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THE EFFECTS OF ACTIVITY PATTERNS ON LONGEVITY
OF ATHLETES AND NON-ATHLETES

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THE EFFECTS OF ACTIVITY PATTERNS ON LONGEVITY OF ATHLETES AND NON-ATHLETES

By

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ABSTRACT

THE EFFECTS OF ACTIVITY PATTERNS ON LONGEVITY
OF ATHLETES AND NON-ATHLETES

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The purpose of this investigation was to examine the relationship between longevity and activity patterns, as reported in 1960, of athletes and non-athletes who had attended Michigan State University prior to 1938. Groups selected for comparison included, by birth decade, living athletes, deceased athletes, living non-athletes and deceased non-athletes. Vocational activity, avocational activity and combined activity ratings were analyzed. A loglinear model was used to examine the relationship between athletes and non-athletes, while Chi-square tests were used in subsequent analyses.

No difference between athletes and non-athletes was noted in terms of percent decreased, birth decade and total activity level. Likewise, no effect on total activity of impending death was noted in the population examined between 1960 and 1976. It was noted that both avocationally and vocationally, those most active in 1960 appeared to have a smaller percentage deceased between 1960 and 1976.

DEDICATION

To Ellis, Margaret and my family--for
their continuous encouragement.

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CHAPTER I

THE PROBLEM

Investigations reporting the effects of activity on longevity have been diverse in their findings. Early experimentation led to the conclusion that college athletes, when compared to the general population, were provided with a slight advantage in terms of lifespan (1,5, 6,9,10,14,18,22,41,42,46,50,51). Further studies compared university athletes with a more comparable group, other college students enrolled at the same time in the same school. Results indicated that all college students were longer-lived than the normal populace (21). In addition, it was found that other college students, particularly honor students, seem to have lived longer than cohorts who were athletes (19,22,28,29, 37,38,44). A final group of papers attempted to assess later life (post-college) activity patterns and evaluate their relationship with mortality. These studies focused primarily on occupational activity levels and concluded that activity did indeed provide some measure of protection against death (2,15,16,34,39,45,49).

Research pertaining to avocational and vocational participation patterns throughout both college and in later life was scant and non-conclusive. The effects of habitual activity patterns on mortality and longevity were also non-conclusive.

Statement of the Problem

The purpose of this investigation was to examine the effects of activity on the longevity of former athletes and non-athletes who had attended Michigan State University prior to 1938. Specifically, subject activity was measured using responses given to the first follow-up questionnaire of the 1952 study entitled Longevity and Morbidity of College Athletes. Three activity ratings were utilized which included vocational activity, avocational activity, and combined activity. Groups selected for comparison under these parameters were living athletes, deceased athletes, living non-athletes, and deceased non-athletes.

The current study sought to provide insight into the following questions:

1. Who was more active in 1960, 22 years after the youngest subject's graduation, athletes or non-athletes?
2. Did activity level as reported in 1960 decrease significantly prior to death (excluding war and catastrophic deaths) and if so, how long prior to death was a decrease in one's activity apparent?
3. How was mortality affected by various types (vocational, avocational or combined) and intensities (sedentary, light, medium, and heavy) of activity?

Significance of the Study

Information concerning the relationship of physical activity to length of life should be provided by the present study. Although one animal study (43) has demonstrated increased longevity as a result of regular physical activity, this has not been observed conclusively in man. Resulting from this study will be information concerning the relative physical activity of former athletes and non-athletes in their later years and this relationship to mortality.

Limitations

1. The study was limited by use of a mailed series of questionnaires (1952, 1960, 1968, and 1976). The numbers of non-respondents, especially large in the original 1952 study, was a source of possibly biased information.
2. Use of a population of male students in attendance at Michigan State University prior to 1938 and largely of a rural origin may have influenced the data and its applicability to predictions for current longevity.
3. The study considered only those respondents alive in 1960 who either were proven deceased or responded to the 1976 questionnaire.
4. The study was additionally limited to the examination of selected, subjectively-rated variables.
5. The study examined activity as reported in the 1960 questionnaire response only.

6. Any deaths attributed to war or catastrophic causes were omitted.
7. A case for causation cannot be made on the basis of the data at hand (a non-causal relationship currently exists).

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Many diverse commentaries have been presented on the values of physical activity as a means for preserving or enhancing health, and consequently life. Galen was of the opinion in the second century A.D. that "while athletes are exercising their profession, their body remains in a dangerous condition, but when they give up their profession they fall into a condition more parlous still; as a fact, some die shortly afterwards; others live for some little time, but do not arrive at old age. . . ." (9). Hippocrates concurred stating that "the truth is, however, that no one is in a more risky state than they. . . ."(48). While such pronouncements bore great weight, ancient converse statements such as that by Timaeus in the Dialogues of Plato which indicated his belief that the body "by moderate exercise reduces to order according to their affinities the particles and affections which are wandering about . . ." (7) have clouded the issue throughout history, and indeed, until much more recent times.

More current investigations have sought to resolve this issue and in some instances have expanded the study beyond the athlete-non-athlete comparisons to examine the role of activity in terms of health and life promotion. Consequently, the current review of literature

focused on three main types of studies conducted within the last one hundred and twenty-five years.

Non-cohort Athlete Studies

The initial studies were conducted along actuarial lines by comparing the general population with select groups of athletes. The first such investigation was initiated in 1873 on 251 men who had rowed in the Oxford-Cambridge Boat Races between 1829 and 1859 (9). In this study Morgan concluded that, taking all the oarsmen together, each individual was "likely to survive the race on an average of some forty-two instead of forty years" as predicted by Dr. Farr's English Life Tables.

A confirming study by Meylan conducted in 1904 (18) on 152 Harvard University crew members found athletes favored by 2.88 years (5.09 years with allowance for Civil War deaths) over mortality table values.

A subsequent study by Gaines and Hunter in 1906 (12) found that Yale athletes graduated prior to 1905 experienced deaths only 49% of those predicted by insurance tables. Additionally, it was shown other graduates had a 70% mortality ratio when compared with an insured population.

Anderson in 1916 (1) compared 808 Yale track, football, baseball, and crew athletes with two insurance populations. As indicated in Table 2.1, the athletes were again favored with an apparent increased longevity.

The 1927 study by Hill (10) on British cricket players drawn from Wisden's Cricketers Almanac again illustrated a superior longevity for athletes at every age.

Table 2.1. Comparison of Actual to Expected Deaths Among Yale University Athletes (From Anderson, 1916)

	Number of Letter Winners	Number of Deaths	Per Cent of Actual to Expected Deaths Actuarial Society Table	Per Cent of Actual to Expected Deaths American Table	Year of Earliest Data
Track	276	13	62	52	1868
Football	213	16	58	52	1872
Baseball	148	11	47	42	1865
Crew	171	18	45	41	1855
Total	803	58	52	46	----

Dublin's initial research in 1928 (6) was confined to pre-1905 graduates of ten Eastern American universities and numbered 4,976 letter winners in six sports or sport categories. Comparisons made with the Medico-Actuarial Table and the American Men Table of Mortality found that taking all athletes together the actual deaths represented, respectively, 93.2% and 91.5% of the table values. Dublin was careful to point out the limitations involved in use of actuarial tables, and did express some concern that while his athletes presented a favorable mortality ratio it might have been still better, considering that the college men selected represented "the cream of the cream of American manhood". Dublin also reported mortality ratios for the data when broken down into sports, age, and colleges (see Tables 2.2, 2.3, and 2.4).

Table 2.2. Percent Actual of Expected Deaths According to American Men Table (From Dublin, 1928)

Sports	All Classes Combined	Classes Prior to 1880	Classes 1880-1889	Classes 1890-1899	Classes 1900-1905
All sports combined	91.5	94.1	94.6	93.6	72.6
Baseball	98.0	98.6	97.4	103.1	81.4
Crew	94.1	92.2	72.1	124.0	113.4
Football	88.3	87.6	94.7	91.6	63.4
Track	91.8	....	121.7	86.6	73.0
Two or more sports	78.3	85.8	80.8	81.0	62.9

Table 2.3. Mortality by Birth Decade of Athletes of Ten Colleges Compared with Expected Deaths by American Men Table (From Dublin, 1928)

Class Group	Actual Deaths	Expected Deaths by American Men Table	Per Cent Actual of Expected Deaths
All classes	1,202	1,314	91.5
Prior to 1880	454	483	94.1
1880-1889	322	340	94.6
1890-1899	310	331	93.6
1900-1905	116	160	72.6

Table 2.4. Mortality of Athletes of Ten Colleges, Compared with the Expected Mortality According to the American Men Ultimate Table. Specified Class Groups Experience on Classes 1905 and Prior (From Dublin, 1928)

College	All Classes Combined	Classes Prior to 1880	Classes 1880-1889	Classes 1890-1899	Classes 1900-1905
All colleges combined	91.5	94.1	94.6	93.6	72.6
Amherst	74.7	91.1	62.9	73.6	56.2
Brown	74.1	80.4	99.5	59.8	51.7
Cornell	94.6	99.5	104.1	97.9	70.0
Dartmouth	113.4	112.4	113.8	127.1	80.9
Harvard	100.1	107.5	99.2	94.9	85.0
Massachusetts Agricultural	84.4	....	98.6	94.0	*
Tulane	94.2	....	....	75.7	120.3
Wesleyan	85.3	93.4	84.2	73.6	61.2
Williams	79.5	....	....	61.9	101.1
Yale	89.2	82.0	93.7	108.6	71.1

*Rate not significant

Another investigation by Reed and Love (42) contrasted Army officers with the actuarial populations, and also West Point athletes with other West Point officers. His 1931 investigation showed favorable longevity for officers over the general populace and also for athletes over other officers.

Two 1930's investigations focused on oarsmen again. Cooper et al. (5) in 1937 found that of the 100 Ormand College rowers 24 had died as compared to an expected 31.8. His comparison was the average Australian insurance holder. The second oarsmen investigation, a 1939 study by Hartley and Llewellyn (9), used Oxford-Cambridge boat race veterans of the 1829 to 1928 era. As with Cooper's work, however, the numbers were relatively small (767). Hartley and Llewellyn compared the study groups, after they had divided it into four groups based on age, with standard mortality tables. As can be seen in Table 2.5, when compared with assured lives of their own generation, college oarsmen seemed favored in terms of longevity. They also pointed out two factors of significance; specifically, that this superiority tended to diminish in late years and also that when compared to the more current 1924-29 standard table the comparison proved less favorable than in up to age 50 comparisons in the first three periods.

In a study which deviated from the preceding investigations in that high school athletes were compared with the United States Census Bureau standard mortality ratios rather than college athletes, Wakefield (50) found that there were 123 actual deaths as opposed to an expected 181.1. Additionally, this 1944 examination found longevity was more favorable in young players (14, 15, and 16 year olds' ratio was 54.2%

Table 2.5. Actual versus Expected Deaths by Selected Age Groups (From Hartley and Llewellyn, 1939)

Age Group	Actual Deaths	Expected Deaths by Standard Table	Actual as Percentage of Expected
Period 1.--1829-62. Standard Mortality Table H^M			
Up to 50	22	25.2	87.3
51 to 70	1	1.0	100.0
Over 70	--	--	--
All ages ..	23	26.2	87.8
Period 2.--1863-93. Standard Mortality Table O^M			
Up to 50	53	62.1	85.3
51 to 70	39	59.8	65.2
Over 70	18	21.6	83.3
All ages ..	110	143.5	76.7
Period 3.--1894-1923. Standard Mortality Table Mean of O^M and A 1924-9			
Up to 50	32*	40.7	78.6
51 to 70	85	98.0	86.7
Over 70	108	125.8	85.9
All ages ..	225	264.5	85.1
Period 4.--1924-8. Standard Mortality Table A 1924-9			
Up to 50	3	3.4	88.2
51 to 70	13	13.2	98.5
Over 70	20	21.9	91.3
All ages ..	36	38.5	93.5

*Excluding 37 Great War deaths.

versus 17, 18, and 19 year olds' ratio of 78.9%) and that the ratio for boys playing in three games in one day was 69.4%. It is also noteworthy here that the group ratio was 67.9%.

Montoye et al. (22) have cited a report on 400 deceased athletes in Czechoslovakia with at least ten years of sports competition conducted by Schmid in 1952. With war deaths omitted, the mean age for various sports was reported along with a comparison of athletes and non-athletes from the general population (see Table 2.6). Again the athletes seemed to have been favored.

Table 2.6. Longevity of Athletes and Non-athletes (From Schmid, 1952)

Year of Birth	Mean Age of Non-athletes (Years)	Mean Age of Athletes (Years)
1861-1870	58.24	66.90
1871-1880	60.28	61.72

Pomeroy and White in 1958 (39) attempted to contrast the longevity of Harvard football players with that of the general Massachusetts population and other Harvard graduates who had not played football but found "adequate data for any such statistical comparison were lacking". They did examine lifelong habits of exercise in a coronary group, both decreased and living, and a group living without coronary disease. It was concluded that "men in the coronary heart disease group engaged in less vigorous exercise than did those without heart disease".

While Karvonen's 1959 paper (14) focused on training of the cardiovascular system, he did examine the length of life of sportsmen involved with their sport over a prolonged period. It was concluded in his study of 388 pre-1930 champion skiers, many of whom still skied, that "training does not shorten life but may even prolong it". The comparisons with the general population were certainly in the athletes' favor, while a similar comparison with a select insured population showed little in the way of difference.

In a continuation of Karvonen's emphasis on cardiovascular studies in former endurance athletes, Pyorala et al. (41) found 93 men aged 40 or more of which 40 had been long distance runners and 53 skiers. A control group selected from a similar social class was compared over numerous variables, one of which was physical activity. It was found that "irrespective of age and absence or presence of cardiovascular disease, the average degree of physical activity was higher in the athletes than in control subjects". Age at death or mortality ratios were not presented, consequently no athlete-population comparisons were made.

Conversely, a Danish study by Schnohr in 1971 (47) on 297 male athlete champions born between 1880 and 1910 sought to examine differences in mortality when compared with the general male population. Up to age 50 a mortality ratio of 61% in favor of the athletes was significant. For the age periods 50 to 64 years and 65 to 80 years the ratios were 108% and 102% respectively. Schnohr, in a closing comment, stated neither former athletic champions nor less successful athletes studied continued vigorous exercise after years of competition.

The final non-cohort athlete study was conducted in 1975 by the Metropolitan Life Insurance Company (51) on major league baseball players and used the white male population of the United States as a comparison base. Mortality ratios for all players indicated that those playing in the 1876-1900 period had a mortality ratio of 103%--whereas the ratio was 71% in the 1901-1973 period. Additional information was provided concerning mortality by position and batting average (see Table 2.7).

Table 2.7. Mortality of Major League Baseball Players Compared with White Males in United States Population (From Metropolitan Life Statistical Bulletin, 1975)

	Players Who Had Careers Beginning			
	1876-1900		1901-1973	
	Deaths	Mortality Ratio*	Deaths	Mortality Ratio*
Batting Average				
.300 or more	77	88%	102	71%
.250-.299	356	99	547	74
.200-.249	364	107	558	65
less than .200	263	109	588	75
All	1,060	103	1,795	71
Position Played				
Pitcher	242	105%	594	79%
Catcher	118	108	184	69
First Base	72	100	96	79
Second Base	65	105	104	68
Third Base	69	103	88	55
Shortstop	58	90	94	67
Outfield	221	95	342	72

Source of basic data: The Baseball Encyclopedia, 2d ed. New York, Macmillan Publishing Co., Inc., 1974.

