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ATTRITION IN THE HIROSHIMA ADULT HEALTH STUDY: FIRST CYCLE ANALYSIS**

The Atomic Bomb Casualty Commission (ABCC) is an epidemiological research institute in Hiroshima and Nagasaki, cooperatively sponsored by the United States National Academy of Sciences and the Japanese National Institutes of Health of the Japanese Ministry of Health and Welfare to investigate the sequelae of radiation upon man. One phase of the comprehensive program,[1] designed to study the late effects of nuclear radiation is the Adult Health Study,[2] a continuing medical examination program involving approximately 20,000 individuals, both exposed and nonexposed, in Hiroshima and Nagasaki. The present report is concerned with attrition in the Hiroshima population only, for first complete cycle of examinations.

In July 1958 ABCC embarked on a new and completely reorganized program in which the major emphasis was directed toward the detection of late radiation sequelae in the survivors of the atomic bombings. The Adult Health study sample was selected as a subsample of a large "master sample population" which had been obtained from several sources, including various censuses, the details of which are published in the report of Beebe, Fujisawa and Yamasaki.[3] The medical subsample consists of four groups matched by age and sex:

Group 1: Exposed within 2,000 meters of the hypocenter with acute radiation symptoms in 1945.

Group 2: Exposed within 2,000 meters of the hypocenter without acute radiation symptoms in 1945.

Group 3: Exposed 3,000-3,499 meters from the hypocenter.

Group 4: Nonexposed, 10,000 or more meters from the hypocenter or not in the city at the time of the bombing.

The importance of a well integrated scientific approach involving the main disciplines of medicine, sociology, and statistics, as well as other

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departments of the institution, cannot be overemphasized. However, the key to the success of an epidemiological investigation of a population group such as the Adult Health Study sample depends ultimately upon the cooperation of the people included in the study. Regardless of the scientific efficiency of the establishment, results from an investigation are seriously compromised if the attrition rate is exceedingly high. Prior to the initiation of the Adult Health Study, ABCC had been conducting a general medical examination program. Experience in that program indicated an attrition of 40-50 per cent,[4] a figure in excess of that which would be acceptable, from a statistical point of view, to permit confidence in the results.

Since many of the subjects in the old program were included in the new adult Health Study, a paramount problem was how to appreciably reduce the attrition rate. In the past, "patient contactors" went to the individuals' homes to inform them of the ABCC study, interview the "patients," schedule appointments for examinations, and on the appropriate days, to provide transportation and accompaniment to the clinic.

Upon reviewing this phase of the program, it was found on the basis of past experience that certain improvements could be made. For example, the contactors required more specific knowledge of the medical program to enable them to explain to the subjects the benefits of complete examinations provided by ABCC. It appeared that the instructions may have been inadequate or confusing, resulting in subjects being omitted from the schedules. Furthermore, the contactors' work had been made more difficult by the fact that the general public held many misconceptions about the nature of ABCC medical examinations.

Discussions and meetings were held with the groups responsible for cooperation of the subjects in an attempt to alleviate the obvious deficiencies before the reorganized program was initiated. Two policy changes were instituted in the established procedure: (1) scheduled evening clinics were held once or twice a week, and occasionally, Sunday clinics were held to accommodate those individuals who could not attend the regular clinic hours, and (2) those individuals, at home or in hospital, who were too ill to come to the clinic, were visited by an ABCC physician and nurse, if the patient agreed.

The rest of the contacting program was followed as before. However, the "patient contactors" were adequately informed of the purposes of the over-all program, the nature and extent of the medical examination, and the importance of eliciting the cooperation of all the individuals. In February 1959, the contacting staff was incorporated into the new Depart-

ment of Medical Sociology, under the direction of a trained, experienced medical sociologist. Under his supervision, in-service training procedures were enhanced; several key personnel in medical sociology were trained and the patient-contacting personnel were strengthened in a variety of ways.

