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Health-Related Behavioral Impact of
the Three Mile Island Nuclear Incident

Report Submitted to the TMI Advisory Panel
On Health Research Studies
of
The Pennsylvania Department of Health

PART I

by

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CHAPTER I

INTRODUCTION

The "nuclear incident" at Three Mile Island (TMI) nuclear power plant beginning on March 28, 1979, resulted in widespread fear of danger to the surrounding population and the temporary exodus of a substantial portion of the population in the vicinity of the facility. Since the event there has been continuous publicity about the situation at the crippled reactor with the result that, what began as a brief crisis, has become a continuous and, for some, a chronically disturbing situation.

The purpose of this report is to describe how persons living in the vicinity of TMI reacted during the crisis, as well as 3 and 9 months later. Data to be presented are drawn from three sources: 1) telephone surveys of persons in the area of TMI funded under contracts of the Pennsylvania Department of Health 2) a similar set of telephone interviews sponsored by the Nuclear Regulatory Commission 3) interviews with patients at the Hershey Medical Center concerning their experiences during the crisis.

The material included here is part one of the total report, and will focus on: 1) characteristics of the population residing in the area of TMI, 2) description of the evacuation decisions and behavior during the crisis period and 3) the extent, severity, and duration of distress experienced by persons living in the vicinity of TMI.

Additional topics, to be submitted later, include the role of coping strategies and social support in mediating stress, the impact of the crisis on the health delivery system and, finally, recommendations for public policy that can be drawn from the previous analyses.

Acknowledgements

Many people have contributed to the findings to be reported here. The authors wish to acknowledge the following persons who have been particularly helpful.

Dr. Cynthia Bullock Flynn of Social Impact Research Inc. and Mr. Michael Kaltman of the Nuclear Regulatory Commission (NRC) were very helpful to the work reported here. In planning the Nuclear Regulatory Commission's TMI telephone survey, they shared their draft questionnaires with us as we did with them. As a result, many of the questions included in the two surveys are the same. This permits cross comparisons and allows the two studies to complement each other, extending the total knowledge beyond what either study could have contributed alone. Dr. Flynn and Mr. Kaltman have also been generous in allowing access to their raw data and, as a result, many analyses reported here involve data from both surveys.

Faculty and patients of the Department of Family and Community Medicine and Pediatrics of the M.S. Hershey Medical Center played an important role in this work. Many of the NRC and Penn State survey items were based on interviews and questionnaire data obtained immediately after the crisis from both patients and staff in those departments. Joseph Leaser, M.D. of Middletown and his patients also generously contributed their time and ideas to this work. Mr. Joseph Dixon was very helpful in carrying out computer analyses and Dr. Robert Munzenrider assisted us in gaining access to NRC data files. Ms. Ellin Hufford assisted in interviews, data collection and analysis.

We are indebted to a number of social scientists who served as formal and informal consultants to this project. Their professional experience and expertise was an invaluable aid in study design, questionnaire construction, data analysis and interpretation. While they are not responsible for conclusions drawn here they have contributed substantially to this effort. We wish to especially acknowledge the assistance of Dr. Morton Kramer, Dr. Elmer Streuning, Dr. David Mechanic, Mr. Paul Cleary, Dr. Evan Pattishall, and Dr. Carl Thompson. We have also been helped by discussions with Dr. Bruce Dohrenwend about how the findings of this study relate to conclusions of the Task Force on Behavioral Effects of the President's Commission on the Accident at Three Mile Island. Dr. Teh Hu, who directed the study of the economic impact of the Three Mile Island crisis collaborated with us in this work. Data for his project was collected in the same surveys as used for this report. Dr. Hu has also been a very helpful consultant in data analysis aspects of this work.

We would like to acknowledge the technical help of the staff of Chilton Research Services, which conducted the telephone surveys reported here. Ms. Nancy Kreuser and Ms. Carol DeGennaro contributed to questionnaire design as well as to the efficient, professional manner in which data collection was carried out.

A sub committee of the TMI Advisory Panel on Health Research Studies was responsible for overseeing this work. Dr. Calvin Fredricks, Dr. Morton Kramer and Dr. Evan Pattishall provided guidance and important support in obtaining resources necessary for this project.

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CHAPTER 2

METHODOLOGY

Findings to be reported here come from three sources: 1) a telephone survey in July, 1979 of 692 persons living within 5 miles of Three Mile Island, (July Penn State survey), 2) a telephone survey in July, 1979 of 1506 persons living within 55 miles of Three Mile Island (July NRC survey) and 3) a telephone survey in January, 1980 which repeats elements of both of the July surveys (January Penn State survey). The January survey included re-interviews with 404 persons from the Penn State July survey plus 550 persons selected so as to replicate the July NRC study. Description of the content and method of each survey follows.

Penn State July Survey

Content: Questions included in this survey were, in part, based on interviews and questionnaires obtained from patients at the Hershey Medical Center and in the practice of Dr. Joseph Leaser in Middletown just after the crisis in April and May, 1979. Questions about stress-related symptoms, reasons for staying or leaving and coping strategies were drawn from this earlier work. In addition, questions were included concerning utilization of health services, use of alcohol, tobacco and tranquilizers, ethnic background, religious activity, social support and marital status. A number of questions concerning economic costs of the crisis were also included and have been analyzed and reported by Dr. Hu.

Data collection: Telephone interviews were conducted from July 12 to July 26, 1979 by Chilton Research Services, a professional interviewing organization in Radnor, Pennsylvania. Random digit dialing was used for all exchanges within the 5 mile radius. The random digit method assures access to all households with phones, both listed as well as unlisted. Interviewers first established whether

it was a home (rather than a business) phone, and whether the home was within 5 miles of Three Mile Island. If these questions were affirmative, they asked to speak to the male head of the household. If the male head was not present, they asked for the female head of household.* Numbers with no answer were called up to four times and refusals were recalled once. Before beginning the interview, an informed consent statement was read as follows:

Good _____ I'm _____ calling from Chilton Research in Radnor, Pennsylvania. We are conducting a study for the Penn State University Medical School and the Pennsylvania Department of Health among residents in your area on the effects of the Three Mile Island incident.

Your participation in this survey is voluntary. Any information which you give us in response to our questions will be kept strictly confidential and will be used only for routine statistical research purposes.

At the end of each interview, each respondent was asked if he or she would agree to be interviewed again at some later date. If the interviewee said yes, his or her name, address and telephone number were recorded. If the interviewee refused, no identifying information was recorded.

Interviews were monitored by supervisory staff at Chilton throughout the survey to insure correct administration of the questionnaire and accurate recording of responses. Completed questionnaires were later checked for completeness and consistency by editors. Questionnaires which did not pass editing were returned to the interviewers for call backs and clarification.

A response rate of 75% was achieved. That is, it is estimated that 75% of households within the 5 mile radius of Three Mile Island which fell into the sample yielded a completed interview. The 25%, non-response is divided into an

*Male head of household was requested first in order to increase the number of male respondents which would normally be under-represented if male or female were requested equally.

estimated 11% refusal rate and an estimated 14% no answer or eligible respondent not available. In addition, it should be noted that 582 or 81% of respondents agreed to be re-interviewed at some future date.

NRC July Survey

A detailed description of how the NRC survey was designed and carried out is available in Three Mile Island Telephone Survey, Preliminary Report of Procedures and Findings A report to the U.S. Nuclear Regulatory Commission by Cynthia Bullock Flynn, September, 1979. A few general comments will be made here. The NRC survey was carried out from July 23 to August 7, 1979 and used the same interviewing organization (Chilton Research Services) as was used for the Penn State study. Approximately 40% of the questions were identical to those in the Penn State study including reasons for leaving or staying, stress-related symptoms, and economic impact of the crisis. Areas which were included in the NRC, but not in the Penn State studies were attitudes toward nuclear power and attitudes toward how the crisis was handled by local, state and federal authorities. Areas unique to the Penn State study included coping strategies, social support and use of health delivery systems. One thousand five hundred and four interviews were completed. Respondents were located from less than 1 to approximately 55 miles from the Three Mile Island facility. Respondents were grouped by distance and direction from the plant. Sampling methods, monitoring and editing procedures were essentially the same as in the Penn State study. Refusal and response rates were also similar in the two studies.

Penn State January Survey

Content: Four types of questions were included in the January follow-up survey: 1) stress-related symptoms and feelings about the situation at Three Mile Island repeated from the July surveys 2) utilization of health delivery system since the April crisis and related economic costs, 3) questions concerning

mental status which, in other research, have been shown to relate to symptom reporting and health care utilization and 4) additional questions concerning the degree of social support available to respondents. Two very similar questionnaires were developed: one to re-interview 404 persons selected randomly from the 582 persons who had agreed to be re-interviewed from the July Penn State study and the second to interview 550 persons who live from 0-55 miles from Three Mile Island and selected in the same manner as in the original NRC survey. Differences between the two questionnaires are largely in demographic information that had to be collected for the 0-55 mile sample, but which had been collected earlier for the 404 re-interview subjects.

Data Collection: Telephone interviews were conducted by Chilton Research Services from January 17 to February 9, 1980, using the same procedures described above. A response rate of 82% and a refusal rate of 11% was achieved for the 0-55 mile sample. Of the 468 subjects approached for re-interview, 9 refused re-interviews, 46 had disconnected phones and had probably moved while 9 did not answer phones on 4 calls.

CHAPTER 3

DESCRIPTION OF THE POPULATION SURVEYED IN THE IMMEDIATE VICINITY OF THREE MILE ISLAND

The objectives of this chapter are: 1) to describe the demographic and other characteristics of the population included in the Penn State July survey within 5 miles of Three Mile Island (PSU survey) and 2) to compare these population characteristics with those of the nation as a whole. This comparison will help in establishing the generalizability of our findings to other locations. It should be noted that the PSU survey of 692 persons within 5 miles of TMI, which is the focus of this chapter, utilized random digit dialing which insured access to all phones in the area, listed as well as unlisted. As explained in chapter 2, a 75% response rate was achieved, with an estimated 11% refusal rate.

DEMOGRAPHIC CHARACTERISTICS

As is indicated in Table 3.1, demographic characteristics of the PSU sample are quite similar to those of the US population. The PSU sample is close to the national norm for average age of heads of households, proportion of males, proportion of the population with a Hispanic background and proportion who are widowed, separated or divorced. However, it differs strikingly in the proportion of the population which is black, (1.0%, versus a national figure of 10.2%), single (10.9%, versus 26.6%), married (73.6%, versus 59.2%) and in the mean family size (3.1 versus 2.87). The differences in % single and married between the PSU sample and national norms are due, at least in part, to different sampling methods and not necessarily to actual population differences. The census

data includes all persons over 14 years of age in assigning marital status categories while the PSU survey included only male and female heads of households in the sample. Therefore, single persons living with parents would be part of the census counts, but would not be present in the PSU sample. The large (42%) who consider themselves "Pennsylvania Dutch" is a unique feature of this population. It should be noted that Amish or Mennonites, who are sometimes identified with the term "Pennsylvania Dutch" are, at most, a small part of this group. While there is no data on whether respondents were Amish or Mennonites (though no Amish would be represented since they have no phones) these groups constitute a small percentage of the persons who consider themselves "Pennsylvania Dutch."

Differences between the PSU sample and national norms are somewhat greater when one looks at education, occupation income and religious affiliation (table 3.2). Here, the study population is somewhat better educated (74.3% have completed high school, compared to 68.0% for the US population), more likely to have a total family income greater than \$10,000, (80% versus 72.6%), but markedly more likely to be employed in a blue-collar occupation (69.0% versus 33.9%). This predominance of blue collar workers may be due to the presence of a steel mill and other manufacturing facilities in the vicinity. The criteria for classification into blue or white collar also differed slightly between this study and the census. Therefore, category definitions may also play a role in these differences. Patterns of religious affiliation were generally similar to the entire population, with the exception of an underrepresentation of Jews and those listing their affiliation as "none" or "other." The percent attending church at least weekly is exactly equal to the national norms.

