Equally Unprepared: Assessing the Hurricane Vulnerability of Undergraduate Students

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ABSTRACT

Students have been described as being both particularly vulnerable to natural disasters and highly resilient in recovery. In addition, they often have been treated as a distinct, homogeneous group sharing similar characteristics. This research tests these ideas through an examination of hurricane-related perceptions and preparations of students in a hurricane-prone area. A survey of over 500 undergraduate students (15% on-campus residents, 85% off campus) was conducted at the University of South Florida, a large, metropolitan-based university located in Tampa Bay, Florida, near the Gulf Coast. Following Mann–Whitney and Kruskal–Wallis tests, results showed that students were ill prepared for hurricanes and lacked specific knowledge of the risk. There were small but statistically significant differences in mean responses with respect to gender, age, and ethnicity on specific questions, while ethnicity most strongly warrants future research. Whether the magnitude of statistical differences results in behavioral differences is unclear. Using discriminant function analysis, attempts to identify heterogeneous subgroups based on gender, ethnicity, and age likewise found weak to moderate significant differences, supporting the contention that students are largely homogeneous with regard to certain aspects of hurricane perceptions and preparedness, though again ethnicity demands closer attention in subsequent studies.

1. Introduction and background

Research on social vulnerabilities related to natural hazards, beyond more traditional studies of geographical or physical vulnerability (e.g., Cutter et al. 2000; Tobin 1999; Tobin and Montz 1997; Wisner et al. 2004), has increased in volume and recognition over the last decade, particularly in the wake of Hurricanes Katrina and Rita in 2005, from which parts of the Gulf of Mexico region are still recovering. Social vulnerability results from structural factors such as socioeconomic status, ethnicity, and age, which may compromise the ability of an individual to prepare for and recover from a disaster (Cutter and Finch 2008). Since differential vulnerability is at least partly the result of social structural factors, it follows that vulnerability is not accidental but rather is firmly entrenched in everyday life (Hewitt 1983). Effective mitigation strategies must begin prior to a disaster (Morrow 1999), though one obstacle is that there is considerable variation in how individuals perceive and prepare for future hazards. Riad and Norris (1998) point out, for example, that people must perceive a problem and believe that any preparations or actions will be beneficial before any meaningful steps are taken.

Many socially vulnerable groups, including the poor and the elderly, have been subjects of intensive research conducted by scholars (Cutter 2006; Kusenbach et al. 2010). Despite this interest in vulnerable populations who live in risk-prone regions, not all groups that deserve attention have been considered in past studies. For instance, studies on the vulnerability of college and university students to hurricanes remain comparatively scarce, which is perhaps surprising given the large number of students and other academic personnel exposed to hurricane risk, especially throughout the Southeast and Gulf coastal regions of the United States. For example, about 90,000 students, administrators, faculty, and staff from some 30 colleges and universities were displaced for up to an entire academic year following Hurricanes Katrina...
and Rita (Mangan et al. 2005; Gill et al. 2006). The Federal Emergency Management Agency (2003) even notes that students are often overlooked when planning for disasters.

The population of interest to us—undergraduate college students—is a distinctive group. Overall, they are simultaneously vulnerable and resilient to disasters in ways that warrant further investigation. For example, undergraduate students might be considered more vulnerable than other populations because of their youth and related factors. Typical undergraduate students can be presumed to lack some important life experiences in comparison with older populations, and even to some degree with same-age peers who are not students; students regularly continue to be emotionally and financially dependent on their parents. Families often provide much-needed support in emergencies, and yet students may live several hours or more away from home, or even out of their home country, while attending college. It causes distress when students and their families are disconnected and cannot communicate very well, let alone help each other (Haney et al. 2007). In addition, some students may not have access to reliable transportation, such as a car, either for financial reasons or because they are unnecessary or even prohibited at some universities (e.g., freshmen cannot have cars on campus). Last, undergraduate students, presumably like many young adults, appear to underestimate the danger and effects of adverse natural and social events, as well as the impacts of their own choices and actions (Steinberg 2007). Even if they perceive actual risks correctly, they are more likely not to feel personally affected or threatened by what might happen. A certain false sense of invincibility or cavalier attitude seems to compromise students’ preparedness and ability to recover from disasters, as suggested by the findings of Lovekamp and Tate (2008). It is therefore not only their youth but also their status as students that might leave them less able than others to prepare for and cope with disasters.

