



Original Research

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Validation and Revision of the Household Emergency Preparedness Instrument (HEPI) by a Pilot Study in the City University of New York

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Abstract

Objective: The aim of this study was to pilot test the Household Emergency Preparedness Instrument (HEPI) with a diverse sample, allowing for assessment of reliability and validity of the instrument. The HEPI is an international, all-hazards questionnaire created to measure disaster preparedness of households, which results in data that can be used to enhance health promotion/disease prevention for individuals and promote resilience for communities.

Methods: A cross-sectional study of faculty, staff, and students ($N=284$) was completed to perform factor analysis to establish the HEPI's construct validity and compare preparedness across groups.

Results: The factor analysis revealed 2 dimensions of general preparedness, explaining 35% of the sample variance (Cronbach's $\alpha = 0.89$): preparedness actions and planning ($\alpha = 0.86$) and disaster supplies and resources ($\alpha = 0.80$). This factor analysis resulted in the revision of the subscale of HEPI questions. Consistent with previous studies, faculty/staff, older age, higher income, and those with previous disaster experience were more prepared. The mean score was 15.28 out of 40 points.

Conclusions: The HEPI is easy to administer and explains an acceptable amount of variance. The reliability was strong in this assessment, particularly for a pilot test. Construct, criterion, face, and content validity support the adequacy of the HEPI to capture essentials of household emergency preparedness.

Rising sea levels and extreme weather events are already impacting people all over the world and are predicted to continue.¹ The Intergovernmental Panel on Climate Change warns that low-lying coastal areas are increasingly vulnerable to the effects of sea level rise, storm surge, flooding, and extreme storm events.¹ Such potential for disasters in the future necessitates the need for emergency preparedness at all levels, to include the individual/household level. Despite the lack of evidence-based emergency preparedness recommendations,² researchers endeavor to determine whether emergency preparedness education regarding what community members need to obtain to be prepared for emergencies can improve preparedness levels³ or whether such emergency preparedness really matters.⁴ Hurricane Katrina decimated New Orleans in August of 2005; the impacts are still felt today.⁵ Superstorm Sandy devastated New York City (NYC) in October 2012,⁶ Hurricane Maria demolished Puerto Rico in 2017,⁷ and Hurricane Florence destroyed areas of eastern North Carolina in 2018.⁸ These events point toward an underlying need to create an evidence-based instrument to measure household emergency preparedness (HEP), guide education efforts to improve HEP, and ultimately determine the impact of HEP among community-dwelling residents.

A Delphi study was recently completed for the purpose of generating a consensus on the concept definition of HEP from experts and community stakeholders representing multiple disciplines and countries to develop an all-hazards, valid and reliable Household Emergency Preparedness Instrument (HEPI).⁹ Delphi participants came to a consensus that adequate HEP is defined as completion of several preparedness actions in addition to assembling a home disaster supply kit that would enable households to endure the common conditions that disasters present, regardless of location.⁹ These common conditions include power outages, deficiencies with drinking water, and being forced to shelter in place for a few days.⁹

The creators of the HEPI defined the construct of HEP and developed the initial instrument questions while establishing evidence to support face, content, and criterion validity of the instrument.⁹ The HEPI - Delphi yielded a 51-question instrument built through qualitative content analysis and group consensus achieved with 3 rounds of data collection. Scaling of the original Delphi instrument was based on similarity of items as presented by the expert panel before

pilot-testing in a general population. The next step of instrument development is to administer the instrument to a representative sample, perform psychometric testing on the instrument to establish construct validity, and make revisions if necessary. The purpose of this cross-sectional study was to pilot test the HEPI to perform psychometric testing and generate reliability and construct validity data. A second purpose was to measure and compare the HEP levels of a convenience sample of faculty, staff, and students from an urban university that is comprised of a socially vulnerable population in a physically vulnerable geographical location.

