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De-gendering firefighting: exploring risk perception and psychological resilience

Arturo Cuesta, Daniel Alvear, Adriana Balboa, Gemma Ortiz

University of Cantabria. Los Castros s/n, 39005 Santander, Spain

cuestaar@unican.es

Abstract. This study explores psychological differences between male and female firefighters. A convenience sample of 202 firefighters (62 females) filled out an anonymous web-based survey designed to capture self-reports on risk propensity, risk tolerance, resilience and coping resilience. Overall small differences were found suggesting that the hypothetical gender discrepancies may be reduced in firefighting occupational contexts. Further research is needed to confirm this.

1. Introduction

Previous research suggests that gender may be relevant in the way firefighters face risks and recover from critical situations. Risk-taking is considered part of the firefighting culture (e.g. firefighters are believed to be motivated to take risks) [1]. In general, it seems that women are more risk-averse than men [2, 3]. A study suggested that females' views are likely to improve safety behaviours in firefighting [4]. Another study suggested that male firefighters exhibited greater risk-taking tendencies compared to their female counterparts [5]. By contrast, a very recent study found that risk-taking is more prevalent in both males and females who have a higher masculine perception of firefighting [6]. Therefore, research has yet to confirm whether women are as prone to risk-taking as their gender counterparts and whether gender plays a significant role in the risk tolerance of firefighting personnel.

Moreover, male and female firefighters experience health and mental consequences due to their exposure to critical incidents as part of their duty. A qualitative study found that female firefighters were concise and males more intense in describing their experiences [7]. Other studies have indicated that females in firefighting occupations tend to experience higher rates of anxiety, posttraumatic stress disorder (PTSD), and suicidal ideations compared to their male counterparts [8, 9]. A study on Emergency Medical Services (EMS) workers found gender-based differences in stress, burnout and coping behaviours [10]. By contrast, a previous study reported that male and female firefighters are more similar than different on both job stressors and symptoms of stress measures [11].

Understanding gender differences in these aspects is critical to enhancing the health, well-being, and occupational functioning of males and females in firefighting. This study aimed to explore gender differences based on self-reported information on risk propensity, risk tolerance, resilience and coping resilience in active firefighters. We used a survey involving a convenience sample of 202 firefighters (62 females). This case study provided us with the opportunity to: 1) report on the methods for the gender analysis, 2) briefly summarize the key findings and 3) draw conclusions about the potential impact of gender on safety behaviour and protection of firefighting personnel.



2. Methods

2.1. Study design

A web-based survey was conducted to investigate gender differences in risk propensity (RP), risk tolerance (RT), resilience (R), and resilience coping (C) among firefighters. The conceptual definitions of the intended constructs are as follows. Risk propensity (RP) refers to individuals' tendency towards taking or avoiding risks [12]. It can be expressed as the risk-seeking or risk-aversion attitudes in individuals. Risk tolerance (RT) is here defined as the level of risk to which firefighters are willing to be exposed while on duty. Tolerance of risk is usually based on an assumption (justified or not) that the risk is slight, the consequences are minor, and that both are outweighed by immediate benefits [13]. Resilience (R) refers to the process and outcome of successfully adapting to difficult or challenging experiences, especially through mental, emotional, and behavioural flexibility and adjustment to external and internal demands [13]. Finally coping (C) is defined as the use of cognitive and behavioural strategies to manage the demands of a situation when these are appraised as taxing or exceeding one's resources or to reduce the negative emotions and conflict caused by stress [13].

The questionnaire comprised items developed by the authors and items from existing validated scales. The first part of the questionnaire collected information from participants including gender (*male/female/prefer not to say*), age, country, experience in service (in years), and whether they seek promotion (*yes/no*). The second part of the questionnaire comprised items to measure risk propensity (5 items with a 9-point Likert scale from the Risk Propensity Scale (RPS) [14]) and risk tolerance (two items from the RPS and three items developed by authors with a 9-point Likert scale). The third part of the questionnaire measured resilience (5 items with a 5-point Likert scale from Brief Resilience Scale (BRS) [15]), and resilience coping (the four items with a 5-point Likert scale from Brief Resilience Coping Scale (BRCS) [16]). Note that participants were specifically asked about their experiences as firefighters in order to respond to the survey items. The English version of the questionnaire was translated by native speakers into Swedish, Italian, Turkish, Polish, Dutch, and Spanish. The translation aimed at achieving equivalence to the original version. The initial translation was made by two independent translators to detect and resolve discrepancies. Also, the resulting versions were back-translated to ensure the accuracy of the translation. Then, the online prefinal versions were sent again to the translators for checking and final approval. The questionnaire was generated using Google Forms, a cloud-based survey development application, and distributed on January 14, 2021, with a predefined closure date of February 21, 2021. The target participants of this survey were first responders who were/will be -directly or indirectly- participating in emergencies including firefighters, police officers, emergency medical service, and civil protection personnel. In addition to the type of service, participants were classified as operational, leading, and training personnel. Only responses from operational firefighters were used in the current study.

