

**Integrating Teamwork into the Transactional Model of Stress and Coping:  
Understanding Occupational Stress in Firefighters**

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**Abstract**

Firefighting is a fundamentally stressful occupation that relies heavily on organized teamwork and effective coping. Traditional stress frameworks including Transactional Model of Stress and Coping, have rarely incorporated team dynamics as integral mechanisms in stress regulation. This study extends this model by examining the mediating roles of teamwork and coping strategies such as problem-focused, emotion-focused and avoidance coping in the relationship between cognitive appraisal and occupational stress among firefighters. The study employed a quantitative, cross-sectional design while data were collected from 400 professional firefighters aged 25–60 years, each with at least five years of operational service experience across nine divisions of Punjab, Pakistan. Standardized and contextually adapted instruments were used including Cognitive Appraisal Scale, Team Process Survey Measure, Brief COPE, and Scale of Occupational Stress for Firefighters (SOOS-F). Results revealed that cognitive appraisal positively predicted problem-focused coping and teamwork while negatively predicted emotion-focused and avoidance coping. Both problem-focused coping and teamwork were associated with lower occupational stress whereas emotion-focused and avoidance coping predicted higher stress levels. Mediation analyses confirmed that teamwork and coping strategies jointly mediated the appraisal–stress relationship indicating both direct and indirect pathways. Theoretically, this study integrates teamwork into Transactional Model of Stress and Coping and enhancing its applicability

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to high-risk, team-dependent professions. Practically, findings highlight the importance of fostering adaptive coping and teamwork to mitigate operational stress in firefighting perspectives.

**Keywords:** *Keywords: Transactional Model, Cognitive Appraisal, Coping Mechanism, Teamwork, Occupational Stress, Firefighters*

## **Introduction**

Occupational stress is a critical global issue which affecting both health and productivity (Makara et al., 2020). It occurs when job demands surpass an individual's coping capacity (Quick & Henderson, 2016). According to Transactional Model of Stress (Lazarus & Folkman, 1984), individuals evaluate situations as beneficial (i.e., eustress) or harmful (i.e., distress) where the former enhances motivation and performance while the latter impairs well-being and effectiveness (Robbins et al., 2018). Coping effectiveness depends on existing resources and stress intensifies when these resources are lacking. Individual factors such as locus of control and cognitive appraisal also shape stress responses (Willis, 2005). Firefighters face unique stressors, broadly categorized as organizational (e.g., workplace policies and procedures; Ricciardelli, 2018) and operational (e.g., exposure to traumatic events; Finney et al., 2013). This study focuses on operational stressors, applying Lazarus's Transactional Model of Stress and Coping (TMSC) to firefighting context. It further extends the model by incorporating teamwork as mediator, acknowledging the inherently collaborative demands of operations at fireground.

This study draws on Lazarus and Folkman's (1984) TMSC which explains stress as arising when perceived demands exceed available resources. TMSC emphasizes cognitive appraisal processes rather than simply listing stressors (Lazarus, 1991). Appraisal occurs in two stages. In primary appraisal, situations are judged as irrelevant, threatening, or challenging. Irrelevant situations lack significance, threatening ones exceed coping capacity and challenging ones promote growth (Largo et al., 2005). Threat appraisals are typically linked to negative outcomes whereas challenge appraisals foster adaptation (Horan et al., 2020). Secondary appraisal stage involves evaluating coping resources such as psychological strengths, social support, physical ability and perceived control (Karademas & Kalantzi, 2004). These processes interact dynamically: threat appraisals diminish coping potential while challenge appraisals enhance it (Ferguson et al., 1999; Esteves & Gomes, 2013).

Coping mechanisms mediate the linkage between cognitive appraisal and stress consequences (Ogden, 2001). These mechanisms represent ongoing cognitive and behavioral efforts to accomplish resource straining demands (García et al., 2018). Coping is generally classified into three types: problem-focused coping which targets stressors directly; emotion-focused coping which regulates emotional responses; and avoidance coping which involves withdrawal or disengagement (Carver, 1997; Largo et al., 2005). Poor use of these strategies may intensify psychological or physiological pressure (Hammig, 2018). Their effectiveness depends on individual traits, social

context, and nature of stressors (Willis, 2005). Halbesleben (2010) further distinguishes between confrontational “*fight*” strategies and avoidant “*flight*” strategies including seeking social support, reframing experiences through positive appraisal and practicing self-care (Carver et al., 1989).

Firefighting is an exceptionally high-risk profession where operational stressors such as exposure to traumatic events, catastrophic injuries/deaths, physically demanding rescues, toxic environments, and unpredictable hazards, often exceed individual coping capacity (Del et al., 2006; Meyer et al., 2012; Skogstad et al., 2013). These demands are compounded by extended work hours, disrupted sleep and constant need for readiness, all of which elevate health risks and contribute to early attrition (Murta & Tróccoli, 2007; Smith et al., 2018). Importantly, such stressors emerge in a team-based environment where effective stress management depends on coordinated appraisal, shared resources and collective regulation of emotions during operations (Britton et al., 2013; Marcelino & Figueiras, 2007). This reality underscores the limitations of traditional individual-focused stress models and highlights the value of incorporating teamwork as mediator between appraisal, coping and stress in firefighting contexts (Eastlake et al., 2015).

Firefighting thus represents a team-dependent profession where coordinated cognitive, emotional and behavioral processes are essential for success under the extreme risk and time pressure (Salas et al., 2018). Regulatory standards such as National Fire Protection Association (NFPA-1001, 2019) and International Association of Fire Chief (IAFC, 2009) institutionalize teamwork through requirements like Two-in/Two-out rule, mandating interdependent action (Roychowdhury, 1998). High-profile cases such as Hudson River landing, illustrate how role clarity (Stanton et al., 2018) and shared accountability (Shuffler et al., 2018) drive mission success. At same time, breakdowns in communication or error correction can generate collective strain, spreading stress across the team (Aust et al., 2023). Teamwork therefore functions as both critical coping resource (reducing threat appraisals through shared cognition) and potential stressor (when coordination fails), reinforcing its relevance as a mediator in extending the TMSC.

