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Article

A Pilot Feasibility Study of a Research Protocol Examining Predictors of Post-Traumatic Stress Symptoms among Malaysian Firefighters

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***Abstract*—Post-Traumatic Stress Symptoms (PTSS) among firefighters are an important concern, and identifying potential risk factors may assist organisations in better managing PTSS in this population. A larger study has been proposed to determine the prevalence and predictors of PTSS among Malaysian firefighters. This pilot feasibility study aimed to evaluate the newly designed research protocol, identify any issues pertaining to the questionnaires' instructions and items, assess the data collection process, and determine the reliability of the instruments intended for the main study. This pilot study recruited firefighters from five fire and rescue stations in a state on the east coast of Peninsular Malaysia, using a cluster sampling approach. This cross-sectional study utilised both paper-based and online surveys to figure out the feasibility of subject recruitment, data collection methods, and data entry procedures. Measurement instruments were evaluated using Confirmatory Factor Analysis (CFA) and reliability analysis (internal consistency and two-week test-retest). Of the 108 respondents, 87% preferred the online questionnaire distribution method. Appropriate amendments to the research protocol, recruitment procedures, and data analysis plan were identified and deemed feasible for implementation in the main study. All instruments demonstrated acceptable values of Composite Reliability (CR), high internal consistency (Cronbach's alpha values greater than 0.7), and moderate to excellent consistency of the Intraclass Correlation Coefficient (ICC) for test-retest reliability (ranging from 0.504 to 0.999). Overall, this pilot study supports the feasibility and reliability of the proposed research protocol for conducting the main study on PTSS among Malaysian firefighters.**

***Keywords*—feasibility study; reliability analysis; online survey; firefighters**

I. INTRODUCTION

Firefighting is one of the most hazardous and emotionally demanding occupations, placing personnel at significant risk of developing trauma-related psychological symptoms [1, 2]. According to the American Psychiatric Association, such symptoms may include intrusive recollections of traumatic events, avoidance of trauma-related cues, negative alterations in mood and cognition, and heightened physiological arousal [3]. Post-Traumatic Stress Symptoms (PTSS) are not a formal diagnostic term in the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, 5th Edition). However, it is commonly used in research to describe the presence of trauma-related symptoms regardless of whether full diagnostic criteria for a disorder are met. PTSS overlaps conceptually with Acute

Stress Disorder (ASD), which requires a specific set of symptoms occurring within 3 to 30 days after a trauma [3, 4]. Nevertheless, firefighters often experience repeated and cumulative exposures rather than a single index event, making PTSS a more flexible and relevant construct for capturing the range of trauma responses in this population. If trauma symptoms persist beyond one month and intensify, a diagnosis of Post-Traumatic Stress Disorder (PTSD) may be considered [4]. For the purposes of this study, PTSS was selected as the primary outcome because it allows for a broader assessment of trauma symptoms without limiting evaluation to a specific diagnostic window.

A systematic review showed the prevalence of PTSD among firefighters from the United States of America, Greece, Israel, Korea, Australia, Saudi Arabia, and Japan can vary greatly from 5.7% to 57% [5]. Numerous predictors of PTSD among firefighters have been identified including demographic factors (age, educational level, and marital status), job factors (years of service, rank, numbers of traumatic events, job stress, organisation stress and burnout, occupational effort, internal locus control, resource availability, and debriefing attendance), social support, post-traumatic growth, comorbidity (anxiety, depression, work-related injuries, and chronic musculoskeletal disorder), coping style, resilience, personality, biological factors (adiponectin level), and physical factors (waist circumference and body mass index) [5]. Understanding these predictors is crucial for guiding organisations in designing effective preventive and intervention strategies for firefighters [1]. Accordingly, a main study has been proposed to examine the prevalence and predictors of PTSS among Malaysian firefighters.

Before conducting the main study, a pilot feasibility study is necessary to ensure the clarity, practicality, and reliability of the research protocol [6]. The purpose of this pilot is not to test hypotheses, but to refine the study design, evaluate the data collection procedures, and identify any issues that may affect the feasibility of full-scale implementation. Since the proposed main study relies on self-administered questionnaires, it is essential to ensure that participants understand the items, remain engaged, and provide honest responses [7]. Unclear items, lengthy formats, or poor motivation can lead to careless or random responding, generating substantial measurement error and poor data quality [8, 9]. Conducting a pilot study enables assessment of participants' comprehension of the instructions and items, as well as evaluation of procedural aspects such as recruitment strategies and the suitability of paper-based versus online surveys. This pilot study will also aid in planning and modifying the entire research protocol to determine an ideal research study with a relevant experimental design and precise performance.

