

## THE DIFFERENTIAL DISTRIBUTION OF DEATH IN DISASTER: A TEST OF THEORETICAL PROPOSITIONS\*

Janice R. Hutton

*University of Colorado, Boulder*

### INTRODUCTION

Repeatedly, persons engaged in disaster research have expressed concern over the need for causal studies of behavioral response to extreme events (Mack and Baker, 1961; Dynes et al., 1967; Barton, 1969; White, 1974; and Mileti et al., 1975). Mileti et al., 1975, is the most recent compilation of what is known about human behavior in natural hazards and disasters. The authors have summarized the published literature, and conceptualized the findings in a manner which encourages causal analysis.

Concern regarding the dearth of specific research attention to older persons in disasters has been most recently expressed by a group at the University of Nebraska at Omaha (Gerontology Program, 1976). This is the most comprehensive study of the impact of disasters on the elderly yet published. The works of Baldi (1974), and Poulschock and Cohen (1975) are examples of research concerned with older victims. The focus of these efforts was service needs of older persons after the damaging flooding associated with Hurricane Agnes. This body of literature reports that older persons are

victimized by disasters in greater proportions than other persons.

A fact which has consistently emerged from the statistics on disasters is that older persons die in greater numbers than would be expected from their proportionate distribution in populations affected by the disaster (Friedsam, 1962; Trainer and Hutton, 1972). Several hypotheses which could help to explain this phenomenon have been constructed and reported in the literature of disaster research, but few have been systematically tested. Five variables were selected from disaster literature to help in examining how it is that older persons are more likely to die in disasters.

### DEATH AND AGE IN DISASTER

Friedsam's article, "Older Persons in Disaster" (1962), notes that according to the limited data available, "casualties do not occur at random in age terms but that the young and the old, particularly the latter, become casualties with far greater frequency than their numbers in the impact populations would lead one to expect" (p. 164). He cites his own analysis of deaths in Cameron Parish, Louisiana, from Hurricane Audrey in 1957, and that of Wallace (1956) for the Worcester tornado of 1953.

Friedsam utilized the age distribution of the white population of the parish, as presented in the 1950 Census, to compare to the age distribution of deaths in the parish. He found that

\*Revision of a paper given at the joint meeting of the Society for the Study of Social Problems and the American Sociological Association, New York, August, 1976. Generous comments on an earlier draft of this article were given by the editors and by Gilbert F. White. My thanks.

for those between the ages of 10 and 59, the percentage of casualties was less than the percentage of people in that age range. The percentage of children who died or were reported missing was slightly greater than the percentage of children in the parish, and the percentage of casualties aged 60 and over was considerably greater (Friedsam, 1962: 165).

Trainer and Hutton (1972) report that for the Rapid City flood of 1972, 27.2% of all known-age dead were aged 60 and over. This percentage is in line with Friedsam's findings on Hurricane Audrey and with Wallace's calculations for age and death in the Worcester tornado (Friedsam, 1962: 165–166). However, when the calculation is refined for Rapid City (in order to compare the population with the available sample) by tabulating only those victims whose residence was in the flood plain and within the city limits, the percentage of known-age dead 60 years old and over is 46.34% (see Table I).

TABLE I

Flood Deaths Among Rapid City's Flood Plain Residents by Age

Age	% Distribution of flood plain population	% Distribution of flood plain deaths	% Difference population to deaths
0– 9	18.39	17.01	+ 1.38
10–19	16.39	4.88	+11.51
20–29	19.23	6.10	+13.13
30–39	9.53	4.88	+ 4.65
40–49	9.20	8.54	+ 0.66
50–59	11.20	12.20	– 1.00
60–69	10.03	19.51	– 9.48
70+	6.02	26.83	–20.81
	100	100	

(Adapted from Trainer and Hutton, 1972)

Table I also shows that the percentage of casualties among the very young was just slightly less than would be expected by their proportion in the population. This fact runs counter to Friedsam's idea that the very young are disproportionately victims of disasters. The percentage of mid-aged victims (10–59 years) is about half (37%) that of their presence in the affected population (66%). Vulnerability

to death dramatically increases with age 50. For persons 70 years and older chances were 1 out of 5 that death would occur for those caught in this late-night, fast-onset, flash flood.

## PROCEDURE

Death among older persons in the Rapid City flood plain occurred disproportionately. Does the present literature of research on disasters provide the explanatory variables to help explain why?