Clinic procedures were modified in an attempt to make the ABCC visit more convenient for the participants. Schedules were adjusted to avoid prolonged periods of waiting. The importance of displaying courtesy and consideration in dealing with participants in an ongoing investigation of this type was stressed to the doctors, nurses and receptionists. Minor conditions were treated at the time of the examination and patients with syphilis were encouraged to return to ABCC for penicillin therapy.

The individual changes were rather minor and superficially unimportant; however, they were designed to increase the morale and understanding of the staff as well as the understanding and cooperation of the patients.

The present report summarizes the attrition data for the complete first cycle of examinations for the Adult Health Study in Hiroshima, July 1958 to December 1960. It represents one mode of evaluating the success, or failure, of the program to elicit the interest and cooperation of the community in a large scale epidemiological investigation.

RESULTS AND ANALYSIS

Population.

The Adult Health Study population for Hiroshima includes 13,719 individuals presented in Table 1 by sex and exposure. The only discrepancies occur in the Group 3 males for the ages 20-29 and 30-39. The actual age discrepancies are mostly confined to a one or two year deviation and any arbitrary age groupings will consequently reveal discrepancies due to the lack of exact matching at the age boundaries of the groupings. Over 92 per cent of the entire Group 3 population exactly matched the Group 1 population by age, and only 4 per cent matched on a three or four year deviation.

The populations in the four exposure groups were put at random into 24 subgroups (A-X). The program was set up so that one subgroup was scheduled for examination each month. For various reasons, it was not always convenient for everyone in a particular subgroup to appear in the clinic in the scheduled month and, therefore, certain criteria had to be

TABLE 1. THE ADULT HEALTH STUDY POPULATION BY AGE, SEX AND DEGREE OF EXPOSURE.

	Males					*Females*					*Both sexes*				
		*Exposure**					*Exposure**					*Exposure**			
Age	*Total*	*1*	*2*	*3*	*4*	*Total*	*1*	*2*	*3*	*4*	*Total*	*1*	*2*	*3*	*4*
20	313	78	78	79	78	380	95	96	92	97	693	173	174	171	175
20-29	831	202	202	226	201	1,161	290	290	292	289	1,992	492	492	518	490
30-39	877	226	226	197	228	2,108	529	526	529	524	2,985	755	752	726	752
40-49	801	201	197	197	206	1,471	367	363	369	372	2,272	568	560	566	578
50-59	1,071	267	269	268	267	1,822	452	459	458	453	2,893	719	728	726	720
60-69	934	231	235	239	229	983	247	247	248	241	1,917	478	482	487	470
70+	424	108	105	103	108	543	135	134	134	140	967	243	239	237	248
Total	5,251	1,313	1,312	1,309	1,317	8,468	2,115	2,115	2,122	2,116	13,719	3,428	3,427	3,431	3,433

* For description of exposure groups, see first page of text.

established for deciding whether an examination at ABCC at another time could be taken. In order to avoid requesting repeated examinations in a short period of time and to allow the person as much freedom and convenience as possible, the twelve-month period preceding the scheduled month of examination was designated as the period to be listed as "in

TABLE 2. SUMMARY OF THE PARTICIPATION SCORES FOR THE FIRST CYCLE OF THE ADULT HEALTH STUDY, BY SCHEDULE GROUPS.

Schedule groups	*Participation scores*
A	78.1
B	79.2
C	74.4
D	76.4
E	77.3
F	76.5
G	80.5
H	78.4
I	81.1
J	81.6
K	82.6
L	81.8
M	83.1
N	83.8
O	86.0
P	86.9
Q	82.9
R	85.4
S	83.5
T	86.6
U	83.9
V	80.8
W	84.6
X	85.5
All groups	81.7

lieu of the scheduled examination" and the twelve month period following the scheduled month as an examination "during the present examination series." Thus, any complete examination performed at ABCC during the 12 month period preceding or subsequent to the scheduled examination was considered valid.

