout, which we also consider a limitation of our study.

This study has broad and clear implications for the management of rescue service in the country and elsewhere. The association of HRQL, mostly physical component, with two out of three burnout domains confirms earlier findings in firefighters and necessitates setting up a more comprehensive medical surveillance system with a focus of annual medical screening and fitness to work. Such annual screening, as mandated by the local legislation covers a broad range of medical conditions and diagnoses, but has never addressed stress, fatigue or burnout as a routine procedure. The panel of screening doctors includes a psychiatrist, but not a medical psychologist, leaving the problems of stress, burnout and fatigue out of the scope during screening. Burnout itself and its predictors, such as stress and fatigue, should be better and timely recognized at any contact of rescue personnel with medical doctors and psychologists, whereas primary burnout prevention programs should be initiated and integrated in the annual medical screening
The associations we identified in our study raise questions for future research. HRQL usually reflects individual satisfaction with one’s health, including already existing chronic and acute diseases and conditions. Because HRQL was found to be consistently associated with most domains of burnout, the one’s health can also predict burnout and, hence, interventions tailored at improving individual health can theoretically ameliorate burnout. However, we could not find studies confirming such hypothesis in rescuers with specific terms of reference, such as in Kazakhstan groups. More studies are needed uncovering the overall and specific health status of such occupational groups, as any associations will help guide primary and secondary burnout prevention.

Conclusions

To conclude, this is the first presentation of the occupational burnout, fatigue and stress in a large sample of professional rescuers of Kazakhstan, which showed that fatigue was an independent predictor of burnout in this group. Because HRQL was also an important predictor of EX and even CY, primary burnout prevention should consider general health status and HRQL and aim to support better physical health through efficient health interventions, exercise and health surveillance as mandated by the local regulations. Burnout prevention in rescuers should focus on fatigue reduction through better worktime and shift planning.

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Competing interests

Authors declare no competing interests.

Author contributions

DV and GK designed the study, analysed study results and drafted the manuscript; ZR, IK, SK and ZT collected data and approved the final version; AU, KB and DO analysed data and approved the final version.

Ethics Approval

This study was approved by the Committee on Bioethics of the al-Farabi Kazakh National University (approval #35/2021). All study participants signed written informed consent to participate.

Data statement

All datasets generated in this study are included in the manuscript.

Patient and Public Involvement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

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# Reporting checklist for cross-sectional study.

Based on the STROBE cross-sectional guidelines.

## Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

Upload your completed checklist as an extra file when you submit to a journal.

In your methods section, say that you used the STROBE cross-sectional reporting guidelines, and cite them as:

von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies.

| Reporting Item | Page Number |
|----------------|-------------|
| **Title and abstract** | |
| Title | #1a | Indicate the study’s design with a commonly used term in the title or the abstract | 1 |
| Abstract | #1b | Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | |
| Background / rationale | #2 | Explain the scientific background and rationale for the investigation being reported | 4 |
| Objectives | #3 | State specific objectives, including any prespecified hypotheses | 4 |
| **Methods** | |
| Study design | #4 | Present key elements of study design early in the paper | 5 |
| Setting | #5 | Describe the setting, locations, and relevant dates, including periods of | 5 |
recruitment, exposure, follow-up, and data collection

Eligibility criteria  
Give the eligibility criteria, and the sources and methods of selection of participants.  
Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable

Data sources / measurement  
For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.

Bias  
Describe any efforts to address potential sources of bias

Study size  
Explain how the study size was arrived at

Quantitative variables  
Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why

Statistical methods  
Describe all statistical methods, including those used to control for confounding

Statistical methods  
Describe any methods used to examine subgroups and interactions

Statistical methods  
Explain how missing data were addressed

Statistical methods  
If applicable, describe analytical methods taking account of sampling strategy

Statistical methods  
Describe any sensitivity analyses

Results

Participants  
Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.

Participants  
Give reasons for non-participation at each stage

Participants  
Consider use of a flow diagram
Descriptive data  #14a Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.

Descriptive data  #14b Indicate number of participants with missing data for each variable of interest

Outcome data  #15 Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.

Main results  #16a Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included

Main results  #16b Report category boundaries when continuous variables were categorized

Main results  #16c If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

Other analyses  #17 Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses

Discussion

Key results  #18 Summarise key results with reference to study objectives

Limitations  #19 Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.

Interpretation  #20 Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.

Generalisability  #21 Discuss the generalisability (external validity) of the study results

Other Information

Funding  #22 Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

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