

Social vulnerability and disasters: development and evaluation of a CONVERGE training module for researchers and practitioners

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Abstract

Purpose – Social vulnerability in the context of disaster management refers to the sociodemographic characteristics of a population and the physical, social, economic, and environmental factors that increase their susceptibility to adverse disaster outcomes and capacity to anticipate, cope with, resist, and recover from disaster events. Because disasters do not impact people equally, researchers, public health practitioners, and emergency managers need training to meet the complex needs of vulnerable populations.

Design/methodology/approach – To address gaps in current education, the CONVERGE initiative, headquartered at the Natural Hazards Center at the University of Colorado Boulder, developed the Social Vulnerability and Disasters Training Module. This free online course draws on decades of research to examine the factors that influence social vulnerability to disasters. Examples of studies and evidence-based programs are included to illuminate common methods for studying social vulnerability and ways that research can guide practice. To evaluate the module, all trainees completed a pre- and post-training questionnaire.

Findings – Between July 2019 and September 2021, 1,089 people completed the module. Wilcoxon signed rank tests demonstrated a significant perceived increase in self-rated knowledge, skills, and attitudes (KSA). Students, members of historically underrepresented populations, and those new to or less experienced in the field, had the greatest perceived increase.



Practical implications – This training module can help participants understand the specific needs of socially vulnerable populations to help reduce human suffering from disasters.

Originality/value – This article describes a novel web-based training and offers evaluation data showing how it can help educate a broad hazards and disaster workforce on an important topic for disaster management.

Keywords Training, Workforce development, Social vulnerability, Hazards, Disasters

Paper type Research paper

1. Introduction

Social vulnerability in the context of disaster management is defined as the sociodemographic characteristics of a population and the physical, social, economic, and environmental factors that increase their susceptibility to adverse disaster outcomes and capacity to anticipate, cope with, resist, and recover from disaster events (Flanagan *et al.*, 2018; Kim and Bostwick, 2020; Ogie and Pradhan, 2019; Wisner *et al.*, 2004). Some examples of characteristics that influence social vulnerability include socioeconomic status, age, race, ethnicity, immigration status, gender, and the presence of a disability (Cutter *et al.*, 2003; Thomas *et al.*, 2013). Decades of research demonstrate that the most socially and economically disadvantaged populations often suffer disproportionately harmful consequences during and after disaster events (Wisner *et al.*, 2004; Flanagan *et al.*, 2011; Fordham *et al.*, 2013; Kim and Bostwick, 2020). For instance, research shows that people of color and people experiencing poverty are more susceptible to hazards, as they are more likely to live in poorly-constructed dwellings in closeness, proximity to hazards and are less likely to have the resources needed to prepare for and withstand the impact of disasters (Fothergill *et al.*, 1999; Morrow, 1999; Fothergill and Peek, 2004; Dash, 2013; Bolin and Kurtz, 2018). Another example of a socially vulnerable population is older adults. Research demonstrates that older adults experience elevated risk for disaster-related loss, injury, emotional distress, or death due to factors that influence their ability to cope with and recover from disasters, such as high rates of chronic illness and disabilities, social isolation, and limited access to disaster-related communication (Bolin and Klenow, 1983; Peek, 2013; Wood and Bourque, 2018). These social factors impact individual and community functioning and well-being before, during, and after a disaster and therefore affect resilience—the ability to resist and recover from an extreme event (Links *et al.*, 2018).

A broad range of professionals working in the disaster field—including researchers from a range of disciplines, public health practitioners, and emergency managers—should be trained to address the needs of potentially vulnerable populations (Anderson, 1990; Andrulis *et al.*, 2007; Peek, 2006; Tierney, 2002). In fact, the Federal Emergency Management Agency (FEMA) Emergency Management Higher Education Program identified literacy in the social determinants of risk and the effects of disasters as one of the core competencies required of emergency management (Feldmann-Jensen *et al.*, 2019). Despite this recognition, most web-based trainings, such as those offered by the National Disaster Preparedness Training Center, the Centers for Disease Control and Prevention (CDC) TRAIN Learning Network, and the FEMA Emergency Management Institute, focus more broadly on the official policies and protocols needed to plan for or coordinate a disaster response, such as the Incident Command System.

Even trainings that address socially vulnerable populations tend to focus more narrowly on one specific vulnerable population group or exist as courses or workshops that are delivered over the duration of several hours or days. For example, the Texas A&M University Defining, Locating, and Reaching Older At-Risk Populations in an Emergency online course focuses specifically on older adults. The Social Vulnerability Approach to Disasters course offered through the Academic Emergency Management and Related Courses for the Higher Education Program at FEMA consists of 31 course sections where each section is one to three hours long. While courses such as these provide vital information, their format and length

may make them inaccessible to a broader audience of students and other professionals. Furthermore, only a limited number of available training programs offer guidance on how to translate the large body of research on social vulnerability into practice. Even fewer programs evaluate impact on knowledge, skills, and attitudes (KSA) that may change as a result of online trainings or other educational programs (Evans *et al.*, 2021).

To respond to these specific gaps in training availability, the National Science Foundation-supported CONVERGE initiative at the Natural Hazards Center at the University of Colorado Boulder developed the Social Vulnerability and Disasters Training Module. This module is designed to teach students, early career researchers, and practitioners who are new to the hazards and disaster field about social drivers of vulnerability to disasters. The module also highlights methods for studying the social factors that contribute to vulnerability before, during, and after a disaster and describes existing vulnerability reduction programs and policies informed by past research. Together these lessons demonstrate how research on social vulnerability to disasters can enhance community resilience by supporting more targeted and effective emergency preparedness, response, recovery, and mitigation efforts.

The Social Vulnerability and Disasters Training Module is one component of a larger training and education program offered through CONVERGE (Evans *et al.*, 2021; Peek *et al.*, 2020a). The broader CONVERGE initiative is designed to promote convergence research, which involves diverse teams working together in novel ways—transcending disciplinary and organizational boundaries—to address vexing social, economic, environmental, and technical challenges in an effort to reduce disaster losses and promote collective well-being (Peek *et al.*, 2020a, p. 1). CONVERGE resources are available for free to anyone, as part of its mission is to prepare a diverse 21st century workforce that is ready to address the social roots of disaster risk (Peek *et al.*, 2020b).

