AVERAGE AGE AT DEATH OF SCIENTISTS IN VARIOUS SPECIALTIES

by

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SUBMARINE MEDICAL RESEARCH LABORATORY

NAVAL SUBMARINE MEDICAL CENTER REPORT NO. 609

Bureau of Medicine and Surgery, Navy Department

Research Work Unit M4306.01-4020B.01

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SUMMARY PAGE

THE PROBLEM

The possibility that the health of submariners deteriorates excessively compared to that of the non-submarine population has been suggested for some time. The purpose of the present study was to assess the likelihood that differences in average life-span for occupational groups, which are closely related to each other, may actually exist.

FINDINGS

An analysis of the death-notices for scientists appearing in **Science** from 1958 to 1968 showed large differences in the average age at death for scientists in different specialties. The average age at death was also appreciably higher for "outdoor" than "indoor" specialties.

APPLICATION

These findings suggest that a full scale study may show that the health and life-span of individuals in rather closely related occupations may well differ by a wide margin. It is possible, then, that different groups within the Navy—indeed, different specialties within a group—may exhibit appreciable differences.

ADMINISTRATIVE INFORMATION

This investigation was conducted as a part of Bureau of Medicine and Surgery Research Work Unit M4306.01-4020B, Longitudinal health study of personnel exposed to submarine environment and diving hazards for extended periods. The present report is No. 1 on that Work Unit. It was approved for publication on 20 January 1970 and designated as Submarine Medical Research Laboratory Report No. 609.

PUBLISHED BY THE NAVAL SUBMARINE MEDICAL CENTER

ABSTRACT

There are large differences in the average age at death of scientists in different specialties whose death-notices appeared in **Science** from 1958 to 1968. They range from 76.7 for archaeologists to 61.8 for men working with radiation. The average age at death for the entire sample of 2,224 men was 67.7; and 68.1 for the total sample of 93 women. The average age at death was appreciably higher for biologists in "outdoor" specialties than for those in "indoor" specialties. The average age at death for physicists, chemists, and earth-scientists—but not biologists—was higher for academic than for non-university personnel. More accurate death-statistics and detailed information about the proportion of people at various age-groups for each specialty are among the information needed to determine whether or not these suggestive results are valid.

AVERAGE AGE AT DEATH OF SCIENTISTS IN VARIOUS SPECIALTIES

INTRODUCTION

It has been suggested for some time that a comparison be made of the state of health of submariners and the non-submarine population in the Navy. The question arises whether differences due to occupation are likely to be discernable in two groups as closely related as different components of the Navy.

This report presents an analysis of the deaths of scientists reported in Science from January 1958 through January 1968, categorized by major field of concentration and also sex. Scientists, presumably, comprise a relative homogeneous group, distinguished primarily, perhaps, by their interests and motivations. The same might be said of different groups within the Navy. The analysis was made to see if differences in length of life—perhaps the ultimate index of health—would be found between such highly comparable groups.

Although the National Center for Health Statistics, formerly the National Office of Vital Statistics, published a detailed breakdown in 1950 of the death rates for the manual trades,[1] its breakdown for scientists is much less complete. Similarly, the National Academy of Sciences-National Research Council has published a statistical analysis of scientists, but life expectancy and mortality tables are lacking.[2]

Some differences in longevity of different groups of scientists have already been documented. A number of studies of physicians have indicated that their longevity is greater than that of the general population,[3] and dentists have even greater longevity.[4] In recent years several studies have shown that radiologists die earlier than physicians in other medical specialties.[5, 6, 7] The studies of radiologists are interesting, of course, since the submarine fleet is now essentially nuclear. The results of the studies on physicians are probably of less significance since physicians presumably will more often obtain better medical attention than the general population.

THE CATEGORIES

Some obituaries were excluded from the tabulation because of lack of information as to the specialty of the deceased, an inability to specify his main occupation from among several listed specialties, or the omission of his age.

A few of the categories require some explanation. The "Medical" category is a broad one and it included all individuals, except psychiatrists, who had some connection with medicine, veterinary medicine, hospitals, or medical schools. Although this broad grouping is not as informative as is possible, the loss is not great, because the longevity of physicians has been studied more than that of any other professional group.

The "Agriculture" category includes agricultural science, forestry, conservation, and wildlife management. The "Earth-Sciences" includes geology, metallurgy, mining engineering, oceanography, and meteorology. "Education" includes all those cited as having occupied administrative positions at schools without any other information as to their original field of training. "Engineering" includes both engineers and inventors. The "Administration" category is composed of men who had held administrative positions in private industry—but not in government or universities—regardless of their specialty.

