

Older Adults' concerns regarding Hurricane-Induced evacuations during COVID-19: Questionnaire findings

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ABSTRACT

The COVID-19 pandemic has drastically affected our day-to-day life in the last few years. This problem becomes even more challenging when older adults are considered due to their less powerful immune system and vulnerability to infectious diseases, especially in Florida where 4.5 million people aged 65 and over reside. With its long coastline, large and rapidly growing of older adult population, and geographic diversity, Florida is also uniquely vulnerable to hurricanes, which significantly increases the associated risks of COVID-19 even further. This study investigates older adults' evacuation-related concerns during COVID-19 using statistical analysis of a questionnaire conducted among 389 older adult Florida residents. The questionnaire includes questions concerning demographic information and older adults' attitudes toward hurricane-induced evacuations during the COVID-19 pandemic. Ordered Probit regression models were developed to investigate the impacts of demographic parameters on older adults' tendencies toward evacuating as well as their preferences to stay at home or shelter during the pandemic. The model results reveal that male participants felt safer to evacuate compared to females. Also, any decrease in the level of income was associated with an increase in the need for help for evacuation by 18%. Findings indicated that the participants who found the evacuation safe normally also had a positive attitude toward staying in their vehicle, hotel, or even shelters if maintaining social distance was possible. Emergency management policies can utilize these findings to enhance hurricane preparations for dealing with the additional health risks posed by the pandemic for older adults, a situation that could be exacerbated by the upcoming hurricane season in Florida.

Introduction

Natural disasters adversely affect millions of people in the United States (U.S.) and cause billions of dollars of economic losses each year (Mukherjee et al., 2018). The Centre for Research on the Epidemiology of Disasters (CRED) lists the U.S. in the top five countries most affected by natural disasters (CRED, 2018). The National Oceanic and Atmospheric Administration (NOAA) estimates a total cost of \$1.75 trillion for weather and climate disaster damages in the U.S. from 1980 to 2019 (NOAA, 2021; Zhu et al., 2020). In 2018 and 2019, 28 weather and

climate disasters were reported in the U.S. with more than \$1 billion in losses. Among all the recorded disasters in U.S. history, hurricanes with an average of \$21.5 billion per event have caused the most damage and destruction. Also, 6,502 deaths were reported from these events since 1980. Among the U.S. states, Florida, because of its unique geography surrounded by subtropical waters, is one of the southern states particularly vulnerable to hurricanes and ranks second after Texas in total damage costs since 1980 (Eschner, 2019; NOAA, 2021). Based on a report by the Hurricane Research Division of NOAA, 40 % of hurricanes that make landfall on the U.S. East coast hit Florida (Kelleher, 2020;

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NOAA, 2021).

In recent years, Florida was hit by three highly destructive hurricanes: Hermine (2016), Irma (2017), and Michael (2018). These extreme storms caused major infrastructure disruption such as roadway closures and power outages in the entire Florida peninsula (Ghorbanzadeh et al., 2020; Kocatepe et al., 2018; Pinzan et al., 2018). In 2016, 80 % of the electrical systems in the City of Tallahassee, the capital of Florida, were drastically affected by Hermine and thousands of customers were without power and had to evacuate the area (Linask, 2018; Schweers, 2018). Accommodation of evacuees from a hurricane is a major public health and safety concern, and authorities expend significant effort managing their essential needs. The upcoming years will likely lead to greater challenges for authorities because of issues with the COVID-19 pandemic. Previous literature has investigated the impact of the COVID-19 pandemic on transportation systems and demonstrated a noticeable influence on a variety of aspects which include, but are not limited to roadway crash patterns (Adanu et al., 2021), traffic emissions (Karaer et al., 2020), micro mobility ridesharing (Hosseinzadeh and Kluger, 2021), public transportation (Tirachini and Cats, 2020), and liner shipping (Elmi et al., 2022).