New York City is the most populous city in the United States (US) and is characterized by diverse people, neighborhoods, landscapes, and aging infrastructure. The city is vulnerable to coastal storms (erosion and flooding), rising sea levels, high winds, high heat, winter weather, earthquakes, fires, chemical/biological/radiological/nuclear incidents, emerging infectious diseases (epidemics and pandemics), and the approximately 22 million people are heavily dependent on energy, public transportation, water, and wastewater treatment.¹⁰

Emergency management agencies in NYC began to aggressively implement emergency preparedness educational interventions after the 9/11 attacks in 2001.¹¹ Martins et al. analyzed data about the emergency preparedness levels of 2,001 NYC residents collected in the months before the 2012 Superstorm Sandy.¹¹ They found that NYC residents engaged in emergency preparedness activities at a greater rate than community members in most geographical locations in the United States. The NYC residents were considered well prepared for disasters, particularly with gathering supplies and developing a family communication plan. Martins et al. attribute these high preparedness levels to high levels of social capital, trust in the government, and community emergency preparedness educational interventions.¹¹ Some of these community interventions include: (a) training health-care providers (HCPs) about how to educate their medically vulnerable patients about emergency preparedness resources¹²; (b) the Ready New York and Know Your Zone public education campaigns¹³; (c) the Notify NYC emergency alert system for risk communications¹³; (d) the NYC Community Emergency Response Teams and Community Organizations Active in Disasters teams of community volunteers who assist their neighbors before and during disasters^{13,14}; (e) training community- and faith-based organizations about how to prepare their employees, services, and facilities for emergencies¹³ and; (f) free HEP classes with distribution of disaster supply kits for participants.¹⁵

Assessments of college and university campus preparedness levels and plans are abundant.^{16–25} However, little is known about the emergency preparedness levels among college students. College students are seldom considered a vulnerable population even though they are living in large institutions and are often geographically separated from families that provide important instrumental and social support.²⁶ Less than half of students receive emergency preparedness information or training during student orientation.¹⁷ Although little research has been done to determine the preparedness levels among college students, what studies have been done demonstrate that college students are unprepared for disasters.^{26–29}

The City University of New York (CUNY) is the third-largest university system in the United States, in terms of enrollment, with more than 274,000-degree-credit students, continuing, and professional education students enrolled at 25 campuses located in all 5 NYC boroughs. The university has 1 of the most diverse student

bodies in the United States, with students hailing from 208 countries, but mostly from NYC.³⁰ As of fall of 2019, the race/ethnicity of all CUNY students was 0.3% American Indian/Alaska Native, 21.2% Asian/Pacific Islander, 25.2% Black, 30.2% Hispanic, and 23.1% White.³¹ Undergraduate enrollment in fall 2019 consisted of 97.2% under the age of 45 and 2.7% were 45 or older.³² As of fall 2016, 34.5% of CUNY's approximately 7600 full-time faculty were from underrepresented groups.³³

Recruiting CUNY faculty, staff, and students as a convenience sample for this pilot study provided a large, diverse, and possibly globally representative group of participants. Culture bias is manifested when an instrument is not conceptually equivalent for cultural subgroups, resulting in different psychometric properties for these groups.³⁴ The assumption of universal applicability of standardized instruments normed on particular cultural or racial/ethnic majority population needs to be tested.³⁵ The diverse sample obtained from CUNY faculty, staff, and students was ideal to evaluate culture bias of the HEPI.

Methods

This pilot study received institutional review board (IRB) approval from Hunter College, CUNY (protocol #2019-1037). The participants' consent was implied by completing the questionnaire. The participants were not compensated for their participation.

No specific race, ethnicity, gender, socioeconomic status, employment status, marital status, citizen status, or education level was targeted for recruitment. Inclusion criteria was noninstitutionalized, English-reading, adults who identified as either a CUNY faculty, staff, or student. Exclusion criteria was persons less than 18 y of age and non-CUNY faculty, staff, or students.

