TITLE PAGE

Burden and Protection: heterogeneous effects of occupational and operational stressors on Burnout dimensions among firefighters

Thalyta Gleyane Silva de Carvalho[1]

Larissa Fortunato Araújo[2]

Eduardo de Paula Lima[3,4]

Alan Lúcio Alencar de Andrade[5]

Maria Luiza Almeida Bastos[6]

Eliana Mattos Lacerda[7]

Marcelo José Monteiro Ferreira[8]

Corresponding Author Full Name

Marcelo José Monteiro Ferreira

Corresponding Author Adress, Phone, E-mail Address

Professor Costa Mendes Street, 1608 - Bloco Didático, 5th floor. Neighborhood: Rodolfo Teófilo, Fortaleza/Ceará/Brazil. Postcode: 60.430-14. Phone Number +55(85) 3366-8645. E-mail: marceloferreira@ufc.br

[1] MD in Public Health. Post Graduated Program in Public Health. Medicine School. Federal University of Ceará. E-mail: thalytagleyane@gmail.com
[2] PhD in Public Health. Postgraduate Program in Public Health. Federal University of Ceará. E-mail: larissafortunatoaraujo@gmail.com
[3] PhD in Public Health. Post Graduated Program in Public Health. Federal University of Minas Gerais. E-mail: edpl@hotmail.com
[4] Military Fire Department of Minas Gerais, Brazil
[5] Military Fire Department of Ceará, Brazil. E-mail: alanluciofortal@gmail.com
[6] MD in Public Health. Post Graduated Program in Public Health. Federal University of Ceará. E-mail: mluiza@alu.ufc.br
[7] PhD in Public Health. London School of Hygiene & Tropical Medicine. London City, United Kingdom. E-mail: Eliana.Lacerda@lshtm.ac.uk
[8] PhD in Public Health. London School of Hygiene and Tropical Medicine, London City, United Kingdom. Postgraduate Program in Public Health. Federal University of Ceará. Address: Professor Costa Mendes Street, 1608 - Bloco Didático, 5th floor. Neighborhood: Rodolfo Teófilo, Fortaleza/Ceará/Brazil. Postcode: 60.430-14. Phone Number +55(85) 3366-8645. E-mail: marceloferreira@ufc.br

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NONE DECLARED CONFLICT OF INTEREST

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Running Tittle: Operational and Organizational Stressors Among Firefighters

Burden and Protection: heterogeneous effects of occupational and operational stressors on Burnout dimensions among firefighters

ABSTRACT

Objective: To investigate the association between occupational stressors and Burnout dimensions among Brazilian firefighters.

Method: A cross-sectional study about firefighters (n=237) was developed in Fortaleza, Northeast of Brazil. Logistic regression analysis was applied to investigate the association between high strain (high demand and low job control), low social support, high operational exposure, and Burnout dimensions (emotional exhaustion, depersonalisation, and low personal accomplishment).

Results: High strain was associated to emotional exhaustion (OR=11.65; 95%CI: 3.92-34.60) and depersonalisation (OR=5.43; 95%CI: 2.03-14.58). Low social support was associated to emotional exhaustion (OR=2.86; 95%CI: 1.24-6.60) and low personal accomplishment (OR=2.59; 95%CI: 1.36-4.93). High operational exposure did not increase the odds of emotional exhaustion and depersonalisation and decreased the odds of low personal accomplishment (OR=0.31; 95%CI: 0.10-0.94).

Conclusion: The study highlights the heterogeneous effects that operational and organisational stressors have on each dimension of Burnout.

Keywords: Burnout; Firefighters; Occupational Stress; Occupational diseases; Occupational Health.

INTRODUCTION

Occupational stress is related to impaired physical and psychological health[1-3]. The burden of stress can result in pathophysiological and psychological disorders in several working settings.[3-6] Among firefighters, the sources of occupational stress are related to the organization of work (organisational stressors) and the nature of the tasks (operational stressors).