Table 2.8 is a summarization of the non-cohort athlete studies to date. In general it can be seen that athletes had apparently secured some benefits from their participation as they lived at least as long or longer than the general population. Prior to accepting this conclusion one should be forewarned of the problems inherent in these types of investigations. As previously pointed out, many of these studies had either too small an initial number or too few of their numbers were deceased to make significant predictions. In addition, many of the mortality tables selected for a comparison provided the investigators with an inherent source of bias. Actuarial tables provided a contrast group of select individuals, those who generally were capable, both physically and financially, of securing life insurance. General population tables reflect both the healthy and the unhealthy in the population, and thus may have tended to accentuate the differences between groups. Use of either table may have provided additional bias in that the comparison is made between mortality ratio on a single year's table and actual athletes, whose life spans many years, consequently many tables.

The very use of college athletes, especially those selected in the early portion of the century and before, could be considered an influence on the results. Dublin perhaps summarized it best when he stated that "the college man was a picked man; his home represented an economic standard far above average; he was usually of American parentage, a race stock with an excellent rate of longevity; his occupation after leaving college was usually one in which he was not subjected to the hazards involved in so many pursuits". It was his belief that as a result it

Table 2.8. Summary of Non-cohort Athlete Longevity Studies

Investigator	Year	Examined Population	Number	Comparison Population	Findings	Comments
Morgan (9)	1873	1829-1859 Oxford and Cambridge University Oarsmen	251	Dr. Farr's English Life Tables	Athletes Favored	By 2.0 Years
Meylan (18)	1904	1852-1892 Harvard University Oarsmen	152	Standard Mortality Tables	Athletes Favored	By 2.88 Years
Gaines and Hunter (12)	1906	Pre 1905 Yale University Athletes	Unspecified	Insurance Tables	Athletes Favored	Mortality Ratio 49%
Anderson (1)	1916	1855-1905 Yale University Athletes	808	Actuarial Society Table (AST) and American Table (AT)	Athletes Favored	AST Mortality Ratio 52% AT Mortality Ratio 46%
Hill (10)	1927	1800-1888 British Cricket Players	3,424	English Life Table No. 4 and English Life Table No. 8	Athletes Favored	Significant at All Ages, All Comparisons
Dublin (6)	1928	1890-1905 Athletes from Ten Eastern American Colleges	4,976	Medico-Actuarial Table (MA) and American Men Table of Mortality (AMTM)	Athletes Favored	MA Mortality Ratio 93.2% AMTM Mortality Ratio 91.5%
Reed and Love (42)	1931	1901 (in servie) - 1916 (commissioned before) West Point Military Academy Officers	Unspecified (Total Study N = 4,991)	American Men Table of Mortality and West Point Officers	Athletes Favored	By .25-1.25 years
Cooper, O'Sullivan and Hughes (5)	1937	Ormand College (Australia) Oarsmen	100	Australian Insurance Table (AIT)	Athletes Favored	Mortality Ratio 75.4%

Table 2.8--Continued

Investigator	Year	Examined Population	Number	Comparison Population	Findings	Comments
Hartley and Llewellyn (9)	1939	1829-1928 Oxford and Cambridge University Oarsmen	767	4 Standard Mortality Tables (Hm, Om, $\bar{X}_{o_m}$+A, A)	Athletes Favored	Period 1 Mortality Ratio 87.8% Period 2 Mortality Ratio 76.7% Period 3 Mortality Ratio 85.1% Period 4 Mortality Ratio 93.5%
Wakefield (50)	1944	1911-1935 Indiana High School Basketball Players	2,919	United States Bureau of Census Life Tables	Athletes Favored	Mortality Ratio 67.9%
Schmid (22)	1952	1861-1880 Czechoslovakian Athletes	400	General Population Non-Athletes	Athletes Favored	By 8.66-1.44 Years
Pomeroy and White (39)	1958	1900-1930 Harvard University Football Letterman	424	1940 General Massachusetts Population and Other Harvard Graduates	Unspecified	Athlete-Population comparison not possible. Coronary group engaged in less virgorous and habitual exercise.
Karvonen (14)	1959	Pre 1930 Finish Champion Skiers	388	1931-1940 and 1951-1955 General Male Finish Population and 1949-1953 Insurance Population	Athletes Favored	By 6-7 Years over 1931-1940, Smaller Differences Over 1951-1953, Non-significant differences with Insurance Population
Pyorala et al. (41)	1967	Finish Long Distance Runners and Skiers	93	Randomly Selected Finish Population	Athletes Favored	Have a higher degree of activity. Mortality Ratio-Comparison not Made
Schnohr (47)	1971	1880-1910 Danish Champion Athletes	297	General Male Population	Athletes Favored	Mortality Ratio to Age 50 61%*, Mortality Ratio Post age 50 108-109%
Metropolitan Life (51)	1975	1876-1973 Major League Baseball Players	6,753	General Population (White Males) of the United States	Athletes Favored	1876-1900 Mortality Ratio 103% 1901-1973 Mortality Ratio 71%

was to be "expected that the athletes would show a lower mortality than the usual mortality tables" (6).

Efforts to eleviate some of this bias and present a clearer insight into the role that athletic participation plays in one's longevity produced a more complete and accurate compilation of data in a new series of studies.

Cohort Athlete Studies

The succeeding studies used non-athletic cohorts as a control to compare peer groups. In this manner, athletes and non-athletes drawn from the same population at the same time could be compared across a wide variety of variables of which age at death or some such measure of mortality was one.

This format was used by numerous investigators including Greenway and Hiscock in 1926 (22). Their study of Yale graduates and lettermen is represented in Table 2.9. While consideration must be given to the small numbers involved, the data indicated, as pointed out by Montoye et al. (22), "that the superior longevity of college athletes may very well be due to the fact that these men were members of a select group, namely college graduates. . . ."

Dublin in 1932 (22,28) attempted to resolve the criticism levelled at his earlier work by comparing the longevity of the same 4,976 letter winners with that of 38,269 graduates of eight eastern American colleges. Of these graduates, 6,500 were honor students and two-thirds were selected from Harvard, Yale and Cornell. The data (see Table 2.10)

Table 2.9. Deaths Among Yale Graduates as Compared with Expected Deaths of American Men Ultimate Table, 1905-1923 (From Greenway and Hiscock, 1926)

Groups	Deaths*	Expected Deaths American Men Ultimate Table	Ratio of Actual to Expected Deaths (Per Cent)
Non "Y" Men	317	381	83
"Y" Men	27	29	93
All Graduates	344	410	84

*Excluding deaths due to war injuries.

Table 2.10. A Comparison of Expectation of Life in Years (From Dublin, 1932)

Age	General College Graduates (38,269)	College Athletes (4,976)	College Honor Men (6,500)	American Men Table (1900-1915)
22	45.71	45.56	47.73	44.29
27	41.68	41.41	43.61	40.18
32	37.59	37.25	39.48	36.03
37	33.51	33.09	35.30	31.83
42	29.44	28.92	31.07	27.66
47	25.37	24.80	26.85	23.62
52	21.43	20.85	22.79	19.79
57	17.78	17.34	19.03	16.25
62	14.48	14.09	15.56	13.06
67	11.47	11.06	12.36	10.28
72	8.81	8.41	9.50	7.91
77	6.52	6.15	7.06	5.96
82	4.56	4.24	4.98	4.41
87	3.01	2.77	3.30	3.21
92	1.92	1.75	2.11	2.30

revealed that honors graduates seemed to have a slightly greater longevity at every age (approximately two years). Also it was shown athletes had a life expectancy which closely paralleled that of other college graduates.

Another group of honors graduates, athletes and a random sample of students from the 1860-1900 Cambridge University classes was the subject of Rook's 1954 examination (44). Survival rates, presented in Table 2.11, along with average age-at-death figures indicated that the 374 honors students generally were longer lived by a period averaging 1.5 years. This difference was not significantly different from those values registered by the 379 randomly selected students or the 772 athletes. Rook's data also indicated the more heavily built man had somewhat of a disadvantage when considering the prospects of longevity.

In the first of a series of studies conducted by Dr. Henry Montoye (22) on Michigan State University athletes and non-athletes, he found only 122 deaths. In this initial study age-at-death examination produced no significant differences between groups. Montoye and colleagues also examined vocational and avocational activities in an effort to determine if regular exercise throughout life had an effect on longevity. It was found that beyond the age of 45 non-athletes were significantly more active in sports. This situation was reversed prior to age 45. Participation in non-sports activities yielded additional significant differences, with non-athletes indicating a greater participation at practically every age period. These results may be somewhat clouded owing to the poor initial returns from questionnaire mailings.

Table 2.11. Survival Rates of Sportsmen and Controls Excluding Deaths Due to War and Accidents (From Rook, 1954)

Age	No. of Survisors at Each Age		
	Sportsmen	Intellectuals	Random Group
20	1,000	1,000	1,000
25	996	987	985
30	982	962	964
35	963	948	949
40	934	937	913
45	898	910	889
50	870	888	867
55	825	841	837
60	763	791	754
65	673	738	634
70	523	597	532
75	377	434	364
80	186	231	193
85	82	92	82
90	23	26	23
No. in group ..	723	362	325
Average age at death	67.97	69.41	67.43
Variance of estimate of average age at death	0.29	0.61	0.74

Seven year follow-up data presented in 1962 (21) verified the original findings on longevity. Montoye summarized "that there were no appreciable differences between athletes and non-athletes in longevity or cause of death, excluding violent deaths. Both athletes and their controls from the university sample lived longer than the general insurance risks. . . ."

Montoye in 1967 (19) presented an updated paper on the status of his groups. In it he studied the original and follow-up groups of deceased subjects. He reported the mean age at death for athletes was 62 years and that for non-athletes it was 64 years (a nonsignificant difference). In discussing the effects of exercise continuance in the seven year period between studies, it was noted that "the amount of physical activity was significantly greater among subjects who survived seven years".

Paffenbarger et al. (31) reported on factors which may have been precursors of coronary heart disease in a study which utilized over 45,000 college students from the University of Pennsylvania and Harvard University between 1921 and 1950. One factor considered was varsity athletics. It was reported that an inverse relationship existed between varsity athletics and coronary heart disease, both in terms of subjects with specified coronary heart disease factors and in terms of mortality from coronary heart disease. The estimated mortality ratio at all ages was 60%.

His second report discussed characteristics predisposing to stroke (32). It contrasted 171 stroke victims with 684 of their classmates and

revealed seven precursors of fatal stroke, one of which was non-participation in sports. The estimated mortality ratio of 0.4 reflects this indirect relationship between death from stroke and participation in varsity athletics.

One of the more recent studies was completed by Polednak and Damon in 1970 (38). The longevity of 2,090 men, alive and dead, from the classes between 1880 and 1916 at Harvard was examined in the same manner as Rook. Data were presented (see Table 2.12) which indicated that minor athletes emerged as the longest-lived group, while major athletes and non-athletes failed to differ. In considering age at death (see Table 2.13) the only consistent finding was that major athletes were the shortest lived in each birth decade. An attempt was made by the authors to explain this trend based on a discussion of somatotype.

Table 2.12. Harvard Athletes, Alive or Dead of Natural Causes; Percentage of Men Reaching Ages 70 and 75, by Birth Decade (From Polednak and Damon, 1970)

Birth Decade	Reaching Age 70						Reaching Age 75					
	1860-69		1870-79		1880-89		1860-69		1870-79		1880-89	
	N	%*	N	%*	N	%*	N	%*	N	%*	N	%*
Major athletes	26	46.4	52	59.7	14	60.9	21	37.5	42	48.3	12	52.2
Minor athletes	29	58.0	86	63.2	55	76.4	21	42.0	72	52.9	48	66.7
Non-athletes	239	57.2	444	60.7	255	62.9	186	44.5	333	45.5	201	49.6

For significance of differences, see text.

*Per cent of men in each athletic category in each birth decade who reached the specified age. Thus, of 56 major athletes alive or dead of natural causes in the birth decade 1860-69, 26, or 46.4%, reached age 70.

Table 2.13. Harvard Athletes: Mean Age at Death for Men Dead of Natural Causes (From Polednak and Damon, 1970)

Age at death (yrs.)	1860-69 N	1860-69 Mean	1860-69 S.D.	1870-79 N	1870-79 Mean	1870-79 S.D.	1880-89 N	1880-89 Mean	1880-89 S.D.
Major athletes	55	67.3	16.8	84	69.8	15.9	16	66.2	14.2
Minor athletes	49	67.9	18.0	119	70.8	14.7	43	67.2	16.8
Non-athletes	416	69.3	17.4	699	70.1	15.0	308	67.7	12.5

Note: Percentage of deaths among original cohort in each birth decade: 1860-69, 99.3%; 1870-79, 94.6%; 1880-89, 75.7%. Differences among athletic categories within each birth decade are not significant.

Polednak expanded his study to include a total of 6,303 Harvard students born between the years 1860 and 1889 (35,37). His data were again divided into birth decades to minimize time trends and as in his earlier paper the most significant finding was the reduced longevity of major athletes relative to their classmates. The differences were small, usually between one and three years in mean age at death, with major athletes the shortest lived in each birth decade. It was anticipated that "since slightly larger percentages of minor athletes are still alive in the two most recent birth decades . . . eventually the minor athletes will improve their longevity in relation to the other two groups".

Ratings for both avocational and vocational activity throughout life were derived from the 1960 follow-up of Montoye's study and presented by Olson (28). In general, those alive in 1968 were found to have been more active in 1960 than those deceased between 1960 and 1968.

This was irrespective of the athlete-non-athlete categorization. College athletes and non-athletes failed to vary in terms of vocational and combined activity ratings. The avocational ratings indicated the former athletes were significantly more active than the non-athletes. Age-at-death comparisons favored non-athletes (see Table 2.14), however differences here were not significant.

Table 2.14. Mean Age at Death of Athletes and Non-athletes (From Olson, 1972)

	1952-1960 Mean		1960-1968 Mean		Total 1952-1968 Mean	
Subjects	N	Age at Death	N	Age at Death	N	Age at Death
Athletes	46	67.32	62	72.29	108	70.17
Non-athletes	30	69.81	57	72.46	87	71.57

Both Harvard and Yale crews, numbering 172, were compared with randomly selected, matched classmates from the years 1882 to 1902. Prout (40) found a highly significant age-at-death advantage in favor of the athletes, the difference being 6.35 years at Yale and 6.24 years at Harvard (see Table 2.15). In view of the preceding studies these results were somewhat of a surprise and unexplained apart from the small numbers involved.

Table 2.15. Comparison of Average Life Span of Crew Members and Controls at Harvard and Yale (From Prout, 1972)

Group	No. of Subjects	Average Life Span	t-test	P
Harvard crew	90	67.79	2.41	<.05
Harvard controls	90	61.54		
Yale crew	82	67.91	2.37	<.05
Yale controls	82	61.56		
Combined crew	172	67.85	3.39	<.01
Combined controls	172	61.55		

A final paper in the cohort athlete series was presented by Olson et al. in 1978 (29). The average age at death for the 275 deceased athletes was 68.13 years, as opposed to 70.17 years for the 227 deceased non-athletes. At the time of the study roughly 40% of all subjects had died.