The main study will utilise five validated instruments within a single questionnaire: the Post-traumatic Stress Disorder Checklist (PCL-5) with Life Event Checklist (LEC-5), the 10-item Connor-Davidson Resilience Scale (CD-RISC-10), the Multidimensional Scale of Perceived Social Support (MSPSS), the Depression, Anxiety, and Stress Scale (DASS-21), and Brief-Coping Oriented to Problem Experienced (COPE). These instruments were selected because each captures a distinct and theoretically important domain associated with trauma response: (1) traumatic exposure, to quantify operational stressors; (2) psychological distress, which influence individual vulnerability; (3) resilience, reflecting adaptive capacity; (4) social support, an established buffer against PTSD; and (5) coping mechanisms, which determine how individuals manage stress responses. Together, these instruments provide a comprehensive framework aligned with existing PTSD models and tailored to the unique occupational demands of firefighters.

Several instruments, such as the Malay versions of the PCL-5, LEC-5, and DASS-21, have already demonstrated validity and reliability among Malaysian samples [10, 11]. The CD-RISC-10 has a strong foundation in trauma research [12]. At the same time, the MSPSS and Brief-COPE have shown consistent reliability across diverse populations, including adolescents and young adults [13, 14]. Nonetheless, the acceptability, feasibility, and reliability of administering all five instruments together among Malaysian firefighters remain largely unexplored.

Therefore, this pilot feasibility study was conducted to evaluate the clarity and usability of the selected instruments, assess the practicality of the data collection procedures, identify potential challenges in recruitment and protocol implementation, and determine the preliminary reliability of the instruments for use in the main study. The findings will guide refinements to the research protocol, ensuring that the main study is methodologically sound, feasible, and appropriate for the target population.

II. MATERIAL AND METHOD

A. Study Design

A cross-sectional pilot study was conducted from March 8th to March 28th, 2023. This pilot study was conducted in two cycles with a two-week interval to determine respondents' preferences for data collection techniques and for test-retest reliability analysis. The Consolidated Standards of Reporting Trials (CONSORT) guideline for pilot and feasibility trials was used to report the present pilot study [6, 15, 16].

B. Setting

Terengganu was selected due to timely administrative approval, logistical feasibility, and the availability of fire and rescue stations with diverse operational responsibilities suitable for feasibility assessment. The target population comprised firefighters stationed in Terengganu, an eastern state of Peninsular Malaysia. Malaysian firefighters respond to a wide range of emergencies, including fires, road traffic accidents, water-related incidents, hazardous material events, and natural disasters such as floods. Of the seventeen stations in the state, five were purposively selected to participate, as they collectively represent the range of incidents typically managed in Malaysian firefighting operations.

C. Subject Recruitment

Evidence suggests that age and occupational exposure are associated with vulnerability to post-traumatic stress. Younger individuals in the general population of the Netherlands have been reported to be at higher risk of PTSD [17], while among

Korean firefighters, age and years of service were significantly associated with PTSD symptomatology [18]. In Malaysia, firefighters stationed at lower-grade fire and rescue stations typically experience fewer emergency incidents than those in higher-grade stations, reflecting variability in trauma exposure across work settings.

In accordance with Criterion A of the DSM-5, exposure to a traumatic event is fundamental to the development of PTSS [19]. As the survey instruments were administered in Malay, participants were required to read and write in Malay. Therefore, the inclusion criteria comprised registered personnel of the Fire and Rescue Department of Malaysia (FRDM) with at least 6 months of operational experience and sufficient proficiency in Malay. Firefighters holding exclusively administrative roles were excluded. To ensure participant safety in this mental health study, individuals diagnosed with or currently receiving treatment for serious psychiatric disorders were excluded, in line with ethical guidelines concerning vulnerable populations.

A randomised cluster sampling approach was used. Five of the seventeen fire and rescue stations in Terengganu were randomly selected, and all eligible firefighters within each selected station were invited to participate. As this was a non-interventional feasibility study with a limited number of clusters, clustering effects were not incorporated into the analysis.

Sample size was calculated using StatCalc (EPI INFO™, Version 7.2.5.0) based on a finite population of 152 firefighters, a 95% confidence level, and a 5% margin of error. The estimate was derived using a previously reported PTSS prevalence of 42% from another Malaysian state [10]. Allowing for a 10% non-response rate, the required sample size was 120 participants.

