

Original Research

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Keywords:

disability; protective action; social vulnerability; tornado

Abbreviations:

CDC, Centers for Disease Control and Prevention; CFA, confirmatory factor analysis; CFI, comparative fit index; PADM, Protective Action Decision Model; PMT, protection motivation theory; RMSEA, root mean square error of approximation; SEM, structural equation modeling; SRMR, standardized root mean square residual; TLI, Tucker-Lewis Index

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Examining Factors Influencing Protective Actions Among Persons with Disabilities During the December 10–11, 2021, Tornado Outbreak in the United States

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Abstract

Objective: This study examined various factors influencing protective actions among persons with disabilities exposed to the December 10–11, 2021, tornado outbreak in the US Midwest and Southeastern regions.

Methods: Survey administration occurred 5 months following the tornado outbreak and included a total of 209 persons with disabilities who lived in one of the counties impacted by tornado warnings. Structural equation modeling was used to examine the direct and indirect effects of hypothesized predictors impacting protective behavioral actions.

Results: Results found that persons with disabilities who had access to more tornado warning sources increased their protective actions, and tornado risk perception further mediated the relationship between warning information sources and protective actions. In addition, results found that persons with disabilities who encountered more situational barriers in their physical and social environment were found to have a decrease in protective action, and having more situational resources was found to contribute to the ability to take protective action.

Conclusions: The current study's results highlight the need for policies and practices that provide additional physical and social resources for persons with disabilities to seek protection during tornado threats.

In the overnight hours of December 10–11, 2021, a deadly tornado outbreak produced catastrophic damage and 90 fatalities across portions of the central and southern United States.¹ While severe tornado outbreaks can broadly affect an entire community, natural hazards do not impact all individuals equally. Historically, persons with disabilities have been disproportionately affected by natural hazards, including tornadoes, as persons with disabilities have various functional needs that can limit their ability to seek protective action. For example, during a tornado warning, the publicly recommended protective action is to shelter in an underground area, such as a basement or storm cellar. However, getting to an underground area most likely involves using stairs, which presents a significant barrier to seeking protection for individuals with mobility issues or ambulatory disabilities.² Furthermore, people with disabilities disproportionately experience poverty and a lack of social support, which limit their access to life-saving resources during a disaster.³ As a result, individuals with disabilities are more likely to die in disasters, be separated from family members, and suffer injuries or health-related complications.⁴ Taken together, these factors may disproportionately place this population at increased risk for life-threatening situations during tornado hazards.

According to the Centers for Disease Control and Prevention (CDC),⁵ disability is defined as a state where a person experiences challenges in performing certain activities due to physical or mental impairments that impact the individual's ability to engage and interact with their environment, resulting in restrictions in daily life. One in 4 American adults, or 61 million people, live with a disability that impacts major life activities, including hearing, vision, cognition, mobility, self-care, and independent living.⁶ While prior research has examined the evacuation process of individuals with disabilities during hurricanes,³ very little empirical research has focused on persons with disabilities facing tornado hazards.² The current study examined factors hypothesized to influence protective actions among a sample of participants with disabilities who experienced tornado threats on December 10–11, 2021. This understanding can provide important insight into tornado warning reception and response recommendations that can more effectively target this growing population group and develop equitable resilience-building strategies for life-saving actions during future tornado threats.