Organisational stressors include a wide range of negative psychosocial characteristics, such as high workload, limited decision-making autonomy, conflicting roles, repetitive or monotonous tasks, low social support, and low professional recognition[7-11]. Operational stressors are defined as traumatic events at work, a high frequent stressor experienced by firefighters. The literature highlights disasters, the risk of death of a colleague, and other threatening situations to life or physical integrity[10-11]. Chronic exposure to operational and organisational stressors can contribute to the emergence of mental health problems, including Burnout[12-14]. The outcome is a psychological response to chronic occupational stressors characterized by symptoms of Emotional Exhaustion (EE), Depersonalisation (DP), and Low Personal Achievement (LPA)[15-17].

The links between Burnout and firefighters' work settings include direct contact with the public, dealing with people's suffering, and providing pre-hospital care. In other words, their health and public safety actions make these professionals a high-risk group for Burnout[18-21]. A survey about US firefighters reported a high prevalence of Burnout, with a high prevalence of EE (11.4%), DP (17.7%), and LPA (38.1%)[22]. Similar studies developed in Greece[23] (19.3% of EE; 5.9% of DP; and 33.6% of LPA) and Japan[24] (reporting 10% of EE; 17.2% of DP; and 33.7% with LPA) also found high prevalence of this outcome. Contrastingly, in Kazakhstan, a study on 604 firefighters showed a low prevalence in the three dimensions of Burnout[25]. In Brazil, surveys developed in two different regions found Burnout prevalence ranging from

2.3%[26] to 55.9%[27], indicating contextual differences between Fire Departments, but also methodological issues to be considered in future investigations.

Several theoretical models have been proposed to assess the effects of organisational stressors on Burnout symptoms. Among them, the Demand-Control Model (DCM) is one of the most internationally recognized[28-34]. The DCM has been effective for use on firefighters, especially considering high time pressure, workload, labour division, and limited autonomy for the lower ranks in Fire Deparments[35,36]. These psychosocial factors add psychological risks to operational stressors frequently faced by these workers in large urban centres[10,11, 37,38].

Despite current evidence regarding Burnout among firefighters, it is still not clear whether the magnitude of operational and organisational stressors have a homogeneous impact on the different dimensions of Burnout in this specific population. The present paper aims to investigate the association between operational and organisational stressors and symptoms of Burnout among Brazilian firefighters.

MATERIALS AND METHODS

Research design and study population

A cross-sectional study about firefighters from the Ceará State Fire Department (CBMCE) was developed between June and August 2019, in units from Fortaleza, the capital city of Ceará State, Brazil. Fortaleza was chosen because it is the only city in the Ceará State that has all the units and hierarchical rankings that comprise the corporation's chain of command. Additionally, that city holds the largest number of those professionals within the State, accounting for about 60% of their total personnel. In this study, all 28 operational and administrative units were included, considering 706 male firefighters distributed in the different units of the CBMCE.

Sample calculation, inclusion, and exclusion criteria

We used a multiple staged design for the sample size calculation, following the criteria defined for finite populations[39]. The total number of 706 firefighters distributed in the different units of the CBMCE was categorised according to their main job activities. We evaluated how much time each member of the target population participant was involved in operational activities and categorised them into the following groups: 1) operational, 2) partially operational, 3) administrative. The operational group included firefighters who exclusively performed operational tasks, such as search and rescue, rescue, urban firefighting, forest fires and other tasks of a similar nature. The partially operational group included the professionals who performed both operational and administrative activities, while the administrative group was comprised of firefighters who performed exclusively administrative tasks within the institution. This categorisation was done through an assessment of the records of the CBMCE's

Personnel Management Coordination and Command sectors, which reviews each professionals' assignments.

FIGURE 1

Subsequently, we calculated a sample size for each stratum on the operational and administrative flowcharts (Figure 1), to ensure representation from the different segments, reaching a minimum sample of 273 individuals. We added 20% of this number to account for possible losses, totaling a sample of 328 individuals (second stage). We then used the equation proposed by Lwanga and Lemeshow[40] to validate composite samples, resulting in a final number of 384 participants. For sample size calculation, we used the following parameters: 5% significance level and 50% prevalence for the event of interest, with a 5% acceptable variation in the expected frequency estimate and a 95% confidence interval.

The inclusion criteria was to work in the institution for at least one year as a permanent professional and the exclusion criteria included: i) being in the initial stage of their career, ii) being on vacation or sick leave at the time of data collection. Women were also excluded, regardless of their role, as there were only 9 firefighters in the institution during the study period.