On the other hand, although college students experience similar stressors as the general population following a hurricane (Ladd and Gill 2011), community residents were much more negatively affected by the hurricane than were students (Van Willigen et al. 2005). In fact, Van Willigen and colleagues note that a relative lack of physical possessions and personal stake in their surroundings might help students bounce back mentally from the emotional stresses of a disaster, since loss of possessions and keepsakes can be a major cause of emotional stress. College students also often have a vital network of resources (e.g., financial aid, friends, mentors) provided via the university setting, and parents often continue to play a prominent role in students’ lives. Higher education, renter status, and usually good health can also contribute greatly to college students’ resilience. Another important consideration is that few students carry the responsibility of caring for young children, elderly relatives, or other vulnerable household members. Clearly, undergraduate students have both advantages and disadvantages when it comes to dealing with disasters, which makes them a distinctive population worthy of further study.

One factor contributing to the paucity of literature on undergraduate student hurricane preparedness is, as mentioned, partially a result of researchers focusing on other, seemingly more vulnerable, populations. Another limitation, however, is the time frame of the modest body of research that currently exists on the topic. Most studies focus on examining short- and long-term effects of hurricanes on students (e.g., their coping ability), rather than issues arising before and during a disaster or threat, such as those related to perception and preparation, that could have direct relevance to personal, institutional, and municipal disaster planning on several fronts, including facilities and infrastructure, mental and physical health services, and so on.

One such study, conducted by Sattler et al. (2002), investigated the effects of Hurricane Georges on college students and their psychological condition. Data from 697 survey participants showed that symptoms of acute stress disorder (ASD) were positively correlated with resource loss. The data also showed that individuals who were better prepared for the storm exhibited fewer symptoms of ASD and were better able to cope afterward. Particularly relevant to this research, the authors found a direct link between the level of disaster preparedness and psychological stress and depression experienced afterward by college students. Similarly, Gill et al. (2007) and Ladd and Gill (2011) found high levels of postdisaster stress in students located in New Orleans, Louisiana, during Hurricane Katrina. These studies therefore provide a direct mandate to assess and improve disaster preparedness in student populations.

Furthermore, Van Willigen et al. (2005) suggest that students are more homogeneous across subgroups than the same subgroups are within the general population. Specific results showed that outcomes for the student population were not affected by differences in gender, income, and ethnicity, which are demographic factors that typically affect vulnerability and recovery in other populations. Results did show, however, that these factors were important in determining outcomes and conditions of nonstudent community members. The authors concluded that “the social location of students effectively buffers them from natural hazards relative to other residents of the community, even others their own age and
income” (Van Willigen et al. 2005, p. 189). Again, however, their study examined the consequences of student status on recovery from a hurricane.

Lovekamp and Tate (2008), although their research concentrated on tornadoes and earthquakes, similarly conclude that students are a distinct population, given their transience, marginal awareness of vulnerabilities, and general lack of disaster preparation. While they hypothesized that gender and ethnicity should affect disaster vulnerability, their survey of 192 students resulted in mixed findings. Namely, Black students reported higher levels of tornado risk than White students, and reported risk increased with class rank. Furthermore, males and White students reported lower overall fear than females and Black students. Yet females, Black students, and students of lower class rank did not express lower levels of preparedness, nor did females or Black students take more actions to prepare for disasters than males or White students. A subsequent qualitative study by Lovekamp and McMahon (2011), likewise focusing on tornadoes, supported the initial study’s conclusions with respect to gender. Their findings suggest that university affiliation, at least in some situations, might provide a buffer against common vulnerabilities by reducing the number of students facing challenges that increase risk, such as parenthood or lack of education.

Universities can play an important role in helping students recover emotionally from the effects of a disaster. As Beggan (2010) notes, planning and decisions at an institutional level must be in place prior to a natural hazard in order to ensure successful recovery. Gutierrez et al. (2005) surveyed a group of 107 students at Valencia Community College in Orlando, Florida, after the devastating Florida hurricanes of 2004 to investigate whether adjustments to courses made after the hurricanes lessened stress for students. The researchers found that over 70% of students reported that specific course adjustments helped to reduce stress, while all students indicated that overall course adjustments helped reduce stress. Gutierrez and colleagues suggest that planning and assistance from schools—not only generic help such as financial or emotional support and resources but also targeted help such as adjusting class schedules and offering more study assistance before upcoming tests—both before and after a disaster help students recover emotionally. This study supports the idea that universities should be held at least somewhat responsible for helping students to learn about and cope with disasters. Such assistance might include dissemination of detailed, accurate forecasts about an impending storm, including information about presumed strength, wind speed, and storm surge, which have been shown to influence people’s willingness to evacuate (e.g., Brommer and Senkbeil 2010; Lazo et al. 2010).

