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U. S. NAVAL SUBMARINE MEDICAL CENTER

Submarine Base, Groton, Conn.

REPORT NO. 628

THE RELATIONSHIP OF KNOWLEDGE OF BIOLOGICAL EFFECTS OF RADIATION AND SUBMARINE CREW MEMBER ATTITUDES TOWARD RADIATION HAZARDS

by

Joseph A. Parent, Jr.
LCDR, MC, USNR

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...STARK, CAPT MC USN
...ANDING OFFICER
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SUBMARINE MEDICAL RESEARCH LABORATORY
NAVAL SUBMARINE MEDICAL CENTER REPORT NO. 628

Bureau of Medicine and Surgery, Navy Department
Research Work Unit MR011.01-5006.01

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SUMMARY PAGE

THE PROBLEM

To investigate the possible relationship between attitudes toward radiation hazards and knowledge of the biological effects of radiation through the development of a questionnaire for use by submarine personnel.

FINDINGS

The data demonstrate a significant correlation among: favorable attitudes of submariners toward radiation hazards; knowledge of the biological effects of radiation and specialized training regarding radiation.

APPLICATION

The findings suggest that the Radiation Knowledge Attitude Questionnaire could be used successfully in a submariner enlisted population to evaluate attitudes toward radiation, which, in turn, could be correlated with knowledge of the biological effects of radiation to provide relevant information regarding a submariner's adjustment status during long-duration submerged cruises. In addition, this information will be useful in evaluating the effectiveness of training in the area of radiation technology generally and in the area of radiation safety in particular.

ADMINISTRATIVE INFORMATION

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ABSTRACT

The development of the Radiation Knowledge Attitude Questionnaire (RKA), its validation, key construction, and determination of reliability, are described. The sample population of one hundred subjects was composed of: submarine medical technicians, Prospective Submarine Medical Officers, Station Hospital Corpsmen, and FBM enlisted crew members. The scores of the three parts of the RKA Questionnaire were evaluated using the chi-square method in regard to major group, subgroup, number of patrols and education. A significant correlation was found among: favorable attitudes toward radiation, knowledge of the biological effects of radiation, and specialized training regarding radiation. Within the FBM enlisted crew group, the number of patrols personnel had did not seem to have any demonstrable effect on attitude or degree of knowledge. However, any effect of the number of patrols may have been obscured by the presence of personnel with specialized training in radiation within the comparison groups. Those with one year or more of college in the FBM enlisted crew group seemed to have a more favorable attitude toward radiation hazards and a higher degree of knowledge about the biological effects of radiation than those with only a high school education. However, in the unspecialized Station Hospital Corpsmen group, the degree of education did not have any apparent influence on attitudes or knowledge about radiation.

In general, the study demonstrates the potential relevance of data pertaining to the interaction of a submariner's knowledge of radiation biology and his attitudes toward radiation hazards. This information is useful in assessing the effectiveness of the submariner selection techniques and in ascertaining the efficacy of the ongoing training programs in the biology of radiation exposure and in the application of radiation safety procedures.

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INTRODUCTION

Reports of radiation injury date back to the late 19th century, in the early years after the discovery of the radioactivity of uranium by Becquerel. These early injuries were skin burns. In 1927 experimental work revealed the effects of radiation on the genetics of the fruit fly.[7] Dramatic demonstration to the public of its dangers occurred when cancer of the bone became evident in the radium dial painters.[7] Since the sensational and devastating effects of nuclear reaction were made evident at Hiroshima and Nagasaki in 1945, the general public has been acutely aware of the hazards of radiation. References to the various effects of acute and chronic exposure to radiation have been numerous in the medical literature and public media as well. Evidence has accumulated from the Hiroshima and Nagasaki experiences implicating radiation in an increased incidence of leukemia,[2,5] thyroid concer,[23] and breast cancer.[26] Public concern with radioactive fallout from nuclear tests and dangers from nuclear powered ships and power installations has been evident in recent years.[11] The references in the public media to radiation hazards have often been of sensational nature and without discrimination, but not entirely without a factual basis.

Problems of environmental radiation exposure have also come under medical and public scrutiny. Uranium miners have been found to have an increased incidence of lung cancer.[20,25] Increased use of nuclear materials for peace time power and the presence of commercial enterprises involving nuclear materials, have increased public awareness. Accidents in this particular field over the years have been relatively few and the overall safety record of government and commercial nuclear enterprises and experimentation has been excellent. However, medical personnel and facilities previously unfamiliar with radiation exposure problems have had contact with exposure incidents.[12] Medical and public concern with the effects of diagnostic x-ray and isotope use has increased and not without a reasonable basis.[3,14,19] The exposure from diagnostic x-ray has a wide range.[13,19,27] Standards for isotope use in pediatrics have not yet been well defined.[22] Chromosomal abnormalities have been reported in subsequent offspring from mothers who had diagnostic, abdominal radiographic exposure.[24] Chromosome changes in peripheral blood leukocytes have been reported after diagnostic x-ray and also after radioisotope therapy for thyroid disease.[4,6] In-utero radiation exposure has been implicated as a possible factor in leukemia.[10] Therapeutic radiation has been also implicated as a factor in some studies of leukemia, but remains in doubt at this time, except for the more convincing British study in patients who received therapeutic radiation for ankylosing spondylitis.[16] Public inquiries as to the danger of diagnostic radiation are not too uncommon, even in regards to the common chest x-ray.[3] The development of safety controls in diagnostic radiology has been less than ideal.

The general public, it would seem, tends to equate all forms of radiation and all sources, as well as the hazards involved. Coupled with the general spread of highly emotionally charged information about radiation are the somewhat natural mysterious qualities of radiation especially evident to those who are relatively uninformed about the physics of radiation. Radiation can neither be seen or felt in the usual sense, yet has such awesome effects even to the changing of genetic nature. The prodigious strides in technology have advanced far ahead of the general attitude toward radiation hazards. Mental adjustment to work with radiation is of importance for reasons of safety, work efficiency and general emotional health.