TABLE 3.1
 DEMOGRAPHIC CHARACTERISTICS - I
 AGE, SEX, RACE, MARITAL STATUS AND FAMILY SIZE

	PSU SURVEY	NATIONAL* NORMS
Mean age, head of household	42.4	45.7**
% Male (respondents)	52.1	46.8***
% Black	1.0	10.2
% Hispanic	4.0	4.7
% Widowed, separated or divorced	15.5	14.2
% Single	10.9	26.6
Mean family size	3.1	2.87

It should also be noted that 42% of this sample identified themselves as "Pennsylvania Dutch," by which is meant descendents of German and Swiss immigrants who settled in the area in the 18th and early 19th centuries.

*"National norms" calculated from latest available census data. Since question format and categories were rarely precisely equivalent, all normative data must be regarded as approximations.

**estimated from group data

***North Eastern United States

OTHER CHARACTERISTICS

Mobility and Home Ownership

Table 3.3 shows the length of residence in area. The most comparable national data are that, in 1978, 85% of the U.S. population had lived in the same county for at least 3 years. An examination of the PSU data shows that length of residence of persons in the sample is approximately the same as those national norms. However, the proportion of the population who own their homes is almost 14% higher than the national average.

Health-Related Characteristics

The PSU study population shows some minor differences in various health-related activities compared to national norms. (See table 3.4) Our respondents were somewhat less likely to use sleeping pills than the national norms, but are more likely to be smokers. The proportion of the population consuming alcoholic beverages at least several times a week is almost identical with the national norm.

SUMMARY

It would appear, on the basis of a limited comparison with the US population as a whole, that the population surveyed in the PSU study is not strikingly deviant from national norms. There are differences in areas such as ethnic composition, education levels, and family and occupational structure, home ownership, sleeping pill use and percent of smokers. However, the sample population was very close to national norms in age of heads of households, church attendance, length of residence in area, and alcohol consumption.

TABLE 3.2

DEMOGRAPHIC CHARACTERISTICS - II

EDUCATION, OCCUPATION, INCOME AND RELIGIOUS AFFILIATION

	PSU SURVEY	NATIONAL NORMS
% completing high school	74.3	68.0
% white collar	22.5	49.6
% blue collar	69.0	33.9
% farmer	1.4	3.0
% other employed	7.1	13.5
% with income above \$10,000	80.0	72.6
Religion		
% Catholic	16.8	27.0
% Protestant	73.3	61.0
% Jewish	0.4	2.0
% Other	5.2	4.0
% None	3.6	6.0
% No answer	0.7	-
% Attending Church at least weekly	40.0	40.0

TABLE 3.3
MOBILITY AND HOME OWNERSHIP

	PSU SURVEY	NATIONAL NORMS
Length of residence in area:		
Less than 1 year	6.6	-
1-5 years	19.4	-
6-10 years	15.6	-
More than 10 years	58.4	-
% Owning homes	77.3	64.0

The percentage of persons living in the area for more than 3 years is estimated to be 83.7. This estimate is arrived at by adding the percentages for more than 10 years, 6-10 years plus half of the 1-5 years group.

TABLE 3.4
HEALTH-RELATED CHARACTERISTICS

	PSU SURVEY	NATIONAL NORMS
% using sleeping pills in last 2 weeks	3.5	5.6*
% smokers	42.6	36.95
% consuming alcoholic beverages at least several times a week	23.3	23.25

*% using at least one sleeping pill in the past week.

CHAPTER 4

RESPONSE TO THE CRISIS

Introduction

This chapter will include findings from both the Penn State July and January surveys as well as in-depth interviews carried out with patients at the M. S. Hershey Medical Center and in the practice of Dr. Joseph Leaser in Middletown shortly after the crisis. The in-depth interviews dealt with experiences during the crisis period. They provided response categories used in the later telephone interviews as well as in-depth material to provide context for the telephone responses. The chapter is divided into three sections: a) the evacuation decision, b) other immediate responses to the crisis, including coping strategies and use of alcohol, tobacco, sleeping pills and tranquilizers and c) attitudes and behaviors regarding TMI in January, 1980.

Evacuation Decisions

I've gone through fire, and I've gone through flood,
(but) this radiation, you can't see ... and I guess
that's why we (left).

Approximately 60 percent of the 692 respondents to the Penn State July survey (within 5 miles of TMI) reported that at least one member of the household left during the crisis period. Fifty one percent of the respondents reported that they themselves had left. The great majority (66%) of evacuees left on Friday March 30, and an additional 12% on Saturday, March 31. (See Figure 4.1) As has been the case with other voluntary evacuations, virtually all of those who left made their own arrangements of lodging, with almost all finding accommodations with friends or relatives (See Table 4.1). Return dates were spread over

FIGURE 4.1
DEPARTURE DATES

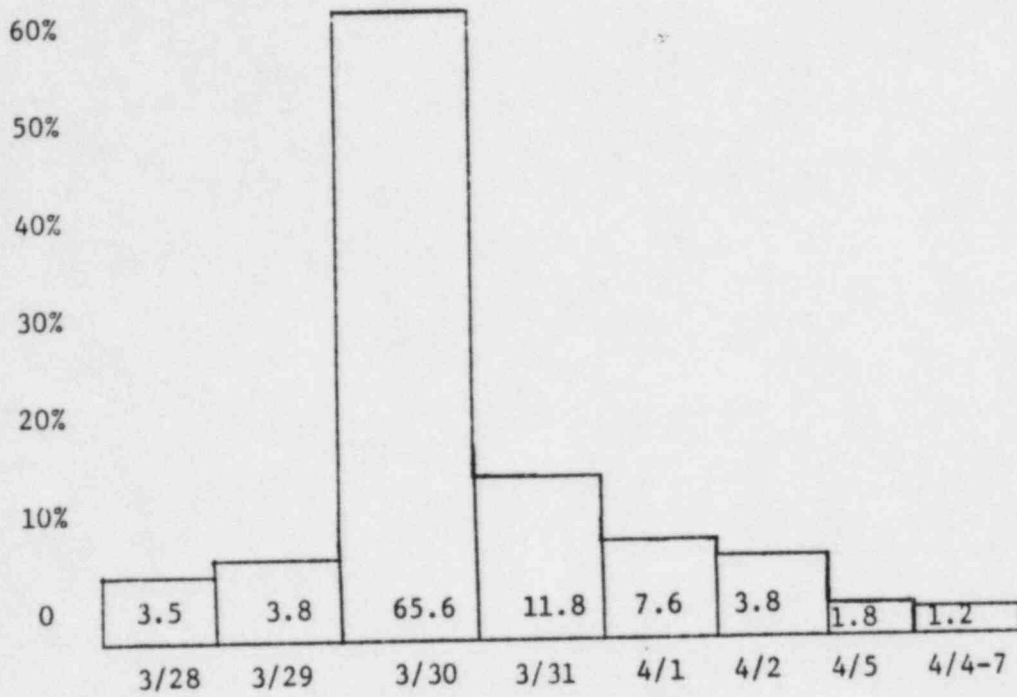
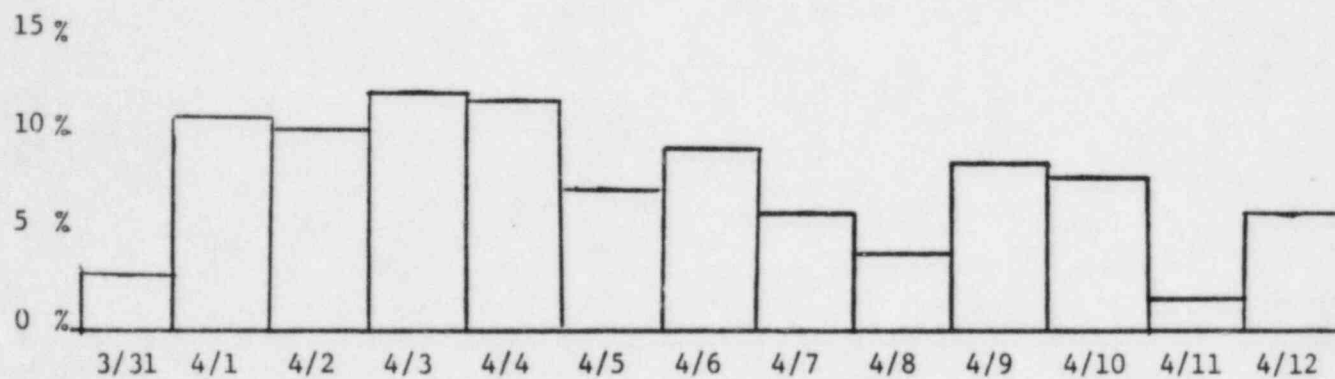


TABLE 4.1
ACCOMMODATIONS FOR EVACUEES

Relatives	69%
Friends	15%
Hotel or Motel	8%
Second Home	7%
Other	1%

a much longer time period. Half of the respondents who left had returned by April 4, and 98% had returned by April 14. (See Figure 4.2)

FIGURE 4-2
RETURN DATES



Reasons for Leaving

Those who left did so for a variety of reasons (See Table 4.2). The most common one (selected by 82% of the leavers) was that the situation seemed dangerous. The in-depth interviews indicated that, for some, the perceived danger was from radiation while for others it was a more generalized fear, heavily influenced by the example of friends and neighbors, as in the example below.*

Interviewer: Why did you leave?

Respondent 1 (Wife): It was because of that bubble.

Respondent 2 (Husband): And a lot of other people were leaving.

Respondent 1: We didn't know what to expect. We didn't know what to think, what's ahead . . .

Interviewer: How dangerous did you think it was?

Respondent 1: I guess we didn't really think too much about it. I didn't think too much about it until Sunday night. Then when they kept talking about (how) this might explode, melt down, or whatever, then we were wondering just what was going to happen. (SY0611)

A second important reason mentioned by leavers (78%) was the confusing character of the information made available to them. In some cases, the confusion arose from the simple fact that different people were saying different things. As one leaver noted,

Everything was so conflicting in the news reports. You'd hear one (local) reporter (saying) there's nothing to worry about; you hear the national (news), the place is blowing up. (SY0611)

*This and other examples which follow has been excerpted from the transcript of a series of interviews carried out at the Department of Family and Community Medicine and Pediatrics at the Hershey Medical Center and the practice of Dr. Joseph Leaser, from April 30 to June 23, 1979.

TABLE 4.2

REASONS FOR EVACUATION
(% of households where someone left)

Situation seemed dangerous	82%
Information confusing	78%
To protect children	50%
To protect pregnancy	8%
To avoid confusion of forced evacuation	68%
Pressure from someone outside of family	22%
Trip planned before accident	7%

However, for some, contradictory information seems to have led to a general erosion of trust in government and company officials:

By then (Friday, March 30) I was getting worried. Because there were too many conflicting reports, I didn't know who I should be believing anymore. I felt that the officials were probably covering up and they were trying to prevent a panic, so they weren't telling us everything.... (MYO608).

The desire to protect children was also frequently offered as a reason for evacuation (50%).

Interviewer: Why did you decide to leave? You said you were frightened for the baby?

Respondent: Yeah, cause, you know they was talking about how it could affect him a couple of years from now. Well, his father was getting kind of crazy too, talking about if I didn't go he was (going to) take him, just the baby, so you know I wasn't gonna let that happen... (N-614)

A wish to avoid a forced evacuation was a commonly cited reason in the telephone survey (68%), although it appears to occupy a secondary role in the face to face interviews. Respondents who voiced their concern about a forced evacuation seemed to be concerned both about the mechanics of such an undertaking, as well as the possibility that warning would not be given in enough time to be of any value.

