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Wisdom of (using) the crowds: Enhancing disasters preparedness through public training in Light Search and Rescue

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ABSTRACT

Following major earthquakes, the vast majority of trapped survivors are rescued by layperson with the first 24–48 h. Most trapped individuals require only Light Search and Rescue (LSR). Therefore, there is sense in training members of the public in LSR competencies to upsurge survivability rates. Since the beginning of the school year 2017–8, all Israeli 10th graders have been undergoing such training. The purpose of this study was to evaluate the efficacy of these training in terms of resilience, self-efficacy and knowledge. A cluster randomized study involving 19 clusters comprising of 35 schools was performed during the first semester of the school year. Students were asked to complete a self-reporting questionnaire before and after the LSR training. In total, 1758 questionnaires were collected, of which 1279 (~73%) were paired with both pre and post data. A significant increase was found in all indices. Resilience score increased from a mean of 2.85 (± 0.70 SD) pre-training to 3.95 (± 0.63 SD) following it ($W = 29.451$, $p < .001$). This difference constitutes a very large effect size of $d = 1.652$ (95%CI: 1.525, 1.779). Significant increases were observed also for self-efficacy and knowledge. Differences across demographic variables were observes, e.g. between the genders, with boys reporting greater levels of resilience than girls. This study demonstrates that SLR trainings for high school students are capable of benefiting students' perception of resilience, self-efficacy and knowledge to perform during crisis. Moreover, the trainings have an equalizing effect on participants resulting in equally high levels of performance following training, despite pre-training differences.

1. Introduction

Emergencies and disasters occur world-wide, frequently without any warning, causing widespread havoc, damage and devastation. Responding to any emergency situation can be challenged by an imbalance between the needs of the affected population and the immediately available resources. In particular, this is evident following major earthquakes, which are capable of disrupting life on an extreme scale [1]. Earthquakes (including tsunamis) are the most deadly form of natural disaster, accounting for 55% of the disaster deaths over the 20-year period between 1994 and 2013, claiming nearly 750,000 lives [2]. During the past decade, the world has seen several major earthquakes that claimed a heavy price in human lives and economic damages, including in Pakistan, Indonesia, Haiti, New-Zealand, Japan, Nepal and Italy. The majority of injuries and deaths caused by earthquakes is due to collapsing of structures [3].

The primary goal of responding to disasters, such as major earthquakes is saving as many lives as possible. One component of such immediate response is Urban Search and Rescue (USAR) of trapped individuals from underneath the rubbles. Usually, the local USAR capacity is overwhelmed, and accordingly, international aid to affected areas frequently involves USAR Teams. These teams are comprised of highly skilled professionals, equipped with rescue dogs and advanced machinery, technology and know-how for extricating the trapped. Most of these teams are subjected to classification, accreditation and rigorous standards set by the United Nations' (UN) International Search and Rescue Advisory Group (INSARAG) in joint collaboration with the UN's Office for the Coordination of Humanitarian Affairs (OCHA) and The United Nations Disaster Assessment and Coordination (UNDAC) [4,5].

Yet, experience shows that for different logistical and operational reasons, dispatching USAR teams, especially on an international mission often lead to delays in their arrival to the affected area.

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Subsequently, and despite best intentions, USAR teams are struggling to be effective in rescuing large numbers of survivors. In terms of cost-effectiveness, USAR teams struggle to "pay-off" in increasing the rates of survivors following major earthquakes [5].

One of the prime examples of this phenomenon is the case of Haiti. In January 2010 a major earthquake struck the small Caribbean country. Post-hoc estimates of deaths resulted by this earthquake revolved around 230,000 people. Given that not all the casualties die immediately after the collapse of the building [6], the hypothetic potential for rescue in this incident was quite high. Moreover, the USAR response to Haiti was the biggest to that date, with nearly 2100 international rescuers and 161 rescue dogs actively participating in the response. However, despite many efforts and best intentions, these teams were able to rescue only 134 live individuals, i.e., around half of a tenth of a percent (~ 0.05%) of the total death toll. Similar or worse ratios were observed in other incidents, including the earthquakes at Bam, Iran (2003), Kashmir Pakistan (2005), Padang, Indonesia (2009), and Nepal (2015) [5,7]. Ergo, the conclusion is that innovative solutions must be found to work in parallel to the USAR teams' efforts and upsurge survivability rates.

In contrast, the literature suggest that the vast majority of survivors rescued from underneath the rubbles following major earthquakes are rescued by layperson, i.e. family members, neighbors, friends, or bystanders. According to accumulated data from numerous case studies, as much as 50–95% of survivors are rescued within the first 24–48 h after the quake by these untrained individuals, using whatever they can find to support their efforts, e.g. metal rods, car Jack, etc [6–12].

