

---

## PUBLIC HEALTH RESEARCH

---

### Prevalence and Predictors for Post-Traumatic Stress Disorder (PTSD) among Firefighters: A Systematic Review

Muhammad Naim Mat Salleh,<sup>1</sup> Halim Ismail,<sup>1</sup> and Hanizah Mohd Yusoff<sup>1</sup>

Department of Community Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre.

\*For reprint and all correspondence: Dr. Halim Bin Ismail, Department of Community Medicine, Faculty of Medicine.

Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, Cheras, 56000 Kuala Lumpur, Malaysia.

Email: halimismail@ppukm.ukm.edu.my

#### ABSTRACT

---

<b>Received</b>	23 May 2019
<b>Accepted</b>	6 April 2020
<b>Introduction</b>	Emergency work with regular exposure to traumatic events may cause a large burden of mental health consequences. Among the first responders, firefighters are generally said to have a larger risk for PTSD as they involve directly and indirectly with critical incidents and traumatic events as part of their duties. This systematic review will determine the prevalence of PTSD and identify factors which associated to the PTSD among firefighters.
<b>Methods</b>	Systematic search was performed for published articles from year 2007 till 2017 from five electronic literature databases and the PRISMA checklist was used for the workflow for article selection. A total of 12 articles were selected for final examination from a total of 188 articles screened.
<b>Results</b>	The prevalence of PTSD among firefighters are ranged from 6.4% to 57 %. Predictors are include demographic factor (age, educational level and marital status), job factors (years of service, rank, numbers of traumatic events, job stress, organization stress and burnout, occupational effort, internal locus control, resource availability, debriefing attendance), social support, post traumatic growth, comorbidity (anxiety, depression, work related injuries, chronic musculoskeletal disorder), coping style, resilience, personality, biological factor (adiponectin level) and physical factor (waist circumference, body mass index).
<b>Conclusions</b>	Various factors identified in different dimensions in order to promote the opportunities for firefighters to grow for a better outcome psychologically. Therefore, it is vital to recognize modifiable factors which are associated with PTSD and research need to focus more on these factors or predictors.
<b>Keywords</b>	Firefighters - PTSD - Factors - Mental Health - Prevalence.

## Post-Traumatic Stress Disorder (PTSD) among Firefighters

### INTRODUCTION

Firefighters are those who are immediately arrive and engage in rescuing activities at the scene. Their roles are characterized by a position of high level of work demand and exposure of physical and psychological stressors.<sup>1</sup>

Currently there is increasing awareness that emergency work could be very distressing. A prolonged and repeated exposure of traumatic events could lead to chronic mental health issues including post-traumatic stress disorder (PTSD).<sup>2</sup> Post-traumatic stress disorder is basically a response to a stressful event which are catastrophic and threatening in nature and subsequently may cause persistent distressful emotional disturbance.<sup>3</sup> Hence, PTSD is diagnosed with four clusters of symptoms which are namely intrusion, avoidance, negative thought and hyperarousal.<sup>4</sup>

These traumatic events are the crucial aspect of what distinguish fire fighters from other occupation which could be regarded as the main psychological stressors including incident with the risk of death or severe injury to the firefighters or victims, witnessing or participation in preventing death or handling severe injury.<sup>3</sup>

In United State of America (USA), the life time prevalence of PTSD among adults are about 6.8 % in a study from 2001 to 2005.<sup>5</sup> On the other hand, the current prevalence of PTSD among firefighters are higher as 7% as reported in a meta-analysis.<sup>6</sup> Similarly, according to a study done in Australia among current firefighters and retired fire fighters showed prevalence of PTSD of 8% and 18% respectively.<sup>2</sup>

Due to closeness and resemblance of symptoms among mental illness, sometimes PTSD sufferers may be overlooked or misdiagnosed and subsequently did not treated properly.<sup>7</sup> In the other hand, PTSD sufferers could also experience physical ill health, problem in social relationship, reduce productivity in work and even suicidal attempt.<sup>8,9</sup> For example, a study in Canada shows that as many as 70 000 first responders which include fire fighters have suffered from PTSD in their lifetimes and overall productivity loss had cost them about \$ 20.7

The keywords that were used:

“PTSD” OR “Post Traumatic Stress Disorder” OR “Traumatic Stress”  
AND  
“Firefighters” OR “Rescuers” OR “First Responders” Or “Fire Officers” Or “Firemen”  
AND  
“Organization” OR “Work-related” OR “Occupational”  
AND  
“Traumatic Events” OR “Critical Incidents” OR “Factors” OR “Predictors” OR “Causes” OR “Risk” OR  
“Vulnerable”