In this paper, we examine responses to a survey about hurricane experience, preparedness, and information that was given to undergraduate students on the Tampa campus at the University of South Florida. First, we evaluated actual perceptions and preparations of these students, including their plans for evacuation. Given the relative neglect of undergraduate students in disaster research, one goal was to obtain baseline data for this population on which subsequent studies could build. Studies that focus on students generally emphasize the impact of student status on disaster recovery and mitigation rather than on preparedness or perceived risk prior to an event (e.g., Ladd and Gill 2011; Sattler et al. 2002; Van Willigen et al. 2005). In light of the limited research on undergraduate students as a distinct population, and the lack of studies on predisaster conditions, such baseline data are important to understanding this group and its actions. The first research question thus asks to what extent undergraduates are prepared for hurricanes and self-report risk. The second research question focuses on the extent to which the undergraduate population is homogeneous with respect to these issues, or whether the population is composed of distinct subgroups, each of which might have different strengths or weaknesses.

Based on the literature, we propose two hypotheses. First, undergraduate students will present a mix of strengths and weaknesses related to disaster perceptions and preparations as a result of their student status. Second, the homogeneity of undergraduates in disasters has been presented largely as a given in the literature, but no other study has tested this assumption explicitly. We predict that undergraduate students will be homogeneous with respect to disaster preparedness and related issues rather than composed of distinct subgroups.

2. Methods

a. Research methods and data

This study was conducted in two phases—the first phase in June and July 2009, and the second in February 2010—with undergraduate students attending the University of South Florida in Tampa. Graduate students were not considered in this study (even though some students in our sample fall outside the traditional age range for undergraduates) because we believe that undergraduate status specifically masks certain other characteristics, resulting in a buffering effect that reduces vulnerability and enhances resilience. Both phases involved research teams consisting of faculty, graduate, and undergraduate students, utilizing
the same questionnaire, a survey instrument consisting of three parts—questions on hurricane-related perceptions, experiences, and preparedness, as well as some background information—with a total of 39 items. The survey was pilot tested and slightly modified to ensure clarity before implementation. It was primarily composed of yes/no and Likert scale questions to limit the length of the interviews to no more than 10 min and to facilitate statistical analysis. No names or addresses were requested by the researchers. University Institutional Review Board (IRB) approval was obtained for all parts of the research. During both phases, in-person surveys were conducted at different times and at various campus locations with high student traffic (such as the library, student center, and campus common areas) to recruit as diverse a set of participants as possible. In this way, bias toward students enrolled in specific programs or of a particular class rank was minimized.

The final dataset, based on a combination of both phases, consists of 503 completed surveys (see Table 1 for an overview of participant characteristics). The demographic makeup of the research sample compares favorably with that of the overall University of South Florida undergraduate population during summer 2009 and spring 2010 semesters (Fig. 1). The most noticeable biases consisted first of a slight underrepresentation of White students and, conversely, an overrepresentation of Asian and African American students; and, second, a slight underrepresentation of women, yet only by an average of 3% in both phases of the survey.

### Table 1. Survey demographics.

<table>
<thead>
<tr>
<th>Demographic category</th>
<th>Percentage (rounded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>55</td>
</tr>
<tr>
<td>African American</td>
<td>15</td>
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<tr>
<td>Hispanic</td>
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<td>Asian/Pacific Islander</td>
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<tr>
<td>Other</td>
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<td>Native American</td>
<td>1</td>
</tr>
<tr>
<td>Gender</td>
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<tr>
<td>Female</td>
<td>46</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>&lt;19</td>
<td>&lt;1</td>
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<td>19–26</td>
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<td>Second year</td>
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<td>Third year</td>
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<td>29</td>
</tr>
<tr>
<td>Fifth year or higher</td>
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</tr>
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<td>Residence location</td>
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<tr>
<td>Off-campus apartment</td>
<td>34</td>
</tr>
<tr>
<td>On-campus dorm</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
</tbody>
</table>

**b. Survey instrument and data analysis**

Beyond basic demographic data, the core of the survey consisted of seven Likert scalar variables, two percentage variables, 12 dichotomous variables, 12 categorical variables, and a few free-response questions designed to elicit more specific information related to some of the variables. Dichotomous variables were used for grouping (e.g., male/female, whether the student had experienced a hurricane, and whether the student would evacuate if ordered). The scalar variables were reported on a scale of 1–5, ranging from strong disagreement or lack of concern/preparedness to strong agreement or great amount of concern/preparedness. The middle response (3) was essentially a “no opinion” or neutral option.

