



Sound the alarm: Health and safety risks associated with alarm response for salaried and retained metropolitan firefighters



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ARTICLE INFO

Article history:

Received 16 December 2014

Received in revised form 7 August 2015

Accepted 17 September 2015

Keywords:

Risk
Alarm response
Emergency services
Fatigue
Sleep inertia

ABSTRACT

Responding to an emergency alarm poses a significant risk to firefighters' health and safety, particularly to cardiovascular health, physical and psychological stress, and fatigue. These risks have been largely categorised for salaried firefighters working 'on station'. Less is known about the factors that contribute to these risks for the vast number of non-salaried personnel who serve in retained roles, often deploying from home. The present study investigated the alarm response procedure for Australian metropolitan fire fighters, identifying common and divergent sources of risk for salaried and retained staff. There were significant differences in procedure between the two workgroups and this resulted in differences in risk profile between groups. Sleep and fatigue, actual response to the alarm stimulus, work-life balance and trauma emerged as sources of risk experienced differently by salaried and retained firefighters. Key findings included reports of fatigue in both groups, but particularly in the case of retained firefighters who manage primary employment as well as their retained position. This also translated into a poor sense of work-life balance. Both groups reported light sleep, insufficient sleep or fragmented sleep as a result of alarm response. In the case of salaried firefighters, this was associated with being woken on station when other appliances are called. There were risks from physical and psychological responses to the alarm stimulus, and reports of sleep inertia when driving soon after waking. The findings of this study highlight the common and divergent risks for these workgroups, and could be used in the ongoing management of firefighters' health and safety.

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1. Introduction

Firefighters act as first responders to the community during times of crisis. As a consequence, firefighters are exposed to a multitude of occupational risks. Existing research demonstrates that the process of responding to an emergency alarm itself presents significant risk to firefighters' health and safety (Barnard and Duncan, 1975; Kales et al., 2003, 2007). Alarm response refers to the procedure by which firefighters are alerted to a situation requiring their action. Typically, an auditory alarm will sound, at any time of the day or night, alerting personnel to the type and location of the incident to which they are responding (Barnes, 2000).

The majority of existing research in the area of alarm response focuses on physiological risks to the individual, particularly to cardiovascular (CV) health (Kales et al., 2003, 2007). The primary risk

associated with alarm response is hypothesized to be the sudden increase in heart rate in response to the alarm itself, followed by a period of strenuous physical activity (Barnard and Duncan, 1975; Karlsson et al., 2011; Kuorinka and Korhonen, 1981). There is also evidence that the noise of the alarm, as well as the sirens on the appliance, are associated with increased blood pressure (Kales et al., 2009). The sudden physical activity associated with an alarm, particularly in contrast to periods of relative inactivity in-between responses, has been purported as a significant physiological and psychological stressor (Barnard and Duncan, 1975; Guidotti, 1992). Similarly, interrupted sleep experienced in the station, commonly associated with the alarm stimulus, was subjectively rated by firefighters as the most severe cause of work-related strain and was highly correlated with fatigue (Kalimo et al., 1980). However, this study addressed only salaried firefighters whose sleep is disturbed when in the station. Another study combining both salaried and volunteer firefighters found that work related injury risk is highest when responding to alarms during the biological night, but did not address how this risk interacts with the alarm response procedure (Riedel et al., 2011).

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Such information is important as safely managing the risk may, for example, be achieved by fire agencies making small adjustments to their alarm response procedures.

The CV health, fatigue, and injury risks outlined above have been largely categorised for salaried firefighters working 'on station' or, to a lesser extent, volunteer firefighters (a firefighter who is not paid for their service; Loh, 2008). Salaried firefighters are paid a salary and work on a rotating shift schedule usually involving a combination of day and night shifts (Takeyama et al., 2005). Far less is known about the large number of non-salaried personnel who may serve in retained roles (approximately 20,000 in Australian and the United Kingdom, combined; Fire and Rescue NSW, 2013a; Queensland Fire and Emergency Services, 2014; South Australian Metropolitan Fire Service, 2012; UK Fire Service Resources Group, 2014). Retained firefighters, as distinct to volunteer firefighters, are paid a retainer fee and then an hourly rate for time spent responding to incidents (Fire and Rescue NSW, 2013b). Retained firefighters usually have a part- or full-time job outside their firefighting duties, but can be 'on-call' at all times, often deploying to an incident from 'home' (Fire and Rescue NSW, 2013b). Both salaried and retained firefighters respond to alarms and are presumably exposed to the same health and safety risks. However, it is likely that the alarm response procedure is experienced differently by these two workgroups, and in turn that the risk profile could differ between groups. However, as described above, health and safety risks associated with alarm response are yet to be explored in a retained firefighter population. Risk management controls that are designed based on risk assessments in salaried personnel may be inappropriate for retained personnel and in the worst case scenario, may actually do harm. As such, the aim of the present study was to determine if there are different risks associated with the alarm response procedure for salaried and retained firefighters. Specifically, the following research questions were addressed:

- (1) What is the alarm response procedure for Australian firefighters in salaried and retained roles?
- (2) What are the risks to the health and safety of salaried and retained firefighters during alarm response?

