

## 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 10<sup>th</sup> 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 ( $\pm$  0.70 SD) pre-training to 3.95 ( $\pm$  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 observed, e.g. between the genders, with boys reporting greater levels of resilience than girls. This study demonstrates that LSR 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 hypothetical 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 contributing 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



Fig. 1. Examples of Light Search and Rescue (LSR) training in Israel.

and a construct of self-efficacy. Both constructs were assessed via a self-reporting questionnaire. Resilience was assessed with seven items presented on a 5-point Likert scale: (a) I think I know what to do in case of a major earthquake; (b) I think I will be capable of coping with the consequences of a major earthquake; (c) I think I know how to extract trapped people from underneath a building rubble; (d) I feel I have enough mental resilience to deal with the consequences of a major earthquake; (e) I feel I have enough physical resilience to deal with the consequences of a major earthquake; (f) I feel uncertain about anything relating to coping with major earthquakes. The Resilience construct was computed as the mean of all seven items following reversing the order of the responses of the last item. The reliability of the construct was assessed using Cronbach's alpha test for both pre-training and post-training datasets, resulting in values of 0.762 and 0.758, respectively.

Self-efficacy was assessed using the questionnaire developed by Chen and Gully [21], re-edited by Chen et al. [22], and translated into Hebrew by G. Flumin in 1998. The tool includes 8 items on a 5-point Likert scale<sup>1</sup> that are pertaining to perception of self-efficacy, e.g. "I will be able to achieve most of the goals that I have set for myself", "I believe I can succeed at most any endeavor to which I set my mind", and "Even when things are tough, I can perform quite well." See complete list of items in [22]. The questionnaire scored Cronbach's alpha values of 0.901 and 0.913 for the pre-training and post-training datasets, respectively.

The questionnaire included an additional item to assess assimilation of skill-related knowledge by the students. Responses to the item ("In my opinion, LSR is more about technique, rather than physical strength") were assessed on the same 5-point Likert scale. Students were also provided with an option to provide open-text impression and thoughts about their experience in the post-training questionnaire.

The demographic variables recorded were gender, place of residence, name of school, religion, and religiosity. No additional demographics were collected to align with the regulations of the Ministry of Education on students' privacy. All data collected was anonymous. Pairing of pre and post questionnaires was performed by asking students to provide the last four digits of their cellular phone number.

The final questionnaire used in this study was validated in preliminary studies performed with graduate level students and alumni.

<sup>1</sup> The original tool utilizes a 3-point Likert scale which we adapted into a standard 5-point scale to more accurately assess the construct's variance, in light of preliminary validation studies performed.

## 2.5. Procedure

Nineteen research assistants, all graduate students, were recruited and assigned a cluster of schools in a specific geographical area. Questionnaire were administered by this team of research assistants, which were independent of schools' faculty. Questionnaires were collected during the first semester of the school year, namely between October and December 2017. The assistants were instructed to collect the pre-training questionnaires on the beginning of the first day (just before the training started) and the post-training questionnaires immediately upon completion of the training on the second day. Assistants then entered the data into premade excel sheets. Data analysis and interpretation was performed by the authors.

## 2.6. Statistical analysis

The statistical analysis of the results was performed using IBM's SPSS Version 24. The analysis included both descriptive and analytical methods, and the statistical tests were chosen according to variables distribution. Prior to analysis, indices were generated and their reliability was assessed using Cronbach's Alpha. Shapiro-Wilk test was used to determine normal distribution of variables. Since all constructs were not normally distributed, only non-parametric tests were used. Spearman correlation test (with Bonferroni correction) was used to examine correlations between continuous variables. Mann-Whitney U and Wilcoxon tests were used to compare means of independent and paired categorical variables, respectively. Effect size was estimated using Cohen's d. Effect size according to this test ranges from small ( $d < 0.20$ ), to medium ( $d = 0.50$ ), to large ( $d = 0.80$ ), and very large ( $d > 1.20$ ) [23,24]. In addition, in order to evaluate the predictive capacity of variables over the relative change in the resilience construct, linear regression analysis was performed in Stepwise mode. Only variables found to be associated with the dependent variable were introduced into the analysis, following negation of multi collinearity ( $VIF < 1.5$ ). The first block included demographic variables (gender (two categories) and religiosity (two categories)). The second block included the other two constructs (relative self-efficacy and relative knowledge). In all statistical analyses performed, a p-value of 0.05 or less was determined as statistically significant.