D. Study Instrument

The questionnaire was divided into six sections, as follows:

Section A: Demographic and occupational information, including age, gender, higher education level, marital status, job rank, and years of service.

Section B: The CD-RISC-10 is a 10-item measure of resilience [20]. Each item was rated on a five-point Likert scale, with responses spanning from 0 (not true at all), 1 (rarely true), 2 (sometimes true), 3 (often true), and 4 (true nearly all the time). The score ranged from 0 to 40. A score in the bottom quartile (0–29) or second quartile (30–32) may suggest problems coping with stress or bouncing back from adversity. This study used a validated Malay version of CD-RISC-10 [21]. Previous research has indicated that the CD-RISC-10 has excellent internal consistency (Cronbach's alpha = 0.94) and test-retest reliability (0.96) [22].

Section C: The MSPSS was devised to measure the extent to which an individual perceives social support from significant others, family, and friends [23]. The MSPSS is a brief, easy-to-administer self-report questionnaire with 12 items rated on a 7-point Likert-type scale ranging from ‘very strongly disagree’ to ‘very strongly agree’. Any mean scale score between 1 and 2.9 could be considered low support, between 3 and 5 moderate support, and between 5.1 and 7 high support. The validated Malay version, MSPSS-M, exhibited good internal consistency (Cronbach's alpha = 0.89), parallel form reliability (0.94), and test-retest reliability (0.77) (Spearman's rho, $p<0.01$) [13].

Section D: The DASS-21 was developed to collect data on psychological distress. The DASS-21 is a 21-item self-report scale designed to assess psychological distress in the domains of depression, anxiety, and stress [24]. The Malay translation of DASS-21 was utilised for this study [25]. Based on previous research among multiracial Malaysian citizens, DASS-21 displayed good validity and reliability, with Cronbach's alpha values of 0.84, 0.74, and 0.79, respectively, for depression, anxiety, and stress. It also has good factor loading, ranging from 0.39 to 0.73, and good correlations among the scales (0.54 and 0.68) [25].

Section E: PCL-5 with LEC-5 was developed by the Center for Traumatic Stress, US Veterans Affairs Department. The PCL-5 has 20 items that reflect the newly revised DSM-5 criteria [26]. Translated Malay versions of PCL-5 and LEC-5 were used for this study [27, 28]. The items are rated using a 5-point Likert scale, with responses ranging from 0 (not at all) to 4 (extremely). A total score of 31 or higher suggests the high severity of PTSD symptoms across samples, whereas scores below 31 may indicate that the respondent has subthreshold PTSD symptoms or does not satisfy the criteria for PTSD. A recent study among Malaysian firefighters demonstrated that the PCL-5 is a psychometrically sound instrument with excellent internal consistency (Cronbach’s alpha = 0.96) and that Cronbach's alphas ranged from 0.827 to 0.926 for the individual constructs [10].

Section F: The Brief-COPE assesses the frequency with which an individual has employed the coping strategies described in the item to deal with everyday stressful situations [29]. The questionnaire items are scored according to four response frequency categories. The recommended scoring method assigns the lowest frequency of doing answers a score of one and the highest frequency a score of four. The minimum and maximum cumulative scores on the Brief-COPE are 2 and 8, respectively. The translated Malay version of Brief-COPE was used in this study [14]. Based on previous research, the total Cronbach’s alpha value of the Malay version of Brief-COPE was 0.83. Most coping strategies also showed acceptable internal consistency, with Cronbach’s alphas greater than 0.5 [14].

E. Study Procedure

This pilot study involved two cycles of data acquisition to provide experimentation with different data collection techniques and to enable test-retest analysis. Respondents who met the eligibility criteria were briefed during the first meeting and informed about the study’s purpose and data collection process. Informed consent from all respondents was obtained prior to conducting the survey.

In this pilot study, four major aspects were considered to assess the feasibility of the research. First, the subject recruitment procedure was observed to ensure that it was appropriate for the target population. Second, the feasibility of the study protocol was determined. Respondents’ comprehension of the questionnaire’s instructions and items was observed. Furthermore, the data collection procedure was evaluated, including the time required to complete the

questionnaires and the appropriateness of the data collection method (paper or online survey).

The third aspect evaluated was the measurement instrument. All measurement instruments must be reliable for the intended population. Confirmatory Factor Analysis (CFA) and reliability analysis were employed to evaluate the reliability of all the instruments mentioned. Note that all instruments' total or subscale scores must be clearly and positively associated with their respective measurements. Finally, the pilot study evaluated the data entry process and the appropriateness of the proposed statistical tests. This final aspect is crucial for ensuring the efficiency of data administration, including data entry and data coding. A flow chart of the pilot study is shown in Fig. 1.