2. Materials and methods

2.1. Participants

Forty-six metropolitan fire fighters from two Australian states participated in semi-structured group interviews. As such, not all participants worked in the same depots. Twenty-two of these participants were full-time, salaried firefighters (mean age $38 \text{ y} \pm 10 \text{ y}$; mean years of experience $9 \text{ y} \pm 8 \text{ y}$). Twenty-four of the participants were retained firefighters (mean age $33 \text{ y} \pm 8 \text{ y}$; mean years of experience $7 \text{ y} \pm 7 \text{ y}$). Of the retained firefighters, 18 were employed in a full- or part-time capacity outside of their work for the fire service. Typical occupations were in the areas of manual labour, trades and retail. All participants in this research were male. Approximately 96% of the broader population of Australian metropolitan firefighters are male (South Australian Metropolitan Fire Service, 2014).

2.2. Procedure

Ethical clearance for this study was granted by Central Queensland University's Human Research Ethics Committee. Given that there is limited existing research addressing this topic, the present study was exploratory and intended to provide a basis for future research efforts in this area. Qualitative methods are common in exploratory research (Nordlöf et al., 2015) and are

considered most appropriate for developing the 'theoretical underpinning' of future quantitative research (Walsh et al., 2013). Specifically, this study used semi-structured group interviews to elicit procedures and risks surrounding alarm response for salaried and retained metropolitan firefighters. Similar qualitative methods have proven useful in previous firefighter research, for example Bearman et al. (2015) used qualitative data collection and analysis techniques to investigate the under-researched area of breakdowns in decision making during the management of a wildfire.

Advertisements for the study were placed around work areas of each participating organisation and distributed to employees via email. Interested participants were assigned a time to attend a group interview. As such, a sample of convenience was used. A total of seven interviews were conducted. One person conducted all but two of the interviews. Both interviewers followed the same procedures and were trained in the same interview methods. Four of the interviews were conducted with salaried firefighters (group sizes $n = 1$, $n = 4$, $n = 7$, $n = 10$) and three were conducted with retained firefighters ($n = 5$, $n = 9$, $n = 10$). Previous research indicates qualitative data collection methods can be effective and successful with up to 14 participants per group (Gill et al., 2008). At the commencement of each interview, participants were provided with a study information sheet and informed about the voluntary and confidential nature of their participation. It is worth noting, however, that because of the group interview method participant's responses were not confidential from one another. This was discussed with each group and participants were required to indicate that discussions within the room would stay confidential within the group. Potential limitations associated with the group interview method are discussed further in the Study Limitations section. Following discussions about confidentiality, informed consent was obtained. Interviews went for between 45 and 90 min, were audio recorded (with participant's permission) and then transcribed at a later date.

A series of questions were used to guide discussions in a semi-structured way. These questions were based primarily on existing knowledge about the alarm response procedure. For example, previous research has demonstrated that the actual alarm stimulus may trigger physiological and psychological responses, and that these may differ depending on the time of day the alarm occurs and the activity being undertaken at the time of the alarm (Barnard and Duncan, 1975; Guidotti, 1992; Kales et al., 2009; Karlsson et al., 2011; Kuorinka and Korhonen, 1981). There is also some evidence that alarm response is associated with increased injury risk (Riedel et al., 2011). As the aim of the present study was to determine if there are different risks associated with the alarm response procedure for salaried and retained firefighters, interview questions were designed to allow participants to discuss the procedures associated with alarm response, how these may differ relative to situational and time of day factors and how these contribute to risk. Responses could then be compared between salaried and retained firefighters to determine procedural differences, differences in risk profile and the interactions between procedure and risk.

The questions used to guide discussions were:

- Q. What are the different types of alarms you respond to?
- Q. What is the actual alarm stimulus?
- Q. Are there any differences in alarm response depending on location:
 - (1) Capital city?
 - (2) Regional area?
 - (3) At home?
 - (4) In the station/depot?
 - (5) Anywhere else?

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