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Influence of physical ability on initial emergency response performance

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Abstract

Purpose – This paper aims to determine the influence of physical ability on initial emergency response performance among emergency response teams.

Design/methodology/approach – In an emergency incident, emergency responders are involved in vigorous physical activities. Previous attempts have demonstrated that job performance of emergency responders depends a great deal on their ability to perform strenuous physical activity. This paper examines the influence of physical ability namely weight, height, and cardiovascular endurance on emergency response performance among fire fighting teams in Malaysia. Emergency response performance was defined as team member's speed in responding to emergency situations. Data on team member's physical ability and emergency response time were collected for the duration of five months. The distance from the waiting room to the fire truck in each selected fire station was used to measure performance.

Findings – This study found that the team with higher average weight and cardiovascular endurance level had better initial response to emergency situations, contrary to the research hypothesis. But it is speculated that the relationship could be further understood by considering the proportion of fat in the body. The relationship between cardiovascular endurance and initial emergency response performance further validates and justifies the use of physical fitness test as a criterion for job performance of fire fighters.

Originality/value – This paper offers empirical evidence of emergency response performance in Malaysia. Specifically, it presents findings on the influence of physical ability measures on initial emergency response performance from a team perspective. In addition, the emergency response performance was measured by the distance traveled by the responders, which serves as a meaningful performance indicator.

Keywords Physical ability, Emergency, Emergency response, Emergency response performance, Emergency incidents, Emergency services, Fire services, Physical testing, Malaysia

Paper type Research paper

1. Introduction

Concerns have been raised about the physical fitness of emergency responders particularly on how it could potentially affect their emergency response performance. This is because emergency response work demands vigorous physical activity (Cady and Valentine, 1999; Davis and Dotson, 1987; Gledhill and Jamnik, 1992; Rhea *et al.*, 2004). In Malaysia, these concerns are further fuelled by the Malaysian National Health and Morbidity Survey, which found that the average Malaysian is steadily becoming less fit and fatter despite current interests in health and fitness (Isahak, 2009). Furthermore, it is commonly reported that emergency responders are either late or take a long time in responding to emergencies (*The Star*, 2007, p. N4; Habibu, 2007; Ismail, 2006; *New Straits Times*, 2008, p. 2; Yoon, 2007).

As emergency response performance is vital in minimizing death, serious injuries, and property damage (Doyle, 1996; Kelly, 1995; Ramachandran, 1999; Tierney *et al.*, 2001),

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it is important to understand the role physical ability of emergency response personnel plays in determining emergency response performance. Such is vital as they serve as the first line of defence in emergencies. In a response phase, the emergency response personnel are required to respond in high speed (Flin and Slaven, 1996; Lewis and Payant, 2003; McGue and Barker, 1996). Speed in initial response is vital to the subsequent response activities. Studies have proven that the first few seconds in an emergency is key (Baldwin, 1994), and speed in responding solely depends on the emergency response personnel and not on the resources or the system used in emergency response. Therefore, emergency response personnel are vital in ensuring success of an emergency work.

2. Literature review

Previous scholars have demonstrated that successful job performance among emergency responders is dependent on their ability to perform strenuous physical activity (Lemon and Hermiston, 1977; Kilbom, 1980; O'Connel *et al.*, 1986; Sothmann *et al.*, 1990). However, very little research has been conducted on the relationship between physical ability and emergency response performance at a collective level and using actual emergency parameters, with some exceptions such as Rhea *et al.* (2004), who investigated the relationship between physical fitness and job performance using an experimental design. In their study, cardiovascular endurance, anaerobic endurance, muscular strength, local muscular endurance, and body composition were administered to identify fitness among fire fighters. In a different study, Williford *et al.* (1999) examined the relationship between physical fitness and job performance in a simulated fire suppression tasks among male fire fighters. Davis *et al.* (1982) investigated the relationship between physical fitness and simulated fire fighting tasks. While these studies have been insightful to our understanding of emergency responder's performance, their examination on the relationship between physical fitness measure and job performance among emergency responders was at the individual level. Because emergency responders work as a team when responding to emergencies, our understanding on how the team members' physical fitness influences the team performance limited.