Firefighting demands highly coordinated team processes e.g., cognitive, behavioral, and interpersonal across three phases: transition (planning), action (real-time response) and interpersonal maintenance (conflict resolution) (LePine et al., 2008). Integrating these Marks’ team process phases with appraisal and coping sequences provides new framework for high-risk professions. Transition processes (e.g., briefing) shape collective appraisals of threat and challenge, action processes (e.g., role coordination) influence coping potential and interpersonal processes (e.g., trust-building) buffer post-event strain. This integration links team functioning to individual stress responses and offers strategies to improve resilience and performance.

At the same time, stress can damage teamwork itself. It disrupts cognition (Petrac et al., 2009), undermines communication and cooperation (Burke et al., 2018) and weakens shared mental models, decision-making and adaptability (Kamphuis et al., 2011). Breakdown in collaboration also heighten negative emotions and collective strain (Pfaff & McNeese, 2010). Because firefighting teams often form rapidly, optimizing coordination, trust and communication is essential (Power, 2018).

Empirical evidence shows that failures often stem from communication gaps while strategies such as closed-loop communication enhance adaptability and success (Wilson et al., 2007). This study emphasizes episodic team processes (Marks et al., 2001), aligning with Extended TMSC to explain how team dynamics mediate stress during operations at fireground.

The extension of TMSC (Lazarus & Folkman, 1984) arises from key limitations in applying it to team-dependent emergency first responders. Traditional TMSC underrepresents collective coping and does not fully capture appraisal in high-risk, team-based environments, oversimplifies stressor categories. To address these gaps, the extended model integrates Marks et al.'s (2001) team process theory and Salas et al.'s (2018) teamwork competencies. It distinguishes between person-related stressors which managed through individual coping and team-related stressors which require collective strategies (Hagemann et al., 2012). Within this framework, primary appraisal incorporates team-contextual factors such as entry in buddy system while secondary appraisal reflects shared resources including role clarity and equipment availability (Karademas & Kalantzi, 2004).

In line with Maxwell and Cole's (2007) recommendations, addressing potential bias in cross-sectional mediation analyses enhances validity of causal inferences and supports design of targeted interventions. This study contributes in two ways. First, it examines the TMSC in firefighting by probing how challenge and threat appraisals explain stress variance in the shared operational context (Taris et al., 2010). Second, it advances theory by embedding teamwork as parallel mediator alongside individual coping strategies, reflecting collective demands of incidents such as response on hazardous material (HazMat) emergency (Aust et al., 2023). By integrating team dynamics into appraisal-coping sequence, the extended TMSC offers a more relevant framework for high-risk professions and practical guidance for enhancing resilience or operational efficacy.

### **Hypotheses**

- H<sub>1</sub>:** Demographic variables and occupational stress are significantly correlated among firefighters.
- H<sub>2</sub>:** Cognitive appraisal significantly predicts coping strategies, teamwork and occupational stress among firefighters.
- H<sub>3</sub>:** Coping strategies and teamwork significantly predict occupational stress among firefighters.
- H<sub>4</sub>:** Coping strategies and teamwork mediate the relationship between cognitive appraisal and occupational stress among firefighters.

### **Research Methodology**

Positivism was chosen as philosophical consideration for current research with an approach transitioning from inductive to deductive and correlation being employed as a strategy. A mono-method with cross-sectional time horizon was the selected choice while quantitative data analysis techniques and procedures (e.g., parallel mediation) were adopted.

The study included male firefighters aged 25 to 60 years who had completed at least six months of training equivalent to Firefighter Level I certification and

possessed a minimum of five years of active field experience. Administrative staff, non-operational personnel and firefighters with less than five years of operational experience were excluded. A total of 450 active firefighters from nine divisions of Punjab were recruited using purposive sampling. Based on G\*Power calculations for a medium effect size, minimum sample of 400 was required. Following data screening, 50 responses were removed i.e., 31 for missing or inappropriate entries and 19 for failing importance perception criteria. Resulting in a final analytic sample of 400 participants meeting the required sample size while ensuring representation across all divisions.

Ethical approval was obtained from Advanced Studies and Research Board (ASRB) of University of Gujrat, Pakistan and all recommendations were implemented. Recruitment followed ethical principles of autonomy, beneficence, justice and integrity (Lindsay & Øvreide, 2009). The sample included firefighters from all districts within Punjab province to ensure comprehensive representation. Informed consent was obtained from both district management and individual participants. They were fully briefed on the study's purpose, significance and voluntary nature. Questionnaires were self-administered with participants provided clear instructions on how to complete each item. An online survey link was distributed and participants were asked to select responses that best reflected their perspectives. They were informed that they could request study findings by contacting the researcher via provided email address or phone number upon completion. At conclusion of study, participants were thanked and acknowledged for their contributions. Permission to use measurement scales including translations, was obtained from the original authors. Participation was entirely voluntary and confidentiality was strictly maintained throughout study.

### ***Demographic Form***

A demographic information form was developed to collect key participant characteristics. The form captured personal and professional details including designation, age, experience, education and district.