Respondent: I decided that there was more danger than I had thought, and I was very worried that we weren't going to be told in time to leave. I was very skeptical of the evacuation technique, and I just thought that I would rather go myself before they ordered it. (G-608)

Responses to the item about pressure from someone outside the immediate family was a relatively infrequent choice in the telephone survey (22%).* The most common form of such pressure came from adult children, who called respondents, urging them to leave, as in the case cited below:

Respondent: ...about ten o'clock my son from Reston, Virginia called and he said "mother I've been trying for hours to get you." He said "you can't get a line into Hershey." Everybody was calling a relative or friend and telling them to come there." and he said "you get out of there fast." He works for the government, and he said "in my building there's some nuclear experts and we've been talking together today and they say that the ones in charge of this are not telling the people the story and, he said "this is terribly dangerous." He said "come down to our place..." (L-504)

Reason for Staying

Those households in which some or all members stayed also attributed their actions to a variety of motivating factors (table 4-3). The most common of these include the feeling that whatever happens is in God's hands (69.6%), the belief that the best course of action would be to wait for an evacuation order (61.9%), a belief that there actually was no real danger, (30.0%), the fear of looters (28.6%), being unable to leave a job (27.4%) and the presence of obligations at home (25.6%). The first two answers, while the most common responses in the telephone survey were rarely mentioned in the interviews. This suggests that they are "secondary" motives. That is, they were positions which were likely to be endorsed by people who also had other reasons for staying. Of the remaining reasons for staying, only the belief that there was no danger (30%) requires some elaboration. There are a number of

*It is possible that some respondents in the telephone interview who had been called by relatives urging them to leave did not list "pressure from someone outside the family" as a reason for leaving because they assumed that it referred to a non-relative.

TABLE 4-3

REASONS FOR STAYING

(% of households where someone stayed)

Whatever happens is in God's hands	69.6%
Waiting for evacuation order	61.9%
Saw no danger	30.0%
Fear of looters	28.6%
Unable to leave job	27.4%
Things to do at home	25.6%
No place to go	12.4%
Too sick or disabled to travel	4.5%
Didn't have transportation	2.4%

different reasons for this response. One was the respondent's feeling that he or she was not personally vulnerable, usually because of age.

Respondent: They (her adult children) worried about me being here, but I felt that I'm older and I didn't feel it could hurt me too much anymore. But with them being of age to have children and so forth, ... I understand that radiation has to do with sterilization...

Others felt there was no danger because of reassurance from people felt to be knowledgeable. This is often, but not always, combined with the belief that the response of the media was far too extreme, as in the case below:

Interviewer: Okay, did anything in particular happen that made you feel any more confident about staying initially?

Respondent: Conversation with my neighbor whose husband had worked (with radiation)... She was very secure that there was really nothing to worry about, any radiation... exposed to our air. ... I think sometimes the news media, just exaggerates the point on everything and that's why I just didn't get upset, 'cause you hear one reporter would say this, and the other would make it sound so serious.

Finally, some individuals felt that, while the danger might be real, it was not substantially greater than hazards which were already being faced.

Respondent: I kinda had a feeling that there's been so many other times that I'm sure we've been endangered by radioactive clouds. We had the China fallout thing a few years ago and I just figured, well, I'm sure we've been exposed to these dangers before. And where you gonna really run that you're gonna be safe: (W-0525)

Summary

It is, of course, impossible to be certain about the correctness of anyone's decision regarding evacuation. The basic facts about the actual degree of danger were unclear. It is possible, however, to make an overall assessment of the process by which individual decisions were reached.

By and large, these decisions seem to have been made in a generally reasonable way. The absence of reliable information did not lead to mass panic, nor to a widespread denial that any threat existed. Those who left did so primarily because of a desire to protect family members who seemed to be unusually vulnerable (e.g. pregnant woman and small children), and because of a general feeling that, given the lack of information, a conservative approach would probably be best. Those who stayed were aware of the possibility of danger, but seem to have concluded that the possibility of genuine harm was outweighed by the costs of leaving and the benefits of staying.

Other Responses to the Crisis

Respondents were also asked the following questions about protective measures other than evacuation:

"Has the use of cow's milk for your family changed since the TMI incident?" (Yes/No)

"Did you do any of the following things to protect the health of household members?" (Kept family inside, had tests for radiation, changed their diets.)

In spite of considerable publicity regarding the possibility of milk contamination, only 8.3% of the respondents reported any change in their use of cows' milk. Of these, 26.7% reported stopping the use of milk altogether, 15% changed to powdered milk, 18.3% changed to milk

from a distant source; the remaining 40% carried out some other change. The only other protective measure carried out by a significant proportion of the population was to remain indoors as much as possible during the period of immediate crisis. Few respondents reported either having radiation tests or changing their diets (See Table 4.4)*.

Respondents were also asked about changes in their use of alcohol, tobacco, sleeping pills and tranquilizers. While these are not direct responses to the crisis, they can be seen as efforts to deal with the anxiety associated with an uncertain situation. Generally, increases were seen for all four substances (See Table 4.5). Approximately 15% of respondents who regularly drank alcoholic beverages reported an increase in their alcohol consumption, while the comparable increase for smokers was about 32%. The total number of people using sleeping pills and tranquilizers in the two weeks following the accident was also much higher than for the two week period preceeding the interview. The use of sleeping pills during the two week period immediately following the crisis was 7.4%, but only 3.5% in July. Similarly, tranquilizers were used by 8.8% of the respondents in the two weeks after the crisis, but by only 4.8% during the two weeks just prior to the interviews in July.

Respondents were also presented with a list of possible coping strategies and asked which, if any, had helped them to deal with the crisis. When the responses to these questions were factor analyzed they were found

*The interview schedule for the face-to-face interviews contained a wider range of possible protective actions including monitoring the radio or TV, keeping bags packed for possible evacuation, keeping the car filled with gas, keeping the family together, and using bottled water. These data have not been analyzed, but it appears that at least the first three actions were relatively common.

TABLE 4-4

OTHER PROTECTIVE MEASURES

% reporting change in use of cow's milk	8.3%
% reporting doing the following things to protect family:	
Kept members inside -	55.8%
Had radiation tests -	5.9%
Changed diet -	3.0%

TABLE 4-5

CHANGES IN USE OF ALCOHOL, TOBACCO, SLEEPING PILLS AND TRANQUILIZERS
DURING CRISIS PERIOD

% Drinkers increasing alcohol use	13.6%
% Smokers increasing smoking	31.9%
% Increase in number of people reporting use of sleeping pills (compared to July, 1979)	112.5%
% Increase in number of people reporting use of tranquilizers (compared to July, 1979)	87.5%

to cluster into two relatively distinct groups (See Table 4-6.) The first consisted of a series of strategies for either distraction (concentrating on movies, TV, or reading, becoming angry, or indulging oneself), or avoidance (trying to put it out of your mind, avoiding people, or sleeping more than usual.) The second group included strategies which involved a more active seeking of information and social support, including prayer, and conversations with friends and relatives, health professionals and members of the clergy. It is interesting to note that health professionals and members of the clergy were only rarely cited as a source of support. One strategy, working harder, was equally likely to be found in both groups.

Responses in January, 1980

The findings reported above are about how people responded during the crisis period and immediately thereafter. However, studies of natural disasters generally reveal at least some relatively long-term effects, (Logue et al., 1979) and while the TMI accident produced no equivalent direct damage to property to health, the possibility of such effects remains. Consequently, it was decided to conduct a second series of interviews to examine, among other things, possible long-term effects of the crisis. As was discussed in Chapter 2, two telephone surveys were carried out in January, 1980: a re-interview of those members of the PSU sample who had given their consent to be contacted again, (the panel study) and a new random sample of the population up to 55 miles from TMI, following the same sampling procedures as used in the original NRC study. Data reported below are from the random sample out to 55 miles. Results of the panel study will be discussed in chapter 6 (to be submitted later) which will deal with what types of persons were most stressed during and after the crisis period.

TABLE 4.6

REPORTED COPING STRATEGIES

GROUP I

Try to forget the whole thing by going to movies, watching TV or reading	24.5%
Force yourself to put it out of your mind	24.1%
Let off steam by getting angry	17.8%
Avoid people, get away by yourself	12.4%
Give yourself a treat by buying something you wanted	10.6%
Sleep more than usual	5.2%

GROUP II

Pray for guidance	56.1%
Seek advice and support from friends and relatives	53.2%
Talk to a doctor or health professional	11.3%
Talk it over with a clergyman or spiritual advisor	8.8%

BOTH GROUPS

Work harder, either at your job or around the house	27.7%
---	-------

Three questions were asked about respondents' reactions to the situation at Three Mile Island in the nine months since the accident

Has the accident at TMI disrupted your life during the nine months since it happened?

It there is another similar TMI accident, do you plan to leave right away?

How do you feel about re-starting TMI? Do you support re-starting it, are you against re-starting it, or don't you care one way or the other?

Responses to the questions about disruptions are shown in Figure 4-3.

As can be seen slightly over 20% of the respondents in the 0-5 band reported that the accident had disrupted their lives during the previous nine months. This rate remains essentially stable for the 6-10 mile population, and drops rapidly thereafter, eventually declining to slightly over 3% for the 41-55 mile band. The question about evacuation decisions in the event of a similar accident produced a somewhat different pattern (See Figure 4-4). Here, responses remained very similar out to 15 miles (0-5 = 53.5%, 6-10 = 46.0% and 11-15 = 43%), and then dropped rapidly. This pattern is also seen in responses to the question about re-starting TMI, as shown in Figure 4-5. The fact that, for all three questions, people closer to TMI showed greater disruptions and concern than did those farther away, indicates that closeness to the facility is a major factor in any long term attitudes toward TMI. This question is dealt with in detail in chapter 5.

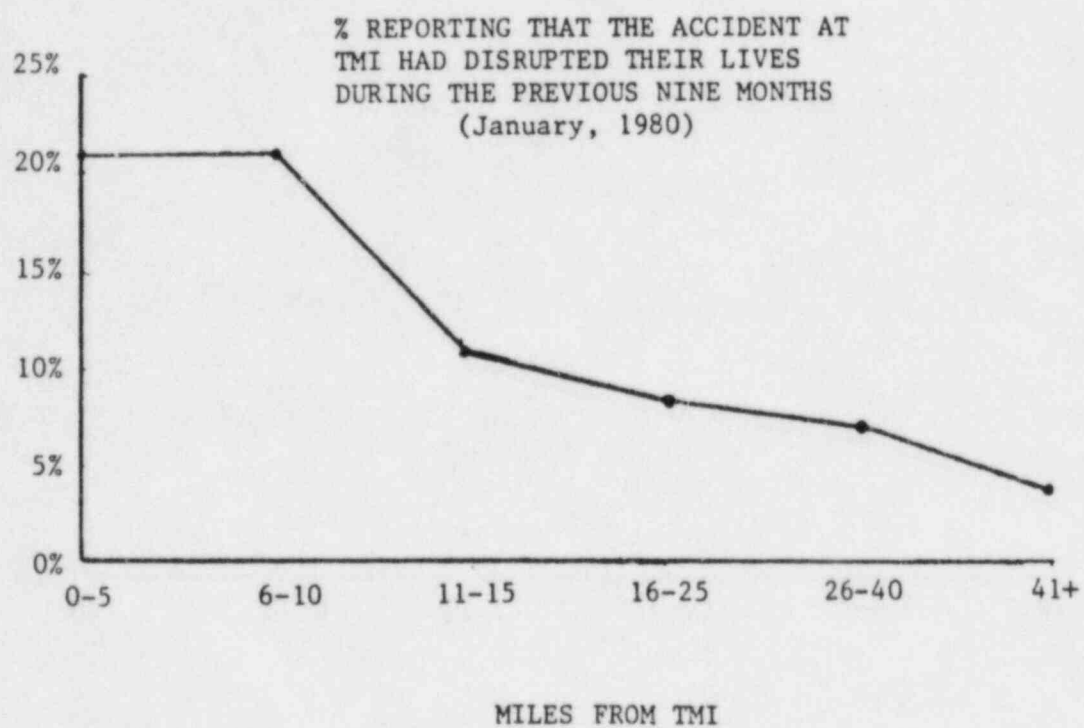
A second impact measure concerned degree of political activity:

Have you personally, been active in any organization or gone to any meeting to influence what happens at TMI?