In an emergency response, personnel work in highly interdependent teams to minimize effectively the impact of an emergency (Doyle, 1996; Ford and Schmidt, 2000; Kelly, 1995). Emergency response personnel need to adapt to a "system's" work approach with high emphasis given on interdependence among team members (Cameron, 1994; Cosgrave, 1996; Klinoff, 2003). When team members work together in concert toward the effective mitigation of an emergency situation, success is attributed to the whole team and not to any one individual (Senior and Swailes, 2004).

According to Robbins (1993), team performance can be partly predicted by task related and intellectual abilities of its team members. Understanding team members' abilities is vital for the attainment of the group outcome. In an emergency situation, the task outcome expected from emergency responders in a response phase is responding with a sense of urgency, which is reflected in the speed of response. When emergency responders are quick in their initial response, minimization of the impact of an emergency incident is likely to be achieved. To be able to respond quickly especially in the initial stage of an emergency, physical ability, which is a task-related ability, of the emergency response team members are more important than their intellectual abilities. Because previous studies on physical abilities of emergency responders have been conducted at the individual level, the present study attempts to look at the aggregate

physical ability of a team of emergency responders. This is because emergency response is a collective action and not an individual action. In this manner, the present study is able to fill the gap in the existing knowledge about team-based performance. In team-based studies, member's abilities are measured at the individual level and then later aggregated into team indexes. A similar technique was applied in this study to ascertain team-based performance in responding to emergencies.

3. Methodology

Participants

As previously noted, emergency responders perform jobs that are physically strenuous. In the present study the ability of emergency responders refers to the ability to perform physical demanding activities (Sothmann *et al.*, 1990). Intuitively speaking, a high level of physical fitness could enable emergency responders to perform their job better (Williford *et al.*, 1999).

As the present study was concerned about team performance, fire fighters were chosen as participants because they respond to emergency situation in teams. A fire fighting team may have seven to nine team members, working interdependently in any emergency situations. Relevant to the present study is the ability of fire fighting team members to respond as quickly as possible. Responding in high speed reflects the physical ability of the fire fighting team members in responding to an emergency call. To know whether the fire fighters are physically fit, the present study took measurements their individual height, weight, and cardiovascular endurance. The individual data were later aggregated to represent the team's data.

Participants of this study were fire fighters from the Fire and Rescue Department of Malaysia (FRDM). They were selected because they are one of the key players that respond to emergencies in Malaysia (Directive No. 20, 2003). In most emergency instances, the FRDM act as the main agency in emergency response and mitigation operations. The research sample consisted of 226 teams from 81 fire stations in five states in Peninsular Malaysia. Throughout Peninsular Malaysia, there are altogether 520 teams working in 193 fire stations. Fire fighters in Malaysia are employed by the FRDM under the Ministry of Housing and Local Government.

To select teams that are representative of all teams in Peninsular Malaysia, cluster sampling was used. As all states have fire stations, the state was considered as a logical cluster. Out of 12 states in the Peninsular Malaysia, five states were then selected randomly. All teams in these selected states were considered as subjects of the present study. A list of team members were then obtained from the respective fire stations in the states selected. However, 100 teams were eliminated from the study for various reasons; they were either not reachable, there were errors in the recording of the initial emergency response time or there were missing data in the formal records. Finally, the final sample for the present study consisted of 126 teams attached to 60 different fire stations, effectively making the response rate of 55.8 percent.

Table I presents background information of team characteristics, which include age, organizational tenure, team tenure, and experience working under a team leader. The table indicates that, on average, the team members were relatively young (mean = 35.44 years old, SD = 3.92), and had been working relatively long time with the FRDM (mean = 12.78 years, SD = 3.92). With respect to team tenure, on average, the team members had been working relatively a long time with the current team (mean = 5.38 years, SD = 3.07), and had been with the supervision of the current team leader relatively long (mean = 3.13 years, SD = 2.07).

The following is a description on how data on physical ability and initial emergency response were gathered.