It has been the author's personal observation that those working with radioactive materials and x-ray equipment often make humorous remarks about radiation effects. A type of nervous humor seemed to be present, particularly in students, or those who were just being familiarized with this field of knowledge. In addition, extremes in attitude are evident, some being very cautious and others being quite careless, with no obvious concern. The very cautious do not seem to display any of the nervous humor and neither do the careless. It seems to be another group within the experienced personnel which displays the nervous humor. Denial, careful attention to detail, and humor are all methods of dealing with anxiety.

Among personnel on FBM submarines, essentially the same observations were made, but in relation to different groups. Personnel with no specialized training regarding radiation other than routine indoctrination seemed to be more apprehensive about the biological effects of radiation than weapons- or nuclear-power-trained personnel. However, even among specifically trained personnel there seemed to be, again, this quite variable attitude toward radiation hazards. Radiation safety on nuclear submarines is rigidly supervised and maintained. It has not assumed the proportions that control of atmospheric conditions has assumed.[9] One of the most significant but incongruous problems encountered was with air activity related to radium dial watches and instruments which was solved by prohibiting their use aboard nuclear submarines.[8] The probability then of harmful effects of radiation during prolonged submergence on nuclear submarines is quite remote.[8, 9]

However, in spite of specialized training regarding radiation in crew groups, basic indoctrination in other groups and this probability, the question exists, "Is there a predominantly favorable attitude toward radiation hazards?" Even more basic to the situation is the question, "What is a favorable attitude toward radiation hazards?" In surveying the literature it was noted that items regarding attitudes toward radiation hazards had been included in psychologic test material previously,[18,21,28,29] but there had been no test instrument developed specifically for determining attitudes about radiation hazards on nuclear submarines. However, it had been found that 35% (11 men) of a random sample of 31 enlisted men from a nuclear submarine had expressed concern about the possibility of injury due to radiation during routine operations.[28] It had also been found in another study that 15% of enlisted volunteers (N=236) sampled and 5% of officer (N=185) for submarine service indicated their belief that "the danger of radiation exposure aboard nuclear submarines is serious."[29,30] Both of these results were obtained in the relatively early years of operation, in 1957 to 1959. It is possible in view of the safety record on nuclear submarines that there has been some change in general attitude of personnel on nuclear submarines. It was decided to investigate the possible relationship between attitude toward radiation hazards and knowledge of biological effects of radiation through the development of a suitable questionnaire.

METHOD AND PROCEDURE

Development of the RKA Questionnaire

The final form of the Radiation-Knowledge-Attitude Questionnaire (RKA) has three parts, each consisting of twenty five items. The questionnaire is contained in Appendix B. Parts I and II of the questionnaire deal with the determination of attitude toward radiation hazards. Each item in Part I is answered on a graded plus or minus scale, depending on how the examinee agrees with the item. The items in Part II are answered yes or no, depending on how the examinee feels the item applies to himself. Part III is a true and false test of the knowled of the biological effects of radia

Each part of the questionnaire developed from about 65 to 70 raw items. The items were developed into their final form after careful attention to composition and direction. The language of the items was purposefully made nontechnical and nonmedical. Items with double meanings were excluded or rewritten if it was feasible. Items were designed to contain only a single obvious idea as far as was possible. Ambiguous items or those which involved a complicated interpretation were avoided. The items were arranged in questionnaire form in random manner except for separating items of a similar nature. The items were reviewed and commented on by: Benjamin B. Weybrew, Ph.D., Head, Personnel Research Branch, Submarine Medical Research Laboratory; CDR D. R. Feely, MC, USN, Director, School of Submarine Medicine; CDR R. F. Reed, MSC, USN, Head, Nuclear Medicine Division, School of Submarine Medicine; CDR G. F. Douglas, MSC, USN, Prospective Head, Nuclear Medicine Division, School of Submarine Medicine; LCDR E. P. Kindwall, MC, USNR, Instructor, School of Submarine Medicine; and LCDR S. C. Klagsbrun, MC, USNR, Psychiatrist, Naval Submarine Medical Center, Naval Submarine Base New London, Groton, Conn. Appropriate suggestions about the items were utilized to improve them. Minor changes in the items were also made after some initial testing.

Additional data to be collected were: 1) Name, 2) Rate, 3) Service Number, 4) Date, 5) Age, 6) Birth Date, 7) Education, 8) Major, If College Trained, 9) Nuclear Power Training, 10) Location of Training, 11) Other Specialized Training Regarding Radiation, 12) Nuclear Submarine Duty, 13) Number of Patrols, 14) Present Duty Station.

Subjects

The RKA Questionnaire in its final form was given to four major groups. Group I was Submarine Medical Technicians from the School of Submarine Medicine who had just completed the nuclear medicine section of their course. Group II was Prospective Submarine Medical Officers who had just completed the nuclear medicine section of their course. Group III was composed of corpsmen from the station hospital, Naval Submarine Base New London, Groton, Conn. Group IV was composed of enlisted crew members from a FBM submarine. Table I on the following page indicates the composition of these groups. The only subjects of Groups I through III who had experience on nuclear submarines were two members of Group I. There were nine crew members from the FBM who had not previously been on an FBM patrol. The questionnaire was not given to the FBM group while on patrol but during the off crew period of shore duty. This may have had some influence on response, since it has been observed that concern about atmosphere conditions fluctuates according to whether the crew is on patrol or on shore duty during the off crew period.[30] This would be likely to apply to attitude toward radiation hazards also.