Although first cycle examinations were initiated in July 1958, the 12-month latitude in the date of examination means that the series under

study did not officially end until July 1961. Therefore, for the present report, a cut-off date of December 31, 1960 was selected since few examinations would accrue during the last 6 months. By including only examinations through December 1960, six Schedule Groups, S-X, are incomplete as far as the first cycle is concerned. Group X has 6 eligible months left for examination; Group W has 5; and so on, to Group S, which has only one month's experience excluded from this study. If the assumption is

TABLE 3. SUMMARY OF THE FOLLOW-UP EXPERIENCE FOR THE FIRST CYCLE OF THE ADULT HEALTH STUDY.

Code	*Outcome of Contact*	*Number*	*Per cent*
1	Examined before present exam. series started	467	3.4
2	Examined during present exam. series	9,908	72.2
3	Refused examination	1,238	9.0
4	Deceased	1,019	7.4
5	To ill to come for exam. and not seen in hospital or at home	74	0.5
6	Moved away from Hiroshima—address known	844	6.2
7	Moved away from Hiroshima—address unknown	112	0.8
8	Future appointment made	27	0.2
9	No contact made	30	0.2
	Total	13,719	99.9
	Participation score* by per cent		81.7

* Participation Score: $\% = [\text{Code } (1+2) \div (\text{Total} - \text{Code } 4)] \times 100$

made that the individuals for these 6 incompleted Schedule Groups will continue to come for examinations in the same proportions as the previous Schedule Groups, then approximately 15 additional persons will be examined from these particular groups. This is less than 0.2 per cent of the 9,908 examinations which are included. In other words, the data included in this study represents approximately 99.8 per cent of the Hiroshima Adult Health Study examinations.

Participation scores by schedule groups.

The participating scores for the Adult Health Study are summarized in Table 2 by Schedule Groups. These scores ranged from 74.4 per cent for Group C to 86.9 per cent for Group P with an average of 81.7 per cent for the 24 groups. It is clear from the results of the contacting program that the rate of examinations for the individual groups increased with time,

leveling off after the first 12 months. This probably reflects the interest and vigorous efforts of the Medical Sociology Department and, particularly, the patient contactors, who continually evaluated and modified their procedures to reduce the attrition rate.

Table 3 summarizes the follow-up experience for the first cycle. Several items of interest in this table warrant discussion at this point and should also be kept in mind when reviewing many of the tables which follow. The key categories in the contacting program concern items 1 and 2, the number or per cent of individuals examined during the first cycle; and item 3, the refusals. Of the entire Adult Health Study population, 75.6 per cent were examined during the first cycle which, in itself, is a creditable figure for an epidemiological investigation of this nature. Of the 24.6 per cent not examined, 7.4 per cent were deceased and excluded from the population base. In addition, 7.0 per cent of the population had moved out of Hiroshima. These individuals have been included in the population base, even though such persons were, for practical purposes, not available to come to the clinic at ABCC for examination. Therefore, if only those persons alive and still resident in Hiroshima were used as the basis for the attrition rate, then 88.4 per cent of the population was examined during the first cycle, which, indeed, is a remarkable figure.

Only 9.0 per cent of the population refused to participate in the program. It must be pointed out that some individuals in this category did not actually refuse to participate, but failed to come at the appointed time, were rescheduled, failed to come again, and so on, until the period for inclusion in the first cycle of examination was terminated. Therefore, anyone who did not receive an examination for reasons other than "too ill to come," "no contact made," or "moved away" were included as refusals for purposes of analysis and presentation.

Under the category "no contact made" are included 30 individuals, or less than 0.2 per cent of the sample, who were apparently living but could not be located during the first cycle. This does not necessarily mean that they are permanently in this category as efforts will be exerted to locate every living individual during each cycle regardless of the experience during the previous cycle.

Participation scores by exposure categories.

The attrition by exposure categories can be analyzed from several points of view; however, the main question to be raised is whether or not there is a difference between the exposure groups as to the rate at which indi-

TABLE 4. CONTACT SCORES BY EXPOSURE CATEGORIES FOR THE FIRST CYCLE OF THE ADULT HEALTH STUDY.