2.2. Ethics

The questionnaire was anonymous, and the privacy policy of the individual's posted information was noted. Due to the nature of this study and considering that no personal data would be collected or stored, written informed consent was not required. However, respondents gave consent to participate by filling in the agreement part of the survey form. The study was approved by the Ethical Committee of the University of Cantabria (CE Proyecto 06/2019).

2.3. Analysis

First, we confirmed that the factorial structure of the scales complied with the KMO criterion ($MSA > 0.60$) and Bartlett's test of sphericity (need to be significant). Then, Principal Component Analysis (PCA) was conducted to assess the underlying structure of the questionnaire and to verify the congruence of components with the extracted factors. The varimax rotation method was applied to enhance interpretability by producing orthogonal factors. Components were retained based on eigenvalues above 1 and loadings ≥ 0.60 [17]. Scale reliability was assessed by Cronbach's alpha

assuming a cut-off acceptability value of 0.6 in this exploratory study [18]. We also ensured that items within each construct correlate well with each other. Variables were expressed as counts and percentages and the scores were normalized and expressed as Median and Interquartile Range (IQR). The statistical differences were computed using Mann-Whitney U-test (Two-sided) as samples were non-normally distributed. The rank-biserial correlation coefficient (r) was used to measure the effect size (the size of the differences between genders). This coefficient varies from -1 to 1: a value of -1 indicates a perfect negative relationship, 0 indicates no relationship, and 1 indicates a perfect positive relationship. Categorical variables were compared using the chi-square test because the expected values were more than 10. Data were analysed using JASP statistical program v0.18.3 (JASP Team, 2024) [18]. For all analyses performed, p -values < 0.05 were considered statistically significant.

3. Results

3.1. Participants

Out of the 206 respondents, 4 participants chose the option 'Prefer not to say' when asked for gender. Due to the small sample size, responses in this category were not analysed. Hence the final sample consisted of 202 firefighters in active fire service (62 females and 140 males) whose characteristics are described in Table 1. There was no significant association between gender and seeking for promotion, $\chi^2(1, N = 202) = 2.93, p = 0.09$.

Table 1. Baseline characteristics of firefighters participating in this study. Significant p -values in bold.

Variable	Overall ($n=202$)	Female ($n=64, 31\%$)	Male ($n=140, 69\%$)	p -value
Age, years	39.7 \pm 9.9	39.6 \pm 8.7	39.8 \pm 10.4	0.86
Country n (%)				<0.01
Netherlands	40 (19.8)	36 (58.1)	4 (2.9)	
Poland	27 (13.4)	2 (3.2)	25 (17.9)	
Spain	63 (31.2)	11 (17.7)	52 (37.1)	
Sweden	62 (30.7)	11 (17.7)	51 (36.4)	
Turkey	10 (5.0)	2 (3.2)	8 (5.7)	
Experience n (%)				0.12
<1 year	1 (0.5)	0 (0.0)	1 (0.7)	
1-5 years	46 (22.8)	17 (27.4)	29 (20.7)	
6-10 years	38 (18.8)	11 (17.7)	27 (19.3)	
11-15 years	40 (19.8)	14 (22.6)	26 (18.6)	
16-20 years	34 (16.8)	14 (22.6)	20 (14.3)	
>20 years	43 (21.3)	6 (9.7)	37 (26.4)	
Seek for promotion? n (%)				0.09
Yes	119 (58.9)	31 (50.0)	88 (62.9)	
No	83 (41.1)	31 (50.0)	52 (37.1)	