Instruments and collected variables

A self-reported questionnaire in Brazilian Portuguese was organised into five blocks. The first block included sociodemographic variables: age (< 29 years old, 30 to 40 years old, or > 40 years old), race (white/black/mixed), marital status (living with partner or living without a partner), and education (high school, undergraduate, or graduate). The second block included job information such as rank (subordinates or officers) and time working for the Fire

Department (< 15 years, 15 to 25 years, or > 25 years). The third block investigated operational exposure in the last 12 months. We asked if the participants worked in the following situations: car accident, cadaver retrieval, suicide attempts, the capture of wild or venomous animals, urban firefighting, forest firefighting, operational driving, and handling dangerous products. A three-point Likert scale was presented for each situation. For the final operational exposure variables, we calculated a composite score organised into high exposure (above the 75th percentile) and low exposure (under the 75th percentile). The fourth block presented items regarding organisational stressors.

We used the Brazilian version of the *Job Stress Scale*[36], developed by Theorell[41], to assess demand, control, and social support. The median scores obtained from answers related to demand and control were combined and allocated into four quadrants: low strain (low demand and high control), passive work (low demand and low control), active work (high demand and high control), and high strain (high demand and low control). The median scores for the social support were also dichotomised into high support and low support and analysed separately. Finally, in the last block, we included the *Maslach Inventory Burnout* (MBI) - HSS version (Human Services Survey)[41] to assess Burnout symptoms.

Scores for each dimension (EE, DP, and LPA) were calculated as proposed and validated by Lautert[42]. Participants were characterised as positive for Burnout if scores were above the 75th percentile for EE and DP or below the 25th percentile for LPA.

Data analysis

First, we performed a descriptive analysis for Burnout dimensions, main exposure variables (organisational stressors and operational stressors), and control variables (sociodemographic and job characteristics). Secondly, we performed univariate analysis

(*Pearson chi-square*) to main exposure variables and control variables considering the Burnout dimensions as outcomes. The univariate analysis was also useful to assess the association between predictor variables (collinearity). A $p<0.20$ criterion was adopted to select variables to the multivariate final models. Finally, we carried out a multivariate stepwise *Logistic Regression Analysis* to estimate Odds Ratios (OR), the 95% Confidence Intervals (95% CI), and p-values for each Burnout dimension. We carried out the analysis by backward elimination. A $p<0.05$ criterion was adopted for the final models. Statistical analyses were performed using the Stata 14.0 software (*Stata Corporation, College Station*, USA).

Ethical procedures

The project was approved by the Research Ethics Committee of the Federal University of Ceará, under protocol 3.246.572, and received the approval of the Public Security Secretariat of the Ceará State Fire Department.

RESULTS

Of the total sampled, 237 (62%) questionnaires were evaluated and validated. The remaining individuals (38%) did not complete the questionnaire, chose not to participate, or filled out the form incorrectly. We observed a prevalence of 23.5%, 21.9%, and 27.3 for EE, DP, and LPA dimensions, respectively.

Most of the respondents were 41 years old or older (71.6%), considered themselves being black or mixed (83.9%), living with a partner (79.8%), and had an undergraduate or a postgraduate degree (68.1%). Regarding job information, 64.3% of the participants occupied subordinate positions at work. More than half of the participants (60.1%) had up to 25 years of professional experience as firefighters. About 13.9% of the respondents reported high

operational exposure in the last 12 months; 23.1% reported high strain (high demand and low control), and 60.3% reported low social support (TABLE 1).

Univariate analysis indicated a significant association between EE and DP with age (p<0.01, for both dimensions), years of work at the Fire Department (p≤0,01, for both dimensions), high strain (p<0.01, for both dimensions) and low social support (p<0.01, for both dimensions). LPA was associated with high operational exposure (p<0.05), high strain (p<0.05) and low social support (p<0.01) (TABLE 1). We also assessed collinearity between exploratory variables. Age and years of work at the Fire Department were associated. Considering our focus on the occupational context of firefighters, we decided to exclude the variable age of multivariate analysis.