1) First Cycle of Data Acquisition: The first cycle of data acquisition was done using paper and online surveys, with the presence of investigators during the survey administration. Almost all four major aspects of determining the research's feasibility were addressed in the first cycle.

Throughout the survey administration, the investigator observed and diligently listened to respondents' comments. The questions like, "Did you find this question confusing?" or "Have words been used that you found difficult to understand?" were asked among the respondents during the data collection process. The investigators evaluated any comments raised by respondents. This step was taken until no further modifications were deemed necessary. Any errors were amended and evaluated for the main study.

2) Second Cycle of Data Acquisition: The second cycle of data acquisition was done using an online survey, without the presence of investigators during the survey administration. This cycle was used to determine the appropriateness of data collection methods (paper or online survey) and to assess test-retest reliability.

Questions about respondents' preferences for paper or online surveys were included in the survey form (i.e., "Are you preferring to do a paper or online survey? Give reason for your choice"). All comments and feedback were taken into consideration.

Test-retest reliability measures the consistency of results when the same test is administered to the same sample at a later time point (24). This evaluation was conducted because it was anticipated that respondents would have similar levels of comprehension.

F. Data Entry and Analysis

Each questionnaire item was assigned an identification code and entered into Excel before being transferred to the Statistical Package for the Social Sciences (SPSS) version 24.0 programme. The sociodemographic information of respondents was subjected to a descriptive analysis. The CFA and reliability testing (internal consistency and test-retest reliability) were conducted on the remaining data. The reliability analysis confirmed that each observed variable aligned with its hypothesised factor structure. In addition, the reliability analysis aimed to ensure that the questionnaire was comprehensive and appropriate, and that the questions were well-defined, clearly understood, and presented consistently [30].

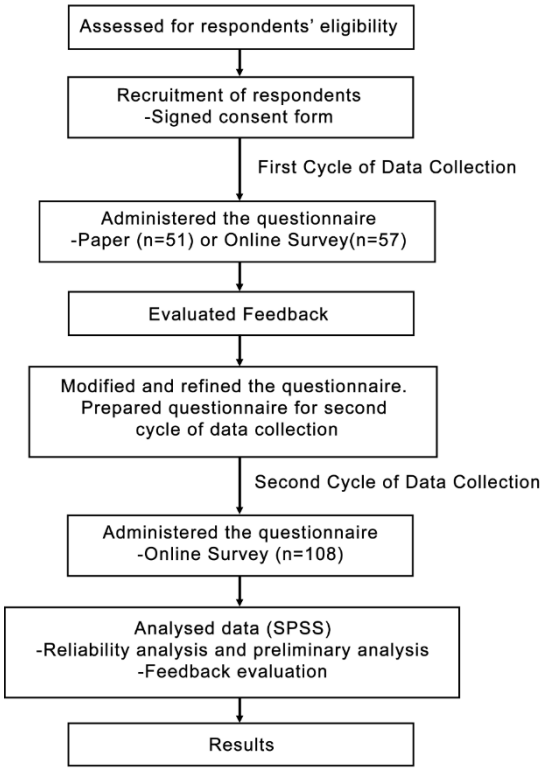

Figure 1. The pilot study flowchart

CFA provides estimates of factor loadings, indicating the strength and direction of the relationship between each observed variable and its corresponding latent factor [31]. High, statistically significant factor loadings indicate that the variables are strong indicators of the intended construct. The acceptable factor loading should be greater than 0.5 [31]. Composite Reliability (CR) is a statistic that helps evaluate the extent to which the observed variables reliably measure a latent factor or construct [32]. It helps researchers determine the reliability of the observed variables in representing the underlying constructs, contributing to the overall quality and validity of the measurement model. CR values greater than 0.7 indicate reliable factors. In contrast, CR values of 0.95 or higher are unacceptable because they may reflect redundancy [33]. Hence, CR should be between 0.7 and 0.95.

Internal consistency refers to the homogeneity of questions within a domain and their ability to measure the same construct [34]. In other words, internal consistency refers to the degree to which different scale items measure the same things. Internal consistency is frequently evaluated using Cronbach's alpha, which is generally considered acceptable for values greater than 0.7 [14, 35]. The greater the Cronbach's alpha, the more homogeneous the test's construction. On the contrary, the lower Cronbach's alpha values indicate that the test may contain heterogeneous factors. Test-retest reliability was estimated using the Interclass Correlation Coefficient (ICC). For group comparisons, a value of 0.7 or greater indicates a high degree of consistency among respondent results [36].