Background Literature

Across many prior studies, research indicates that the protective actions people make during hazard situations (eg, tornado, flood, hurricane) are impacted by a variety of factors, including cognitive and psychological factors that influence decisions, the availability and effectiveness of resources available, and the role of risk communication sources.⁷⁻⁹ The protection motivation theory (PMT)¹⁰ and the Protective Action Decision Model (PADM)⁸ are theoretical models that aim to predict protective behaviors at the individual level. These models propose that when individuals become aware of a potential hazard, it triggers an evaluation of risk perception, which then influences their behavioral response. For instance, the PADM, by Lindell and Perry (2012),⁸ is a framework that presents the hazard protective decision-making process as a multi-stage model that involves a sequence of responses, including paying attention to warnings and environmental cues, perceiving personal threat and coping capabilities, and ultimately engaging in behaviors and actions such as gathering information and taking protective actions like seeking shelter or evacuating. First and foremost, effective reception of warning messages or hazard cues is critical. This includes ensuring that warnings are clear and concise, using multiple methods to disseminate the warning (such as television, radio, and social media), and providing specific instructions for how to take protective action.¹¹⁻¹³ Prior research has found that receiving credible, accurate information from multiple sources or channels is a significant motivator for taking a behavioral protective response.^{8,14} Furthermore, different warning information sources can extend the reach and accessibility. Research has shown that relying on a single warning source can lead to delays in receiving timely and accurate information, and therefore “multi-channel” avenues for receiving emergency messaging are recommended.^{15,16}

Other factors that can influence protective action can include the perceived severity of the hazard and likelihood of the hazard occurring.^{17,18} Tornado risk perception refers to an individual's subjective interpretation of the likelihood of a tornado occurring and the potential personalized consequences of a tornado hazard. For example, individuals are more likely to take action in response to a tornado warning if they believe that the tornado hazard is a severe threat likely to occur and potentially inflict harm to the individual or loved ones.^{8,14,19} Furthermore, hazard risk perception can also be seen as a mediating factor, influencing or contributing further to the relationship between hazard warning information and hazard protective action.²⁰ In the context of tornado hazards, for instance, First et al.²¹ found that risk perception further mediated the relationship between tornado hazard warning information and protective action in a sample of adults exposed to tornado and flash flood hazards in the Southeast United States.²¹ However, these relationships between warning sources, risk perception, and protective action have not yet been examined in the context of persons with disabilities facing tornado threats.

Lindell and Perry's (2012)⁸ PADM is a useful conceptual framework for analyzing persons with disabilities protective decision-making process during a potential tornado hazard.⁸ While the PADM has been widely used and validated through various research methods, most hazard studies have used single equation models that are not able to analyze the multivariate relationships between information sources, risk perception, and hazard adjustment.²² Structural equation modeling (SEM) is a statistical technique used to analyze multivariate relationships among variables, including latent variables and their indicators.

It is particularly useful in examining theoretical models and assessing the goodness of fit between the model and the observed data.²³ The primary objective of the current study is to investigate and understand the decision-making process of individuals with disabilities when it comes to protective actions during tornado events using SEM analysis. In this present study, the focus is not to replicate every element of the PADM through empirical means, as such a comprehensive endeavor is better suited for future research projects. However, there is a significant gap in the understanding of protective action perceptions, particularly in the context of tornadoes in the United States, and specifically for individuals with disabilities. Consistent with applications of the PADM, the following hypotheses were formulated related to information resources, risk perception, and protective behaviors:

H1: For persons with disabilities during the December 10-11, 2021, tornado outbreak, more tornado information sources will be associated with (a) tornado risk perception and (b) protective behavioral actions.

H2: More tornado risk perception (a) will be associated with protective behavioral actions, and (b) will mediate the relationship between tornado information sources and protective behavioral actions.

Furthermore, according to the PADM, situational barriers and resources play a significant role in shaping the decision-making process.⁸ Previous disability and disaster studies have found that persons with disabilities are less likely to receive timely warnings before a disaster event and often find shelter options challenging to access or even inaccessible due to barriers within the environment.²⁴ For example, among persons with disabilities who experience blindness or limited vision, lack of access to visual information (eg, geographic maps of areas of impact) related to hazards creates a barrier that impacts the receiving emergency information.²⁵ Likewise, deaf or hearing impaired individuals may experience a delay in receiving tornado warning information (eg, reading and processing text information).¹⁹ In addition, individuals with cognitive disabilities may not understand technical warning information or experience anxiety or confusion in response to emergency alerts.²⁶ Beyond encountering situational barriers to receiving warnings, persons with disabilities may also encounter barriers in taking behavioral actions during rapid-onset hazards like tornadoes. For example, building designs that require descending stairs to seek protective shelter have been found to impact individuals with mobility issues.²⁷ In addition, many persons with disabilities may have reductions in their ability to drive and transport themselves to a safe location.² This is particularly concerning for persons with disabilities who live in mobile homes²⁸ and may need to evacuate their homes for safe shelter.²⁹ Thus, a significant factor in behavioral response for persons with disabilities during tornado threats may be related to situational barriers that create conditions of vulnerability to hazards.^{7,30,31} Overall, situational barriers can impede persons with disabilities' ability to perceive the threat, access relevant information, process it effectively, and take necessary protective actions. Conversely, situational resources can facilitate each stage of the PADM, enhancing persons with disabilities' capacity to engage in effective protective behaviors. Drawing from the literature summarized in this section, the following hypotheses related to situational barriers and resources are posed in the current study:

H3: Encountering more situational (a) barriers will be negatively associated with protective behavioral actions, and (b) resources will be positively associated with protective behavioral actions.

Methods

Survey Design and Instrument

The design of the survey instrument used in this study was informed by previous research that has been discussed earlier, focusing on hazard communication, the decision-making processes related to protective actions (PADM), and the intersection of disability and disasters. To construct the survey, the current study's authors incorporated several survey questions and validated instruments from their previous hazard studies.^{21,32,33} Before implementation, the survey was programmed online using Qualtrics's online platform. The survey questions underwent a pretest phase involving 43 participants with disabilities. Based on the analysis of pretest data, it was determined that the survey was ready for full-scale implementation. The target population was adults (age 18 years and older) and who identified as living with a disability and living in one of the counties affected by the tornado outbreak that occurred on December 10–11, 2021.

Data collection procedures were approved by the authors' Internal Review Board (IRB-22-06947-XM). The Qualtrics panel aggregator was chosen as the online data collection platform, which provides researchers with access to research panels and monitors the data collection procedure and controls for issues such as duplicate responses or unreasonably quick completion times. Participants were invited by Qualtrics panels to participate in the study based on their zip codes. Participants were first asked to confirm that they lived in one of the areas impacted by the December 2021 tornado outbreak and, second, whether they identified as having a disability. If the participants answered "yes" to both questions listed above, they were provided with an online consent form outlining the purpose of the survey. The consent form assured anonymity and confidentiality of participants' responses, that the data were secure, and that participation was voluntary and that participants could withdraw from the study at any time. Following reading the consent form, participants were required to click the button, "I consent to participate in this research survey," and were then provided with a link to the online survey.

Data were collected during May 20–30, 2022, approximately 5 months following the tornado outbreak and focused on the 64 cities of 28 counties of 4 states in the Midwest and Southeast of the United States—Tennessee, Kentucky, Illinois, and Arkansas—where tornado outbreaks occurred on December 10 and 11, 2021. The response rate for the survey was 39.9% with 523 participants beginning the survey and 314 exiting before completing the survey, resulting in a final sample of 209 participants who completed the survey. Participants who completed the survey were compensated for their participation with incentives through Qualtrics's incentive program, which offers various cash incentives and rewards.

Measures

Tornado hazard information

Tornado hazard information sources were assessed by asking participants what sources of information they used during the December 10–11, 2021, tornado warnings in their area (eg, TV, commercial radio, outdoor warning sirens, family and friends, wireless emergency alerts).¹¹ Response options were "not at all" (0), "a little" (1), "somewhat" (2), and "a great deal" (3). The scores of all items were summed to create a manifest variable ($M = 17.2$, $SD = 4.27$).

Tornado risk perception

Tornado risk perception was assessed with 6 items assessing the degree to which the respondent perceives tornado hazard situations as a threat (eg, tornadoes are likely to happen, cause major damage, injure family members or me) scored on a 5-point numeric scale from 1 ("strongly disagree") to 5 ("strongly agree") to create a latent variable.