In multivariate models, we found different patterns of association for each dimension of Burnout. Table 2 shows that active work (OR=3.40; 95%CI:1.02-11.33), high strain (OR=11.65; 95%CI: 3.92-34.60), and low social support (OR=2.86; 95%CI: 1.24-6.60) increased the odds of EE significantly. Active work (OR=4.72; 95%IC: 1.60-13.94) and high strain (OR=5.43; 95%CI: 2.03-14.58) were also associated with DP (TABLE 3). Finally, Table 4 presents lower odds of LPA for firefighters who reported high operational exposure (OR=0.31; 95%CI: 0.10-0.94) and higher odds for those who reported low social support (OR=2.59; 95%CI: 1.36-4.93).

DISCUSSION

Operational exposure and organisational stressors were associated with Burnout symptoms among Brazilian firefighters. However, the effects are heterogeneous and vary for each dimension of this outcome. The inverse association between high operational exposure

and LPA was unexpected. This result may indicate a protective characteristic of the work environment in this population.

The association between high strain, low social support, and Burnout was consistent with the literature, but we found some variation for each dimension. High strain increased the odds of EE and DP. This result was expected since the combination of high demand and low control is recognised as a risk factor for several mental health outcomes[34, 43]. According to the DCM, high work demands are characterised by high time pressure to perform work activities, fast pace, and contradictory demands[33]. Low control is characterised by a lack of autonomy for making decisions, and limited opportunities to apply and develop skills[33, 44]. Both organisational stressors are reported in highly hierarchised emergency institutions such as Fire departments[10,11].

Social support at work includes the relationship between colleagues, but also with subordinates and hierarchical superiors. Moreover, social support can be emotional, informational, and instrumental; all these forms are relevant for mental health, especially Burnout [45,46]. High social support environments among firefighters foster dialogue and trust, allowing individuals to share distressing emotions and thoughts about work. This kind of support is especially important among workers exposed to daily severe traumatic events. In summary, positive social relationships may act as a protective factor by counterbalancing the negative effects of occupational stress and reducing the development of psychological problems[34,47,48].

Operational exposure was inversely associated with LPA. This means the lower the levels of exposure to traumatic events, the lower the personal achievement. This finding may be closely related to the specificity of the group in focus[49,50]. Firefighters are aware of the work requirements and the associated risk with performing their tasks. Therefore, the rigorous and

systematic process of professional training may help these professionals to cope with high levels of stress at work[49]. Beyond that, we can speculate that operational exposure may be a driver for high symbolic rewards and recognition at work. Although operational activities pose greater risks to firefighters' physical and mental health, they are also strongly linked to professional recognition by society. In other words, the more directly linked to the operational service, the greater the social value received by the worker[45].

The present study opens new avenues to understanding the role of occupational stressors on specific dimensions of Burnout. The sampling design and the use of validated instruments for the Brazilian context are strengths we highlight. Nonetheless, we recognise some limitations. The cross-sectional design prevented us from discussing causality. Since organisational stressors were the main source of stress among firefighters, we can speculate that unmeasured variables, such as administrative tasks, may play an important role in the risk of Burnout, confounding the effect of operational activities. The low response rate to our study should also be considered a limiting factor. Furthermore, characteristics of our study population may have limited the analytical power of this research: almost all men in the study population did not allow us to verify the effect of sex in the study; in addition to the small number of participants under 40 years of age. Future studies should consider assessing a wider range of job characteristics.

CONCLUSION

Operational and organisational stressors have heterogeneous effects on Burnout dimensions among firefighters. An unexpected association between low operational exposure and low personal achievement was found, probably reflecting the social recognition for workers directly involved in firefighting, rescuing, and pre-hospital care. This finding unveils new

aspects to be considered in occupational health for emergency workers. We recommend individual and organisational interventions to adjust demands, provide autonomy, and fair reward systems in Fire Departments. These actions should be articulated with intersectoral policies involving occupational mental health surveillance programs.