The special needs of the people age 65 and older (older adults) have been widely investigated in previous studies (Stergiopoulos and Herrmann, 2003; Vahedi Saheli and Effati, 2019). This age group, as one of the most vulnerable segments of society, has its particular concerns and complexities during the COVID-19 pandemic (Niu et al., 2020). In Florida, between 1950 and 2010, the proportion of older adults rose from 8.6 % to 17.3 %, and this trend continues (Bureau of Economic and Business Research, 2021). Previous studies during the pandemic established the vulnerability of older adults with COVID-19 infection and confirmed their need for special attention (Nair et al., 2021). For instance, Koloushani et al. (2021) investigated the crash pattern during curfews that were imposed during the COVID-19 pandemic in study areas with various demographic characteristics and revealed that the census blocks populated by older adults tended to maintain their normal mobility patterns, even during the pandemic (Koloushani et al., 2021). The same response from older adults has been also confirmed in another research conducted by Botzon et al. (2021) and revealed similar findings, specifically that older adults reported being less likely to evacuate under a voluntary order (Botzen et al., 2021). Pourfalahatoun and Miller in 2022 also conducted a research to assess the impact of the COVID-19 pandemic on shared micro mobility and outlined some demographic factors, including age, that may affect ridership utilization (Pourfalahatoun and Miller, 2022). The COVID-19 pandemic differentially affected older adults. Older adults in the USA constitute 16 % of the population, yet they incurred over 74 % of all COVID-19 deaths (National Center for Health Statistics, 2022). Sands et al. (2022) recently assessed physical health effects of disaster-related peritraumatic stress among older adults and found that those who experienced high levels of peritraumatic stress from Hurricane Sandy were twice as likely to sustain a new lung disease diagnosis, diabetes diagnosis, and arthritis diagnosis in the following four years (Sands et al., 2022).

Several studies have assessed the impacts of severe weather events, specifically hurricanes. For example, Ulak et al. (2018), analyzed the Hermine-induced power outages via spatial and statistical analyses in the City of Tallahassee. Their findings indicated that higher-income families in the city were affected less as compared to families in other income groups (Ulak et al., 2018). Also, the areas with more extensive overhead power lines experienced more power outages. Kocatepe et al. (2019) developed a convolutional neural network (CNN) model to predict the probability of future hurricane-related roadway closures using wind speeds in Tallahassee (Kocatepe et al., 2019). Recently, Ghorbanzadeh et al. (2020) applied spatial and statistical approaches to assess the impacts of Hermine (2016) and Michael (2018) in the City of Tallahassee on power outages and roadway closures (Ghorbanzadeh et al., 2020). The results of this study revealed the same patterns for power outages in both hurricanes, showing that the center of

Tallahassee was affected to a greater degree as compared to the other areas (Ghorbanzadeh et al., 2020). Another study conducted by Ghorbanzadeh et al. (2021) assessed the transportation network vulnerability and indicated the significant correlation between roadway closure and power lines in Tallahassee during Hurricane Hermine in Florida but its impacts on older adults during an evacuation remain unexplored (Ghorbanzadeh et al., 2021). Thus, this research aims to better understand the concerns and issues among older adults who may need to evacuate during a hurricane. The result of the current study should provide information that could help understand the difficulties for older adults that could arise during a natural-disaster evacuation event and improve evacuation preparedness for older adults.

In this study, a questionnaire was developed and distributed to a sample of community-dwelling older adults from a database of volunteers who had registered to support aging studies at Florida State University. This approach has been widely used in previous studies (Nwachukwu et al., 2020; Suryavanshi et al., 2020). Zhao et al. (2020) recently analyzed questionnaire data to investigate the anxiety level of participants who were quarantined for probable COVID-19 infection and identified factors predictive of anxiety (Zhao et al., 2020). Xiang et al. (2019) also conducted research to evaluate the effectiveness of community-based care facilities in China based on data collected by questionnaires distributed among older adults and prioritized the key items that can be supposedly provided by embedded retirement facilities (ERFs) (Xiang et al., 2019). The current research utilizes older adults' responses to the questionnaire to identify their main concerns related to evacuating from areas that were affected by hurricanes during the COVID-19 pandemic.

Despite the distinct concerns expressed by older adults about hurricane-induced evacuations during the COVID-19 pandemic, few studies have investigated the impact on older adults' preferences for staying at home or evacuating from areas affected during the hurricane season in the presence of the pandemic. For instance, Botzon et al. (2021) recently conducted a study to assess individual risk perceptions and hurricane preparedness based on households' responses to an online questionnaire. Specifically, the study was based on a survey of 600 respondents of coastal residents of various age ranges in Florida (i.e., the average age was 34 years) and concluded that the concern about COVID-19 significantly diminished the likelihood of older adults evacuating and is part of the most significant contributory factors (Botzen et al., 2021). Accordingly, the current study focused on older adults and their thoughts and concerns about natural-disaster-related evacuations during a pandemic. It provides a deeper understanding of the behavioral characteristics of aging populations who would be subjected to inevitable challenges as a result of the COVID-19 pandemic if they wanted to evacuate at the time of a hurricane and assesses their particular concerns (e.g., maintaining social distance). Thus, we examined whether preferences/concerns of older adults are associated with sociodemographic parameters. Findings of this study could be critical in aiding emergency officials and planners in developing more efficient emergency plans and strategies ahead of future potential hurricanes with a particular focus on older adults.