Given that this was a pilot study, assuming a simple design of 1 population self-classified into 2 groups based on responses to the survey (prepared or not prepared), the minimum sample size was calculated as $N > 50 + 8m$ (where m is the number of groups), which is the common method for determining sample sizes in this scenario.³⁶ In this case, $m = 2$ (prepared or not prepared) so the minimum sample size required per group was 66 participants. Based on potential missing data of approximately 10%, the minimum sample size sought for each group was 75 participants, or 150 participants total. Nine of the 25 CUNY campuses granted permission for the researchers to recruit participants from their campuses. Deans and department heads chose whether or not to forward the IRB-approved recruitment and consent script by means of e-mail and served as gatekeepers for recruitment. As a result, varying numbers of CUNY faculty, staff, and students on participating campuses received the link to the survey.

Data were collected using Qualtrics online survey software version February 2020 (Qualtrics, Provo, UT) to distribute the HEPI.⁹ The HEPI is an all-hazards, comprehensive, 51-question instrument used to ascertain if a respondent is prepared for disasters. There is support for face, content, and criterion validity of this instrument.⁹ The HEPI questions are objective and ask about what the respondent presently owns or does in a dichotomous format. As this was a pilot test of the new instrument, virtual focus group-style questions were asked at the conclusion of the HEPI. Participants were asked to rate the perceived clarity of the HEPI instructions and questions, the difficulty of the HEPI, and the reasonableness of the length of the HEPI. In addition, 1 open-ended question was included to inquire about anything the participant would like the researchers to know about the experience of completing the HEPI. Open-ended interview questions provide the

participants the opportunity to describe their experience in greater detail.³⁷ Focus groups representative of the intended respondents are useful for (a) developing insights into lay-person perceptions of HEP, (b) informing authors about the language and terminology that particular groups of people use, and (c) revealing unexpected additional issues related to HEP that were not identified through the conventional means of the literature review or the Delphi study.³⁸

Data Analysis

The open-ended question responses were analyzed with qualitative content analysis by means of NVivo software for Mac version 11.4.1 (QSR International Pty Ltd, Doncaster, Victoria, AU). Participants' responses were coded, counted, and placed into categories by 2 researchers separately first, then discrepancies were discussed and agreed upon, and then the data was summarized. These data were primarily used to learn about the participants' experience with completing the HEPI.

The level of statistical significance for Type I error was set at $P < 0.05$. Evidence-based estimation of effect size is not currently available. On the basis of expert judgment, Type II error was set at $\beta = 0.20$. All data analyses were completed with the Statistical Package for the Social Sciences for Windows version 26.0 software (International Business Machines Corporation, Armonk, NY).

Nine nondemographic items dispersed randomly throughout the scales were left blank. The most commonly occurring subscale response was used to replace those missing items before summing the subscale scores for Preparedness Actions and Planning (PAP) and Disaster Supplies and Resources (DSR). These subscales represent basic preparedness applicable to all individuals/households. Assumptions appropriate for statistical testing were evaluated and corrections were applied as required for the various statistical analyses used to test hypotheses.

It is appropriate to measure reliability of the HEPI by looking at the internal consistency of the questions. Internal consistency indicates how well the questions fit together conceptually, which can be assessed by looking at the inter-item correlations.^{38,39} This looks at the relationship among questions that are all indicators of the latent variable of HEP. Questions that have a strong relationship to HEP will have a strong relationship to one another.³⁸ The HEPI would be considered internally consistent to the extent that its questions are highly intercorrelated, as evidenced by coefficient alphas greater than .65.³⁸

The HEPI is intended to measure actual preparedness for individuals/households; resulting in questions restricted to a dichotomous (yes or no) response format. For example: Have you prepared and discussed a family emergency plan? Scales using this type of response format do not perform well when subjected to traditional factor or component analyses. An alternative approach that is based on polychoric correlations was used to examine the factor structure of the new instrument.⁴⁰

The Access and Functional Needs (AFN) subscale is highly individualized and only applicable to a specific subset of the population (participants with a disability, aged greater than 65, on at least 1 prescription medication, or who are pregnant) and was not included in the factor or reliability analysis. The same is true for the Special Actions (SA) subscale that is applicable to only those who have specific lifestyle or family characteristics (Table 1).