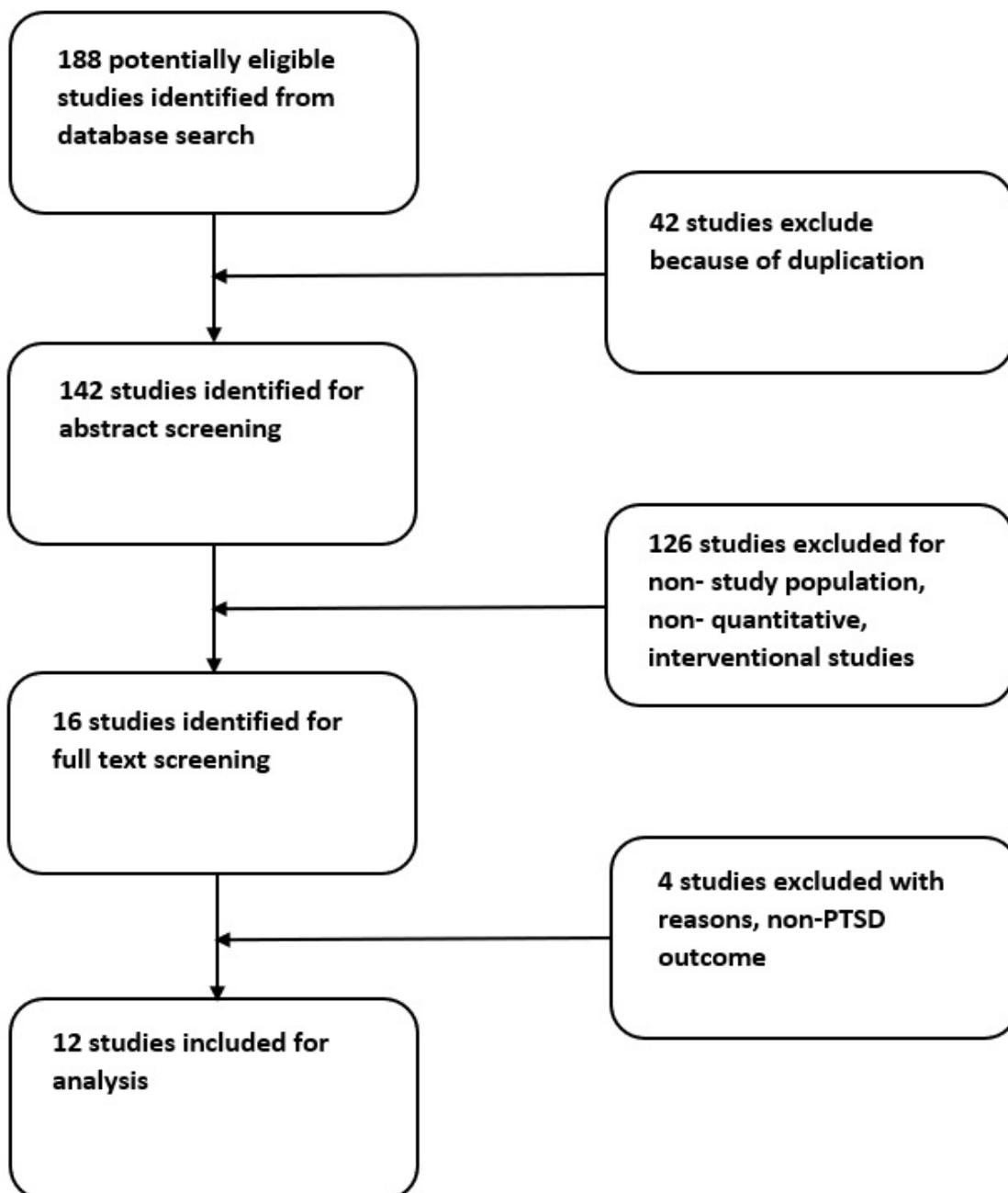
billion annually which involve half -million workers with mental illness.<sup>10</sup>

Therefore, this systematic review is trying to identify the PTSD among firefighters worldwide and their factors (occupational and non-occupational) which associated to the PTSD.

### METHODS

Systematic search was performed for article which relevant and published from 2007 till 2017 from five electronic databases (MEDLINE®, Scopus, Ovid, ScienceDirect and SAGE). Articles were screened for inclusion criteria (e.g. published in peer-reviewed journal and in English language, using a quantitative tool for measuring outcome and participants were firefighters). From the relevant papers data was extracted and thematic analysis was used to develop a list of key predictors which affect the outcome among firefighters. Two reviewer involved in the screening process. Prisma checklist<sup>11</sup> for the work flow of our article search. (Figure -1).

The studies identified from the databases searches were screened via: (a) diagnosis of post-traumatic stress disorder or PTSD or traumatic stress using validated instrument, (b) description of the predictors or risk which correlates to PTSD (either with or without validated measures), (c) study sample of firefighters with minimum number should not be less than 30. Studies were excluded on the basis of (i) Study design (e.g. non-quantitative study, interventional study), (ii) lack of empirical data (e.g. no association of PTSD and factors), (iii) use of of multiple sample population (e.g. first responders, emergency workers) and not analysing the exclusive subpopulation. The titles of the articles were screened according to the eligibility criteria, and relevant abstract were retrieved and screened using similar criteria. A total of 16 full text articles was subsequently retrieved and evaluated based on the inclusion and exclusion criteria. Total of 142 articles were from the initial search and after excluding duplicates. The list of references in each articles was checked to ensure saturation.



**Figure 1** Process of articles selection based on PRISMA flow diagram<sup>11</sup>

**Table 1** Characteristic of studies, prevalence and predictors of PTSD among firefighters

Authors (Years)	Population	Study Design	Tools	Prevalence of PTSD	Predictors
Alghamdi et al. (2016) <sup>12</sup>	N=200, Saudi Arabia firefighters	Cross Sectional	Screen for Post-Traumatic Stress Symptoms (SPTSS) Scale	57%	<ul style="list-style-type: none"> <li>• Anxiety</li> <li>• Depression</li> <li>• Passive coping</li> </ul>
Doley et al. (2016) <sup>13</sup>	N=277 Australia	Cross sectional	Life Events Inventory: The List of	28%	<ul style="list-style-type: none"> <li>• Recent adverse life events</li> <li>• Intrusion</li> </ul>