The first part of our findings on student vulnerability is compiled from descriptive statistics such as frequencies and an analysis of the categorical and free-response questions from the survey. For the second part, we conducted more intensive quantitative analyses. The scalar variables were first tested for normality. These tests showed that individually none of the variables is normally distributed (Shapiro–Wilk test $p < 0.05$ for each variable), whether examined as a single group or divided into groups of interest such as male/female, various ethnicities, or living on/off campus.

The data analysis included three statistical tests. First, in order to compare means between and among groups for a single variable, the Mann–Whitney test was used for two groups, and the Kruskal–Wallis test was used for three or more groups. Second, to establish and test whether subgroups were in fact distinct with respect to survey responses, it was important to evaluate the interaction of all variables simultaneously. This was accomplished through the use of standard, or direct, discriminant
function analysis (Tabachnick and Fidell 2013). Discriminant function analysis provides a means to determine the combination of variables that provides the maximum degree of differentiation and isolation within a given set of groups, and it speaks to whether it is possible to identify defined subgroups within our overall sample.

3. Results: Students’ preparedness and risk

The participants overall exhibited a surprisingly high degree of unpreparedness for hurricanes, as measured by (i) factual misperceptions and knowledge gaps, (ii) lack of preparedness, and (iii) lack of concern (the cavalier attitude).

a. Misperceptions and knowledge gaps

As a group, only 40% of participants knew the hurricane season begins in June, while 44% correctly stated that November marks the end. The fact that fewer than half of the surveyed undergraduate students even knew when to be prepared for hurricanes is disconcerting. More troubling, 34% thought that the season begins later than June, while 52% indicated that the season ends before November, which could indicate added risk for those students. Interestingly, the data also show that students as a whole overestimate the risk of a hurricane making landfall in the Tampa Bay area. While the actual chance of a hurricane hitting the area in any given year is, depending on the source, between 4% and 18% (Florida Hurricane Info 2010; J. Malmstadt 2010, personal communication; United States Landfalling Hurricane Probability Project 2013), the median response from students as a group was 30%, with a range of 0%–100%.

Regardless of whether students stated that they would evacuate to a shelter in the event of a hurricane (yes/no), when asked about the location of the nearest shelter, free-response answers ranged from distances or times (2%), generic locations (13%), or specifically named schools or locations (22%), but the majority did not know or were unsure (54%). Only 2% of respondents correctly identified the nearest general shelter for the campus area (the elementary school on campus), whereas 7% identified the sports arena on campus, which is actually a designated special needs shelter and is not open to the general population (Table 2). Nearly all respondents were unsure where the shelter nearest to the university is located despite clear information made available by the university, even though a designated hurricane shelter is not a very commonly stated evacuation destination among students. Should a hurricane unexpectedly change course or significantly strengthen, for instance, which can happen in a matter of hours, students may have limited time to make evacuation plans and might need to rely on local shelters.

b. Lack of preparedness, despite ample experience

Our sample of students had a fair amount of familiarity with hurricanes, which makes the identified gaps in knowledge somewhat surprising. Most students, about 91%, listed Florida as their home state, which is close to the reported 95% of all University of South Florida (USF) freshmen in 2009 who came from Florida. The mean residence time in Tampa was 51 months, though the median was only 18 months (the mean is strongly influenced by long-term residents who have spent most or all their lives in Tampa). Fully 80% responded that they had experienced a hurricane at least once, though this experience ranged from driving through one to enduring three strong hurricanes at home in a single season. Furthermore, 10% had evacuated on account of a hurricane at least once. Given this ample experience, it would be reasonable to assume this group would be relatively well prepared for possible future storms. Unfortunately, this does not appear to be the case.

A little over one-quarter (28%) of students reported they had made some preparations for a hurricane. When asked to elaborate, however, most only listed having bottled water, canned food, batteries, or even simply owning a raincoat. Because these are fairly common items in many households and dorms, it is possible they were not purchased, or reserved specifically, in preparation for a hurricane. Only around 8% of students had made more viable preparations, such as purchasing a generator, having supplies for reinforcing windows at hand, or gathering important documents in a single location, though some preparations of this magnitude may be less critical (or even impractical or outright impossible) for typical undergraduate living spaces and arrangements. Nevertheless, the percentage of students who had made preparations is very low, given that the official policy in the study area for residents not living
in mobile homes promotes a shelter-in-place model when appropriate, wherein residents are asked to be prepared to remain in their homes for up to 72 hours without expectations of running water, power, or other assistance unless an evacuation is specifically ordered. This policy is intended to reduce congestion on roads as well as limit overcrowding at evacuation shelters. Because official university policy does not permit resident students to remain on campus during a hurricane, and given that about 83% live off campus (48% in apartments and 35% in houses), a larger portion of students should be more self-reliant and proactive in making preparations.