Measures and data collection procedures

Weight. In the present study, weight was the measured weight of the individual team members at the time of data collection. Weight was measured using a digital weighing scale certified prior to usage by Metrology Corporation Malaysia Sdn. Bhd., an authorized agency to conduct reliability tests. The weighing scale auto calibrates its setting every time it is activated. The subjects were weighed in usual on-job attire without shoes to the nearest 0.5 kg. To form the most reliable measurement, the individual team member's weight was averaged to represent the team's weight.

Height. Similarly, height was the measured height of the individual team members at the time of data collection. Height was measured using a portable height rod similar to the height rod being used by the Ministry of Health at public hospitals and health centers throughout the country. Similar to previous studies, height was measured with an accuracy of 0.1 mm when subjects were asked to stand without shoes (e.g. Ramana *et al.*, 2004; Samson *et al.*, 2000). To form the most reliable measurement, the individual team member's height was averaged to represent the team's height.

Cardiovascular endurance. The final physical ability dimension is cardiovascular endurance of the team members. Similar to height and weight, cardiovascular endurance was the measured cardiovascular endurance of the individual team members at the time of data collection. Studies in the sports field usually measure cardiovascular endurance through a 12 minute run known as the Cooper test (which is also known as the Cooper 12 minutes run) (Cooper, 1977). In these studies, the subjects were normally required to run as far as possible on an open track in 12 minutes and the distance traveled was recorded, which represented the cardiovascular endurance score. In the present study, however, cardiovascular endurance was measured using a modified Cooper test, which is a two-minute walking test, instead of the original Cooper 12 minutes run. The abbreviated or modified version was introduced by Butland *et al.* (1982) in their study to investigate exercise tolerance among respiratory disease patients. In their study the patients were required to walk for two minutes to examine their exercise tolerance level. They found that the two-minute walking test to be highly correlated with the original 12-minute Cooper test and suggested that the modified test is a reproducible measure for endurance. The modified test was later validated in Samson *et al.*'s (2000) study on functional mobility among adults in the Netherlands.

While using the original 12-minute Cooper test was exemplary, a modified Cooper test was employed in the present study for various reasons. First, the condition of the subjects at the time of data collection did not permit the use of the original test. When the data were being collected, the fire fighters were on standby, which required them to wear appropriate attires for emergency response work. Second, to conduct the Cooper

Variable	Mean	SD
Average age of team members	35.44	3.92
Average tenure of team members	12.78	3.92
Average experience as a member of a team	5.38	3.07
Average experience working under a team leader	3.13	2.07

Table I.
Description of sample (team characteristics)

12-minute run, a big area or field would be required; such facility was not available at fire stations. Third, the Cooper 12-minute run would tire the subjects; when this happened, job performance in an actual emergency would be potentially affected.

In the present study, subjects were required to walk individually as fast as possible for two minutes and the distance was recorded in meters. A standard distance of 10 m was marked in the fire engine bay and team members were asked to walk up and down from and to the marker. The engine bay was used to minimize other factors such as weather conditions, heat, etc., which would influence the distance walked. By doing so, the study had taken into consideration variability in distance walked, if any, which could be influenced by external factors. Similar consideration was taken throughout the data collection process to ensure that the data collected followed some standard procedure. To form the most reliable measurement, the individual team member's cardiovascular endurance was averaged to represent the team's cardiovascular endurance.

As noted earlier, the three variables of weight, height, and cardiovascular endurance were measured at the individual level and later averaged to represent the team construct of physical ability. Historically, researchers have adopted three different methods in operationalizing team composition. They are mean of individual scores, variance of individual scores, and the highest or lowest individual traits (Barrick *et al.*, 1998). Of these three methods, calculating the mean score of the individual measure (e.g. Bond and Ng, 2004; Chatman and Flynn, 2001; English *et al.*, 2004; Halfhill *et al.*, 2005; Janicik and Bartel, 2003; O'Connell *et al.*, 2002; Stewart *et al.*, 2005) is the most common method used (Barrick *et al.*, 1998). In this method, each team member's responses are aggregated using mean scores to reflect the team composition (Wech *et al.*, 1998). Similar method of operationalizing physical ability has been used in the field of team-based sports (Arnason *et al.*, 2004). Therefore, the present study also employed the mean of individual scores method to operationalize the construct of physical ability at the team level.