Results

The survey was accessed by 348 participants with 295 consenting, meeting the inclusion criteria, and beginning the survey. Data were reviewed for completeness and retained for the 284 participants who completed at least 95% of the survey (Table 2), 26.7% ($n = 71$) of which identified as having a country of origin outside of the United States. Approximately 50% of the surveys were completed by students ($n = 140$) compared with faculty/staff ($n = 138$); likewise, almost 50% reported they were married or partnered ($n = 145$) compared with not married or partnered ($n = 133$). Caucasian participants ($n = 148$) were most frequently represented, followed by Asian ($n = 52$), Hispanic/Latino ($n = 39$), Black/African American ($n = 23$), and Other ($n = 14$) participants. Faculty/staff were better prepared than students, people 50 y and older were more prepared than those 29 and younger, and members of the Hispanic/Latino and White/Caucasian group were significantly better prepared ($P \leq 0.001$) than those in the other race/ethnicity groups. See Table 2 for additional information on the demographic characteristics and general preparedness of the CUNY sample.

Regarding factor analysis, the adequacy of the polychoric correlation matrix was assessed favorably resulting in a highly significant Bartlett's statistic, a very good KMO (.92) indicating the sample size was sufficient for factor-analysis, and a narrow bootstrap 95% CI of .902 to .904. This indicates the quantity and quality of the data were appropriate for this method of factor analysis. The first factor analysis, based on a 4-factor solution (representing the 4 scales organized from the data generated in the Delphi study of experts), did not yield a reasonable solution. The factor analysis output indicated a 2-factor solution might be optimal and when run, 31 of the 34 general preparedness questions loaded on 1 of 2 dimensions and explained 35% of the variance represented in this sample. The study participants did not discriminate types of preparedness items as precisely as expected. The sample represented in this study is likely more consistent with the general population than the Delphi experts and changes to scaling were made to reflect the 2 dimensions represented in the factor analysis. The first dimension presented as the PAP scale (Cronbach's alpha = .86) and the second dimension presented as the DSR scale (Cronbach's alpha = .80). Together, the 2 scales represent the General Preparedness (Cronbach's alpha = .89) of individuals or families. Yes-responses to the questions were summed across the subscales and for the General Preparedness (GP) scores. Nine of the DSR items were assigned an extra point if the item was included in an emergency supply kit. Refer to Table 1 for more information on the HEPI before and after factor analysis and how survey questions were re-clustered to better fit the 2 dimensions of GP identified in the factor analysis process.

Higher scores on the HEPI indicate higher levels of preparedness. Excluding the AFN and SA subscales that are not applicable to all respondents, the minimum score a participant could receive on the GP scale is 0 and the maximum score is 40 (1 point for each yes-response and 0 points for each no-response). The mean GP score for this sample was 15.28 and the range was 1 to 37.

Of the 127 participants reporting AFN, 122 responded to the question of HCP discussion of HEP. Only 10 of those individuals and 5 individuals who did not report access and/or functional needs (a total of 5.4% of the total sample) responded positively to the question. Those who had a discussion with their HCP were some of the best prepared study participants with a GP $M = 19.33$