## 3. Theory

The primary goal of responding to disasters is saving as many lives as possible. One component of such an immediate response is search

**Table 1**  
Demographic distribution of the overall and paired samples.

Variable	Overall sample (N = 1758) n (%)	Paired sample (N = 1279) n (%)	Chi-Square ( $\chi^2$ , df, p-value)
<b>Gender</b>			
Female	821 (46.7%)	618 (48.3%)	$\chi^2 = 0.654$ df = 1 p = 0.419
Male	932 (53.0%)	661 (51.7%)	
Missing	5 (0.3%)	0 (0.0%)	
<b>Religion</b>			
Jews	1591 (90.5%)	1164 (91.0%)	$\chi^2 = 2.943$ df = 2 p = 0.229
Arab	153 (8.6%)	111 (8.7%)	
Missing	14 (0.8%)	4 (0.3%)	
<b>Religiosity</b>			
Secular	819 (46.6%)	617 (48.2%)	$\chi^2 = 8.132$ df = 4 p = 0.087
Traditional	477 (27.1%)	324 (25.3%)	
Religious	329 (18.7%)	264 (20.6%)	
Other	100 (5.7%)	62 (4.8%)	
Missing	33 (1.9%)	12 (0.9%)	
<b>Training region</b>			
Center & Jerusalem	886 (50.4%)	644 (50.4%)	$\chi^2 = 8.119$ df = 4
Dan District (greater Tel- Aviv)	615 (35.0%)	411 (32.1%)	
Northern district	146 (8.3%)	125 (9.8%)	p = 0.087
Southern district	81 (4.6%)	81 (6.3%)	
Haifa District)	30 (1.7%)	18 (1.4%)	

and rescue of trapped individuals from underneath the rubbles. Accordingly, international aid to affected areas frequently involves Urban Search and Rescue (USAR) teams. Yet, despite best intentions, experience shows that for different reasons, USAR teams are struggling to be effective in rescuing large numbers of survivors.

Moreover, following major earthquakes, the vast majority of trapped survivors are actually rescued by layperson, i.e. family members, neighbors, friends, or bystanders, with the first 24–48 h. Most trapped individuals require only Light Search and Rescue (LSR), and therefore these untrained individual rescuers use what-ever they can find to support their efforts, e.g. metal rods, car Jack, etc. Therefore, empowering the public by equipping them with life-saving and community-based light search and rescue competencies can considerably increase availability and accessibility of rescuers during emergencies and consequently upsurge survivability of the trapped.

#### 4. Results

In total, 1758 questionnaires were collected, of which 1279 (~73%) were paired with both pre and post data. The demographic distribution of participants is provided in Table 1 (for both overall and paired samples). The two samples are comparable as there are no statistically significant differences between them, according to Chi-square test (see Table 1).

A significant increase was measured in all constructs assessed (Fig. 2). This result is maintained in both the general sample and the paired sample, with no differences in values across samples (data not shown). Consequently, the following results will address the paired sample only. Concerning resilience, students scored a mean of 2.85 ( $\pm 0.70$  SD) out of 5 prior to the training and a mean of 3.95 ( $\pm 0.63$  SD) following it. This difference is statistically significant according to Wilcoxon Paired Samples Test ( $W = 29.451$ ,  $p < .001$ ). This difference constitutes a very large effect size of  $d_{\text{cohen}} = 1.652$  (95%CI: 1.525, 1.779). Self-efficacy score averaged at 3.96 ( $\pm 0.63$  SD) prior to training and was significantly higher following it with a mean of 4.25 ( $\pm 0.62$  SD), according to the same test ( $W = 17.626$ ,  $p < .001$ ). This difference constitutes a small to medium effect size of  $d_{\text{cohen}} = 0.464$  (95%CI: 0.353, 0.575). In addition, constructs tested were significantly inter-correlated (Table 2).

Moreover, students demonstrated significantly better understanding

of LSR required skills post training compared to before the training. The mean rating of the item pertaining to knowledge ("In my opinion, LSR is more about technique, rather than physical strength") prior to the training was 3.45 ( $\pm 0.96$  SD), and following it increased to 4.08 ( $\pm 0.94$  SD). This difference is significantly different according to Wilcoxon Paired Samples Test ( $W = 17.137$ ,  $p < .001$ ). This difference constitutes a medium to large effect size of  $d_{\text{cohen}} = 0.663$  (95%CI: 0.583, 0.743).