Validation of the RKA Questionnaire

The objective of validation was to determine what would be considered a favorable response to the attitude items in Parts I and II and then construct a key using this information. This was accomplished through the use of the judgments of ten experts, using the format in Appendix A. The format was given to ten Naval Medical Corps and Medical Service Corps Officers who, by their training in nuclear medicine and health physics, were considered expert judges regarding the determination of what would be considered a favorable attitude toward radiation hazards. They are listed in the Acknowledgements and include members of the staff of Brookhaven National Laboratory, staff of the school of Submarine Medicine, and the Squadron 14 Medical Officer. The format requires the judges to designate whether a particular response to an item is a favorable one. The number of judges indicating whether a response is favorable is then used to determine whether the item will be used for the key to determine if an attitude is relatively favorable in a test subject. In order to be used as a keyed item it was required that the expert judges' response to the item be at least 90% and the remaining response could not be a neutral one. Table II shows the responses of the judges to each item and the resulting keyed items. The keyed items are also indicated in the RKA Questionnaire in Appendix B. Items 14 and 22 were not used because one judge scored a neutral response to these items. In Part I a total of 17 items were keyed and in Part II 10 items were used. Note that 13 of the items keyed in Part I and

Table I. Composition of Groups and Subgroups

Group I Submarine Medical Technicians	Group II Prospective Submarine M. O.	Group III Station Hospital Corpsmen	Group IV FBM Submarine Crew		
N = 9	N = 10	N = 17	N = 64		
			Nuclear	Weapons	Other
1 HMC	10 LT, MC	1 HM1	2 EMC	1 FTCM	1 MMC
2 HM1		3 HM3	1 EM1	1 FT2	3 MM1
6 HM2		6 HN	3 EM2	2 FTG2	1 MM3
		7 HA	1 MMCS	1 FTB2	2 ET1
			1 MMC	1 TMC	1 ETN2
			2 MM1	2 TM2	1 IC1
			5 MM2	1 TM3	1 RMC
			1 MM3	1 TMSN	1 RM3
			1 ICC	1 MT1	1 QMC
			1 IC1	1 MT2	1 QM1
			1 IC2	1 MT3	2 QM2
			2 ET1		2 QM3
			2 ETR2		1 SKC
					1 SK2
					1 CSC
					1 CS2
					2 CS3
					2 TN
					1 YNSN
					1 FN
					1 SN
N			23	13	28

Table II. Expert Judges' Evaluation and Key for Part I and Part II

Item No.	Part I				Part II			
	Judges Positive Response Favorable	Judges Negative Response Favorable	Either /or	Key	Judges Positive Response Favorable	Judges Negative Response Favorable	Either /or	Key
1	10	0	0		6	4	0	
2	1	9	0	-	6	4	0	
3	2	8			9	1	0	+
4	1	9	0	-	2	7	0	
5	8	2	0		1	9	0	-
6	0	10	0	-	3	7	0	
7	0	10	0	-	0	10	0	-
8	0	10	0	-	1	9	0	-
9	3	7	0		2	8	0	
10	0	10	0	-	0	10	0	-
11	1	9	0	-	5	5	0	
12	0	10	0	-	2	8	0	
13	1	9	0	-	4	6	0	
14	0	10	0	-	0	9	1	
15	6	3	1		1	9	0	-
16	6	4	0		6	4	0	
17	0	10	0	-	3	7	0	
18	0	10	0	-	0	10	0	-
19	0	10	0	-	2	8	0	
20	7	3	0		1	8	1	
21	0	10	0	-	1	9	0	-
22	4	6	0		0	9	1	
23	0	10	0	-	3	7	0	
24	0	10	0	-	0	10	0	-
25	0	10	0	-	9	1	0	+

four of the items keyed in Part II received a 100% response by the expert judges. It was also required for items in Part I that the response to the item be in the three or four range on the answer scale to be scored. The key for Parts I and II, when developed, indicated a relatively more favorable attitude the higher the score. Part III items were verified using the sources listed in the references. The higher the score on Part III the greater relative knowledge of the biological effects of radiation.

RESULTS AND DISCUSSION

Reliability was estimated by computing a Split-half Pearson Product Moment Correlation (first half test versus second half test) then correcting to whole test length using the Spearman Brown formula.[15] The corrected value indicates the reliability of the whole test. Reliability could also be determined experimentally using the retest method. This would be done by giving the questionnaire a second time to the same group under exactly the same conditions as the first trial. However, this is highly impractical, so the split-half calculation is used. The PPMC values for Part I and Part III, when corrected for whole test values, are 0.92 and 0.80 respectively which are quite reasonable results since the maximum value is 1.0. Part II, was calculated to have a negative PPMC value which indicates a zero reliability or reproducibility. Subsequent to this calculation there was no longer any consideration of Part II data.

The objective of the study was to investigate a possible correlation or relationship between attitude and knowledge regarding radiation. It was essential then to determine if there was any relationship between Part I and Part III, i.e., was there a less than chance relationship in an examinee getting a high score on Part I and a high score on Part III or a low score on both Parts? The interrelationship of Part I and Part III scores was determined using chi square. The results are shown in Table III. The relationship between Part I and Part III scores is significant at less than the .001 level. The contingency coefficient which indicates the size or degree of interrelationship which exists was calculated to be 0.34. The maximum value for the contingency coefficient for the two by two table is 0.70. The value obtained indicates a significant degree of interrelationship.

Table IV shows the means and standard deviations of scores from Part I through III. Part II values are shown only to indicate the low range of variability between the various groups on this part of the questionnaire. Values for Part II of the last two combined patrol groups were not calculated since the reliability of Part II at that point in the study had been determined to be zero. Note that on scanning the means of Parts I and III, in those groups with specialized training regarding radiation, the values are generally higher for the means than those without specialized training regarding radiation. Group III, the Station Hospital Corpsmen, have no specialized training

Table III. Interrelationship of Part I and Part III Scores Chi Square

		RKA Part III		
		<Median	>Median	
RKA Part I	>Median	17	37	52
	<Median	31	15	48
		48	52	100

Median Part I = 12
Median Part III = 18
N = 100

$$X^2_{RKA} = 12.83 \quad P < .001$$

Table IV. Means and Standard Deviations

RKA	Part I			Part II			Part III		
	N	M	σ	N	M	σ	N	M	σ
Group I	9	13.11	5.32	9	8.66	0.58	9	22.33	2.04
Group II	10	12.30	4.67	10	7.90	1.22	10	23.00	1.73
Group III	17	6.82	5.52	17	8.52	0.81	17	16.00	2.37
Group IV	64	10.57	6.68	64	8.66	1.15	64	17.15	4.23
Nuclear	23	13.78	4.17	23	9.00	0.84	23	19.22	2.79
Weapons	13	10.08	7.21	13	8.69	1.01	13	14.62	5.91
Other	28	8.00	8.33	28	8.36	1.09	28	16.61	3.33
0 Patrols	9	11.33	6.15	9	8.67	0.91	9	16.56	5.84
1 Patrol	17	10.41	6.81	17	8.94	0.74	17	16.12	5.28
2 Patrols	7	11.71	7.13	7	8.14	0.86	7	18.00	2.07
>2 Patrols	31	10.03	6.67	31	8.61	1.20	31	17.68	3.05
≥1 Patrols	55	10.36	6.79	******************			55	17.24	3.88
>1 Patrol	38	10.34	6.78	******************			38	17.74	2.91