The descriptive and inferential analyses were conducted to determine the prevalence of PTSS and the association between PTSS and the other studied factors. This step was taken in order to evaluate the efficacy of any manipulations and to characterise the key features of the data.

G. Ethical Consideration

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Research Ethics Committee, Universiti Sains Islam Malaysia (USIM/JKEP/2023-246). Written permission was granted from the Planning and Research Division, Fire and Rescue Department of Malaysia.

III. RESULTS AND DISCUSSION

A total of 108 firefighters from five fire and rescue stations participated in this pilot study (90% response rate). All of them were Malays and Muslims. The majority of them were men (97.2%), had completed secondary school (73.1%), and were married (91.7%). 32.4% of them served as firefighters for more than 20 years, while another 35.2% served as firefighters for less than 10 years. This basic descriptive analysis of respondents' characteristics and job profiles is presented in Table I.

TABLE I. CHARACTERISTICS OF THE RESPONDENTS (N = 108)

Characteristics	Frequency, n (%)
Age	
21-27	15 (13.9)
28-34	23 (21.3)
35-41	29 (26.9)
42-49	21 (19.4)
50-56	20 (18.5)
Gender	
Male	105 (97.2)
Female	3 (2.8)
Education Level	
Secondary School	79 (73.1)
Diploma/Certificate	28 (25.9)
Bachelor Degree	1 (0.9)
Marital Status	
Single	8 (7.4)
Married	99 (91.7)
Divorced	1 (0.9)
Years of Service	
1-5	28 (25.9)
6-10	10 (9.3)
11-15	11 (10.2)
16-20	24 (22.2)
>20	35 (32.4)
Job Rank	
Fire Officer	51 (47.2)
Senior Fire Officer	53 (49.1)
Lead Fire Officer	4 (3.7)

A. Subject Recruitment

The Planning and Research Division (Fire and Rescue Department of Malaysia) database was found to be suitable as a sampling frame for identifying eligible participants. Fire and rescue stations served as the primary sampling units (clusters), and the study population was stratified by station location. Five stations were randomly selected from the seventeen stations in Terengganu. All eligible firefighters at each selected station were then invited to participate, resulting in a cluster-based sampling approach. The majority of those invited consented to participate, resulting in a high response rate.

Based on Pearson's correlation test between years of service and case variant, there is a significant linear correlation between the years of service and case variant ($p<0.001$). The observed Pearson's correlation coefficient is 0.383, indicating a positive, medium correlation. Hence, including years of service as one of the eligibility criteria for participants will help obtain respondents who meet Criterion A of DSM-5 for PTSS.

B. Feasibility of the Study Protocol

Fifty-one respondents completed the questionnaires via paper survey. None of them reported difficulty following the procedure for the paper survey. During the online survey, a few respondents reported receiving an email with an incomplete link to the questionnaire. To resolve the issue, the investigators combined the consent form and questionnaire into a single link. If respondents attempted the survey, they should have consented to the study. In the second cycle of data collection, none of them raised any additional problems with this revised online survey procedure.

The investigators received feedback about the LEC-5 instrument. However, the investigators discovered a solution to the problem. The name "*Senarai Semak Kejadian Trauma* (Traumatic Events Checklist)" was confusing to some respondents when applied to the LEC-5. They believed that it was necessary to mark only traumatic events that had already caused them traumatic stress. In contrast, this is merely a list of events they have previously encountered. Due to that, LEC-5 was renamed "*Senarai Semak Pengalaman Dalam Perkhidmatan* (In-Service Experience Checklist)". As a result, none of them left this checklist blank in the second cycle of data collection.

In addition, respondents took longer to recall and calculate the frequency of experiencing traumatic events on the LEC-5 instrument. Therefore, the investigators decided to use the LEC-5 developed by Salleh et al. (2019) without frequency notation [28]. As a result, the average time required to complete a questionnaire dropped from 35 minutes to 20 minutes. Respondents also hesitated when answering the LEC-5 and suggested that a road accident may involve a train accident. In contrast, an accident on the water may involve a ship accident. At the investigators' consideration, these incidents were included as examples in the corresponding question item.

Overall, there were no reports of respondents having difficulty comprehending the language in the questionnaires. The feedback from the second cycle of data collection indicated that 87% of respondents preferred online distribution of the questionnaire. Hence, online surveys will be used as a data collection technique in the future main study.

