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Work demand, stress and work-related musculoskeletal disorders among emergency workers

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Abstract

Purpose – The demanding nature of firefighting exposes firefighters to unprecedented work stress and work-related musculoskeletal disorders (WMSDs). Even though relationships among work demand, work stress and WMSDs have been examined, the mediating role of work stress in the relationship between work demand and WMSDs requires more attention, particularly among emergency workers. The purpose of this paper is therefore to assess the mediation role of firefighters’ work stress in the pathway of work demand and WMSDs.

Design/methodology/approach – A quantitative research design was used. Convenient sampling was employed to select 320 firefighters from the Greater Accra region of Ghana. Data were analyzed using descriptive, correlation and regression.

Findings – The findings revealed that work demand and stress significantly affect WMSDs. Also, work demand has a significant positive effect on work stress. It was further found that work stress partially mediates the relationship between work demand and WMSDs.

Research limitations/implications – The usage of cross-sectional data limits the strength of causality and observation of changes within units of observation over time, hence the need to use longitudinal data in future studies.

Originality/value – The novelty of this study lies in the revelation of the influence of stress in the pathway of work demand and WMSDs among emergency professionals, using an African lens.

Keywords Stress, Firefighters, Work demand, Work-related musculoskeletal disorders

Paper type Research paper

Introduction

The firefighting profession is dominated by speed, pressure, uncertainty and massive workload. Categorized among highly injurious occupations universally, firefighters face lots of hazards such as falls from heights, heat, stress, burns, work-related musculoskeletal disorders (WMSDs) and respiratory complications caused by the inhalation of smoke and other chemicals (Heinrichs et al., 2005; ILO, 2016; Kim et al., 2013; Malek et al., 2009, 2010; Throne et al., 2000). The ILO (2003) estimated that the ratio of firefighter to citizen among European countries was 1: 1,000–1,200, whereas that of Africa (Mali) was 1: 33,435. Accelerating fire outbreaks in developing nations like Ghana can lead to increased firefighter work demand. In Ghana for instance, the GNFS (2016) fights thousands of fires on yearly basis. Most of these firefighting activities place huge work demands on firefighters, which can lead to the development of work stress and WMSDs. In 2015 for example, the GNFS (2016) fought 6,214 fires throughout Ghana. It is worth noting that WMSDs have been associated with work stress, high workload and demand, low job control and work monotony (Cañadas-De la Fuente et al., 2015; Norlund et al., 2010), thereby suggesting a pathway between work demand and workplace health complications.
(Lusa et al., 2015). According to the ILO (2016), an estimated 2.2m annual deaths occur at the workplace. This alarming situation needs the concerted effort of researchers, practitioners, national governments and international bodies. According to Larsman et al. (2006), perceived work demand explains 36 percent of variance in stress, whereas both perceived work demand and stress explain 20 percent of variance in musculoskeletal disorders. Sprigg et al. (2007) contended that musculoskeletal complaints in modern work organizations can be attributed to work demand. It was further indicated that the association between workload and musculoskeletal disorders can be mediated by job-related strain (Sprigg et al., 2007). Similarly, Larsman et al. (2006) examined the relationship among workload, WMSDs and felt stress among computer users. Their findings indicated that felt stress fully mediates the relationship between work demand and neck/shoulder musculoskeletal symptoms. Even though some studies have explored the concepts of work demand, WMSDs and work stress, they seem to be sparsely studied (Fonseca and Fernandes, 2010; Kim et al., 2013). Recent studies have shown that the demand of one’s work can lead to the development of stress and WMSDs (Azma et al., 2015; ILO, 2016). Meanwhile, the influential role of work stress in the trajectory between work demand and WMSDs appears not to have received the needed scholarly attention in the African setting, particularly among emergency workers. The current study therefore seeks to examine the mediation role of work stress in the relationship between work demand and WMSDs among firefighters.