Initial emergency response performance. Emergency response performance in the present study refers to the team member's performance in responding to an emergency situation. The performance of the teams was assessed based on responses to actual emergency incidences. The assessment was made on the team's outcome and not on the individual's in the team. The present study looked at the initial emergency response performance only because of various uncontrollable situational factors. Weather condition, road traffic condition, access to the emergency incident scene, and prior knowledge of the emergency incident location are factors that could influence the overall emergency response performance. By considering the initial response performance only, variance in the findings due to the external factors could be controlled.

In the current study, initial emergency response refers to performance of the team in responding to an emergency. It was measured from the moment a distress call is received until the team leaves from the standby point. The measure of emergency response performance was adapted from previous studies (e.g. Al-Ghamdi, 2002; Altintas and Bilir, 2001; Fitzsimmons, 1973; O'Meara, 2005; Pons and Markovchick, 2002; Pons *et al.*, 2005). Initial emergency response performance in the present study was used as an indicator of the overall team performance. The team was assessed based on its response time to emergency incidents. Response time is an appropriate measure to evaluate the performance of any emergency response agencies (Al-Ghamdi, 2002). It is the fundamental factor that determines a victim's survival and the extent of property damage.

Initial emergency response time is a component of a response time, which is defined in the present study as the duration from the time of incident notification to the time when the emergency team departures from the stations. In an emergency incidence, teams have to respond with a sense of urgency. Prior to an incident the team members will be on standby at the waiting room in their respective fire stations. Upon receiving an emergency call, the team members will be alerted by an alarm bell that rings for 30 seconds. The team members will then need to quickly put on their appropriate attire and rush to the fire truck. It is a standard procedure that the time of call, the time of alarm bell ring activation, the time of alarm bell ring deactivation, and the time of fire truck leaving the stations are recorded. In addition, the time members reach the scene and the time the incident is successfully mitigated are also recorded. A sample of recorded time for each component is presented in Table II. As mentioned earlier all these recorded times serve as a performance measure in emergency response studies undertaken by Fitzsimmons (1973), Altintas and Bilir (2001), Al-Ghamdi (2002), and Pons *et al.* (2005).

Despite the various response time components, only the initial response time was used as the performance measure in the present study. The initial response time is the difference in seconds between the time of call received (A) and the time of fire truck leaving the station (D), as specified in Table II. The time of call here refers to the time when the recipient officer has taken the relevant details of the emergency from the caller. In line with the guideline set by the FRDM, the time of fire truck leaving the station (D) is measured by the initial movement of the fire engine from its static position. The initial emergency response time taken also took into account the distance travelled by emergency responders (i.e. from the waiting room to the fire truck). In other words, the index of performance in the present study was measured as time taken to travel over a distance (seconds per meter). Controlling the distance will give meaningful performance data as distance travelled in each station varies.

The initial response time is an important indicator of performance as it has been stressed that the first few seconds in emergency is vital (Baldwin, 1994). In addition, Landy and Farr (1983) stressed that performance measurement is an index of output or production. Similarly, the time taken to respond by the fire fighting teams is a form of work output and therefore, the initial emergency response time clearly is a form of performance measurement. Furthermore, performance measured through the time taken in the initial response which measures from the time of call received is similar to the previous studies in the field of emergency response (Al-Ghamdi, 2002; Altintas and Bilir, 2001; Fitzsimmons, 1973; Pons *et al.*, 2005). Thus, the time taken in the initial response serves as the team performance measure.