The univariate analysis of the results suggests some differences in perception of resilience and self-efficacy across demographic variables (see also Fig. 3). For example, boys report higher levels of resilience compared to girls, both before the training and after. Before the training, boys' mean perceived resilience measured 3.04 ( $\pm 0.67$  SD), whereas girls averaged at 2.64 ( $\pm 0.67$  SD). This difference is statistically significant according to Mann-Whitney *U* Test ( $Z = -10.417$ ,  $p < .001$ ). Similarly, following the training, boys' perceived resilience averaged at 4.03 ( $\pm 0.61$  SD), which was higher compared to the mean of girls of 3.87 ( $\pm 0.64$  SD), according to the same test ( $Z = -4.678$ ,  $p < .001$ ). No differences were observed between the genders with regards to perception of self-efficacy, neither before ( $3.99 \pm 0.64$  for boys and  $3.93 \pm 0.63$  for girls;  $Z = -1.883$ ,  $p = .06$ ) nor after the training ( $4.26 \pm 0.62$  for boys and  $4.23 \pm 0.62$  for girls,  $Z = -0.987$ ,  $p = .324$ ), according to the same test. Similarly, no differences were observed between the genders with regards to knowledge, neither before nor after the training (data not shown).

In addition, some differences were observed on the basis of religion or religiosity. Prior to the training, Jews demonstrate higher levels of self-efficacy ( $3.98 \pm 0.63$ ) compared with Arabs ( $3.81 \pm 0.65$ ), according to Mann-Whitney *U* Test ( $Z = 2.687$ ,  $p = .007$ ). However, this difference disappeared following the training with both groups reporting similar high levels of self-efficacy (Jews:  $4.25 \pm 0.62$ ; Arabs:  $4.16 \pm 0.62$ ;  $Z = -1.652$ ,  $p = .098$ ), according to the same test. Likewise, prior to training, more religious students report higher levels of resilience ( $2.98 \pm 0.68$ ) compared with secular students ( $2.79 \pm 0.70$ ), according to Mann-Whitney *U* Test ( $Z = 2.692$ ,  $p = .007$ ). However, this difference too becomes null following the training with both groups reporting similar high levels of resilience (Secular:  $3.94 \pm 0.64$ ; religious:  $3.97 \pm 0.62$ ;  $Z = 0.903$ ,  $p = .367$ ), according to the same test.

There were also differences in resilience and self-efficacy between students from different geographical regions. Prior to training, students from the northern and southern regions of Israel report similar levels of resilience ( $2.88 \pm 0.77$ ) compared with students from the center ( $2.84 \pm 0.68$ ), according to Mann-Whitney *U* Test ( $Z = -0.592$ ,  $p = .554$ ); however, following the training the students from the center report significantly higher levels of resilience ( $3.98 \pm 0.63$ ) compared to their peers from the north and south ( $3.84 \pm 0.62$ ), according to the same test ( $Z = 2.991$ ,  $p = .003$ ). In terms of self-efficacy, students from the center report greater levels of self-efficacy both prior to ( $3.98 \pm 0.62$ ) and following training ( $4.26 \pm 0.63$ ) compared to their peers from the north and south prior to ( $3.87 \pm 0.70$ ) and following the training ( $4.17 \pm 0.57$ ), according to the same test ( $Z = 2.359$ ,  $p = .018$  prior to training;  $Z = 2.601$ ,  $p = .009$  following training). In contrast, students from the north and south demonstrate better performance in the knowledge item following the training ( $4.22 \pm 0.82$ ) compared to their peers from the center ( $4.05 \pm 0.96$ ), according to the same test ( $Z = -2.160$ ,  $p = 0.031$ ). There were no differences in knowledge between the groups prior to the training (data not shown).

In an effort to assess and compare students' improvement, residual variables were calculated for relative change in resilience, self-efficacy, and knowledge. In all three cases, the variable was computed as the difference between post and pre measurements divided by the pre measurements. Analysis of demographic differences was conducted for these variables as well. The results are summarized in Table 3.