From time to time, Science notes the death of prominent men who were not scientists. These people, together with three economists, were tabulated in the "non-Science" category.

The "Radiation" category is unique. A number of men might well have been placed into more than one category. Typically, once a man had been tabulated in one category, he was not listed in any other. This is not true of the "radiation" category. Every individual in this group is also listed under another specialty, such as physics, biology, or medicine. No one was included in this category unless his obituary specifically indicated laboratory work with some form of radiation.

RESULTS

The mean ages at death of the men in the various categories are ranked in Table I, along with the number of men in each category and the standard deviations of the means. Archaeologists had the highest average age at death, while administrators and men working with radiation had the lowest average age at death. The difference between these extreme means is nearly 15 years, larger than the standard deviations associated with these means. The mean age at death for the entire sample of 2,224 men is 67.7.

Table I. Mean age at death and standard deviations of the means for male scientists, by specialty, 1958-68.

Specialty	Number	Mean Age (years)	S.D.
Archaeology	12	76.7	10.7
Astronomy	41	75.8	11.8
Anthropology	18	72.2	11.3
Engineering	192	71.1	13.0
Sociology	23	71.0	12.0
Non-Science	70	70.0	14.1
Earth-Science	109	69.6	14.6
Agriculture	130	68.9	13.2
Medicine	493	68.8	12.9
Biology	322	68.5	15.2
Education	96	67.5	11.3
Chemistry	179	66.0	13.6
Psychiatry	47	65.9	10.5
Mathematics	51	65.5	13.5
Physics	176	64.4	16.0
Psychology	51	62.7	13.6
Pharmacy	34	62.3	13.9
Administration	180	61.8	12.4
Radiation	33	61.8	14.2
Total	2,224	67.7	

The tabulations for the women are given in Table II. Although there are very few individuals in any given category, every specialty is represented except "Pharmacy." It is interesting to see that, despite a low correlation between the rankings for the men and women, the mean age at death for the three women who held administrative positions is 59.3; the one woman cited as having worked in a radiation-laboratory died at 42; and the women who lived the longest worked in the agricultural sciences, archaeology and engineering—specialties in which men also ranked high in longevity.

Table II. Mean age at death of female scientists, by specialty, 1958-68

Specialty	Number	Mean Age (years)
Agriculture	1	84.0
Archaeology	1	83.0
Engineering	1	82.0
Education	5	76.8
Psychiatry	2	74.5
Physics	5	73.6
Sociology	3	72.7
Medicine	24	69.2
Psychology	6	67.8
Chemistry	6	66.5
Biology	28	65.6
Earth-Sciences	3	64.3
Anthropology	1	62.0
Astronomy	1	61.0
Administration	3	59.3
Mathematics	2	56.2
Non-Science	1	56.0
Radiation	1	42.0
Total	93	68.1

But of most interest is that the mean age at death for the total sample of 93 women is 68.1, virtually the same as that for the men. The life-expectancy of women in the U. S. is, of course, much greater than that of men. It is now 76.6 years for 20 year old white women compared to 70.2 for men, a difference which declines very little as the sample is restricted to much older individuals.[8] The small differences in the mean ages of men and women whose deaths were noted in **Science** suggest that when men and women engage in the same occupations, they die at the same time.

If the life expectancy of white American men who have reached the age of 20 is a total of 70.2 years, then this sample of men has fallen short of attaining that average age by 2.5 years, and the women have died an average of 8.5 years too soon. What is more, since these tabulations include those foreigners whose deaths were noted, these differences might well have been increased if the sample had been restricted to Americans. The reason is that most of the foreigners came from the scientifically advanced countries, and of these, only France and Japan are reported to have lower life expectancies than the U. S. Not only the Scandinavians, British, Dutch, West Germans, and Swiss, but also even the people of Italy, Spain, Greece, and Czechoslovakia are said to have higher life expectancies than Americans.[9]

than for the general population except for the 30-35 age range. For the women, the curve is much higher than for the general white female population at all ages below the age of 70 (Fig. 1B). Interestingly, the curve for the non-scientific group agrees much better with the curve reported for the general population (Fig. 1C).