### ***Cognitive Appraisal Scale (CAS)***

The study employed Urdu-adapted CAS for firefighters (Ali & Shahzadi, 2025) that was formerly developed by Gomes and Teixeira (2013). This 15-item instrument assesses five dimensions on seven-point Likert type scale ranging from 0 to 6. Three dimensions capture primary appraisal including work importance ( $\alpha = .94$ ), threat perception ( $\alpha = .88$ ) and challenge perception ( $\alpha = .91$ ) while two dimensions assess secondary appraisal namely coping potential ( $\alpha = .95$ ) and perceived control ( $\alpha = .88$ ). Overall scale demonstrated strong reliability ( $\alpha = .83$ ), supporting its suitability for measuring cognitive appraisals of stress among firefighters.

### ***Brief Coping Orientation to Problems Experienced (COPE) Scale***

The study employed 25-item Urdu-adapted Brief COPE inventory (Nisa & Siddiqui, 2020) that was modified from original measure of Carver (1997). The adapted version assesses three coping strategies. Problem-focused coping includes eight items ( $\alpha = .77$ ), emotion-focused coping includes seven items ( $\alpha = .66$ ) and

avoidance coping includes ten items ( $\alpha = .67$ ). Participants rated each item on a four-point Likert type scale ranging from 0 (*not at all*) to 3 (*doing a lot*). Higher scores on each subscale indicate greater use of corresponding coping strategy.

**Team Process Survey Measure (TPSM)**

The study utilized 10-item Urdu-adapted TPSM (Ali & Shahzadi, 2025) which originally developed by Mathieu et al. (2020) to assess three team processes. The transition process includes three items measuring *mission analysis*, *goal specification* and *strategy formulation* ( $\alpha = .93$ ). The action process includes four items assessing *progress monitoring and coordination* ( $\alpha = .94$ ). The interpersonal process includes three items measuring *conflict management and motivation* ( $\alpha = .92$ ). Participants rated each item on a five-point Likert type scale ranging from 1 (*not at all*) to 5 (*very great extent*). Overall scale confirmed excellent reliability ( $\alpha = .96$ ).

**Scale of Occupational Stress for Firefighters (SOOS-F)**

The study employed 30-item SOOS-F (Ali & Shahzadi, 2025) which assessing two main dimensions of operational occupational stress. Teamwork-related stress includes 17 items which further divided into *synergy-related stress* (nine items;  $\alpha = .92$ ) and *fire-dynamics related stress* (eight items;  $\alpha = .91$ ). Person-related stress includes 13 items ( $\alpha = .93$ ). Firefighter rated each item on a five-point Likert type scale ranging from 1(*never*) to 5 (*always*). Higher scores indicate greater levels of stress. Overall scale proven excellent internal consistency ( $\alpha = .96$ ) which supporting its suitability for estimating operational occupational stress among firefighters.

**Results**

The analysis commenced with descriptive statistics to summarize the demographic characteristics of participating firefighters. Main analyses included three components: first, assessing the reliability of all measurement scales; second, examining the bivariate correlations among key study variables and dichotomous demographics; third, performing mediation analyses to test coping strategies and teamwork as parallel mediators. All analyses were carried out using SPSS v 26 and PROCESS macro (Hayes, 2012) with statistical significance set at  $p < .05$ .

**Demographic Characteristics of Sample**

Descriptive statistics were computed to summarize the demographic characteristics of 400 firefighters included in sample. The results are presented in Table 1.

**Table 1 :Demographic Characteristics of Firefighters for Analysis (N = 400)**

| Variable           | <i>f</i> | %     |
|--------------------|----------|-------|
| <b>Designation</b> |          |       |
| Firefighters       | 319      | 79.75 |
| Lead Firefighters  | 81       | 10.25 |
| <b>Age</b>         |          |       |

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|                     |     |       |
|---------------------|-----|-------|
| Below 30 years      | 46  | 11.50 |
| Above 30 years      | 354 | 88.50 |
| <b>Experience</b>   |     |       |
| Below 10 years      | 127 | 31.75 |
| Above 10 years      | 273 | 68.25 |
| <b>Education</b>    |     |       |
| Intermediate        | 116 | 29.00 |
| Graduation or Above | 284 | 71.00 |
| <b>District</b>     |     |       |
| Bahawalpur          | 45  | 11.25 |
| Gujranwala          | 44  | 11.00 |
| Rawalpindi          | 43  | 10.75 |
| Dera Ghazi Khan     | 42  | 10.50 |
| Lahore              | 45  | 11.25 |
| Sahiwal             | 46  | 11.50 |
| Faisalabad          | 44  | 11.00 |
| Multan              | 46  | 11.50 |
| Sargodha            | 45  | 11.25 |

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*Note.* % = percentage; *f* = frequency

As shown in Table 1, majority of participants were operational firefighters, comprising 79.75% of sample. Seniority was reflected in age, with 88.50% aged older than 30 years and experience, with 68.25% having more than ten years of service. Educational attainment was high with 71% holding at least a graduate degree and representation from all nine divisions was almost equal. This demographic profile specifies experienced and educated cohort, well-suited to offer insights into operational occupational stress dynamics.

Descriptive statistics including number of items, actual and potential score ranges, means, standard deviations and Cronbach’s alpha, were computed for all study measures to assess reliability. Results are presented in Table 2.

