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A survey to identify physically demanding tasks performed during storm damage operations by Australian State Emergency Services personnel

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ABSTRACT

Purpose: To identify and characterize the physically demanding tasks performed by SES personnel during storm damage work.
Methods: Thirty-six tasks identified as the most operationally important to storm damage work were included in a survey which was available to all SES volunteers. The survey aimed to identify the physical demand, operational importance, frequency, duration, principal actions and fitness components of each task.
Results: Twelve tasks were identified as the most physically demanding. Of these, carrying sandbags, lifting sandbags and shoveling sand (with hands) rated highest. Covering roof damages with tarpaulin and erecting external weather proofing were ranked highest for operational importance. Box lifting (single-person) and erecting external weather proofing returned the highest mode values for frequency, whereas tasks involving handling sandbags returned the highest mean and median frequency values. Covering roof damages with tarpaulin was identified as the longest task. Bending, lifting, twisting and carrying were the most common actions identified for the physically demanding tasks. Muscular strength and muscular endurance were the primary fitness components identified for the twelve tasks.
Conclusion: SES personnel perform a variety of storm response tasks, many of which are physically demanding. All or most of the physically demanding tasks contain elements of bending, lifting, twisting and carrying, and call upon personnel's muscular strength and muscular endurance capabilities.

1. Introduction

Storm events and floods account for 40–50% of all disaster-related deaths worldwide (Diaz, 2004; Noji, 1991). In the last decade of the 20th century, floods were responsible for an estimated 100,000 deaths globally and adversely affected 1.4 billion people (Jonkman, 2005). In Australia, storms cause more damage than any other event (FitGerald et al., 2010; State Emergency Services, 2011), and resulted in 73 fatalities between 1997 and 2008 (FitGerald et al., 2010). In addition, damage arising from storms causes significant financial burden (State Emergency Services, 2011; Bureau of Meteorology, 2009); major storm events in Australia can cause insurance losses of more than $1.5 billion, with total losses considerably higher (Bureau of Meteorology, 2009).

The prevalence of storm events has necessitated the formation of agency branches specifically trained for storm management, such as Public Safety Canada (Public Safety Canada, 2011) and the Federal Emergency Management Agency (FEMA, 2011) in the United States. In Australia, the State Emergency Services (SES) is the lead storm response organization, comprising 27,000 volunteer members nationwide (Australian Council of State Emergency Services, 2008). State Emergency Service personnel typically perform tasks such as filling and positioning sandbags around properties in preparation for storms and flooding, clearing debris (e.g. trees, housing materials) that result from storm damage, constructing temporary support for storm damaged structures and assisting in the rescue of injured civilians (State Emergency Services, 2011). To date, little is known about the physical demand of the tasks performed by the SES or other dedicated storm management agencies. Identifying and characterizing the physically demanding tasks may allow for the development of general guidelines regarding the fitness requirements for personnel performing storm damage duties safely and productively. Further, the in-depth analysis of workplace procedures may be the first step

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towards developing valid physical selection tests to verify that personnel are physically capable of performing the tasks expected of them (Payne and Harvey, 2010). Recent legislation states that volunteers are owed the same duty of care as paid workers; as such, the SES is legally responsible for ensuring that volunteers are capable of the work required of them (Work Health and Safety Act, 2011).

To identify the physically demanding tasks performed during SES storm response requires a detailed job task analysis (JTA). Firstly, an inventory of the key tasks performed by personnel is compiled through review of training manuals, operating procedures and conference with subject matter experts (SME; Sharkey and Davis, 2008; Hughes et al., 1989; Rayson, 2000; Taylor and Groeller, 2003). Thereafter, incumbents are surveyed to subjectively assess the operational importance, frequency, duration, physical demand, core fitness components (i.e., strength, endurance) and movements involved with the tasks (Sharkey and Davis, 2008; Viswesvaran et al., 1996; Landy and Vasey, 1991). This subjective approach is preferred to direct observation of irregular and potentially dangerous events such as storm response (Hughes et al., 1989). Further, a survey can capture perspectives from large numbers of incumbents across varying experience levels, which is thought to improve eventual acceptance of guidelines/policies arising from JTA research (Maurer and Tross, 2000).

The present study aims to undertake a subjective JTA to identify the most physically demanding tasks performed by SES personnel during storm damage work, and then characterize the operational importance, frequency, duration, principal actions (i.e., movements) and underlying fitness components of these tasks.