The per cent distributions of death by age for various specialties are shown in Fig. 2. There are marked differences not only between their location along the abscissa, but between their shapes as well. Those for the physicists, psychologists, and pharmacists are quite flat (Fig. 2A), in contrast to the peaked distributions for the educators, psychiatrists, and sociologists (Fig. 2B). There is a distinct difference even between the distributions for physicists and chemists (Fig. 2C), samples of almost identical size and rep-

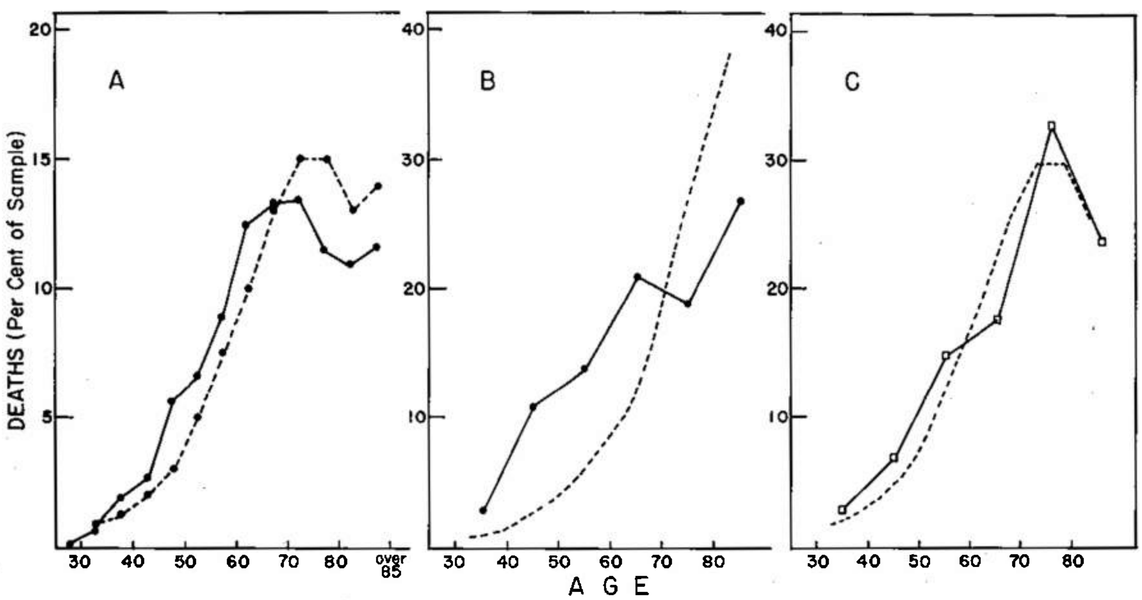

Fig. 1. **(A) Mortality distribution for the present of men (solid line) and that for white American men who have reached the age of 20 (dotted line).**

(B) Mortality distribution for present sample of women (solid line) and that for white American women who have reached the age of 20.

(C) Mortality distribution for the Non-Science category (solid line) and that for white American men who have reached the age of 20.

A comparison of the per cent distributions of death by age for the present samples of men and women with those for white American men and women who have reached the age of 20,[10] is given in Figure 1. Below the age of 70, the curve for men (Fig. 1A) is consistently higher for the scientific sample