Methodology

Survey design and sample data

In an attempt to identify older adults' concerns at the time of evacuation during the COVID-19 pandemic, a total of 405 individuals accepted an invitation to participate in a study by completing a questionnaire. They Questionnaire respondents were drawn from a database of people who are affiliated with the Institute for Successful Longevity (ISL) Institute for Successful Longevity (ISL), 2020), had agreed to be contacted regarding participation in research projects, and were older adults. Members of the database were recruited through mailings, advertisements, and social media about participating in aging-related

research under the initiative of the ISL. Interested people provided basic demographic information, and contact information. Members were instructed they would be contacted by researchers about volunteering for a variety of studies from surveys to longitudinal studies that might last as long as a year (Carr et al., 2022). Potential respondents were contacted via e-mail and invited to participate in a short survey administered using Qualtrics, an online questionnaire tool.

A targeted questionnaire was developed for this project with an emphasis on assessing evacuation attitudes and their predictors. The questionnaire included two sets of questions, one concerning demographics and the other related to older adults' attitudes toward hurricane-induced evacuations during the COVID-19 pandemic. The phrasing of demographic questions was chosen to be compatible with national surveys conducted in the USA (e.g., categories for education, income, and residence). The demographic section included questions about age, gender, marital status, the highest level of education, income range, race, and pet ownership. According to the 2021–2022 American Pet Products Association (APPA) National Pet Owners Survey, 56 % of Florida households own a pet, which equates to 4,628,000 homes (American Pet Products Association, 2022). There was also a section that asked about their attitudes toward staying at home, in a shelter, or a hotel; concerns about social distancing; the need for help for evacuation; and feelings about comfortable evacuation (See Table 1). In addition to the aforementioned information, some additional demographics in a county level have been provided in Table 1 to describe the characteristics of the study area. The questionnaire also included two separate questions that asked about participants' preferred mode of transportation prior to the COVID-19 pandemic and during the past month. It was determined that 379 (out of 389) participants preferred to drive on their own to their destinations prior to the pandemic, and 360 (out of 389) of them expressed the same preference within the past month of the survey. In addition, considering the demographics provided in Table 1, the volunteers are relatively wealthy and hence biased in the direction of vehicle ownership. We therefore assume that evacuees will probably prefer driving in the event of hurricane-induced evacuations in the future regardless of the COVID-19 pandemic situation. Among these 405 respondents, 389 were located in a three-county area of Florida (Wakulla, Leon, and Gadsden counties). All others were removed from analyses. The questionnaire interface was designed to be user-friendly to enable the majority of older adults to participate on the device of their choice (i.e., personal computer, tablet, or smartphone). Despite this, some applicants who participated in the study did not fully complete the questionnaire; however, the completion rate was high (92.7 %).

Utilizing the questionnaire data, this paper adopted the following statistical approach to assess how COVID-19 would impact older adults' decisions on their behavior at the time of evacuation. Among the variables extracted from the questionnaire, the participant's annual income was one of the contributing factors that had a significant correlation with older adults' decisions for evacuation. Table 1 illustrates the frequency of each income range and the associated percentage. Note that some other factors, for instance, race and living in coastal cities, were not added to the regression model due to the lack of variation among the participants. That is, 361 out of 389 participants were White, and a negligible percentage of participants (8 %) lived in coastal cities. Moreover, coastal city residence was not significantly correlated with the remaining dependent variables (See Fig. 1).

Statistical analysis

As part of this study, we had to determine the most relevant variables from a large list of possible variables. Moreover, the precise identification of some non-linear relationships required accurate and robust statistical analysis. Initially, there were 25 variables extracted from the questionnaire to investigate. In terms of their theoretical or potential importance, these variables were divided into 13 significant and 14 nonsignificant variables based on the Pearson correlation coefficients

Table 1
Counties and participants demographics.