While cohort athlete studies provided a unique and superior approach to the study of the effects of activity on longevity, several points should be considered before conclusive statements are made. As in the non-cohort investigations, many of these peer group studies used either relatively small numbers in formulating conclusions (22,28,30,32, 38,40) or, in some cases, the number of actual dead proved to be few (19,21,22,28,29,31,32). An additional criticism might be levelled at the peer group selection procedures. As Polednak points out in his study (37,38), the subjects still formulate a select group. His group were chosen from those who had applied for gymnasium lockers at Harvard

and hence were interested, to some degree at least, in athletics. Likewise, other studies did not investigate the activity patterns experienced by their cohorts while in school (22,28,31,32,40,44). In either case, college students still provide a select group with apparent and distinct advantages over the general populace in terms of longevity (22,28).

Despite these criticisms, several interesting conclusions were indicated. In almost all the papers, summarized in Table 2.16, the distinct advantage registered by the athletes in the non-cohort studies was not present [the exceptions being Prout's study (40) and also that of Paffenbarger et al. (31,32)]. It appeared that minor athletes or honors students had some advantage, though not significant, over major athletes. Second, the hypothesis that college groups were longer lived, as indicated by mortality tables, was borne out thus inhibiting the extrapolation of findings to cover trends in the general population.

Examination of data from both sets of studies indicated that while athletics in college may have had no significant positive effect on longevity, they certainly had no detrimental effect, as no investigation showed a significantly greater longevity for the non-athlete controls used. It is important to note, however, that these data apply only to athletics while in college. Apart from the studies based on Montoye's original group, no investigator undertook to measure later activity, either vocational or avocational. Hence, the effects of later life or habitual activity may be the determining factor in the analysis of the longevity-activity relationship.

Table 2.16. Summary of Cohort Athlete Longevity Studies

Investigator	Year	Examined Population	Number	Comparison Population	Number	Findings	Comments
Greenway and Hiscock (28)	1926	Post 1904 Yale University Lettermen	686	1905-1923 Yale University Non-Lettermen	9,421	Controls Favored	Actual to Expected Deaths (%) Controls 83% "Y" Men 93%
Dublin (22, 28)	1932	1870-1905 Eastern American College Lettermen	4,976	1870-1905 Eastern American College (8) Non-Lettermen	38,269	Honors Men (Controls) Favored	Generally by 2 Years - Over Both Athletes and Other Students (Non-Significant)
Rook (44)	1941	1860-1900 Cambridge University Athletes	772	1860-1900 Cambridge University Honors and Random Graduates	374 (Honors) 336 (Random)	Honors Men (Controls) Favored	Generally by 1.5 Years - Over Both Athletes and Other Students (Non-Significant)
Montoye et al. (22)	1957	Pre 1938 Michigan State University Lettermen	628	Pre 1938 Michigan State University Students	563	No Difference (in Age at Death)	122 Deceased
Montoye et al. (21)	1962	Pre 1938 Michigan State University Lettermen	628	Pre 1938 Michigan State University Students	563	No Difference (in Age at Death)	206 Deceased
Montoye et al. (19)	1967	Pre 1938 Michigan State University Lettermen	628	Pre 1938 Michigan State University Students	563	Non-Athletes Favored	By 2 Years (Non-Significant) 206 Deceased
Paffenbarger et al. (31)	1967	1921-1950 University of Pennsylvania and Harvard University Varsity Athletes	63	1921-1950 University of Pennsylvania and Harvard University Students	590	Athletes Favored (In Coronary Heart Deaths)	Mortality Ratio = .6
Paffenbarger et al. (32)	1967	1921-1950 University of Pennsylvania and Harvard University Varsity Athletes	118	1921-1950 University of Pennsylvania and Harvard University Students	855	Athletes Favored (In Fatal Stroke)	Mortality Ratio = .4

Table 2.16--Continued

Investigator	Year	Examined Population	Number	Comparison Population	Number	Findings	Comments
Polednak and Damon (38)	1970	1880-1916 Harvard University Lettermen (Major Athletes)	177	1880-1916 Harvard University Students (Minor and Non-Athletes)	275 (Minor) 1638 (Non)	Minor Athletes Favored	Major Athletes Shortest Lived
Polednak (37)	1972	1880-1916 Harvard University Lettermen (Major Athletes)	668	1880-1916 Harvard University Students (Minor and Non-Athletes)	1501 (Minor) 4134 (Non)	Minor Athletes and Non-Athletes Favored	By 1-3 Years
Olson (28)	1972	Pre 1938 Michigan State University Lettermen	628	Pre 1938 Michigan State University Students	563	Non-Athletes Favored	By 1.4 Years
Prout (40)	1972	1882-1902 Harvard and Yale University Crews	172	1882-1902 Harvard and Yale University Students	172	Athletes Favored	By 6.24-6.35 Years (Significant)
Olson (29)	1978	Pre 1938 Michigan State University Lettermen	628	Pre 1938 Michigan State University Students	563	Non-Athletes Favored	By 1.86 Years (Non-Significant)

Habitual Studies

In an effort to better appreciate the role which activity plays in longevity and mortality investigators focused on examination of habitual activity patterns. These studies concentrated primarily on vocational activity and drew their samples from the ranks of the general public in most cases.

Pearl (34) initiated the study of habitual activity when he examined some 132 occupations over the course of three years. His data, summarized in Current Opinion, showed it was "very difficult to kill a man by physical hard work before he is 40, occupational and industrial hazards excluded. But after the age of forty is passed our results tell an entirely different story. From 35 to 44 inclusive, the death rate in heavy occupations is 3.9% greater than that for the light occupations . . . from 45 through 54 it rises to 12.8% greater . . . from 55 through 64 to 18.6%". The main pratfall in Pearl's work may have been in his groups of 'heavy' and 'light' occupations. Examination of his heavy grouping showed many occupations currently found to be abnormally associated with environmentally caused disease states, such as iron and steel workers or miners.

Pearl's 1924 investigation was followed almost 30 years later by the first of a series of studies by Morris and colleagues (23,24,25,26). His paper entitled "Morbidity in Relation to the Physical Activity of Work" examined 1930 to 1932 data with special emphasis on deaths in middle age (26). While mortality from all causes combined showed little difference between light and heavy workers (see Table 2.17), seven

Table 2.17. Mortality Rates for Men Aged 45-64 Years from All Causes (From Morris and Heady, 1953)

Age	Heavy Workers	Intermediate and Doubtful	Light Workers
45-54	10,208	12,561	11,150
55-64	21,042	25,782	23,757

conditions were isolated in which there was greater mortality among middle-aged men engaged in light jobs. These included coronary heart disease, lung cancer, appendicitis, prostate disorders, duodenal ulcers, diabetes, and liver cirrhosis, and were contrasted with the single significant condition, accidents, in which heavy workers surpassed light workers in terms of fatalities.

Focusing on coronary heart disease in London bus drivers and conductors, Morris (25) found that despite similar economic and social backgrounds, the more active group of conductors had less coronary heart disease, it appeared later in life, was less severe, and immediate death occurred less frequently. Conductors did have a higher incidence of angina pectoris, the more benign form of the disease. In a follow-up study (27) an attempt was made to classify drivers and conductors in terms of physique at the onset of work as evidence existed which related body build to coronary heart disease. Using uniform size as a guide, drivers were found to have had greater girths when they joined the service. These findings suggested the possibility that if coronary heart disease and somatotype were related, a self-selection factor

accounted for the earlier reported discrepancy between drivers and conductors rather than activity levels. In both cases, however, numbers were small and further study was warranted.

Morris also reported on postal workers drawn from a 1949-50 data collection (25). By dividing the 35-59 year old workers into three activity categories, it was reported that the experience of the men resembled that of the transportation workers; that is, the active group had less coronary heart disease, it was less severe, and the incidence of angina pectoris was greater. Again the numbers were relatively small.

Subsequent studies by Morris (23,24) have produced similar results and have led him to conclude in causal terms "that physical activity of work is protection against coronary (ischaemic) heart disease".

Other coronary related studies appeared to confirm the work of Morris. Brunner and Manelis (4) found in Israeli kibbutzim living, those in sedentary occupations had three times the mortality and three times the incidence of myocardial infarctions. Likewise, Kahn (13) found Washington, D. C. postal carriers at an advantage over clerks in his 1963 studies. Frank's work (8) on "physical inactivity as a lethal factor in myocardial infarction" also lends support to this contention. Finally, Fox and Haskell (7), in reviewing the relationship between physical activity and prevention of coronary heart disease, summarized that those presumed more active, both occupationally and non-occupationally, had less coronary heart disease. In addition, they state "that for exercise to be of benefit it must be continued throughout one's life".

Taylor et al. (49) confirmed the previous finding regarding coronary heart disease and activity, but at the same time found age-adjusted rates for all deaths on the order of 11.83 per 1,000 per year for clerks, 10.29 for switchmen, and 7.62 for section men. His study was based on 1954-56 deaths in white males with a minimum of ten years experience in the railway industry. Clerks were rated as most sedentary, switchmen were intermediate in terms of occupational activity and section men were rated most active. The apparent benefits attributed to occupational activity were based on few deaths in a relatively short period of time, and no control was evident for discrepancies in social level, residency (urban-rural), or the extremely large portion of violent deaths.

In 1969, Palmore (33) was investigating factors involved in predicting longevity. His subjects, numbering 268, were volunteers between 60 and 94 years from North Carolina. Evaluation of varied activities, including leisure and total ratings, showed little independent association with longevity, as measured by number of years lived after testing or an estimate of the number of years the subject will have lived. This study was hampered by small original numbers, a small number deceased, and questionable methods for data collection.

A study using 6,928 Californian men and women followed mortality for 5.5 years after the original data collection. Belloc (2) found 371 death certificates and had an 86% return on her questionnaire. The results for men who had engaged in active sports were found to indicate that they had the lowest mortality, one-half of that found in men who only sometimes gardened or exercised. Similar results were reported for women.

Karvonen et al. (15,16) reported an investigation concerning 396 elite skiers in Finland born from 1845 to 1910 in which he followed their mortality up to 1967. He found 325 had died and 14 had disappeared. His findings indicated the elite skiers survived on average 4.3 to 2.8 years longer than the corresponding male population in Finland. These results parallel Karvonen's initial report (14). However, additional information was obtained on avocational activity by sending out a questionnaire in 1957. Of 90 respondents, 70 surviving skiers still actively skied in the winters of 1955-56 and 1956-57.

The most current study was presented in 1977 by Rose and Cohen (45). It sought to examine a large number of longevity predictors obtained from survivors of 500 deceased male Bostonians who had died at the age of 50 and over. In their study they measured degree of exertion both on the job and off (see Figure 2.1). The most significant finding was that avocational activity was a predictor of longevity, whereas vocational activity was not. To this end, those low in vocational activity and high in avocational lived 3.8 years longer than those low in both. In their summary it was pointed out that only four factors were more important longevity predictors than off-job activity.

Table 2.18 summarizes the habitual studies presented. With the exception of the work by Frank et al. and that of Rose and Cohen, all investigations focused on occupational or vocational activity. Few of these studies were channeled towards an investigation of all deaths; many chose only to examine coronary heart disease and the effect activity has on it. Despite this it was apparent the investigators all favored activity as a beneficial factor in terms of improving longevity.

FIGURE 2.1 - VOCATIONAL AND AVOCATIONAL PHYSICAL ACTIVITY BY AGE (From Rose and Cohen, 1976)

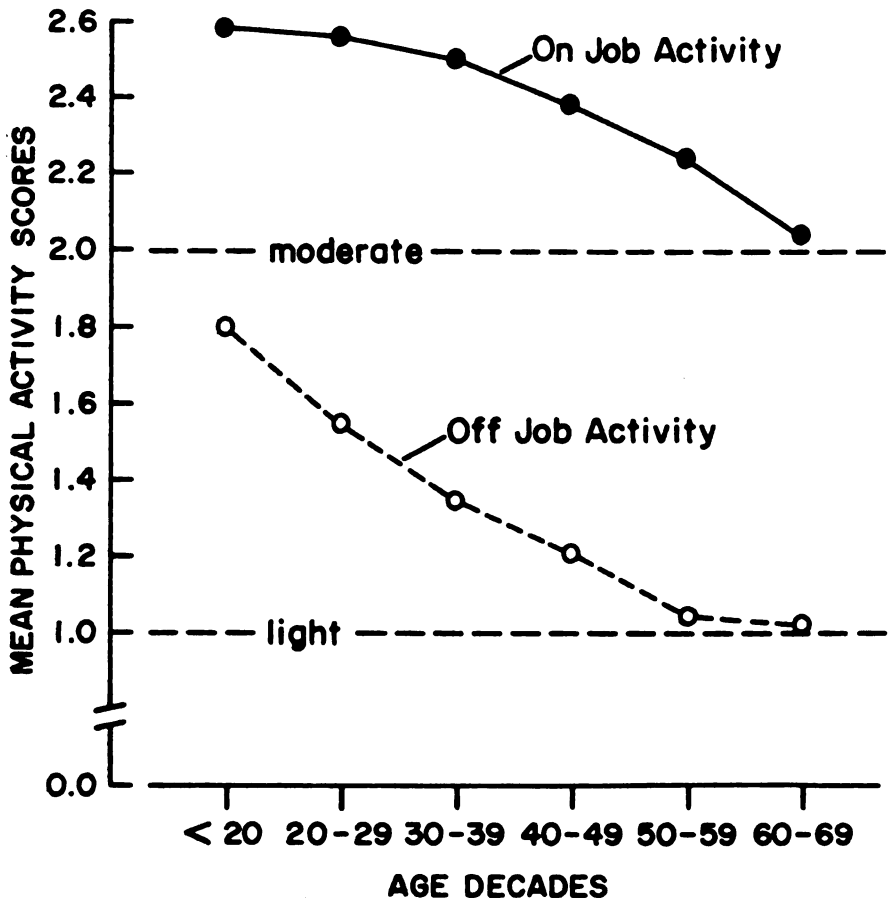


Table 2.18. Summary of Habitual Studies

Author	Date	Country	Examined Activity Type	Prime Parameters Studied	Findings
Pearl (34)	1926	Britain	Vocational	Mortality	Light Activity Favored Over Heavy
Morris (26)	1953	Britain	Vocational	Coronary Heart Disease	Activity Favored
Morris (25,26)	1953, 1956	Britain	Vocational	Coronary Heart Disease	Activity Favored
Morris (23,24)	1958, 1959	Britain	Vocational	Coronary Heart Disease	Activity Favored
Brumer and Haneiis (4)	1960	Israel	Vocational	Coronary Heart Disease and Myocardial Infarction	Activity Favored
Kahn (13)	1963	U.S.A.	Vocational	Coronary Heart Disease	Activity Favored
Frank et al. (8)	1966	U.S.A.	Vocational, Avocational Combined	Coronary Heart Disease	Activity Favored
Fox and Haskell (7)	1968	U.S.A.	Review	Coronary Heart Disease	Activity Favored
Breslow and Buell (3)	1960	U.S.A.	Vocational	Coronary Heart Disease	Activity Favored
Taylor et al. (49)	1962	U.S.A.	Vocational	Coronary Heart Disease and Causes of Death	Activity Favored
Palmore (33)	1969	U.S.A.	Combined	Causes of Death	Activity Not a Predictor of Longevity
Belloc (2)	1973	U.S.A.	Avocational	Causes of Death	Heavy Activity Favored Over Light
Karvonen (15,16)	1974, 1976	Finland	Avocational	Causes of Death	Activity Favored
Rose and Cohen (45)	1977	U.S.A.	Vocational, Avocational	Causes of Death	Avocational Activity a Longevity Predictor, Vocational Longevity Not a Longevity Predictor

Summary

A general review of previous studies seemed to indicate that activity in early life (while in college) had no apparent negative effect on mortality. Studies on later life activity, primarily occupational, implied a favorable relationship with longevity. Few studies have been conducted which explore both vocational and avocational activity patterns throughout life and the relationship with morality.