Time of call received (A)	Time of alarm activation (B)	Time of alarm deactivation (C)	Time of fire truck leaving the station (D)	Time taken to leave station (D-A) (in seconds)
21:45:00	21:45:30	21:46:00	21:46:21	81
16:11:00	16:11:30	16:12:00	16:12:40	100
12:03:00	12:03:30	12:04:00	12:04:30	90
20:38:00	20:38:30	20:39:00	20:39:50	110
21:32:00	21:32:30	21:33:00	21:33:25	85

Source: Fire and Rescue Department Malaysia (FRDM)

Table II.
Sample of recorded response time component

In the present study a customized form was developed to record the time components and the time taken in the initial emergency response. This form was used at each selected fire station in the study. The initial emergency response time for the present study only accounted for fire and road accidents because these incidents require use of fire engines to respond; other incidents such as responding to a snake or venomous animal threat usually require the use of vans or a four wheel drive vehicle only. An entire team is involved in cases where a fire engine is used while the use of vans or four-wheeled drive vehicles normally requires a few members of the team. Because the present study was interested to understand team performance, hence responses that involved the entire team members were taken into consideration. Furthermore, cases involving the use of by vans or four-wheeled drive vehicles usually do not have a high sense of urgency compared to cases involving fire or road accidents.

In addition to initial response time, data on the distance from the waiting room to the fire truck in each selected fire station were also collected. The distance was weighted to the initial emergency response to give a meaningful performance indicator. The emergency response time was measured by time taken per meter for each response and later averaged based on the frequency of cases. The average weighted initial emergency response time was then averaged over the five months period; averaging served to smooth any potential aberrations associated with a single month's or incident's weighted initial emergency response performance (Carpenter, 2002).

Data for initial response time were gathered from formal records called the *Occurrence Book* in the respective fire stations. The book is used to record various daily activities performed in the fire station. It contains the team member attendance, the daily job description performed inside and outside the station, the details of visitors who come to the fire station, the details of the person in-charge of recording the information in the book, the station's vehicular movement, etc. In a case of emergency occurrence, the details of the caller identity, the time the call was received, the time the alarm was activated, the time the fire engine left the station, the time the truck reached the scene, the time of the first extinguishing effort, the time the operation was called off, the time the truck left the emergency scene, the time it returned to the station, and the name of the commanding officer are furnished in the book.

In summary the performance of initial emergency response was measured based on the time interval from the emergency call received to the time of initial movement of the fire engine from the static position at the fire engine bay and adjusted for the distance traveled from the waiting room to the fire engine.

4. Findings

Table III is a summary of descriptive statistics pertaining to team member physical ability variables. The SD for team member cardiovascular endurance is relatively higher than the other ability variables namely weight and height. The mean score of average team member weight is 75.30 kg, with a SD of 4.95. The minimum and maximum scores are 63.67 and 88.93 kg, respectively. The mean score of average team member height is 168.40 cm, with a SD of 2.25, while the minimum and maximum scores are 162.13 and 173.32 cm, respectively. Finally, the mean score of average team member cardiovascular endurance ranges from 109.6 to 176.79 m, with a mean of 142.50 (SD = 11.02).

Moderate level of positive correlation was found for the relation between height and weight, which is significant at 0.05 level. In the case of the predictor variable, weighted initial emergency response time, high level negative correlation was found with

cardiovascular endurance ($r = -0.30$). The negative relationship indicates that teams with high cardiovascular endurance are more likely to have faster initial emergency response time than teams with lower cardiovascular endurance. However, correlations between weight and height with weighted initial emergency response time are not significant.

The multiple correlation (R), squared multiple correlation (R^2), and adjusted squared multiple correlation (R^2_{adj}) indicate how well the combination of independent variables predicts the dependent variable. The results showed that the regression equation with all the predictors are significant, $R = 0.39$, $R^2 = 0.15$, $R^2_{adj} = 0.13$, $F\ (3, 122) = 7.13$, $p < 0.001$. In other words, the multiple correlation coefficient between the predictors and the dependent variable are 0.39, and all these three predictors account for 15 percent of the variation in the initial emergency response performance. The generalizability of this model in another population was shown to be 0.13. The value of R^2 dropped to only 0.02 (about 5 percent) in the R^2_{adj} which indicates that the cross-validity of this model is fine. The significant F-test revealed that the relationship between the dependent variable and the independent variables is linear and the model significantly predicts the dependent variable.