In this article, we introduce the Social Vulnerability and Disasters Training Module, which is the first in a series of online trainings that have been released through CONVERGE since 2019. We begin by describing the development of the module so that readers can understand more about the content and what distinguishes this module from other available online trainings. Despite the importance of social vulnerability to hazards and disaster research and practice, we are not aware of any evaluation research that demonstrates the effectiveness of such trainings. We work to fill this gap by presenting evaluation data that shows who has completed the training and whether it can enhance perceived knowledge, attitudes, and skills related to social vulnerability and disasters. By describing the development, content, and evaluation of this module, this article contributes to the limited scholarship examining web-based trainings on social vulnerability to disasters.

2. Overview of the training module

This training module is an online course that focuses on the social factors that contribute to disaster vulnerability among at-risk populations. It is a web-based training that uses e-learning best practices to engage users (Centers for Disease Control and Prevention, 2013; Wood *et al.*, 2019). Pedagogically, web-based online trainings like the one we created have been found to be effective for building knowledge and skills—as measured by baseline and follow-up self-report surveys—in other areas such as health care (Webb *et al.*, 2017). To further enhance user engagement, various interactive strategies are integrated throughout our training module, including graphics, images, slideshows, and embedded resource links. Case studies drawn from the peer-reviewed literature highlight different methods used to examine social vulnerability across geographic and hazard contexts. The main text, as well as call out boxes, describes evidence-based practices to address disparities in disaster outcomes. A progress bar and navigational tools guide learners through the content and track where they are in the module. To ensure that users remain attentive to the content as they progress through the module,

knowledge checks consisting of two multiple choice questions are included at the end of each major lesson. Users can take a 10-question quiz at the end of the module and access links to additional resources. The module takes approximately 30–60 min to complete and all materials presented meet accessibility standards required by the University of Colorado Boulder.

The module begins with a list of learning objectives to orient the user to the course content. The module is organized into four main lessons: (1) Background, (2) Methodological Approaches, (3) Knowledge to Action, and (4) Future Directions. The *Background* lesson introduces participants to the module by defining social vulnerability and highlighting distinctions between physical and social vulnerability perspectives. To illustrate how historical and contemporary factors contribute to negative disaster outcomes, an interactive slideshow reviews the vulnerability of African Americans living in New Orleans before, during, and after Hurricane Katrina (Plate 1). The lesson concludes with a summary of the literature on populations that are especially vulnerable to hazards and disasters.

The *Methodological Approaches* lesson describes the primary methods used to study social vulnerability, including quantitative, qualitative, and mixed methods approaches.

|| Historical Events – Slideshow



1865–1965: Post-Slavery Jim Crow South

Plate 1.
Excerpt from the
CONVERGE Social
Vulnerability and
Disasters Training
Module background
lesson

Discriminatory housing policies, including a 1924 New Orleans law that prohibits racial integration in neighborhoods, leads to housing segregation throughout the region. Post-World War II federal subsidies encourage White relocation to suburbs, leading to high concentrations of low-income and predominantly Black communities residing in the city center.^a

Source(s): Shutterstock.com

^aSeicshnaydre *et al.* (2018)

Examples of past studies drawing on different methodological approaches are emphasized through a series of case examples (Plate 2). The lesson also highlights existing datasets that can be used to quantify vulnerability, such as the CDC Social Vulnerability Index (Flanagan *et al.*, 2011). Specific ethical considerations for working with socially vulnerable populations in a disaster context are described to emphasize the importance of ethical and culturally competent research practices (Wu *et al.*, 2022).

The *Knowledge to Action* lesson bridges research and practice by highlighting how studying vulnerable populations and using the results of those studies improves hazards and disaster practice. Examples of how research has been used to inform evidence-based trainings, tools, and

EXAMPLE

|| Longitudinal Survey Research



The Gulf Long Term Follow-Up Study is a *longitudinal* examination of the long-term health impacts of the Deepwater Horizon oil spill. The study collected *telephone survey* data from adult participants who helped with the oil spill clean up, or who took trainings, signed up to work, or were sent to the Gulf to help with the disaster. A subset of participants additionally received *questionnaires* on physical and mental health, *clinical exams*, and collections of *biological and environmental samples*. Data were collected over multiple years, with the first wave of data collected between 2011 and 2013 and the second wave of data collected between 2013 and 2016.

tThe longitudinal design has the potential to examine the long-term physical and mental health outcomes of the oil spill, as well as differential impact among minority and low-income participants. Some preliminary findings indicate that proximity to the spill and duration of clean-up work may be associated with heart disease,^a and that workers involved in handling oily plants and wildlife or dead animal recovery may possess lower lung function.^b

Source(s): Shutterstock.com

^aStrelitz *et al.* (2019)

^bGam *et al.* (2018)

Plate 2.
Case example
presented in the
CONVERGE Social
Vulnerability and
Disasters Training
Module methodological
approaches lesson

policies are presented throughout. For instance, the lesson describes how psychological and communication sciences, studies in issues management, and practical lessons learned from emergency responses led to the development of a now widely used Crisis and Emergency Risk Communication manual ([Centers for Disease Control and Prevention, 2018](#)). It also explains how evidence-based tools can be used to advance preparedness and planning efforts. For example, the module features the Vulnerable and At-Risk Populations Resource Guide Toolkit, which provides health departments with a repository of resources, maps, case studies, and presentation templates needed to identify and plan for vulnerable populations in their specific jurisdictional areas ([MacDonald et al., 2012](#)). A logic model summarizes the connections between research, practice, and population outcomes at the end of the lesson.

The fourth and final lesson in the module, *Future Directions*, provides 10 recommendations for informing future research, interventions, and public health and emergency management practice. The recommendations focus on the topics of (1) intersectionality, (2) interdisciplinary collaborations, (3) causal inference, (4) evidence-based practices, (5) inclusion of socially vulnerable populations in planning, (6) participatory action research, (7) working with non-governmental organizations, (8) collaboration between researchers and practitioners, (9) the use of geographical information systems in research and practice, and (10) non-Western contexts and perspectives.