	Exposure groups					*Results of significance tests between exposure groups*	
Schedule Groups	*Inner proximal with symptoms*	*Inner proximal without symptoms*	*Distal*	*Nonexposed*	*Total*	$X^2_{(3)}$	
A	80.2	75.4	83.2	73.5	78.1	4.64	N.S.
B	77.0	77.4	81.5	80.9	79.2	1.33	N.S.
C	79.4	69.7	75.6	73.2	74.4	3.45	N.S.
D	83.6	78.8	72.9	70.4	76.4	7.87	*
E	77.4	80.0	79.4	72.6	77.3	2.55	N.S.
F	82.1	69.1	78.0	76.9	76.5	6.61	Sugg.
G.	83.7	83.6	79.1	75.7	80.5	3.79	N.S.
H	80.7	83.5	73.5	76.1	78.4	4.66	N.S.
I	86.2	78.4	82.6	77.7	81.1	4.06	N.S.
J	86.8	81.4	78.9	79.1	81.6	3.60	N.S.
K	81.0	86.7	84.3	78.3	82.6	3.87	N.S.
L	85.3	77.2	82.1	82.7	81.8	3.14	N.S.
M	85.9	85.4	84.1	77.3	83.1	4.51	N.S.
N	85.0	82.2	87.6	80.5	83.8	2.80	N.S.
O	88.0	80.6	87.5	87.5	86.0	4.03	N.S.
P	91.7	84.1	87.7	84.2	86.9	4.47	N.S.
Q	84.3	85.4	84.5	77.4	82.9	3.75	N.S.
R	90.2	82.7	85.7	83.0	85.4	3.80	N.S.
S	82.6	90.8	85.7	75.2	83.5	12.50	**
T	87.1	89.7	83.6	86.3	86.6	2.13	N.S.
U	91.0	86.3	76.4	81.7	83.9	11.27	*
V	80.0	83.1	81.6	78.7	80.8	.94	N.S.
W	83.6	85.6	86.3	83.2	84.7	.68	N.S.
X	86.6	87.6	87.2	80.6	85.5	3.49	N.S.
Total	84.1	81.8	82.1	78.8	81.7		
Results of significance tests between Schedule Groups $X^2_{(23)}$	36.26 *	61.25 **	40.57 *	35.53 *	173.61 *		

* Significant ($P<0.05$).

** Highly significant ($P<0.001$).

viduals participated in the study. More specifically, is there a consistent relation between attrition and the degree of exposure? Superficially, it might be hypothesized that the group with radiation symptoms would be the group most easily attracted to or influenced in participating in the Adult Health Study. The "exposed without symptoms," the "distal exposed," and the "nonexposed," as groups, conceivably would be progressively less readily agreeable to and less interested in participating in such a medical study. Interest in a medical examination would be assumed to bear a direct relation to proximity to the hypocenter of the bomb.

The data by exposure categories for the individual Schedule Groups is presented in Table 4. If there were no real difference between the participation scores for the various exposure groups there should be no difference in the number of times that each of the exposure groups had the highest participation score. In other words, each group should have the highest participation score one-fourth of the time. The following tabulation summarizes the first cycle experience in this respect:

	Exposure groups			
	1	*2*	*3*	*4*
No. of Schedule Groups for which the exposure group had the highest participation score	12	8	4	0
No. of times each exposure group would be expected to have the highest participation score if attrition were unrelated to exposure	6	6	6	6

Obviously, the results confirm the hypothesis that exposure category is related to the participation score. The data exhibit a definite and regular trend, with Groups 1 and 2 having an excess of highest scores and Groups 3 and 4 having a deficit. In fact, Group 4 never had the highest score.

Although the above data support the concept of significant differences between participation scores for exposure groups, the absolute difference between the percentages for the exposure categories is equally important. The results of significance tests between the four exposure groups for individual Schedule Groups are summarized in the last column of Table 4. In only three instances, Schedule Groups D, S, and U, were the differences observed between the participation scores of the exposure groups individually significant.