According to the univariate analyses, the multi-variate analysis performed utilized a linear regression model to predict relative change

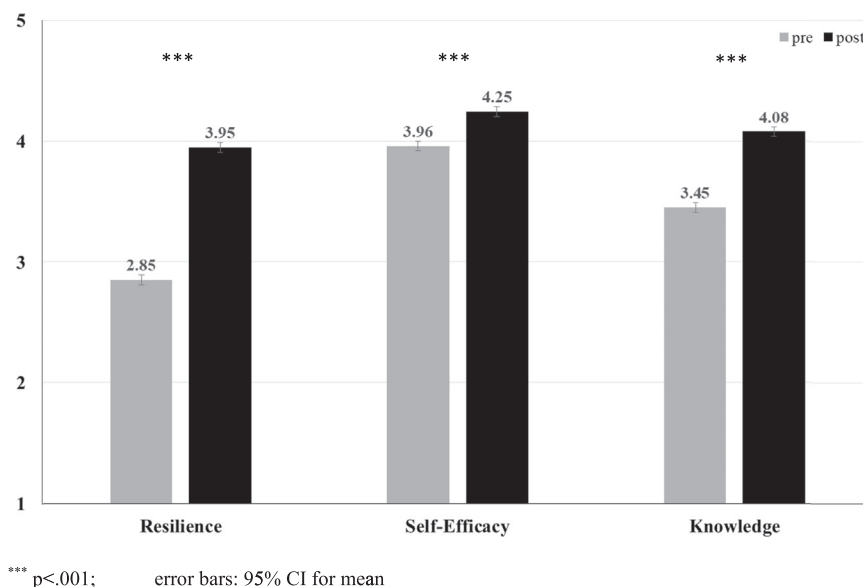


Fig. 2. Students' perception of resilience, self-efficacy and knowledge before (Pre) and after (Post) Light Search and Rescue (LSR) training (N = 1279).

in resilience. The regression model was performed in Stepwise mode with the first block containing the two demographic variable found to be associated with the dependent variable in the univariate analysis: Gender (two categories) and religiosity (two categories), and the second block containing the residual variables of self-efficacy and knowledge. The model was found to be statistically significant and account for 12.5% of the variance of the dependent variable. All independent variables were found to be predictors of relative change in resilience, with the exception of religiosity (Table 4). The predominant predictor of change in resilience in this model was the relative change in self-efficacy ( $\beta = 0.204$ ).

5. Discussion

In the past decades, numerous studies and case reports have demonstrated that following major earthquakes, the extraction of trapped victims is attempted by the lay public [6,8–12,25]. Abrams et al. [25] have made one of the first attempts in advocating for the importance of public education in light search and rescue (p. 151): "it is suggested that citizens living in regions of high seismic risk and trained in basic search and rescue... are the most immediate resource for early response after an earthquake." The authors also outlined their basic concepts of Light Search and Rescue (LSR) training for the lay public. Yet this notion was kept mostly overlooked for years following that call.

A more recent appeal for a change in the Urban Search and Rescue dogma was made by Peleg [7] (Pp 651–2): "Perhaps it is time to shift the paradigm from reliance on professional rescuers arriving from great distances to promoting "prepared communities," particularly in disaster-prone cities... Training the local population on how to provide light rescue... will boost community resilience, foster social capital, and in all likelihood, increase the odds of freeing trapped survivors after an earthquake."

The current study evaluated the first known state-sponsored attempt at providing such LSR training to the general public, in this case high-school students. The findings of this study demonstrate the efficacy of LSR trainings in increasing participants' resilience, self-efficacy and knowledge. The results demonstrate significant increase in all three components assessed, with varying degrees of effect size, ranging from small-medium (for the change in self-efficacy), through medium-large (for knowledge) to very large (for resilience).

While the positive effect of the LSR training on the indices measured might not be surprising, it is of utmost importance. Other studies have demonstrated before that increased perception of resilience and self-efficacy can serve to promote better performance in times of needs and or under pressure [e.g. 26–28]. In essence, this would suggest that training could be beneficial not just for the well-being and self-esteem of trainees, rather it could have a downstream effect on their performance when they will need to use the skills they have obtained.

Interestingly, the findings of this study suggest that the LSR training have an equalizing effect on participants resulting in nullifying of pre-training differences following the training. This is demonstrated in the lack of differences between Jews and Arabs and between secular and religious students post-training, whereas these groups demonstrated differences in self-efficacy and resilience (respectively) prior to the training. In other words, the trainings have a greater effect on participants starting from a lower standing point, and allow them to catch up with their peers and emerge from the other side performing similarly high. Similar notions indicating the beneficial effects of training to narrowing of socio-demographic-based gaps were reported elsewhere in the world in different contexts [e.g., 29,30].

An exception to this rule is the variability observed among students from different geographical regions. These differences could be explained in the general context of resilience in Israel. Compared to

Table 2 Spearman correlations of assessed constructs (perceived resilience, self-efficacy and knowledge).