regarding radiation and have the lowest means for Parts I and III. Groups I and II have somewhat similar training in nuclear medicine and medical orientation and their means are quite similar. Within the FBM Group the Nuclear Subgroup has the highest means for Parts I and III. Subgroup Other has the lowest mean for Part I. The Weapons Subgroup is intermediate, except for its low mean for Part III. This low mean on Part III may be due to several quite low scores in this Weapons Subgroup, a finding which may be peculiar to this group and not to weapons personnel in general. However, there was found to be no significant difference between the Weapons Subgroup and Subgroup Other in Part III scores using the chi square method. Note that the Part II means vary little among all the groups and subgroups. The means for the various Patrol Groups also do not vary widely for either Part I or Part III.

Table V shows the comparison of Part I and Part III scores between the major groups.

Table V. Comparison of Group Scores Chi Square

N/N	9/10	9/17	9/64	10/17	10/64	64/17
Groups ***	I/II	I/III	I/IV	II/III	II/IV	IV/III
RKA Part I	0.02	6.25*	1.70	7.40**	0.99	6.72**
RKA Part III	0.00	18.92**	8.95**	19.95**	9.83**	6.90**

df=1

**=significance P< .01 (chi square, median split)

*=significance P< .05

***(Note: By convention in all chi square tables, if a significant difference exists between groups or subgroups, the group or subgroup with the more favorable attitude or greater knowledge will be the numerator in the table.)

A significant difference was noted in both Part I and Part III scores between all groups and Group III, the Station Hospital Corpsmen. This indicates a relatively more favorable attitude and higher degree of knowledge about radiation biological effects in all other groups in comparison with Group III. All groups except Group III have some specialized training regarding radiation. There was also a significant difference in Part III scores when comparing Group I and Group II with Group IV. This was not surprising since Group I and Group II were both medically oriented groups and have quite similar training in nuclear medicine. However, there was no significant difference in attitude among Groups I, II, and IV according to the RKA Questionnaire. Note that there was also no significant difference found between Group I and Group II.

Table VI shows the chi square comparison of the scores of the Subgroups from Group IV, the FBM Enlisted Crew Group.

Table VI shows that there was a significant difference in Part I and Part III scores between the Nuclear Subgroup and Subgroup Other. This indicates a relatively more favorable attitude toward radiation hazards and a greater degree of knowledge of radiation's biologic effects in the Nuclear Subgroup, according to the RKA Questionnaire. There was no significant difference between the Weapons Subgroup and Subgroup Other. A significant difference is indicated between the Nuclear and Weapons Subgroup only in the Part III scores. There may, however, still be a difference in attitude toward radiation hazards between these two subgroups, but the sensitivity of Part I is not great enough to detect it. Another possibility is that there actually is no difference in attitude between these two subgroups because of their specialized training qualitatively, yet some

Table VI. Comparison of Subgroup Scores Chi Square

N/N	23/13	23/28	13/28
Subgroups	Nuclear Weapons	Nuclear Other	Weapons Other
RKA Part I	1.56	4.65*	0.76
RKA Part III	5.06*	5.79*	0.10

df=1

*=significance P < .05 (chi square, median split)

difference in their knowledge exists because of the relatively greater depth of training of the Nuclear Subgroup. There is probably a grey zone where there are differences in the knowledge of a group and not in the attitude, since knowledge alone is not the only factor in determining attitude. Also, the Weapons Subgroup tested was relatively smaller than the Nuclear Subgroup and sample size may also be a factor. However, since no difference was found between the Weapons Subgroup and Subgroup Other in attitude, and a difference was found between the Nuclear Subgroup and Subgroup Other in attitude, one might infer from equalities that there might be a difference in attitude between the Weapons and Nuclear Subgroup.

In Table VII a comparison of Groups and Subgroups is made.

There was a significant difference between Group III, the Station Hospital Corpsmen, and the Nuclear Subgroup in both Part I and Part III scores. This indicates a relatively more favorable attitude toward radiation hazards and a relatively higher degree of knowledge about the biological effects of radiation in the Nuclear Subgroup according to the RKA Questionnaire. There was no significant difference between Groups I and II and the Nuclear and Weapons Subgroup except on the Part III scores. This would tend to support the hypothesis that there is no difference in attitude between the Nuclear and Weapons Subgroup, since Groups I and II would probably be the strongest in favorable attitude because of their training in nuclear medicine. There was a significant difference between Group III and the Weapons Subgroup in Part I scores but none in Part II scores. A more favorable attitude might be expected in the Weapons Subgroup because of their training and orientation to nuclear weapons and submarines. The similarity in knowledge is difficult to explain. This probably is not characteristic of weapons personnel in general but is related to a number of quite low scores in this particular weapons group. The sample size of the Weapons Subgroup is also quite small and this may be an additional factor.

No significant difference was found between Groups I and II and Subgroup Other except in Part III. This could be explained by the nuclear submarine experience and basic indoctrination in radiation safety of Subgroup Other with a resulting similarly favorable attitude, yet obviously not the depth of knowledge of Groups I and II. There is no difference statistically between Group III and Subgroup Other in either Part I or Part III.