The numbers relating to evacuation are equally disconcerting, with only 29% of students reporting having an evacuation plan. Furthermore, 12% of respondents said they would not evacuate even if ordered. Of those who listed a destination to which they would evacuate, locations were varied: family home (53%), shelter (17%), friend’s home (9%), hotel (6%), and some other location (13%). Students stating they would evacuate to their family home are perhaps less of a concern even if they are unaware of shelter locations or do not have an evacuation plan ready, but, as mentioned, hurricanes can shift paths and increase in strength quickly. Yet, 17% would indeed seek refuge in a shelter, and, as shown above, very few know the correct shelter location. Furthermore, some destinations listed, including friends’ homes, hotels, or other unnamed locations, could be unreliable or even dangerous in a hurricane. These findings are in line with research showing that levels of evacuation readiness among coastal residents in the United States are alarmingly low (Baker 1991; Herman and Datz 2012). As a point of comparison, in a similar study following Hurricane Rita conducted by Beggan (2010), 75% of students stayed with family or friends, 17% stayed at a hotel, and only 4% went to a shelter. Likewise, Gill et al. (2006) found that 71% of students evacuated to their parents’ homes during Hurricane Katrina. Students in our study therefore indicate less reliance on family in case of evacuation than in these studies, making the apparent lack of preparation and planning even more troubling.

c. Lack of concern

Although no single cause can account for students’ knowledge gaps and lack of preparation, as noted above, one contributing factor might be a sense of invincibility and a cavalier attitude. While this assertion is difficult to quantify, the fact that only 8% of students had made any substantial preparations might indicate such an attitude. Furthermore, fewer than one-third have an evacuation plan, and more than 10% would refuse to evacuate even if ordered. Also, the university has a free notification system in place for which students can register that will send a text message in case of a campus emergency, including weather-related events. The results show that most students (94%) are aware of the system, though slightly fewer (82%) actually have registered for it. While the relatively high rate of participation is encouraging, one in five students remains unregistered and could thus miss out on vital information in case of a storm. Signing up for the alert system is offered as part of the mandatory registration system for an e-mail account and access to electronic campus services, though it can be declined. As such, many students likely opted in by default, which might explain the relatively high participation rate rather than reflecting true concern for personal safety.

Regardless of what the root cause is for these findings, the result is a general lack of conscientious preparedness, which translates into elevated risk for undergraduate students. While future research might contribute to an understanding of underlying causes for the discovered lack of preparation and knowledge among students, the remainder of this paper is devoted to assessing homogeneity, or lack thereof, among students as a group. Understanding similarities and differences among students from diverse backgrounds with respect to hurricane preparedness can inform and assist future research concerning the social, cultural, and economic foundations for this variation, as well as inform policy.

4. Results: Structural homogeneity of students

Surveyed students demonstrated a fairly high degree of homogeneity, whether looking at (i) specific questions or (ii) their overall responses. Potentially interesting findings related especially to ethnicity emerged, however, that deserve further investigation.

a. Student homogeneity by question

As noted above, when asked whether there was a chance of a hurricane of any strength hitting the area in a given year, the median response from students as a group was 30%. The median response for males, however, was 25%, while for females it was 40%, which was a significant difference in a Mann–Whitney U test \( p < 0.0005 \). Furthermore, the level of concern among women about a hurricane striking was significantly higher (mean = 2.99) than men (mean = 2.55) (Mann–Whitney U test, \( p < 0.0005 \)). Men rated their preparedness in terms of physical items and having an evacuation plan, and readiness, a more general category that encompasses mental perceptions and knowledge (means = 3.03 and 3.01, respectively), higher than women (means = 2.66 and 2.69, respectively) (Mann–Whitney U test, \( p = 0.001 \) and 0.003, respectively). The results for all other scalar variables were not significantly different. Although these differences are
statistically significant, the means were within about 0.40 (Table 3); such small magnitudes may have little impact on real-world behavior. Nevertheless, it is worth exploring further the differences in male/female student preparation and actual behavior.