	Resilience pre	Resilience post	Self-Efficacy pre	Self-Efficacy post	Knowledge pre
Resilience post	.349**				
Self-Efficacy pre	.243**	.302**			
Self-Efficacy post	.201**	.552**	.609**		
Knowledge pre	.102**	.044	.152**	.076*	
Knowledge post	.048	.278**	.155**	.301**	.242**

\*\* p < .001 (two-tailed); \* p < .01 (two-tailed), non-significant following Bonferroni's correction.

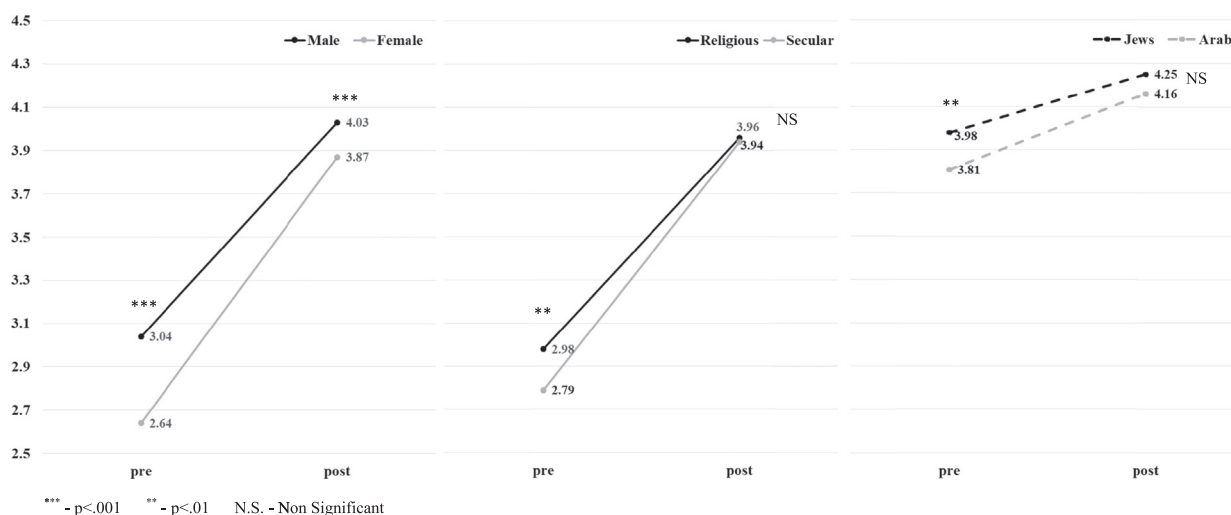


Fig. 3. Comparison of Students' perception of resilience (right; complete lines) and self-efficacy (left; dashed lines) before (pre) and after (post) Light Search and Rescue (LSR) training according to demographic groups (N = 1279). Note that some differences between demographic groups are nullified post training, rendering an equally high level of perceived resilience or self-efficacy in either demographic groups.

students from the central regions, students of the northern and southern regions of Israel have endured many more situations of elevated alert or emergencies, due to regional militarized conflicts [31]. This elevated exposure could explain why northern and southern students report lower levels of relative change in resilience and higher levels of relative change in knowledge. Change in resilience might be difficult to achieve among the students who are highly victimized by unfortunate circumstances, presumably due to multifactorial socio-psychological reasons that were not assessed in this current study [31]. However, the same circumstances might make them sharper in acquiring lifesaving skills and make them more attentive to lifesaving lessons, which could explain their better performance in the knowledge skill. It should be noted that students from both geographical groups initiated the training with a similar level of reported resilience, and the data suggest that residents of the center regions report greater levels of resilience post-training. Therefore, an alternative explanation is that students from the central regions are more affected by the training and are left with a sense of greater achievement following it compared to students from the north or south. Explaining the particularities of this phenomenon is difficult to do without controlling for possible confounders that were not assessed in this study.

Another exception is observed for the differences among the genders. It appears that while no differences exist between boys and girls in terms of self-efficacy, the differences in resilience exhibited prior to the training persist following it. Given that our tool for assessing these

constructs is self-report based, perhaps the differences between the genders have more to do with gender-based reporting patterns rather than actual differences. In this sense, our results mirror similar findings found in a longitudinal study from 2012 that evaluated the efficacy of Basic life Support (BLS) skills of high school students before and after cardiopulmonary resuscitation training. While no differences between the overall BLS performance of boys and girls was observed, the authors reported that significantly more boys than girls had judged themselves more confident before the training. This led the authors to deduce that girls might be more cautious in their self-evaluation compared to boys [32]. We assume that the differences reported in this study might be following the same reasoning.