At the end of the module, users can take a 10-question multiple choice quiz to receive a certificate of completion. At present, those who complete the module can gain one contact hour of general management training through the International Association of Emergency Managers certification program. After completing the module, users can also access links to datasets, key readings, and web resources related to social vulnerability and disasters on the module's additional resources page. In addition, the CONVERGE website features an annotated bibliography of the publications that informed the development of the training module.

3. Material and methods

3.1 Module development

To develop the Social Vulnerability and Disasters Training Module, our team first identified and reviewed frequently cited literature focusing on social vulnerability to hazards and disasters. We selected specific search terms based on the extensive public health and social science literature on social vulnerability. Our goal was to identify both theoretical and empirical literature that offered a thorough overview of historical, economic, and social factors that influence disaster outcomes across a range of groups. As such, we searched for studies that used a variety of theoretical lenses and methodological approaches and focused on different populations that were previously identified as highly susceptible to disaster in the literature.

We ranked the results from the searches in descending order by the total number of times they had been cited. After completing a review of the abstracts to eliminate duplicate, non-English language [\[1\]](#), and non-relevant publications, we organized the remaining publications generated from each search according to document type (e.g. empirical research article, theoretical/review article, book, book chapter, and report) and separated the top 25 most cited publications of each document type into separate spreadsheets. We summarized these top-cited publications according to academic discipline, disaster name, disaster category (e.g. natural, technological, and terrorism), and disaster phase to ensure that the training module included a diversity of publications focused on a range of issues of importance in the hazards and disaster field. We reviewed the reference lists of the identified publications and consulted with two subject matter experts (SMEs) in at-risk populations at the CDC Center for Preparedness and Response to further identify relevant literature that did not emerge in our

original searches. The CDC funded the work for this training module and the two contracted SMEs regularly met with the module development team to provide feedback on its content and structure, with a particular emphasis on the practical application of the module to inform evidence-based preparedness and response.

Once the literature review was complete, our project team developed an outline for the training module. Two team members drafted sections of the module which were then regularly presented to the principal investigator and the two CDC SMEs. To complement the background literature, the CDC SMEs helped to identify additional tools and practical resources.

After multiple iterations, revisions, and rewrites, a draft of the module was complete. We then worked with a web developer with expertise in online learning technology to implement the content in an online learning management system, LearnDash. LearnDash is a WordPress plugin created by leading learning industry professionals that provides practical and experience-driven guidance for individuals and organizations developing online courses. This learning management system allows our team to make revisions and updates to the module as new articles and books are published. This is an especially important feature given the rapidly growing and dynamic nature of social vulnerability research.

Once the module was fully developed in LearnDash, we invited our colleagues from the Natural Hazards Center to review the module and to test the system for functionality. We also asked 23 undergraduate engineering students participating in the National Science Foundation's Research Experience for Undergraduates summer program to serve as our student testers. They completed the module and provided written feedback using a standardized review sheet and also met with us in an online forum to share verbal feedback. Once we had integrated their suggestions, our core project team reviewed the module one final time before publishing it on the CONVERGE website (<https://converge.colorado.edu/resources/training-modules/>) in July of 2019.

3.2 Dissemination

Our goal with this module is to reach a multidisciplinary hazards and disaster audience, with a strong emphasis on students and emerging researchers and practitioners. Accordingly, we used several methods to disseminate the training module. We shared an announcement of the module's release via the Natural Hazards Center online news publication, social media, and various listservs, professional networks, and contacts so that we could reach people across many academic disciplines, as well as in policy and practice communities. We submitted paperwork to CDC's TRAIN Learning Network to list the training module as a course on their website and to ensure availability to public health researchers and practitioners (<https://www.train.org/cdctrain/course/1087625/>). To reach academic instructors and students, we worked with faculty who developed classroom assignments involving the training module, which we then posted to the CONVERGE Assignment Bank. The module developers presented on the training at several academic and professional conferences including the 44th and 45th Annual Natural Hazards Workshops, the 2020 National Earthquake Conference, and the 2020 National Hurricane Conference. We also hosted a 30-min webinar where we invited members of the Natural Hazard Center's network to attend a demonstration of the module. The recorded and captioned video of the webinar was then shared on our project website at <https://converge.colorado.edu/category/webinars/>.

3.3 Evaluation

The purpose of the evaluation of the Social Vulnerability and Disasters Training Module was to assess who completed the training and determine whether it had the ability to enhance perceived knowledge, attitudes, and skills related to social vulnerability and disasters. We

were also interested in assessing whether we reached our target audience of students and early career researchers and practitioners who are new to the hazards and disaster field.

Before enrolling in the module, users were first required to register for an account where they provided demographic and professional information. We asked registered users to self-identify as a core, periodic, situational or emerging researcher or practitioner to capture stages of career development and commitment to the hazards and disaster field as established by the [National Research Council \(2006\)](#) and [Peek et al. \(2020b\)](#). The *core* research category included those who strongly self-identify as a hazards/disaster researcher or practitioner, have a deep commitment to the field, and have engaged in hazards and disaster work for a sustained amount of time. The *emerging* category included students and others who are new to the field and who are still learning about its disciplinary or interdisciplinary histories, theories, methods, and approaches. The *situational* category included those not previously trained or involved in the hazards field, but who had the opportunity to study new phenomena or processes based on a disaster event. The *periodic* category included those who are not primarily engaged in hazards and disaster research or practice but who focus on related topics periodically throughout their professional career ([Peek et al., 2020b](#), pp. 1,078, 1,080).