The responses to this question are somewhat surprising (See Table 4-7).

While absolute values are not great, even for the 0-5 band, this represents a high level of political participation. While precise comparison is

FIGURE 4-3



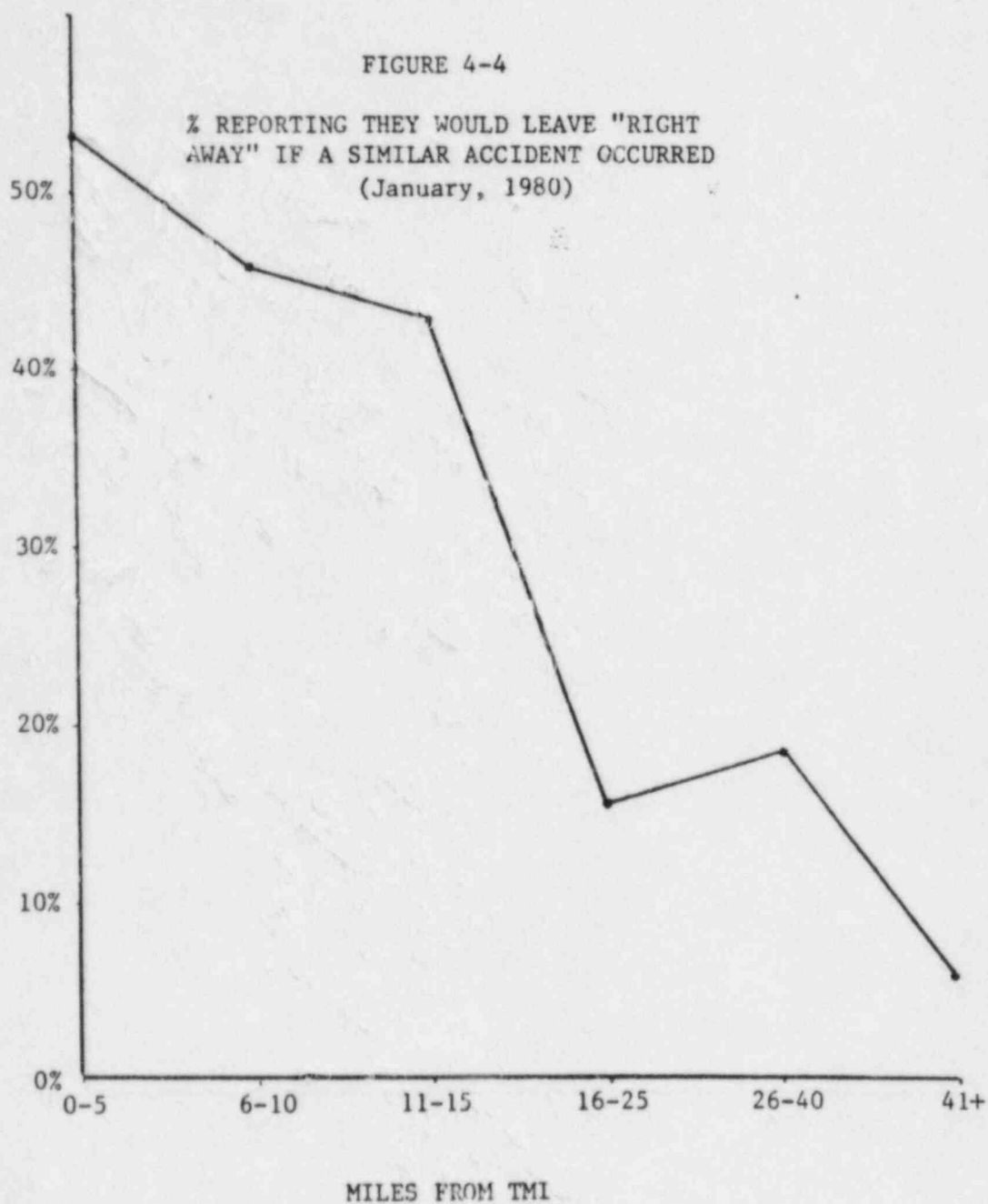


FIGURE 4-5
% AGAINST RE-STARTING TMI
(January, 1980)

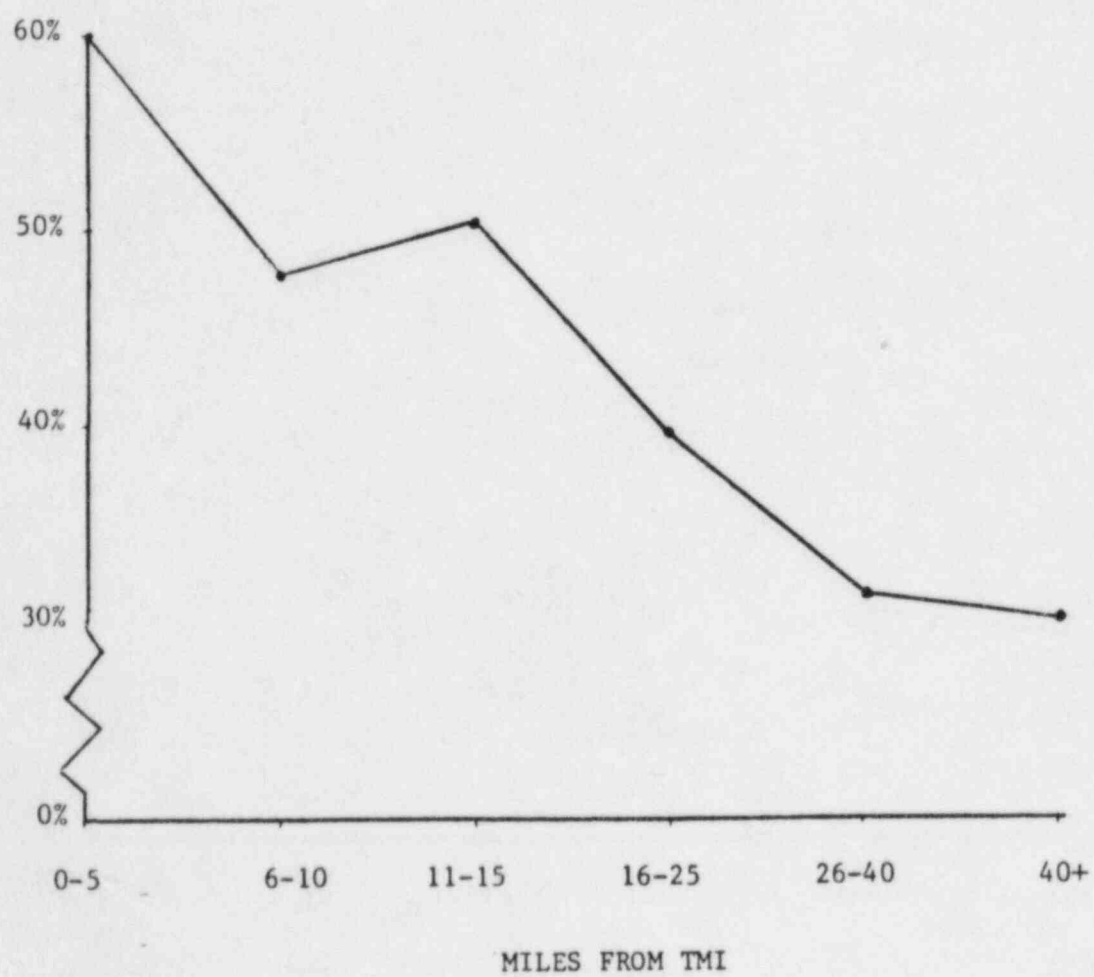


TABLE 4-7

POLITICAL ACTIVITY REGARDING TMI
APRIL 1979 - TO JANUARY 1980

MILES FROM TMI:	0-5	6-10	11-15	16-25	26-40	41+
Proportion of population reporting having been active in organization or attending meeting in order to influence what happens at TMI	12.9	9.0%	4.9%	2.9%	-	-

difficult, one generally finds that political activity of any kind is relatively rare. Thus a 1973 NORC survey found that only 5.2% of their respondents had ever participated in any kind of anti-war or pro-war demonstration, and only 9.5% had ever been involved in picketing in the course of a labor dispute. The discrepancy is even greater when one considers that the NORC questions refer to activities over an entire lifetime, where political activity related to the TMI accident could have occurred only with a period of nine months.

In chapter 5 we will consider additional findings about attitudes and symptom reporting in January, 1980. We will discuss also how the January patterns compare to responses in July.

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INTENSITY, EXTENT AND DURATION OF DISTRESS EXPERIENCED BY
THE POPULATION SURROUNDING THREE MILE ISLAND

Introduction

Data to be discussed in this chapter were collected in the July NRC study and in the January Penn State study which are described in detail in chapter 2. These studies sampled households largely with a 55 mile radius of Three Mile Island, though a small percentage of respondents in both studies extended as far as 100 miles. The fact that these surveys included persons at a considerable distance from the plant made it possible to use the farthest group, i.e. persons living beyond 40 miles of TMI, as a control group against which to compare responses of persons closer to TMI. By matching persons at different distances on demographic variables (i.e., age, sex, education, income and marital status) we can infer that, if distress is higher close to TMI, that this is related to events at Three Mile Island.* This analysis can be carried out using multiple regression analysis with dummy variables for each distance group.

It should be pointed out that the distance variable is a conservative indicator of distress due to Three Mile Island. Persons living in the farthest group may have experienced some degree of distress because of the crisis and these effects are lost in comparisons across distance. Therefore, while we may reasonably infer that, if distress levels are higher close to TMI than farther away, that this is a result of a proximity to Three Mile Island, we are not sure that this reflects all the distress that was caused by the crisis and its aftermath.

*Since not all possible demographic variables have been controlled, we cannot be absolutely certain that proximity to Three Mile Island is the only cause of distance effects, only that it is a likely cause.

Interpretation of distress responses

Three types of stress indicators were collected in these surveys: 1) direct statements about how worried, upset, etc. respondents have been about the situation at Three Mile Island, 2) the Langner index of psychological distress (Langner, 1962), and 3) respondents' reports of mental and physical symptoms that are often associated with stress. The stress-related symptoms used in this study were drawn from research on stress (Selye, 1956) as well as from interviews with patients at the Hershey Medical Center and in the practice of Dr. Joseph Leaser in Middletown immediately following the crisis. These stress-related symptoms were broken into two groups, based on a factor analysis. The first group, which deals primarily with physical symptoms, includes headaches, diarrhea, constipation, abdominal pain, sweating spells, stomach trouble, frequent urination, and rash, and we will call this group "Physical Stress Symptoms." The second group, which deals with overt behaviors, includes irritability, fits of anger, sleeplessness, loss of appetite, feeling trembly, trouble thinking, and overeating. We will call this second group "Behavioral Stress Symptoms." Results will be discussed separately for the two groups of symptoms.

Accuracy of Responses

Before reviewing the results, it is important to discuss variables which can cause discrepancies between what is reported and what actually occurred, since they must be considered in any interpretation given to the findings. There are at least five variables which can distort respondents' reports of their experiences during and after the Three Mile Island crisis.