C. The Reliability of the Measurement Instrument

The factor loadings for the CD-RISC-10 items and their CR indicated that the observed variables adequately measured the intended construct. The ICC of CD-RISC-10 ranges from 0.594 to 0.790. It indicated that this instrument has moderate to good consistency. This analysis suggested that the Malay version of CD-RISC-10 was reliable, with strong internal consistency (Cronbach's alpha = 0.862). Table II summarises the results of the CD-RISC-10 reliability analysis.

TABLE III. RESULT OF RELIABILITY TESTING ON CONNOR-DAVIDSON RESILIENCE SCALE (CD-RISC-10)

Item	Confirmatory Factor Analysis		Reliability Analysis	
	Factor Loading	Composite Reliability	ICC Value	Cronbach's Alpha
Item 01	0.521	0.903	0.622	0.862
Item 02	0.659		0.762	
Item 03	0.384		0.594	
Item 04	0.752		0.696	
Item 05	0.619		0.709	
Item 06	0.832		0.774	
Item 07	0.593		0.778	
Item 08	0.827		0.748	
Item 09	0.823		0.754	
Item 10	0.846		0.790	

Note: ICC = Intraclass Correlation Coefficient

Based on the CFA model of MSPSS, all the latent variables in a measurement model were reliable. The ICC for the Malay version of MSPSS ranges from 0.740 to 0.878. It indicated that this instrument has moderate to good consistency. It is also suggested that the items in each domain in the MSPSS were reliable as having high internal consistency with Cronbach's alpha of 0.934, 0.879, and 0.890 (refer to domains of significant others, family, and friends, respectively). Table III summarises the results of the MSPSS reliability analysis.

TABLE IIIII. RESULT OF RELIABILITY TESTING ON MULTIDIMENSIONAL SCALE OF PERCEIVED SOCIAL SUPPORT (MSPSS)

Domain/Item	Confirmatory Factor Analysis		Reliability Analysis	
	Factor Loading	Composite Reliability	ICC Value	Cronbach's Alpha
Significant Others				
Item 01	0.949	0.938	0.864	0.934
Item 02	0.962		0.812	
Item 05	0.866		0.858	
Item 10	0.770		0.878	
Family				
Item 03	0.914	0.868	0.805	0.879
Item 04	0.950		0.872	
Item 08	0.598		0.746	
Item 11	0.654		0.684	
Friends				
Item 06	0.882	0.907	0.857	0.890
Item 07	0.719		0.787	
Item 09	0.911		0.825	
Item 12	0.849		0.740	

Note: ICC = Intraclass Correlation Coefficient

The factor loadings for the DASS-21 items and their CR also showed strong values on the observed variables, indicating that the items measured their intended construct. The ICC range for the Malay version of DASS-21 was 0.504 to 0.740. It indicated that this instrument has moderate consistency. It is also suggested that the items in each domain of the DASS-21 were reliable because they had high internal consistency with Cronbach's alpha of 0.847, 0.769, and 0.824. All the mentioned results are presented in Table IV.

The PCL-5 CFA model showed that almost all factor loadings were greater than 0.5, and its CR value was within a good range, indicating that the observed variables reliably measure the desired construct. The ICC of PCL-5 ranges from 0.661 to 0.931. It indicated that this instrument has moderate to excellent consistency. The internal consistency of each domain was high, with Cronbach's alpha values were greater than 0.7. This Malay version of the PCL-5 also had an aggregate Cronbach's alpha of 0.903, indicating that its items are reliable for measuring PTSD symptoms. Table V presents the results of the PCL-5 reliability analysis.

TABLE IV. RESULT OF RELIABILITY TESTING ON DEPRESSION, ANXIETY AND STRESS SCALE (DASS-21)

Domain/Item	Confirmatory Factor Analysis		Reliability Analysis	
	Factor Loading	Composite Reliability	ICC Value	Cronbach's Alpha
Stress				
Item 01	0.684	0.880	0.659	0.847
Item 06	0.621		0.583	
Item 08	0.718		0.541	
Item 11	0.806		0.729	
Item 12	0.806		0.578	
Item 14	0.663		0.542	
Item 18	0.694		0.504	
Anxiety				
Item 02	0.685	0.880	0.736	0.769
Item 04	0.715		0.627	
Item 07	0.658		0.637	
Item 09	0.689		0.673	
Item 15	0.720		0.550	
Item 19	0.747		0.692	
Item 20	0.786		0.740	
Depression				
Item 03	0.612	0.864	0.593	0.824
Item 05	0.801		0.603	
Item 10	0.630		0.563	
Item 13	0.679		0.635	
Item 16	0.724		0.512	
Item 17	0.719		0.726	
Item 21	0.656		0.651	