Annual income	Frequency	Percent		
\$10,000 - \$19,999	20	5.2 %		
\$20,000 - \$39,999	29	7.4 %		
\$40,000 - \$59,999	65	16.8 %		
\$60,000 - \$79,999	70	18.0 %		
\$80,000 - \$99,999	60	15.3 %		
\$100,000 or more	105	26.9 %		
Preferred not to answer	40	10.4 %		
Median household income (2020 Dollars)*	Gadsden	Wakulla	Leon	
	\$41,135	\$67,480	\$54,675	
Participant Gender	Frequency	Percent		
Female	261	67.1 %		
Male	128	32.9 %		
Number of females (Percent of the total population)*	Gadsden	Wakulla	Leon	
	52.5 %	45.9 %	52.7 %	
Marital Status	Frequency	Percent		
Married or living as married	245	63.0 %		
Separated/Divorced/Widowed	144	37.0 %		
Number of husband-wife family (Percent of the total households)*	Gadsden	Wakulla	Leon	
	42.0 %	53.2 %	36.7 %	
Living Alone	Frequency	Percent		
Yes	218	56.0 %		
No	171	44.0 %		
Householders (+65) living alone (Percent of the total households)*	Gadsden	Wakulla	Leon	
	25.5 %	22.3 %	30.1 %	
College Degree	Frequency	Percent		
Some college degree	368	94.6 %		
No college degree	21	5.4 %		
Bachelor's Degree or Higher (Percent of persons + 25)*	Gadsden	Wakulla	Leon	
	20.1 %	25.4 %	38.9 %	
Race	Frequency	Percent		
White	359	92.3 %		
Others	30	7.7 %		
White Person (Percent of the total population)*	Gadsden	Wakulla	Leon	
	41.5 %	82.2 %	61.7 %	
Chronic Disease	Frequency	Percent		
Yes	208	53.5 %		
No	181	46.5 %		
Death caused by chronic disease (Percent of the total death)**	Gadsden	Wakulla	Leon	
	32.7 %	34.9 %	31.3 %	
Pet Ownership	Frequency	Percent		
Yes	237	60.9 %		
No	152	39.1 %		

* Source: U.S. Census Bureau, American Community Survey (ACS) (United States Census Bureau, 2020). ** Source: Florida Department of Health - Bureau of Community Health Assessment (Florida Department of Health, 2020).

and Boruta variable selection method. A literature review in this study indicates that the Boruta method has been accepted as one of the most effective methods for automatically identifying and discarding unwanted features (noise) (Bhalaji et al., 2018; Degenhardt et al., 2019; Kursu et al., 2010). Boruta method, in contrast to traditional variable selection methods that consist of fitting a model on predictors and response variables, does not require any input from the user as a threshold. Boruta method, instead, is designed to wrap around the random forest model using the randomized version of the predictors and the response variable to account for multi-variable relationships. Thus, it provides us with a more reliable and unbiased list of effective features that bear more predictive value on the response variable (Kursu et al., 2010). Genenhardt et al. compared the performance of several variable selection methods, including the Boruta algorithm, the Vita method, recurrent relative variable importance, and recursive feature elimination (RFE). This study validates the Boruta method for efficient implementation (Degenhardt et al., 2019). Furthermore, Bhalaji et al. investigated the Boruta method from an accuracy and precision