To evaluate the effectiveness of the training module, we asked users to answer a series of brief KSA assessment questions before and after completing the module. KSA is a framework that has been widely used to evaluate educational trainings. For instance, it has been used by CDC-funded Preparedness and Emergency Response Learning Centers to evaluate preparedness training and curricula for public health practitioners ([Centers for Disease Control and Prevention and Association of Schools of Public Health, 2012](#)). To ensure user confidentiality, we did not connect the names of the users with their pre- and post-KSA responses. We measured KSA through the following self-report items:

- (1) On a scale from 1 (lowest) to 10 (highest), please rate your knowledge about social vulnerability to hazards and disasters.
- (2) On a scale from 1 (lowest) to 10 (highest), please rate your methodological skill set for conducting hazards and disaster research on vulnerable populations.
- (3) On a scale from 1 (lowest) to 10 (highest), how important do you think building social vulnerability knowledge and skills is to hazards and disaster research?

Given that our three main outcome variables were measured as ordinal scales, we used non-parametric statistical tests in our evaluation. We conducted Wilcoxon signed rank tests to evaluate changes in perceived KSA between pre- and post-assessments. To explore how user background characteristics influenced changes in KSA, we conducted Kruskal–Wallis tests for each of the KSA outcomes by gender identity, race/ethnicity, geographical locations, highest degree completed, student status, researcher/practitioner category, and affiliated organization. Statistical analyses were conducted in SPSS.

4. Results

Between July 7, 2019 and September 7, 2021, 1,089 people registered for and completed the training module ([Table 1](#)). The majority of these participants identified as female (58.0%), White (51.9%), and between 16 and 25 years old (56.9%). Most trainees resided in the US or its territories (81.2%), had completed a high school degree or GED as the highest level of education attained (43.5%), were students (86.4%), and self-identified as emerging researchers or practitioners (73.7%). Nearly three-quarters of users reported an affiliation with an academic institution (74.5%). The mean number of years of experience in hazards and disaster research or practice was 2.18 years, (min = 0 years, max = 40 years).

		Social vulnerability and disasters
Variable	N (%)	
<i>Gender identity</i>		
Female	632 (58.0%)	
Male	452 (39.0%)	
Other	32 (2.9%)	
<i>Race and ethnicity</i>		
White	565 (51.9%)	
Black	109 (10.0%)	
Asian	107 (9.8%)	
Hispanic	74 (6.8%)	
Some other race or ethnicity ¹	99 (9.1%)	
More than one race	68 (6.2%)	
Prefer not to answer	72 (6.6%)	
<i>Age range</i>		
16–25	620 (56.9%)	
26–35	202 (18.5%)	
36–45	89 (8.2%)	
46–55	45 (4.1%)	
56–65	19 (1.7%)	
66+	2 (0.2%)	
No answer	112 (10.3%)	
<i>Mean age (standard deviation)</i>		
	26.3 (61.7)	
<i>Geographical location by country</i>		
United States and US Territories	884 (81.2%)	
Canada	124 (11.4%)	
Turkey	40 (3.7%)	
Nepal	6 (0.6%)	
United Kingdom	5 (0.5%)	
India	4 (0.4%)	
Mozambique	4 (0.4%)	
New Zealand	3 (0.3%)	
Australia	2 (0.2%)	
Barbados	2 (0.2%)	
Chile	2 (0.2%)	
Austria	1 (0.1%)	
Bangladesh	1 (0.1%)	
France	1 (0.1%)	
Ireland	1 (0.1%)	
Japan	1 (0.1%)	
Pakistan	1 (0.1%)	
Philippines	1 (0.1%)	
Romania	1 (0.1%)	
Syria	1 (0.1%)	
<i>Highest degree completed</i>		
High School/GED	474 (43.5%)	
Associate	140 (12.9%)	
Bachelor's	248 (22.8%)	
Master's	126 (11.6%)	
Doctorate	81 (7.4%)	
Prefer not to answer	20 (1.8%)	
<i>(continued)</i>		

Table 1.
Sociodemographic
characteristics of
CONVERGE social
vulnerability and
disasters training
module trainees

DPM
31,6

22

Variable	N (%)
<i>Student status</i>	
Yes	941 (86.4%)
No	148 (13.6%)
<i>Researcher category</i>	
Core	116 (10.7%)
Emerging	803 (73.7%)
Situational	80 (7.3%)
Periodic	90 (8.3%)
<i>Organizational affiliation</i>	
Academic institution	811 (74.5%)
Federal, state, or local government	105 (9.6%)
Other ²	173 (15.9%)
<i>Mean time in hazards and disaster research or practice</i>	
Total number of trainees	2.18 years
	1,089 (100%)
Note(s): ¹ “Some Other Race or Ethnicity” consists of respondents who indicated their race or ethnicity as Indigenous, Arab, Native Hawaiian, or prefer to self-describe	
² Due to small sample sizes, respondents who indicated they had an affiliation other than government or academia—including those in the private sector, a nonprofit, or other institution, as well as those who are retired or unemployed—were condensed into “Other”	

Table 1.

Table 2.
Wilcoxon signed ranked tests assessing differences in perceived knowledge, skills, and attitudes before and after completing the CONVERGE social vulnerability and disasters training module¹

The results from the Wilcoxon signed rank tests demonstrated a significant increase across self-reported perceived KSA (Table 2). Specifically, users reported a mean increase of 2.83 points in self-rated knowledge, a mean increase of 3.10 points in self-rated skills, and a mean increase of 1.51 points in self-rated attitudes.

Results from the Kruskal–Wallis tests examining group differences in self-reported change in KSA across participant attributes are shown in Table 3. Overall, respondents who identified as non-White and were students had a significantly greater mean rank change in self-rated knowledge compared to White ($H = 6.00, p \leq 0.05$) and non-student ($H = 34.33, p \leq 0.001$) participants. Additionally, group differences in change in knowledge between education level ($H = 46.32, p \leq 0.001$), researcher/practitioner categories ($H = 32.84, p \leq 0.001$), and affiliation ($H = 19.46, p \leq 0.01$) were statistically significant, with people with lower educational attainment levels, situational and periodic researchers, and those affiliated with an organization other than academia or government having the highest mean rank change.