### Hypotheses

Figure 1 synthesizes the hypothesized relationships to be examined. They derive from propositions found in a summary of behavior in disasters (Mileti et al., 1975: 42–52). The seven relationships are number in the diagram to correspond with the propositions presented below. The term "older persons" refers to persons 60 years and older. "Younger persons" are 59–16 years (16 being the age of the youngest respondent in the study).

### Propositions.

- 1 Persons who receive warning of impending threat are more likely to evacuate than persons who do not receive warning.
- 2 Older persons are less likely than the young to receive warning of impending threat.
- 3 Older persons are less likely to evacuate prior to impact than younger persons.
- 4 Persons who have had severe flood experience in their past are more likely to evacuate (when warning is received) than persons who have not had severe flood experience.
- 5 Older persons are more likely to have had severe flood experience than younger persons.
- 6 The greater the perceived time before impact, the less likely it is that evacuation will occur.
- 7 Older persons are more likely to perceive a longer time to impact (upon receipt of warning) than younger persons.

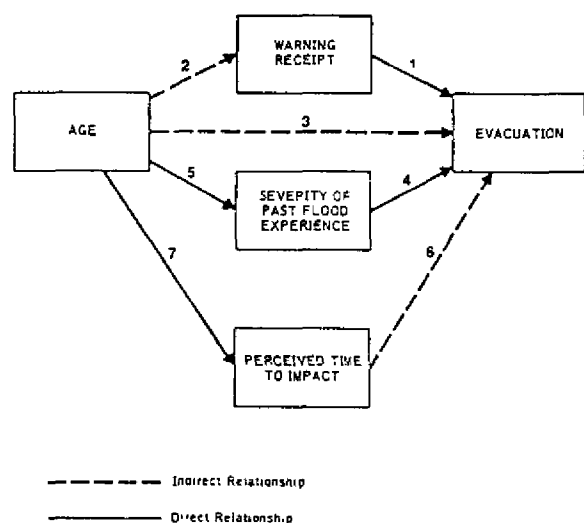


Fig. 1. Hypothesized relationships considered.

#### Data

The data [1] were derived from face-to-face interviews with 189 respondents who were drawn in a 1:8 systematic random sample of flood plain dwellings within the city limits of Rapid City, South Dakota (Mileti, 1974: 77-81), as of June 9, 1972, the day of the flash flood.

The primary aim of that study was to ascertain response to warnings prior to the onset of the destructive flash flood of 1972. Five households originally drawn for the sample were homes of persons who died in the flood. In the study of death in disaster, this obvious bias will always be present.

#### Analysis

Chi-square tests of significance, and contingency coefficients were calculated for the hypothesized relationships.

#### FINDINGS

The hypotheses considered will be restated, and the findings about each then discussed. Table II summarizes the set of results from chi-square analysis for all the hypothesized relationships.

1 Persons who receive warning of impending threat are more likely to evacuate than persons who do not receive warning.

To state the obvious, except by chance, pre-impact evacuation could not occur if warning was not received. Of course, some persons will perceive environmental cues as sufficient reason to take protective action, for example, putting their car under cover when the sky looks like hail might be coming. As would be expected, receiving warning is significantly related to evacuating. This relationship holds for older persons as well as younger persons.

2 Older persons are less likely than the young to receive warning of impending threat.

3 Older persons are less likely to evacuate prior to impact than younger persons.

In examining the relationship between old age and higher death in disasters, previous research suggests that older persons die in greater numbers because they do not receive warnings as frequently as younger persons (Friedsam, 1962). This was not the case with the Rapid City flood. There was no significant difference by age for receiving warning. Older persons were only slightly less likely to receive warnings than younger persons.

Past research has shown that, assuming warning was received, older persons are less apt to evacuate than younger persons (Friedsam, 1962, Moore et al., 1963). In Rapid City there was no significant difference by age for evacuation. About half of the persons who received warning evacuated prior to impact. When older persons received warning, they were slightly more likely to evacuate.

The relationships between age, warning receipt, and evacuation in Rapid City do not help explain the relative vulnerability of older persons in that disaster.