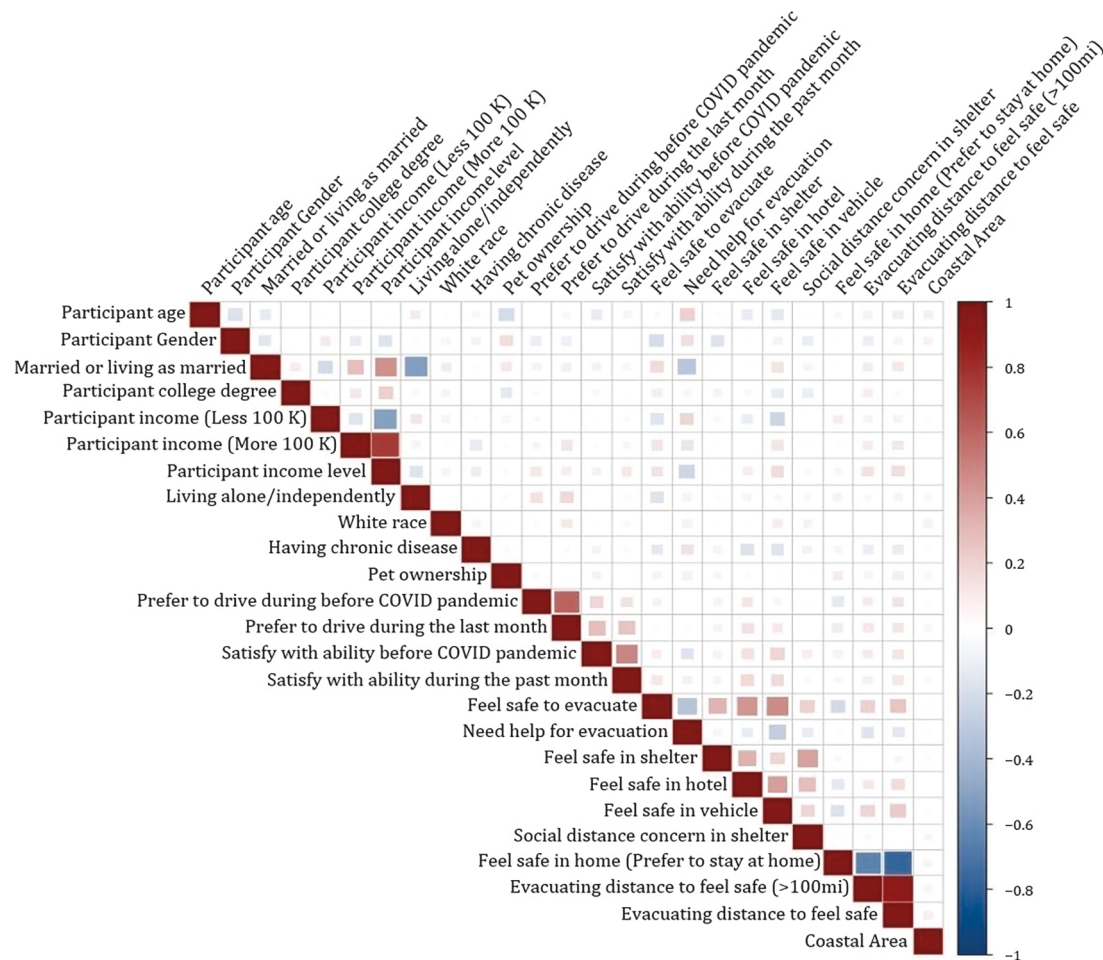


Fig. 1. Correlation matrix of contributing variables.

perspective and found that it outperformed Chi-Square feature selection (Bhalaji et al., 2018). Due to the above-mentioned advantages, Boruta has been utilized as a means of identifying reliable independent variables. The nonsignificant variables were dropped from further consideration. Next, each of the 13 significant variables was inspected to see if they contributed to possible major underlying patterns in the data. In the first step of the statistical analysis, Boruta variable selection method was conducted to rank the variables based on their importance. Pearson correlation coefficients between important factors were also obtained to avoid collinearity by removing the correlated independent variables (See Fig. 1). Next, a set of four separate ordered Probit regression models were developed to identify how different factors impacted older adults' decisions at the time of a hurricane.

It is also worth mentioning that the questionnaire contained some questions that asked about older adults' attitudes towards contributing factors to their decisions, including staying at a shelter, comfort with evacuation, and maintaining social distance. The options for these types of questions were defined based on the Likert scale that measured agreement or disagreement using a symmetric or balanced scale. Following the Boruta variable selection and Pearson correlation analysis, a set of ordered Probit regression models was proposed in this paper to investigate the association between explanatory variables including sociodemographic variables, and older adults' attitudes toward decisions to evacuate during the COVID-19 pandemic. As the responses (i.e., Evacuating safely, Needing help with evacuation, Feeling safe in a vehicle, and Feeling safe in a shelter) to these regression models are ordinal categorical variables, we constructed four ordered Probit models. All dependent variables are categorized according to a five-

point Likert scale, namely; 1: Strongly Disagree, 2: Somewhat Disagree, 3: Neither Agree nor Disagree, 4: Somewhat Agree and 5: Strongly Agree. The list of considered variables and their descriptions are given in Table 2. Note that the above-mentioned ordered Probit models are distinct from each other with respect to their corresponding dependent and independent variables. Meaning that a dependent variable in a model may be utilized in another model as an independent variable. For instance, MODEL 1 considered the variable entitled "Feel Safe to Evacuate", as the dependent (response) variable, while the other three models (i.e., MODEL 2, MODEL 3, and MODEL 4) considered it as an independent (predictor) variable. Table 3 summarizes the obtained results of the statistics-based analysis.