**Table 2: Questionnaire’s Cronbach Alpha CAS, Brief COPE, TPSM, and SOOS-F**

| Variables  | <i>k</i> | <i>M(SD)</i> | Range  |           | <i>α</i> |
|------------|----------|--------------|--------|-----------|----------|
|            |          |              | Actual | Potential |          |
| CAS        | 15       | 10.67(1.15)  | 3.5-15 | 0-15      | .90      |
| Brief COPE | 25       | 45.22(7.56)  | 11-70  | 0-75      | .81      |
| TPSM       | 10       | 47.78(6.90)  | 15-50  | 10-50     | .94      |
| SOOS-F     | 30       | 71.41(28.24) | 40-150 | 30-150    | .96      |

*Note.* *k* = no. of items; *α* = reliability; *M* = mean; *SD* = standard deviation; CAS = cognitive appraisal scale; Brief COPE = coping orientation to problems experienced; TPSM = team processes survey measure; SOOS-F = scale of occupational stress for firefighters

As presented in Table 2, all the study measures confirmed strong internal consistency. Reliability coefficients were  $\alpha = .90$  for cognitive appraisal,  $\alpha = .81$  for Brief COPE,  $\alpha = .94$  for Team Process Survey Measure and  $\alpha = .96$  for scale of occupational stress. These values exceeded from recommended threshold of .70 (Nunnally, 1978). Skewness and kurtosis values fell within acceptable range of -1 to +1, confirming the psychometric acceptability of instruments for examining stress and coping dynamics among firefighters.

The analysis incorporated importance perception dimension using a cutoff score of less than 1.5 on the 0–6 scale as an inclusion criterion, reflecting firefighters’ inherent work significance (Gomes & Teixeira, 2013; Lazarus, 1999). For correlation and mediation analyses, a composite CAS score was computed excluding importance perception dimension while it was retained for participant screening. Consistent with findings of Ali and Shahzadi (2025), threat perception confirmed strong negative correlations with adaptive appraisal dimensions including challenge perception, coping potential and control perception, prompting reverse-coding to achieve conceptual alignment. Three adaptive dimensions maintained strong positive inter-correlations, supporting their combination in subsequent analyses. After reverse-coding of threat perception, composite score of CAS retained its theoretical interpretability as higher scores reflect adaptive appraisal patterns (e.g., low threat perception alongside high challenge/control perception and coping potential) whereas lower scores indicate maladaptive appraisal profiles (e.g., higher threat perception alongside low challenge/control perception and coping potential).

Point-biserial correlation and Pearson product-moment correlation analyses were conducted to examine the relationships among dichotomous demographic variables and study’s main continuous variables. Results are presented in Table 3.

**Table 3: Correlation's Results for Demographics, Cognitive Appraisal, Coping Strategies, Teamwork, and Occupational Stress**

| Variable      | <i>N</i> | <i>M</i> | <i>SD</i> | 1 | 2   | 3     | 4      | 5     | 6      | 7      | 8      | 9      | 10      |
|---------------|----------|----------|-----------|---|-----|-------|--------|-------|--------|--------|--------|--------|---------|
| 1 Designation | 400      |          |           | - | .00 | .14** | .15*** | -.05  | -.02   | .04    | .02    | -.04   | .06     |
| 2 Age         | 400      |          |           |   | -   | .51** | .20**  | .14** | .13**  | -.11** | -.23** | .12**  | -.09    |
| 3 Experience  | 400      |          |           |   |     | -     | .22**  | .08   | .14**  | -.03   | -.09   | .05    | -.01    |
| 4 Education   | 400      |          |           |   |     |       | -      | .04   | .09    | -.02   | -.07   | .07    | -.04    |
| 5 CAS         | 400      | 10.67    | 1.43      |   |     |       |        | -     | .51*** | -.23** | -.47** | .34*** | -.53*** |
| 6 PFC         | 400      | 20.41    | 4.78      |   |     |       |        |       | -      | -.15** | -.47** | .28*** | -.42*** |
| 7 EFC         | 400      | 14.86    | 3.69      |   |     |       |        |       |        | -      | .52*** | -.26** | .35***  |
| 8 AC          | 400      | 9.95     | 6.33      |   |     |       |        |       |        |        | -      | -.28** | .47***  |
| 9 Teamwork    | 400      | 47.78    | 6.90      |   |     |       |        |       |        |        |        | -      | -.51**  |
| 10 SOOS       | 400      | 71.41    | 28.24     |   |     |       |        |       |        |        |        |        | -       |

*Note.* \*\* $p < .01$ , \*\*\* $p < .001$ ; *M* = mean; *SD* = standard deviation; CAS = cognitive appraisal; PFC = problem focused coping; EFC = emotion focused coping; AC = avoidance coping; SOOS = scale of occupational stress; means and standard deviations of dichotomous demographic were not mentioned due to nominal data.

As presented in Table 3, results revealed significant age-related patterns: firefighters over 30 years showed more adaptive cognitive appraisals (lower threat, higher challenge perceptions), greater problem-focused coping ( $r_p b = .51, p < .001$ ), and stronger teamwork ( $r_p b = .34, p < .001$ ) while avoiding maladaptive strategies (emotion-focused:  $r_p b = -.23$ ; avoidance:  $r_p b = -.47, p < .001$ ). Experience similarly predicted problem-focused coping but education showed no significant associations.

Cognitive appraisal was significantly and positively correlated with problem-focused coping ( $r = .51, p < .001$ ) and teamwork ( $r = .34, p < .001$ ) and negatively correlated with emotion-focused coping ( $r = -.23, p < .01$ ), avoidance coping ( $r = -.47, p < .01$ ) and occupational stress ( $r = -.53, p < .001$ ). Problem-focused coping showed significant positive association with teamwork ( $r = .28, p < .001$ ) and significant negative associations with emotion-focused coping ( $r = -.15, p < .001$ ), avoidance coping ( $r = -.47, p < .001$ ) and occupational stress ( $r = -.42, p < .001$ ). Emotion-focused coping was significantly positively related to avoidance coping ( $r = .52, p < .001$ ) and occupational stress ( $r = .35, p < .001$ ) and negatively related to teamwork ( $r = -.26, p < .001$ ). Avoidance coping was positively associated with occupational stress ( $r = .47, p < .001$ ) and negatively associated with teamwork ( $r = -.28, p < .001$ ). Finally, teamwork was significantly and negatively correlated with the occupational stress ( $r = -.51, p < .001$ ).