Among students of different ethnicities, we found greater variation (Table 4). A Kruskal–Wallis test showed significant differences among Black, Hispanic, and White respondents on four questions: level of concern that a hurricane will hit, preparedness, readiness, and degree of support for a mandatory hurricane workshop (p < 0.0005 for all). Blacks reported lower overall preparedness (mean = 2.29) and readiness (mean = 2.39) than Hispanics (means = 2.71 and 2.70, respectively) or Whites (means = 3.05 and 3.03, respectively). Whites were the least concerned about the possibility of a hurricane strike (mean = 2.57), followed by Blacks (mean = 3.09) and Hispanics (mean = 3.17). Perhaps it is unsurprising, then, that Hispanics were most in favor of a mandatory hurricane workshop (mean = 3.61), followed by Blacks (mean = 3.47) and Whites (mean = 2.82). These differences are greater in magnitude overall than those for gender and warrant closer attention in future studies.

Differences by class rank (i.e., years of study) were not particularly prevalent, with significant variation only on self-reported readiness (Kruskal–Wallis test, p = 0.029) and level of support for a mandatory hurricane workshop (Kruskal–Wallis test, p < 0.0005). Even so, the range of means for readiness across all years was only about 0.40 out of a five-point scale (so less than 10%), which again suggests this variation might not imply major behavioral differences.

b. Student homogeneity by group

While there were significant differences in responses among the student population for individual questions, one fundamental question of this study was to what degree it is possible to identify subgroups within the sample population based on the totality of their responses. To examine this, we used discriminant function analysis. Finding homogeneity, or a lack of distinct subgroups, does not mean that significant differences will not be present for individual questions, or that such differences are unimportant. Rather, it means that as a whole, certain groups are more similar than dissimilar. For this analysis, the seven scalar variables were used in the initial model, and any variables that were not significant to the model were removed, as determined by Wilks’s lambda, after which the process was run again using only the remaining significant variables. In addition, prior probabilities for group membership were computed from actual group sizes since they are unequal, and in some cases, decidedly so, but this is an important step when differential membership is the result of “some real process in the population that should be reflected in classification” (Tabachnick and Fidell 2013, p. 410), as is the case in our sample, which closely represents the actual distribution of enrolled students. Unequal group sizes therefore pose no particular problems for discriminant function analysis (Tabachnick and Fidell 2013, p. 383).

The three types of subgroups considered are gender, ethnicity, and class rank (year in college). We chose the first two types of subgroups because significant social differences based on gender and ethnicity are often found in the general population (Cutter 2006). The third subgroup was selected to allow for an indication of differences across students’ class rank, measured by number of years in college, an indicator that also generally corresponds with age (Table 5).

The first analysis attempted to classify men (n = 232) and women (n = 270) into two groups. For this pairing, only three of the seven variables were significant in the model: level of concern that a hurricane will strike the area (p < 0.0005), self-assessed preparedness (p = 0.001), and self-assessed readiness (p = 0.003). Box’s M test,

<table>
<thead>
<tr>
<th>Question</th>
<th>Ethnicity</th>
<th>Mean (0–5)</th>
<th>Significance (Kruskal–Wallis test p value)</th>
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<tr>
<td>Level of concern?</td>
<td>Black</td>
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<td>&lt;0.0005</td>
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<td></td>
<td>Hispanic</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>2.57</td>
<td></td>
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<tr>
<td>Level of preparedness?</td>
<td>Black</td>
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<td>&lt;0.0005</td>
</tr>
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<td></td>
<td>Hispanic</td>
<td>2.71</td>
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</tr>
<tr>
<td></td>
<td>White</td>
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<td>Level of readiness?</td>
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<td>Hispanic</td>
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<td></td>
<td>White</td>
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<td>Support for mandatory workshop?</td>
<td>Black</td>
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<td>Hispanic</td>
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<tr>
<td></td>
<td>White</td>
<td>2.82</td>
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TABLE 5. Discriminant function analyses summary.

<table>
<thead>
<tr>
<th>Grouping variable</th>
<th>Group (n)</th>
<th>Percentage correctly assigned</th>
<th>Significant model variables (p value)</th>
<th>Box’s M (p value)</th>
<th>Wilks’s lambda (p value)</th>
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<tr>
<td>Gender</td>
<td>Male (232)</td>
<td>59.9</td>
<td>Level of concern (&lt;0.0005); preparedness (0.001); readiness (0.003)</td>
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<td>&lt;0.0005</td>
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<tr>
<td>Ethnicity</td>
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<td>67.3</td>
<td>Level of concern; preparedness; readiness; and mandatory workshop (all &lt;0.0005)</td>
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</tr>
<tr>
<td></td>
<td>White (278)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class rank</td>
<td>1 (59)</td>
<td>33.7</td>
<td>Level of readiness (0.038); mandatory workshop (&lt;0.0005); university provided good information (0.05)</td>
<td>0.851</td>
<td>&lt;0.0005 (first function); 0.016 (second function)</td>
</tr>
<tr>
<td></td>
<td>2 (83)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>3 (148)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>4 (145)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>5 (61)</td>
<td></td>
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</tbody>
</table>