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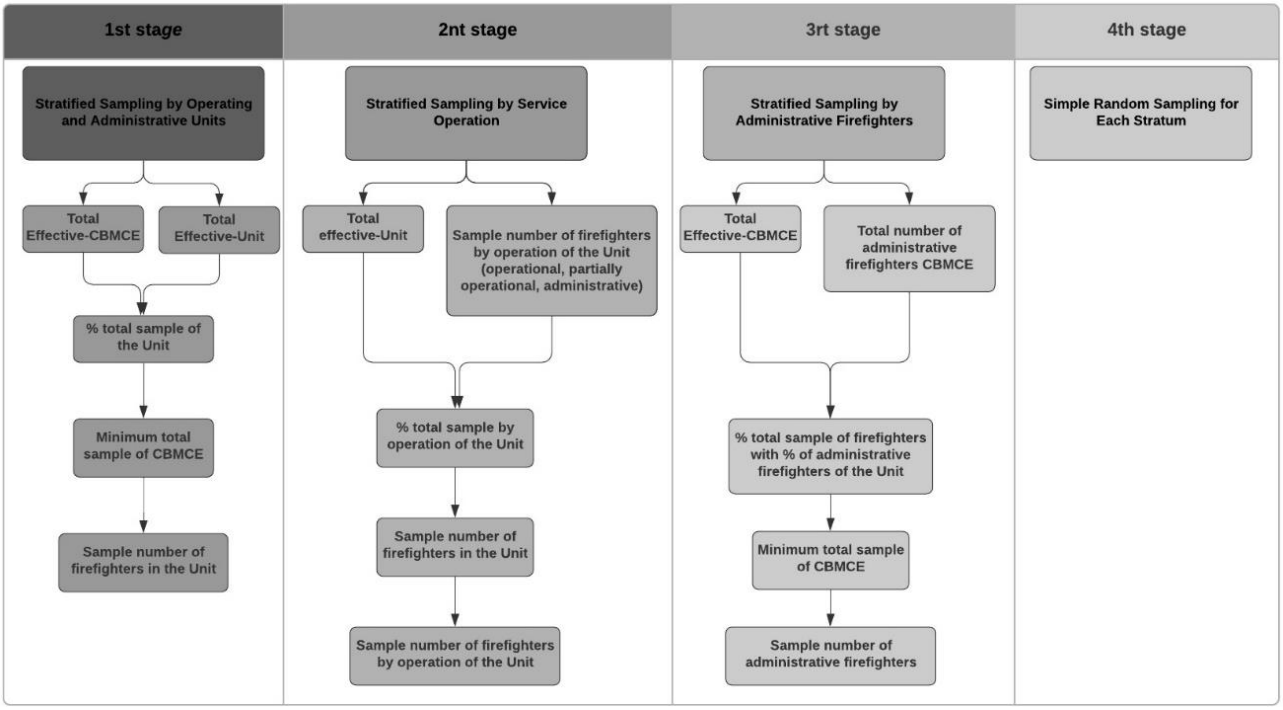
FIGURE CAPTION/LEGEND LIST

Figure 1 - Proportional Stratified Sampling Process

Figure

Burden and Protection: heterogeneous effects of occupational and operational stressors on Burnout dimensions among firefighters

Figure 1 - Proportional Stratified Sampling Process



Table

Burden and protection: heterogeneous effects of occupational and operational stressors on Burnout dimensions among firefighters

TABLE 1: Brazilian firefighters' (n=237) sociodemographic characteristics, job information, and occupational stressors stratified by three dimensions of Burnout symptoms – descriptive and univariate analysis (Pearson chi-square) (continue)

Variable of study	N	(%)	Emotional Exhaustion		Depersonalisation		Low Professional Achievement	
			%	p-value	%	p-value	%	p-value
Sociodemographic			23.5		21.9		27.3	
Age (years)								
< 29	14	6.2	14.3	<0.001	21.4	<0.001	21.4	0.552
30 -|40	50	22.2	46.0		44.0		32.0	
> 40	161	71.6	19.2		16.1		24.8	
Race								
White	38	16.1	23.7	0.994	21.0	0.927	21.1	0.358
Black / Mixed	198	83.9	23.7		21.7		28.0	
Marital Status								
With a partner	190	79.8	21.6	0.158	21.0	0.554	25.8	0.295
Without a partner	48	20.2	31.2		25.0		33.3	
Education								
High School	76	31.9	25.0	0.161	19.7	0.443	30.3	0.630
Undergraduate	70	29.4	30.0		27.1		28.6	
Graduate	92	38.7	17.4		19.6		23.9	
Occupational Rank								
Subordinates	153	64.3	27.5	0.056	25.5	0.068	30.7	0.113
Officers	85	25.6	16.5		15.3		21.2	
Length of Service								
<15 years	65	27.3	36.9	0.01	38.5	<0.01	29.2	0.92
15 - 25 years	78	32.8	18.0		12.8		26.9	
>25 years	95	39.9	19.0		17.9		26.3	