CHAPTER III

METHODS OF PROCEDURE

The purpose of this investigation was to determine the difference in the activity patterns, as revealed in the 1960 questionnaire responses, of athletes and non-athletes. Second, an examination of activity patterns and their relation to mortality of athletes and non-athletes was carried out.

Data Base - Background

The current investigation was drawn from a questionnaire study of living and deceased athletes and non-athletes who were enrolled at Michigan State University prior to 1938. Athletes, defined as one who had earned a major sports letter, were listed in the Athletic Director's office at M.S.U. along with data concerning awards (letters), years of participation, and class (senior, junior, etc.). Non-athletes or controls, those not receiving a major sports letter, were selected according to a stratified random sampling technique from the student directories of the school. Specifically, for each athlete who competed in a given year a control was randomly selected from that same year and at the same class level from the student directory. In total 1,129 athletes were matched with 1,129 non-athletes.

In 1952 a questionnaire (see Appendix A) was forwarded with a return, stamped envelope to each of the 2,258 subjects. Returns from the 1952 questionnaire revealed 628 athletes and 563 non-athletes had responded. Of the respondees, 122 were deceased. Return percentages on the initial study were 55.6 and 49.9 respectively for athletes and non-athletes.

A follow-up study was carried out in 1960 with 1060 questionnaires (see Appendix A) forwarded to 558 athletes and 502 non-athletes. Of the 92.1% of the athletes responding 52 were deceased whereas 32 deceased non-athletes appeared among the 91.4% of the returned non-athlete questionnaires.

Subsequent follow-up studies were carried out in 1968 and 1976 (see Appendix A). The second follow-up was sent to 942 subjects of which 490 were athletes and 452 were non-athletes. Percentage returns for the study were 96.1% for athletes and 97.3% for non-athletes. Of these 66 athletes and 62 non-athletes were deceased. The most recent questionnaire was mailed to 392 athletes of which 93.8% responded and to 359 non-athletes of which 92.8% responded. Death had occurred in 89 athletes and 78 non-athletes.

Figure 3.1 is a summarization of numbers of subjects involved in the initial and subsequent 3 surveys.

All information on the return questionnaires was coded and tabulated. It was then punched and verified on 80-column IBM cards, and subsequently stored on tape.

Table 3.1. Configuration for Numbers in the Michigan State Longevity Study 1952-1976 (From Olson et al., 1978)

	Athletes		Non-athletes		Total	
1952						
Surveyed	1129		1129		2258	
Returned	625		557		1182	
% Returned		55.4		49.3		52.4
Deceased	67		55		122	
Living	558		502		1060	
1960						
Surveyed	558		502		1060	
Returned	514		458		972	
% Returned		92.1		91.4		91.7
Deceased	52		32		84	
Living	462		426		888	
1968						
Surveyed	490		452		942	
Returned	471		440		911	
% Returned		96.1		97.3		96.7
Deceased	66		62		128	
Living	405		378		783	
1976						
Surveyed	392		359		751	
Returned	368		333		701	
% Returned		93.8		92.8		93.3
Deceased	89		78		167	
Living	279		255		534	

Current Study Design

Sample Selection

The current study considered only those respondents from the 1960 follow-up from whom a questionnaire was returned in 1976 or for whom a death certificate was obtained. Selection of this group provided access to both the vocational and avocational data on the 1960 questionnaire. In addition, during the 16 year interval between the 1960 and 1976 studies, 155 athletes and 140 non-athletes had died thus providing data for analysis of mortality and age at death versus activity pattern comparisons.

Activity Ratings

Two activity types were drawn from the data contained in the 1960 questionnaire. A third variable was created from the preceding two. The variables of concern included:

1. Vocational activity pattern. The United States Employment Service Dictionary of Occupational Titles was used for classification of occupations. They were scaled on the basis of retired, sedentary, light activity, medium activity, heavy activity, and insufficient data. Where necessary, for statistical purposes, several categories were collapsed into one. Such instances were noted.
2. Avocational activity patterns. In terms of energy output, the scale used for avocational activity patterns was structured to parallel that for vocational activity patterns. Avocational activity patterns were based on an evaluation of several

variables on the 1960 questionnaire which included: yard and house maintenance, calisthenics, hobbies, and recreational participation. Blind subjective analysis by Dr. W. Van Huss and Kenneth Stephens was used to determine a rating in each case. The following scale was implemented in rating each subject:

Sedentary: A sedentary individual was one who either did minimal yard and house maintenance, participated in a low energy hobby, or walked less than a mile per day. In general no other or regular activity pattern existed.

Light: one was considered having a light avocational activity pattern if they participated in regular house and yard maintenance or regular calisthenics. Persons who were hobby oriented, participated in seasonal (summer only, etc.) activities, or walked more than a mile on a continuing basis were considered as 'light'.

Medium: regular house and yard maintenance, a hobby orientation, regular calisthenics which included rhythmical endurance exercises, and regular participation in a low energy output sport such as golf were part of a medium activity pattern.

Heavy: a subject was considered to have a heavy activity pattern if all four above activities were participated in regularly or if a high energy output sport such as paddleball was part of his regular pattern.

3. Combination activity pattern. For each subject a combined activity pattern rating was created. This was used as an indication of overall activity by 1960 respondents.

Statistical Analysis

Numerical values were assigned each of the previously categorized activity levels, specifically:

1. Vocational activity patterns. Sedentary and retired individuals, who obviously had no vocational activity, were assigned to a common category represented numerically "1". Vocational activity category "2" included those individuals rated as having a light activity pattern while on the job. The final category represented "3" numerically, was composed of those who were either involved in medium or heavy work occupationally. The combination of these two groups was necessary for statistical purposes, as there were too few in each group to enable meaningful analysis.
2. Avocational activity patterns. Those individuals found to be sedentary avocationally were grouped and represented as "1's". The second group, numerically 2, were those whose avocational patterns revealed some light activity. Owing to the relatively few responses coded avocationally as "medium" or "heavy", a "medium plus" category, 3, was created by collapsing the two previous categories into a single one thus enabling a sufficient number for statistical analyses.

3. Combination activity pattern. The combined activity pattern, an indication of the overall activity of a subject, was a combination of vocational and avocational categories. The initial category, 1, was composed of those subjects who were sedentary avocationally and either retired or sedentary vocationally. Category 2 was a relative measure of those who were not sedentary, that is, they had more activity than the sedentary subjects. Those individuals considered included in this category were those avocationally sedentary and vocationally light or those vocationally sedentary or retired and avocationally light. The final combined activity category included all the remaining subjects and was numerically represented 3. This category also was a relative measure of total activity and indicated those individuals within it had participated in significantly more activity than either sedentary or light activity subjects.

While not an absolute measure of activity, these categorizations enable comparisons of subjects with progressive increases in activity levels.

A "loglinear model" was derived to analyze the relationships among the four following categories: athlete (yes, no), dead (yes, no), decade of birth (1880-1889, 1890-1899, 1900-1909, 1910-1919), and total activity (1, 2, 3). This model functioned by selectively and progressively dropping variables, or combinations of variables, from an established model (equation). In this manner, the relative value of the categorical variables to the model could be evaluated.

A univariate, one-way analysis of variance was used to examine the relationship of activity level, as recorded from the 1960 questionnaire, to year of death between 1960 and 1976.

All other comparisons were made using a two-way cross-tabulations.

An alpha level of .05 was required to denote statistical significance in loglinear analyses, and .1 for any subsequent analysis was indicative of significance.

CHAPTER IV

RESULTS AND DISCUSSION

The results and discussion of the athlete-non-athlete comparisons will be presented in conjunction with a brief explanation of the log-linear model. Subsequent sections on deaths between 1960 and 1976 related to activity level in 1960, avocational activity patterns, vocational activity patterns, and total activity patterns will follow.

Athlete-Non-athlete Comparisons

A loglinear model was derived to analyze the relationships among the four categorical variables, with special emphasis focused on the athlete-non-athlete comparison. Figures 4.1 through 4.5 illustrate these relationships by use of two-way tables. The results of the log-linear model indicated that there was no significant difference between athletes and non-athletes when any single or combination of categorical variables were considered (see Table 4.1).

In summarizing Table 4.1, there was apparently no difference between athletes and non-athletes in terms of percentages deceased, percentages in birth decades, or percentages in specific activity categories. Consequently, all subsequent analyses disregarded the athlete-non-athlete variable and focused instead on the relationship of the whole group with activity type and level.