For self-reported changes in skills before and after completing the training module, those living outside the US and students reported a significantly greater mean rank change compared to US-based ($H = 13.26, p \leq 0.001$) and non-student ($H = 57.06, p \leq 0.001$) participants. In addition, group differences between education level ($H = 70.59, p \leq 0.001$), researcher/practitioner categories ($H = 53.90, p \leq 0.001$), and affiliation ($H = 13.87, p \leq 0.001$) were statistically significant, with individuals with lower education, situational and emerging researchers, and those affiliated with an organization other than academia or government

Outcome	Median score before	Median score after	Mean score change	p value
Knowledge	5.00	8.00	2.83	<0.001
Skills	4.00	8.00	3.10	<0.001
Attitudes	8.00	10.00	1.51	<0.001

Note(s): ¹Scores fall within a range of 1–10, where 1 is lowest and 10 is highest

Gender identity	Mean rank knowledge change	Mean rank skills change	Mean rank attitudes change
Female	549.71	552.83	545.84
Male	537.08	535.25	542.70
Other	557.13	519.81	559.08
Kruskal–Wallis H	0.47	1.025	0.10
<i>Race and ethnicity</i>			
White	522.73	541.97	553.51
Non-White ¹	569.02	548.27	535.83
Kruskal–Wallis H	6.00*	0.11	0.94
<i>Geographical location</i>			
United States and US Territories	536.94	528.45	545.50
Outside the United States ²	579.77	616.39	542.85
Kruskal–Wallis H	3.15	13.26***	0.91
<i>Highest degree completed</i>			
High School/GED	588.23	584.40	568.58
Associate	600.24	613.52	530.50
Bachelor's	538.66	570.26	534.32
Master's	425.72	405.72	522.75
Doctorate	419.95	376.31	473.39
Prefer not to answer	470.23	379.15	650.25
Kruskal–Wallis H	46.32***	70.59***	11.24*
<i>Student status</i>			
Yes	566.93	573.28	549.39
No	405.54	365.20	517.08
Kruskal–Wallis H	34.33***	57.06***	1.47
<i>Researcher/Practitioner category</i>			
Core	390.80	355.78	494.73
Emerging	558.75	572.44	550.50
Situational	587.88	600.49	552.23
Periodic	582.97	494.77	554.31
Kruskal–Wallis H	32.84***	53.90***	3.63
<i>Organizational affiliation</i>			
Academia	551.21	548.29	544.38
Government	424.60	447.24	551.41
Other ³	588.95	588.92	544.03
Kruskal–Wallis H	19.46***	13.87***	0.05

Note(s): * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

¹Due to small sample sizes for specific race and ethnicity categories, respondents who identified as Black, Asian, Hispanic, Arab, Indigenous, Native Hawaiian, two or more races, or preferred to self-describe were recoded into the “Non-White” category

²Due to small sample sizes, respondents who indicated their location outside of the United States and its territories were recoded into an “Outside the US” category

³Due to small sample sizes, respondents who indicated they had an affiliation other than government or academic were condensed into an “Other” category

Table 3.
Kruskal–Wallis tests
for change in
knowledge, skills, and
attitudes across
participant attributes

having the highest mean rank change. Group differences in self-reported change in attitudes were significant across education level ($H = 11.24$, $p \leq 0.05$), with individuals with lower education having the highest mean rank change.

5. Discussion

We developed the CONVERGE Social Vulnerability and Disasters Training Module as part of a broader effort to enhance the ethical conduct and scientific rigor of hazards and disaster research and practice (Evans *et al.*, 2021; Peek *et al.*, 2020a, b). Unlike other web-based trainings that are delivered over the course of several hours or days or focus on one specific vulnerable population, our module succinctly summarizes a vast literature and provides actionable guidance on how research can be translated into practice. By presenting case studies of what methods are used to study social vulnerability and examples of evidence-based programs and policy that emphasize equitable resource allocation, targeted communications, and planning for vulnerable populations, this module responds to longstanding calls to expand and train the hazards and disaster workforce to address the needs of those most vulnerable to disasters (Anderson, 1990; Andrulis *et al.*, 2007; Peek, 2006; Peek *et al.*, 2020b; Tierney, 2002).

In the little more than two years since its launch, 1,089 trainees completed the Social Vulnerability and Disasters Training Module. The majority of trainees were students, affiliated with an academic institution, and self-identified as emerging researchers or practitioners. This demonstrates that our dissemination plan was successful at reaching those who are new to or less experienced in the hazards and disaster field, which is one of our broader project goals (Peek *et al.*, 2020a). In terms of demographics, respondents came from diverse backgrounds, including historically underrepresented groups within the hazards and disaster field, such as women, racial and ethnic minorities, and people from low-income countries. These demographic data also show that this module has successfully responded to recent calls for more education and training programs that recognize the growing disciplinary, professional, and demographic diversity of the disaster workforce (Madrigano *et al.*, 2017; Peek *et al.*, 2020b).

The results from the evaluation demonstrate a significant increase in self-reported KSA. Although we recognize that these significant increases may be biased given the self-assessment design of our evaluation (Braun *et al.*, 2012), the relative increases across the different KSA measures, as well as differences in assessment scores across different subgroups, provide additional insight into the module's potential impact on learning outcomes. On average, users experienced the greatest self-reported perceived change in *skills*, specifically suggesting that after taking the module, they perceived their methodological skill set for studying socially vulnerable populations to be the most impacted. This finding is encouraging as the module is meant to act as a starting point to build research competencies, with much of the module pointing to additional resources such as case studies of different methods, secondary datasets, and other tools. The increase in self-reported *knowledge* was also high, demonstrating that users considered the module helpful in building practical awareness and understanding of social conditions and drivers of poor disaster outcomes among socially vulnerable populations. Past research suggests that the very act of completing a self-evaluation can lead to improved learning outcomes, providing additional support for enhanced knowledge (Ross, 2006). In comparison to skills and knowledge, increases in self-reported *attitudes* about the importance of the topic of disaster-related social vulnerability were more modest. This may be because users began with a more positive orientation toward this topic at baseline and therefore had less opportunity to improve their attitudes. This makes sense given that these users were either likely to voluntarily choose to take the module or were assigned this training as part of a related college course or other professional training program.