## Post-Traumatic Stress Disorder (PTSD) among Firefighters

	volunteer fire fighters		Threatening Experiences		
Levy-Gigi et al. (2015) <sup>14</sup>	N=69 active-duty firefighters Southern Israel	Cross Sectional	Structured Clinical Interview for the Diagnostic and Statistical Manual for Mental Disorders – Fourth Edition Criterion A for PTSD and the Post-traumatic Diagnostic Scale (PTDS)	5.7%	<ul style="list-style-type: none"> <li>• Problem- and emotion-focused coping and mix focused coping.</li> <li>• Depressive symptoms</li> <li>• General and work-related traumatic events</li> </ul>
Harvey et al. (2015) <sup>15</sup>	current (n = 488) and retired (n = 265) fire-fighters from Fire and Rescue New South Wales, Australia	Cross sectional	Impact of Event Scale-Revised-Greek version (IES-R-Gr)	13%	<ul style="list-style-type: none"> <li>• Higher rank</li> <li>• Older age</li> <li>• Year of service</li> </ul>
Katsavouni et al. (2015) <sup>16</sup>	N=3289 firefighters in Greece	Cross sectional	Impact of Event Scale-Revised-Greek version (IES-R-Gr)	13%	<ul style="list-style-type: none"> <li>• Work Related Injuries (WRIs)</li> <li>• Chronic musculoskeletal disorder (CMD)</li> <li>• Burnout (Depersonalization dimension)</li> <li>• Age</li> <li>• Years in service</li> </ul>
Lee et al. (2014) <sup>17</sup>	N=552 Korean firefighters	Cross sectional	Impact of Event Scale-Revised (IESR)	No finding	<ul style="list-style-type: none"> <li>• Perceived stress</li> <li>• High levels of Resilience</li> <li>• Number of traumatic events</li> </ul>
Meyer et al. (2012) <sup>18</sup>	N=142 Professional Firefighters Texas	Cross sectional	Clinician Administered PTSD Scale	6.4%	<ul style="list-style-type: none"> <li>• Lower education</li> <li>• Low Social Support</li> <li>• Higher Occupational Stress</li> <li>• COPE-Self-Blame</li> </ul>
Chung et al. (2015) <sup>19</sup>	N=185 male firefighters	Cross sectional	Impact Event Scale-Revised Korean Version (IESR-K)	35.1%	<ul style="list-style-type: none"> <li>• Job duration</li> <li>• Age</li> <li>• Masculinity-femininity (Personality)</li> <li>• Social introversion (Personality)</li> <li>• Job stress</li> </ul>
Na et al. (2017) <sup>20</sup>	N=507 male firefighters. Korean	Cross sectional	Impact Event Scale-Revised Korean Version (IESR-K)	27.4%	<ul style="list-style-type: none"> <li>• Adiponectin level</li> <li>• Age</li> <li>• Duration of service</li> <li>• Marriage</li> <li>• Depression</li> <li>• BMI</li> </ul>
Armstrong et al. (2014) <sup>21</sup>	N=218 firefighters	Cross sectional	Impact of Events Scale-Revised (IES-R)	23%	<ul style="list-style-type: none"> <li>• Job stress</li> <li>• Cognitive coping</li> </ul>

Saijo et al. (2012) <sup>22</sup>	N=1621 firefighters Japan	Cross sectional	Japanese version of the IES-R	9.7%	<ul style="list-style-type: none"> <li>• Organisational stress</li> <li>• Traumatic events</li> <li>• Depression</li> <li>• Job stress</li> <li>• Social support</li> </ul>
Sattler et al. (2013) <sup>23</sup>	N=286 firefighter s in Washington	Cross sectional	Posttraumatic Stress Symptoms Scale	51%	<ul style="list-style-type: none"> <li>• Years of Service</li> <li>• Burnout</li> <li>• Occupational effort</li> <li>• Disengagement coping</li> <li>• Critical incident</li> <li>• Debriefing attendance</li> <li>• Posttraumatic growth</li> <li>• Social support</li> <li>• Internal locus of control</li> <li>• Resources Availability</li> </ul>

## RESULTS

This systematic review included studies from 2007 to 2017. As methodological statement earlier, the studies are from USA, Greece, Israel, Korea, Australia, Saudi Arabia and Japan. A total of 12 studies were observational type with all of them were cross-sectional studies. The samples of these studies were mainly consisting of professional firefighters and volunteer firefighters. The sample size ranging from n=69 to n=3289. The study instruments used to measure level of PTSD and its predictors were also varies. Most of the studies adopting pre-existing PTSD scale either based on DSM III, DSM IV or ICD 10. Table 1 outlines the factors examined by each of the 12 included studies. The prevalence of PTSD among firefighters are ranged from 6.4% to 57 %.

### Predictors for PTSD

#### Demographics Factors

Association between age and PTSD has been examined in four studies.<sup>15, 16, 19, 20</sup> In different studies Meyer et al. found that lower educational status associated with PTSD<sup>17</sup> and non-married firefighters had association with PTSD.<sup>20</sup>

#### Job factors

Harvey et al. noted that high level position in the hierarchy of rank in firefighting service are associated with PTSD.<sup>14</sup> Year of service also linked to PTSD where the longer the duration of service it is more likely to have PTSD by several studies.<sup>15,16,19,20,23</sup> Job stress appear to be an important predictor as it showed to have relationship with PTSD in five studies.<sup>17,18,19,21,22</sup> Other related occupational factor which related to PTSD including organization stress<sup>21</sup> found by Armstrong et al. and burnout which showed a significant relationship in

two studies.<sup>16,23</sup> Another significant factor related to work that associated with PTSD are the occupational effort, internal locus control and resource availability and debriefing attendance.<sup>23</sup>

#### Comorbidity

Psychological disorder is an important factor in the development of PTSD among firefighters. A few studies had found significant association between depression and PTSD<sup>13,14,20,22</sup> whereas a study by Alghamdi et al. found that depression and anxiety both associated with PTSD among firefighters.<sup>12</sup> In different studies looking at physical illness, there are association between work related injuries (WRI) and chronic musculoskeletal disease (CMD) and PTSD.<sup>16</sup> In the other hand, a study looking at physical and biological factors, body mass index (BMI) and adiponectin level are significantly associated with PTSD.<sup>20</sup>

#### Coping

Coping strategies have been studied in many occasions where different coping style are found to be significantly associated with PTSD among fire fighters. Alghamdi et al. found that passive coping was associated with PTSD,<sup>12</sup> while Doley et al. found that problem - and emotion-focused coping and mix focused coping were associated with PTSD.<sup>13</sup> However, in a different study, Sattler et al. showed that disengagement coping was associated with PTSD<sup>23</sup> and finally Meyer et al. found self-blame coping was associated with PTSD.<sup>18</sup>

#### Social Support

Social support are very important predictors toward development of PTSD. It is known that social support able to buffer the psychological impact resulted from a traumatic experience or

## Post-Traumatic Stress Disorder (PTSD) among Firefighters

encountering a critical incident related their job scope where low social support will increase the risk for incurring PTSD among firefighters.<sup>18,22,23</sup>