Work demand and work stress

Jones and Fletcher (1996) defined “work demand as the degree to which the working environment contains stimuli that require some effort” (p. 34). The notion is that job demands may lead to work stress if they necessitate extra effort above the normal way of attaining work targets (Deemerouti et al., 2001). It can therefore be said that for job demand to exist, there should be aspects of the job that require a worker to exert additional energies in order to perform his or her work. Both quantitative (workload) and qualitative (pressure/speed) work demand can lead to adverse health effects on workers. Selye (1974) defined stressors “as events that trigger a physiological and psychological response from the organism, in order to distinguish stimulus from response” (p. 171). Hence, stress can be a negative or positive circumstance that reacts to a stressor and that can have an impact on the mental or physical health and well-being of a person. Similarly, the ILO (2016) defined stress as “the harmful physical and emotional response caused by an imbalance between the perceived demands and the perceived resources and abilities of individuals to cope with those demands” (p. 2). Work stress may result from the organization, work design and interpersonal relations, and happens when work demands do not match or outweigh the abilities, resources or needs of the worker, or when the knowledge or capabilities of an individual worker or group to cope are not matched with the expectations of the institution. According to Drakopoulos et al. (2012), work stress is a health problem that affects industrial performance.

The relationship between work demand and stress has received considerable attention. The Health and Safety Executive (2007), for instance, explained that work stress is the adverse reaction people have due to excessive pressure or other types of demands placed on them. Similarly, Noblet and Lamontagne (2006) opined that occupational stress occurs when external demands and conditions do not match a person’s needs, expectations or ideas or exceed their physical capacity, skills or knowledge for comfortably handling a role. In England, the association between work demand and coping in predicting levels of stress and depression was tested using 870 respondents (Mark and Smith, 2011), and was found that job demand, extrinsic effort and over-commitment were associated with higher levels of anxiety and depression. Herrero et al. (2012) tested for work demand-induced stress among men and women and reported that work demand significantly predicted work stress.
Further, stress levels were high among females than males when exposed to demanding tasks. Løkke and Madsen (2014) examined stress among Danish managers and found that workload, managerial level, work situation and amount of work at home predict work stress. From the findings of Haus et al. (2016), emergency service managers face a lot of work demands which lead to stress. Some of such stressors are event-specific stressors as well as group-specific stressors. Other work demand aspects that cause stress to emergency workers include dealing with the media, assuming responsibility for decisions made and justification for failed assignments (Haus et al., 2016). The findings of Løkke and Madsen (2014) indicate that stress in emergency professions can be caused by activities at the workplace and off the workplace but Haus et al. (2016) categorized stress into event-specific, group-specific and general work stress. This shows that stress can emanate from multiple sources from both on-the-job and off-the-job factors. Even though workload is related to stress and exhaustion, job control and personal development buffer the relationship (Panari et al., 2010). However, too much workload can lead to burnout if not managed well (Moyer et al., 2017). Contrastingly, Gardner and Fletcher (2009) reported that a potentially stressful work demand could result in positive rather than negative outcomes. Notwithstanding this contrasting finding, work demand is likely to lead to work stress among firefighters.