FIGURE 4.1 - PERCENT ATHLETES AND NON-ATHLETES IN VARIED AVOCATIONAL ACTIVITY LEVELS

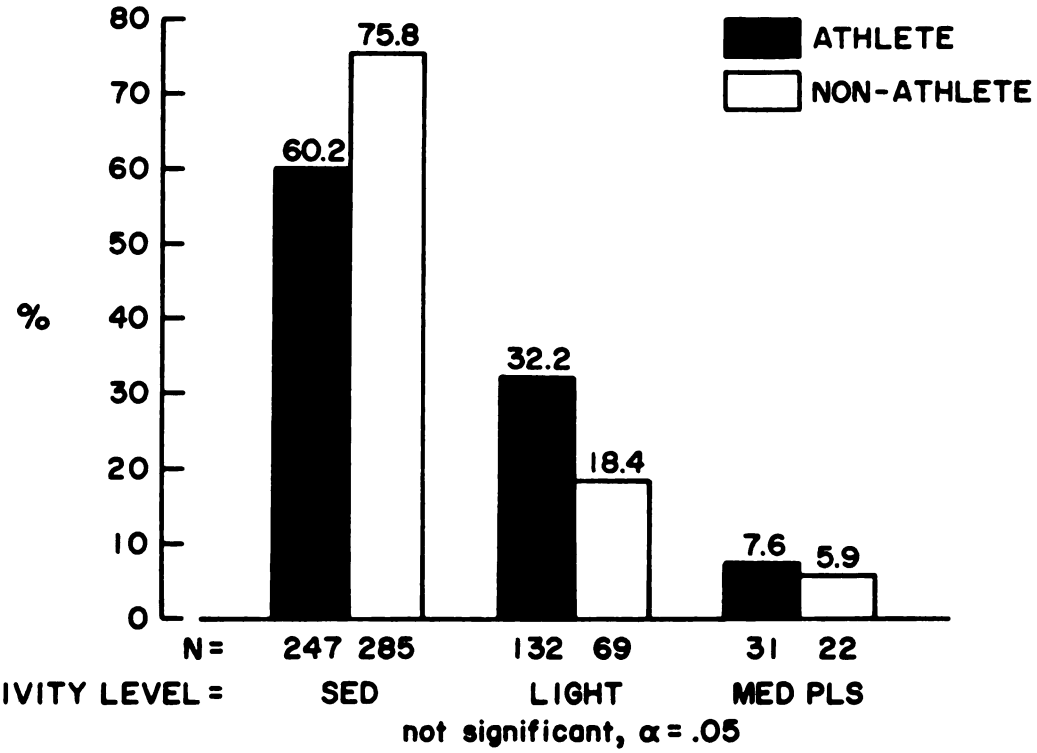


FIGURE 4.2 - PERCENT ATHLETES AND NON-ATHLETES IN VARIED VOCATIONAL ACTIVITY LEVELS

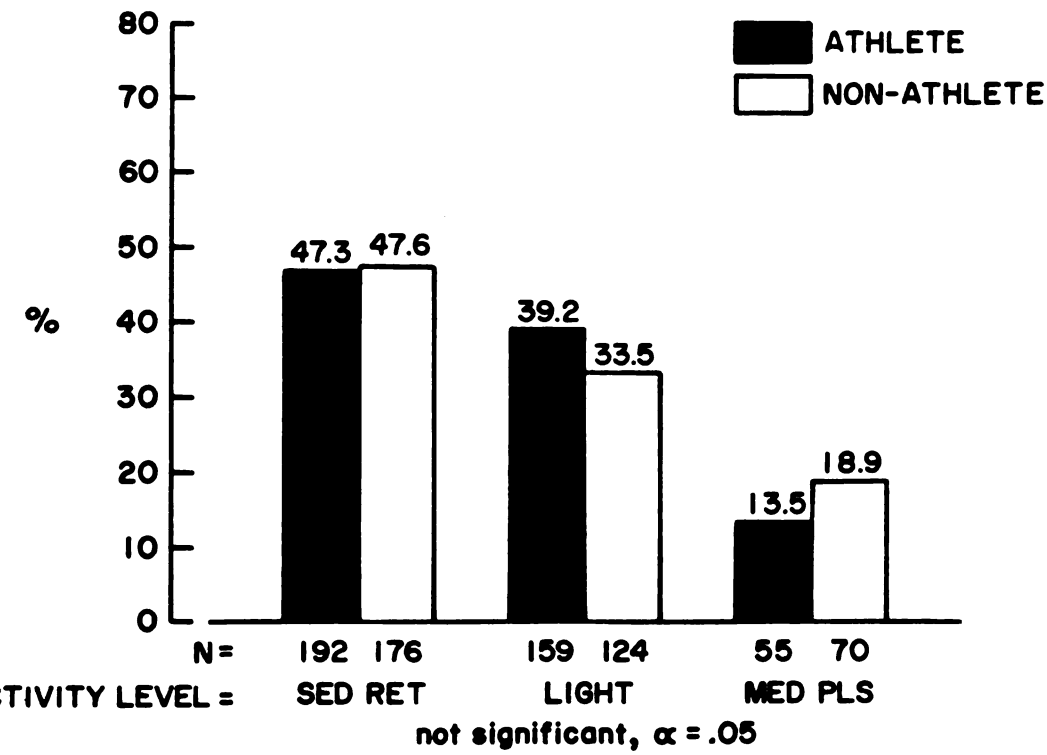


FIGURE 4.3 - PERCENT ATHLETES AND NON-ATHLETES IN VARIED TOTAL ACTIVITY LEVELS

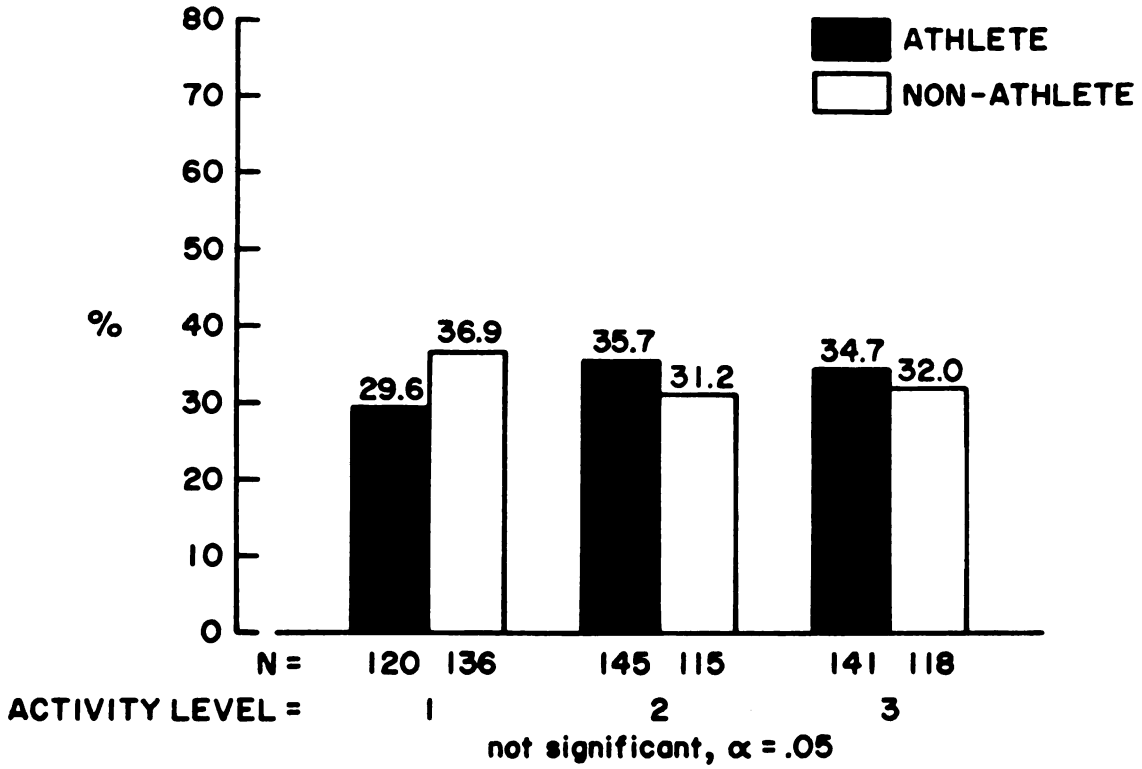


FIGURE 4.4 - PERCENT ATHLETES AND NON-ATHLETES DECEASED

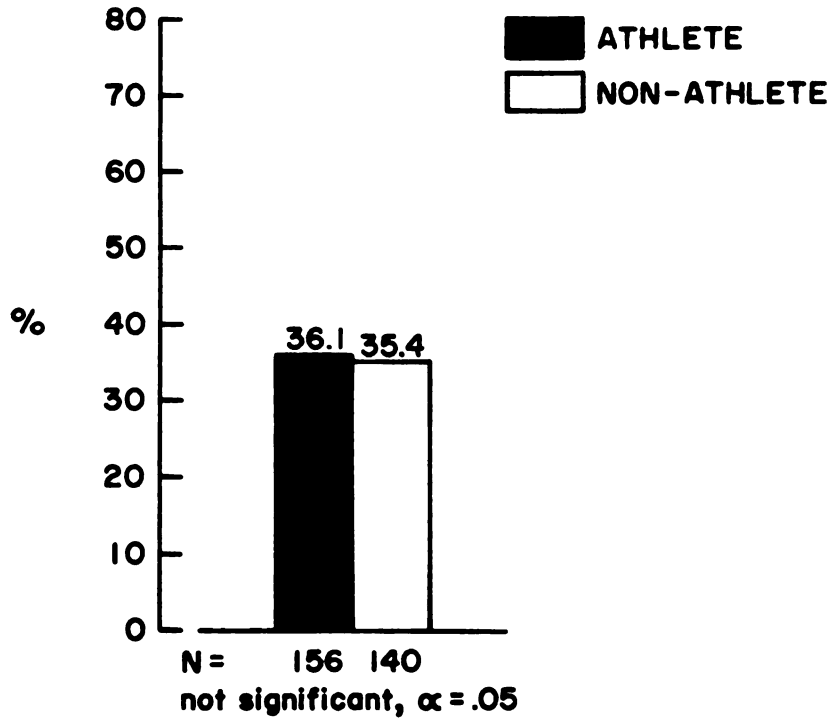


FIGURE 4.5- PERCENT ATHLETES AND NON-ATHLETES IN VARIED BIRTH DECADES

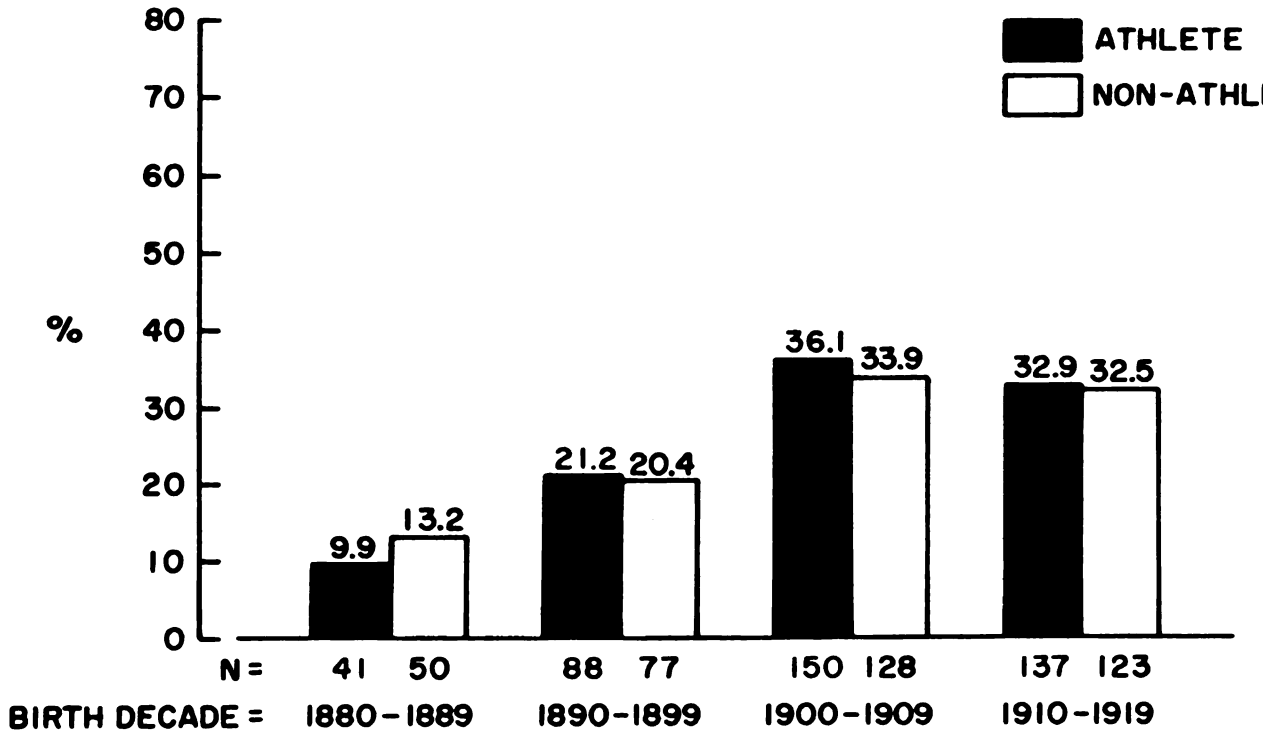


Table 4.1. Summary of Loglinear Model Analyses

Model	Variables	Significance
1.	all 3	
2.	234/1	N.S.
3.	23/24/34/1	N.S.
4.	23/24/1	S.
5.	23/34/1	S.
6.	24/34/1	S.
7.	23/24/34/12	N.S.
8.	23/24/34/13	N.S.
9.	23/24/34/14	N.S.

S. = significant at $P < .05$ level

N.S. = non-significant

1. = athlete-non-athlete

2. = deceased (yes, no)

3. = total activity level (sedentary/retired, light, medium plus)

4. = birth decade (1880-1889, 1890-1899, 1900-1909, 1910-1919)

Deaths Between 1960 and 1976 Related to Total Activity

No significant differences were observed in total activity level as reported in 1960 by year of death between 1960 and 1976 (Figure 4.6). A general trend was apparent which indicated that those deceased towards 1976 had a somewhat higher total activity level in 1960 than those who died shortly after the 1960 questionnaire was completed. Those deceased in the later years of the study were significantly ($P < .1$) younger in 1960 than those dying in the earlier years.

Generally no sharp effect on activity by impending death was seen. In other words, death occurring in the next year apparently did not inhibit activity in the population examined.

Since there was no sharp effect on activity of impending death noted, all deaths recorded between 1960 and 1976 were included in the subsequent analysis of activity patterns.

Avocational Activity Comparisons

Figure 4.7 illustrates graphically the avocational activity comparisons by birth decade. In the oldest sample group, birth decade 1880-1889, a significant difference was noted between those who were sedentary and those rated most active in terms of percent deceased. Those rated sedentary avocationally in 1960 had a higher percentage deceased than either light or medium plus groups. The finding that the most active appeared to survive the longest might reflect either the small numbers involved in the medium plus activity group or may, in fact

FIGURE 4.6 - ACTIVITY LEVEL REPORTED IN 1960 AND DEATHS BETWEEN 1960 AND 1976

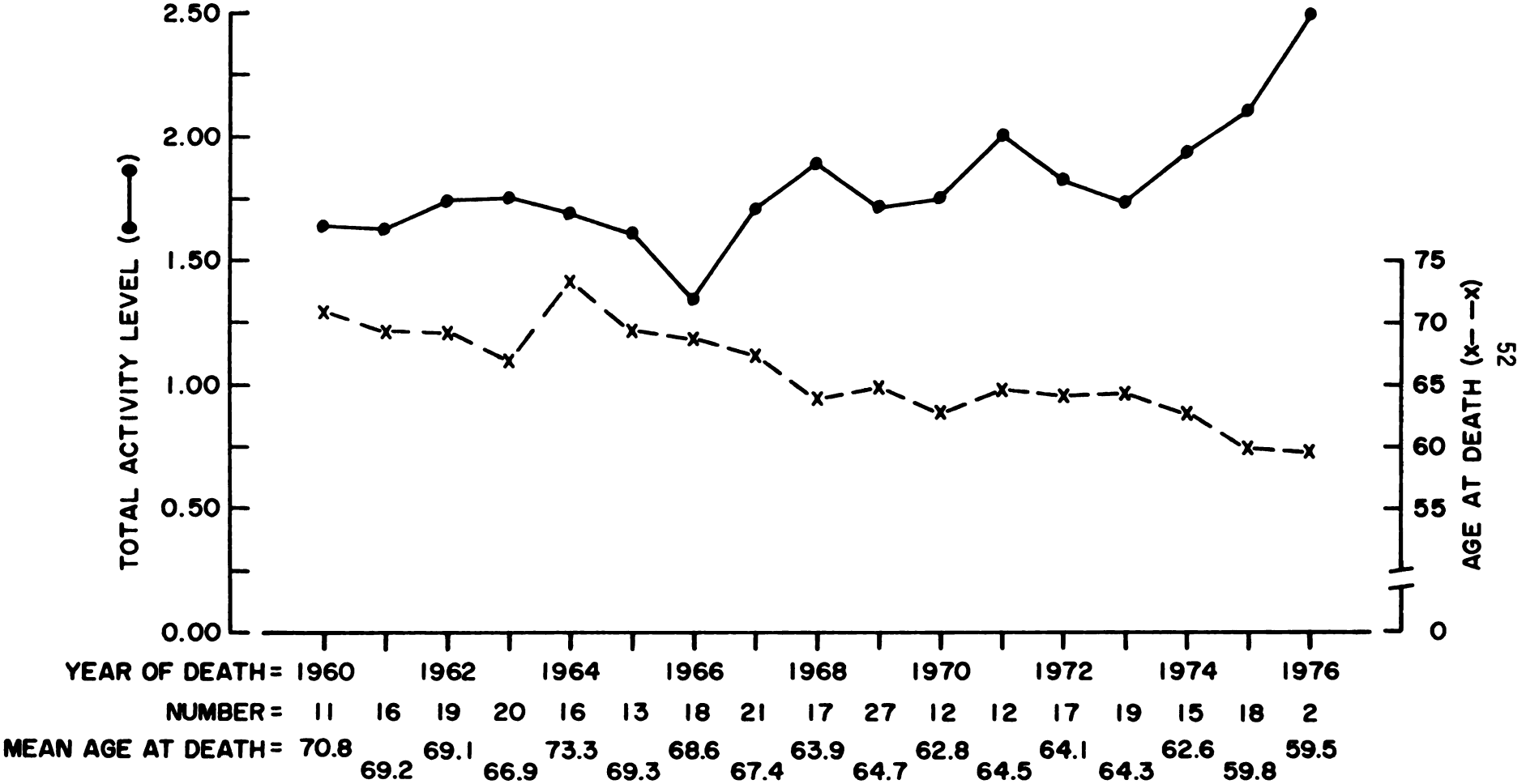
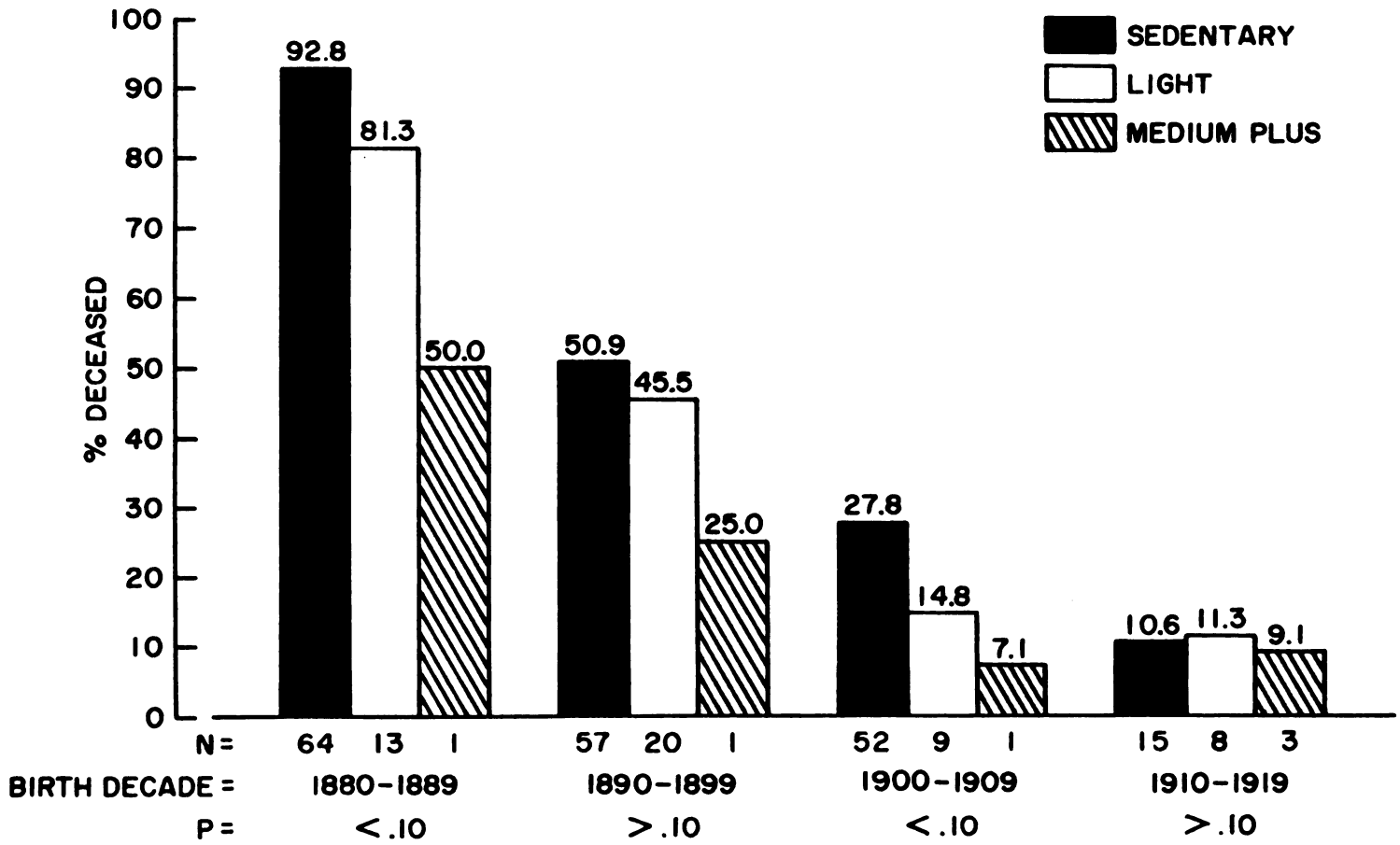


FIGURE 4.7 – AVOCATIONAL ACTIVITY LEVEL IN 1960 AND PERCENT DECEASED BETWEEN 1960 AND 1976 BY BIRTH DECADE



indicate the positive effect of high avocational activity levels.