4 Persons who have had severe flood experience in their past are more likely to

TABLE II

Summary of Relationships Between Variables

Relationship	X <sup>2</sup>	Significance level	Contingency coefficient
1 Warning receipt to evacuation	5.29	0.035	0.190
2 Age to warning receipt	1.02	NS*	—
3 Age to evacuation	0.0017	NS	—
4 Past flood experience to evacuation	6.76	0.035	0.264
**5 Age to past flood experience			
for persons 60 years +	0.418	NS	—
for persons 16–59	6.342	0.02	0.306
6 Perceived time to impact to evacuation	5.593	NS	—
**7 Age to perceived time to impact			
for persons 60 years +	0.270	NS	—
for persons 16–59	5.322	0.02	0.212

\*NS indicates no significance at the 0.05 level

\*\*Three-dimensional chi-squares were derived for Relationships (5) and (7).

evacuate (when warning is received) than persons who have not had severe flood experience.

5 Older persons are more likely to have had severe flood experience than younger persons.

Past research indicates that people tend to define some potential impact in terms of prior experience with that disaster agent (Drabek and Boggs, 1968). Severity of prior flood experience was used here to test this idea.

There is an important relationship between age, severity of prior flood experience, and evacuation, as indicated in Table II. Only half of those interviewed had previous flood experiences and, of those who had, two thirds had experienced little severity.

Those persons who had prior severe flood experience were more likely to evacuate than those who had not ( $C=0.264$ ). This association is stronger for younger persons ( $C=0.306$ ); the relationship is not significant for older persons ( $C=0.119$ ). Older persons were no more likely to have had previous severe flood experience than younger persons. Evacuation was more likely for older persons who had had previous severe flood experience, but the

absence of such experience did not interfere with evacuation.

While prior severe flood experience enhanced evacuation for younger persons, that experience is not associated with evacuation for older persons. Current theory indicates that persons tend to act appropriately according to their previous experience with a given hazard. Previous hazard experience can, therefore, serve as a hindrance to actions adaptive to the new (perhaps more severe) threat. The subjective interpretation of what is "severe" impedes precision in measuring this concept. While this analysis did not help in that specification, the task of developing a more objective measure of severity should not prove difficult.

Another subjective perception which has been shown to be related to adaptive response is the perceived amount of time [2] before impact (Mileti et al., 1975).

6 The more time before impact persons perceive, the less likely it is that evacuation will occur.

7 Older persons are more likely to perceive a longer time to impact (upon receipt of warning) than younger persons.

As with flood severity, the association between perceived short time and evacuation was significant for younger persons ( $C=0.212$ ), and very low for older persons ( $C=0.085$ ). There was no significant relationship for the sample as a whole ( $C=0.189$ ). Older persons more often perceived less time before impact than younger persons, but the time perception did not necessarily result in preimpact evacuation. Perceived short time before impact was more common among older persons. While perceiving a short time to impact was associated with evacuation for younger persons, this association was absent for older persons. The most immediate explanation for this difference is that, on the whole, older persons may take longer to evacuate (having made the decision to do so) than younger persons simply due to physical or opportunity limitations.

To recapitulate, seven relationships were examined in accordance with propositions from current disaster literature. Warning receipt was significantly related to evacuation, as expected. Prior severe flood experience was significantly related to evacuation for the population as a whole, and for younger persons (16–59 years). This experience measure was not related to evacuation for older persons (60+ years). Perceived short time before impact was significantly related to evacuation for the younger group, but was not related for older persons.

There were two important negative findings. In Rapid City there was no significant relationship for either age and warning receipt or for age and evacuation. These two findings run counter to common threads in the literature.

## CONCLUSIONS

Some of the studies which have examined the reasons for the higher casualty rate among older persons have hinged their explanations on psychological differences; attachment to objects, preoccupation with time, and information processing, to account for "reluctance to leave" (Friedsam, 1961).

Other studies offer sociological explanations. Drabek and Boggs (1968), in their study of

families and disaster in the Denver, Colorado flood of 1965, found that if older persons have a place to go, e.g. have relatives in the area, they are just as willing to leave as anyone else.

The basic contribution of this study in explaining the relative vulnerability of older persons in disasters is that it negates some commonly held notions about the relevant explanatory relationships. These data indicate that older persons are as likely to leave, given warning, as others, regardless of other factors. The results suggest that disproportionate death for older persons occurs among that segment of persons who *do not receive warning*.

Another finding of this study is that, in Rapid City, older persons were as likely to receive warning as others. It can be said, then, that for those persons who do not receive warnings, it is the old who cannot withstand impact. It is at the time of impact that disproportionate victimization of older persons occurs. If time of impact is the point in time which renders disproportionately higher numbers of older victims, then psychological explanations will not be helpful in formulating policies to minimize the inequity.