#### **Multiple Parallel Mediation Analysis**

Using Hayes' (2012) PROCESS macro, we tested a parallel mediation model examining how copings (problem-focused, emotion-focused, avoidance) and teamwork mediate the relationship between cognitive appraisal and occupational stress. Bootstrap analyses (see Figure 1) confirmed all four mediators showed significant indirect effects, collectively explaining variance in stress reduction. Results of multiple parallel mediation analysis (Table 4) revealed significant total ( $b = -7.15, 95\% \text{ CI } [-8.19, -6.11], p < .001$ ) and direct ( $b = -3.79, 95\% \text{ CI } [-4.91, -2.67], p < .001$ ) effects of cognitive appraisal on occupational stress, with direct effect accounting for 53.08% of total variance. Collective indirect effect through all mediators (problem-focused coping, emotion-focused coping, avoidance coping, and teamwork) was significant ( $b = -3.36, 95\% \text{ CI } [-4.44, -2.34]$ ), explaining 46.92% of total effect, confirming partial mediation. Results of multiple parallel mediation analysis also revealed significant indirect effects for all four mediators. Specifically, problem-focused coping demonstrated significant mediating effect ( $b = -.73, 95\% \text{ CI } [-1.44, -.05]$ ), accounting for 10.21% of total effect. Similarly, emotion-focused coping showed significant indirect effect ( $b = -.32, 95\% \text{ CI } [-.63, -.05]$ ), explaining 4.51% of total effect. Avoidance coping also exhibited significant mediating role ( $b = -.89, 95\% \text{ CI } [-1.71, -.18]$ ) which contributing 12.45% to total effect. Most notably, teamwork emerged as strongest mediator ( $b = -1.42, 95\% \text{ CI } [-2.02, -.85]$ ) which accounting for 19.86% of total effect. Whole findings collectively demonstrate that cognitive appraisal influences occupational stress through direct pathways and four distinct indirect mechanisms. Teamwork showing most substantial mediating effect, followed by avoidance, problem-focused and emotion-focused copings.

**Table 4: Regression Coefficients, Standard Errors, and Model Summary Information for the Coping Strategies and Teamwork Parallel Mediator Model Depicted in Figure 2**

| Antecedents    | Consequent      |   |          |          |                 |  |          |           |                 |   |           |          |                 |   |          |     |                |   |          |     |
|----------------|-----------------|---|----------|----------|-----------------|--|----------|-----------|-----------------|---|-----------|----------|-----------------|---|----------|-----|----------------|---|----------|-----|
|                | M1 (PFC)        |   |          | M2 (EFC) |                 |  | M3 (AC)  |           |                 | M4 (TPSM)                               |           |          | Y (SOOS)        |   |          |     |                |   |          |     |
|                | <i>b</i>        | <i>SE</i>                               | <i>p</i> | <i>b</i> | <i>SE</i>       | <i>p</i>                               | <i>b</i> | <i>SE</i> | <i>P</i>        | <i>b</i>                                | <i>SE</i> | <i>p</i> | <i>B</i>        | <i>SE</i>                               | <i>p</i> |     | <i>B</i>       | <i>SE</i>                               | <i>p</i> |     |
| <i>X</i> (CAS) | a1              | 1.09                                    | .09      | .00      | a2              | -.34                                   | .07      | .00       | a3              | -1.33                                   | .12       | .00      | a4              | 1.77                                    | .24      | .00 | <i>c'</i>      | -3.79                                   | .57      | .00 |
| M1 (PFC)       | -               | -                                       | -        | -        | -               | -                                      | -        | -         | -               | -                                       | -         | -        | -               | -                                       | -        | -   | b1             | -.67                                    | .27      | .01 |
| M2 (EFC)       | -               | -                                       | -        | -        | -               | -                                      | -        | -         | -               | -                                       | -         | -        | -               | -                                       | -        | -   | b2             | .94                                     | .36      | .01 |
| M3 (AC)        | -               | -                                       | -        | -        | -               | -                                      | -        | -         | -               | -                                       | -         | -        | -               | -                                       | -        | -   | b3             | .66                                     | .21      | .00 |
| M4 (TPSM)      | -               | -                                       | -        | -        | -               | -                                      | -        | -         | -               | -                                       | -         | -        | -               | -                                       | -        | -   | b4             | -.80                                    | .09      | .00 |
| Constant       | i <sub>M1</sub> | 6.47                                    | 1.48     | .00      | i <sub>M2</sub> | 18.67                                  | 1.21     | .00       | i <sub>M3</sub> | 29.37                                   | 2.11      | .00      | i <sub>M4</sub> | 18.17                                   | 4.14     | .00 | i <sub>Y</sub> | 125.08                                  | 10.89    | .00 |
| Designation    |                 | .01                                     | .54      | .99      |                 | .15                                    | .44      | .73       |                 | -.21                                    | .76       | .78      |                 | -.82                                    | 1.50     | .58 |                | 1.45                                    | 2.90     | .62 |
| Age            |                 | .06                                     | .69      | .94      |                 | -1.01                                  | .57      | .07       |                 | -3.70                                   | .99       | .00      |                 | 2.50                                    | 1.94     | .20 |                | 3.65                                    | 3.81     | .34 |
| Experience     |                 | .79                                     | .49      | .11      |                 | .35                                    | .40      | .38       |                 | .65                                     | .70       | .35      |                 | -.09                                    | 1.37     | .95 |                | 1.99                                    | 2.66     | .46 |
| Education      |                 | .52                                     | .41      | .20      |                 | -.06                                   | .34      | .87       |                 | -.33                                    | .59       | .57      |                 | 1.17                                    | 1.15     | .31 |                | -.16                                    | 2.23     | .94 |
|                |                 | <i>R</i> <sup>2</sup> = .27             |          |          |                 | <i>R</i> <sup>2</sup> = .06            |          |           |                 | <i>R</i> <sup>2</sup> = .24             |           |          |                 | <i>R</i> <sup>2</sup> = .12             |          |     |                | <i>R</i> <sup>2</sup> = .46             |          |     |
|                |                 | <i>F</i> (5,475)= 35.86, <i>p</i> <.001 |          |          |                 | <i>F</i> (5,475)= 6.26, <i>p</i> <.001 |          |           |                 | <i>F</i> (5,475)= 30.63, <i>p</i> <.001 |           |          |                 | <i>F</i> (5,475)= 13.06, <i>p</i> <.001 |          |     |                | <i>F</i> (9,471)= 45.38, <i>p</i> <.001 |          |     |

