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Simulation of noise exposure level of fire-fighters in emergency response services in Malaysia

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ABSTRACT

Excessive exposure to noise may lead to noise-induced hearing loss (NIHL). NIHL has emerged as the biggest cause of world occupational disease in recent years. Occupational hearing loss is among the common work related diseases in Malaysia. It has been proven that occupational NIHL shows the highest number of cases compared to other occupational diseases. Many occupational noise exposure studies have been conducted in various occupational sectors. However, no studies have been done on noise exposure of fire-fighters in Malaysia. This study aims to determine noise intensity and noise dose exposed to the fire-fighters during emergency response activity, to develop fire-fighter noise exposure indicator profile, and to propose solutions in order to reduce potential hearing loss among fire-fighters. Noise measurement from sirens emitted from truck and sirens at the station was carried out at Taman Universiti Fire Station using Sound Level Meter (SLM). Measurement was conducted on all pieces of equipment on truck including power saw, circular saw, hydraulic power unit, generator set, air compressor, and high and low pump. In order to assess the noise dose, a list of noise-producing equipment and the estimated total time of exposure is provided. Once the data had been analysed, an indicator system was constructed. As anticipated, all types of sirens and equipment produced noise greater than 85db except for noise emitted from AlarmCAD lite, emergency siren and generator set. Useful exposure indicator profile and solutions were proposed to reduce fire-fighters potential hearing loss.

1. Introduction

Different countries refer to different regulations regarding noise emission (Mulholland and Attenborough, 1981). Certain countries allow certain noise emission level during specific period of time, task and characteristic of noise. Malaysia practices noise regulations from Factory and Machinery Regulation (FMR), Occupational Safety and Health Act (OSHA), Health and Safety Executive (HSE), Department of Environment (DOE) and a few other approaches for recommendation and reference issue on noise to human and environment. The noise regulation in Malaysia came into force in 1st February 1989 which is Factory and Machinery (Noise Exposure) Regulation (1989). The regulation requires compliance from all factories in any occupations involving exposure to excessive noise level in workplace. However, whenever it is not feasible to comply with this regulation, the occupier must provide or supplement controls with approved hearing protection devices.

The Occupational Safety and Health Act came into force on 25th February 1994 (OSHA, 1994). This act is to make further provision for security, health and welfare of a person at work. The OSHA regulations provide a permissible exposure level (PEL) for workers. OSHA's Occupational Noise Exposure rule (29CFR 1910.95) requires for employers to carry out noise exposure assessments and all the employees must be protected against the effects of noise exposure above an 8-h time-weighted average (TWA) of 85 dB (dB) with an exchange rate of 5. The World Health Organization (WHO) has developed recommended guidelines for noise exposure for the general population to include leisure-based activities. WHO recommended guidelines for noise exposure suggest up to 70 dB over a 24-h period can be considered safe to human hearing at which the risk for hearing impairment is negligible. To avoid hearing impairment, the peak sound pressure level (SPL) of impulse noise for adults and children shall not exceed 140 dB and 120 dB respectively (Berglund et al., 1999).

Firefighting is a dangerous occupation and associated with a variety of hazards, including rigorous physical training activities, exercise and emergency situations involving high temperatures, smoke and other air contaminants, ergonomic issues, and others (Poplin et al., 2011). According to Paterson et al. (2016), responding to an emergency alarm could lead to a significant risk on the fire-fighters' health and safety. As a result, roughly 1.1 million fire-fighters in U.S National Fire Protection

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Association (NFPA) in 2015 were known to be subjected to elevated risk of a number of occupational injuries and illness (Poplin et al., 2011). One potentially damaging illness is noise-induced hearing lost (NIHL) from constant excessive noise. Reports by Reischl et al. (1979), (1981) and Tubbs (1995) confirmed that NIHL was the reason for multiple hearing lost among fire-fighters that experience excessive high intensity noise exposure while working. Much worse is the hearing losses occurred early in their careers statistically (Ide, 2011). Organizations are required to measure noise levels and provide protective measures if warranted. Unfortunately, according to Schwennker (2011) noise control in the fire-fighting industry is difficult because loud noise is used as a control to warn people of impending danger. The relatively loud sirens and horns of fire trucks serve an alert system to the public to avoid the perimeter of emergency vehicles. In addition, research has shown that fire-fighters are exposed to relatively loud noise from the rescue equipment such as chainsaws (113 dBA), jaws of life (94 dBA), and chisels (106 dBA) (Diel, 2001). Neitzel et al. (2012) found that sawing metal, concrete, wood, and dry wall during ventilation activities produced some of the highest task-based noise levels (between 105 and 109 dBA) measured in the study. Nevertheless, despite of all the loud noise experienced by fire-fighters, there is also suggestion to come out with a more proper means of quantifying such exposure to noise in different work environments to aid in the diagnosis of hearing loss (Taxini and Guida, 2013). All of these reports clearly show that a proper monitoring and prevention measures should be made available immediately.