**Work demand and WMSDs**

WMSDs can have multiple causes from both inside and outside the work environment. According to Nunes (2009), “WMSDs include a wide range of inflammatory and degenerative conditions affecting muscles, tendons, ligaments, joints, peripheral nerves and supporting blood vessels” (p. 121). Basically, musculoskeletal disorders have been used to indicate complications in the nerves, tendons, muscles and supporting structures of the body. Musculoskeletal conditions may occur when muscles or tendons are overextended or over-used beyond their capabilities. Research indicates that WMSDs are common among rescue and emergency service workers, particularly firefighters (Kim et al., 2013; Lim et al., 2014; Lusa et al., 2015). Westgaard and Winkel (1997) contended that firefighters are predisposed to musculoskeletal disorders and need support. As such, Lim et al. (2014) proposed for the adoption of an integrated health management system for emergency service workers because musculoskeletal complaints, shift work and depression were found to be related to sleep problems due to their engagement in catastrophic activities (Dirkzwager et al., 2004; Lusa et al., 2015). Oranye et al. (2017) maintained that work-related musculoskeletal injuries are caused by organizational processes and policies. The extent of work demands placed on workers can result in musculoskeletal injuries. In Korea, Kim et al. (2013) reported that organizational factors such as work demand, physical environment, organizational structure, occupational climate, inadequate rewards and job insecurity lead to WMSDs. Similarly, the findings of Cole et al. (2005) revealed that apart from sex and education, psychological demand, job insecurity and physical exertion also lead to work-related injuries. Even though both the findings of Kim et al. (2013) and Cole et al. (2005) reveal that work demands lead to WMSDs, the former places much emphasis on only physical work demands while the latter stresses on both physical and psychological work demands. Fonseca and Fernandes (2010) also revealed that physical work demands such as handling heavy materials, poor sitting posture and repetitive tasks, psychosocial demands and hazardous physical fitness result in work-related musculoskeletal complaints in the neck, shoulder or upper back and the lower back. While previous studies have centered on causes of musculoskeletal complaints (Aznas et al., 2015; Kim et al., 2013; Lim et al., 2014; Lusa et al., 2015), da Costa and Vieira (2008) suggested that stretching can minimize the occurrence of WMSDs. According to Keea and Seo (2007), the shoulder is the most predisposed body part to WMSDs, followed by the knee, lower back, hand or wrist, neck, ankle or feet, finger and then other areas of body but differ among countries.
In a related study among Asian nurses, Smith et al. (2006) reported that WMSDs were predicted by manually lifting sick people, carrying out physically backbreaking tasks and high mental demands. Also, Lee et al. (2008) found that high job uncertainty suggestively augmented the danger for lower-back musculoskeletal complaints after controlling for physical workload and individual characteristics. The findings of Smith et al. (2006) point to the effect of both physical and psychological job demands as causes of WMSDs, whereas Lee et al. (2008) attributed causes of WMSDs to physical work demands and personal characteristics of individual workers. Oakman and Bartram (2017) suggested that physical and psychosocial workplace factors are key to WMSDs development. In respect of these factors, Krause et al.’s (2005) report indicated that workers who are exposed to high levels of physical workload and ergonomic activities are three to five times more likely to experience higher musculoskeletal levels than their colleagues with minimal exposures. From the review, it is evident that the more demanding tasks assigned to workers, the higher their likelihood of developing WMSDs. Hence, work demand will have a significant positive effect on WMSDs.

Work stress and WMSDs
Workers who are more stressed are more likely to develop WMSDs. Among the causes of WMSDs are repetitive motion, awkward posture, forceful exertions, pressure points and static postures (NIOSH, 2007). When workers are given tasks that exceed their capabilities in the absence of needed resources, they are likely to use means that will result in repetitive injuries. WMSDs are among the leading reported health complaints in emergency and health care services (Oranye et al., 2017; Smyth et al., 2017). Although Abaraogu et al. (2017) reported that no stress dimension significantly relates to WMSDs, Azma et al. (2015) demonstrated that factors like stress, job demand, control and changes lead to disorders in body parts like the neck, shoulders, back and hip. Kim et al. (2013) also examined the levels of WMSDs among Korean male fire service workers and found that work stress has a significant relationship with WMSDs. In addition, Azma et al. (2015) reported a relationship between work stress and pain in specific body parts such as the neck, shoulder and back, while Kim et al. (2013) also reported of a relationship between work stress and WMSDs in general. A study by Mehtaa and Parijat (2012) revealed that psychosocial risk factors such as stress predict WMSDs. Further, the finding of Leino (1989) indicated that the prevalence of chronic musculoskeletal disease was associated with symptomatic stress among both men and women. Psychosocial and work factors are among the leading causes of WMSDs (Wahlstrom, 2005). Devereux and Buckle (2000) contended that work stress reactions lead to WMSDs and suggested a reciprocal relationship between them. da Costa and Vieira (2010) also revealed that apart from physical work demands, WMSDs are caused by high psychosocial work demands, hence the need to test for a causal relationship. This implies that work stress can cause pain and hurt in specific body parts or in all body parts depending on the severity of the stress.