A comparison of scores on Part I and Part III was made considering the number of submarine patrols which had been made by members of the FBM Group, Group IV. The composition and partition of the different patrol groups is shown in Table VIII. No significant difference was found between the various patrol groups. Previously, in discussing the means of the scores, it was noted that there was little difference in the means of the patrol groups. A possible factor in obscuring any difference in the patrol groups could be the relatively high percentage of nuclear power trained personnel in the patrol groups

Table VII. Comparison of Group and Subgroup Scores Chi Square

N/N	9/23	9/23	23/17	9/13	10/13	17/13	9/28	10/28	17/28
Groups or Subgroups	I / Nuclear	II / Nuclear	Nuclear / III	I / Weapons	II / Weapons	Weapons / III	I / Other	II / Other	III / Other
RKA Part I	0.09	0.25	7.48**	0.36	0.62	4.34	2.06	2.79	2.31
RKA Part III	4.90*	5.38**	9.82**	10.54**	11.37**	1.66	13.99**	15.08**	1.73

df=1

**=significance $P < .01$ (chi square, median split)

*=significance $P < .05$

Table VIII. Composition of Patrol Groups within Group IV

Patrols	0	1	2	>2
N	9	17	7	31
	1 MM1 2 MM2* 1 MM3* 2 EM2* 1 FTG2** 1 CS3 1 TMSN**	1 MM1* 1 MM1 1 MM2* 1 EM2* 1 ETR2* 1 ICC* 1 IC1* 2 TM2** 1 TM3** 1 CSC 1 CS3 1 QM2 1 QM3 1 SK2 1 RM3 1 YNSN	2 MM2* 1 IC2* 1 FTB2** 1 QM3 1 FN 1 SN	1 MMC* 1 MMC 1 MMCS* 1 MM1* 1 MM1 1 MM3 2 EMC* 1 EM1* 2 ET1* 2 ET1 1 ETR2* 1 ETN2 1 IC1 1 TMC** 1 MT1** 1 MT2** 1 MT3** 1 FTCM** 1 FT2** 1 FTG2** 1 QMC 1 QM1 1 QM2 1 SKC 1 RMC 1 CS2 2 TN
	N--%	N--%	N--%	N--%
Nuclear	5-56%	6-35%	3-43%	9-29%
Weapons	2-22%	3-28%	1-14%	7-23%
Other	2-22%	8-47%	3-43%	15-48%

*Nuclear
**Weapons

in which any differences would be most likely to be evident. These groups would be those with the least or no submarine experiences. The 0 Patrol Group had 56% nuclear power trained personnel and the 1 Patrol Group had 35%. The percentage of weapons personnel would also be a consideration since they also receive more than the routine indoctrination about radiation. The effect of the number of patrols would be more likely demonstrated within a group without specialized training regarding radiation such as Subgroup Other. However, Subgroup Other had an inadequate number of personnel in the 0, 1, or 2 patrol categories for statistical evaluation. The patrol groups were also recombined into new groups for comparison to try and further determine if there were any differences in Part I or Part III scores. These comparisons were made: 1) 0 and ≥ 1 patrol 2) 0+1 and > 1 patrol and 3) 0 and >1 patrol. No significant difference was found among these groups using the chi square method. With a larger sample size comparisons of patrol experience within each subgroup could be made which might provide information on subgroup differences due to patrol experience.

A comparison of those in Groups III and IV with a high school education and those with one year or more of college is made in Table IX. No evaluation of education within the Subgroups of Group IV could be made because of the low N of the education groups. Group II was excluded from this comparison because of the medical school training which is particularly specialized. No comparison could be made using Group I alone because of an inadequate N of the education groups. A significant difference was found in Part I and Part III scores only in Group IV. In Group IV only 9 of the total N of 64 had any college training of one year or more. Three of those with college training were also nuclear power trained. None of those with college training were weapons personnel. In the College Group: one had no patrols; four had one patrol; two had two patrols, and two had more than two patrols. These results may suggest that college training does not have a significant effect on attitude or knowledge about radiation unless specialized training or a particular orientation to radiation is also present.

Table IX. Comparison of College versus High School Education in Groups II and IV Chi Square

N/N	8/9	9/55
Education	College / High School	College / High School
Groups	III	IV
Part I	0.07	5.89*
Part III	0.06	4.93*

df=1

*=significance P=<.05

(chi square, median split)

SUMMARY AND CONCLUSION

In the determination of the conclusions from the data of this study the specific limitations of the size of the sample groups and their selection are recognized, as well as the many factors that affect attitude, and the various influences affecting the development of a test instrument to measure psychologic data.

The objective of the study was to develop a questionnaire to investigate the possible relationship between attitude toward radiation hazards and the knowledge of the biological effects of radiation. A three part, 75 item test instrument was developed and named the RKA Questionnaire. Parts I and II were concerned with the determination of attitude and Part III with the determination of knowledge about the biological effects of radiation. The RKA Questionnaire was given to four different major groups with a total sample N of 100. The Groups were: Group I, Submarine Medical Technicians; Group II, Prospective Submarine Medical Officers; Group III, Station Hospital Corpsmen; Group IV, Enlisted FBM Crew Members. A key was developed for Parts I and II using the judgments of ten experts who determined whether the items indicated a favorable or unfavorable attitude response. The items were keyed so that a high score indicated a relatively favorable attitude. The reliability of the questionnaire was determined by using a Split-half Pearson Product Moment Correlation, correcting for test length using the Spearman Brown Formula. The PPMC for Parts I and II indicated a significant degree of reliability. However, Part II was found to be unreliable and was then excluded from the study. A significant relationship between a high score on Parts I and III or a low score on both parts was found by chi square. The scores of Parts I and III were evaluated using the chi square, considering the following comparisons:

1) Major Groups (considers specialized training regarding radiation)

2) Subgroups of Group IV (considers specialized training regarding radiation within the submarine group)

3) Major Groups and Subgroups (considers similarities and differences between major groups and submarine subgroups)

4) Number of Patrols (considers effect of the number of patrols within the submarine group)

5) College Training versus High School Education (considers effect of education within Groups III and IV)

The conclusions that were drawn from the data of the RKA Questionnaire in this study and its particular sample groups are:

1) The RKA Questionnaire, excluding Part II, seems to be a reliable test instrument for determining relative favorability of attitude toward radiation hazards and correlating this with the degree of knowledge about the biological effects of radiation.

2) Generally a relatively favorable attitude correlates with specialized training regarding radiation and the degree of knowledge about the biological effects of radiation.

3) The number of patrols on a nuclear submarine was found not to

influence the attitude toward radiation hazards or knowledge about radiation biological effects according to the RKA Questionnaire. However, any effect could have been obscured by the presence of specialized personnel within the comparison groups.