### Resilience and post traumatic growth

A vital quality is the ability of a person that may overcome a traumatic episode in their lifetime experience. Therefore, a study by done by Lee et al. showed that resilience is one of the predictors toward development of PTSD.<sup>17</sup> Furthermore, a study looking at the positive outcome of experiencing a traumatic event which is the post traumatic growth showed that it is associated with PTSD as well.<sup>23</sup>

### Personality

Personality is said one of the individual characteristic that may predict one to suffer of PTSD or not. One of the researches by Chung et al. show that there are significant association between personality of masculinity-femininity and social introversion with PTSD among firefighters.<sup>19</sup>

## DISCUSSION

We conducted a systematic review of sources of evidence to determine the prevalence of PTSD and its predictors. A total of 12 papers were found in our systematic search of 5 main databases. These studies were considered acceptable in quality. Although all the studies were cross sectional in nature, we found that variety of factors in different dimension may contribute to a certain degree towards development of PTSD among firefighters in different research setting. Even though these factors did not determine the causal effect directly, it somehow give a overall picture of how wide the predictors could be considered in a study revolving PTSD among firefighters especially the modifiable factors. Based in this review, we can conclude that job factors, individual factors as well as social support were the predictors which play a enormous role in moderating PTSD beside the traumatic event itself.

### Demographic factors

From the sociodemographic point of view, several factors are associated with PTSD among firefighters. They are age, educational status and marital status. Previous studies have identified several demographic risk factors which increased risk for PTSD including gender, age, and socioeconomic status.<sup>24</sup> In a different study by De Vries & Olff, the rate of PTSD in the younger age group was fourfold higher than the older age group and the rate decreased steadily with age advancement.<sup>25</sup> In a study done in Netherland in 2009 regarding lifetime prevalence of PTSD showed that employment reduce the risk of PTSD half compared to unemployed.<sup>25</sup> Another study also found there is increased risk of developing PTSD by exposure to multiple events at younger age.<sup>26</sup> Being

single is also significant risk factor for PTSD found in as study in Saudi Arabia Firefighters as being single put them with less opportunity for emotional and social support compared to married firefighters.<sup>12</sup>

### Job factors

Years of Service, Higher Rank and Traumatic Events

In a study in Greece showed that young and inexperienced firefighters were more at risk of post-traumatic stress symptoms<sup>27</sup> while a study among retired fire-fighters showed a significant association between PTSD and higher job rank level as they tended to be in higher age group with more experiences as they may encountered a greater number of potentially traumatic events.<sup>15</sup> The type and severity of traumatic events which different in frequency of exposures may be the possible risk factors associated with the differences in post-trauma symptoms<sup>28</sup> among firefighter in different age group. Moreover, the higher the frequency of fatal incidents attended in the duration of service are associated with the higher risk for development of psychological disorders as it is found that a fire fighter who had attended more than 21 fatal incidents during his service duration had associated with higher probabilities of having PTSD.<sup>15</sup>

### Job stress, Organization stress and Burnout

Additional life stress was the second strongest predictor of PTSD<sup>29</sup> according to Brewin et al. Factors occupational stress in firefighters include frequent sleep disturbance, the demand to remain on high alert, and emotional stress associated with breaking and conveying tragic news.<sup>30</sup> In a study found that organizational factors may be a stronger predictor of posttraumatic stress than post event debriefing, social support, or a measure of hardiness.<sup>31</sup> Organisational factors serve as a framework in which traumatic events often encountered and therefore are associated to the PTSD.<sup>32</sup> In addition to that, organizational factors may also influence the interpretation by the workers of a particular post traumatic events.<sup>33</sup> In a study among urban professional firefighters, occupational stress was not only linked with PTSD but also with depression and alcohol abuse.<sup>34</sup> Therefore, occupational stress is found to be very important predictor of mental health outcomes among firefighters.<sup>18</sup> In a study by Mitani et al. found that burnout also correlate with PTSD where specifically the emotional exhaustion dimension and depersonalization dimension of burnout linked more to PTSD.<sup>35</sup> In the other hand, burnout was associated with the higher number of years in service.<sup>34</sup>

Occupational effort, Internal Locus Control and Resource Availability

Study by Settler which use the model of conservation of resources (COR) to explore occupational related factors which related to PTSD.<sup>23</sup> This model suggests that the availability of resource can facilitate the growth of resilience by acting as a buffer during resource depletion.<sup>36</sup> These resources will help firefighters to tackle the encounter of traumatic incidents, to act as mutual social support among them and to enable them to mould the traumatic experiences in positive perspective.<sup>36</sup> In contrary, the unavailability of resources will expose the worker for higher risk as they are unable to recover in an appropriate timeframe and manner<sup>36</sup> as well as unable to cope with the emotional and physical strains of critical incident exposure.<sup>37</sup> Locus of control refers to the extent to which individuals believe that they are able to control events affecting them and it is found to be associated with strong protective factor against PTSD symptoms.<sup>38</sup> Those with an internal locus of control will promotes positive influences as it is associated with more resilience against emotional dysfunction.<sup>39</sup> Occupational effort found to appear as one of the stress factor in conjunction with other occupational stress factors like burnout which are associated with posttraumatic stress symptoms.<sup>23</sup> These findings have implications for improvement of working condition in order to eliminate occupational stressors in order to improve the general working environment.