3.2. Construct validity and reliability

The items presented loadings ≥ 0.60 on factors, with a Cronbach's alpha (α) ranging from 0.60 to 0.70 (Table 2). The correlation between items was significant. Pearson's r ranged from 0.17 to 0.49 in RP scale, from 0.16 to 0.45 in RT scale, from 0.19 to 0.48 in R scale and from 0.18 to 0.33 in C scale. The correlation between scales was also measured. As expected, there was a positive significant correlation between RP scale and R scale ($r = 0.18, p = 0.01$), between R scale and C scale ($r = 0.18, p < 0.001$) as well as between RT scale and C scale ($r = 0.27, p < 0.001$).

3.3. Gender comparison

Risk Propensity (RP).-Respondents rated self-protective concerns (i.e. $RP1$ - $RP3$) as relatively low-risk tendency and duty related concerns (i.e. $RP4$ and $RP5$) as relatively high-risk tendency. Risk aversion ($RP3$) was higher in males and females were less worried about uncertainty ($RP4$) than males. However, the overall RP did not differ significantly ($W=4880, p=0.16$), despite females attaining higher scores than males.

Risk Tolerance (RT).- Male firefighters generally exhibited higher risk acceptance compared to female firefighters particularly when asked about having been involved in extremely risky situations (RT3) and their perceived likelihood of getting injured in the future (RT4). Gender differences in the overall RT were not high but still significant (W=3524, $p=0.03$).

Resilience (R).- Respondents showed high resilience overall, thus suggesting robust psychological adaptation to challenging situations in both genders. Female firefighters demonstrated slightly higher resilience compared to male firefighters, particularly in R1, R3, R5. However, overall differences in R between were not statistically significant (W=4992, $p=0.09$).

Coping (C).- Males reported significantly higher scores than females in control of reaction (C2) and look for ways to replace the losses (C4) whereas females had a greater optimism for resilient coping (C3) than males. Overall, both genders reported similar levels of coping ability, with males scoring slightly higher on average compared to females. Hence, differences in the C were not statistically significant (W=3814, $p=0.17$), suggesting comparable coping between genders in dealing with challenging firefighting situations.

Table 2. Constructs, items, loadings and gender differences in firefighters. Significant p -values in bold.

Constructs (Cronbach alpha)/Items	Load	Normalized scores Median (IQR)		p value	r
		Male	Female		
RP. Risk Propensity ($\alpha=0.65$)					
RP1. Safety first (R)*	0.74	0.00 (0.21)	0.00 (0.17)	0.48	-0.06
RP2. I do not take risk with my health (R)*	0.75	0.25 (0.28)	0.25 (0.13)	0.39	-0.07
RP3. I prefer to avoid risks (R)*	0.67	0.25 (0.25)	0.38 (0.38)	0.03	0.19
RP4. I really dislike not knowing what is going to happen (R)*	0.60	0.50 (0.63)	0.63 (0.38)	0.03	0.19
RP5. I view myself as: from 1 (Risk avoider) to 9 (Risk seeker)*	0.60	0.38 (0.38)	0.50 (0.38)	0.58	0.05
Overall RP		0.38 (0.29)	0.44 (0.21)	0.16	0.12
RT. Risk Tolerance ($\alpha=0.66$)					
RT1. I take risks regularly*	0.67	0.50 (0.50)	0.63 (0.38)	0.55	0.05
RT2. I have experienced benefits from risky actions	0.68	0.63 (0.38)	0.63 (0.25)	0.93	0.00
RT3. I have been involved in extremely risk situations	0.66	0.75 (0.50)	0.63 (0.38)	<0.01	-0.33
RT4. I'm likely to get hurt in the future	0.64	0.50 (0.50)	0.25 (0.38)	<0.01	-0.36
RT5. I usually view new risks as a challenge*	0.60	0.75 (0.38)	0.75 (0.38)	0.60	0.05
Overall RT		0.60 (0.25)	0.54 (0.23)	0.03	-0.19
R. Resilience ($\alpha=0.70$)					
R1. I have a hard time making it through stressful events (R)^	0.74	0.75 (0.50)	0.75 (0.25)	0.01	0.21
R2. It does not take me long to recover from a stressful event^	0.61	0.75 (0.50)	0.75 (0.25)	0.69	-0.03
R3. It is hard for me to snap back when something bad happens (R)^	0.78	0.75 (0.50)	0.75 (0.25)	0.38	0.07
R4. I usually come through difficult times with little trouble^	0.68	0.75 (0.25)	0.75 (0.25)	0.64	0.04
R5. I tend to take a long time to get over set-backs in my life (R)^	0.78	0.75 (0.25)	0.75 (0.19)	0.10	0.14
Overall R		0.63 (0.27)	0.69 (0.25)	0.09	0.15
C. Coping ($\alpha=0.60$)					
C1. I look for creative ways to alter difficult situations+	0.80	0.75 (0.50)	0.75 (0.19)	0.83	0.02
C2. Regardless of what happens to me, I believe I can control my reaction to it+	0.71	0.75 (0.00)	0.75 (0.25)	0.01	-0.20
C3. I believe that I can grow in positive ways by dealing with difficult situations+	0.61	0.75 (0.50)	0.75 (0.25)	<0.01	0.27
C4. I actively look for ways to replace the losses I encounter in life+	0.68	0.75 (0.00)	0.50 (0.25)	<0.01	-0.28
Overall C		0.73 (0.20)	0.67 (0.27)	0.17	-0.12