The Kruskal–Wallis tests revealed that certain participants self-reported greater perceived benefits from the module. Researchers and practitioners who considered themselves to be emerging, periodic, or situational in the hazards and disaster field reported the largest perceived increase in self-reported knowledge and skills relative to more seasoned professionals who self-identified as core researchers or practitioners. Students and those with a high school/GED or associate degree as their highest level of education also self-reported a greater perceived increase in knowledge and skills compared to non-students and

those with more education. This strongly perceived impact among those who are new to the field or still in school is important for ameliorating the worst impacts of disaster, as it supports training of the next generation of researchers and practitioners to address the needs of socially vulnerable populations ([Andrulis et al., 2007](#)).

Interestingly, those affiliated with the private sector, a nonprofit, or other institution, as well as individuals who are retired or unemployed, reported a greater perceived increase in knowledge and skills than those affiliated with academia or government. Despite perceptions of experiencing a greater benefit from the module, this group only included 173 participants, compared to the 916 trainees affiliated with academia or government. This suggests that our research team should continue to find ways to disseminate this module to a broader audience, including practitioners working in public health and emergency management, in both nonprofit and private sectors. With our continued partnership with the CDC to develop other training modules, we hope to identify additional strategies to reach these non-academic and non-government audiences.

Our results indicate that certain underrepresented populations in the hazards and disaster field reported the greatest perceived benefits from the module in terms of building knowledge and skills, such non-White racial/ethnic groups and those residing outside the US—including those in middle- and low-income countries. If this reported perception is valid, this finding would be particularly promising, as more diversity in the hazard and disaster field has been widely acknowledged to be necessary for better understanding of and more inclusive planning for vulnerable populations ([Anderson, 1990](#); [Dixon and Louis-Charles, 2015](#)). As more CONVERGE training modules are released, we will continue to disseminate these resources to organizations that support the education and mentoring of underrepresented populations, such as the Bill Anderson Fund ([Bill Anderson Fund, 2021](#)) and the Gender and Disaster Network ([Gender and Disaster Network, 2019](#)).

There are certain limitations that need to be acknowledged. First, the evaluation relied on self-reported perceptions of change across only three questions used to measure complex concepts of KSA. Self-report evaluation methods are subject to self-assessment biases, such as the desire to provide responses that reinforce the researcher intentions (i.e. acquiescence bias) and the tendency for participants to give socially desirable responses (i.e. social desirability bias) ([Braun et al., 2012](#); [Conway and Ross, 1984](#); [Karpen, 2018](#); [Ross, 2006](#)). However, given the online format of the training module, we concluded that self-assessment was the most feasible and efficient evaluation approach for reaching a large number of geographically distributed users. Research also suggests that student self-assessments can produce reliable results that partially correlate with potentially more objective assessments, such as teacher evaluations ([Ross, 2006](#)). Second, the training module is currently active and freely available so the results may change as more trainees continue to complete the module over time. Third, our cross-sectional evaluation design does not allow for the examination of longer-term academic attainment or career trajectories of the majority student population that were included in this evaluation. We therefore have no way of knowing whether they will apply the knowledge attained on socially vulnerable populations in their future studies or careers. Fourth, we recognize that all trainees self-selected or were assigned via a course or other training requirement to complete this module. It is therefore possible that the results are subject to selection bias. Despite these limitations, we believe this module can address gaps among existing web-based trainings and help to educate a broad hazards and disaster workforce on an important topic for disaster preparedness and response. To improve future training module evaluations, we should attempt to address these aforementioned limitations, such as using more specific evaluation questions, employing more objective measures, and incorporating a longitudinal follow-up.

6. Conclusion

A community is only as resilient as its most vulnerable populations. To effectively plan for and manage increasingly frequent and intense disasters, it is essential that researchers,

public health professionals, emergency managers, and others working across sectors in the hazards and disaster field understand and are able to characterize how and why certain people are at risk before, during, and after a disaster (Maurice, 2013; McPhillips *et al.*, 2018). The CONVERGE Social Vulnerability and Disasters Training Module summarizes decades of scholarly literature to help educate users about historically rooted social structures and enduring economic inequalities that influence how people prepare for, cope with, and are affected by disaster; uses case studies to describe different methods used to study social vulnerability; and provides real-world examples to highlight evidence-based tools and programs. The module is freely available online, incorporates best practices for e-learning, meets accessibility standards, and is disseminated through multiple platforms. It is therefore poised to continue to reach a large number of current and future generations of researchers and practitioners working in the hazards and disaster field. By increasing self-reported KSA among emergent researchers and practitioners, this module can help prepare trainees to conduct and translate research on socially vulnerable populations which can ultimately help to reduce disaster disparities and encourage more equitable outcomes in disasters.

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Note

1. Only English publications were included due to the language proficiency of the module developers.

References

- Anderson, W.A. (1990), "Nurturing the next generation of hazards researchers", *Natural Hazards Observer*, Vol. 15 No. 2, pp. 1-2.
- Andrulis, D.P., Siddiqui, N.J. and Gantner, J.L. (2007), "Preparing racially and ethnically diverse communities for public health emergencies", *Health Affairs*, Vol. 26 No. 5, pp. 1269-1279, doi: [10.1377/hlthaff.26.5.1269](https://doi.org/10.1377/hlthaff.26.5.1269).
- Bill Anderson Fund (2021), "Addressing disaster disparities", available at: <https://billandersonfund.org/> (accessed 7 December 2021).
- Bolin, R. and Klenow, D.J. (1983), "Response of the elderly to disaster: an age-stratified analysis", *The International Journal of Aging and Human Development*, Vol. 16 No. 4, pp. 283-296, doi: [10.2190/MQEG-YN39-8D5V-WKMP](https://doi.org/10.2190/MQEG-YN39-8D5V-WKMP).