#### Debriefing attendance

Debriefing activities include sharing experiences about the event and discussing emotional reactions and thoughts regarding the incident with peers and facilitators instantly following the event of critical incident.<sup>23</sup> The debriefing is considered to be a preventative step to halt the development of PTSD in emergency workers.<sup>40</sup> Receiving a psychological intervention immediately after exposure will prevent the onset of PTSD symptoms and shorten the recovery time if already occurred.<sup>40</sup>

#### Post traumatic growth

Post critical incident or traumatic event exposure is said to promote positive consequences in individual which known as posttraumatic growth.<sup>23</sup> Therefore the fire-fighters may develop a better ability to manage priority in life and also increase level of awareness about positive life changes as they recollect about the incident.<sup>41</sup> Later on, they may develop new coping strategies, achieve a healthier appreciation for life and able embrace new approach of self-efficacy.<sup>23,42</sup> This projection of positive outcomes may counterbalance some of the negative experiences due to the traumatic event exposure.<sup>41,42</sup>

#### Social Support

Social support in individual is defined as when the subject believes they are cared for and loved, is

esteemed, valued and belongs to a social network of communication and mutual.<sup>43</sup> Fire-fighters are experiencing the impact of highly stressful work in their routine duties and thus could be reduced by the support of family and friends. According to a study, social support is a significant predictor for PTSD as it plays a mediator role between traumatic events and PTSD.<sup>44</sup> This supports previous findings indicating that perceived social support is a strong predictor of PTSD symptoms among professional firefighters exposed to a variety of traumatic events.<sup>44,45</sup> Similar findings show that poor social support was the strongest predictor of PTSD<sup>29</sup> as observed by Brewin et al. and the second strongest predictor<sup>47</sup> as observed by Ozer et al. These findings showed that good social support is believed to act as a buffer against the adverse outcome of the traumatic stressors among fire- fighters.<sup>18</sup>

#### Comorbidity

##### Psychological disorder (Anxiety and Depression)

Post-traumatic stress disorder may regularly coexist with other mental illness such as depression and anxiety disorders.<sup>39</sup> A longitudinal comparison study was conducted among rescue and disaster workers showed that those who were exposed to traumatic events had significantly higher depression than those who were not exposed to traumatic event.<sup>48</sup> Likewise, Chiu et al. found that depression as the comorbidity for PTSD among fire-fighters in a fire department in a study post disaster of World Trade Centre attack.<sup>49</sup> Similarly, a study was conducted to examine contributing factors to PTSD revealed that depression is one of the contributing factors among fire-fighters besides alcoholism.<sup>50</sup> Moreover, a study was carried out to show that a considerable range of fire-fighters who had PTSD had concurrent psychological comorbidity as well including anxiety and depression.<sup>51,52</sup>

##### Physical disorder (Work Related Injuries (WRI) and Chronic Musculoskeletal Disorder (CMD))

A study done among those who had injury following accident showed that 12% of injured workers had PTSD and 11% had subclinical PTSD after 6 months period.<sup>53</sup> In different study, there is about 18 % of projected incidence of PTSD among the injured workers after eight months of accident.<sup>54</sup> Many workers who sustained occupational injuries will not only suffer from physical disabilities but in addition to that they also may experience range of psychological disturbance, disturbing accident memories, impairment in contextual memory, emotional disorders and even some of them fulfil the criteria for post-traumatic stress disorder (PTSD).<sup>16,56,57,58</sup> Stress is said to be one of the factors which contribute to the development of musculoskeletal problems.<sup>55</sup>

#### Coping

## Post-Traumatic Stress Disorder (PTSD) among Firefighters

The relationship between the strategies for coping among fire fighters and the result of traumatic events has been examined in several studies. Problem-focused coping strategies are described as engaging in behaviours to overcome problems associated with the traumatic event and usually achieved by defining the problem, considering alternative solutions and selecting a strategy to address the problem.<sup>59</sup> In the other hand, emotion-focused coping strategies are described as concentrating effort toward managing emotional responses to the stressful encounter by dealing the hostile feelings and trying to find ways to divert emotions associated with a stressful event.<sup>60</sup> Some of the previous research findings has suggested that problem-focused coping is more effective compared to emotion-focused coping in terms of reducing negative emotional responses toward stressful events.<sup>61,62</sup> In the other hand, according to Silver et al. avoidant coping strategies adopted in dealing with negative feelings from traumatic events were linked with increased levels of PTSD symptoms.<sup>63</sup> Similarly, it was found that avoidant coping strategies among fire-fighters who involved in a rescue mission significantly associated with PTSD.<sup>64</sup> Coping strategies of self-blame and using-substances also elevate the predicted risk for development of PTSD symptoms and may act as moderator in the association of social support and PTSD<sup>18</sup> and therefore an individual with higher in self-blame coping style and lower in social support may be at elevated risk for PTSD symptoms.<sup>65</sup> A different study was conducted among fire-fighters in Australia found that active and passive coping strategies are as well associated with PTSD.<sup>66</sup>

### Resilience

Resilience is defined as the absence of psychopathology in the result of exposure to potentially traumatic events.<sup>67</sup> Resilience to mental health problems thus reflects the individual ability to deal effectively with emotional consequences post trauma exposure and therefore associated with fewer PTSD symptoms.<sup>68,69</sup> The resilience however could be interrupted if an individual has inadequate protective factors to buffer against adversities in life.<sup>70</sup>

### Personality

Certain trait of personality in individual for repeated traumatic exposure had been known to be the risk for PTSD.<sup>19</sup> In a study, it was found that masculinity-femininity and social introversion trait was significantly associated with PTSD symptoms and specifically social introversion was the most important factor of PTSD development among the firefighters.<sup>19</sup> In a different study looking at different domain of personalities which suggested that neuroticism was the most likely to be associated with PTSD<sup>72</sup> as they had an inclination to encounter an adverse event with strong emotion and they are

also more sensitive to stressor whereby their responses are more rapid and intense but with slower rate to regain a normal state.<sup>72</sup>

### Biological and physical factors

#### Adiponectin level

The adiponectin level was found to be inversely correlated with the severity of PTSD.<sup>20</sup> Studies have showed that adiponectin has pleiotropic activity and they are mainly distributed in the hippocampus and hypothalamus<sup>73,74</sup> which are closely associated with PTSD via modulation of the hypothalamus-pituitary adrenal (HPA) axis.<sup>75,76</sup> One of the mechanisms that has been postulated which lead to development symptoms of PTSD is by abnormal fear extinction<sup>77</sup> which is primarily modulated in the hippocampus.<sup>78,79</sup>