TABLE 5. PARTICIPATION SCORES BY AGE, SEX AND EXPOSURE FOR THE FIRST CYCLE OF THE ADULT HEALTH STUDY

Males: *Age*	*Inner proximal with symptoms*	*Inner proximal without symptoms*	*Distal*	*Nonexposed*	*Total*	*Results of significance tests between exposure groups* $X^2_{(3)}$	
10-19	81.1	76.6	79.5	83.3	80.1	1.16	N.S.
20-29	70.5	69.2	74.4	63.9	69.7	5.52	N.S.
30-39	84.6	84.4	81.5	78.1	82.2	4.20	N.S.
40-49	81.7	84.0	81.5	78.1	81.3	2.22	N.S.
50-59	87.3	84.4	83.0	83.5	84.5	2.06	N.S.
60-69	85.6	84.0	83.8	85.2	84.7	.361	N.S.
70+	90.8	78.3	88.1	80.9	84.5	4.97	N.S.
All ages	82.7	80.9	81.0	78.6	80.8	20.5	N.S.
Results of significance tests between age groups $X^2_{(6)}$	28.7 **	24.3 **	9.96 N.S.	34.5 **	97.5 **		
Females:							
10-19	85.3	80.0	75.8	76.0	79.3	3.38	N.S.
20-29	80.8	79.6	78.5	72.2	77.8	7.24	Sugg.
30-39	85.2	82.8	84.1	83.0	83.8	1.30	N.S.
40-49	88.0	85.2	84.6	82.0	84.9	5.10	N.S.
50-59	86.7	83.5	85.6	78.4	83.5	12.9	**
60-69	84.3	78.1	79.5	78.4	80.1	3.40	N.S.
70+	79.2	83.7	81.3	73.0	79.1	3.63	N.S.
All ages	85.0	82.3	82.7	79.0	82.2	37.0	*
Results of significance tests between age groups X^2	10.2 N.S.	6.99 N.S.	12.3 Sugg.	17.9 **	47.4 **		

* Significant ($P<0.05$).

** Highly significant ($P<0.001$).

In addition, the variation within a particular exposure group is as great as the maximum difference between exposure groups for any particular Schedule Group. That is, Exposure Group 1 has a variation of approximately 15 per cent; Group 2, 12 per cent; Group 3, 15 per cent; and Group 4, 18 per cent; the largest variation between exposure groups is found in Schedule Groups S and U, being approximately 15 per cent. The results of the significance tests within exposure groups but between Schedule Groups are presented at the bottom of Table 4, and are statistically significant for all four exposure groups. The conclusions to be drawn from the analyses of these data can be summarized as follows. Although the participation scores appear to exhibit a definite trend with exposure, Group 1 having the highest participation and Group 4 the lowest, absolute differences between the rates of the exposure categories are small.

Participation scores by age and sex.

The data by age and sex are presented in Table 5. For males the differences between the age groups were significant for three of the four exposure groups. Only in the "distal" group was the variation small enough to be nonsignificant. On the other hand, only the "nonexposed" females exhibited significant differences between the participation scores by age.

Exposure group differences were re-examined on an age and sex specific basis. In only one instance, the 50-59 year old females, was a significant result obtained. The results are consistent with and support the previous findings that the variation within exposure groups is as great or greater than the variation between exposure categories.

Sex differences were analyzed on an age-exposure specific basis, permitting 32 such comparisons, including the combined age comparisons for each exposure group which was performed by oriented or directed Chi Square tests. Only two significant results were obtained, both with the 20-29 year age groups for those with and without symptoms. Out of 32 comparisons, the probability of finding two or more significant results by chance alone is 0.40.

In addition, these data were tested on the theory that if there was no difference between the sexes, the contacting scores for males should be higher than the female scores in 50 per cent of the cases. In practice, this is exactly what occurred, indicating little sex difference in the attrition rates.

Participation scores by marital status.

Results of the analyses by marital status clearly demonstrate significant differences in the participation scores. For males the differences between marital groups are statistically significant for each of the exposure categories. The married and widowed individuals participated in the clinic program to a considerably greater extent than the single and divorced or separated individuals (85% vs. 68%). However, it must be emphasized that the married group comprises approximately 73 per cent of the male Adult Health Study population, and the numbers of subjects in the single and divorced groups are rather small. Therefore, although the variation between exposure categories is similar for each of the marital groupings, only for the married group is it statistically significant.

