

# Assessment of a Severe-Weather Warning System and Disaster Preparedness, Calhoun County, Alabama, 1994

## ABSTRACT

Tornado preparedness, warning system effectiveness, and shelter-seeking behavior were examined in two Alabama areas after tornado warnings. In the area without sirens, only 28.9% of 194 respondents heard a tornado warning; of these, 73.2% first received the warning from radios or television. In the area with sirens, 88.1% of 193 respondents heard a warning, and 61.8% first received the warning from a siren. Knowledge of warnings, access to shelter, and education were key predictors for seeking shelter. Our findings indicate that installing sirens, providing access to shelter, and teaching appropriate responses to warnings are important elements of an effective disaster prevention system. (*Am J Public Health*. 1996;86:87-89)

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### Introduction

The public health consequences of tornadoes are well documented.<sup>1-5</sup> The importance of establishing a local observer network and issuing timely warnings for preventing tornado-related injury and death has also been suggested.<sup>6-9</sup> However, no data are currently available regarding (1) the effectiveness of severe weather warning systems, (2) the level of preparedness in communities at risk, and (3) shelter-seeking behavior after warnings. To provide this information, we conducted two household surveys in Calhoun County, Alabama, after a series of tornadoes crossed the area.

### Methods

Using modified cluster sampling, we conducted two surveys of approximately 200 households in areas under tornado warnings. Survey 1 was conducted within the path taken by tornadoes through an area without sirens. Survey 2 was conducted in an area outside of the tornado path with two sirens.

#### Survey 1

*Stage 1.* We outlined the path of the tornado using a detailed map and identified portions of roadway that lay within 1.5 miles on either side of the tornado's path. Each portion was designated a cluster. Because the path in Calhoun County contained only 44 such clusters and because many areas were sparsely populated, we sampled every cluster. *Stage 2.* Beginning from a random start within each cluster, we selected five consecutive households.

#### Survey 2

*Stage 1.* Using a detailed street map of Jacksonville, we overlaid a grid made up of sections approximately four square city blocks in area. We randomly selected 30 of the 101 sections and designated each

as a cluster. *Stage 2.* Beginning from a random start and direction within each cluster, we selected seven consecutive households. This sampling technique was commonly used in assessing vaccine coverage<sup>10-12</sup> and has been reported to be a practical method for assessing needs after disasters.<sup>13</sup> We randomly selected and interviewed one adult from each household and assessed knowledge about tornado preparedness by asking whether they understood the National Weather Service definitions<sup>14</sup> of tornado watch and tornado warning (with *watch* indicating conditions favorable for a tornado, and *warning* indicating that a tornado has been detected) and whether they had access to shelter. We assessed the effectiveness of a warning system by asking participants if they heard a warning on the day of the tornado and by which method they first learned of the warning. In survey 2, we also asked whether respondents would usually seek shelter if they heard a warning and examined predictors for seeking shelter using a multiple logistic regression model.<sup>15,16</sup>

### Results

#### Survey 1

The mean age of the 194 interviewees was 48 years. Of these, 84

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**TABLE 1—Types of Houses, Access to Shelters, and Methods by Which Warnings Were Received among the Survey Populations, Calhoun County, Alabama, 1994**

	Survey 1 (No Siren)		Survey 2 (With Sirens)	
	No.	%	No.	%
Single-family dwellings	141	72.7	178	92.7
Mobile home	53	27.3	1	0.5
Others <sup>a</sup>	0	0.0	13	6.8
Access to shelters <sup>b</sup>				
Yes	38	19.6	63	32.6
No	156	80.4	130	67.4
Total no. of participants	194	100.0	193	100.0
Participants who received warnings	56	100.0	170	100.0
By siren	3	5.4	105	61.8
By television and radio	41	73.2	57	33.5
By others <sup>c</sup>	12	21.4	8	4.8

<sup>a</sup>Others included apartments, townhouses, and duplexes.

<sup>b</sup>Those who had basements or access to other forms of underground shelter within 5 minutes' walking distance were considered to have access.

<sup>c</sup>Others included word of mouth, phone, and radio scanner.

**TABLE 2—Predictors for Not Seeking Shelter among Participants in the Survey 2 Population, Calhoun County, Alabama, 1994**

Characteristic	Seeking Shelter		OR	Adjusted OR	95% CI
	No	Yes			
Access to shelter					
Yes	10	53	1.0	1.0	...
No	55	75	3.9	2.3	1.2, 5.4
Understanding of warning					
Yes	46	118	1.0	1.0	...
No	19	10	4.9	2.0	0.7, 5.7
Education, y					
< 12	23	9	9.5	6.5	2.2, 19.3
12	28	68	2.0	1.8	0.8, 3.7
> 12	14	51	1.0	1.0	...

Note. The multiple logistic regression model included age, sex, access to shelter, knowledge of warning, and level of education. The Hosmer and Lemeshow goodness-of-fit statistic = 3.10 with 8 degrees of freedom ( $P = .93$ ). OR = odds ratio; CI = confidence interval.