- Bolin, B. and Kurtz, L.C. (2018), "Race, class, ethnicity, and disaster vulnerability", in Rodríguez, H., Donner, W. and Trainor, J.E. (Eds), *Handbook of Disaster Research*, 2nd ed., Springer, Cham, Switzerland, pp. 181-203.
- Braun, E., Woodley, A., Richardson, J.T. and Leidner, B. (2012), "Self-rated competences questionnaires from a design perspective", *Educational Research Review*, Vol. 7 No. 1, pp. 1-18, doi: [10.1016/j.edurev.2011.11.005](https://doi.org/10.1016/j.edurev.2011.11.005).
- Centers for Disease Control and Prevention (2013), "CDC's e-learning essential: a guide for creating quality electronic learning", available at: <https://www.cdc.gov/trainingdevelopment/pdf/ElrngEsstls.pdf> (accessed 15 May 2020).
- Centers for Disease Control and Prevention (2018), "CERC: messages and audiences", available at: https://emergency.cdc.gov/cerc/ppt/CERC_Messages_and_Audiences.pdf (accessed 15 May 2020).
- Centers for Disease Control and Prevention and Association of Schools of Public Health (2012), "Knowledge, skills, and attitudes (KSAs) for the public health preparedness and response core competency model", available at: <https://emeraldcoasthcc.org/sites/emeraldcoasthcc.site/files/ksa-public-health.pdf> (accessed 15 May 2020).
- Conway, M. and Ross, M. (1984), "Getting what you want by revising what you had", *Journal of Personality and Social Psychology*, Vol. 47 No. 4, pp. 738-748, doi: [10.1037/0022-3514.47.4.738](https://doi.org/10.1037/0022-3514.47.4.738).
- Cutter, S.L., Boruff, B.J. and Shirley, W.L. (2003), "Social vulnerability to environmental hazards", *Social Science Quarterly*, Vol. 84 No. 2, pp. 242-261, doi: [10.1111/1540-6237.8402002](https://doi.org/10.1111/1540-6237.8402002).
- Dash, N. (2013), "Race and ethnicity", in Thomas, D.S.K., Phillips, B.D., Lovekamp, W.E. and Fothergill (Eds), *Social Vulnerability to Disasters*, 2nd ed., CRC Press, Boca Raton, FL, pp. 113-138.
- Dixon, B. and Louis-Charles, H. (2015), "A blue print for change: an emerging initiative paves the way for increased diversity in hazards mitigation", *Natural Hazards Observer*, Vol. 39 No. 6.
- Evans, C.M., Adams, R.M. and Peek, L. (2021), "Incorporating mental health research into disaster risk reduction: an online training module for the hazards and disaster workforce", *International Journal of Environmental Research and Public Health*, Vol. 18 No. 3, pp. 1244-1259, doi: [10.3390/ijerph18031244](https://doi.org/10.3390/ijerph18031244).
- Feldmann-Jensen, S., Jensen, S.J., Smith, S.M. and Vigneaux, G. (2019), "The next generation core competencies for emergency management", *Journal of Emergency Management*, Vol. 17 No. 1, pp. 17-25, doi: [10.5055/jem.2019.0393](https://doi.org/10.5055/jem.2019.0393).
- Flanagan, B.E., Gregory, E.W., Hallisey, E.J., Heitgard, J.L. and Lewis, B. (2011), "A social vulnerability index for disaster management", *Journal of Homeland Security and Emergency Management*, Vol. 8 No. 1, pp. 1-22, doi: [10.2202/1547-7355.1792](https://doi.org/10.2202/1547-7355.1792).
- Flanagan, B.E., Hallisey, E.J., Adams, E. and Lavery, A. (2018), "Measuring community vulnerability to natural and anthropogenic hazards: the Centers for disease Control and prevention's social vulnerability index", *Journal of Environmental Health*, Vol. 80 No. 10, pp. 34-36.
- Fordham, M., Lovekamp, W.E., Thomas, D.S.K. and Phillips, B.D. (2013), "Understanding social vulnerability", in Thomas, D.S.K., Phillips, B.D., Lovekamp, W.E. and Fothergill, A. (Eds), *Social Vulnerability to Disasters*, 2nd ed., CRC Press, Boca Raton, FL, pp. 1-32.
- Fothergill, A. and Peek, L.A. (2004), "Poverty and disasters in the United States: a review of recent sociological findings", *Natural Hazards*, Vol. 32 No. 1, pp. 89-110, doi: [10.1023/B:NHAZ.0000026792.76181.d9](https://doi.org/10.1023/B:NHAZ.0000026792.76181.d9).
- Fothergill, A., Maestas, E.G.M. and Darlington, J.D. (1999), "Race, ethnicity and disasters in the United States: a review of the literature", *Disasters*, Vol. 23 No. 2, pp. 156-173, doi: [10.1111/1467-7717.00111](https://doi.org/10.1111/1467-7717.00111).
- Gam, K.B., Engel, L.S., Kwok, R.K., Curry, M.D., Stewart, P.A., Stenzel, M.R., McGrath, J.A., Jackson II, W.B., Lichtveld, M.Y. and Sandler, D.P. (2018), "Association between Deepwater Horizon oil spill response and cleanup work experiences and lung function", *Environment International*, Vol. 121, pp. 695-702.