#### Body Mass Index (BMI)

Study suggested the level of adiponectin were inversely correlated with body mass index (BMI).<sup>80</sup> As observed in a study involving mouse model, low level of adiponectin was associated with abnormal glucose tolerance and increased caloric intake and the PTSD symptom group had higher rate of BMI and obesity compared to the controls groups.<sup>81</sup> A recent meta-analysis also showed that the probability for obesity in the experimented group for PTSD was almost two times higher compared to the control group.<sup>82</sup> Alternately, PTSD also linked with food addiction,<sup>83</sup> which is positively correlated with the level of its severity.<sup>20</sup>

## CONCLUSION

This systematic review adds exclusively to the literature through being the one of review to concurrently use multiple domains namely personal, occupational, and social support factors to predict PTSD especially in firefighters. This review also found new perspective from biological point of view which need to be explored more in line with development and risk of PTSD. Moreover, this review strengthened previous reported findings in different perspective and model respectively as well. Therefore, this review has documented how broad the risk factors that can be associated with PTSD among firefighters. In order to reduce the chances of negative outcomes and promote the opportunities for firefighters to grow for a better outcome psychologically, it is vital to recognize factors that are modifiable which are associated with PTSD and more research need to focus on these factors. This is very crucial aspect as firefighters are among the first responders which part of emergency service delivery which routinely exposed to potentially traumatic and critical events as part of their daily work duties

## REFERENCES

1. Benedek DM, Fullerton C, Ursano RJ. First responders: mental health consequences of natural and human-made disasters for public health and public safety workers. *Annu. Rev. Public Health.* 2007; 28:55-68.
2. McFarlane AC, Bryant RA. Post-traumatic stress disorder in occupational settings: anticipating and managing the risk. *Occupational Medicine.* 2007; 57:404-10.
3. Haugen PT, Evces M, Weiss DS. Treating posttraumatic stress disorder in first responders: A systematic review. *Clinical psychology review.* 2012; 32:370-80.
4. Pietrzak RH, Tsai J, Armour C et al. Functional significance of a novel 7-factor model of DSM-5 PTSD symptoms: Results from the National Health and Resilience in Veterans Study. *Journal of Affective Disorders.* 2015; 174:522-6.
5. Kessler RC, Berglund P, Demler O et al. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry.* 2005; 62: 593-602.
6. Berger W, Coutinho ES, Figueira I et al. Rescuers at risk: a systematic review and meta-regression analysis of the worldwide current prevalence and correlates of PTSD in rescue workers. *Social psychiatry and psychiatric epidemiology.* 2012; 47: 1001-11.
7. Sareen, J., Cox B. J., Stein M. B. et al. Physical and Mental Comorbidity, Disability, and Suicidal Behavior Associated with Posttraumatic Stress Disorder in a Large Community Sample. *Psychosomatic medicine.* 2007; 69: 242-248.
8. Nock MK, Hwang I, Sampson NA, Kessler RC. Mental disorders, comorbidity and suicidal behavior: results from the National Comorbidity Survey Replication. *Molecular psychiatry.* 2010; 15: 868.
9. Schnurr PP, Lunney CA, Bovin MJ, Marx BP. Posttraumatic stress disorder and quality of life: extension of findings to veterans of the wars in Iraq and Afghanistan. *Clinical psychology review.* 2009; 29: 727-35.
10. Wilson S, Guliani H, Boichev G. On the economics of post-traumatic stress disorder among first responders in Canada. *Journal of Community Safety and Well-Being.* 2016;1: 26-31.
11. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine.* 2009; 151:264-9.
12. Alghamdi M, Hunt N, Thomas S. Prevalence rate of PTSD, Depression and Anxiety symptoms among Saudi Firefighters. *Journal of Traumatic Stress Disorders and Treatment* 2016; 6 :1-6.
13. Doley RM, Bell R, Watt BD. An investigation into the relationship between long-term posttraumatic stress disorder symptoms and coping in Australian volunteer firefighters. *The Journal of nervous and mental disease.* 2016; 204: 530-6.
14. Levy-Gigi E, Bonanno GA, Shapiro AR, et al. Emotion regulatory flexibility sheds light on the elusive relationship between repeated traumatic exposure and posttraumatic stress disorder symptoms. *Clinical psychological science.* 2016;4: 28-39.
15. Harvey SB, Milligan-Saville JS, Paterson HM et al. The mental health of fire-fighters: An examination of the impact of repeated trauma exposure. *Australian & New Zealand Journal of Psychiatry.* 2016; 50: 649-58.
16. Katsavouni F, Bebetos E, Malliou P, Beneka A. The relationship between burnout, PTSD symptoms and injuries in firefighters. *Occupational medicine.* 2015; 66:32-7.
17. Lee JS, Ahn YS, Jeong KS et al. Resilience buffers the impact of traumatic events on the development of PTSD symptoms in firefighters. *Journal of affective disorders.* 2014; 162: 128-33.
18. Meyer EC, Zimering R, Daly E et al. Predictors of posttraumatic stress disorder and other psychological symptoms in trauma-exposed firefighters. *Psychological Services.* 2012; 9: 1.
19. Chung IS, Lee MY, Jung SW, Nam CW. Minnesota multiphasic personality inventory as related factor for post traumatic stress disorder symptoms according to job stress level in experienced firefighters: 5-year study. *Annals of occupational and environmental medicine.* 2015; 27: 16.
20. Na KS, Kim EK, Park JT. Decreased plasma adiponectin among male firefighters with symptoms of post-traumatic stress disorder. *Journal of affective disorders.* 2017; 221: 254-8.
21. Armstrong D, Shakespeare-Finch J, Shochet I. Predicting post-traumatic growth and post-traumatic stress in firefighters. *Australian Journal of Psychology.* 2014; 66: 38-46.