Results and discussions

Questionnaire findings indicate that the average participant age was 71 years old, with a mode of 73 years old. More than 50 % of participants had existing health conditions such as heart disease, high blood pressure, diabetes, chronic lung disease (including asthma), obesity, kidney disease, liver disease, or compromised immune systems. The majority of participants (63 %) were married or living with a partner. 39 % of participants have received a Master's degree or other post-graduate training. Similarly, 30.3 % of participants had an average annual income of \$100,000 or more. A total of 66 % of the participants lived independently whereas 44 % lived with others. A majority of participants lived in either a house, apartment, or condominium. 61 % of participants (237 out of 389) were pet owners and based on a descriptive section in the questionnaire, 220 of them (93 %) were concerned about

Table 2
Definitions of significant predictor variables.

Predictor variable	Description
Gender	Participant gender: Female: 1; Male: 0
Age	Participant age
Alone	Living alone/independently: Yes: 1; No: 0
Married	Married or living as married: 1; Never married OR Separated OR Divorced OR Widowed: 0
Income Level	Total combined household income in the last 12 months: Less 20 K: 1; 20 K–40 K: 2; 40–60: 3; 60–80: 4; 80–100: 5; More 100 K: 6
Income Less 20 K	Total combined household income in the last 12 months less than 20 K (Yes: 1; No: 0)
Feel Safe to Evacuate	Feel safe/confident to evacuate this hurricane season: Strongly agree: 5; (Somewhat) Agree: 4; Neutral OR Don't know OR Refuse: 3; (Somewhat) Disagree: 2; Strongly disagree: 1
Need Help for Evacuation	Need help for evacuation: Strongly agree: 5; (Somewhat) Agree: 4; Neutral OR Don't know OR Refuse: 3; (Somewhat) Disagree: 2; Strongly disagree: 1
Social Distancing In Shelter	Feel safe when you cannot maintain social distancing at a shelter and/or during evacuation: Strongly agree: 5; (Somewhat) Agree: 4; Neutral OR Don't know OR Refuse: 3; (Somewhat) Disagree: 2; Strongly disagree: 1
Feel Safe In Shelter	Feel safe to stay at a shelter during hurricane = Strongly agree: 5; (Somewhat) Agree: 4; Neutral OR Don't know OR Refuse: 3; (Somewhat) Disagree: 2; Strongly disagree: 1
Feel Safe In Hotel	Feel safe to stay at hotel = Strongly agree: 5; (Somewhat) Agree: 4; Neutral OR Don't know OR Refuse: 3; (Somewhat) Disagree: 2; Strongly disagree: 1
Feel Safe In Vehicle	Feel safe to stay in vehicle = Strongly agree: 5; (Somewhat) Agree: 4; Neutral OR Don't know OR Refuse: 3; (Somewhat) Disagree: 2; Strongly disagree: 1
Distance to Feel Safe	The greatest travel distance that he/she would feel safe/comfortable evacuating from my home in mile = Stay at home: 0; 0 to 100 mile: 1; 100 to 200 mile: 2; More than 200 miles: 3

their pets during the evacuation, regardless of staying in their own car or finding a hotel or a shelter. It is worth mentioning that the factor concerning pet ownership was highly correlated with age. Thus, we dropped the pet ownership factor from the list of significant independent variables to develop a more accurate regression model and avoid multicollinearity. Other common responses included: feeling lonely and isolated, not being able to see friends and family, canceled vacations, no impact, less dining out, wearing a mask, and loss of recreational activities.

To identify the contributing factors extracted from the questionnaire, a correlation analysis was conducted. The highest correlation was observed between “marital status”, and “need for help for evacuation” variables (−0.33). This negative correlation indicates that older adults who were married and living with their spouses needed less help for evacuation. Also, “income level” was significantly negatively correlated with the “need for help for evacuation” (−0.24). This indicates that lower-income older adults needed more help in case they decided to evacuate from the hurricane-affected areas in the presence of the COVID-19 pandemic. Furthermore, the significant negative correlation (shown in dark blue in Fig. 1) between the “Safety Distance” variable and the “Feel Safe in Home” variable reveals that older adults would probably prefer to stay home during hurricanes if they had to travel a considerable distance to reach a nearby safe location. As such, risk management authorities may need to provide better shelter management for older adults and make them aware of all available facilities in their vicinity.”

All the aforementioned conclusions obtained by the Pearson correlation analysis require more robust statistical supports. Thus, following the correlation analysis, ordered Probit regression models were developed using various independent variables to identify contributing factors on older adults' decisions. The results of the proposed statistical models are presented in Table 3. In this table, “ β ” values show the negative and positive impacts of the predictor variables on the response variable. “SE” stands for standard error and calculates the precision of

the model by estimating the standard deviation of the coefficients. Furthermore, “*p-value*” represents the level of significance of each variable regarding the response variable. Adding nonsignificant predictor variables may cause collinearity problems and result in biased estimated coefficients. Thus, in this paper, we removed nonsignificant independent variables to avoid biased results based on the *p-values*.