Note: ICC = Intraclass Correlation Coefficient

For the Brief-COPE questionnaire, all coping styles items had satisfactory CR values, even though some had poor factor loading. It means that their constructs match the observed data. The ICC of the Malay version of Brief-COPE ranges from 0.601 to 0.999. It indicated that this instrument has moderate to excellent consistency. Avoidant, problem-focused, and emotional-focused coping styles also showed high internal consistency, with Cronbach's alphas greater than 0.7 (0.756, 0.920, and 0.885, respectively). The result of the reliability analysis of Brief-COPE is shown in Table VI.

D. Analysis of the Main Study Objective

Data entry into SPSS was smoothly conducted. A simple linear regression analysis was used to determine the association between PTSS and the studied factors. The studied factors that were found to be significantly associated with PTSS were resilience, stress, anxiety, depression, family support, significant others support, problem-focused coping, emotion-focused coping, and avoidant coping (p-value < 0.05).

Data analysis for this pilot study suggests that the PCL-5 score can be analysed as a numerical variable for inferential analysis to ensure the severity of PTSS is meticulously

represented, and as a categorical variable to simplify data interpretation and organise data into meaningful groups.

TABLE V. RESULT OF CFA AND RELIABILITY TESTING ON POST-TRAUMATIC CHECKLIST-5 (PCL-5)

Item	Confirmatory Factor Analysis		Reliability Analysis	
	Factor Loading	Composite Reliability	ICC Value	Cronbach's Alpha
Item 01	0.530		0.922	
Item 02	0.672		0.931	
Item 03	0.678		0.852	
Item 04	0.591		0.846	
Item 05	0.628		0.722	
Item 06	0.463		0.750	
Item 07	0.493		0.787	
Item 08	0.506		0.840	
Item 09	0.648		0.800	
Item 10	0.665		0.889	
Item 11	0.745	0.935	0.661	0.903
Item 12	0.698		0.769	
Item 13	0.674		0.767	
Item 14	0.719		0.891	
Item 15	0.673		0.790	
Item 16	0.602		0.816	
Item 17	0.625		0.781	
Item 18	0.796		0.839	
Item 19	0.773		0.769	
Item 20	0.703		0.688	

Note: ICC = Intraclass Correlation Coefficient

E. Discussion

The completion of this pilot study, which replicated the procedures of the main study, demonstrated the feasibility of the study protocol. The response rate in the pilot study was high, which was encouraging. A similar recruitment method will be employed in the main study.

Some respondents had trouble comprehending the initial LEC-5 instrument's instructions. The LEC-5's items also left some respondents hesitant and unable to give their responses. To address those issues, appropriate modifications were made and will be utilised in the main study. These modifications do not interfere with the scoring protocol of the respective instrument. This incident demonstrated that sometimes minor adjustments are required to facilitate understanding of questionnaire instructions in a certain population.

The online survey method was also chosen by a majority vote in the feedback section during the second cycle of data collection. Respondents reported preferring online surveys because they were more convenient and accessible [37]. Besides, online surveys also speed up and secure data collection, as responses are typically automatically stored in the survey portal's database [38]. It also eliminates the need for manual data entry, reducing errors.

Based on the CFA model, all the instruments used in Brief-COPE showed satisfactory quality in representing the underlying constructs. In the avoidant coping construct, the subdomain of substance use showed items with similar factor loadings. Redundant items may contribute less unique information, potentially affecting reliability [39]. Based on respondents' characteristics, the involvement of 100% Muslims in this pilot study might cause respondents to have very similar responses to items related to substance use. Since the original developer of Brief-COPE categorised avoidant coping as "the least popular coping style" rather than "avoidant coping" (as in the Malay version), it is already justified that the items in the avoidant coping group might not have originally been structured into a single definite factor [29].