## Post-Traumatic Stress Disorder (PTSD) among Firefighters

22. Saijo Y, Ueno T, Hashimoto Y. Post-traumatic stress disorder and job stress among firefighters of urban Japan. *Prehospital and disaster medicine*. 2012; 27: 59-63.
23. Sattler DN, Boyd B, Kirsch J. Trauma-exposed firefighters: Relationships among posttraumatic growth, posttraumatic stress, resource availability, coping and critical incident stress debriefing experience. *Stress and Health* 2014; 30: 356-65.
24. Donnelly E, Siebert D. Occupational risk factors in the emergency medical services. *Prehospital and disaster medicine*. 2009; 24: 422-9.
25. De Vries GJ, Olf M. The lifetime prevalence of traumatic events and posttraumatic stress disorder in the Netherlands. *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies*. 2009; 22: 259-67.
26. Breslau N, Wilcox HC, Storr CL et al. Trauma exposure and posttraumatic stress disorder: a study of youths in urban America. *Journal of Urban Health*. 2004; 81: 530-44.
27. Psarros C, Theleritis CG, Martinaki S, Bergiannaki ID. Traumatic reactions in firefighters after wildfires in Greece. *Lancet*. 2008; 371: 301.
28. Del Ben KS, Scotti JR, Chen YC, Fortson BL. Prevalence of posttraumatic stress disorder symptoms in firefighters. *Work & Stress*. 2006; 20: 37-48.
29. Brewin CR, Andrews B, Valentine JD. Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of consulting and clinical psychology*. 2000; 68: 748.
30. Beaton RD, Murphy SA. Sources of occupational stress among firefighter/EMTs and firefighter/paramedics and correlations with job-related outcomes. *Prehospital and Disaster Medicine*. 1993; 8: 140-50.
31. Paton D, Smith L, Violanti JM, & Eränen L. Work-related traumatic stress: Risk, vulnerability and resilience. In J. M. Violanti, D. Paton, & C. Dunning (Eds.), *Posttraumatic stress intervention: Challenges, issues, and perspectives*. Springfield, IL, US: Charles C Thomas Publisher. 2000: 187-204.
32. Tedeschi RG, Calhoun LG. *Posttraumatic growth in clinical practice*. 1st ed. New York, Routledge. 2012.
33. Paton D., Smith L. M., Ramsay R., Akande D. Assessing the impact of trauma in work-related populations: Occupational and cultural determinants of reactivity. In R. Gist & B. Lubin (Eds.), *Response to disaster: Psychosocial, community, and ecological approaches*. Philadelphia: Brunner/Mazel; 1999:83-99.
34. Murphy SA, Beaton RD, Pike KC, Cain KC. Firefighters and paramedics: years of service, job aspirations, and burnout. *AAOHN journal*. 1994; 42: 534-40.
35. Mitani S, Fujita M, Nakata K, Shirakawa T. Impact of post-traumatic stress disorder and job-related stress on burnout: A study of fire service workers. *The Journal of emergency medicine*. 2006 Jul 1; 31: 7-11.
36. Hobfoll SE. Conservation of resources and disaster in cultural context: The caravans and passageways for resources. *Psychiatry: Interpersonal & Biological Processes*. 2012; 75: 227-32.
37. Bryant RA, Harvey AG. Posttraumatic stress reactions in volunteer firefighters. *Journal of traumatic stress*. 1996; 9: 51-62.
38. Zhang W, Liu H, Jiang X et al. A longitudinal study of posttraumatic stress disorder symptoms and its relationship with coping skill and locus of control in adolescents after an earthquake in China. *PloS one*. 2014; 9: e88263.
39. Ahmed AS. Post-traumatic stress disorder, resilience and vulnerability. *Advances in Psychiatric Treatment*. 2007; 13: 369-75.
40. Lohr J. M., Hooke W., Gist R., Tolin D. F. Novel and controversial treatments for trauma-related stress disorders. In S. O. Lilienfeld, S. J. Lynn, & J. M. Lohr (Eds.), *Science and pseudoscience in clinical psychology*. New York, NY, US: Guilford Press. 2003: 243-272.
41. Groleau JM, Calhoun LG, Cann A, Tedeschi RG. The role of centrality of events in posttraumatic distress and posttraumatic growth. *Psychological Trauma: Theory, Research, Practice, and Policy*. 2013; 5:477.
42. Linley PA, Joseph S. Positive change following trauma and adversity: A review. *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies* 2004; 17: 11-21.
43. Cobb, S. Social support as a moderator of life stress. *Psychosomatic Medicine*. 1976; 38: 300-314.
44. Regehr C, Hill J, Knott T, Sault B. Social support, self-efficacy and trauma in new recruits and experienced firefighters. *Stress and Health*. 2003; 19: 189-93.
45. Regehr C. Social support as a mediator of psychological distress in firefighters. *The Irish Journal of Psychology*. 2009; 30: 87-98.