which tests the assumption of homogeneity of the covariance matrices and which, if significant, would violate an assumption of this technique, was not significant (p = 0.925). The single resulting discriminant function is significant (Wilks’s lambda, p < 0.0005). Despite this, the model correctly assigned only 48.1% of males and 70% of females. Overall, only 59.9% of the original cases were classified correctly, which is only marginally more accurate than the 50.3% that would be expected by weighted chance alone. In other words, even based on the three significant factors differentiating men and women in the sample, attempts to identify distinct groups are only weakly successful. Taken as a whole, then, men and women could be considered homogeneous with respect to their combined responses.

The second analysis examined groupings based on ethnicity. Only Black (n = 75), Hispanic (n = 69), and White (n = 278) ethnicities were considered because of the low number of respondents in other categories. The same three variables were significant (p < 0.0005 for all) in this model as in the gender analysis, as well as a fourth variable measuring level of agreement that the university should offer a mandatory hurricane workshop (p < 0.0005). Box’s M test was not significant (p = 0.06). Of the two functions generated by the model, only the first one is significant (Wilks’s lambda, p < 0.0005) and accounts for 92.6% of the variation in ethnicity. The two variables that comprise the single significant function are level of desire for a mandatory hurricane workshop and level of concern that a hurricane will strike. While the model correctly assigned 67.3% of the respondents to their correct self-reported ethnicity, it incorrectly assigned 85.3% of Blacks and 97.5% of Hispanics as White. The overall success rate of classification (67.3%) indicates a moderately successful classificatory model, better than the 49.3% expected by chance, suggesting that differences among ethnicities may be more pronounced than between genders. The higher rate of incorrect assignment of Hispanic students, more so than Black students, to the White group suggests that Hispanics and Whites share more in common overall with respect to the significant variables than either do with Blacks, who overall might be both more concerned about a hurricane and have greater interest in workshops to help prepare. Further research is needed to better distinguish this finding.

The third and final analysis examined groupings based on class rank, using first year (n = 59), second year (n = 83), third year (n = 148), fourth year (n = 145), and other (students with more than four years in school, and returning adult students, n = 61). The three significant variables for this model were self-assessed readiness (p = 0.038), support for a mandatory hurricane workshop (p < 0.0005), and level of agreement that the university provided good information concerning hurricanes (p = 0.05). Box’s M test was once again not significant (p = 0.851), but two of the three functions generated were significant. The first (Wilks’s lambda, p < 0.0005) differentiates students based on their support for a mandatory hurricane workshop and accounts for 66.5% of the variation, while the second (Wilks's lambda, p = 0.016) divides students up based on their belief that the university provided adequate hurricane information and accounts for 23.2% of variation, or cumulatively 89.7%. This model correctly classified 33.7% of original cases, better than the 23.2% that would be expected by chance. Again, this model is weakly predictive but it does suggest that class rank, perhaps as a proxy for age, might contribute to shifting perspectives on readiness and the necessity of hurricane-related information.

5. Discussion and recommendations

Most research that has examined disasters and student populations at universities has focused on which attributes contribute to better mitigation and recovery after an event. This study, however, has provided insight into two other important questions regarding hurricanes: first, how well-prepared and knowledgeable are
undergraduate students living in an area threatened by
hurricanes; and second, is the student population homo-
genous or is it composed of distinct subgroups, each
having unique challenges and strengths when preparing
for hurricanes?

The answer to the first question appears fairly clear:
students are highly vulnerable to hurricanes because
they lack preparation. This vulnerability begins with a
basic lack of knowledge, such as not knowing the correct
duration of the hurricane season or the location of the
nearest hurricane shelter, even among those who plan to
evacuate there. Such knowledge gaps are particularly
surprising given that most students were from Florida,
and four out of five respondents already had experienced
at least one hurricane. Despite their storm experience,
very few students had made even minimal preparations,
whether to shelter in place or to evacuate. We had ex-
pected to find that students would have both strengths
and weaknesses related to preparation, yet our results
clearly show that students are underprepared. While no
single reason can account for these findings, it is pos-
sible that an attitude of “invincibility” could contribute,
meaning a belief that nothing serious will happen, despite
overestimating the actual threat. In addition, it may be
reasonable to assume that students believe that any
necessary information will be made available in the event
of an approaching storm, regardless of the unpredict-
ability of storm track and strength; that is, the Internet,
university officials, parents, the media, or other sources
will provide information with sufficient lead time, making
preparations well ahead of time needless and thus more
costly than what they are considered to be worth. This
belief is dangerous, however, given a hurricane’s poten-
tial to change course and strengthen rapidly. Regardless,
both of these possibilities, as well as others that might
account for a dangerous lack of preparedness, warrant
further research.