Work demand, work stress and WMSDs
Both work demand and work stress are contributory factors to WMSDs development (da Costa and Vieira, 2008), although perceptions may differ among different people (Oranye et al., 2017). Previous studies established links among musculoskeletal disorders and physical and psychosocial work factors such as stress (Carayon et al., 1999; Hagen et al., 1998). For instance, it is presumable that workers whose work environments require them to exert extra energies are likely to be more susceptible to WMSDs than workers with low work demands. Research suggests relationships among work demand, work stress and WMSDs. Kim et al. (2013), for example, revealed that among the work stress subgroup, physical environment, work demand, organizational structure, occupational climate,
inadequate rewards and job insecurity had relationships with the manifestation of WMSDs, but not with work control and conflict. However, in general, work stress was correlated to the incidence of WMSDs. In Canada, Cole et al. (2005) found that apart from sex, education and job insecurity, high levels of physical exertion and psychological demands relate with work-related repetitive strain injuries. Park and Jang (2010) also found that work demand had a significant relationship with neck and shoulder complaints. The findings further revealed that high work demand and low decision opportunity significantly predicted shoulder and neck complaints among respondents. It was suggested that further studies need to be conducted to clarify the association between psychosocial factors and upper extremity musculoskeletal disorders and possibly work stress. The studies of Kim et al. (2013), Park and Jang (2010) and Cole et al. (2005) suggest a relationship between work demand and WMSDs, but Kim et al. (2013) treated work stress and work demand as composite variables other than as sub-dimensions. This shows that work demand and work stress can affect WMSDs at the same time. On the other hand, work demand can cause work stress, which, in turn, can lead to WMSDs. In Brazil, Fonseca and Fernandes (2010) also reported that work-related musculoskeletal complaints in the neck, shoulder or upper back and the lower back had relationships with physical work demands (handling heavy materials, poor back position and repetitive tasks), psychosocial demands and hazardous physical fitness. Apart from that, musculoskeletal complaints in distal upper parts were related to physical work demands (repetitive and energetic tasks) as well as number of years in service. In the USA, Krause et al. (2005) reported that occurrences of extreme bodily aches were 47 percent in general, 43 percent (neck), 59 percent (upper back) and 63 percent (low back pain). Respondents who fell within the uppermost exposure quartiles for physical workload and ergonomic complaints were more probable to report extreme aches than those in the lowermost quartile. Carayon et al. (1999) hinted of possible pathways of physiological, psychological and behavioral reactions to stress that can also directly or indirectly affect WMSDs. It was further expressed that psychosocial work factors such as work pressure and lack of control which cause stress can also lead to ergonomic factors such as forceful exertions, repetitive action and awkward posture that have been linked to WMSDs. In order to fully understand the etiology of WMSDs, it is important to examine both physical ergonomic and psychosocial work factors simultaneously (Carayon et al., 1999). From the review, WMSDs are a major industrial health concern and workers whose tasks are characterized by a lot of demands are more likely to develop WMSDs than those whose tasks are less demanding. Both work demands and work stress have relationships with WMSDs. Further, work demand has a significant relationship with work stress. These indicate that there can be a pathway from work demand to WMSDs through work stress. Hence, it is proposed that work stress will mediate the relationship between work demand and WMSDs (Figure 1).

**Hypotheses**

*H1.* Firefighters’ work demand will have a significant positive effect on WMSDs.

*H2.* Firefighters’ work demand will have a significant positive effect on work stress.

![Work demand, stress and WMSDs](image-url)
**Method**

**Design and participants**

Using a cross-sectional survey design, the study conveniently sampled 320 firefighters in the Greater Accra Regional Fire Command, Ghana. The Greater Accra region was selected due to its high records of fire outbreaks in Ghana (GNFS, 2016). Participants were sampled from the lowest rank (Recruit firefighter) to the highest rank (Chief fire officer). The sample comprised of 234 (73.1 percent) males and 86 (26.9 percent) females. The majority of the respondents 104 (32.5 percent) were aged \(25 \leq 34\) years, while the majority 181 (56.6 percent) worked for more than 12 h per day.

**Measures**

A self-reported questionnaire was used for data collection. The questionnaire had four sections: demography, work demand, WMSDs and work stress. The demography section was made up of items such as gender, age and working hours. Sex (Cole *et al.*, 2005), age (Shaik *et al.*, 2014) and working hours (Park and Jang, 2010) were controlled for since they can affect WMSDs. Van Veldhoven and Meijman’s (1994) eight-item questionnaire was adapted to measure work demand. Rated on a five-point Likert scale (1 – strongly disagree, 2 – disagree, 3 – neutral, 4 – agree to 5 – strongly agree), the instrument had an original Cronbach’s \(\alpha\) coefficient of 0.87 and had typical statements like “I have to work fast.” The Cronbach’s \(\alpha\) value for the current study is 0.80.

Also, WMSDs were measured using the standardized Nordic questionnaire (Kuorinka *et al.*, 1987). The Nordic questionnaire measures pains, hurts or aches in any of nine body parts (neck, shoulder, elbow, wrist, upper back, lower back, hip, knee and ankle) for the last 12 months. Items were rated on a five-point Likert scale (1 – very unlikely, 2 – unlikely, 3 – neutral, 4 – likely and 5 – very likely) with a Cronbach’s \(\alpha\) coefficient of 0.92 for the current study.