Table 1. HEPI scaling after factor analysis

HEPI questions	Original scaling
Preparedness Actions and Planning (PAP)	
Have you prepared and discussed a family emergency plan?	PA
Have you practiced or drilled on what to do in an emergency at home?	PA
Have you taken first aid training?	PA
Do you have a fire escape plan for your home?	PA
Do you know the types of disasters that are most likely to occur in your community?	PA
Do you have important family documents (such as copies of insurance policies, identification, and bank account records) in a waterproof, portable container or stored on a flash drive or cloud storage server?	PA
Do you have supplies set aside in your home in a kit to use in case of a disaster?	PA
Do you check your disaster supplies regularly for expired items?	PA
Have you planned for how you and your family would contact each other in an emergency?	CP
In the event of an evacuation, have you considered safe and unsafe places in your community?	EP
Do you know if your home is in an evacuation zone?	EP
Have you planned where to go if you had to evacuate from your home?	EP
Have you planned what route to take if you evacuate from home?	EP
Do you have a family meeting place in case of separation?	EP
Is everyone in your home aware of your evacuation plan?	EP
Do you know where your local emergency shelter is?	EP
Do you have a plan for what you will take if you had to leave your home quickly?	EP
Have you prepared a small kit with emergency supplies to take with you if you had to leave quickly?	EP
Disaster Supplies and Resources (DSR)	
Do you have working smoke detectors?	PA
Do you have a source of transportation to leave your neighborhood quickly in the event of a necessary evacuation of your home?	EP
If there were no power or telephones, would you have a way to receive information about disasters in your area, such as with a solar, hand-crank, or battery-operated radio?	CP
Do you have a supply of water that would provide at least 3.8 liters (one gallon) of water per day for each person in your home for one week?	DS
Do you have a one-week supply of ready-to-eat food that will not spoil for all those living with you? ^a	DS
Do you have moist wipes, hand sanitizer, and other personal hygiene supplies (soap, tampons, pads, etc.)? ^a	DS
Do you have a flashlight/torch, a headlamp, lanterns, glow sticks, candles, or other non-electric portable lighting? ^a	DS
Do you have a first aid kit? ^a	DS
Do you have a sleeping bag or warm blanket for each person? ^a	DS
Do you have cash? ^a	DS
Do you have extra batteries? ^a	DS
Do you have matches? ^a	DS
Do you have a fire extinguisher? ^a	DS
Special Actions (SA)	
Do you have a wrench, pliers, or multi-tool to turn off utilities (water, gas, propane, etc.)?	DS
If you wear prescription glasses or contact lenses, do you have extra glasses or contact lenses?	DS
If you have a baby, do you have a one-week supply of formula, bottles, and baby food?	DS
If you have a baby, do you have a one-week supply of diapers/nappies?	DS
If you have a pet, do you have a one-week supply of pet food and water for each pet?	DS
If your pet takes medications, do you have a two-week supply of pet medications?	DS
Have you signed up for a community emergency alert system?	PA
If you have the shut off valves in your home, do you know how to turn off the utilities (water, gas, propane, etc.)?	PA
Do you have written contact information of family and friends?	CP
Do you have family or friends that you could stay with during an emergency?	EP
If you have a pet, do you have an evacuation plan for your pet?	EP
Access and Functional Needs (AFN)	
Do you (or someone that you live with) have a disability, are you 65 years of age or older, do you take at least one prescription medication, or are you pregnant?	AFN Screening
Do you have your medical history written on paper or stored on a flash drive or cloud storage server?	AFN
Do you have a list of your doctors on paper or stored on a flash drive or cloud storage server?	AFN
Have you asked family or friends if they will be able to help you in a disaster?	AFN

(Continued)

Table 1. (Continued)

HEPI questions	Original scaling
If you take prescription medications, do you have a list of your medications including how much you must take?	AFN
If you take medications prescribed to you by your doctor, do you have a two-week supply of extra medications?	AFN
Do you have a two-week supply of special diet food, syringes, blood sugar monitoring strips, oxygen cylinders, or other needed medical supplies?	AFN
Do you have a plan for an alternate power source for medical equipment or refrigerated medicine in the event of a power outage?	AFN
Do you have a small cooler, portable ice chest, ice box, cool box, chilly bin, or an esky and cold packs/freezer bricks for refrigerated medications?	AFN
Do you have a paper copy of your advanced directives or provider's order for life-sustaining treatment form, or is it stored on a flash drive or cloud storage server?	AFN

Note: Items included in Factor Analysis are shaded in gray. Original Scaling: Preparedness Actions (PA), Communication Plans (CP), Evacuation Plans (EP), Disaster Supplies (DS), and Access & Functional Needs (AFN). Scaling after Factor Analysis: Preparedness Actions and Planning (PAP) and Disaster Supplies & Resources (DSR). Scales remaining but not applicable to all: Special Actions (SA) and Access & Functional Needs (AFN).