4) In the FBM Enlisted Crew Group those with one year or more of college training tended to have a more favorable attitude toward radiation hazards and a relatively higher degree of knowledge about radiation biological effects than those with only a high school education. However, no difference was found between education groups within the Station Hospital Corpsmen Group.

Implications of the results of this study are important when considering the relationships of attitude to effectiveness of training, work efficiency, and radiation safety. An extension of this study to include a larger sample of enlisted FBM crew members from several submarines would provide a more substantial evaluation of attitudes within the submarine force. Further evaluation of the subgroups from the submarine groups in a larger sample would better characterize these groups in attitude and knowledge. Valuable information could be provided about the effectiveness of instruction by using the RKA Questionnaire before and after training. Identification and characterization of those personnel with relatively unfavorable attitudes might also provide useful information for personnel selection.

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REFERENCES

1. Atomic Radiation. RCA Service Company, Camden, N. J., 1957.

2. Bizzozero, O. J., Jr.; Johnson, K. G., and Ciocco, A. Radiation-related Leukemia in Hiroshima and Nagasaki, 1946-1964. New Eng. J. Med. 274:1095-1101, 1966.

3. Blatz, H. Common Causes of Excessive Patient Exposure in Diagnostic Radiology. New Eng. J. Med. 271:1184-1188, 1964.

4. Bloom, A. D. and Tjio, J. H. In Vivo Effects of Diagnostic X-Radiation on Human Chromosomes. New Eng. J. Med. 270:1341-1344, 1964.

5. Brill, A. B., Tomonaga, M., and Heyssel, R. M. Leukemia in Man Following Exposure to Ionizing Radiation: Summary of Findings in Hiroshima and Nagasaki and Comparison with Other Human Experience. Ann. Intern. Med. 56:590-609, 1962.

6. Cantolino, S. J., Schmickel, R. D., Ball, M., and Cisar, C. F. Chromosomal Aberrations Following Radioiodine Therapy. New Eng. J. Med. 275:739-745, 1966.

7. Cronkite, E. P. and Bond, V. P. Radiation Injury In Man. Charles C. Thomas, Springfield, Illinois, 1960.

8. Ebersole, J. H. Radiation Exposure Patterns Aboard the USS Nautilus. New Eng. J. Med. 256:67-74, 1957.

9. Ebersole, J. H. The New Dimensions of Submarine Medicine. New Eng. J. Med. 262:599-610, 1960.

10. Gibson, R. W., Bross, I. D., Graham, S., Lilienfeld, A. M., Schuman, L. M., Levin, M. L., Dowd, J. E. Leukemia in Children Exposed to Multiple Risk Factors. New Eng. J. Med. 279:906-909, 1968.

11. Grendon, A. and Biorad, M. Public Reaction to Nuclear Facilities. Am. J. Pub. Health. 11·126-131, 1967.

12. Karas, J. S. and Stanbury, J. B. Fatal Radiation Syndrome From an Accidental Nuclear Excursion. New Eng. J. Med. 272:755-761, 1965.

13. Lindell, B. and Dobson, R. L. Ionizing Radiation and Health. World Health Organization, Geneva, Switzerland, 1961.

14. Little, J. B. Environmental Hazards: Ionizing Radiation. New Eng. J. Med. 275:929-937, 1966.

15. McNemar, Q. Psychological Statistics. John Wiley and Sons, Inc., New York, N. Y., 1949.

16. Miller, R. W. Radiation, Chromosomes and Viruses in the Etiology of Leukemia: Evidence From Epidemiologic Research. New Eng. J. Med. 271:30-36, 1964.

17. Molish, H. B., Weybrew, B. B., and Ninow, E. H. Attitude Changes During and Recoverability Following Prolonged Periods of Marine Submergence. USN Med. Res. Lab. Report No. 369, December, 1961.

18. Ninow, E. H. The Use of a Standard Psychiatric Interview to Predict Motivation of Enlisted Men for Submarine Service. USN Med. Res. Lab. Report No. 344, November 1960.

19. Peterson, O. S., Jr. Radiation Hazards in Medical

Practice. New Eng. J. Med. 257:756-760, 1957.

20. Radiation Exposure of Uranium Miners. Federal Radiation Council, Washington, D.C., 1968.

21. Rubin, B. and Parker, J. W. The Self-Reported Motivational Questionnaire (SMQ). USN Med. Res. Lab. Report No. 348, February, 1961.

22. Seltzer, R. A., Kereiakes, J. G. and Saenger, E. L. Radiation Exposure From Radioisotopes in Pediatrics. New Eng. J. Med. 271:84-96, 1964.

23. Socolow, E. L., Hashizuma, A., Neriishi, S., and Niitani, R. Thyroid Carcinoma in Man After Exposure to Ionizing Radiation: Summary of Findings in Hiroshima and Nagasaki. New Eng. J. Med. 268:406-410, 1963.

24. Uchida, I., Holinorga, R. and Lawler, C. Maternal Radiation and Chromosomal Aberrations. Lancet. I:1045-1048, 1968.

25. Wagoner, J. K., Archer, V. E., Lundrin, F. E., Jr.; Holaday, D. A., and Lloyd, W. J. Radiation as the Cause of Lung Cancer Among Uranium Miners. New Eng. J. Med. 273:181-180, 1965.

26. Wanebo, C. K., Johnson, K. G., Sato, K., and Thorslund, T. W. Breast Cancer After Exposure to Atomic Bombings. New Eng. J. Med. 279:667-671, 1968.

27. Webster, W. E. and Merill, O. E. Radiation Hazards: II Measurement of Gonadal Dose in Radiographic Examinations. New Eng. J. Med. 257:811-819, 1957.

28. Weybrew, B. B. Psychological and Psychophysiological Effects of Long Periods of Submergence. I Analysis of Data Collected During a 265 Hr. Completely Submerged Habitability Cruise Made By the USS Nautilus (SSN 571). USN Med. Res. Lab. Report No. 281, February, 1957.

29. Weybrew, B. B. and Molish, H. B. Approaches to The Study of Motivation of Officer Candidates for Submarine Service. USN Med. Res. Lab. Report No. 321, October, 1958.