Based on the findings obtained by MODEL 1, female participants felt less safe to evacuate than male participants. Also, independently living participants had similar feelings toward evacuation compared to the participants who lived with others. The negative coefficient associated with a need for help (−0.409) at the time of evacuation indicated that a participant with a need for help at the time of evacuation did not have a positive attitude toward evacuation because he or she thought it was unsafe. The positive coefficients for the remaining factors revealed that if older adults could consider the hotel, shelter, or vehicle safe to stay in, they would prefer to evacuate even during the COVID-19 pandemic.

MODEL 2, on the other hand, considered older adults' need for help as the dependent variable and confirmed that older age, never married or separated, and low-income participants needed more help for evacuation, at least during the COVID-19 pandemic. An important result shown by MODEL 3 is that low-income participants and those who needed more help for evacuation did not feel safe to stay in their own vehicle in case they decided to evacuate from the affected areas (associated negative coefficients).

MODEL 4 confirmed the results illustrated in Fig. 1 regarding the positive correlation between the perceived importance of social distancing and willingness to stay in a shelter during a hurricane. This indicates that participants who did not care about social distancing would find shelters safe enough to stay even during the COVID-19 pandemic. Table 4 indicates social distancing was among the major concerns and a significant percentage of participants would not feel safe if they could not maintain social distancing at a shelter and/or during evacuation.

Conclusions and future work

Due to the vulnerability of the older adults to COVID-19 infection, we need to have plans and actions aimed at improving the quality of evacuations and critical facilities such as shelters better tuned to the needs of older people at the time of a hurricane or other disaster event. Toward this goal, this paper assessed the influence of selected socio-demographic factors that may impact older adults' decisions at the time of hurricane-induced evacuation during the COVID-19 pandemic using statistical analysis of a questionnaire. Ordered Probit regression models were developed to identify factors predictive of older adults' concerns about evacuation. The information obtained by the statistical models indicated that level of income and marital status had significant effects on the perceived need for help and willingness to evacuate from affected areas. Also, staying in a shelter would be acceptable for older adults if maintaining social distance was possible. Furthermore, males appeared more willing to evacuate compared to females.

The obtained results are practical in terms of a) learning the expectations of older adults, b) summarizing the reasons behind their avoidance of evacuation during a pandemic, and c) identifying important issues that should be considered for future hurricane seasons to provide more effective emergency services for this segment of the population due to their particular concerns caused by the COVID-19 pandemic. Risk communication and emergency management policies can thus utilize these findings to improve hurricane preparedness when dealing with additional health risks threatening older adults during the pandemic, a situation that could be exacerbated by the future hurricane seasons in Florida. For instance, the obtained results enable the authorities to identify the optimal locations for temporary debris management based upon the preferences of older adults at the time of hurricane-induced evacuation in order to minimize the health risks that may occur (Nickdoost and Choi, 2023). Following are some other practical

Table 3
Ordinal Probit regression model results for categorical dependent variables.