^aOne-point weight added for items included in an emergency supply kit.

(8.89) compared with $M = 15.06$ (6.83) for those whose HCPs did not discuss HEP with them ($t(282) = 2.32$; $P = 0.021$). See Table 2 for a complete description of sample characteristics and group differences in GP.

To examine the overall impact of the significant demographic variables on GP, the following variables were dichotomized: married or partnered to not married or partnered, faculty/staff to students, Hispanic/Latino and Caucasian/White to any other race/ethnicity, graduate degree to no graduate degree, annual income \$75,000 or greater to less than \$75,000, HCP discussed HEP to HCP did not discuss HEP, owned home to did not own home, and previous home damage due to disaster to no previous home damage due to disaster. Using standard multiple regression, GP was regressed on the 9 variables, together, they explained 20% of the variance found in the level of preparedness for this diverse group ($R^2 = .205$; adjusted $R^2 = .178$; $F(9, 268) = 7.67$; $P < 0.001$). However, only 1 of the 9 dichotomized variables, previous home damage due to disaster event, provided a significant independent impact on GP (unstandardized $B = 3.17$; $t = 3.70$; $P < 0.000$) having the greatest unique impact on GP represented by a part correlation of $r = .20$.

The core theme from the qualitative data was that participation in the HEPI helped participants learn what is needed to be prepared, made them realize that they were unprepared, and inspired them to develop a HEP plan. Several participants recommended that HEP educational resources be included at the completion of the HEPI. Five participants wrote they felt anxious after completing the HEPI. The authors will include in the instructions for researchers to disclose to their IRB and potential participants that completion of the HEPI may cause anxiety. The second most common theme from the qualitative data was that the HEPI was user-friendly, with descriptors of “easy,” “quick,” “understandable,” and “clear” commonly mentioned. This theme was supported by the quantitative data, with 98% ($n = 278$) of the sample rating the clarity of the instructions for the survey as extremely clear, 98% ($n = 277$) rating the clarity of the questions as extremely clear, 77% ($n = 218$) rating the length of the survey as extremely reasonable, and 75% ($n = 212$) rating the level of difficulty of the survey as extremely easy on a 5-point rating scale.

Discussion

The HEPI Delphi study was conducted to begin the process of developing the “gold standard” HEP instrument.⁹ Disaster supply

kits are often used as a potential measure of preparedness; however, because disaster supply kits are not empirically confirmed, using supply kits as an indicator of HEP calls into question the validity of the instruments that are used. The most appropriate form of validity for HEP instruments, predictive validity, has yet to be explored.² “Predictive validity indicates the extent to which an individual’s future level of performance on a criterion can be predicted from knowledge of performance on a prior measure” (p. 176).³⁴ To assess predictive validity, researchers are encouraged to use the HEPI in longitudinal studies evaluating survival and resilience outcomes associated with suitable HEP.

The finding that students were less prepared than faculty and staff is consistent with findings of other studies that indicate students were generally unprepared for disasters.^{27–29} A small study of 80 university students in Ontario, Canada living off-campus and outside a family home revealed that despite the majority (69.2%) of participants believing they were personally responsible for their wellbeing during an emergency, 75.2% reported having no emergency preparedness kit or a designated stockpile of emergency preparedness items.²⁸ In another study of 503 students at a Florida university, only 28% of participants reported having completed some form of hurricane preparation.²⁷ Follow-up related to the level of preparation revealed that this included possessing items typical to households or dormitory rooms such as canned food, bottled water, batteries, and a raincoat; thus, it is not clear if any of these items were obtained specifically for HEP.