The 1890-1899 birth decade group revealed the same general trend, that is, those sedentary had the highest percentage deceased, followed by those rated light avocationally, and then the medium plus avocational group which had the fewest, percentage-wise, deceased. The differences were non-significant and again numbers in the higher activity levels were small.

A significantly larger percentage of the 1900-1909 sedentary individuals were deceased than either those rated as light or medium plus. Consideration must be given to the relatively few deceased in each group. Only 27.8% of the sedentary group, 14.8% of the light group, and 7.1% of those medium plus avocationally had died as of 1976.

Similarly, approximately 10% of those in each avocational activity group of birth decade 1910-1919 had died by 1976. The relatively small portion of those deceased and the fact that those in this birth decade were quite young between 1960 and 1976 may have accounted for the change in trend. Larger numbers in light and medium plus groups may have accounted for the lack of difference between percentages deceased in each avocational activity group.

In general, an apparent trend indicated that increased avocational activity improved one's chances for survival (as indicated by percent deceased). Those most active, especially in older age groups, appeared to have the best survival rates. In addition, Figure 4.7 indicated that the oldest group had the highest percentages deceased as well as having more rated sedentary and fewer rated medium plus in avocational activity.

Progressively fewer and smaller percentages of the subjects in other birth decade groups were deceased between 1960 and 1976, and a trend towards increased activity avocationally with decreasing age was apparent.

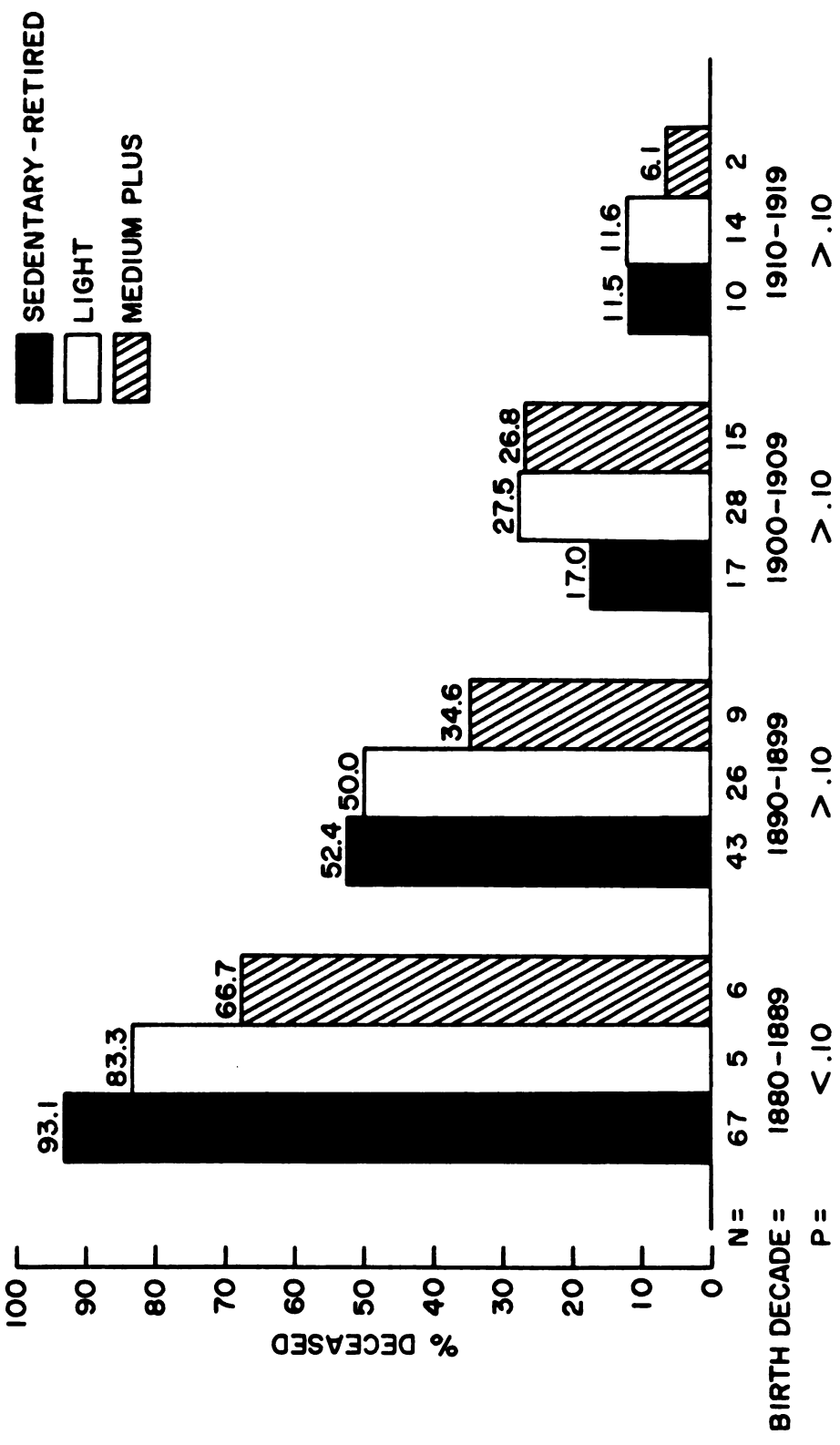
Vocational Activity Comparisons

In the 1880-1889 birth decade group a significantly higher percentage of those rated vocationally as sedentary-retired were deceased than either of the other two groups (Figure 4.8). The medium plus vocational group had the lowest percentage deceased between 1960 and 1976. While an apparent positive vocational activity effect existed, it should be noted that at this advanced age (subjects ranged from 71 to 80 years) few of those studied were still working, consequently, a possible source of bias existed in the relatively small numbers in the light and medium plus activity groups.

While there was no significance, a similar trend existed in the 1890-1899 birth decade group. Individuals examined here ranged in age from 61 to 70 years. There was a possibility that a larger number would be more active and grouped in either the light or medium plus vocational category. This may, in part, be reflected in the smaller percentage deceased in the sedentary-retired group and the higher percentages deceased in the light or medium plus groups relative to the sedentary-retired group.

For those born between 1900 and 1909, the trend was not consistent with that of the preceding two age categories. In this situation a

FIGURE 4.8 - VOCATIONAL ACTIVITY LEVEL IN 1960 AND PERCENT DECEASED BETWEEN 1960 AND 1976 BY BIRTH DECADE



smaller percentage, 17%, of the sedentary-retired group was deceased; whereas, 27.5% of the light vocational group and 26.8% of the medium plus activity group were deceased. The reason for this shift may have been related to the fact that the subjects ranged from 51 to 60 years of age in 1960, prior to retirement, when they reported vocational activity patterns. Thus, in the sixteen year period covered by this investigation, more of the subjects were vocationally active and fewer were in retirement. The relatively small percentage deceased in the whole birth decade (less than 30%) may also have been a contributing cause in the deviation from the established trend.

The youngest age category considered dealt with subjects of 41 to 50 years of age and, consequently, less than 12% in each activity group were deceased. These small percentages deceased were probably the reason for the lack of significance between vocational activity groups in this birth decade.

The general findings suggest a vocational activity effect in the oldest two age groups, though only significant in the 1880-1889 group. In the youngest two age groupings, while no significant differences were observed, the trend appeared to indicate that a larger percentage of deceased were in the light vocational category. As with the avocational activity comparisons, the older groups had a larger percentage deceased, as well as progressively larger percentages of vocationally sedentary-retired individuals.

Total Activity Comparisons

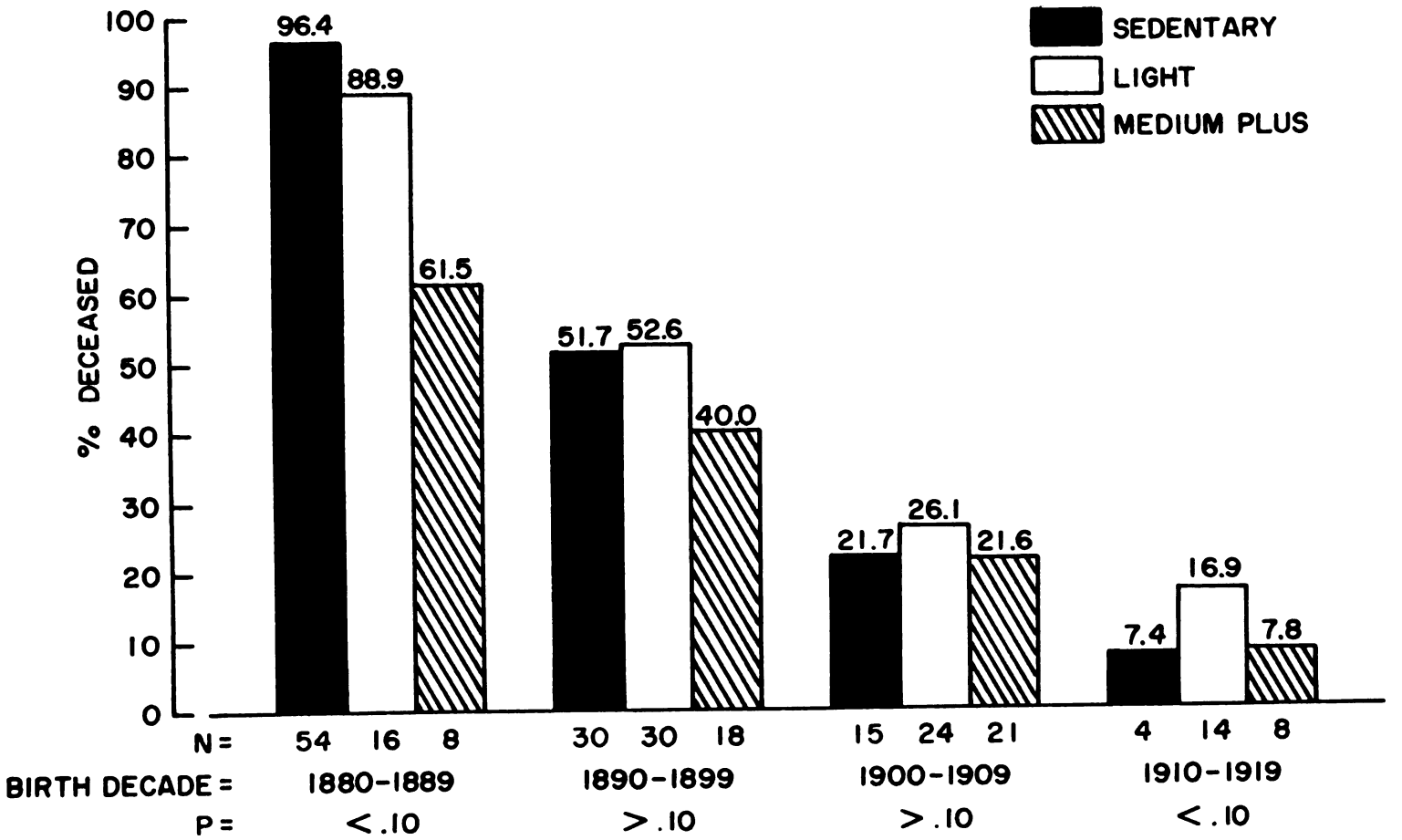
Examination of the figure for the 1880-1889 birth decade (Figure 4.9) revealed a similar total activity pattern as observed earlier in both avocational and vocational activity comparisons. The relatively small numbers in the two most active groups and advanced age were thought to contribute to the significant difference which existed between the sedentary and the more active groups.

In the 1890-1899 birth decade the second most active group had the largest percentage deceased, 52.6%, while the sedentary group was in close proximity with 51.7% deceased. The most active group, medium plus, had roughly 11% fewer deceased subjects than the other groups. All total activity differences in this age category were non-significant. The lower percentage of deceased in the most active group may be related to the combination of reported work in 1960 and also increased avocational activity due to retirement in these 61 to 70 year old subjects.

Small percentages deceased in all categories produced non-significant differences in total activity in the 1900 to 1910 birth decade. Those in the second most active group were found again to have the largest percentage deceased while those in the remaining two groups were virtually indistinguishable in terms of percentages deceased. It was felt that the relative youth of this group, 51 to 60 years old in 1960, was a major factor in the low numbers of "sedentaries" considered.

The final birth decade category considered, 1910-1919, once again indicated the second most active group in terms of total activity had

FIGURE 4.9- TOTAL ACTIVITY LEVEL IN 1960 AND PERCENT DECEASED BETWEEN 1960 AND 1976 BY BIRTH DECADE



the largest percentage deceased, 16.9%, while the most active group had 7.8% deceased and the relatively sedentary group had only 7.4% deceased. These significant differences were accounted for, in part, by the small percentages deceased. The fact that the more active groups appeared to have larger proportions deceased may well have been a function of the formation of the category or may have reflected the relative youth of this birth category in that few individuals 41 to 50 years of age are sedentary both avocationally and vocationally.

The general trends in total activity patterns were much the same as for the avocational and vocational activity patterns. A larger proportion of the oldest subjects were deceased, as was expected, and a larger number of the older subjects were more sedentary. Conversely, the younger subjects were more active and fewer were deceased. The only unexplained general trend was that the second most active group in total activity appeared to have larger percentages deceased in all birth decades except the 1880-1889 period.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of the present investigation was to examine the effects of activity on the longevity of former athletes and non-athletes who had attended Michigan State University prior to 1938.

Specifically, subject activity was measured using responses to the 1960 Longevity and Morbidity of Male Graduates of Michigan State University questionnaire. Three activity ratings were utilized which included avocational activity, vocational activity, and total activity. Groups selected for comparison under these parameters included, by birth decade, living athletes, deceased athletes, living non-athletes, and deceased non-athletes.

A loglinear model was used to examine the relationship between the four categories: athlete (yes, no), deceased (yes, no), activity rating (sedentary / retired, light, medium plus), birth decade (1880-1889, 1890-1899, 1900-1909, 1910-1919). These results were portrayed by two-way tables. One-way analysis of variance and Chi square were used in subsequent analyses. Appropriate graphs were constructed to represent percent deceased in each activity category.

Conclusions

The results of the investigation have led to the following conclusions:

1. There was no difference between athletes and non-athletes in any variable considered, i.e., percent deceased, birth decade, and total activity level.

2. No sharp effect on total activity of impending death was noted in the population examined between 1960 and 1976.

3. Avocationally, a trend existed which indicated a higher percentage of those who were most sedentary in 1960 were deceased, while smaller percentages of those active were deceased between 1960 and 1976. In short, avocationally, an activity effect may have been shown.

4. In vocational activity patterns, those most active in 1960 appeared to have a smaller percentage deceased between 1960 and 1976.