TABLE VIV. RESULT OF RELIABILITY TESTING ON BRIEF-COPE

Domain/Subdomain/Item		Confirmatory Factor Analysis		Reliability Analysis	
		Factor Loading	Composite Reliability	ICC Value	Cronbach's Alpha
Avoidant Coping					
Self-distraction	Item 01	0.403		0.813	
	Item 19	0.544		0.823	
Denial	Item 03	0.547		0.622	
	Item 08	0.564		0.781	
Substance use	Item 04	0.048		0.999	
	Item 11	0.048	0.755	0.999	0.756
Behavioural disengagement	Item 06	0.463		0.622	
	Item 16	0.456		0.601	
Venting	Item 09	0.510		0.729	
	Item 21	0.501		0.724	
Self-blame	Item 13	0.622		0.870	
	Item 26	0.626		0.822	
Problem-focused Coping					
Active coping	Item 02	0.683		0.798	
	Item 07	0.835		0.843	
Use of instrumental support	Item 10	0.761		0.781	
	Item 23	0.848	0.919	0.822	0.920
Planning	Item 14	0.873		0.882	
	Item 25	0.847		0.845	
Emotional-focused Coping					
Use of emotional support	Item 05	0.630		0.771	
	Item 15	0.723		0.781	
Positive reinterpretation	Item 12	0.796		0.801	
	Item 17	0.882		0.847	
Humour	Item 18	0.484	0.890	0.854	0.885
	Item 28	0.049		0.728	
Acceptance	Item 20	0.771		0.797	
	Item 24	0.698		0.844	
Turning to religion	Item 22	0.748		0.847	
	Item 27	0.730		0.814	

Note: ICC = Intraclass Correlation Coefficient

Another reliability analysis suggested that the Malay versions of PCL-5 (MPCL-5) and DASS-21 produced results comparable to those of their original translations and validations [25, 27]. Nevertheless, the ICC for the DASS-21 did not achieve the same range of moderate to excellent consistency as that obtained with the PCL-5. Perhaps the reason was that the DASS-21 instructed respondents to rate each statement for the current week. In contrast, the PCL-5 asked for responses in terms of months. Because the repeated test was conducted after two week, it is anticipated that the respondent's current situation will differ slightly each week. Nonetheless, the moderate ICC of the DASS-21 in our study still indicates its reliability. Hence, both PCL-5 and DASS-21

demonstrated the consistency and feasibility of the instruments for measuring the PTSS and emotional states of depression, anxiety, and stress among firefighters in Malaysia.

The developer of CD-RISC has authorised the use of this instrument only in the 2-, 10-, and 25-item versions, as only those have been adequately tested and validated. Our study revealed that the instrument's internal consistency reflected its reliability in assessing firefighters' resilience. This instrument was anticipated to have good reliability because it was not only developed from years of extensive research in PTSD but also because it has been used in a variety of populations (including large community samples, survivors of various traumas, Alzheimer's caregivers, adolescents, elders, patients in treatment for PTSD, members of different ethnic groups and cultures, and selected professional or athletic groups) [40].

As in previous research, the reliability analyses of the Malay versions of the MSPSS (M-MSPSS) and Brief-COPE (Malay Brief-COPE) in this study revealed high psychometric value [13, 14]. Despite the item's length, its reliability result remains encouraging. Thus, the findings of the present study provided evidence that the Malay Brief-COPE and M-MSPSS were reliable enough to be used together with the other instruments. Overall, data entry for this study was not problematic. It assisted the investigator in determining the most appropriate variable type for data analysis.

The major strength of this study is that the research focuses on a specific organisation. Hence, it is easier to design a procedure for respondent recruitment. In addition, this study received good cooperation from the targeted population due to its high response rate (90%).

Although promising, this pilot study was not without its limitations. Selection bias may have occurred due to voluntary participation and the use of cluster sampling, which may have favoured firefighters who were more willing to participate or more psychologically well-adjusted. In addition, only five stations from one state were included, which limits representativeness. These issues will be addressed in the main study through a larger, more diverse, and probabilistically selected sample. Besides, the cross-sectional nature of the study is another limitation. Since the data were obtained from a self-reported questionnaire, they may be subject to recall bias.

IV. CONCLUSION

This pilot study generated preliminary evidence regarding the feasibility of the proposed research protocol, including the practicality of recruitment procedures, data collection methods, and the use of the selected measurement instruments. While the protocol demonstrated acceptable reliability and operational viability, the findings—particularly estimates of the prevalence of PTSS—must be interpreted with caution, as the study was not designed or powered to produce representative or generalisable estimates. Although the instruments demonstrated satisfactory psychometric performance in this pilot sample, further validation in a larger, more diverse firefighter population is warranted. Overall, the pilot findings support progression to the main study, with refinement of sampling and analytical strategies to strengthen the robustness of subsequent inferences regarding predictors of PTSS among Malaysian firefighters.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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