- 1 Memory Most of the questions concerning stress asked respondents to remember events that occurred during the crisis

period or during the two weeks just prior to the interview. Since memory is rarely perfect and often selective (i.e. people tend to remember things that they think are important and sometimes forget things that are upsetting), there is ample opportunity for distortion to occur.

- 2 Mental Status It has been shown (Mechanic, 1972) that persons with poor mental status (e.g. anxiety, confusion, depression, etc.) tend to report more physical symptoms than others. It is not clear whether these people experience more symptoms or whether they simply attend to and remember symptoms which otherwise would have been forgotten. To the extent that it is the latter, people with poor mental status may report inflated symptom rates.
- 3 Willingness to Acknowledge Feelings and Symptoms Some persons are more open in telling others about their feelings and physical conditions than are others. It has been suggested that this variable may play a role in why women report more symptoms than men and why persons from certain cultural groups report higher symptom frequencies (Mechanic, 1972).
- 4 Attitudes and Commitments Many social psychological studies have shown that people tend to remember and report events in a manner that is consistent with their attitudes or their behavior (Festinger, 1957). This tendency could, for example, play a role in what pro or anti nuclear power people remember from their experiences during the crisis.
- 5 Conscious Distortion It is possible that some respondents consciously distorted their answers in hopes of affecting public policy toward Three Mile Island. For example, a

persons who is against re-opening TMI might over-state symptoms or feelings which he or she experienced during the crisis in an attempt to influence survey results toward showing that people in the vicinity of the island were experiencing distress.

Research with the Langner index and on symptom reporting in general (Mechanic, 1980) have demonstrated that they can be affected by many of these variables. Therefore, it is unlikely that reports of symptoms will match exactly how people felt during and after the crisis. As a result, in interpreting results, symptom frequencies should not necessarily be taken at face value. Instead, interpretations should be made cautiously looking at general patterns of responses and examining consistency of answers, rather than interpreting each response literally.

RESULTS

The three stress indices discussed above (feeling of concern, stress-related symptoms and the Langner index of psychological distress), will be discussed separately and then compared. Discussions will focus on differences with distance as compared to the control group (persons living beyond 40 miles from the facility).

Feelings of concern about TMI

Two questions concerning feelings about TMI were asked in both the July 1979 survey as well as in the January 1980 survey. Results will be reported separately for each question. The first question asked about how upset the respondent was about TMI. The exact phrasing was as follows.

- 1) How upset do (did) you feel about the situation at Three Mile Island?

extremely upset
quite upset
somewhat upset
a little upset
not at all upset
don't know

This question was asked twice; first in the July 1979 survey when respondents were asked how they had felt in April 1979, during the crisis period, and, second, in the January 1980 survey when they were asked how upset they presently felt.

Results are reported in figures 5-1 and 5-2. Data are presented in two ways. First is the percent of persons within each distance group who reported being extremely or quite upset about the situation at Three Mile Island (figure 5-1). This chart shows a sharp overall drop from April 1979 to January, 1980, though both lines are higher close to TMI. It is interesting to note that, even in the farthest group, over 20% were extremely or very upset in April and 7% still felt this way in July. This indicates, as suggested earlier, that distress was experienced to some degree even in the farthest group.

Second, these same data are reported after using multiple regression analysis to control for a number of demographic variables (age, sex, education, income and marital status), which differed somewhat at different distances, and, therefore, may have distorted the results. These "refined" results are shown in figure 5-2 in terms of variations from the farthest group (beyond 40 miles). Figure 5-2 also shows where response levels are significantly different from the response levels beyond 40 miles when age, sex, education, income and marital status have been controlled.

Figure 5-2 shows a marked distance effect in April, 1979 immediately following TMI, as well as in January, 1980, though the percentages for January within 15 miles are half what they were in April. In April, the

FIGURE 5-1

% OF RESPONDENTS EXTREMELY UPSET
OR QUITE UPSET ABOUT TMI
AT VARYING DISTANCES FROM THREE
MILE ISLAND

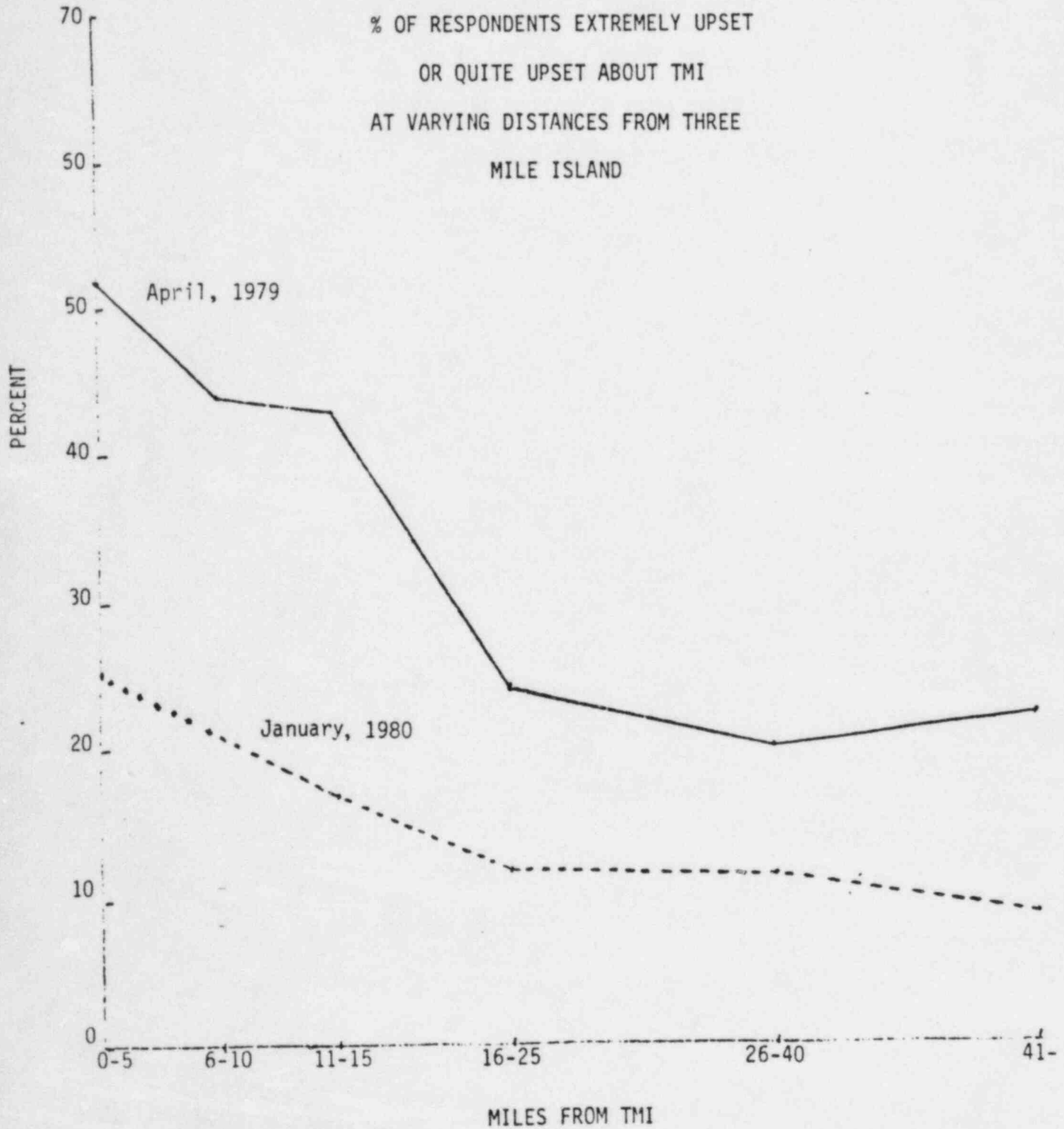
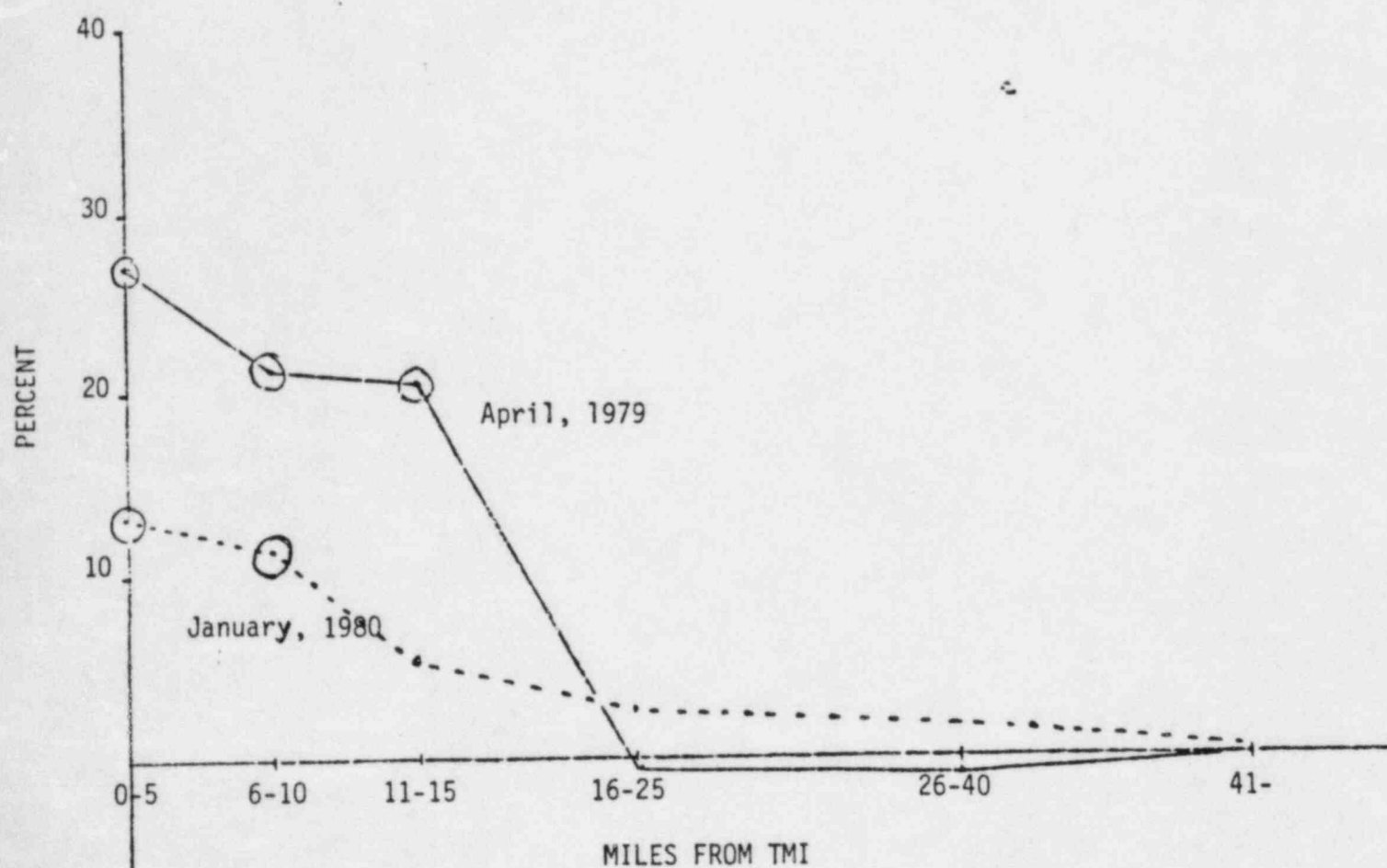


FIGURE 5-2
 CORRECTED* PERCENT OF RESPONDENTS EXTREMELY
 OR QUITE UPSET ABOUT TMI
 AT VARYING DISTANCES FROM THREE MILE ISLAND
 PLOTTED AS DIFFERENCES FROM THE GROUP BEYOND 40 MILES



*Age, sex, education, income and marital status controlled

A circled point indicates that the percent of persons who are extremely or very upset about TMI at that distance is significantly greater than the percent of persons beyond 40 miles who are extremely or very upset

probabilities of being extremely or very upset are significantly higher than the farthest group for the 0-5, 6-10 and 11-15 mile groups and then drop to below the level of statistical significance beyond that. In January, they are significantly different for only the 0-5 and 6-10 mile groups.