The F-test ($F\ (3, 122) = 7.13$, $p < 0.001$) indicates an overall significant prediction in the independent variables to the dependent variables, but it lacks information about the importance of each independent variable. Table IV shows that the individual contributor of each predictor is presented by the standardized regression weight of each predictor within a regression equation (Green and Salkind, 2008). Among the three predictors, cardiovascular endurance ($\beta = -0.31$, $t = -3.75$, $p = 0.00$) has the highest and significant standardized β coefficient, which indicates that cardiovascular endurance is the most important variable in predicting initial emergency response

Variables	Mean	SD	1	2	3	4
Team weight	75.30	4.95	–			
Team height	168.40	2.25	0.19*	–		
Team cardiovascular endurance	142.50	11.02	−0.06	−0.08	–	
Weighted team initial emergency response time	3.71	0.78	−0.16	0.13	0.30**	–

Notes: *$p < 0.05$; **$p < 0.01$

Table III.
Mean, SD, and correlation of team physical ability and emergency response performance variables

	Dependent variable Initial emergency response performance
Independent variables	
Weight	−0.300**
Height	0.124
Cardiovascular endurance	−0.232**
F-value	7.129
R^2	0.149
Adjusted R^2	0.128

Notes: *$p < 0.05$; **$p < 0.01$

Table IV.
Results of regression analysis

performance. The other important predictor is weight ($\beta = -0.21$, $t = -2.47$, $p = 0.02$). However, height ($\beta = 0.12$, $t = 1.69$, $p = 0.09$) is not significantly related to initial emergency response performance. Thus, in summary it can be said that better initial emergency performance can be obtained when teams are composed of members who have higher cardiovascular endurance, and higher average body weight.

5. Discussion

In the present examination, physical ability is the team member resources studied. Here, ability refers to the task-related abilities of the team members (Robbins, 1993) such as weight, height, and cardiovascular endurance. An emergency responder has a physically demanding job (Davis *et al.*, 1982; Gledhill and Jamnik, 1992; Williford *et al.*, 1999) and a high level of physical fitness is functional in the accomplishment of a job performance (Rhea *et al.*, 2004). As such, the choice of the three ability dimensions is valid and offers an accurate portrayal of what is required of emergency responders such as fire fighters. The following discusses the results of each ability dimension.

Weight

In the present study, body weight was found to significantly influence the emergency response team's initial emergency response time. In general the result appears to confirm Robbins's (1993) contention that ability is crucial for teams, such as emergency response team, to perform. What is surprising, however, is the direction between weight and initial response time; instead of showing a negative relationship, the result shows a positive relationship between team average body weight and initial emergency response performance. The study found that the higher the average body weight of the team, the better its performance in responding initially to emergencies. As such, the present finding further contributes to the mixed results obtained in previous empirical efforts. For example, while some researchers found weight to negatively contribute to performance, i.e. the lesser the weight the better the performance (e.g. Buchner *et al.*, 1996; Samson *et al.*, 2000; Troosters *et al.*, 1999), others found weight to have no significant influence at all (e.g. Arnason *et al.*, 2004). The present study seems to be consistent with those who found a positive result between weight and performance, such as Williford *et al.* (1999), who studied fire fighters employed by the Montgomery Fire Department and found that the higher the body weight individuals had, the better they performed in simulated fire and rescue exercises.

So what accounts for the findings? Why do teams who have higher body weight perform better? One plausible explanation may lie in the methods of measuring body weight, as suggested by Williford *et al.* (1999). Based on the literatures they cited, they argued that a body is commonly divided into two components: fat body and fat-free body. While fat body refers to the fatty substances in a body, fat free body refers to the portion of the body remaining after all the fatty substances are extracted (Hodgdon, 1992). While Copay and Charles (1998) argued that excessive fat leads to obesity and is thought that higher percentage of body fat hinders performance in many physical activities, Davis and Starck (1980) reasoned that some fat in the body is important for normal physiological functioning such as fuel source, insulation, and padding. In the context of fire fighters some body fat is therefore crucial for them to perform their physically demanding job (Davis *et al.*, 1982; Gledhill and Jamnik, 1992; Williford *et al.*, 1999).