Recommendations

1. Emphasis should be placed on collecting data which reflect activity patterns (avocational, vocational, and total) in subsequent years, and comparisons should be made in and based on such life-long patterns.

2. Continued examination of the relationship between longevity and activity is warranted.

3. Follow-up studies should be continued until all subjects are deceased.

4. The current study should be expanded to include athletes and non-athletes of a more current era enrolled at Michigan State University.

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APPENDICES

APPENDIX A

QUESTIONNAIRES
(1952, 1960, 1968, 1976)

NATIONAL STUDY OF LONGEVITY AND MORBIDITY OF ATHLETES IN COLLEGES AND UNIVERSITIES

Form A. This Form is for graduates who earned a college letter in one or more sports.

(Please Fill in this Form as Completely and Accurately as Possible)

Date _____

Name of Athlete (please print) _____ Year of Birth _____ Weight at Graduation from College _____

IF ATHLETE IS LIVING

Present address _____

Present weight _____ lbs.

Present general condition of health

(Check one):

Good _____

Fair _____

Poor _____

Married _____ Single _____

(Check one)

IF ATHLETE IS DECEASED

Age at death _____ yrs.

Cause of death stated on death certificate:

Primary _____

Secondary _____

If answer is unknown, state the generally accepted cause of death _____

Was death sudden _____ or lingering _____

Was he married _____ or single _____

Person entering information on this form:

Name _____

Address _____

Relationship _____

Athletic and General Sports History of Athlete

Name of Sport	High School	College	Amateur Non-School	Profes-sional	Age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age

Activity During Adult Life, *Excluding* Playing Participation In Sports

Include vocational and avocational activities

Number of hours of physical activity (daily or almost daily)

Age	Vigorous	Moderate	Mild
yrs. to yrs.	hrs.	hrs.	hrs.
yrs. to yrs.	hrs.	hrs.	hrs.
yrs. to yrs.	hrs.	hrs.	hrs.
yrs. to yrs.	hrs.	hrs.	hrs.

Military Service

Branch of Service _____ Age _____ yrs. to _____ yrs.

Physical activity involved (check): Vigorous _____ Moderate _____ Mild _____

If more than one branch of the Service, name the others and indicate the amount of physical activity involved _____

Economic Status of Home From Early Childhood Upward

Before and During College years	After College Years	Comments
(check one)	(check one)	
Satisfactory _____	Satisfactory _____	
Unsatisfactory _____	Unsatisfactory _____	

Medical History

AILMENT

1. Infectious and Contagious Diseases (State age of occurrence).

_____

_____

2. Childhood rheumatism (State, if possible, age of occurrence of any manifestations in this group).

Growing pains ____ Chorea ____

Rheumatic fever _____

1st attack _____

2nd attack _____

3rd attack _____

Tonsilitis____ Tonsils removed____

Heart defects (give as complete a diagnosis as possible, such as murmurs, enlargement, irregularity, heart failure, etc). _____

_____

_____

3. Hypertension (Mention complications such as strokes, coronary thrombosis, heart failure, uremia, etc., along with age of occurrence) _____

_____

4. Arterio Sclerosis _____

_____

5. Angina Pectoris _____ Coronary Thrombosis _____

Indicate frequency of attacks

Diabetes _____ Peripheral Vascular Disease _____

6. Other Diseases (mention organ or body system affected, and age of occurrence): _____

_____

_____

_____

Smoking and Drinking Habits

Use alcoholic drinks: never _____ moderately _____ excessively _____

Use tobacco: What form _____ How much _____

Hereditary History

Relationship	If Living		If Deceased	
	Age	Ailment, if any	Age at Death	Cause of Death
Paternal grandfather				
Paternal grandmother				
Maternal grandfather				
Maternal grandmother				
Father				
Mother				
Brothers				
Sisters				

(If Hypertension, Coronary Thrombosis or Diabetes present in family, please indicate)

Do you think that participation in athletics is beneficial, harmful, or has no effect?

Please comment; if critical of program, give reasons _____

_____

_____

_____

_____

_____

_____

Other comments which will provide additional information on your participation or lack of participation in sports.

Some examples: "Did not participate in college because I was no longer an amateur athlete." "Did not participate on advice of a physician." "Did not participate because I had to work my way through college." "I wasn't good enough to make the team." Etc _____

_____

_____

_____

NATIONAL STUDY OF LONGEVITY AND MORBIDITY OF MALE GRADUATES OF COLLEGES AND UNIVERSITIES

Form B. This Form is for men who did not earn a letter in sports

(Please Fill in this Form as Completely and Accurately as Possible)

Date _____

Name of Alumnus (please print) _____ Year of Birth _____ Weight at Graduation from College _____

IF ALUMNUS IS LIVING

Present address _____

Present weight _____ lbs.

Present general condition of health

(Check one):

Good _____

Fair _____

Poor _____

Married _____ Single _____

(Check one)

IF ALUMNUS IS DECEASED

Age at death _____ yrs.

Cause of death stated on death certificate:

Primary _____

Secondary _____

If answer is unknown, state the generally accepted cause of death _____

Was death sudden _____ or lingering _____

Was he married _____ or single _____

Person entering information on this form:

Name _____

Address _____

Relationship _____

Athletic and General Sports History of Alumnus

Name of Sport	High School	College	Amateur Non-School	Professional	Age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age
					yrs. to yrs. of age

Activity During Adult Life, *Excluding* Playing Participation In Sports

Include vocational and avocational activities

Number of hours of physical activity (daily or almost daily)

Age	Vigorous	Moderate	Mild
yrs. to yrs.	hrs.	hrs.	hrs.
yrs. to yrs.	hrs.	hrs.	hrs.
yrs. to yrs.	hrs.	hrs.	hrs.
yrs. to yrs.	hrs.	hrs.	hrs.

Military Service

Branch of Service _____ Age _____ yrs. to _____ yrs.

Physical activity involved (check): Vigorous _____ Moderate _____ Mild _____

If more than one branch of the Service, name the others and indicate the amount of physical activity involved _____

Economic Status of Home From Early Childhood Upward

Before and During College years	After College Years	Comments
(check one)	(check one)	
Satisfactory _____	Satisfactory _____	
Unsatisfactory _____	Unsatisfactory _____	

Medical History

AILMENT

1 Infectious and Contagious Diseases (State age of occurrence).

_____

_____

2. Childhood rheumatism (State, if possible, age of occurrence of any manifestations in this group).

Growing pains ____ Chorea ____

Rheumatic fever _____

1st attack _____

2nd attack _____

3rd attack _____

Tonsilitis____ Tonsils removed____

Heart defects (give as complete a diagnosis as possible, such as murmurs, enlargement, irregularity, heart failure, etc). _____

_____

_____

3. Hypertension (Mention complications such as strokes, coronary thrombosis, heart failure, uremia, etc., along with age of occurrence) _____

_____

4. Arterio Sclerosis _____

_____

5. Angina Pectoris _____ Coronary Thrombosis _____

Indicate frequency of attacks

Diabetes _____ Peripheral Vascular Disease _____

6. Other Diseases (mention organ or body system affected, and age of occurrence): _____

_____

_____

_____

Smoking and Drinking Habits

Use alcoholic drinks: never _____ moderately _____ excessively _____

Use tobacco: What form _____ How much _____

Hereditary History

Relationship	If Living		If Deceased	
	Age	Ailment, if any	Age at Death	Cause of Death
Paternal grandfather				
Paternal grandmother				
Maternal grandfather				
Maternal grandmother				
Father				
Mother				
Brothers				
Sisters				

(If Hypertension, Coronary Thrombosis or Diabetes present in family, please indicate)

Do you think that participation in athletics is beneficial, harmful, or has no effect?

Please comment; if critical of program, give reasons _____

_____

_____

_____

_____

_____

_____

_____

Other comments which will provide additional information on your participation or lack of participation in sports.

Some examples: "I played basketball for high school during afternoons and for a club in the evenings in 1926." "Did not play football during junior college year on account of fracture or operation." "Etc _____" _____

_____

_____

_____

_____

MICHIGAN STATE UNIVERSITY
Department of Health, Physical Education and Recreation

FOLLOW-UP STUDY OF LONGEVITY AND MORBIDITY OF
MALE GRADUATES OF MICHIGAN STATE UNIVERSITY

NAME OF ALUMNUS (Please print) _____Date_____

PRESENT ADDRESS _____

MARITAL STATUS (Check one) __Married __Single __Widowed __Divorced

PRESENT WEIGHT _____lbs. If your weight has changed more than 15 lbs. within the last seven years, please explain _____

RACE __White __Negro __Other _____

PRESENT OCCUPATION _____From 19__ to 19__

ANY PREVIOUS FULL TIME OCCUPATIONS:

1. _____From 19__ to 19__
2. _____From 19__ to 19__
3. _____From 19__ to 19__
4. _____From 19__ to 19__

SMOKING HABITS:
(Please check only those which apply)

__Smoke __Do not smoke
(If you do not smoke, please disregard the remaining questions in this section)

Cigarettes:
1. Less than 1/2 pack per day__
2. 1/2 to 1 pack per day__
3. Over 1 pack per day__

Cigars:
1. Less than 3 per day__
2. 3 to 6 per day__
3. Over 6 per day__

Pipe:
1. Less than 4 bowls per day__
2. 4 to 10 bowls per day__
3. Over 10 bowls per day__

Chew:
1. Less than 1/4 pack per day__
2. 1/4 to 3/4 pack per day__
3. Over 3/4 pack per day__

DRINKING HABITS
(Please check only those which apply)

__Drink __Do not drink
(If you do not drink, please disregard the remaining questions in this section)

Beer:
1. Occasional bottle__
2. 1 to 3 bottles per day__
3. Over 3 bottles per day__

Wine:
1. Occasional glass other than for religious use__
2. Daily but less than 1/2 bottle__
3. Over 1/2 bottle per day__

Whiskey (gin, etc.):
1. Occasional glass__
2. 1 to 3 shots per day__
3. 4 to 6 shots per day__
4. Over 6 shots per day__

LONGEVITY OF BROTHERS AND SISTERS: (If any of your brothers and sisters have died in the past seven years, please furnish information requested)

Relationship	Cause of Death	Age at Death
Brothers	_____	_____
	_____	_____
	_____	_____
	_____	_____
Sisters	_____	_____
	_____	_____

MEDICAL HISTORY: What ailments have you had in the last seven years? (Examples: Coronary Thrombosis, High Blood Pressure, Cancer, Diabetes, TB, etc.)

		Age at Occurrence
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____

FAMILY: Do you have any children? __Yes __No
(If your answer is yes, please furnish information requested)

Sons: Number living___ Number deceased___
Age and cause of death _____
_____

Daughters: Number living___ Number deceased___
Age and cause of death _____
_____

NON-VOCATIONAL ACTIVITY RECORD FOR THE PAST YEAR:

1. Do you __Mow your own lawn? __Do other yard or house maintenance?
(Please describe)_____

2. Do you __Have a garden? What do you do in connection with this?
_____

3. Do you __Do any sitting up exercises in the winter?
__In the summer? How long does each session last? _____
When was the last time?_____ The time before that?
_____

4. Do you walk or bike to work? _____ How far? _____
How often? _____

5. Do you have any hobbies or engage in other non-vocational work or recreation regularly? EXCLUDING SPORTS (Please list below)

Hobby or Activity	How Often Do You Participate?
a. _____	_____
b. _____	_____
c. _____	_____
d. _____	_____

6. What sports did you engage in regularly during the past summer months? (Please use the list below as a guide)

	Sport	How Often?	When Was the Last Time?	The Time Before?
a.				
b.				
c.				
d.				
e.				

7. What sports did you engage in regularly during the past winter months? (Please use the list below as a guide)

	Sport	How Often?	When Was the Last Time?	The Time Before?
a.				
b.				
c.				
d.				
e.				
f.				

LIST OF SPORTS ACTIVITIES

Angling (fishing)
Archery
Badminton
Baseball
Basketball
Bicycling
Birling
Bob-Sledding
Bowling
Boxing
Canoeing
Codeball
Cricket
Cross Country
Curling
Fencing
Field Ball
Football
Golf
Gymnastics
Handball
Hiking
Hockey (field)
Hockey (ice)
Horseback Riding
Horseshoe Pitching
Hunting
Hurling
Ice Boating
Jai Alai
JuJitsu
Lawn Bowling
Mountain Climbing
Paddle Tennis
Polo (horse)
Polo (water)
Rowing and Sculling
Sailing
Shuffleboard
Skating (ice)
Skating (roller)
Skeet and/or Trap Shooting
Skiing
Snow Shoeing
Squash Rackets
Swimming
Table Tennis
Tennis
Track and Field
Trapping
Volley Ball
Walking Competitive
Weight Lifting
Wrestling

Serial No. _____

SECOND FOLLOW-UP OF THE LONGEVITY
AND MORBIDITY OF MALE GRADUATES OF MICHIGAN STATE UNIVERSITY

Name of Alumnus _____ Date _____

Street _____ City _____ State _____

PERSONAL INFORMATION

1. Have there been any changes in your marital status since 1960 (our previous follow up)?
   Yes ☐ No ☐
   (If yes to question 1, answer A; if no, move on to question 2)

   A. Please Explain _____

2. Present weight _____ lbs. A. Have you lost 15 lbs. or more since 1960? Yes ☐ No ☐
   (If yes to question A, answer 1 and 2; if no, move on to question 3)

   1. How many times did you lose this much weight? 1-2 times ☐ 3 or more times ☐
   2. Any specific reason for these weight fluctuations? _____

3. Height (in inches)_____
4. Which of these body type classification do you feel is closest to your body build?
   Stocky ☐ Medium ☐ Slender ☐

OCCUPATIONAL INFORMATION

5. Are you presently working (job or self employed)? Yes ☐ No ☐
   (If no, answer A; if yes, move on to question 6)

   A. Have you had a job or been self employed at any time since 1960? Yes ☐ No ☐
   (If no, skip to question 7; if yes, move on to question 6)

6. Answer the following questions about your present occupation or the last job you have had since 1960.
   A. What kind of work (for example, engineer, teacher, doctor)_____
   B. About how much time on the job is spent sitting?
      Practically all ☐ More than half ☐ About half ☐ Almost none ☐
   C. About how much time on the job is spent walking?
      Practically all ☐ More than half ☐ About half ☐ Almost none ☐
   D. About how much walking getting to and from your job? Blocks _____ Miles _____
   E. What type of transportation do you use to and from your job (check all that apply)
      Subway ☐ Bus ☐ Car ☐ Bicycle ☐ Others (Please describe)_____
   F. How often do you have to lift heavy weights or carry heavy things on the job?
      Frequently ☐ Sometimes ☐ Very infrequently (or never) ☐
   G. How many hours a week do you work on your job? _____ (Hours per week)
   H. How much tension in your job? Great Deal ☐ Some ☐ Very Little ☐ None ☐
   I. Any responsibility for supervising other workers on the job? Yes ☐ No ☐
      (If yes, answer 1; if no, move on to J)

      1. About how many on the average do you supervise? _____

   J. When did you start on this job? Year _____
   K. Just before this job were you doing the same type of work?
      Yes, did the same type of work ☐. I was on that job _____ years. No, this was my first job ☐.
      No, did different type of work ☐. If you check this item, please answer the following questions, 1, 2, 3, and 4:

      1. How long did you do this different type of work? _____ years.
      2. What kind of work was it? _____
      3. On this job did you spend more or less time sitting than your present job?
         More ☐ Less ☐ Same ☐
      4. Was there more or less walking on this earlier job than on your present (or last) job?
         More ☐ Less ☐ Same ☐

LEISURE TIME ACTIVITIES

7. How often do you do the following? (For each activity listed, please check whether you do it frequently, sometimes, or very infrequently.)