TABLE 1: Brazilian firefighters' (n=237) sociodemographic characteristics, job information, and occupational stressors stratified by Burnout symptoms – descriptive and univariate analysis (Pearson chi-square) (continue)

Variable of study	N	(%)	Emotional Exhaustion		Depersonalisation		Low Professional Achievement	
			%	p-value	%	p-value	%	p-value
Operational exposure								
Low	205	86.1	22.9	.585	20.0	.085	29.8	.035
High	33	13.9	27.3		33.3		12.1	
Demand-Control								
Low Strain	66	27.7	7.6	<0.001	10.6	<0.001	18.2	0.015
Active Work	36	15.1	25.0		33.3		13.9	
Passive Work	81	34.0	12.3		14.8		34.6	
High Strain	55	23.1	58.2		38.2		36.4	
Social Support					esc			
High	94	39.7	9.6	<0.001	10.6	<0.001	17.0	0.004
Low	143	60.3	32.2		29.4		34.3	

N: absolute number; %: Percentage;

TABLE 2: Burnout symptoms (Emotional Exhaustion) among Brazilian firefighters (n=237)

	Model 1 (crude)			Model 2*		
	OR	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**
Operational exposure						
Low / Medium	1.00			-		
High	1.26	0.54-2.90	0.586			
Demand-Control						
Low Strain	1.00			1.00		
Active Work	4.07	1.24-13.28	0.020	3.40	1.02-11.33	0.047
Passive Work	1.72	0.56-5.30	0.346	1.39	0.44-4.37	0.575
High Strain	17.00	5.89-48.87	<0.001	11.65	3.92-34.60	<0.001
Social Support						
High	1.00			1.00		
Low	4.49	2.07-9.69	<0.001	2.86	1.24-6.60	0.014

Abbreviations: 95%CI = 95% Confidence Interval. OR – Odds Ratio
* Logistic Regression Analysis

TABLE 3: Burnout symptoms (Depersonalisation) among Brazilian firefighters (n=237)

	Model 1 (crude)			Model 2*		
	OR	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**
Operational exposure						
Low / Medium	1.00			-		
High	2.00	0.89-4.45	0.090			
Demand-Control						
Low Strain	1.00			1.00		
Active Work	4.21	1.48-12.00	0.007	4.72	1.60-13.94	0.005
Passive Work	1.47	0.54-3.96	0.451	1.82	0.65-5.05	0.250
High Strain	5.21	2.01-13.51	0.001	5.43	2.03-14.58	<0.001
Social Support						
High	1.00			-		
Low	3.49	1.65-7.38	0.001			

Abbreviations: 95%CI = 95% Confidence Interval. OR – Odds Ratio
* Logistic Regression Analysis

TABLE 4: Burnout symptoms (Low Personal Accomplishment) among Brazilian firefighters (n=237)

	Model 1			Model 2*		
	OR	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**
Operational exposure						
Low / Medium	1.00			1.00		
High	0.33	0.11-0.96	0.043	0.31	0.10-0.94	0.038
Demand-Control						
Low Strain	1.00			-		
Active Work	0.72	0.23-2.25	0.579			
Passive Work	2.38	1.09-5.16	0.029			
High Strain	2.57	1.12-5.91	0.026			
Social Support						
High	1.00			1.00		
Low	2.54	1.34-4.82	0.012	2.59	1.36-4.93	0.004

Abbreviations: 95%CI = 95% Confidence Interval. OR – Odds Ratio
* Logistic Regression Analysis

Burden and Protection: heterogeneous effects of occupational and operational stressors on Burnout dimensions among firefighters

CLINICAL SIGNIFICANCE

This manuscript investigates the association between operational and organizational stressors and burnout syndrome, within its symptom's domains among firefighters in a large urban center in Northeast Brazil. Our results are innovative and may indicate another interpretative reading of the impact of these stressors on the mental health of this population.