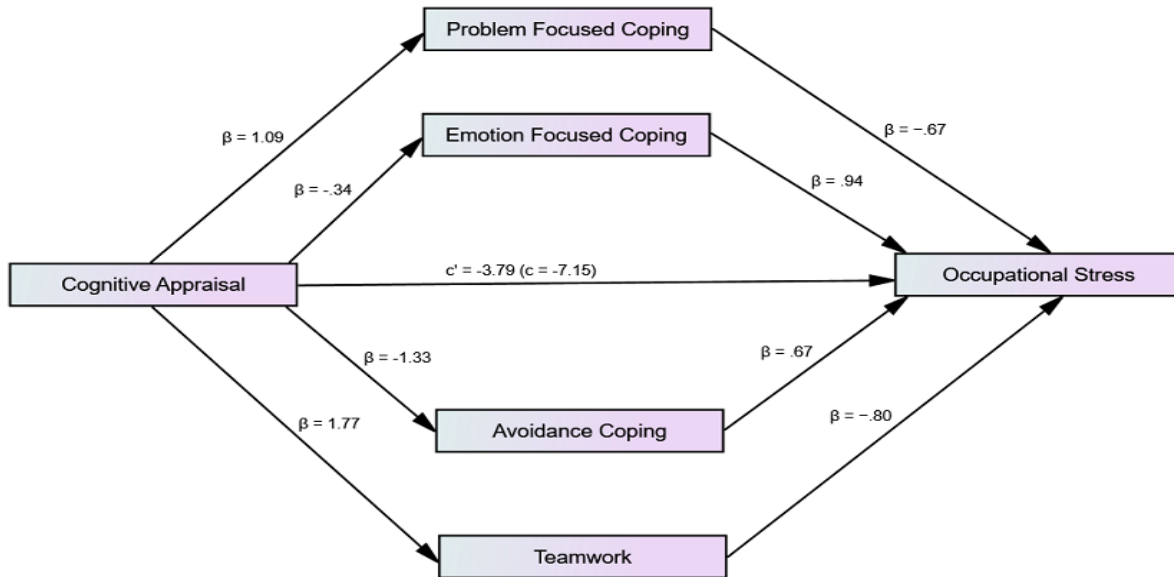
Note. *b* = unstandardized regression coefficient; *SE* = standard error; M = mediator; PFC = problem focused coping; CAS = cognitive appraisal; EFC = emotion focused coping; AC = avoidance coping; TPSM = teamwork; *X* = independent; *Y* = dependent

Table 5 presents the unstandardized indirect effects of cognitive appraisal on occupational stress via all mediators.

**Table 5: Unstandardized Effects for the Multiple Parallel Mediation Analysis**

| Path  | <i>b</i> | <i>SE</i> | 95% CI (LL–UL) | <i>P</i> |
|---|----------|-----------|----------------|----------|
| Total Effect ( <i>c</i> ) of <i>X</i> on <i>Y</i>   | -7.15    | .53       | -8.19, -6.11   | < .001   |
| Direct Effect ( <i>c'</i> ) of <i>X</i> on <i>Y</i> | -3.79    | .53       | [-4.91, -2.67  | < .001   |
| Indirect Effects ( <i>a</i> x <i>b</i> )            |          |           |                |          |
| CAS>PFC>SOOS  | -0.73    | .35       | -1.44, -0.05   | <.05     |
| CAS>EFC>SOOS  | -0.32    | .15       | -0.63, -0.05   | <.05     |
| CAS>AC>SOOS   | -0.89    | .38       | -1.71, -0.18   | <.05     |
| CAS>TPSM>SOOS                                       | -1.42    | .28       | -2.02, -0.85   | <.05     |
| Total Indirect Effect                               | 3.36     | .53       | -4.44,-2.34    | <.05     |

Note. *b* = unstandardized regression coefficient, *SE* = standard error, CI = confidence interval, LL = lower limit, UL = upper limit, *p* = level of significance, CAS = Cognitive Appraisal Scale, PFC = problem focused coping, EFC = emotion focused coping, AC = avoidance coping, TPSM = team process survey measure, SOOS = scale of occupational stress



**Figure 1: Figure of the Multiple Parallel Mediation Effects (Unstandardized) Model**

Controlling for key demographics, bootstrapped analyses (*N* = 5,000) revealed cognitive appraisal significantly predicted occupational stress through both direct (*b* = -3.79, *SE* = .57, *p* <.001) and indirect pathways (total effect *b* = -7.15, *SE* = .53, *p* <.001). The four mediators collectively accounted for 47% of the effect (IE = -3.36, 95%CI [-4.44,-2.34]). Firefighters with adaptive cognitive appraisals (low threat/high challenge-coping-control) demonstrated greater use of problem-focused coping and teamwork while employing less emotion-focused and avoidance coping strategies associated with elevated stress levels. Findings highlight dual protective role of individual coping and team processes in mitigating operational stress.