The Impact of Event scale developed by Horowitz *et al.* (1979) was adapted to measure work stress. This 15-item scale comprised of statements that examined whether a firefighter had ever been stressed as a result of a firefighting event or activity (Horowitz *et al.*, 1979; Weiss and Marmar, 1997). The scale was rated on a five-point Likert scale (1 – never, 2 – rarely, 3 – sometimes, 4 – often to 5 – always) and had an original reliability value of 0.86. The scale had typical statements like “I thought about it when I didn’t mean to.” The Cronbach’s \(\alpha\) coefficient for the current study was 0.75.

**Data collection and analysis**

Data for this study were collected from March to May 2016. Questionnaires were self-administered to firefighters within the Greater Accra Regional Fire Command. Ethical considerations such as approval, informed consent, voluntarily participation, confidentiality and anonymity were adhered to. Predictive Analytics Software (PASW) version 22.0 was the tool used for data analyses. Respondents’ demography was analyzed descriptively. Correlation test was preliminarily used to test relationships among variables. Further, simple linear and multiple regressions were used to test for the direct effect of work demand and work stress on WMSDs, and the mediation role of work stress in the relationship between work demand and WMSDs, respectively. Baron and Kenny’s (1986) mediation analysis procedure was used to test whether work stress mediates the relationship between work demand and WMSDs.
Results
From Table I, skewness for work demand, work stress and WMSDs was \((-0.110, -0.257\) and \(-0.206\)), respectively. Also kurtoses for work demand, work stress and WMSDs was \((-0.305, -0.121\) and \(-1.367\)), respectively. Since all variables were within the bound of \((-1.96, -1.96\)), they were all normally distributed. Further, there was no multicollinearity since all variables had correlates below 0.80, as shown in Table II. Expectation maximization approach was used to manage missing data.

In order to determine the relationship among the variables, a Pearson’s correlation test was carried out. From Table II, sex \((r = -0.059, p < 0.05)\) and age \((r = 0.023, p < 0.05)\) did not have significant relationships with WMSDs. However, working hours \((r = 0.150**, p < 0.01)\), work demand \((r = 0.228**, p < 0.01)\) and work stress \((r = 0.180**, p < 0.01)\) were significantly related with WMSDs. Also, work demand and work stress were significantly related \((r = 0.206**, p < 0.01)\).

Effect testing
The effect of firefighters’ work demand on WMSDs
The first hypothesis sought to find out whether firefighters’ work demand had a significant positive effect on WMSDs. A Pearson’s correlation test was first carried out to find out if work demand and WMSDs have any relationship. From Table II, work demand and WMSDs were significantly related \((r = 0.228**, p < 0.01)\). Further, a linear regression was conducted, where work demand was used to predict WMSDs. From Table III, work demand has a significant positive effect on WMSDs \((\beta = 0.228, p < 0.01)\). Therefore, \(H1\) was supported. This suggests that a unit increase in the work demand of firefighters will lead to a 22.8 percent increase in the development of WMSDs. In addition, work demand explained 5.2 percent of variation in WMSDs \((R^2 = 0.052)\).

The effect of firefighters’ work demand on work stress
\(H2\) sought to determine whether the work demand of firefighters will have a significant effect on work stress. In order to determine whether work demand and work stress are related, a Pearson’s correlation test was conducted. From Table II, there was a significant

<table>
<thead>
<tr>
<th>Variable</th>
<th>Skewness</th>
<th>SE</th>
<th>z-Scores</th>
<th>Kurtosis</th>
<th>SE</th>
<th>z-Scores</th>
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<td>1. WD</td>
<td>-0.015</td>
<td>0.136</td>
<td>-0.110</td>
<td>-0.083</td>
<td>0.272</td>
<td>-0.305</td>
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<tr>
<td>2. WS</td>
<td>-0.035</td>
<td>0.136</td>
<td>-0.257</td>
<td>-0.033</td>
<td>0.272</td>
<td>-0.121</td>
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<tr>
<td>3. WMSDs</td>
<td>-0.028</td>
<td>0.136</td>
<td>-0.206</td>
<td>-0.372</td>
<td>0.272</td>
<td>-1.367</td>
</tr>
</tbody>
</table>