The abovementioned suggests that the more members of the public are educated with basic Light Search and Rescue (LSR) skills (see methodology for details), the more rescuers will be available immediately following a major earthquake, and the greater the chances are for saving more lives. Empowering members of the public and training them to assume basic life-saving skills during emergencies can considerably increase availability and accessibility of rapid care for casualties and consequently upsurge survivability. Wise utilization of crowdsourcing has been recognized as a vital component of disaster management, mostly for information gathering [e.g., 13]. Crowdsourcing during crises and emergencies could also assist in overcoming the shortage in first responders relative to the excess of needs. Enlisting a large number of people from all communities to provide essential rescue and/or life-saving procedures was already proven to be contributing to a substantial expansion of emergency medical teams' capacity. Tasks such as using defibrillators to resuscitate patients suffering from cardiac arrest [e.g., [14]]; appointing "life-guardians" to properly conduct chest compressions, resuscitation and/or staunch bleeding [e.g., [15]]; providing first mental aid to stress victims [e.g., [16]]; and/or performing light rescue operations to extricate victims trapped under rubble [e.g., [8,12]] have been reported to be of major contribution during crises.

As presented above, numerous studies have shown that crowdsourcing may significantly contribute to early warning, enhanced risk awareness, effective communication and a more optimal provision of medical services and accordingly raise societal resilience [17]. It has also been shown that the establishment of search and rescue networks is a substantial component of disaster management and their effective utilization increases community resilience [18]. What has not yet been sufficiently investigated is using crowdsourcing for performing additional tasks, such as light search and rescue operations and their potential impact on the levels of resilience [19].

In 2016, the authors approached the Israeli Home Front Command (HFC; Israel's Civil Protection agency) and presented them with the data and the implied plausible effectiveness of mass light search and rescue training. Subsequently, the HFC, together with the Israeli Ministry of Education, decided to enroll all 16 years-old high-school students in a two-day training of LSR, to be provided by specialized training companies, according to pre-approved training program by the HFC. The decision was made in an effort to establish knowledge and know-how of LSR skills among a wide geographic distribution. According to the Israeli government, this move will allow to generate a pool of more than 100,000 people capable of performing life-saving tasks in case of emergency annually. Hence, in the school year of 2017–2018 this pilot study was initiated throughout the country.

The purpose of this study was to evaluate the efficacy of the LSR trainings provided to the students in terms of knowledge as well as perceived levels of resilience and self-efficacy. We hypothesized that following the training, students will demonstrate significantly higher levels of perceived resilience, self-efficacy and knowledge in LSR skills in case of emergency, compared to the pre-training levels.

2. Materials and methods

2.1. Ethical approval

In line with the Israeli law concerning studies involving minors in the education system, this study was approved by the Chief Scientist of the Ministry of Education (approval number 9753, from 17 October, 2017). Students were sampled on a voluntary basis only. Students were informed that they can refuse to participate or choose to drop out of the study at any time without any repercussions.

2.2. Light Search and Rescue trainings

The main intervention assessed in this study was a Light Search and Rescue (LSR) training. The two days training consists of two components. The first is a theoretical session relayed at the classroom during the first day, in which students are exposed to the contents pertaining to earthquake hazards, fire extinguishing and hazardous materials safety, characteristics of a collapsed structure, and the principles of light search and rescue practices. The second part, conducted on the following day, is a hands-on practice. The training provider sets a training site at the school courtyard, which includes several simulation stations for different LSR techniques and the equipment needed for training: cutting through wood and metals, concrete cleaving, heavy objects lifting and supporting, and first aid. See Fig. 1 for an example of a LSR training site. Overall the training lasts 10 h (five hours per day). The training includes a final evaluation exercise and upon its successful conclusion the students receive an official certificate signed by the Home Front Command.

2.3. Population and sample

The population undergoing the LSR training was defined by the Ministry of Education and Home Front Command as 10th graders belonging to the secular and religious state educational system in both the Jewish and Arab communities throughout the State of Israel. Excluded from the training program, and therefore from the study, were students of the Jewish ultraorthodox education system. A cluster randomized study was performed during the first semester of the 2017–2018 school year. Nineteen clusters comprising of 35 schools were randomly chosen from a list of participating schools obtained from the Home Front Command, which was responsible for coordination and supervision of the trainings. All students enrolled into the training were invited to participate in the study. Despite the fact that all trainees were informed that participation is voluntary, the response rate at each training cycle was very high with 80–100% of trainees completing the first round of questionnaire. A minimum sample size of 383 paired questionnaires was deemed sufficient in light of the population size (~ 120,000), a confidence level of 95%, and an acceptable marginal error of 5% [20].

2.4. Variables and tools

The primary outcomes of this study were a construct of resilience