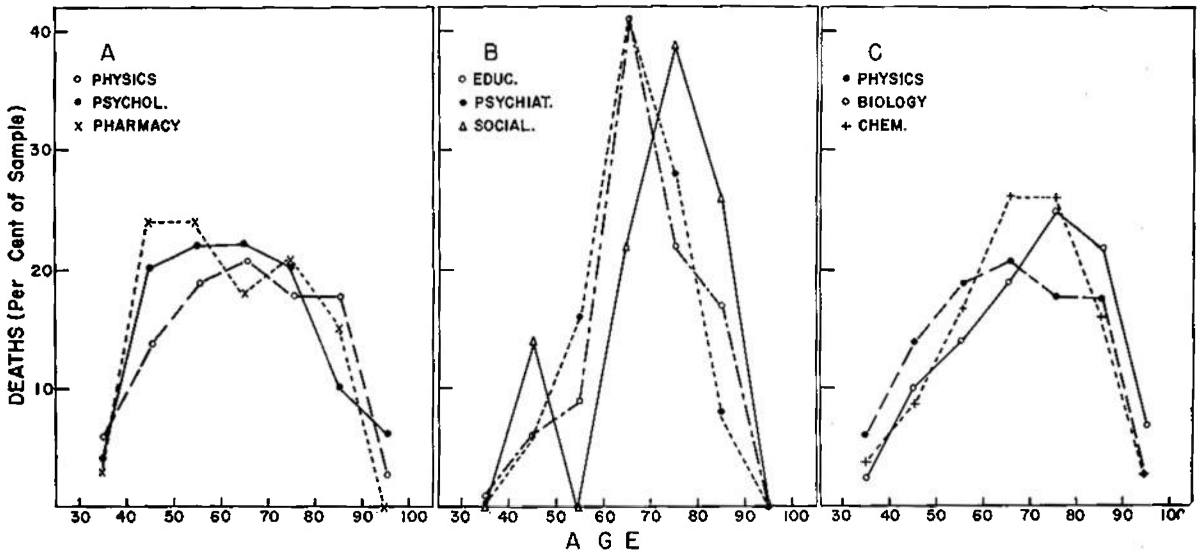

Fig. 2. Mortality distributions for various specialties showing (A) "flat" and (B) peaked distributions. (C) compares the distributions for physicists, biologists and chemists.

resenting groups which, one would imagine, are rather similar. The distributions of the "radiation" group and the astronomers, the longest-lived group of comparable size, are shown in Fig. 3A. A comparable difference exists between the distributions for the "administration" and "engineering" groups, both relatively large samples, as shown in Fig. 3B.

The flat distributions in Fig. 2A are associated with low average life spans and result from an undue proportion of deaths at the younger ages. It seems likely that the low average longevity of physicists is the result of the inclusion of a large proportion of men working with radiation, and the elimination of these individuals would result in a distribution similar to that for the chemists. What has caused the low averages for psychologists and pharmacists? One possible factor is an unusually high suicide rate among the latter. Powell[11] noted one study which showed the suicide rate of pharmacists to be 120 per 100,000, compared with only 15 per 100,000 for engineers, for example.

THE OUTDOOR LIFE

It is clear that, for one reason or another, there are sizable differences in the average life-span of the men in different scientific specialties whose deaths are reported in **Science.** Table I suggests that a contributing factor may be the degree to which a given specialty can be considered an outdoor or indoor occupation. The longer life-spans are found for such specialties as archaeology, anthropology, the earth-sciences, and agricultural sciences, whose essential business is undoubtedly conducted out of doors. The engineering category is, no doubt, composed of men with markedly different occupational habits; civil engineering may entail a considerable amount of exercise. (It is hard to say to what extent astronomy should be considered an "outdoor" occupation.)

To examine the hypothesis that an outdoor occupation is associated with the longer life-spans, the death-notices from 1958 through 1962 were retabulated for the biologists.

They were chosen because they constituted the largest sample except for medicine, and because biology is a diverse field which is easily divided into outdoor and indoor groups. Persons specializing in botany, entomology, limnology, and zoology, for example, would seem to be out of doors more than those working in such specialties as embryology, physiology, histology, or cytology. In fact, the mean age at death of the 114 biologists in the outdoor group was 70.0 (S.D. 14.2) while that for the 81 men in the indoor group was 64.8 (S.D. 16.3). If this difference is valid, we still cannot say, of course, whether outdoor life leads to a longer life or whether healthier people gravitate toward outdoor occupations.

But one other interesting comment can be made on this point. Figure 4 shows the distributions for archaeology, anthropology, and the earth-sciences, three outdoor and rather strenuous occupations. Despite the great differences in sample size, all three distributions are virtually identical and bimodal. It may be that in such occupational groups, there are those individuals who are not suited to the strenuous life and die early, while others thrive on it.

THE GROVES OF ACADEME

According to folklore, academic life is an "ivory-tower" existence, secure and sheltered from the debilitating effects of nervous tension. This notion suggested a final analysis. The physicists, chemists, biologists (including the "agricultural" scientists) and earth-scientists who died between 1958 and 1962 were divided according to whether or not they had been employed primarily by universities. Table III shows that the university physicists, chemists, and earth-scientists—but not the biologists—lived considerably longer, on the average, than their non-university counterparts. A comparison between the "administration" and "education" categories is, to some extent, also relevant, because the latter is composed of men who were in more or less administrative positions in universities. Their average age at death was greater than the non-university "administrators."