The second question concerns perceived threat to the respondent and his or her family. This question was phrased as follows.

How serious a threat do (did) you feel the Three Mile Island Nuclear Station is (was) for you and your family's safety?

a very serious threat
a serious threat
somewhat of a threat
no threat at all
don't know

This question was asked in the July, 1979 survey about how respondents had felt in April, immediately following the accident as well as for how they felt in July. The same question was also asked in the January survey for how respondents felt in January.

Results are shown in figures 5-3 and 5-4. The methods of analysis were the same as for the previous question and the findings are strikingly similar. While the overall percentages dropped sharply from April to July, (Figure 5-3), there was relatively little change from July, 1979 to January, 1980. When the three time periods are plotted as deviations from the farthest group with demographic variables controlled (figure 5-4) the three time periods are strikingly similar. There is a 10 percent drop from April to July with January scores between the two. For all three times the 0-5, 6-10 and 11-15 mile groups are significantly higher than the group beyond 40 miles.

Frequency of "physical stress symptoms" (i.e. headache, diarrhea, constipation, abdominal pain, sweating spells, stomach trouble, frequent urination and rash) are summarized in Figures 5-5 and 5-6. Results are reported in terms of percent of persons who reported at least one of these

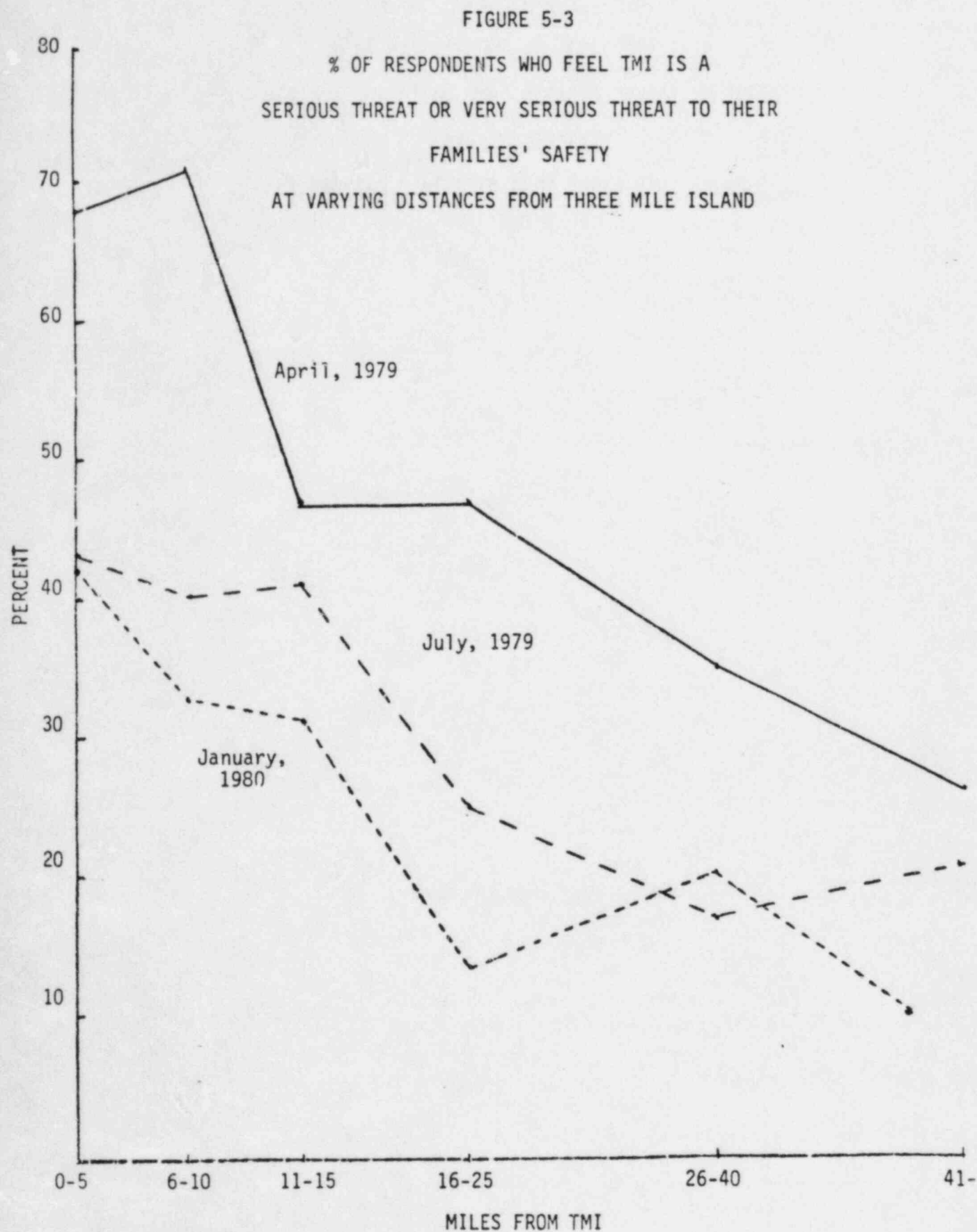
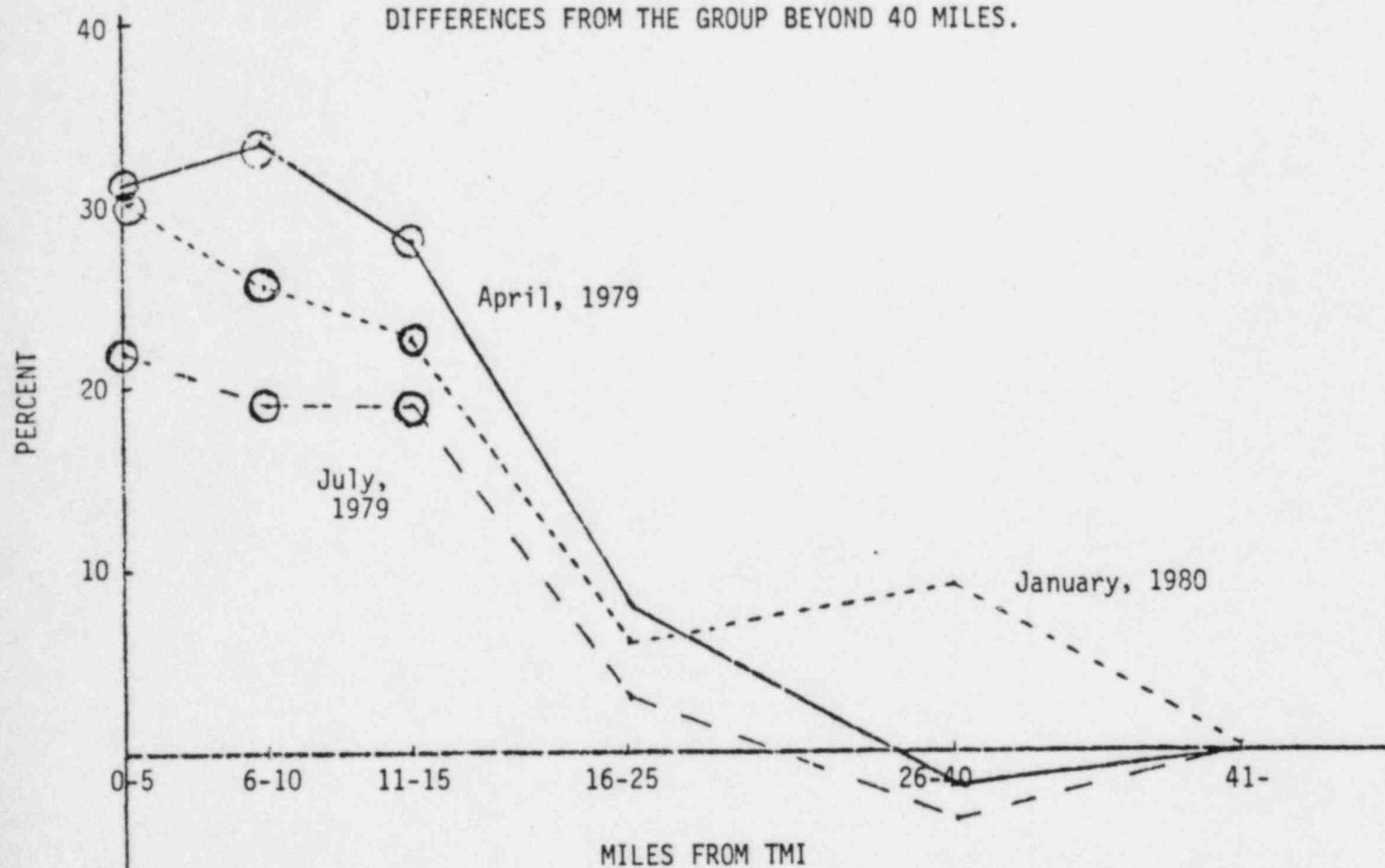


FIGURE 5-4

CORRECTED* PERCENT OF RESPONDENTS WHO FEEL TMI IS A SERIOUS
OR VERY SERIOUS THREAT TO THEIR FAMILY'S SAFETY AT
VARYING DISTANCES FROM THREE MILE ISLAND PLOTTED AS
DIFFERENCES FROM THE GROUP BEYOND 40 MILES.



*Age, sex, education, income and marital status are controlled

A circled point indicates that the percent of persons feeling that TMI is a very serious or serious threat at that distance is significantly greater than the percent of persons beyond 40 miles who feel TMI is a very serious or serious threat.

symptoms for each time period. Data analysis and presentation format are the same as for the two questions cited earlier.

The percent distributions, shown in figure 5-5, show large overall differences for April, July and January. The highest rates are reported in January, followed by July and then April. The fact that July rates are higher than April are possibly due to memory since both sets of data were collected in July. Therefore, in answering about April, respondents had to remember back three months, but in answering about July, they only had to remember for the two weeks just prior to the interview. The higher rates for January than July are possibly due to seasonal variations in symptom reporting rather than memory since both involved memory for only the past two weeks. The Health Interview Survey, a nationwide survey conducted by the National Center for Health Statistics, reports that acute symptoms are, on the average, 1.4 times higher in January than in July (DHEW Publication No. (PHS) 79-1560). This is approximately the same as the differences found here.

The fact that all three sets of data slope, that is, are higher close to TMI than far away, suggests that, as with the attitude measures reported earlier, closeness to TMI did have an influence on symptom reporting. Figure 5-6 makes this point more convincingly because demographic variables (i.e. age, sex, education, income and marital status) have been controlled and probabilities are plotted as deviations from the control group (beyond 40 miles) which eliminates the general level differences and allows comparisons of the slopes alone. Figure 5-6 not only shows raised response frequencies close to TMI, it also shows a sharp drop between 15 and 25 miles, the same as with the attitude data. Statistical significance, as shown in figure 5-6 also drops after 15 miles. The percent of the population above baseline at all three times is approximately ten percent.