Ideally weight should have been measured by determining the proportion of fat in the body. In addition, skinfolds measurement could have been used as it is the most widely used anthropometric estimation of body size or composition (Plowman and Smith, 1997). However, this method requires special training (Hodgdon, 1992). As time did not permit the researcher to obtain such training, the method was not employed. Future researchers interested in examining this issue may want to consider getting such training. Consequently, it was decided that anthropometric measurement of weight was instead used because it was relatively easier to carry out and adapted to field conditions (Marriott and Grumstrup-Scott, 1992). In the present study, body weight was simply obtained from each of every team member before it was averaged. Such technique of measuring weight is also most commonly used for a specific population (Grinker, 1992).

Another possible explanation is with respect to fire fighters' daily job roles and responsibility. Specifically, fire fighters frequently train in physical-related activities. They perform various non-emergency activities at work when there are no emergency occurrences. These activities include equipment inspection, fire and rescue operation training, fire hydrant inspection, fire engine and pump maintenance, pre-planning activities, and sports. In addition, they are required to undergo bi-yearly fitness assessments through a 2.4 km run. These physical activities are to help achieve the desirable maintenance of fat-free weight (Plowman and Smith, 1997; Powers and Howley, 1994). These types of activities could impact on the present results. The frequent training fire fighters have could make them respond faster. As Harman and Frykman (1992) reasoned, there are many fatter individuals who can run faster than leaner ones and many lean individuals who do not run as fast as expected. Hence, it may be possible that weight in the present study is composed of body fats necessary for physical functioning. Therefore, it is not totally surprising that the more weight the fire fighting team members have the better they are in initially responding to emergencies.

Height

In the present study it was expected that height would negatively influence team performance. Unfortunately it was found that body height was not statistically significant in predicting emergency response team's initial performance. The finding obtained in the present study appears to be consistent with other studies that looked into similar issue on team performance (Arnason *et al.*, 2004). For example, Ostojic (2000) found no relationship between team height and team success among elite Serbian soccer teams. Similarly height did not explain performance at the individual level, as shown by Wilmore and Haskell (1972). Similarly, Buchner *et al.* (1996) found height did not explain the variance in speed among older adults.

One plausible explanation could be due to the nature of the job being performed. To some extent height may not necessarily play a major role in initial emergency response or other tasks such as responding to rescue and extinguishing tasks, and managing emergency calls. These tasks are delineated in the job descriptions of fire fighters so that they understand the performance they are expected to achieve (Bohlander *et al.*, 2001). Given the nature of these tasks, height requirement may be irrelevant for fire fighters to carry out them effectively.

Another possible reason could be the way performance was measured in the present study. In previous studies (e.g. Troosters *et al.*, 1999; Williford *et al.*, 1999), performance was measured on a longer duration, but in this study initial emergency response time

was measured within 87 seconds. For example, studies that found height to be related to performance measured the latter by a six-minute walking distance (Troosters *et al.*, 1999), and a set of physical fitness test (Williford *et al.*, 1999). It is therefore possible that the relationship expected between height and initial emergency performance was not found because of the short duration taken to measure performance (Barrick *et al.*, 2000; Tay *et al.*, 2006). This may be simply too short a period of time to observe the effect of height on the initial emergency response performance.

Cardiovascular endurance

A negative relationship was expected between cardiovascular endurance and initial emergency response performance. Cardiovascular endurance (fitness) refers to the ability of the body to deliver blood and oxygen to the various tissues and organs of the body (Copay and Charles, 1998). The result indicates that cardiovascular endurance was statistically significant in predicting emergency response team's initial performance. It further confirms Robbins's (1993) contention that ability is crucial for teams to perform especially among emergency response teams. The study found an inverse relationship between the team's average cardiovascular endurance and the initial emergency response performance. The present study found that teams with higher average cardiovascular endurance could perform better than those with lower average cardiovascular endurance. The finding obtained in the current study further validates the earlier works conducted among fire fighters (Davis and Dotson, 1987; Williford *et al.*, 1999). In particular, especially Williford *et al.*'s (1999) work found that individuals with higher cardiovascular endurance perform better, i.e. shorter time for forcible entry, hoisting, victim rescue, and stair climb. Based on the empirical findings shown in the literatures, physical fitness testing has been incorporated as a criterion for job performance of fire fighters (Rafilson, 1995). In addition, Rhea *et al.* (2004) highlighted that cardiovascular endurance is an important factor and should not be neglected in training of fire fighters.