For females, participation scores exhibit less variation and only in the "distal" group are the differences between marital status significant. The rates for the married and widowed categories are higher than those of the single and divorced or separated; however, the differences are less pronounced than those for the males. Also, the variation between the exposure groups is similar for each of the marital categories, but only the differences for the "married" are significant. The reason for this is the same as for the males, namely, the number of individuals in the three marital categories other than the "married" one are rather small; the "married" includes approximately 67 per cent of the female clinic population.

Participation scores by history of prior contact with ABCC.

Approximately 50 per cent of the Adult Health study population had participated in previous ABCC investigations. Two opposing hypotheses are immediately suggested. Firstly, the individuals who had been included in previous ABCC studies or who had ever been to the clinic before would have some knowledge of the ABCC program and should be less skeptical of the type of examination and, theoretically, be more receptive to the efforts of the patient contactors. On the other hand, participation in any survey means a certain amount of inconvenience and the person who has already submitted to at least one physical examination may be more resistant to subsequent appeals. The evidence from the medical program preceding the present Adult Health Study indicated a 40 to 50 per cent attrition rate,[4] which would tend to support this second theory.

Table 6 summarizes the data with respect to this variable. It is evident that the group with prior ABCC contact had consistently higher rates of

participation than the newly contacted individuals. The differences were significant in each exposure group and are mainly due to the rather low rates of the group for which prior ABCC contact was unknown. However, there was a difference of about 7 per cent between the two large groups with a known history. These two groups include approximately 97 per cent of the sample.

TABLE 6. PARTICIPATION SCORES BY PRIOR CONTACT WITH ABCC AND EXPOSURE FOR THE FIRST CYCLE OF THE ADULT HEALTH STUDY.

	Exposure groups					*Results of significance test between exposure groups*	
Prior history	*Inner proximal with symptoms*	*Inner proximal without symptoms*	*Distal*	*Nonexposed*	*Total*	$X^2_{(3)}$	
New—No prior contact with ABCC	74.7	80.4	80.2	78.0	79.0	9.53	*
Prior contact with ABCC	86.7	86.2	84.9	85.6	85.9	3.02	N.S.
(a) Acceptance	93.5	93.2	94.2	93.4	93.6	0.79	N.S.
(b) Refusals	76.8	78.0	74.3	72.5	75.9	4.00	N.S.
Prior contact with ABCC unknown	65.7	58.6	61.2	58.7	62.2	1.55	N.S.
Total	84.1	81.8	82.1	78.8	81.7		

* Significant ($P<0.05$).

The group with prior ABCC contact was further subdivided into individuals who had participated and those who had refused to participate in the previous studies. Although the differences in the rates between these two groups are significant for each exposure category, and the rate for the "accepted" group is extremely high (93.6 per cent), the important figure is the rate for the previous refusals. Roughly 76 per cent of the individuals who had previously refused to participate in an ABCC program had been persuaded to actively support this study. This figure is an indication of the vigorous efforts of the Medical Sociology Department and, in particular, the patient contactors, and attests to their enthusiasm and appreciation of their vital role in the success of this medical program.

There was little variation between exposure categories among persons who had previously been contacted or for whom the history was unknown.

Only the group with no prior ABCC contact exhibited significant differences between exposure categories.

Participation rates by occupation.

The comparisons between occupations exhibit a completely different trend for the two sexes. In the males, significant differences are observed

TABLE 7. CONTACT SCORE FOR THOSE IN THE LABOR FORCE AND NOT IN THE LABOR FORCE, BY SEX AND EXPOSURE, FOR THE FIRST CYCLE OF THE ADULT HEALTH STUDY.