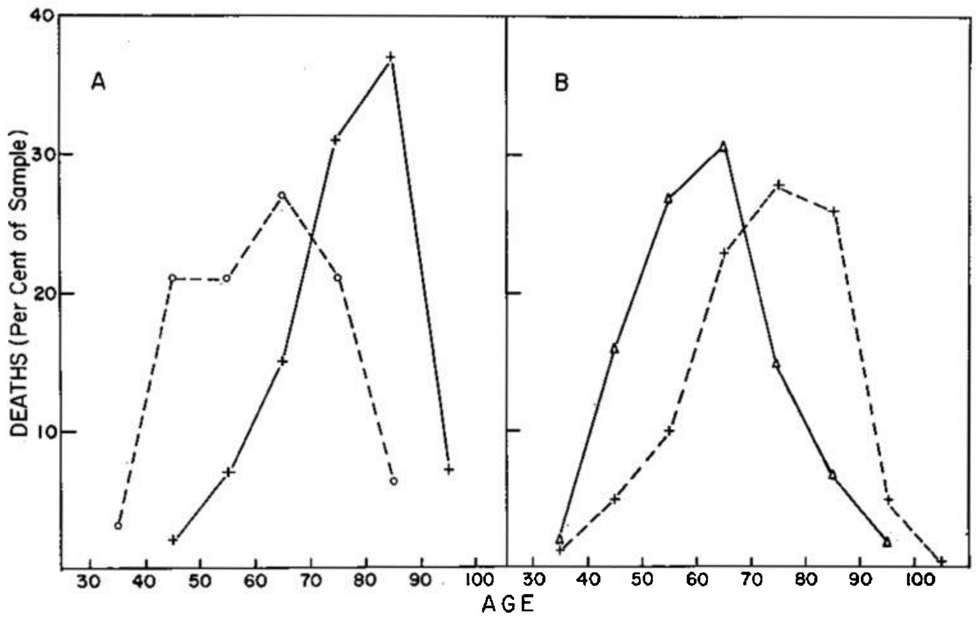

Fig. 3. Mortality distributions for (A) 41 astronomers (solid line) and 33 "radiologists" and (B) 180 administrators (solid line) and 192 engineers.

Table III. Mean age at death and standard deviations of the means for scientists in universities compared with those employed elsewhere, 1958-62.

Specialty	Number	Mean Age (years)	S.D.
University			
Physics	55	69.2	13.9
Chemistry	47	67.4	13.2
Biology	152	67.5	15.5
Earth-Sciences	26	72.2	13.5
Non-university			
Physics	40	58.7	16.4
Chemistry	76	63.1	13.5
Biology	67	68.4	15.3
Earth-Sciences	38	66.8	12.4

WHAT SIGNIFICANCE?

These results conform to U. S. Government statistics which indicate that professional-technical people have higher mortality rates between the ages of 30 and 55 than the average for all the white occupational groups, while "managers" have slightly higher mortality rates than both of these after the age of 45.[12] But a very recent study carried out among employees of the Bell System reported a lower death rate for college graduates than for non-college men and found no more heart disease for higher management than for lower level people.[13] Another study has recently reported that higher death rates are associated with low income and education, but it dealt only with the very extremes of population.[14] These studies are, in a sense, irrelevant to the present question, since all scientists are presumably college graduates.

The present results also conform to the various reports that radiologists have shorter lives. The present differences are much greater than those previously observed, but the reason may be that the sample is composed mostly of physicists who are, presumably, working with radiation of much higher energy than the medical radiologists in the previous studies.

Nevertheless, no validity or significance can be claimed for these differences without further information. A conclusive study would, first of all, have to be based on a more definitive examination of death notices. The basis for reporting deaths in **Science** was not determined. Other factors not determined were completeness of coverage and whether the likelihood of a death being reported was the same for those in different specialties, for active and retired persons, and for university and non-university personnel.

There is a tendency to report the deaths of the more notable persons. If physicists tend to become eminent earlier in their careers than do men in the earth-sciences, then the death of a young physicist would be more likely to be noted than that of a young geologist.

What is more, one would expect to find different distributions for the specialties, since the earliest age at which a man would probably qualify for a given specialty will vary. For example, a man is considered to be an engineer after he has completed four years of college, but a physician must have an additional four years of education, and a psychiatrist must have had still more training.

A person generally does not become an administrator until he has had several years of experience, and not many men would achieve this position at an early age. Thus, deaths would not be reported for psychiatrists or administrators as early in life as for engineers, simply because it is unlikely that many would have become psychiatrists or administrators that soon.

Conversely, physicists and psychologists may have a low average age at death because there are relatively large numbers of young men going into these specialties, increasing the chances that a young scientist in this age group would die.* These examples make clear why the significance of the differences. cannot be assessed without knowing the proportion of men and women in each age group for each specialty.