Notes: WD, work demand; WS, work stress; WMSDs, work-related musculoskeletal disorders

<table>
<thead>
<tr>
<th>Variables</th>
<th>(M)</th>
<th>(SD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>1. Sex</td>
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</tr>
<tr>
<td>2. Age</td>
<td>0.92</td>
<td>0.27</td>
<td>-0.026</td>
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</tr>
<tr>
<td>3. WHrs</td>
<td>0.43</td>
<td>0.50</td>
<td>0.251**</td>
<td>0.030</td>
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<td></td>
<td></td>
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<tr>
<td>4. WD</td>
<td>29.24</td>
<td>4.17</td>
<td>-0.064</td>
<td>-0.002</td>
<td>0.008</td>
<td>1</td>
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<tr>
<td>5. WS</td>
<td>47.64</td>
<td>8.12</td>
<td>-0.049</td>
<td>0.005</td>
<td>-0.109</td>
<td>0.206**</td>
<td>1</td>
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<tr>
<td>6. WMSDs</td>
<td>32.28</td>
<td>8.44</td>
<td>-0.059</td>
<td>0.023</td>
<td>0.150**</td>
<td>0.228**</td>
<td>0.180**</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes: WHrs, working hours; WD, work demand; WMSDs, work-related musculoskeletal disorders; WS, work stress; \(M\), mean. **\(p < 0.01\) (two-tailed)
positive relationship between work demand and work stress \((r = 0.206**, p < 0.01)\). In order to determine the extent of the relationship, a linear regression test was carried out. From Table III, the results show that work demand has a significant positive effect on work stress \((\beta = 0.206, p < 0.01)\). Hence, \(H2\) was supported. This implies that a unit increase in work demand will lead to 20.6 unit increase in work stress. It was also found that work demand explained 4.3 percent of variance in work stress \((R^2 = 0.043)\).

The effect of firefighters’ work stress on the development of WMSDs

\(H3\) sought to find out whether work stress will have a significant positive effect on WMSDs. In order to determine the relationship between work stress and WMSDs, a Pearson’s correlation test was carried out. From Table II, work stress and WMSDs had a significant positive relationship \((r = 0.180**, p < 0.01)\). To test whether firefighters’ work stress has a significant positive effect on the development of WMSDs, a regression test was conducted, whereby work stress was used to predict WMSDs. From Table III, work stress has a significant positive effect on WMSDs \((\beta = 0.138, p < 0.05)\). Therefore, \(H3\) was supported. This suggests that a unit increase in firefighters’ work stress will lead to a 13.8 percent increase in WMSDs.

The mediation effect of work stress in the relationship between work demand and WMSDs

\(H4\) sought to find out whether work stress mediates the relationship between work demand and WMSDs. In order to test this hypothesis, a three-step regression test was conducted using Baron and Kenny’s (1986) mediation approach. From Table III, in step 1, work demand was used to predict WMSDs and the coefficient was significantly positive \((\beta = 0.228, p < 0.01)\). In step 2, work demand was used to predict work stress. From Table III, work demand had a significant positive effect on work stress \((\beta = 0.206, p < 0.01)\). Both work demand and work stress were regressed on WMSDs in step 3. From Table III, both work stress \((\beta = 0.138, p < 0.05)\) and work demand \((\beta = 0.199, p < 0.01)\) have significant positive effects on WMSDs. In all the steps, the models were fit as indicated by the \(F\)-statistics \((step 1 = 17.362**, step 2 = 14.129** and step 3 = 11.955**\). Further, in step 3, there was a significant change in \(R^2\) \((\Delta R^2 = 0.070)\). Since the regression coefficient for work demand in step 3 \((\beta = 0.199, p < 0.01)\) is less than the coefficient in step 1 \((\beta = 0.228, p < 0.01)\), and yet significant, work stress partially mediates the relationship between work demand and WMSDs. Therefore, \(H4\) was supported.