Average sound levels for the fire engine air horn and electric sirens were measured to be about 98 dBA inside the engine's crew cab and about 115 dBA outside the cab. Fig. 1 shows the noise monitoring on emergency equipment whereas Figs. 2 and 3 illustrates various types of fire-fighter saws and electrical sirens on fire truck, respectively as claimed by Moss (2015). Additionally, a study conducted by Schwennker (2011) stated that the equipment used at the fire stations showed noise level measurements ranging from 81 dBA to 108 dBA whereby 13 of the 15 pieces of equipment had measured noise levels greater than 85 dBA. Therefore, it is highly recommended by that study for fire-fighters to wear hearing protection devices while using these pieces of equipment to lower their risk of NIHL. According to a study conducted by Ide (2007), more than 90% of approximately 230 fire-fighters agreed that good hearing is essential for the majority of fire ground tasks. Other studies have documented low use of hearing protection devices among fire-fighters (Hong et al., 2011), despite acknowledgement by many surveyed fire-fighters of the potential for NIHL. Previous study also claimed that while fire-fighters acknowledged the importance of hearing on the job, few were willing to use hearing protection devices during firefighting activities (Hong and Samo, 2007). Previous research has suggested that fire-fighters' hearing threshold levels (HTLs) decline faster than expected during their careers compared with age-matched members of the general population (Kang et al., 2015). Kales et al. (2001) found that fire-fighters experience an average accelerated hearing loss of 6 dB at the 90th percentile when compared with population databases from the International Standards Organization (ISO). These researchers also claimed that hearing loss associated with firefighting is strongly associated with age and the duration of service as a fire-fighter, and that hearing loss is associated with the relative higher frequencies of sound perception.

In a second study, Hong et al. (2008) stated that hearing conservation programs and diligent use of hearing protection devices could significantly reduce the risk and prevalence of NIHL in the firefighting population. Their study showed that hearing loss interventions could be successful if followed appropriately. Some previous studies have stated that individual perception as well as contextual factors are important predictors of safety behaviour, including the use of hearing protection devices (HPD) (Arezes and Miguel, 2005). Researchers also recommended that effective interventions are needed to educate fire-fighters about the hazardous effects of noise and the importance of hearing protection devices. The aim of this study was to assess occupational noise exposure among fire-fighters and the compliance of permissible noise exposure limit to the fire-fighters emergency service activity. Fire-fighter noise exposure indicator profile was developed and solutions were proposed in order to reduce potential hearing loss among fire-fighters.

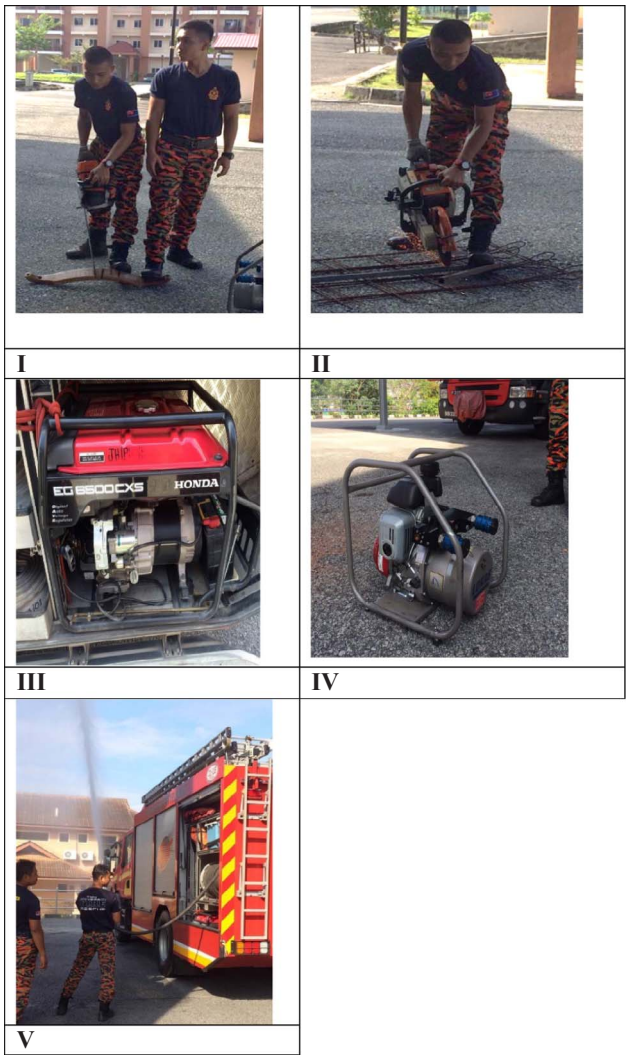

Fig. 1. Noise monitoring on emergency equipment. (I) Noise measuring while cutting log with chain saw. (II) Noise measuring while cutting metals with circular saw. (III) Generator set. (IV) Hydraulic power unit. (V) Noise measuring while running high pump and low pump.

Fig. 2. Fire-fighters various types of saws, roof chainsaw, K-12/Partner (rotary) saw, standard chainsaw, and/or a reciprocating saw.