	Exposure groups				
	Inner proximal with symptoms	*Inner proximal without symptoms*	*Distal*	*Nonexposed*	*Total*
Males:					
Labor force	86.6	83.6	84.5	81.7	84.1
Not in labor force	77.3	79.9	74.1	78.8	77.5
Total	85.0	83.0	82.8	81.2	83.0
Results of significance test between labor force and $X^2_{(1)}$	9.80	1.15	11.1	.722	22.8
Not labor force	**	N.S.	**	N.S.	**
Females:					
Labor force	88.4	84.8	84.7	81.0	84.8
Not in labor force	84.7	82.8	82.7	80.2	82.6
Total	85.9	83.4	83.4	80.4	83.3
Results of significance test between labor force and $X^2_{(1)}$	4.49	1.00	1.12	.152	6.76
Not labor force	*	N.S.	N.S.	N.S.	N.S.

* Significant ($P<0.05$).
** Highly significant ($P<0.001$).

in all the exposure categories with the exception of the "inner proximal without symptoms" group. In the females, none of the differences between the occupational rates were significant for any of the exposure categories. It must be pointed out, however, that 65 per cent of the female population is in the category "not in labor force." Consequently, the number of women in the various occupations is quite small and quite large differences

are required to obtain statistical significance. However, the range of rates is 20 plus in each exposure group for the males, and only approximately half as great in the females.

The differences between exposure groups for fixed occupation are quite small. In the males, only one category, service workers, displayed a significant difference in respect to exposure, while two categories in the females had significant differences, namely, "farmers, fishermen, etc.," and "not in labor force." Again it is apparent that the variation between exposure categories is considerably less than the differences within the variable against which the comparisons are being made.

Table 7 summarizes the results of the attrition data on the broader basis of "in labor force" vs. "not in labor force." The variation within exposure groups is again more pronounced in the males than females. For the females, only in the "inner proximal with symptoms" group is the difference significant.

SUMMARY AND CONCLUSIONS

The participation data for the first cycle of the Adult Health Study conducted in Hiroshima during the period July 1958 to December 31, 1960 have been presented. The continuing medical examination program includes approximately 13,700 individuals who form the Adult Health Study population of the Atomic Bomb Casualty Commission in Hiroshima, Japan, and was designed to investigate the late effects of nuclear irradiation on man. The Adult Health Study population is composed of four exposure groups of equal size, matched by age and sex.

Participation scores were analyzed by exposure, age, sex, and socioeconomic variables, as well as by a history of previous contact with the ABCC programs. Significant differences were demonstrated between the participation scores by age, marital status, history of prior contact with ABCC, and occupation (this latter category was significant only for males). Although differences were observed for these variables, the significance was usually attributable to one discrepant category in each of the variables, often the least populated, such as "separated or divorced" for marital status; and "previous history unknown" for prior ABCC contact.

A trend was apparent with respect to exposure, with the lowest participation noted in the nonexposed and the highest participation in the "exposed with symptoms" group; however, the absolute differences were not statis-

tically significant when analyzed in relation to all of the remaining variables. Sex differences were not significant.

Although relatively minor differences were demonstrated for some variables, the outstanding features of this program are the remarkably low attrition rates which were observed. Only 9 per cent of the population were in the so-called "refusal" category and over 80 per cent of the living population, including non-Hiroshima residents, were examined during the first cycle of the program.

REFERENCES

1. Francis, T. (chairman), Jablon, S., and Moore, F. E.: Report of *ad hoc* Committee for Appraisal of ABCC Program. Unpublished memorandum dated 6 November 1955, Hiroshima, and addressd to Dr. R. Keith Cannan, Chairman, Division of Medical Sciences, National Academy of Sciences, National Research Council.
2. Hollingsworth, J. W. and Beebe, G. W.: Adult Health Study; Provisional Research Plan. ABCC Technical Report 09-60, 1960.
3. Beebe, G. W., Fujisawa, H. and Yamasaki, M.: Adult Health Study; Reference Papers: A. Selection of the Sample; B. Characteristics of the Sample. ABCC Technical Report 10-60, 1960.
4. Hollingsworth, J. W., Beebe, G. W., and Yamasaki, M.: ABCC Adult Medical Study (ME-55), Tables on First Cycle Examinations, 1950-1953, Hiroshima. ABCC Internal Technical Report 08-61 (pg. 8).