2. Methods

2.1. Survey development

An initial job inventory of the tasks performed during storm damage operations was compiled using training manuals and policy documents supplied by the SES. An eight-person SME committee (one from each Australian State and Territory) was then internally formed to assist in the identification of tasks performed during storm damage work. All SME consented to having their insights included in the job inventory and subsequent survey.

A group discussion was held between researchers and the SME working party to edit and refine the job inventory where appropriate. A 65-item job inventory was finalized. The SME working party was then asked to rank each task on a seven-point scale for operational importance; ranging from 'low' (1) to 'high' (7; Sanchez and Levine, 1989). The 36 tasks that were unanimously ranked a 'high' (7) by SME's (Table 1) were incorporated into the survey.

Table 1
Job inventory of operationally important tasks performed during SES storm response.

Task number	Task description
1	Preparation of personal protective clothing/equipment
2	Driving vehicles (including 4 × 4) to/from response
3	Carrying equipment from vehicle/trailer to site (single-person)
4	Carrying equipment from vehicle/trailer to site (multiple-person)
5	Carrying equipment from site to vehicle/trailer (single-person)
6	Carrying equipment from site to vehicle/trailer (multiple-person)
7	Box lifting (single-person)
8	Box lifting (multiple-person)
9	Setting up portable lighting (including generators)
10	Erecting ladders
11	Taking down ladders
12	Establishing roof safety systems
13	Ascending ladders (without equipment)
14	Ascending ladders (with equipment)
15	Descending ladders (without equipment)
16	Descending ladders (with equipment)
17	Passing equipment on ladder
18	Receiving equipment on ladder
19	Moving from ladder to roof
20	Moving from roof to ladder
21	Moving on a roof
22	Moving in a roof
23	Clearing blockages in roof drains and gutters
24	Erecting external weather proofing
25	Clearing debris using hand/power tools (at heights)
26	Clearing debris using hand/power tools (at ground level)
27	Covering roof damages with tarpaulin
28	Constructing temporary support for storm damaged walls
29	Shoveling sand (with hands)
30	Shoveling sand (using handtools)
31	Filling sandbags
32	Lifting sandbags
33	Carrying sandbags
34	Holding sandbags
35	Pull-starting equipment (e.g. pumps, generators, chainsaws)
36	Operating a radio

2.2. Survey

The survey was designed to be completely anonymous in accordance with the ethical approval granted by Deakin University Human Research Ethics Committee. All data was non-identifiable to both researchers and the SES.

The survey aimed to identify the operational importance, physical demand, frequency, duration, movements and fitness components involved with the tasks performed by SES personnel during storm damage management. Participants were asked to describe the tasks as they occur 'in a regular day of Storm Damage operations', although the authors are aware that storm events may vary considerably. For each task, participants were asked to rank operational importance and physical demand on seven-point 'low' (1) to 'high' (7) rating scales (Sanchez and Levine, 1989). Physical demand was adapted from the more commonly used task domain of 'task difficulty' (Sanchez and Levine, 1989) as it more aptly describes the purpose of the research. Physical demand has previously been used in JTA to characterize the tasks performed by soldiers (Rayson, 1998), firefighters (Phillips et al., 2011) and correctional officers (Hughes et al., 1989). In quantifying the frequency of each task, participants were asked 'how many times would this task be performed in a regular day of Storm Damage operations?'. To determine the duration of each task, participants were asked 'how long does this task usually take (minutes)?'. For both frequency- and duration-related questions, participants were able to directly input the number value that they considered appropriate. To determine the movements performed during each task, participants were asked to select one or more from the following list: lift, carry, push, pull, run, climb, crawl, sit, twist, bend, walk and dig. This list of movements was adapted from previous JTA research (Rayson, 1998) to include movements commonly performed during Storm Damage work, as identified by the SME working party. To identify the principal fitness components associated with each task, participants were asked to choose one or more of the following: muscular strength, muscular endurance and speed. Participants were informed at the beginning of the survey that they were allowed to skip over questions without answering if they were unfamiliar with the task or if they did not feel that the supplied answers adequately represented the task in question.

The SME working party members were responsible for distributing information about the survey to the unit leaders across their respective state or territory. The unit leaders made SES volunteers aware of the survey and the primary aims of the research at their SES unit meetings, typically held twice monthly. Emails were then sent out to the SES member mailing list containing the survey link.