Instead, the results support the explanation that it is the differential distribution by age of relative strength, good health and physical capabilities which account for the old age and death in disasters relationship. If this idea has any strength in explaining the relationship, then natural disasters which occur without prior warning should take an even larger toll of older victims.

The Gerontology Program report says, "Ultimately, however, one must have the resources (e.g. health, transportation, knowledge, etc.) to exit a disaster situation. The evidence to date would suggest the elderly to possess fewer of these factors than any other age group." (1976. 11).

Since producing policy-relevant findings is one aim of research about disasters, these results point to the need for much more work in theory testing. Studies of disasters must employ representative samples so that more sophisticated analysis can do a better job of testing theory. In the current rudimentary

stage of disaster behavior theory development the publication of negative findings is useful, and must be encouraged.

## NOTES

- 1 The data were collected for a study conducted as part of the research "An Assessment of Research on Natural Hazards," Institute of Behavioral Science, University of Colorado, with funds from the National Science Foundation (RANN, GI 32942), (Mileti, 1974, 1975; White and Haas, 1975). Any opinions, conclusions or recommendations herein do not necessarily reflect the views of the National Science Foundation.
- 2 There was 1 hour and 45 minutes between the time of the first urgent public media warnings for Rapid City and the time the flood hit the city (Mileti, 1974). Respondents' answers were coded as either "less than one hour" (a short period), or "one hour or greater."

## REFERENCES

- Baldi, J.J. (1974). "Project Search: Anatomy of a Survey Under Disaster Conditions," *Gerontologist*, 14: 100-105.
- Barton, Allen H. (1969). *Communities in Disaster*. New York: Anchor Books.
- Drabek, T.E. and Boggs, K.S. (1968). "Families in Disaster Reactions and Relatives," *Journal of Marriage and the Family*, August: 443-451.
- Dynes, R.R., Haas, J.E. and Quarantelli, E.J. (1967). "Administrative, Methodological and Theoretical Problems of Disaster Research," *Indian Sociological Bulletin*, IV (July): 215-227.
- Friedsam, H.J. (1961). "Reactions of Older Persons to Disaster-Caused Losses: An Hypothesis of Relative Deprivation," *Gerontologist*, XXX, 3: 34-37.
- Friedsam, H.J. (1962). "Older Persons in Disaster," in Baker, G.W. and Chapman, D.W., (eds.), *Man and Society in Disaster*, pp. 151-184. New York: Basic Books.
- Gerontology Program, University of Nebraska at Omaha 1976 *Service Priorities for the Elderly in Natural Disasters*. Prepared for Eastern Nebraska Office of Aging. Omaha, Nebraska
- Mack, R.W. and Baker, G.W. (1961). *The Occasion Instant*. Disaster Study No. 15. Washington, D.C.: National Academy of Sciences - National Research Council.
- Mileti, D.S. (1974) "A Normative Causal Model Analysis of Disaster Warning Response." Ph.D. Dissertation. Boulder: University of Colorado, Department of Sociology.
- Mileti, D.S. (1975) *Natural Hazard Warning Systems: A Research Assessment*. Boulder: Institute of Behavioral Science, University of Colorado.
- Mileti, D.S., Drabek, T.E. and Haas, J.E. (1975). *Human Systems in Extreme Environments: A Sociological Perspective*. Boulder: Institute of Behavioral Science, University of Colorado.
- Moore, H.E., et al., (1963). *Before the Wind: A Study of the Response to Hurricane Carla*. Disaster Study No. 19. Washington, D.C.: National Academy of Sciences, National Research Council.
- Poulschok, S.W. and Cohen, E.S. (1975). "The Elderly in the Aftermath of a Disaster," *Gerontologist* 15: 357-361.
- Trainer, P.B. and Hutton, J.R. (1972). "An Approach to the Differential Distribution of Deaths from Disaster." Paper presented at meetings of the Midwest Council on Social Research in Aging, Kansas City, Missouri. Boulder: Institute of Behavioral Science, University of Colorado
- Wallace, A.F.C. (1956). *Tornado in Worcester. An Explanatory Study of Individual and Community Behavior in an Extreme Situation*. Disaster Study No. 3. Washington, D.C. National Academy of Sciences, National Research Council.
- White, G.F. (ed.) (1974) *Natural Hazards, Local, National and Global*. New York: Oxford University Press.
- White, G.F. and Haas, J.E. (1975). *Assessment of Research on Natural Hazards*. Cambridge, Mass.: M.I.T. Press.