Despite differences observed in some demographic variables, the overarching conclusion of this study is that SLR training for high school students is capable of benefiting with their perception of resilience, self-efficacy and knowledge to perform during crisis. Additional research can be proposed to better understand the mechanism of this benefiting effect and the long-term capacity to maintain it.

### 5.1. Limitations

This study has three main limitations. First, the study employs a questionnaire that might be subject to reporting-bias due to the fact that it measures construct through reporting, rather than objective assessment. Second, the study was performed among a population of high-

Table 3

Means, standard deviation, and Mann-Whitney U Test comparison of relative change<sup>+</sup> in assessed constructs (perceived resilience, self-efficacy, and knowledge) across demographic variables.

	Resilience			Self-efficacy			Knowledge		
	Mean ± SD	Z	p-value	Mean ± SD	Z	p-value	Mean ± SD	Z	p-value
<b>Gender</b>									
Male (n = 663)	0.38 ± 0.36	7.451	< .001	0.08 ± 0.22	0.789	.430	0.29 ± 0.63	0.643	.520
Female (n = 618)	0.55 ± 0.45			0.09 ± 0.22			0.31 ± 0.63		
<b>Religion</b>									
Jews (n = 1,162)	0.47 ± 0.41	-1.515	.130	0.09 ± 0.22	1.261	.207	0.29 ± 0.61	0.730	.465
Other (n = 111)	0.41 ± 0.45			0.11 ± 0.19			0.37 ± 0.77		
<b>Religiosity</b>									
Secular (n = 615)	0.50 ± 0.44	1.977	.048	0.10 ± 0.23	-0.861	.389	0.33 ± 0.67	- 1.838	.066
Religious (n = 585)	0.44 ± 0.38			0.08 ± 0.15			0.26 ± 0.56		
<b>Place</b>									
North/south (n = 222)	0.43 ± 0.46	2.780	.005	0.11 ± 0.32	-0.779	.436	0.38 ± 0.69	- 2.791	.005
Center (n = 1,055)	0.47 ± 0.40			0.08 ± 0.19			0.29 ± 0.61		

**Table 4**

Results of linear regression analysis of relative change in resilience according to demographic variables and self-efficacy and knowledge constructs.

Model		Unstandardized Coefficients		Standardized Coefficients	t	ANOVA
		B	Std. Error	Beta		
1	(Constant)	.308	.051		6.035***	26.165 ***
	Gender	– .160	.023	.193	6.835***	
	Religiosity	– .052	.023	– .063	– 2.241*	
2	(Constant)	.254	.050		5.072***	40.724 ***
	Gender	.158	.023	.192	6.960***	
	Religiosity	– .043	.023	– .052	– 1.872	
3	Self-efficacy	.470	.057	.226	8.183***	42.611 ***
	(Constant)	.215	.050		4.325***	
	Gender	.156	.022	.188	6.955***	
	Religiosity	– .035	.022	– .042	– 1.539	
	Self-efficacy	.425	.057	.204	7.477***	
	Knowledge	.121	.018	.181	6.625***	

Regression performed in Stepwise mode with two blocks. The first block included demographic variables (gender – two categories; religiosity – two categories), and the second block included assessed constructs (relative change to self-efficacy (cont.) and relative change to knowledge (cont.)). Included in the regression analysis were variables significantly associated with the dependent variable (relative change in resilience). No collinearity observed between included variables (all VIFs values below 1.5) \*\*\* -  $p < .001$  \* -  $p < .05$ .

school students in Israel. Though it stands to reason that the conclusions may be generalized and applicable to many other societies that strive to enhance resilience to varied disasters, this should be made with caution, preferably following further study to evaluate the applicability of the findings in other populations. Third, for practical considerations, the tool used assessed only the construct reported and cannot control for possible confounders associated with these constructs.

## 6. Conclusions

The results of this study demonstrate that Light Search and Rescue (LSR) training for the general public could potentially have a beneficial outcome in promoting public readiness and resilience to face the adverse implications of a major earthquake. The findings illustrate that following LSR training, high-school students reported significantly higher levels of resilience, self-efficacy and knowledge. The outcomes of this study demonstrate a potentially significant contribution to promoting public resilience by empowering local communities to become more competent and self-reliant in saving lives following major disasters. Further studies are required to assess the long term effects of these training, their efficacy for other types of trainees (e.g., adults), and their contribution to the resilience of surrounding societal layers (families, communities, etc.).

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