FIGURE 5-5

PERCENT OF RESPONDENTS WITH ONE OR MORE PHYSICAL STRESS SYMPTOMS
AT VARYING DISTANCES FROM THREE MILE ISLAND

(HEADACHE, DIARRHEA, CONSTIPATION,
ABDOMINAL PAIN, SWEATING SPELLS,
STOMACH TROUBLE, FREQUENT
URINATION, AND RASH)

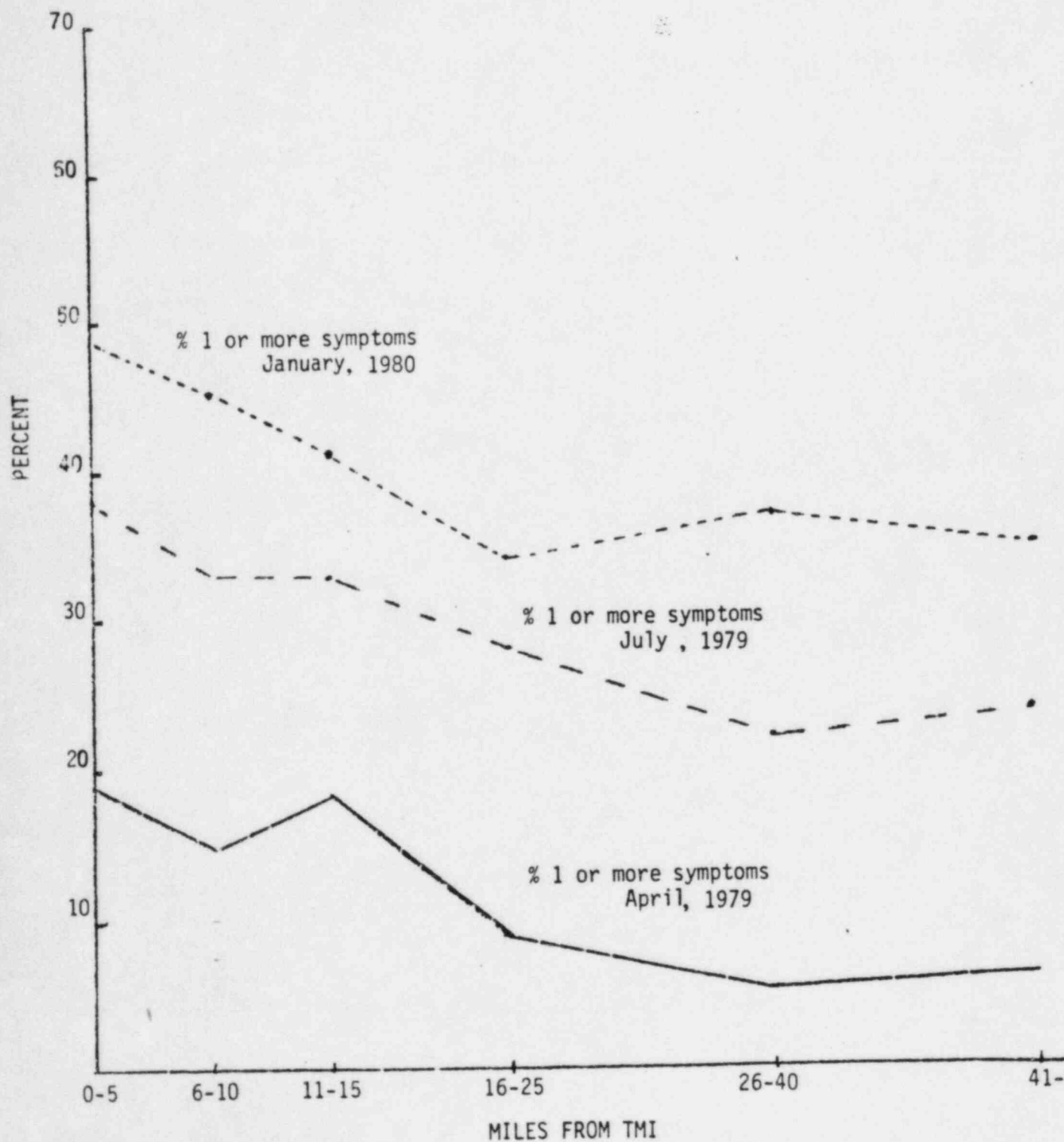
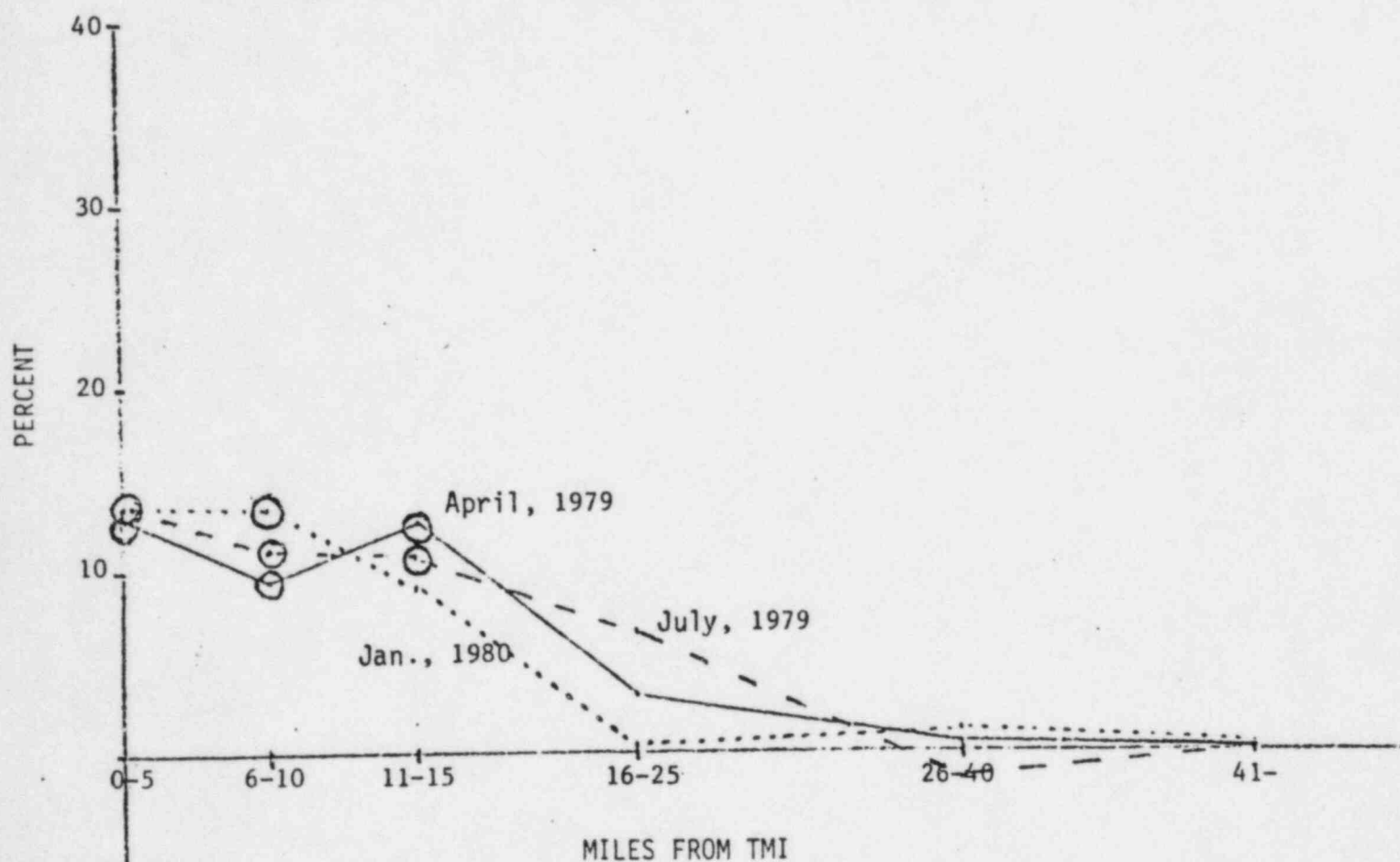


FIGURE 5-6
 CORRECTED* PERCENT OF RESPONDENTS
 WITH ONE OR MORE PHYSICAL STRESS SYMPTOMS
 AT VARYING DISTANCES FROM THREE MILE ISLAND
 PLOTTED AS DIFFERENCES FROM THE GROUP BEYOND 40 MILES



* Age, sex education, income and marital status controlled

A circled point indicates that the percent of persons who report at least one symptom at that distance is significantly greater than the percent of persons beyond 40 miles who report at least one symptom.

Analysis of "behavioral" stress symptom reporting (i.e. loss of appetite, overeating, trouble sleeping, feeling trembly or shaky, trouble thinking clearly, irritability and extreme anger) is shown in figures 5-7 and 5-8. The method of analysis and presentation parallels those reported earlier. Figure 5-7 shows some general level differences among the three time periods, as was found with the "physical" stress symptoms. These are probably due to the same causes. Figure 5-8, which includes controls for demographic variables as well as differences in general levels, again shows significantly higher levels of symptom reporting compared to the control group out to 15 miles for April and January, but during July for only the 0-5 mile and 11-15 miles groups. Figure 5-8 also shows highest rates within 15 miles for January followed by April and July. There is a rise in symptom reporting in January for the 26-40 mile group, but this is not significantly different from the group beyond 40 miles. In general, this figure repeats the patterns of the other measures, showing raised levels of symptom reporting out to 15 miles for April, July and January.

The last set of data to be reported here are responses to the Langner index of psychological distress which was included only in the January survey. This scale includes questions about depression, anxiety and some psychosomatic symptoms. Data were analyzed in the same manner as for the other distress indices. However, in this case, there were no statistically significant differences between groups close to TMI and the farthest comparison group.

DISCUSSION

As was pointed out earlier, there are a number of variables that can affect symptom reporting rates in addition to actually having symptoms. As a result, we cannot be certain that what people report is the same as what they experienced. However, it is possible to make some inferences from the general pattern of results that do not require accepting responses at face value.

FIGURE 5-7

% OF RESPONDENTS WITH ONE OR MORE BEHAVIORAL STRESS SYMPTOMS
AT VARYING DISTANCES FROM THREE MILE ISLAND

(LOSS OF APPETITE, OVEREATING, TROUBLE
SLEEPING, FEELING TREMBLY OR SHAKY,
TROUBLE THINKING CLEARLY, IRRITABILITY
AND EXTREME ANGER)