The finding that previous home damage provided significant independent impact on HEP is consistent with a previous study of 756 graduate and undergraduate students at a southeastern university in which disaster experience was a strong predictor for students’ actual and perceived disaster preparedness.²⁹ It differs from a study of 503 undergraduate students at a Florida university, which found that, although 80% of participants indicated they had some experience with hurricanes, only 28% reported having completed some level of hurricane preparation and only 29% had an evacuation plan.²⁷

The current findings that faculty/staff were better prepared than students, those over 50 are better prepared than those 29 and younger, and that Hispanic/Latino and White/Caucasian participants were better prepared than those in the other race/ethnicity groups are consistent with findings of a study of preparedness using the 2013 American Housing Survey.⁴¹ In Malmin’s study, the most resilient households based on cumulative preparedness scores included those with the presence of married couples, older adults,

Table 2. Demographic characteristics and GP of CUNY sample

Characteristics	Frequency	Valid %	GP M (SD)
Role			
Faculty/staff	138	49.6	17.06 (6.79)***
Student	140	50.4	13.24 (6.55)
Gender			
Male	71	25.5	15.16 (7.86)
Female	201	72.3	15.03 (6.61)
Other	6	2.2	15.67 (5.75)
Age			
18–29	110	39.6	13.14 (6.33) c
30–39	49	17.6	14.86 (6.84)
40–49	47	16.9	15.89 (6.80)
50–59	36	12.9	17.20 (6.62)*
60–69	26	9.4	18.38 (8.27)**
70 +	10	3.6	17.44 (6.13)
Race/ethnicity			
Asian	52	18.8	11.65 (6.04) c
Black/African American	23	8.3	13.00 (5.44)
Hispanic/Latino	39	14.1	17.15 (8.77)***
White/Caucasian	148	53.6	16.13 (6.27)***
Other	14	5.1	14.36 (8.22)
Current relationship status			
Married/partnered	145	52.2	16.71 (6.67)***
Not married/partnered	133	47.8	13.42 (6.82)
Education			
High school or equivalent	13	4.4	14.77 (7.33)
Some college	50	18.0	12.00 (5.47) c
Associate's degree	23	8.3	12.43 (5.78) c
Bachelor's degree	59	21.2	14.88 (7.06)
Graduate degree	133	47.8	16.93 (7.00)*
Household income			
Less than \$20,000	38	14.3	11.29 (6.32) c
\$20,000 to \$34,999	39	14.7	13.26 (6.41)
\$35,000 to 49,999	20	7.5	15.15 (7.49)
\$50,000 to \$74,999	40	15.1	13.70 (6.04)
\$75,000 to \$99,999	23	8.7	16.70 (7.25)*
\$100,000 to \$149,999	53	20.0	16.60 (6.06)**
\$150,000 or more	52	19.6	17.23 (6.94)***
Daily medication			
Yes	123	44.2	16.03 (6.61)
No	155	55.8	14.43 (7.11)
Require special medical equipment			
Yes	18	6.5	15.83 (8.10)
No	260	93.5	15.09 (6.86)
Disability requiring assistance			
Yes	28	10.1	16.54 (7.22)
No	250	89.9	14.98 (6.89)
HCP discussion of HEP			
Yes	15	5.4	19.33 (8.89)*
No	269	94.6	15.06 (6.83)
Military service (current or past)			
Yes	3	1.1	17.67 (8.39)
No	275	98.9	15.11 (6.92)
English is first language			
Yes	217	78.3	15.49 (6.70)

(Continued)

Table 2. (Continued)

Characteristics	Frequency	Valid %	GP M (SD)
No	60	21.7	13.82 (7.67)
Country of origin is United States			
Yes	195	73.3	15.69 (6.88)
No	71	26.7	14.38 (7.22)
Home ownership			
Own	127	45.8	16.92 (6.55)***
Rent	132	47.7	13.85 (7.11) c
Other	18	6.5	11.44 (4.19) c
Type of home			
Detached single family	92	33.3	16.00 (7.03)
Multi-family 1 or more stories	65	23.6	13.29 (6.55)
Multi-family 3 or more stories	92	33.3	15.65 (7.25)
Other	27	9.8	14.67 (5.66)
Years in current community			
0 - 5	84	30.4	14.12 (5.93)
More than 5	192	69.6	15.55 (7.29)
Home damage due to disaster			
Yes	82	29.6	17.95 (8.29)***
No	195	70.4	13.90 (5.87)

Note: c = comparison group. HCP discussion of HEP = health-care provider discussion of household emergency preparedness).