Discussion

The study sought to find out whether work stress mediates the relationship between work demand and WMSDs. The first objective sought to find out whether firefighters’ work demand had a significant positive effect on WMSDs. The findings revealed that work demand has a significant positive effect on WMSDs. This suggests that an increase in the work demand of workers will lead to increase in the development of WMSDs. This finding

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
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<tbody>
<tr>
<td>WMSDs (DV)</td>
<td>WMSDs (DV)</td>
<td>WMSDs (DV)</td>
</tr>
<tr>
<td>WD</td>
<td>0.228**</td>
<td>0.206**</td>
</tr>
<tr>
<td>WS</td>
<td>0.138*</td>
<td></td>
</tr>
<tr>
<td>(F)-stats</td>
<td>17.362**</td>
<td>14.129**</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.052</td>
<td>0.043</td>
</tr>
<tr>
<td>(\Delta R^2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** DV, dependent variable; \(F\)-stats, \(F\)-statistics; \(\Delta R^2\), change in \(R^2\). *p < 0.05; **p < 0.01
agrees with an earlier finding by Kim et al. (2013) which indicated that organizational factors such as work demand, physical environment and other organization factors lead to WMSDs. The finding also supports an earlier finding of Cole et al. (2005) that revealed that apart from sex and education, psychological demand and physical exertion also lead to work-related injuries. The finding also buttresses Smith et al.’s (2006) report that revealed that WMSDs are predicted by manually lifting sick people, carrying out physically backbreaking tasks and high mental demands. Lee et al. (2008) also found that high job uncertainty suggestively augmented the danger for lower-back musculoskeletal complaints after controlling for physical workload and individual characteristics. These findings reveal that when workers are subjected to high work demand, it will predispose them to higher levels of WMSDs. Therefore in the firefighting profession, when firefighters are assigned tasks that demand a lot of effort such as speed, climbing, lifting of water hose and standing to fight fire for long hours in awkward positions, they are more likely to experience WMSDs. This implies that when workers are engaged in highly demanding work activities, the likelihood to exert more energy is higher, and which can result in WMSDs.

The second objective sought to determine whether work demands of firefighters significantly affect work stress. It was found that work demand has a significant positive effect on work stress. This implies that an increase in work demand will result in an increase in work stress. The current finding confirms Noblet and Lamontagne’s (2006) postulation that work stress occurs when external demand and conditions do not match a person’s needs, expectations or ideas or exceeds their physical capacity, skills or knowledge for comfortably handling a situation. The research outcome also agrees with Mark and Smith’s (2011) findings that indicated that job demand, extrinsic effort and over-commitment were associated with higher levels of anxiety and depression. Similarly, Herrero et al. (2012) found work demand to predict work stress among both men and women. Løkke and Madsen (2014) also found that workload, managerial level, work situation and working at home lead to work stress. However, the finding contrasts with findings by Gardner and Fletcher (2009) that revealed that a potentially stressful work demand could result in positive rather than negative outcomes. Notwithstanding this contrasting finding, a lot of research points to the fact that high work demands lead to some elevated stress levels. These findings are suggestive that physical and psychosocial work demand can cause stress at the workplace. When firefighters are subjected to extreme work demands such as taking quick decisions in emergency situations, having to deal with complex fire outbreaks and handling of injured and dead persons they become prone to stress.

The third objective sought to find out whether work stress will have a significant positive effect on WMSDs. The finding shows that work stress has a significant positive effect on WMSDs. This implies that as work stress increases, WMSDs also increase. Although the finding contradicts Abaraogu et al.’s (2017) report that indicated that no stress dimension significantly relates to WMSDs, the result supports findings by Azma et al. (2015) who revealed that factors like stress, job demand, control and changes lead to disorders in parts of the body such as the neck, shoulders, back and hip. The finding also supports those of Kim et al. (2013) who found work stress to be significantly related with WMSDs among Korean male firefighters, Mehtaa and Parijat (2012) who revealed that psychosocial risk factors such as stress predict WMSDs and Leino (1989) who reported a relationship between chronic musculoskeletal ailments and symptomatic stress. This seems to reinforce Wahlstrom’s (2005) opinion that psychosocial and work factors are among the leading causes of WMSDs. The current finding affirms earlier findings by Devereux and Buckle (2000) that revealed that work stress leads to WMSDs and suggested a reciprocal relationship between them. Based on these, it is suggestive that the more workers get stressed, the higher their chances of developing WMSDs.