Barriers

Based on prior research,^{2,34} the survey included questions that were developed to identify potential barriers experienced by persons with disabilities in their physical and social environments that could impede action for tornado protection. Participants answered "no" (0) or "yes" (1) related to 6 situational protective barriers during the December 10–11, 2021, tornadoes: no Internet or power to receive alerts, did not hear sirens or alerts, medical or mobility issues when sheltering, not having physical access to shelter, lack of transportation, and not having assistance to be able to shelter. The items were summed to create an observed variable ($M = 2.31$, $SD = 1.41$).

Resources

Based on prior research,^{2,34} the survey included questions that were developed to identify potential resources in participants' physical and social environments that could assist in facilitating action for tornado protection. Participants answered "no" (0) or "yes" (1) related to 5 protective resources. Questions asked involved whether they were able to access any of the following resources during the December 10–11, 2021, tornadoes: having access to emergency financial resources, having access to transportation, having family and friends for assistance, having a safe place to go during a tornado, and confidence in the ability to seek protection. The resource items were summed to create a manifest variable ($M = 2.45$, $SD = 1.05$).

Protective behavioral actions

Tornado protective action was measured by 3 items related to the December 10–11, 2021, tornado outbreak, to create a latent variable. These items asked about searching for more information, seeking confirmation of the tornado threat, and taking protective shelter (getting to a basement or storm shelter, etc). Each item was scored on a 5-point numeric scale from 1 ("strongly disagree") to 5 ("strongly agree").

Analysis

SEM was used to examine and model the protective behavioral actions among persons with disabilities during the December 2022 tornado outbreak. Data analyses were completed using R statistical software and the *Lavaan* Package.³⁵ First, a confirmatory factor analysis (CFA) of the measurement structure between latent variables and indicators was conducted. In a CFA for latent variables, lambda (λ) or loadings refer to the coefficients that represent the strength and direction of the relationship between indicators and the underlying latent variables. Lambda loadings above 0.40 or 0.50 are commonly regarded as acceptable and indicative of a strong relationship between the indicator and the latent variable.²³

Once the measurement model was established, a structural model was analyzed to investigate the direct and indirect relationships between the independent and dependent variables using multiple regression. Within the structural model, standardized coefficients,

also known as beta values (β), indicate the magnitude and direction of the relationship between the independent variables and the dependent variables.²³ The beta values represent the change in the dependent variable for a 1-unit change in the corresponding independent variable while holding all other independent variables constant.²³ In hypothesis testing, researchers set a significance level, commonly denoted as α (alpha), which is typically 0.05. If the P value is less than the significance level ($P < \alpha$), the relationship is considered statistically significant. To ensure the hypothesized SEM models fit the sample data, this study followed Little's³⁶ guidelines for goodness of fit indices for the estimated models, including the root mean square error of approximation (RMSEA values of < 0.08), standardized root mean square residual (SRMR values of ≤ 0.08), Tucker-Lewis Index (TLI values of ≥ 0.90), and comparative fit index (CFI values of ≥ 0.90). After testing the hypothesized relationships of variables in the structural model, this study further tested the indirect effects of the mediating pathway using Preacher and Hayes's (2008)³⁷ recommended procedure of bootstrapping to ensure the indirect estimate's confidence intervals do not contain zero.

Results

Of the 209 participants, frequency distributions found the majority of participants had difficulty with cognition ($n = 164$, 78.5%), followed by independent living ($n = 82$, 39.2%), difficulty with walking or stairs ($n = 49$, 23.4%), blind or visual impairment ($n = 60$, 28.7%), and deaf or hearing impairment ($n = 18$, 8.61%). A majority of participants were female (84.1%) and white ($n = 145$, 69.4%). The age of participants ranged from 18 to 69 years and older, with 18- to 29-year-olds at 76.1% ($n = 159$), 30- to 49-year-olds at 15.8% ($n = 33$), and 50- to 69-year-olds at 8.13% ($n = 17$). Over half of all participants had less than US \$29 999 in income at 66.6% ($n = 95$), and the majority of participants had a high school degree or higher ($n = 162$, 75.5%). Demographic information for the study is provided in Table 1.