30. Weybrew, B. B. Psychological Problems of Prolonged Marine Submergence. In Burns, N. M., Chambers, R. M. and Hendler, E. Unusual Environments and Human Behavior. The Free Press of Glencoe, New York, N. Y. 1963. Part I, pp 87-125.

APPENDIX A

EXPERTS' JUDGMENTS CONCERNING "DIRECTION" OF ATTITUDES TOWARD RADIATION

Lieutenant J. Parent, MC, USNR
Medical Officer - SSBN 602(Gold)

Instructions to Expert Judges:

Responses to a series of test items pertaining to attitudes and knowledge have been obtained from more than 100 enlisted submariners. These data are now being analysed; however, we need judgments from experts in the radiation field as to the direction of the attitude than can be inferred from how the subjects responded to each item. Here, we use "direction of attitude" to refer to whether responses in the agree direction or disagree direction are indicative of favorable (appropriate, desirable, proper) attitudes toward matters pertaining to radiation.

There are two parts to the questionnaire, each requiring slightly different directions.

Part I RKA - (Radiation Knowledge Questionnaire)

Note that the men have responded to each item by choosing a number from - 4 through + 4 to indicate: (1) whether they agree or disagree (plus or minus) and, (2) how intensely do they agree (+) or disagree (-).

Now we are asking the expert judges to decide whether agreeing (+ response) or disagreeing (- response) is, in your opinion, indicative of favorable or desirable attitudes toward the radiation situation. To do this, simply check ONE of the two columns for each item, either AGREEING to the item (+ response) is favorable or DISAGREEING to the item (- response) is favorable. With this information we will be able to get an attitude score to relate to a number of background and personality variables.

Thank you in advance for your assistance.

APPENDIX A (Continued)

Part I - RKA (Radiation Knowledge Questionnaire)

Item Number	Agreeing (+ Response) Is Favorable	Disagreeing (- Response) Is Favorable
1	____	____
2	____	____
3	____	____
4	____	____
5	____	____
6	____	____
7	____	____
8	____	____
9	____	____
10	____	____
11	____	____
12	____	____
13	____	____
14	____	____
15	____	____
16	____	____
17	____	____
18	____	____
19	____	____
20	____	____
21	____	____
22	____	____
23	____	____
24	____	____
25	____	____

20 - blank

APPENDIX A (Continued)

The task for Part II of the RKA Questionnaire is similar. Note that the men choose either YES or NO to each item. We are asking the expert Judges to indicate whether a response YES or a response NO is, in your opinion, favorable. Please check one or the other.

Item Number	Response YES Is Favorable	Response NO Is Favorable
1	—	—
2	—	—
3	—	—
4	—	—
5	—	—
6	—	—
7	—	—
8	—	—
9	—	—
10	—	—
11	—	—
12	—	—
13	—	—
14	—	—
15	—	—
16	—	—
17	—	—
18	—	—
19	—	—
20	—	—
21	—	—
22	—	—
23	—	—
24	—	—
25	—	—

APPENDIX B

RKA QUESTIONNAIRE - DATA SHEET AND PART I RESPONSE FORMAT

(Print all information)

Name: ______________________________ Rate/Rank: ______ Date: __________
Last First Middle

Service No.: __________________ Date of Birth: __________ Age: __________

Education: __________________ Major if college trained: __________________

Nuclear Power Training: Yes ____ No ____ If yes, indicate place: __________________

Other training having to do with radiation: Yes _____ No _____ If yes, explain __________

____

Nuclear Submarine Duty: Yes ______ No ______ If yes, number of patrols __________

Present duty station: ____

This is a questionnaire which is designed to determine your attitude toward radiation. We would appreciate your frank and honest response to each item. All responses will be treated in a CONFIDENTIAL manner.

Scale	Response
+4	
	Agree strongly
+3	
	Agree considerably
+2	
	Agree slightly
+1	
0	Neither agree or disagree
-1	
	Disagree slightly
-2	
	Disagree considerably
-3	
	Disagree strongly

1 [ ]	2 [ ]	3 [ ]	4 [ ]	5 [ ]
6 [ ]	7 [ ]	8 [ ]	9 [ ]	10 [ ]
11 [ ]	12 [ ]	13 [ ]	14 [ ]	15 [ ]
16 [ ]	17 [ ]	18 [ ]	19 [ ]	20 [ ]
21 [ ]	22 [ ]	23 [ ]	24 [ ]	25 [ ]

APPENDIX B (CONTINUED)

RKA QUESTIONNAIRE

Part I
(Keyed Items Indicated by Minus)

Name: ______________________________ Service No. ________________
Last First Middle

1. I should know more about the effect of radiation on the human body.

\- 2. Men serving aboard nuclear submarines are more likely to develop some type of cancer because of the radiation.

3. Duty on nuclear submarines is more dangerous because of the radiation.

\- 4. Men serving aboard nuclear submarines are more likely to develop kidney disease because of the radiation.

5. There is a definite risk of radiation exposure aboard a nuclear submarine.

\- 6. Men serving aboard nuclear submarines are more likely to develop lung disease because of the radiation.

\- 7. A man should not have too many patrols on a nuclear submarine because of the radiation.

\- 8. Men serving aboard nuclear submarines are more likely to develop thyroid cancer because of the radiation.

9. The nuclear reactor is a greater source of danger on a nuclear submarine than the atmospheric conditions.

\- 10. Men serving aborad nuclear submarines are more likely to develop heart disease because of the radiation.

\- 11. The nuclear reactor is the greatest potential source of danger aboard a nuclear submarine.

\- 12. Men serving aboard nuclear submarines are more likely to develop brain tumors because of the radiation.

\- 13. Men serving aboard nuclear submarines are more likely to develop eye disease because of the radiation.

APPENDIX B (CONTINUED)

RKA QUESTIONNAIRE
Part I
(Keyed Items Indicated by Minus)

– 14. The radiation on a nuclear submarine affects a man's ability to have sexual relations.

15. The nuclear reactor is a greater source of danger to personnel on a nuclear submarine than the nuclear weapons that are carried.

16. Men serving aboard nuclear submarines should be very concerned about their yearly exposure to radiation.

– 17. A man serving aboard a nuclear submarine has a greater chance of developing sterility because of the radiation.