46. Regehr C, Hill J, Glancy GD. Individual predictors of traumatic reactions in firefighters. *The Journal of nervous and mental disease*. 2000; 188: 333-9.
47. Ozer EJ, Best SR, Lipsey TL, Weiss DS. Predictors of posttraumatic stress disorder and symptoms in adults: a meta-analysis. *Psychological bulletin*. 2003; 129:52.
48. Fullerton CS, Ursano RJ, Wang L. Acute stress disorder, posttraumatic stress disorder, and depression in disaster or rescue workers. *American Journal of Psychiatry*. 2004; 161: 1370-6.
49. Chiu S, Niles JK, Webber MP et al. Evaluating risk factors and possible mediation effects in posttraumatic depression and posttraumatic stress disorder comorbidity. *Public Health Reports*. 2011; 126: 201-9.
50. Carey MG, Al-Zaiti SS, Dean GE et al. Sleep problems, depression, substance use, social bonding, and quality of life in professional firefighters. *Journal of occupational and environmental medicine/American College of Occupational and Environmental Medicine*. 2011; 53: 928.
51. Brady KT, Clary CM. Affective and anxiety comorbidity in post-traumatic stress disorder treatment trials of sertraline. *Comprehensive psychiatry*. 2003; 44: 360-9.
52. Hashemian F, Khoshnood K, Desai MM et al. Anxiety, depression, and posttraumatic stress in Iranian survivors of chemical warfare. *Jama*. 2006; 296: 560-6.
53. Nyberg E, Stieglitz RD, Frommberger U, Berger M. Psychological disorders after severe occupational accidents. *Versicherungsmedizin*. 2003; 55: 76-81.
54. Matthews LR, Harris LM, Cumming S. Trauma-related appraisals and coping styles of injured adults with and without symptoms of PTSD and their relationship to work potential. *Disability and rehabilitation*. 2009; 31: 1577-83.
55. Kim MG, Kim KS, Ryoo JH, Yoo SW. Relationship between occupational stress and work-related musculoskeletal disorders in Korean male firefighters. *Annals of occupational and environmental medicine*. 2013; 25:9.
56. Grunert BK, Weis JM, Smucker MR, Christianson HF. Imagery rescripting and reprocessing therapy after failed prolonged exposure for post-traumatic stress disorder following industrial injury. *Journal of Behavior Therapy and Experimental Psychiatry*. 2007; 38:317-28.
57. Novara C, Buodo G, Ghisi M et al. Integrated assessment of emotional distress after work-related accidents. *Stress and Health: Journal of the International Society for the Investigation of Stress*. 2009; 25: 195-204.
58. Gustafsson M, Ahlström G. Problems experienced during the first year of an acute traumatic hand injury—a prospective study. *Journal of Clinical Nursing*. 2004; 13: 986-95.
59. L. Carroll, "Problem-focused coping," in *Encyclopedia of Behavioral Medicine*. Springer, New York. 2013: 1540-1541.
60. Brannon L, Feist J, Updegraff JA. *Health psychology: An introduction to behavior and health*. 8th Ed. Belmont, CA, Cengage Learning. 2013.
61. Elwood LS, Hahn KS, Olatunji BO, Williams NL. Cognitive vulnerabilities to the development of PTSD: A review of four vulnerabilities and the proposal of an integrative vulnerability model. *Clinical Psychology Review*. 2009; 29: 87-100.
62. Zeidner M. Contextual and personal predictors of adaptive outcomes under terror attack: The case of Israeli adolescents. *Journal of Youth and Adolescence*. 2005; 34: 459-70.
63. Silver RC, Holman EA, McIntosh DN et al. Nationwide longitudinal study of psychological responses to September 11. *Jama*. 2002; 288: 1235-44.
64. Chang CM, Lee LC, Connor KM, Davidson JR, Jeffries K, Lai TJ. Posttraumatic distress and coping strategies among rescue workers after an earthquake. *The Journal of nervous and mental disease*. 2003; 191: 391-8.
65. Guay S, Billette V, Marchand A. Exploring the links between posttraumatic stress disorder and social support: Processes and potential research avenues. *Journal of Traumatic Stress: Official Publication of The International Society for Traumatic Stress Studies*. 2006; 19: 327-38.
66. Chamberlin MJ, Green HJ. Stress and coping strategies among firefighters and recruits. *Journal of Loss and Trauma*. 2010; 15: 548-60.
67. Klasen F, Oettingen G, Daniels J et al. Posttraumatic resilience in former Ugandan child soldiers. *Child development*. 2010; 81: 1096-113.
68. Connor KM, Davidson JR, Lee LC. Spirituality, resilience, and anger in survivors of violent trauma: A community survey. *Journal of traumatic stress*. 2003; 16: 487-94.

## Post-Traumatic Stress Disorder (PTSD) among Firefighters

69. Haddadi P, Besharat MA. Resilience, vulnerability and mental health. *Procedia-Social and Behavioral Sciences*. 2010; 5: 639-42.
70. Fletcher D, Sarkar M. Psychological resilience: A review and critique of definitions, concepts, and theory. *European Psychologist*. 2013; 18:12.
71. Lawrence JW, Fauerbach JA. Personality, coping, chronic stress, social support and PTSD symptoms among adult burn survivors: a path analysis. *The Journal of burn care & rehabilitation*. 2003; 24: 63-72.
72. Jakšić N, Brajković L, Ivezić E et al. The role of personality traits in posttraumatic stress disorder (PTSD). *Psychiatria Danubina*. 2012; 24: 256-66.
73. Thundyil J, Pavlovski D, Sobey CG, Arumugam TV. Adiponectin receptor signalling in the brain. *British journal of pharmacology*. 2012; 165: 313-27.
74. Kubota N, Yano W, Kubota T, et al. Adiponectin stimulates AMP-activated protein kinase in the hypothalamus and increases food intake. *Cell metabolism*. 2007; 6: 55-68.
75. Gunnar MR, Quevedo KM. Early care experiences and HPA axis regulation in children: a mechanism for later trauma vulnerability. *Progress in brain research* 2007; 167:137-49.
76. Mehta D, Binder EB. Gene × environment vulnerability factors for PTSD: the HPA-axis. *Neuropharmacology*. 2012; 62: 654-62.
77. Garfinkel SN, Abelson JL, King AP et al. Impaired contextual modulation of memories in PTSD: an fMRI and psychophysiological study of extinction retention and fear renewal. *Journal of Neuroscience*. 2014; 34: 13435-43.
78. Corcoran KA, Maren S. Hippocampal inactivation disrupts contextual retrieval of fear memory after extinction. *Journal of Neuroscience*. 2001; 21: 1720-6.
79. Ji J, Maren S. Hippocampal involvement in contextual modulation of fear extinction. *Hippocampus*. 2007; 17: 749-58.
80. Qi Y, Takahashi N, Hileman SM et al. Adiponectin acts in the brain to decrease body weight. *Nature medicine*. 2004; 10: 524.
81. Castaneda TR, Nogueiras R, Müller TD et al. Decreased glucose tolerance and plasma adiponectin: resistin ratio in a mouse model of post-traumatic stress disorder. *Diabetologia*. 2011; 54: 900-9.
82. Bartoli F, Crocarno C, Alamia A et al. Posttraumatic Stress Disorder and Risk of Obesity: Systematic Review and Meta-Analysis. *Journal of Clinical Psychiatry*. 2015; 76: E1253-+.
83. Mason SM, Flint AJ, Roberts AL et al. Posttraumatic stress disorder symptoms and food addiction in women by timing and type of trauma exposure. *JAMA psychiatry*. 2014; 71:1271-8.