SEM was employed to test both the measurement model and the hypothesized structural models. The measurement model was found to exhibit acceptable fit: $\chi^2(85) = 185.286$, $P < 0.001$, RMSEA = 0.072, CFI = 0.910, TLI = 0.901, SRMR = 0.075. See Table 2 for the CFA of latent variables for the measurement model. After establishing the measurement model, the hypothesized structural relationships between variables were analyzed and the structural model achieved acceptable fit: $\chi^2(135) = 1917.624$, $P < 0.01$, CFI = 0.912, TLI = 0.905, RMSEA = 0.079, SRMR = 0.070. For the relation between tornado hazard warning information and risk perceptions, results found that having access to more tornado warning information was found to increase tornado risk perception among persons with disabilities ($\beta = 0.349$, $P < 0.001$; H1a was confirmed). Multiple sources of tornado warning information were also found to have a significant positive influence on protective behavioral actions ($\beta = 0.500$, $P < 0.001$; H1b was supported) among persons with disabilities.

For the associations between tornado risk perception and protective behavioral actions, results found that H2a (risk perceptions will be positively related to increased protective behavioral actions) was confirmed. Results also found that tornado risk perception increased protective behavioral actions ($\beta = 0.271$, $P < 0.01$). H2b proposed that tornado risk perception would mediate the relationship between tornado hazard information and protective behavioral actions. H2b was also confirmed when tornado risk perception was found to positively

mediate the relationship between tornado hazard information and protective behavioral actions ($\beta = 0.043$, $P < 0.05$ [CI 95%: 0.015, 0.088]) based on the 95% confidence interval from 1000 bootstrapped resamples, and the CIs were found to exclude zero.³⁷ These results indicated that tornado risk perception has a significant mediating effect between the relationship of receiving tornado hazard information and taking protective action.

Finally, this study examined how different situational barriers and resources may impact tornado protective action among persons with disabilities. The study predicted that (H3a) situational barriers would be negatively related to tornado behavioral actions, and (H3b) situational resources would be positively related to tornado behavioral actions among persons with disabilities. Results found that persons with disabilities encountering more situational barriers were inversely related to tornado behavioral actions ($\beta = -0.118$, $P < 0.05$; H3a supported), and persons with disabilities with access to more resources were positively related to protective behavioral actions ($\beta = 0.162$, $P < 0.05$; H3b confirmed). See Table 3 and Figure 1 for regression pathways and estimates of model fit.

Limitations

Despite this study's contributions, there are several limitations and opportunities for future research. First, due to the sample size of participants, this current study was unable to conduct statistical testing of the variables across different subgroups of disability (eg, mobility, cognitive, chronic health). The sample was also primarily white and were young people (ages 18–29) with disabilities. Due to these limitations, it will be important to replicate this work with larger, diverse samples in the future. This study also utilized a survey questionnaire and respondents may have provided socially desirable answers, which may introduce bias that may have affected the survey results. Finally, this study was a cross-sectional survey in design and, therefore, the data cannot make claims of causal order.

Discussion

Focusing on the December 2021 tornado outbreak across portions of the Midwest and Southeast United States, this study surveyed 209 persons with various disability types (eg, mobility, vision, hearing, cognition, mobility, and self-care). The current study's results indicate several main findings. First, results indicate the likelihood of persons with disabilities taking protective behavioral action was higher for those who received multiple sources of tornado warning information during the December 10–11, 2021, tornado outbreak. As results show, persons with disabilities who received more tornado hazard information via multiple information sources (eg, television, commercial radio, websites, wireless emergency alerts) were found to increase their likelihood of protective behavioral action (eg, seeking confirmation, sheltering safely). These findings are consistent with prior research^{8,11,12} that highlight the importance of risk communication and receiving multiple alerts for tornado warnings to initiate protective actions. In addition, this finding further illustrates the need for tornado alert systems and products being fully accessible and to have access to appropriate communication tools, such as a text-to-speech device or a portable speaker that can amplify alerts.^{9,38}

Second, results found that persons with disabilities who received tornado warning information during the December