* $P < 0.05$.

** $P < 0.01$.

*** $P \leq 0.001$.

and those with higher incomes; the least resilient households included Asian households and those that included children or disabled individuals. In a study on HEP behaviors in Virginia, a greater proportion of Asian-American households reported being “unprepared” compared with Caucasian or Black/African American households.⁴²

The current study found those with higher income levels and graduate degrees had higher levels of GP. Ferguson et al. found that households in which high school was the highest level of education attained reported feeling “unprepared” at twice the proportion of households with a baccalaureate degree.⁴² Bell et al. completed a study with 2256 community-dwelling older adults, in which an income less than \$30,000 per year was associated with lower odds of having a multi-day supply of food and water; and having a high school education or less was associated with lower odds of having a stocked emergency kit or having discussed evacuation plans with family or friends.⁴³ In contrast, a study exploring the effectiveness of household emergency plans during tornadoes found no significant differences between older and younger adults in level of education on plan effectiveness, although the plans of older adults were less likely to be as detailed.⁴⁴

The finding that the best-prepared study participants were those who had discussed preparedness with their HCP is consistent with the findings of studies of those with health needs,^{45,46} providing further evidence that HCP education is an important component of preparedness education to those most vulnerable. The authors recommend the inclusion of preparedness measures in HCP education as a part of regular patient/client care.

New York has been impacted by numerous disasters throughout history.⁴⁷ However, even with robust community-level HEP interventions targeting NYC residents,^{12–15} the sample assessed in this study was not considered particularly well prepared, exhibiting a mean GP score of 15.28 of 40 possible points. The

participants who previously had damage to their homes from a disaster were significantly more prepared for emergencies. This is consistent with researchers in Japan who found that those who experienced damage from the Great East Japan Earthquake in 2011 were more prepared for emergencies.⁴⁸ This disaster experience, previously linked to improved preparedness levels⁴⁵ may impact perceived risk, which has been linked to higher HEP levels.⁴⁹

Limitations

This cross-sectional study used a convenience sample and retains the expected limitations of such a study design. Although the CUNY population is diverse and housed on multiple campuses on all 5 boroughs in NYC, the sample size was small and drawn from the same general geographic location. Data collection took place during the COVID-19 pandemic, which may have affected response rate. Some participants indicated that they experienced anxiety when completing the survey; concerns related to personal or family well-being during the pandemic may have exacerbated emotional response to the subject matter and altered participants' responses to the survey.

Conclusions

Although the results from previous studies indicate a wide variation in preparedness levels among different demographics, making comparisons is problematic as HEP was measured inconsistently across such demographics. Having an empirically developed instrument facilitates HEP measurement that can be compared across demographics, improving interventions and targeted education to improve HEP levels. Furthermore, future studies should endeavor to assess associations between HEP, survival, postdisaster

needs, and outcomes, particularly among vulnerable community members with chronic conditions and/or AFNs. The next steps for the HEPI evaluation should include a predictive validity study, a known-groups validity examination, and a test-retest reliability assessment.

The HEPI is easy to administer in-person or online, it accurately captures the various indicators of HEP and explains an acceptable amount of the variance. The internal consistency reliability was strong in this assessment, particularly for a pilot test. Criterion, construct, content, and face validity support the adequacy of the new instrument to capture essentials of HEP. The HEPI takes approximately 15 min to complete and does not ask about sensitive information, making respondent and researcher burden low.

Researchers, emergency planners, and educators may use the HEPI for noncommercial purposes without cost under the following conditions: (a) the HEPI developers are properly credited in publications and presentations; (b) if the HEPI is translated to a language other than English or modified in any way, these changes are disclosed in publications; and (c) psychometric data analysis for the instrument is provided to the HEPI developers. This information will inform future modifications of the HEPI. For a copy of the survey and instructions on how to use and score the HEPI, contact the corresponding author of this article.

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