- Gender and Disaster Network (2019), "More about the beginnings and 'vision' of GDN", available at: <https://www.gdnonline.org/about> (accessed 7 December 2021).
- Karpen, S.C. (2018), "The social psychology of biased self-assessment", *American Journal of Pharmaceutical Education*, Vol. 82 No. 5, pp. 441-448, doi: [10.5688/ajpe6299](https://doi.org/10.5688/ajpe6299).
- Kim, S.J. and Bostwick, W. (2020), "Social vulnerability and racial inequality in COVID-19 deaths in Chicago", *Health Education and Behavior*, Vol. 47 No. 4, pp. 509-513, doi: [10.1177/1090198120929677](https://doi.org/10.1177/1090198120929677).
- Links, J.M., Schwartz, B.S., Lin, S., Kanarek, N., Mitrani-Reiser, J., Sell, T.K., Watson, C.R., Ward, D., Slemple, C., Burhans, R., Gill, K., Igusa, Tak., Zhao, X., Aguirre, B., Trainor, J., Nigg, J., Inglesby, T., Carbone, E. and Kendra, J.M. (2018), "COPEWELL: a conceptual framework and system dynamics model for predicting community functioning and resilience after disasters", *Disaster Medicine and Public Health Preparedness*, Vol. 12 No. 1, pp. 127-137, doi: [10.1017/dmp.2017.39](https://doi.org/10.1017/dmp.2017.39).
- MacDonald, P.D.M., Horney, J.A., Bevc, C.A., Markiewicz, M., Gunther-Mohr, C. and Simon, M.C. (2012), "Vulnerable & at-risk populations resource guide: introducing a new tool for preparedness planning", available at: <https://sph.unc.edu/files/2015/07/nciph-perre-varp-guide.pdf> (accessed 15 May 2020).
- Madrigano, J., Chandra, A., Costigan, T. and Acosta, J.D. (2017), "Beyond disaster preparedness: building a resilience-oriented workforce for the future", *International Journal of Environmental Research and Public Health*, Vol. 14 No. 12, pp. 1563-1577, doi: [10.3390/ijerph14121563](https://doi.org/10.3390/ijerph14121563).
- Maurice, J. (2013), "Mitigating disasters—a promising start", *The Lancet*, Vol. 381 No. 9878, pp. 1611-1613, doi: [10.1016/S0140-6736\(13\)61008-9](https://doi.org/10.1016/S0140-6736(13)61008-9).
- McPhillips, L.E., Chang, H., Chester, M.V., Depietri, Y., Friedman, E., Grimm, N.B., Jominoski, J.S., McPhearson, T., Medex-Lazaro, P., Rosi, E.J. and Shafiei Shiva, J. (2018), "Defining extreme events: a cross-disciplinary review", *Earth's Future*, Vol. 6 No. 3, pp. 441-455, doi: [10.1002/2017EF000686](https://doi.org/10.1002/2017EF000686).
- Morrow, B.H. (1999), "Identifying and mapping community vulnerability", *Disasters*, Vol. 23 No. 1, pp. 1-18.
- National Research Council (2006), "Facing hazards and disasters: understanding human dimensions", available at: <https://www.nap.edu/catalog/11671/facing-hazards-and-disasters-understanding-human-dimensions> (accessed 3 January 2022).
- Ogie, R.I. and Pradhan, B. (2019), "Natural hazards and social vulnerability of place: the strength-based approach applied to Wollongong, Australia", *International Journal of Disaster Risk Science*, Vol. 10 No. 3, pp. 404-420, doi: [10.1007/s13753-019-0224-y](https://doi.org/10.1007/s13753-019-0224-y).
- Peek, L. (2006), "Transforming the field of disaster research through training the next generation", *International Journal of Mass Emergencies and Disasters*, Vol. 24 No. 3, pp. 371-389.
- Peek, L. (2013), "Age", in Thomas, D.S.K., Phillips, B.D., Lovekamp, W.E. and Fothergill, A. (Eds), *Social Vulnerability to Disasters*, 2nd ed., CRC Press, Boca Raton, FL, pp. 243-262.
- Peek, L., Tobin, J., Adams, R.M., Wu, H. and Mathews, M.C. (2020a), "A framework for convergence research in the hazards and disaster field: the Natural Hazards Engineering Research Infrastructure CONVERGE facility", *Frontiers in Built Environment*, Vol. 6, pp. 110-129, doi: [10.3389/fbuil.2020.00110](https://doi.org/10.3389/fbuil.2020.00110).
- Peek, L., Champeau, H., Austin, J., Mathews, M. and Wu, H. (2020b), "What methods do social scientists use to study disasters? An analysis of the Social Science Extreme Events Research (SSEER) network", *American Behavioral Scientist*, Vol. 64 No. 8, pp. 1066-1094, doi: [10.1177/0002764220938105](https://doi.org/10.1177/0002764220938105).
- Ross, J.A. (2006), "The reliability, validity, and utility of self-assessment", *Practical Assessment, Research, and Evaluation*, Vol. 11 No. 1, pp. 1-13, doi: [10.7275/9wph-vv65](https://doi.org/10.7275/9wph-vv65).
- Seicshnaydre, S., Collins, R.A., Hill, C. and Ciardullo, M. (2018), "Rigging the real estate market: Segregation, inequality, and disaster Risk", *The Data Center*, pp. 1-12.

-
- Strelitz, J., Keil, A.P., Richardson, D.B., *et al.* (2019), "Self-reported myocardial infarction and fatal coronary heart disease among oil spill workers and community members 5 years after Deepwater Horizon", *Environmental Research*, Vol. 168, pp. 70-79.
- Thomas, D.S.K., Phillips, B.D., Lovekamp, W.E. and Fothergill, A. (Eds) (2013), *Social Vulnerability to Disasters*, 2nd ed., CRC Press, Boca Raton, FL.
- Tierney, K.J. (2002), "The field turns fifty: social change and the practice of disaster research", in Stallings, R.A. (Ed.), *Methods of Disaster Research*, Xlibris, Philadelphia, PA, pp. 349-374.
- Webb, J., Stockwell, J. and Chavez-Ugalde, Y. (2017), "The reach, adoption, and effectiveness of online training for healthcare professionals", *Public Health*, Vol. 153, pp. 107-110, doi: [10.1016/j.puhe.2017.08.016](https://doi.org/10.1016/j.puhe.2017.08.016).
- Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (Eds) (2004), *At Risk: Natural Hazards, People's Vulnerability, and Disasters*, 2nd ed., Routledge, New York, NY.
- Wood, M.M. and Bourque, L.B. (2018), "Morbidity and mortality associated with disasters", in *Handbook of Disaster Research*, 2nd ed., Springer, Cham, Switzerland, pp. 357-383.
- Wood, S.J., Rogers, M.H., Frost, M.D., Revere, D., Rose, B.A. and D'Ambrosio, L. (2019), "Enhancing access to quality online training to strengthen public health preparedness and response", *Journal of Public Health Management and Practice*, Vol. 25 No. 6, pp. E1-E9, doi: [10.1097/PHH.0000000000000811](https://doi.org/10.1097/PHH.0000000000000811).
- Wu, H., Peek, L., Matthews, M.C. and Mattson, N. (2022), "Cultural competence for hazards and disaster researchers: framework and training Module", *Natural Hazards Review*, Vol. 23 No. 1, doi: [10.1061/\(ASCE\)NH.1527-6996.0000536](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000536).

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