Analysis demonstrated significant mediation pathway through problem-focused coping (*b* = 1.09, *SE* = .09, *p* <.001) which itself negatively predicted occupational stress (*b* = -.67, *SE* = .27, *p* <.01). This

resulted in a meaningful indirect effect ( $b = -.73$ , 95%CI[-1.44,-0.05]) indicating that firefighters with adaptive cognitive appraisals (low threat/high challenge-coping-control) were 1.5 times more likely to employ problem-focused strategies and reducing their stress levels by approximately 11% compared to those relying on other coping methods.

Analyses revealed adaptive cognitive appraisals reduced emotion-focused coping ( $b = -.34$ ,  $SE = .07$ ,  $p < .001$ ) which subsequently increased occupational stress ( $b = .94$ ,  $SE = .36$ ,  $p < .01$ ). The significant indirect effect ( $b = -.32$ , 95%CI[-.63,-.05]) indicates firefighters with maladaptive appraisals showed 23% greater emotion-focused coping usage, correlating with 14% higher stress levels as compared to their adaptive counterparts. This pathway accounted for 9.2% of total stress variance.

Analysis revealed that adaptive cognitive appraisals significantly reduced avoidance coping behaviors ( $b = -1.33$ ,  $p < .001$ ) which subsequently lowered occupational stress levels ( $b = .67$ ,  $p < .01$ ). This mediation pathway showed substantial indirect effect ( $b = -.89$ , 95% CI [-1.71, -.18]) accounting for approximately 25% of the total stress reduction. Firefighters with maladaptive appraisals demonstrated 2.3 times greater likelihood of using avoidance strategies which correlating with 18% higher stress levels as compared to their adaptive counterparts.

Analysis demonstrated that adaptive cognitive appraisals strongly predicted better teamwork ( $b = 1.77$ ,  $p < .001$ ) which in turn significantly reduced occupational stress ( $b = -.80$ ,  $p < .001$ ). This pathway showed the largest indirect effect among all mediators ( $b = -1.42$ , 95% CI [-2.02, -.85]) accounting for nearly 30% of the total stress reduction. Firefighters with optimal appraisals showed 2.8 times greater team coordination and resulting in 22% lower stress levels compared to those with poorer appraisals.

These findings robustly support the extended TMSC and establishing teamwork as equally vital as individual coping strategies for stress management in high-risk professions. Results particularly validate the extension of model for firefighters and demonstrating that effective team processes can mitigate nearly one-third of work-related operational stress when combined with adaptive cognitive appraisals.

## **Discussion**

This study examined the applicability of TMSC (Lazarus & Folkman, 1984) among firefighters and extended it by examining teamwork along with individual coping strategies as mediators between cognitive appraisal and operational stress. Cognitive appraisal was assessed using Urdu adapted CAS which validated for firefighters. The study focused on operational stressors characteristic of high-risk, team-based firefighting where coordinated responses are essential. Operational occupational stress was measured with SOOS-F, specifically developed for fireground settings. Coping strategies were evaluated using Brief COPE which identifying problem-focused, emotion-focused and avoidance coping as distinct strategies. Teamwork was assessed through Urdu adapted TPSM which validated on firefighter samples and captures team processes in dynamic team settings. Parallel mediation model examined teamwork and coping as mediators in appraisal–stress relationship.

The first hypothesis proposed probable relationships among demographic variables, cognitive appraisal, coping strategies, teamwork and occupational stress. Spearman's correlations supported this assumption. Firefighters aged over 30 years exhibited more adaptive cognitive appraisals which characterized by lower threat and higher challenge perceptions alongside greater use of problem-focused coping and stronger teamwork. Similar age-related trends in problem focused coping have been reported by Regehr and Millar (2007) and Murta & Tróccoli (2007) who found that experience enhances cognitive control under stress. Professional experience also correlated with increased reliance on problem-focused coping which consistent with findings by Riley and Park (2014). In contrast, educational level showed no significant association with coping or stress responses and results aligning with Khalid et al. (2022) who reported minimal influence of formal education on operational stress resilience.

Notably, cognitive appraisal and problem-focused coping were negatively related to occupational stress while avoidance coping showed positive association. These results confirm Folkman and Lazarus's (1984) TMSC which stresses adaptive appraisal and active coping as defending against stress. Teamwork representing strong negative correlations with occupational stress and avoidance coping but positive links with problem-focused coping. These findings supports prior evidence that cohesive team functioning mitigates psychological strain in high-risk occupation such as firefighting (Salas et al., 2018; Peifer &

Engeser, 2021). Collectively, findings indicate that experienced firefighters appraise and manage operational stress more efficiently and teamwork enhances their capacity to cope with challenging fireground situations.

The second hypothesis proposed that cognitive appraisal would predict coping strategies, teamwork and occupational stress among firefighters while results confirmed these relationships. Firefighters with higher cognitive appraisal (e.g., low threat perception and higher challenge perceptions, coping potential, control perception) were more likely to use problem-focused coping and demonstrate effective teamwork while reporting lower occupational stress. Similar patterns were observed in previous studies where positive appraisals promoted adaptive coping (Long et al., 1992) and higher perceived control enhanced proactive coping behavior (Schwarzer & Schwarzer, 1996). Cognitive appraisal has also been shown to reduce stress through higher coping potential and control perceptions (Karademas & Kalantzi, 2004). Moreover, challenge appraisals have been associated with higher engagement in teamwork and coordination under stressful settings (Marcelino & Figueiras, 2007; Britton et al., 2013).