The fourth objective sought to find out whether work stress mediates the relationship between work demand and WMSDs. The finding revealed that work stress partially
mediates the relationship between work demand and WMSDs. This implies that work demand can lead to work stress which can consequently lead to WMSDs. However, work demands can also affect WMSDs directly. This finding confirms Carayon et al.’s (1999) suggestion of possible pathways of physiological, psychological and behavioral reactions to stress that can also directly or indirectly affect WMSDs. It is indicative that psychosocial work factors such as work pressure and lack of control which cause stress can also lead to ergonomic factors such as forceful exertions, repetitive action and awkward posture that have been linked to WMSDs (Cole et al., 2005; Kim et al., 2013; Park and Jang, 2010). The findings suggest that although work demand can cause work stress, which can consequently lead to WMSDs, work demands can also lead to WMSDs without the intervention of work stress. Hence, work stress lies in the pathway between work demand and WMSDs. However, work demand can culminate into WMSDs without necessarily causing work stress which will rather lead to WMSDs.

Conclusion
Despite the strides in occupational health management and employee well-being activities, health research in the fire service appears scanty, particularly in developing countries. It is indicative that work demand and work stress lead to WMSDs. However, work demand also leads to work stress. Tasks that expose workers to high stimuli that necessitate emotional and physical responses due to discrepancies in resource availability and task requirements will lead to exhaustion and depersonalization. There is the possibility that some workers may be assigned to jobs that exceed their capacity in the absence of resources or support which can result in stress or emotional exhaustion. In order to manage work demand-induced stress, there is a need for managers and supervisors to assign tasks to workers based on their individual capacities to reduce stress incidences at the workplace. However, within the fire service, it is accepted that this may not always be possible, given the nature of the job. Also managers need to provide support in terms of equipment, resources and training to help workers overcome stress tendencies.

Again, work demand leads to WMSDs. When workers are assigned tasks that contain stimuli that require extra effort in accomplishing them, they may exert energies that exceed their normal capacities. This will lead to potential overstretching and overworking which can result in pains, aches and hurts in joints, tendons and body parts. Sometimes workers use unorthodox or crude means to accomplish tasks that are demanding, and this can lead to the development of WMSDs. In order to minimize the tendencies of WMSDs, organizational leaders are entreated to evaluate jobs to ascertain their demands before assigning them to workers. Apart from that, it is necessary for organizational leaders to mechanize extremely demanding manual tasks to curtail the incidences of WMSDs. While it is ideal that extremely demanding manual tasks are mechanized, this can be challenging to achieve within a fire service – where control over the task is often limited. In addition, there should be regular physical and medical checks on workers to assess their fitness levels in order to assign the right task to the right person at the right time.

Further, even though work stress affects WMSDs, work demands can also affect WMSDs through work stress. Per the nature of the firefighting job, it is not always possible to minimize demands within the fire service – as demands are created externally. However, more support can be offered to mitigate these demands to some degree. This suggests that when workers are exposed to demanding assignments they will be stressed, and when the stress is not managed, it can result in WMSDs. Jobs that are characterized by heavy workload, speed and pressure can lead to exhaustion if there are no resources to match the demand, which can consequently lead to pains, aches and discomfort in body parts, joints and tendons. Since work stress lies in the trajectory between work demand and WMSDs, it is prudent to minimize the demand associated with tasks which is a root cause. This can
minimize or prevent work stress from occurring, and consequently WMSDs. Hence, managers and supervisors should design and assign tasks to workers, having in mind suitable workers to handle them as well as provide the needed resources to aid them accomplish the tasks without overexertion. Where work demands lead to work stress, where possible, managers could consider preventing it from culminating into WMSDs by reassigning other employees to assist workers with demanding tasks, providing equipment to make the work easier, altering the work design to help accomplish results with minimal exertion and counseling workers to cope with stress. Workers should also be encouraged to seek assistance or support from supervisors and co-workers, when they realize that their work demands are above their capacities.

Limitations and areas for further research
This study used cross-sectional data for analysis, which limits the ability to establish causality. It is therefore suggested that future studies should use longitudinal designs to strengthen the acceptability of causality. Longitudinal designs will also help to assess changes within units of observation over time. Also the scope of the study is limited to only firefighters, although there are other similar emergency professions which could have been considered. It is therefore recommended that further studies be conducted in other emergency occupations such as the military, police and other hazardous professions. Geographically, the study can be expanded to cover other parts of the country and other developing countries. Finally, the adoption of a quantitative research approach limits the in-depth nature of information collected. In order to get in-depth responses from respondents, a qualitative approach is deemed necessary.

References


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