Regressors	MODEL 1 Feel safe to evacuate				MODEL 2 Need help for evacuation			
	β	SE	p	95 %	β	SE	p	95 %
Intercept								
Somewhat disagree	0.033	0.539	0.951	×	−1.311	1.467	0.372	×
Neither agree nor disagree	−0.901	0.534	0.092	×	−2.353	1.473	0.110	×
Somewhat agree	−1.729	0.536	0.001	✓	−3.183	1.483	0.032	✓
Strongly agree	−3.263	0.553	≈ 0	✓	−4.863	1.523	0.001	✓
Gender	−0.435	0.234	0.063	×				
Age					0.062	0.019	≈ 0	✓
Alone	−0.435	0.214	0.042	✓				
Married					−0.804	0.258	≈ 0	✓
Income Level					−0.182	0.083	0.028	✓
Income Less 20 K								
Feel Safe to Evacuate					−0.399	0.100	≈ 0	✓
Need Help for Evacuation	−0.409	0.096	≈ 0	✓				
Social Distance In Shelter								
Feel Safe In Shelter	0.529	0.122	≈ 0	✓				
Feel Safe In Hotel	0.409	0.095	≈ 0	✓				
Feel Safe In Vehicle	0.419	0.096	≈ 0	✓	−0.245	0.108	0.023	✓
Distance to Feel Safe	0.303	0.094	≈ 0	✓				
N: 389; df: 7; $p \approx 0$ Likelihood Ratio = 169.12 Adjusted R-squared = 0.38					N: 349; df: 5; $p \approx 0$ Likelihood Ratio = 84.06 Adjusted R-squared = 0.24			
Regressors	MODEL 3 Feel safe in vehicle				MODEL 4 Feel safe in shelter			
	β	SE	p	95%	β	SE	p	95%
Intercept								
Somewhat disagree	0.560	0.476	0.239	×	−3.654	0.547	≈ 0	✓
Neither agree nor disagree	−0.759	0.458	0.097	×	−4.754	0.570	≈ 0	✓
Somewhat agree	−1.631	0.461	0.004	✓	−6.353	0.607	≈ 0	✓
Strongly agree	−3.545	0.488	≈ 0	✓	−7.530	0.656	≈ 0	✓
Gender					−0.472	0.216	0.028	✓
Age								
Alone								
Married								
Income Level								
Income Less 20K	−0.942	0.432	0.029	✓				
Feel Safe to Evacuate	0.336	0.091	≈ 0	✓	0.431	0.114	0.002	✓
Need Help for Evacuation	−0.312	0.094	0.001	✓				
Social Distance In Shelter					0.456	0.084	≈ 0	✓
Feel Safe In Shelter								
Feel Safe In Hotel	0.533	0.087	≈ 0	✓	0.374	0.095	≈ 0	✓
Feel Safe In Vehicle								
Distance to Feel Safe	0.099	0.088	0.261	×				
N: 389; df: 5; $p \approx 0$ Likelihood Ratio = 129.00 Adjusted R-squared = 0.30					N: 389; df: 384; $p \approx 0$ Likelihood Ratio = 116.93 Adjusted R-squared = 0.28			

Table 4
Participant comfort if social distancing is not maintained.

I would feel safe if I could not maintain social distancing at a shelter and/or during evacuation.	Frequency	Percent
Strongly agree	23	5.9 %
Somewhat agree	33	8.5 %
Neither agree nor disagree	17	4.4 %
Somewhat disagree	62	15.9 %
Strongly disagree	253	65.1 %
I don't know	1	0.3 %

recommendations for promoting evacuation during the COVID-19 pandemic: a) Highlighting women evacuating (rather than men) in brochures for evacuation planning, given the differential reluctance of women, b) Providing volunteers to those who need help evacuating (e. g., dispatch buses with helpers on board), c) Highlighting that stocking supplies of free N95 and KN95 masks would be provided given concerns about social distancing, and trying to expand sleeping space to provide greater social distance., and d) Providing ride services targeting low-income aging adults (e.g., prioritizing buses for low-income areas and making sure that they stock free masks). In addition, this obtained

information and knowledge will serve as a basis for a comparative evaluation of older adults' behavior during and after a hurricane-induced evacuation.

A potential limitation of this study is the use of a non-representative sample (more highly educated, higher income than the general population), and the relatively small number of participants for the questionnaires as well as their demographic diversity compared to national questionnaires; however, we believe we have identified several significant issues even with the current study. In spite of the fact that our sample is composed of a community sample that is not fully representative of the entire population, the bias implies that evacuation reluctance will be underestimated as a result. Another concern is that attitudes were assessed at a time when masks were in short supply and not of high enough quality to assure protection in crowded indoor environments. Also, these data were collected prior to the push for vaccination among older adults (or provision of booster shots), which may have impacted their answers to the questionnaire. Future work should focus on obtaining a representative sample to validate the findings of the current study. We hope that the results of this study will help emergency agencies in attaining a better understanding of older adults' perceptions in the event of a hurricane during the COVID-19 pandemic. The approach used in this paper can also be extended to other states.

This paper does not address a discussion of the studied variables on the efficiency of the aging-focused emergency evacuation and sheltering operations, which should be a target for future work.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author Contributions

The authors confirm contribution to the paper as follows: study conception and design: M. Koloushani, M. Ghorbanzadeh, N. Gray, E. E. Ozguven, N. Charness, A. Yazici, W. Boot, D. Eby, and L. Molnar; analysis and interpretation of results: M. Koloushani, M. Ghorbanzadeh, N. Gray, E. E. Ozguven, N. Charness, A. Yazici; manuscript preparation: M. Koloushani, M. Ghorbanzadeh, N. Gray, E. E. Ozguven, N. Charness, and A. Yazici. W. Boot, D. Eby, and L. Molnar. All authors reviewed the results and approved the final version of the manuscript.

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