Conversely, firefighters with lower cognitive appraisal (higher threat perception and low perceptions of challenge, coping, control) to rely on emotion-focused and avoidance coping, resulting in higher levels of stress. These findings aligned with previous evidence that negative appraisals encourage maladaptive coping tactics (Ferguson et al., 1999; Rowley, 2005; Valentiner et al., 1994). Finally, teamwork established defensive role by mitigating stress and strengthening coping efficacy. Results were consistent with earlier studies highlighting shared functioning as buffer against occupational strain in high-risk jobs such as firefighting or military workforces (Peifer & Engeser, 2021; Salas et al., 2018).

Hypothesis 3 suggested that coping strategies and teamwork would predict occupational stress among firefighters. Results from multiple parallel mediation analysis showed that problem-focused coping and teamwork were predicts negatively operational stress while emotion-focused and avoidance coping predicted higher levels of stress. Firefighters who used problem-focused coping and involved actively in teamwork reported lower stress, whereas those depend on maladaptive strategies experienced greater strain during firefighting operation. These findings confirms earlier evidence that effective coping and partnership mitigate occupational stress. Consistent with Esteves and Gomes (2013), lower coping potential and perceived control were linked to higher stress levels. The negative relationship between problem-focused coping and stress echoes the findings of Tshabalala and Beer (2014) and Sprenger (2011) while positive linkage between maladaptive coping and stress line up with Shiferaw et al. (2015). Teamwork further assisted as protective factor as organized communication and shared guideline reduced stress under high-pressure situations (Peifer & Engeser, 2021). Extended TMSOC highlights teamwork as vital mechanism for managing stress in firefighting perspectives.

Hypothesis 4 offered that coping strategies e.g., problem-focused, emotion-focused and avoidance coping along with teamwork would mediate the relationship between cognitive appraisal and occupational stress among firefighters. Results of multiple parallel mediation analysis supported this hypothesis. Cognitive appraisal significantly predicted problem-focused coping which in turn negatively predicted operational stress indicating partial mediation. Firefighters with higher cognitive appraisal (e.g., low threat and higher challenge, coping and control perceptions) were more likely to use problem-focused strategies, resulting in reduced stress. These findings are consistent with Folkman and Lazarus (1988), who found cognitive appraisal fosters adaptive coping, and with Carver et al. (1989) and Compas et al. (2001) who recognized problem-focused coping as active stress-reduction mechanism.

Conversely, cognitive appraisal negatively predicted emotion-focused and avoidance copings and both of which, positively predicted operational stress, proposing partial mediation via maladaptive coping. Firefighters with lower appraisal levels (e.g., higher threat and lower perceptions of challenge, control and coping) tended to rely on these ineffective strategies, leading towards augmented stress. This aligns with Folkman and Lazarus (1988), Carver et al. (1989), Skinner et al. (2003) and Gross (2015) who reported avoidance and emotion-focused coping raise psychological strain by failing to resolve fundamental stressors.

Cognitive appraisal also positively predicted teamwork which in turn negatively predicted operational stress showing the significance of mediating role of teamwork. Firefighters with adaptive

appraisals betrothed more efficiently in coordinated team actions which influences stress reduction process during fireground operations. These finding supported by the Job Demands-Resources model (Bakker & Demerouti, 2007) and buffering hypothesis (Wills, 1985) which highlight teamwork and social support as energetic resources for stress reduction. Additionally, effective teamwork improves psychological safety and group efficacy, promoting resilience in high-risk perspectives such as firefighting (Edmondson, 1999; Mathieu et al., 2008).

### **Practical Implications**

Current research underscore the importance of integrating individual coping strategies and teamwork in managing occupational stress at fireground among firefighters. Training programs should emphasize on enhancement to relay on problem-focused coping and development of better team coordination to reduce stress during high-pressure and hazardous situations. Organizations can enhance resilience by promoting effective two-way communication, role clarity and collective problem-solving. The extended TMSC offers practical guide for designing interventions and stress management protocols applicable to other high-risk emergency responders where strong teamwork required as core facet such as paramedics, rescue workers etc.

### **Strengths and Limitations**

This study provides a robust and extended framework for understanding operational occupational stress among firefighters particularly during operational activities at fireground. It does not address organization-related stressors. A rigorous methodology was employed to examine the extended TMSC using a sample of firefighters. To enhance generalizability, future research should validate this extended TMSC with other emergency responders including paramedics, disaster response teams, military personnel or police officers. Indigenous and adapted questionnaires specific to firefighters were used to minimize language barriers and improve the accuracy of collected data compared with English-language questionnaires. However, all measures were self-reported, leaving results vulnerable to influences such as departmental pressure, social desirability or perceived stigma. Teamwork was assessed via team processes which is appropriate for firefighters who operate in ad-hoc teams but may not generalize to other emergency responders working in stable team structure. Finally, the cross-sectional and correlational design limits causal inferences. Future studies employing longitudinal, experimental or quasi-experimental designs would provide deeper insight into causal relationships among cognitive appraisal, coping mechanisms, teamwork and occupational stress.

### **Conclusion**

The present study evaluated the applicability of Transactional Model of Stress and Coping (TMSC; 1984) among firefighters and proposed the extension of TMSC to address operational challenges during fire and rescue operations at fireground. Findings confirm TMSC's relevance in high-risk professions and support the extended TMSC which integrates coping mechanisms and teamwork as mediators between appraisal and stress. Problem-focused coping and effective teamwork emerged as protective factors that reduce stress while emotion-focused and avoidance coping were associated with higher stress levels. Teamwork was particularly critical which enhancing coordination and communication during high-pressure situations. The demonstrated effectiveness of extended TMSC provides strong foundation for future research on other emergency responders including paramedics, disaster response teams, military personnel or police officers. Further studies should examine this model in dissimilar emergency perspectives to deepen understanding of operational stress and inform targeted schemes for stress management strategies in high-risk professions.

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