*Some weight is given to this possibility by the fact that, according to the National Register of Scientific and Technical Personnel compiled by the National Science Foundation,[15] the highest ranking specialties in Table I, except for engineers, are the smallest groups; four of the top five categories comprise one percent or less of the total scientific population, which may indicate that relatively few young people are entering these specialties. On the other hand, Brooks[16] has reported that in the last few years the highest increases in gradaute enrollment were in astronomy and the earth-sciences (apart from classical geology). These figures may be too recent, however, to bear on the present results.

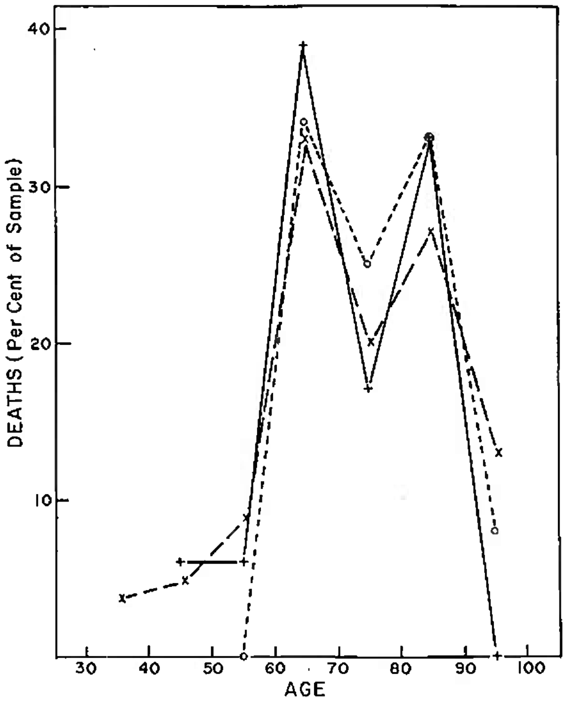

Fig. 4. Mortality distributions for 12 archaelogists (+), 18 anthropologists (O), and 102 earth-scientists (X).

There is, however, a certain plausibility about these results. It seems reasonable that outdoor occupations or an academic environment should lead to a longer life. It also seems likely that there are proportionally far fewer psychiatrists and administrators in the younger age groups than there are engineers; if the present results were simply statistical artifacts, it would not be the former who would have the low average life-spans. The present results are in no way conclusive, but they do suggest an interesting area for inquiry, an area to which almost no attention has apparently been paid. It seems well worthwhile to carry out the proposal to compare health measures from different groups in the Navy.

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UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* U.S.Naval Submarine Medical Center Submarine Medical Research Laboratory	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

AVERAGE AGE AT DEATH OF SCIENTISTS IN VARIOUS SPECIALTIES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Interim report

5. AUTHOR(S) *(First name, middle initial, last name)*

Saul M. Luria

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
20 January 1970	7	16

8a. CONTRACT OR GRANT NO. b. PROJECT NO. M4306.01-4020B.01 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) SMRL - 609 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

10. DISTRIBUTION STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	U.S.Naval Submarine Medical Center Box 600, Naval Submarine Base Groton, Connecticut 06340

13. ABSTRACT

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Life-span						
Longevity of scientists						

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LECTURE, PAPER OR EXHIBIT FOR PRESENTATION

NSMC Form 5720/1 (rev 3-6-67)

CLEARANCE OF ARTICLE FOR PUBLICATION (X) LECTURE, PAPER OR EXHIBIT FOR PRESENTATION ( )
(Check applicable)

Submission Date: 16 Jan 1970 609

Nature of Presentation & Title ~~SMRL Report~~	Subtask No. & Title to which related
Average age at death of scientist in various specialties.	M4306.01-4020B Longitudinal health study

Proposed for Presentation at: (date, name, place)

Funding:	Presentation:
TAD ( )	At own Initiative ( )
Authorization Orders ( )	Invitation ( ) attach invitation
Leave ( )	Official Request (X) attach request
Other Funding is (not) required for:	
	(Signature)

Review and Recommendation	Signature	Date
Branch Head: Recommend () Not Recommend ( )		
Division Head: Recommend () Not Recommend ( )		
Chief Scientist: Recommend (✓) Not Recommend ( )	Charles F. Bell	1/26/70
Director, SMRL: Recommend (✓) Not Recommend ( )		2/10/70

Approval

Clearance (~~not~~) granted ✓ = No. 797 MK

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