*Items from the Risk Propensity Scale [14]; ^Items from the Brief Resilience Scale [15]; + Items from the Brief Resilience Coping Scale [16]; (R)=Reversed scores; IQR= Interquartile range; r = Rank biserial correlation coefficient.

4. Discussion

The present study was designed to explore psychological gender differences among firefighters. An online survey was used to assess risk propensity, risk tolerance, resilience, and coping resilience. In total

202 frontline firefighters (62 females) were involved in the study. Initially, the reliability and validity of the survey instrument were assessed to ensure that it was acceptable for assessing the constructs of interest. Subsequently, self-reported data were disaggregated by gender and compared.

Results revealed minimal differences between male and female firefighters. We found that female firefighters exhibit similar risk propensity as their gender counterparts, with females even scoring higher on average. This suggests that factors beyond gender are likely to influence risk-taking. Women firefighters may have higher achievement motivation, possibly driven by competition and social pressure within the profession [4, 20]. Previous research has not shown gender differences in risk propensity in the general population [14], indicating that our findings are noteworthy but not conclusive.

Our results also showed that male firefighters are more risk-tolerant than female firefighters. Differences are not substantial but statistically significant. Gender discrepancies were particularly evident when scoring involvement in extremely risky situations and future injury likelihood. Normative expectations related to masculinity might explain this. For instance, male firefighters are less likely to report injuries than female firefighters due to cultural norms (e.g. it is a sign of weakness) [21]. Tolerance of risk is usually based on an assumption (justified or not) that the risk is small and leads to immediate benefits. Nevertheless, in our study, both genders provided similar scores when asked about the benefits of risky actions. In a prior study of urban firefighters utilizing the Brief Resilient Scale, Smith et al. reported a connection between male gender and greater resilience [22]. However, our current study did not find significant gender differences. Interestingly female firefighters perceived themselves as more resilient in confronting job stressors across all items. Further research with greater samples using different resilience scales is desirable to confirm this. Finally, in this exploratory study, we did not find significant gender differences in the inclinations to cope with stress among firefighters. These results differ from some published studies [8-10] but they seem to be consistent with other earlier findings [11]. It is important to note that the reported scores showed that male and female firefighters are expected to be goal-directed, believe in their ability to address adverse situations, and usually succeed in their selected challenges [15, 16].

To sum up, our results suggest that the hypothetical gender discrepancies may be reduced in the firefighting occupational contexts. Gender norms may not influence the perceptions and attitudes of firefighters. Further research is needed to challenge gender stereotypes emphasizing the importance of gender diversity while considering the psychological attributes and capabilities of each firefighter. However, our findings are subject to at least three limitations. First, the scales used were designed for the general population, which may not accurately capture the psychological attributes of firefighters. This perhaps caused lower Cronbach's alpha values, as the items may not fully reflect the unique experiences and characteristics of firefighters. Second, a convenience and relatively small sample was used. This may affect the generalizability of the findings. Third, despite the anonymity of the questionnaire, relying on self-reported data can introduce social desirability and/or recall biases that may affect the accuracy.

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