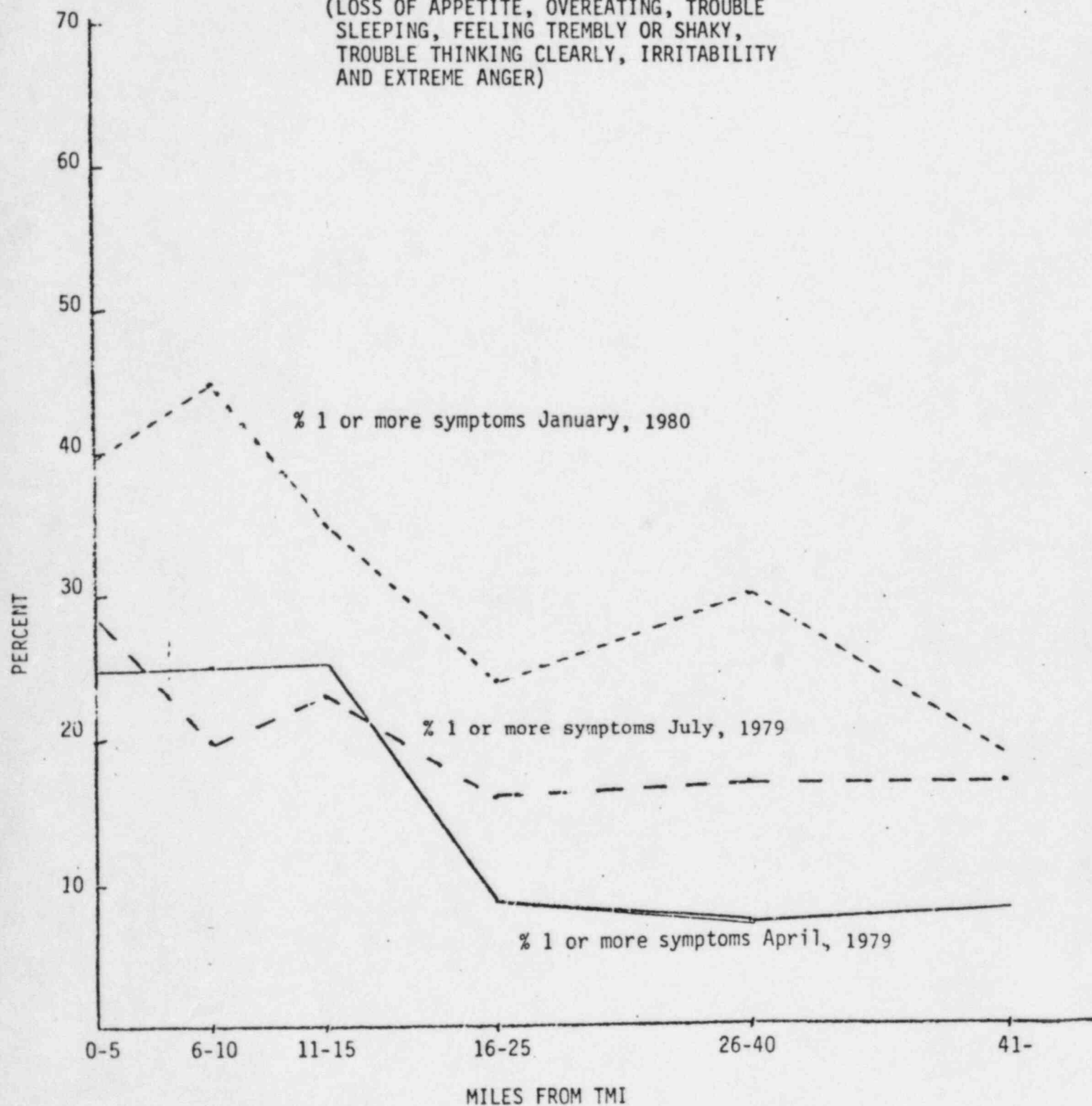
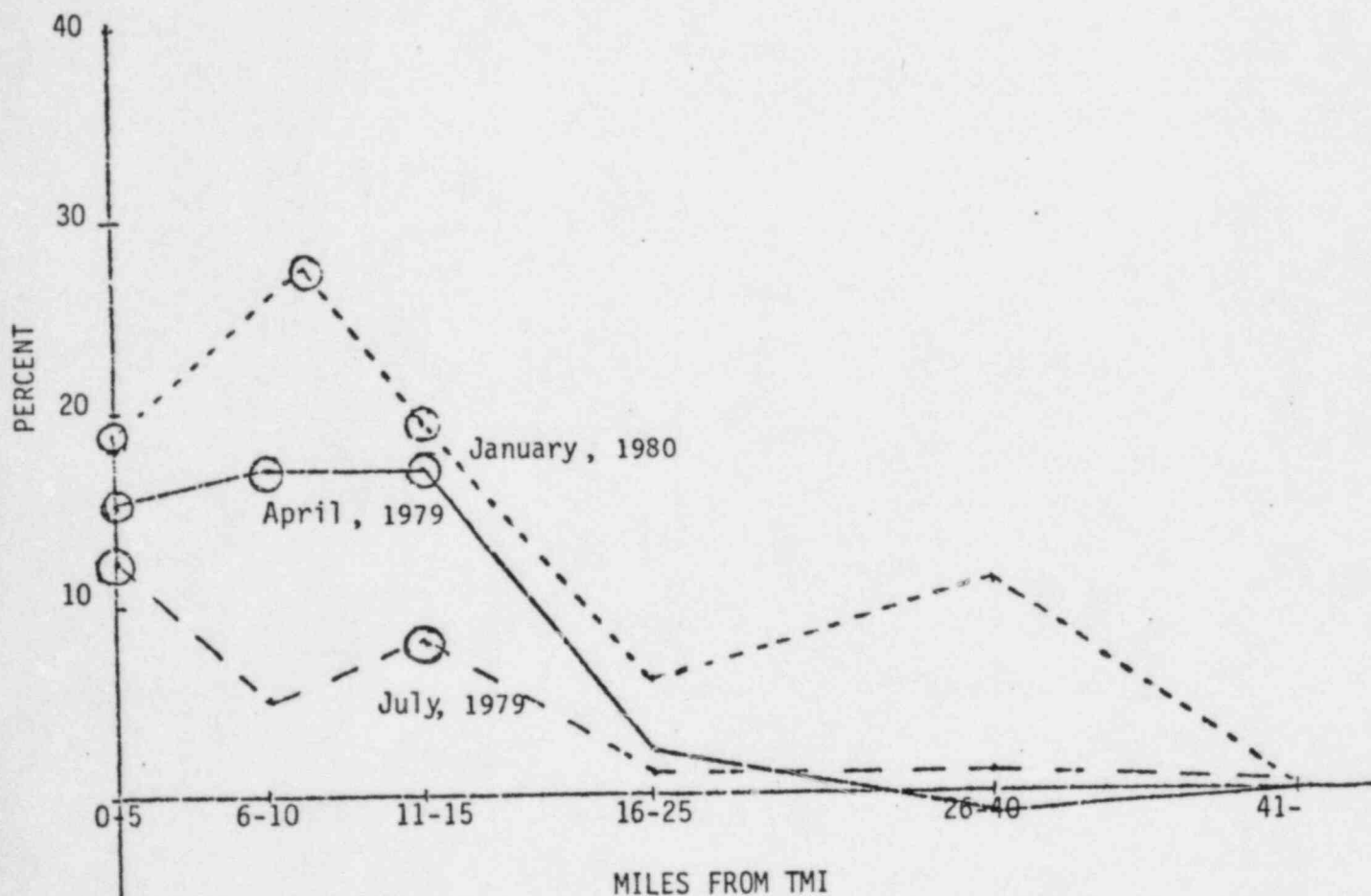


FIGURE 5-8
 CORRECTED* PERCENT OF RESPONDENTS
 WITH ONE OR MORE BEHAVIORAL STRESS SYMPTOMS
 AT VARYING DISTANCES FROM THREE MILE ISLAND PLOTTED AS
 DIFFERENCES FROM THE GROUP BEYOND 40 MILES



*Age, sex, education, income and marital status controlled.

A circled point indicates that the percent of persons who report at least one symptom at that distance is significantly greater than the percent of persons beyond 40 miles who report at least one symptom.

While there are several possible explanations for why symptom reporting is higher near TMI than farther away, they all indicate higher levels of stress near the Island. For example, if poor mental status (e.g. anxiety, depression, etc.) caused the higher reporting rates, poor mental status is, itself an indicator of distress. If the higher reporting rates near TMI are due to strong negative attitudes toward TMI which lead people to notice and remember symptoms, this too, indicates higher distress near the Island. Finally, if conscious distortion played a role in raising rates, this too can be considered an indicator of distress since conscious distortion would be expected where feelings are very strong. As a result, it is possible to conclude that distress (whether expressed through actual symptoms, increased tendency to notice and remember symptoms or conscious distortion in reporting symptoms) is higher close to Three Mile Island.

The similarity between findings for attitudes and for stress-related symptoms is striking. Both sets of data show raised levels of distress out to 15 miles and both sets of data indicate essentially the same pattern for April, July and January. This suggests that they are reflecting the same underlying distress levels. The fact that the Langner scale shows a different pattern from the other distress measures suggests that it may be measuring a different degree of distress or a different type of distress than are questions about attitudes or stress-related symptoms. An examination of items in the Langner scale suggests that both may be the case. For example, the Langner scale asks if the respondent is often troubled with headaches, while the stress-related symptom items only ask whether the respondent had experienced a headache in the past two weeks. Also, the Langner scale includes questions about depression as well as psychosomatic symptoms not included in either the physical stress or behavioral stress symptom lists.

A detailed analysis of each of the items in the Langner index and the stress-related symptom lists supports this interpretation. Several items in the Langner index allow for three responses: never, sometimes or often. The usual Langner scoring of these items is to only count "often" as a positive response. When this is done, none of these items show an increase close to TMI. However, when the response "sometimes" is also included, a procedure which makes the scoring more comparable to the PSU and NRC studies, a distance effect is seen, but only for those items which overlap with the stress-related symptom lists. This indicates that differences in both type and severity of symptoms assessed contribute to the different findings with these two distress measures.

Relationship of these findings to other studies

This is one of several studies concerned with mental stress experienced by the population surrounding Three Mile Island. Of the studies made public to date the one which overlaps most with this work is the report by the Task Force on Behavioral Effects of the President's Commission on the Accident at Three Mile Island.

The task force report included findings for several different sub groups including workers at TMI, mothers of young children, as well as some general population data. Since much of the task force's work concerned sub groups, it is not directly relevant to the findings reported here. However, two specific findings are relevant: 1) results of three administrations of the "demoralization" scale to persons within 20 miles of TMI and one administration to a control group in Wilkesbarre, Pennsylvania and 2) results of three administrations of "distrust of authorities" scale to persons within 20 miles of TMI and one administration to a control group in Wilkesbarre. The "demoralization" scale is made up of questions that are very similar to questions in the Langner scale used

in our studies. In fact, the two scales share some of the same items and the correlation between the Langner and demoralization scales is over .90, which makes them essentially equivalent. The distrust of authority scale includes questions about trust in federal or utility company officials regarding safety of TMI and whether respondents feel state or federal officials had been truthful. With this in mind, we will review the findings of the two studies.

The Presidential Commission Task Force found that demoralization scores were markedly raised among persons interviewed in April, immediately after the accident, but that they fell sharply in a second sample in May and showed a small additional drop in a third sample in July. A comparison of demoralization scores of mothers with small children in the vicinity of TMI and in Wilkesbarre showed no significant difference in July. These facts led the task force researchers to conclude that, on this measure of distress, the population had returned to baseline by July. The task force findings are consistent with the findings reported here for the Langner index. In January, we, too, found no differences in Langner scale scores between persons living close to TMI and persons living beyond 40 miles. In this respect, the results of the two studies are consistent.

The second task force measure involved the "distrust of authority" scale. The task force reported that the level of distrust was markedly elevated immediately following the accident and that it dropped slightly in May with a slight additional drop in July. However, they also found in July that it was higher near TMI than in a control group in Wilkesbarre. They also compared responses in July to results of a national survey which included similar questions. They concluded that, even in July, distrust near TMI was above the national level. These findings show a similar pattern to those reported here where ratings of upset and concern about safety of TMI were elevated near TMI in both April and July in comparison to persons living beyond 40 miles.

While the report of the presidential task force and the studies reported here are in substantial agreement, this may not appear to be the case from reading the summary statement of the presidential Commission on Three Mile Island. This is because writers of the summary report (who were not the same people who wrote the task force report) included only the findings from the Demoralization scale in their discussion of long term effects and ignored the findings about trust in authority. Their conclusion that "There was immediate, short-lived* mental distress produced by the accident among certain groups of the general population..." is correct if, by mental distress, is meant only behaviors assessed by the demoralization scale (and the Langner scale). However, long term effects through July were shown in the task force studies in the form of distrust of authority. In our study, long term effects were demonstrated through January 1980 in the form of being upset about TMI, concern about safety of self and family, and, closely related to these, awareness and reporting of symptoms frequently associated with stress.

SUMMARY

Between ten and twenty percent of the population within 15 miles of TMI had heightened levels of distress (compared to persons beyond 40 miles from TMI) as indicated by statements of being upset about TMI, concern about safety for themselves and their families and reporting of symptoms frequently associated with stress. This distress, which began during the crisis period, continued into January, 1980, nine months after the original crisis.

*underlining ours

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