The answer to the second question is that in our study
sample, attempts to identify factors that strongly defined
subgroups were only marginally successful. No matter
which subgroups were considered (gender, ethnicity, or
class rank), our analyses produced significant, though
somewhat weak, demarcations between or among groups;
these, ethnicity perhaps deserves the most future at-
tention. For the most part, however, these findings align
with our prediction and demonstrate that undergraduate
student status itself seems to mask certain sociodemo-
graphic attributes that might make a difference when
preparing for hurricanes. Once again, reasons for this near
homogeneity are likely complex, though the suggestions
made above might hold true here as well. Undergraduate
students as a whole face similar levels of vulnerability and
lack of preparedness because they believe that they will
have sufficient time and resources to handle the threat of
a hurricane with fairly short notice. The same attributes
that contribute to successful mitigation might apply here
as well, such as lack of children; relatively few possessions
and financial assistance from parents, loans and grants;
a location outside the immediate area to which they can
evacuate; and so on. Length of affiliation with the uni-
versity, measured by class rank, made only a marginal
difference. This indicates that all students regardless of
age and rank are fairly similar to each other, presumably
based on shared characteristics and experiences. This
finding holds true for gender as well. While other studies
(e.g., Cupples 2007) have shown nuanced and important
ways in which women experience and recover from di-
sasters different from men, student status seems to mask
such differences in terms of preparations and mindset
prior to an event, at least to some extent.

Our research also contributes to understanding the
complexity of vulnerability within special populations.
The results, along with the existing research we have
highlighted, demonstrate that vulnerability is best un-
derstood as a process that unfolds over time rather than
as a set of inherent or invariant characteristics. Among
surveyed students, general vulnerability appears elevated
despite the stated considerable experience with hurri-
canes. As such, different aspects of vulnerability in vari-
ous populations need to be emphasized by institutions
and agencies at different times, and issues of disaster
preparation and concern within and among groups de-
serve further attention, particularly if these differences
heighten risk compared to the general population.

This study does have some analytical limitations. The
sampling strategy was not truly random, whereby, for
example, student names would be randomly selected for
participation out of the entire enrolled population. Such
an approach was impossible in this instance, but even so,
the resulting sample closely tracked that of the student
body. Also, the sample size is large enough that statis-
tically significant variations were detected for certain
questions, for example, that in reality might be too small
to translate into meaningful real-world behavioral dif-
fferences. On a five-point scale, a difference between
means of 3.4 and 3.8 might be statistically significant, for
instance, but the degree to which this manifests in actual
practice is more difficult to establish. In the future, to
address this we would like to design a study and gather
a larger dataset that is amenable to Monte Carlo–type
subset sampling and analyses that will facilitate a better
understanding of the relationship between statistically
significant results and actual decisions, behaviors, and
outcomes.

The lack of preparations and high degree of misinfor-
mation on the part of undergraduate students coupled
with the inability to strongly identify subgroups around these issues are interesting findings. It is clear at this university, and likely at many others, that students are uninformed or unaware of important, basic facts such as the location of the nearest evacuation shelter or how to prepare, despite the ready availability of such information from the university. This highlights the need to assess university policies throughout regions at high risk from hurricanes, including whether or not all schools are adequately informing students about hurricanes. For example, more precise and informative use of e-warning systems on campuses might mitigate some consequences of inadequate preparation.

A second possibility for future research is to include graduate students as a comparative group to undergraduates, and to compare both groups to the broader general population. A third avenue for future research involves determining perceptions related to where responsibility lies for student hurricane preparation. Should schools be responsible for ensuring that students are prepared and informed, or does that burden lie with students themselves? Or is it a shared responsibility? In what ways, if any, should community planning at the city, county, or state level account for students (or other groups)? To what degree should emergency management offices involve universities and their resources in the planning process? And, are there differences in perceptions of responsibility among students, school administrators, community disaster professionals, and even parents? Answering these and other important questions will not only result in a safer and more prepared student population but also reduce overall risk in the many communities along the Gulf and Atlantic coasts.

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