As noted earlier, fire fighters have a physically demanding job (Davis *et al.*, 1982; Gledhill and Jamnik, 1992; Williford *et al.*, 1999) and a high level of physical fitness could help them perform their job well (Rhea *et al.*, 2004). Indeed, successful job performance has been shown to be dependent on fire fighters' ability to perform strenuous physical activity (Sothmann *et al.*, 1990). Initial response to a distress call is a form of physical activity that needs fire fighters to be physically fit. When certain standards of physical fitness are met, fire fighter's job performance can be improved (Davis *et al.*, 1982), as indicated by the current finding. Hence, fire fighters need to constantly undergo physical fitness training during their non-emergency working hours to make sure they are fit to respond quickly to any emergency calls. The fact that fire fighting teams in Malaysia are able to respond below 90 seconds (*The Star*, 2007, p. N4), as required by the FRDM, offers evidence that they are fit to do their job well and that they are in acceptable fitness level.

6. Implications

Given the exploratory nature of this study by aggregating individual data at the group level analysis, it is premature to suggest guidelines for selecting successful fire fighting teams. However, the findings from the present study could help the FRDM in their recruitment, selection, and training activities. First, the recruitment and selection of fire fighters indicate the importance of meeting some physical ability requirement. The study further affirms and justifies the current practice of FRDM to include

physical-ability-related employment test in their recruitment and selection considerations (Rafilson, 1995). Second, the study also has some implications to the training activities conducted by the FRDM. The findings also create a need to increase the frequency of cardiovascular endurance test. This would assist the fire fighters to maintain the state of their physical fitness. Previous studies have suggested that such physical training programs are a critical determinant of team performance, particularly under conditions of high workload and high stress in which fire fighting teams generally must operate (e.g. Cannon-Bowers *et al.*, 1993). However, in the present study the impact of training on initial emergency response performance was not examined; hence future studies need to be directed at understanding this relationship. In addition to physical training programs, a good health and safety program that includes physical fitness is imperative for the effective functioning of emergency responders.

In addition to the practical implication, the present study has contributed new information to the body of knowledge in emergency response research. The findings offer contribution to the Robbins's (1993) group behavior model and field theory (Lewin, 1951). The physical ability variables especially weight and cardiovascular endurance have been examined at the individual level (e.g. Buchner *et al.*, 1996; Davis and Dotson, 1987; Samson *et al.*, 2000; Troosters *et al.*, 1999). For example, Williford *et al.* (1999), who studied fire fighters employed by the Montgomery Fire Department, found that higher body weight enables them to perform better in simulated fire and rescue exercises. However, in the present study, these variables were aggregated to represent team-level variables. Although the present study used aggregated physical ability constructs, the findings have been found to significantly predict team performance. However, very few studies have used the aggregated physical ability construct at the team level and more studies are required to further validate this method.

While the present study was primarily concerned with the influence of physical endurance on initial emergency response performance, it acknowledges other factors that could impact performance as well such as shifts and fatigue, which were not considered. Hence, future studies could consider examining the influence of other factors on initial emergency response performance.

7. Conclusion

As noted earlier, the aim of this paper is to examine the influence of emergency response team's physical ability on emergency response performance using actual emergency response scenario. To reiterate, the initial emergency response performance was measured by taking recorded measures of time taken once the fire fighting team received a distress call to the dispatch of the fire engine. To conclude, the study has provided some empirical evidence that the weight and cardiovascular endurance of firefighting team members significantly influence the team's initial emergency response performance. In other words, the study has empirically shown that fit emergency responders can respond quicker than their unfit counterparts.

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