(43.3%) were women, 188 (96.9%) were White, 145 (74.7%) had a high school education or higher, and 173 (89.2%) knew the difference between a tornado watch and a tornado warning.

Of 194 participants, 38 (20%) had access to shelters, and only 56 (28.9%) received a warning before the touchdown of the first tornado. Among these 56 who received warnings, 41 (73.2%) first received a warning from radio or television (Table 1), and only 30 (53.6%) sought shelter.

### Survey 2

The mean age of the 193 interviewees was 54 years. Of these, 108 (56.0%) were women, 171 (88.6%) were White, 161 (83.4%) had a high school level of education or higher, and 165 (85.5%) knew the difference between a tornado watch and a tornado warning. Of participants, 63 (32.6%) had access to shelters, and 170 (88.1%) reported that they received a warning before the touchdown of the first tornado. Of those who received warnings, 105 (61.8%) first re-

ceived the warning from a siren (Table 1), and only 53 (31.2%) sought shelter.

### Predictors of Shelter-Seeking Behavior

In survey 2 (area with tornado warnings but not struck by the tornados), we estimated predictors for people's usual shelter-seeking behavior. People who had less than a high school education, who did not have access to a shelter, or who could not define correctly the meaning of *tornado warning* were less likely to seek shelter than others (Table 2).

### Discussion

Our results indicate that persons in an area served by a siren were more likely to have received warnings than those not in such an area. Although comparing two similar communities with and without sirens that both are outside of the tornado path may provide a more accurate assessment of the effectiveness of sirens as a warning system, the dramatic difference in the awareness of the warnings among survey participants (28.9% in survey 1 vs 88.1% in survey 2) could not be explained by whether or not the areas were damaged by the tornado. This result supports the importance of developing passive warning networks, including sirens, to provide timely warnings.

Nonetheless, improving the local warning system will be effective only if people at risk have access to safe shelters and know how to react appropriately to warnings. In this study, we found that fewer than half of the people had access to shelters, and among those who did not seek shelter, most received but ignored the warning on the day when the tornado struck. Moreover, although most participants knew that a warning meant a tornado had been sighted, nearly 30% stated that they did not "usually" seek shelter when such a warning was issued.

We limited the examination of shelter-seeking behavior to survey 2, which was conducted in an area where the tornado did not touch down. (In survey 1, people's knowledge about warnings and the appropriate responses to these warnings may have been affected after the devastating effects of the tornado.) Our findings illustrate that the variables assessed in survey 2 are independent predictors of shelter-seeking behavior. First, the availability of shelters is an important factor in determining shelter-seeking behavior. Thus, local public safety agencies should identify convenient shelters and educate the public about where to go and

what to do in the event of an emergency. Second, the warning message should be clear and simple so that everyone understands the meanings of tornado watch and tornado warning. Finally, the sixfold difference in shelter-seeking behavior between people with less than a high school education and those with more than a high school education suggests that public health officials should increase educational efforts and specifically target persons with less than a high school education with prevention strategies that would be most relevant to them.

In summary, findings from this study indicate that installing sirens, providing access to shelter, and teaching appropriate responses to warnings are important elements in developing an effective disaster prevention system. □

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This paper is dedicated to the people of Calhoun County, Alabama.

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## Patterns in US Medical Expenditures and Utilization for Injury, 1987

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### Introduction

Nearly one in four Americans are injured each year. As the largest cause of medical spending among those aged 5 to 50 and the second largest cause overall,<sup>1,2</sup> injuries result in 114 million physician contacts annually and are responsible for more than 25% of all emergency room and hospital clinic visits.<sup>3</sup>

National medical cost estimates by nature of illness are collected about once a decade. In 1980, the National Medical Care Utilization and Expenditure Survey, conducted by the National Center for Health Statistics, surveyed 17 000 persons in 10 000 households. In 1987, the National Medical Expenditure Survey was conducted by the Center for General Health Services Intramural Research,

Agency for Health Care Policy and Research. Having included approximately 35 000 individuals in 14 000 households, this survey provides the most recent national expenditure and source of payment data on injuries.

This article uses the public use tapes, which were released in 1991/93, to ana-

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**Editor's Note.** See related annotation by Rice and Max (p 14) in this issue.

**Note.** The views expressed here are the authors' and do not necessarily reflect those of the US Department of Health and Human Services' Maternal and Child Health Bureau.

## ABSTRACT

This article is based on data released in 1991/93 from the 1987 National Medical Expenditure Survey. Medical spending and utilization patterns are analyzed for 13 major categories of injury. Medical spending on injury in 1987 was \$64.7 billion in 1993 dollars. Nonhospitalized medically treated injuries averaged \$571 in medical spending per case, \$181 per visit, and 3.2 visits per injury. The prevalence-based survey estimate of medical spending on injuries during 1987 is 10% lower than the incidence-based estimates of lifetime medical spending resulting from injuries in 1985. (*Am J Public Health*. 1996;86:89-93)