Table 1. Descriptive statistics of participants

	N	%
Gender		
Female	175	84.1
Male	25	12.0
Transgender	5	2.40
Non-binary	3	1.44
Age		
18-29	159	76.1
30-49	33	15.8
50-69	17	8.13
Over 70	0	0.0
Race/ethnicity		
American Indian/Alaska Native	1	0.48
Asian/Asian American	2	0.96
Black/African American/Afro-Caribbean	39	18.7
Hispanic/Latino/Latina/Latinx	16	7.66
Native Hawaiian/Other Pacific Islander	0	0.0
White, not of Hispanic origin	145	69.4
Other	6	2.87
Education		
Grade school	2	0.96
Some high school	6	2.87
High school/GED	76	36.34
Some college, but no degree	78	37.3
College degree (AA, BA, BS, etc)	43	20.6
Advanced degree (MA, PhD, JD, etc)	4	1.91
Income		
Less than US \$15 000	44	21.1
\$15 000 to \$29 999	51	24.4
\$30 000 to \$44 999	47	22.5
\$45 000 to \$59 999	29	13.9
\$60 000 to \$74 999	17	8.13
\$75 000 to \$104 999	14	6.70
\$105 000 or more	7	3.35
Employment		
Full-time employment	76	36.4
Part-time employment	41	19.6
Unemployed	31	14.8
Self-employed	8	3.83
Homemaker	15	7.18
Student	29	13.9
Retired	9	4.31
Housing structure		
A mobile home	15	7.18
A 1-family house, detached from other buildings	111	53.1
A 1-family house, attached to other buildings	26	12.4
A building with apartments	51	24.4
A boat, RV, van	2	0.96
Other	4	1.91
Region		
Tennessee	119	56.9
Kentucky	48	22.9
Illinois	28	13.4
Arkansas	14	6.69

(Continued)

Table 1. (Continued)

	N	%
Disability		
Deaf or hearing impairment (hearing)	18	8.61
Blind or vision impairment (vision)	60	28.7
Having difficulty concentrating, remembering, or making decisions (cognitive)	164	78.5
Having difficulty walking or climbing stairs (ambulatory)	49	23.4
Having difficulty dressing or bathing (self-care)	9	4.31
Having difficulty doing errands alone (independent living)	82	39.23

Table 2. Confirmatory factor analysis of latent variables for measurement model

Latent variable and indicators	λ
Tornado risk perception (TR)	
TR1: I think that a tornado can cause major damage to my home.	0.871
TR2: I think that a tornado can cause injury to me or other family members.	0.783
TR3: Thinking about the possibility of a tornado makes me feel fearful.	0.491
TR4: Thinking about the possibility of a tornado makes me feel worried.	0.459
Tornado protective action (PA)	
PA1: I searched for more information of forecasted timing and severity of the tornado threats (eg, look to TV, social media, online, apps).	0.758
PA2: I sought confirmation of the tornado threats (eg, looked outside, environmental cues).	0.731
PA3: I took action to protect myself or my loved ones against the threat of tornadoes that day (eg, safe shelter in a basement, storm shelter, or interior room).	0.709

N = 209, Model Fit statistics $\chi^2(85) = 185.286, P < 0.001, RMSEA = 0.072, CFI = 0.910, TLI = 0.901, SRMR = 0.075.$

Table 3. Structural model estimates

Direct and indirect paths	Standard estimate	Standard error
Tornado hazard info → Tornado risk ($R^2 = 0.12$)	0.349***	0.028
Tornado hazard info → Protective actions ($R^2 = 0.47$)	0.500***	0.100
Tornado risk → Protective actions ($R^2 = 0.47$)	0.271**	0.104
Barriers → Protective actions ($R^2 = 0.47$)	- 0.118*	0.091
Resources → Protective actions ($R^2 = 0.47$)	0.162*	0.103
Tornado hazard info → Tornado risk → Protective actions ($R^2 = 0.47$)	0.043* [CI: 0.015–0.088]	0.018

N = 209, Model Fit statistics: $\chi^2(119) = 1438.879, P < 0.01, CFI = 0.91, TLI = 0.90, RMSEA = 0.08, SRMR = 0.07; *P < 0.05, **P < 0.01, ***P < 0.001.$