– 18. Radiation aboard a nuclear submarine has some effect on a crew member's intelligence.

– 19. Men serving aboard nuclear submarines are more likely to develop disease of the testicles because of the radiation.

20. Working with radioactive materials is risky business.

– 21. Men serving aboard nuclear submarines are more likely to develop skin cancer.

22. Radiation is a somewhat mysterious force.

– 23. Men serving aboard nuclear submarines are more likely to develop mental conditions because of the radiation.

– 24. Men serving aboard nuclear submarines are more likely to develop intestinal disease because of the radiation.

– 25. Men serving aboard nuclear submarines have more stomach problems because of the radiation.

APPENDIX B (CONTINUED)

RKA QUESTIONNAIRE

Part II

(Keyed Items Circled)

This is a questionnaire which is designed to determine your attitude toward radiation. We would appreciate your frank and honest response to each item. All responses will be treated in a confidential manner.

INSTRUCTIONS: Read each item carefully. Circle YES if the item applies to you, or NO if the item does not apply to you.

Yes	No	1. I would feel concerned about the radiation if I had to have five chest x-rays in one year.
Yes	No	2. I am concerned about radioactive fall-out at times.
Yes	No	3. If offered an excellent job in civilian life that involved working with radiation, I probably would take it.
Yes	No	4. If an atomic attack occurred, I would have more fear about the radiation than the blast.
Yes	No	5. I would feel very anxious if asked to enter the reactor compartment to do some routine work.
Yes	No	6. I would rather undergo an operation for cancer than receive radiation therapy, assuming they would have about the same long-term results.
Yes	No	7. I would rather be burned extensively in an attack than exposed to any radiation.
Yes	No	8. I would worry greatly if told I had been exposed to significant but not dangerous amount of radiation.
Yes	No	9. I feel that there is more danger from radiation aboard a nuclear submarine than from an enemy attack on the submarine.
Yes	No	10. If I were a truck driver I would rather have a job hauling gasoline than radioactive substances.
Yes	No	11. I have occasionally worried about the effects of radiation on myself.
Yes	No	12. I would rather have both legs broken than receive an exposure to radiation that was significant but would not cause symptoms.

APPENDIX B (CONTINUED)

RKA QUESTIONNAIRE

Part II
(Keyed Items Circled)

Yes	No	13. On a nuclear submarine I would rather not work consistently near the reactor compartment.
Yes	No	14. If I were a laboratory worker I would rather work with viruses and bacteria than radioactive substances.
Yes	**No**	15. If I were on nuclear submarine duty and my wife had an abnormal baby, I might think it was because of radiation.
Yes	No	16. In the event of an attack, I would be more concerned about the effects of radiation from a bomb than the possibility of germ warfare.
Yes	No	17. I would feel somewhat nervous if asked to participate in a test that involved eating a harmless radioactive substance.
Yes	**No**	18. I feel that men serving aboard nuclear submarines have shorter life spans because of the radiation.
Yes	No	19. I would feel concerned about the radiation if I had to have three chest x-rays in a year.
Yes	No	20. If I were a laboratory worker, I would rather work with chemical poisons than with radioactive substances.
Yes	**No**	21. I have dreamed about being exposed to radiation.
Yes	No	22. I would be worried about the radiation if a man in the bed next to mine in the hospital had been exposed to radiation and was seriously ill.
Yes	No	23. If I developed leukemia after serving aboard a nuclear submarine, I might feel that the radiation was responsible.
Yes	**No**	24. If I were a truck driver I would rather have a job hauling explosives rather than radioactive materials.
Yes	No	25. I would worry less about radiation if I knew more about its effects on the human body.

APPENDIX B (CONTINUED)

RKA QUESTIONNAIRE

Part III

(Keyed Items Circled)

INSTRUCTIONS: Answer each item as carefully as possible. Circle T before the statement if it is TRUE or MOSTLY TRUE. Circle F if it is FALSE or MOSTLY FALSE.

T	(F)	1. The bone marrow is relatively resistant to radiation effects.
(T)	F	2. It is possible for a man to receive exposure to radiation that would affect his ability to produce children but not make him feel ill.
(T)	F	3. Radiation exposure can cause cataracts.
(T)	F	4. Radiation can cause bone cancer.
T	(F)	5. The principal danger from fall-out is external exposure to radiation.
(T)	F	6. Human red blood cells are relatively resistant to radiation.
(T)	F	7. Hair loss is a symptom of significant radiation exposure.
T	(F)	8. The same dose of radiation to the intestines and to the brain is more likely to cause injury to the brain.
T	(F)	9. A person can feel the radiation if he passes next to a strong radiation source.
(T)	F	10. Significant exposure to radiation can shorten life without causing a specific disease.
T	(F)	11. Men are more resistant to the effects of radiation that rats.
(T)	F	12. Diarrhea is a symptom of significant radiation exposure.
(T)	F	13. Radiation has been shown to be a factor in some cases of thyroid cancer.

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13. ABSTRACT
The development of the Radiation-Knowledge-Attitude Questionnaire (RKA), its validation, key construction, and determination of reliability are described. The sample population of one hundred subjects was composed of Submarine Medical Technicians, Prospective Submarine Medical Officers, Station Hospital Corpsmen, and Fleet Ballistic Missile (FBM) Enlisted crew members. The scores of the three parts of the RKA Questionnaire were evaluated using the chi-square method in regard to major group, subgroup, number of patrols and education. A significant correlation was found among; favorable attitudes toward radiation, knowledge of the biological effects of radiation, and specialized training regarding radiation. Within the FBM enlisted crew group the number of patrols personnel had did not seem to have any demonstrable effect on attitude or degree of knowledge. However, any effect of the number of patrols may have been obscured by the presence of personnel with specialized training in radiation within the comparison groups. Those with one year or more of college in the FBM enlisted crew group seemed to have a more favorable attitude toward radiation hazards and a higher degree of knowledge about the biological effects of radiation than those with only a high school education. However, in the unspecialized Station Hospital Corpsmen group, the degree of education did not have any apparent influence on attitudes or knowledge about radiation.

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