10–11, 2021, tornado outbreak from multiple sources increased their perceived risk of the threat for tornadoes and the risks associated with them. Prior research has shown that tornado risk perception is an important factor in determining an

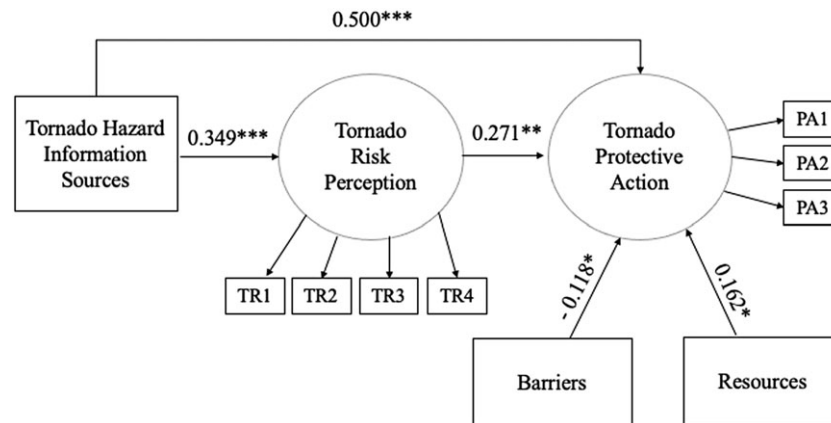


Figure 1. Diagram of structural model. $N = 209$, Model Fit statistics: $\chi^2(119) = 1438.879$, $P < 0.01$, CFI = 0.91, TLI = 0.90, RMSEA = 0.08, SRMR = 0.07; * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

individual's response to tornado warning information and the likelihood of that person taking protective action.^{8,19} Furthermore, results found that tornado risk perception served as a mediating role between tornado information and tornado protective actions during the December 10–11, 2021, event for persons with disabilities. These findings support prior research on the mediating role of hazard risk perception in the protective decision-making process^{8,20} and further extend our understanding of the information processing stages among persons with disabilities during hazards.

Finally, as indicated by the SEM results, situational barriers impeded protective action for persons with disabilities, whereas resources in the environment contributed to protective action. Together, these findings highlight a multitude of barriers encountered by persons with disabilities that negatively impacted their ability to seek protection from tornado threats on December 10–11, 2021. Barriers included not having Internet or power to receive alerts; not hearing sirens or alerts, medical, or mobility issues when sheltering; not having physical access to shelter; lack of transportation; and not having assistance to be able to shelter. In addition, this study captured and identified resources for persons with disabilities that were found to contribute to their ability to seek protection. These resources included having access to emergency financial resources, having access to transportation, having family and friends for assistance, having a safe place to go during a tornado, and having confidence in the ability to seek protection. Overall, these findings illustrate that during hazards (eg, tornadoes), the implementation of a protective behavioral response does not solely depend upon a person with a disability's intention to take protective action, but also on conditions in that person's physical and social environment.^{2,34} In other words, there can be situations in which persons with disabilities are able to access warning information and perceive a tornado as a risk and therefore want to seek protective action, but they encounter barriers and/or a lack of resources to get to a safe shelter.²⁵ Thus, a crucial means for persons with disabilities to reduce their vulnerability during tornadoes is by having access to tornado protective resources such as a safe shelter and/or assistance to get to a safe shelter. In terms of implications, these findings highlight the need for mitigation policies, programs, and services that support equitable access to protection for persons with disabilities during tornado threats.

Conclusions

This study provided several key findings that advance understanding of protective decision-making during tornado hazards among persons with disabilities. By identifying several significant factors that support or prevent protective actions, these findings highlight the need for equitable access for the protection of persons with disabilities during tornado threats. However, throughout the planning and implementation of any policies and practices, persons with disabilities should always be included. The phrase “nothing about us without us” is a slogan that has been used by disability rights activists to ensure that persons with disabilities are actively involved in the design and implementation of policies, programs, and services that affect them, rather than being left out or excluded.³⁹

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