	Frequently	Sometimes	Very Infrequently (Or Never)
A. Take walk in good weather	☐	☐	☐
B. Work around the house or apartment (painting, repairing, etc.)	☐	☐	☐
C. Gardening in spring or summer	☐	☐	☐
D. Take part in sports during season	☐	☐	☐

E. If you take part in sports, please indicate what kind of sports and frequency either by the week or year.

SPORT	Frequency Per Wk.	or Per Yr.	SPORT	Frequency Per Wk.	or Per Yr.
☐ Angling (fishing)			☐ Judo		
☐ Archery			☐ Lawn Bowling		
☐ Badminton			☐ Mountain Climbing		
☐ Baseball			☐ Paddle Tennis		
☐ Basketball			☐ Polo (horse)		
☐ Bicycling			☐ Polo (water)		
☐ Bob-Sledding			☐ Rowing & Sculling		
☐ Bowling (exclude lawn bowling here)			☐ Shuffleboard		
☐ Boxing			☐ Skating (ice)		
☐ Canoeing			☐ Skating (roller)		
☐ Codeball			☐ Skiing		
☐ Cricket			☐ Snow Shoeing		
☐ Cross Country			☐ Squash Rackets		
☐ Curling			☐ Swimming		
☐ Fencing			☐ Table Tennis		
☐ Football			☐ Tennis		
☐ Golf			☐ Track & Field		
☐ Gymnastics			☐ Trapping		
☐ Handball			☐ Volleyball		
☐ Hiking			☐ Weight Lifting		
☐ Hockey (field)			☐ Wrestling		
☐ Hockey (ice)					
☐ Horseback Riding			Others:		
☐ Horseshoe Pitching			☐ _____		
☐ Hunting			☐ _____		
☐ Ice Boating			☐ _____		
☐ Jai Alai			☐ _____		

F. Have you been using an exercise plan at any time during or since 1960? Yes ☐ No ☐
(If yes to question F, answer 1 and 2; if no, answer question G)

1. Please check how often you used this plan. Frequently ☐ Sometimes ☐ Very infrequently ☐

2. Give a brief explanation of the exercises and amounts of time spent. _____

_____

_____

G. Up till the time you graduated from high school did you live mostly on the farm? ☐ How many years? _____ Or did you live in the city? ☐ How many years? _____ .

DIET RECALL

8. List the things you ate and drank yesterday (this should preferably be a week day). When possible, give the specific name of the item, e.g., Fresca or Coca Cola, rather than soft drink; McDonald's hamburger; whole milk, skim milk, half and half, rather than just milk. Indicate the amount you ate or drank in terms of cups (200 ml), tablespoons, teaspoons, ounces, numbers and approximate size, e.g., small, large, medium for fruits, vegetables, etc.

You may list meats either in ounces or size of pieces: one hamburger patty (3" diameter x 1" thick) weighs 3 oz.; an average serving of steak (3" x 3" x ½") weighs 3 oz. Be sure to include everything you ate or drank yesterday — candy, liquor, coffee (list sugar and cream, if used), popcorn, potato chips, etc., as well as your regular meals. To help you estimate sizes, a rule is marked off on the edge of this page.

Breakfast	
Item	Amount or Size

Morning Snacks	
Item	Amount or Size

Lunch	
Item	Amount or Size

Afternoon Snacks	
Item	Amount or Size

Dinner	
Item	Amount or Size

Evening Snacks	
Item	Amount or Size

A. Check date of diet record: Sun. ☐ Mon. ☐ Tues. ☐ Wed. ☐ Thurs. ☐ Fri. ☐ Sat. ☐

B. Did yesterday's meals include any special or unusual event, e.g., party, birthday, anniversary, picnic, etc.? Yes ☐ No ☐

1. If yes, what was it?_____

C. Does the above represent your usual day's food intake? Yes ☐ No ☐

1. If no, how did it differ from your usual intake?_____

D. Check the column which indicates the approximate frequency with which you consume each food.

Food	Daily	Weekly	Never
Whole milk			
Cream or half and half			
Ice cream (not ice milk)			
Cheese (other than cottage)			
Butter			
Margarine			
Sour cream			
Salad dressings (not low calorie)			
Eggs			
Gravy			
Fat around meat			
Pork			
Veal			
French-fried potatoes			
Fried meat, fried potatoes, etc.			
Other deep-fat fried foods			

Food	Daily	Weekly	Never
Fish			
Beef			
Cream or custard pies			
Cream puddings			
Sugar: in coffee, tea, etc.			
Sugar: on cereal			
Sugar: on fruits, vegetables			
Frosted cakes, brownies, sweet rolls, etc.			
Soft drinks (other than low or non-calorie)			
Honey			
Jelly, jam, preserves, marmalade			
Syrups (on pancakes, waffles, etc.)			
Molasses			
Sweetened fruit juices, syrups, etc.			

9. Do you drink coffee? Yes ☐ No ☐ (If yes, answer question a; if no, go on to question 10)

A. What is the average number of cups per day? 1-3 ☐ 4-6 ☐ 7-9 ☐ more ☐

SMOKING HABITS

10. Do you smoke at the present time? Yes ☐ No ☐ (If yes to question 10, answer A and B)

A. About how old were you when you first began to smoke? _____ Yrs. old.

B. What is the average number of cigarettes_____ cigars_____ pipefuls_____ you smoke per day. (continue on to question 11)

(If no to question 10, answer C)

C. Did you ever smoke regularly? Yes ☐ No ☐

(If yes to C, answer 1, 2, and 3; if no, move on to question 11)

1. About how old were you when you started smoking? _____ Yrs. old.
2. About how old were you when you stopped smoking? _____ Yrs. old.
3. When you were smoking, what was the average number of cigarettes_____ cigars_____ pipefuls_____ that you smoked per day?

DRINKING HABITS

11. Do you drink at the present time? Yes ☐ No ☐

(If yes to question 11, answer A)

A. Please check the amounts you usually drink.

Beer	Wine	Whiskey (gin, etc.)
☐ Occasional bottle	☐ Occasional glass other than for religious use	☐ Occasional glass
☐ 1 to 3 bottles per day	☐ Daily, but less than ½ bottle	☐ 3 to 6 shots per day
☐ over 3 bottles per day	☐ Over ½ bottle per day	☐ over 6 shots per day

(continue on to question 12)

(If no to question 11, answer B)

B. Did you ever drink regularly? Yes ☐ No ☐

(If yes to question B, answer 1 and 2; if no, go on to question 12)

1. Please give the number of years that you drank regularly before you quit _____Yrs., and why you quit _____
2. Please check the amounts you usually drank.

Beer	Wine	Whiskey (gin, etc.)
☐ Occasional bottle	☐ Occasional glass other than for religious use	☐ Occasional glass
☐ 1 to 3 bottles per day	☐ Daily, but less than ½ bottle	☐ 3 to 6 shots per day
☐ over 3 bottles per day	☐ Over ½ bottle per day	☐ over 6 shots per day

HEREDITARY HISTORY

12. If there are any changes in this history since 1960, will you please bring this information up to date, and make any additions or corrections in the data listed below.

RELATIONSHIP	If Living		If Deceased	
	Age	Ailment, if any	Age at Death	Cause of Death
Father				
Mother				
Brothers				
Sisters				

A. Father's occupation _____

MEDICAL HISTORY

13. If you have had any of these diseases since 1960, will you please bring this information up to date. Make any correction or addition in the data we listed below.

Ailment	Age at Onset	Are you still troubled with this condition?		Are you taking medication or treatment for it?	
		Yes	No	Yes	No
High Blood Pressure	_____	☐	☐	☐	☐
Angina Pectoris	_____	☐	☐	☐	☐
Stroke (Cerebral Thrombosis)	_____	☐	☐	☐	☐
Heart Attack (Coronary Thrombosis)	_____	☐	☐	☐	☐
Rheumatic Heart Disease	_____	☐	☐	☐	☐
Cancer	_____	☐	☐	☐	☐
Diabetes	_____	☐	☐	☐	☐
Tuberculosis	_____	☐	☐	☐	☐
Ulcer	_____	☐	☐	☐	☐
Liver Ailment	_____	☐	☐	☐	☐
Arthritis	_____	☐	☐	☐	☐
Gout	_____	☐	☐	☐	☐
Other	_____	☐	☐	☐	☐

Serial No. _____

THIRD FOLLOW-UP OF THE LONGEVITY
AND MORBIDITY OF MALE GRADUATES OF MICHIGAN STATE UNIVERSITY

Name of Alumnus _____ Date _____

Street _____ City _____ State _____

Social Security Number _____

PERSONAL INFORMATION

1. Have there been any changes in your marital status since 1968 (our previous follow-up)?
Yes ☐ No ☐
(If yes to question 1, answer A; if no, move on to question 2)

A. Please Explain _____

2. Present weight _____ lbs. A. Have you lost 15 lbs. or more since 1968? Yes ☐ No ☐

OCCUPATIONAL INFORMATION

3. Are you presently working (job or self employed)? Yes ☐ No ☐
(If no, answer A; if yes, move on to question 4)

A. Have you had a job or been self employed at any time since 1968? Yes ☐ No ☐
(If no, skip to question 5; if yes, move on to question 4)

4. Is this the same job you reported on the 1968 questionnaire? Yes ☐ No ☐
(If yes, move on to question 5; if no, answer the following questions A through J.

A. What kind of work (for example, engineer, teacher, doctor) _____

B. About how much time on the job is spent sitting?
Practically all ☐ More than half ☐ About half ☐ Almost none ☐

C. About how much time on the job is spent walking?
Practically all ☐ More than half ☐ About half ☐ Almost none ☐

D. Do you ever walk to or from work? Yes ☐ No ☐
If yes, how far do you walk? Blocks _____ Miles _____ How many times a year _____
Do you ever bicycle to and from work? Yes ☐ No ☐ If yes, how far do you cycle (both ways)?
Blocks _____ Miles _____ Number of times per year _____

E. What type of transportation do you use to and from your job (check all that apply)?
Subway ☐ Bus ☐ Car ☐ Bicycle ☐ Walking ☐ Others (Please describe) _____

F. How often do you have to lift heavy weights or carry heavy things on the job?
Frequently ☐ Sometimes ☐ Very infrequently (or never) ☐

G. How many hours a week do you work on your job? _____ (Hours per week)

H. How much tension in your job? Great deal ☐ Some ☐ Very little ☐ None ☐

I. Any responsibility for supervising other workers on the job? Yes ☐ No ☐
(If yes, answer 1; if no, move on to J)

1. About how many on the average do you supervise? _____

J. When did you start on this job? Year _____

LEISURE TIME ACTIVITIES

5. How many hours a month do you do the following activities and which months? (List number of hours involved in each activity under the month(s) you participate. Leave blank where not involved.)

ACTIVITY	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fishing - bank, boat, ice	—	—	—	—	—	—	—	—	—	—	—	—
Fishing - wading	—	—	—	—	—	—	—	—	—	—	—	—
Archery, target	—	—	—	—	—	—	—	—	—	—	—	—
Badminton	—	—	—	—	—	—	—	—	—	—	—	—
Baseball - hard, soft	—	—	—	—	—	—	—	—	—	—	—	—
Basketball	—	—	—	—	—	—	—	—	—	—	—	—
Bicycling - pleasure	—	—	—	—	—	—	—	—	—	—	—	—
Tobagganing, sledding	—	—	—	—	—	—	—	—	—	—	—	—
Bowling, including lawn	—	—	—	—	—	—	—	—	—	—	—	—
Canoeing or rowing	—	—	—	—	—	—	—	—	—	—	—	—
Jogging	—	—	—	—	—	—	—	—	—	—	—	—
Curling	—	—	—	—	—	—	—	—	—	—	—	—
Fencing	—	—	—	—	—	—	—	—	—	—	—	—
Gardening	—	—	—	—	—	—	—	—	—	—	—	—
Lawn mowing - riding	—	—	—	—	—	—	—	—	—	—	—	—
Lawn mowing - power mower	—	—	—	—	—	—	—	—	—	—	—	—
Lawn mowing - hand mower	—	—	—	—	—	—	—	—	—	—	—	—
Snow shoveling	—	—	—	—	—	—	—	—	—	—	—	—
Golf - walking	—	—	—	—	—	—	—	—	—	—	—	—
Golf - power cart	—	—	—	—	—	—	—	—	—	—	—	—
Handball, including paddleball, racket and squash	—	—	—	—	—	—	—	—	—	—	—	—
Walking - back packing	—	—	—	—	—	—	—	—	—	—	—	—
Walking - cross country	—	—	—	—	—	—	—	—	—	—	—	—
Walking - mountain climbing	—	—	—	—	—	—	—	—	—	—	—	—
Walking - pleasure	—	—	—	—	—	—	—	—	—	—	—	—
Home workshop (carpentry)	—	—	—	—	—	—	—	—	—	—	—	—
Horseback riding	—	—	—	—	—	—	—	—	—	—	—	—
Horseshoe pitching	—	—	—	—	—	—	—	—	—	—	—	—
Hunting - bow and gun	—	—	—	—	—	—	—	—	—	—	—	—
Sailing - ice and water	—	—	—	—	—	—	—	—	—	—	—	—
Judo, including karate	—	—	—	—	—	—	—	—	—	—	—	—
Paddle tennis	—	—	—	—	—	—	—	—	—	—	—	—
Rowing, skulling	—	—	—	—	—	—	—	—	—	—	—	—
Shuffleboard (not hand)	—	—	—	—	—	—	—	—	—	—	—	—
Skating - ice, roller	—	—	—	—	—	—	—	—	—	—	—	—
Skiing - downhill	—	—	—	—	—	—	—	—	—	—	—	—
Skiing - cross country	—	—	—	—	—	—	—	—	—	—	—	—
Skiing - water	—	—	—	—	—	—	—	—	—	—	—	—
Snowshoeing	—	—	—	—	—	—	—	—	—	—	—	—
Dancing - ballroom	—	—	—	—	—	—	—	—	—	—	—	—
Dancing - square	—	—	—	—	—	—	—	—	—	—	—	—
Swimming - pleasure	—	—	—	—	—	—	—	—	—	—	—	—
Swimming - exercise	—	—	—	—	—	—	—	—	—	—	—	—
Table tennis	—	—	—	—	—	—	—	—	—	—	—	—
Tennis - singles	—	—	—	—	—	—	—	—	—	—	—	—
Tennis - doubles	—	—	—	—	—	—	—	—	—	—	—	—
Volleyball	—	—	—	—	—	—	—	—	—	—	—	—
Weight lifting	—	—	—	—	—	—	—	—	—	—	—	—
Calisthenics - home	—	—	—	—	—	—	—	—	—	—	—	—
Calisthenics - Health Club	—	—	—	—	—	—	—	—	—	—	—	—
Others:												
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—
_____	—	—	—	—	—	—	—	—	—	—	—	—

6. If you have been routinely exercising under a home exercise plan or Health Club plan (commercial, Y.M.C.A., Athletic Club, etc.) answer the following questions:

A. Number of hours per month _____, which months (circle): Jan., Feb., Mar., Apr., May, June, July, Aug., Sept., Oct., Nov., Dec.

B. What type of exercises? _____

_____

DIET RECALL

7. List the things you ate and drank yesterday (this should preferably be a week day). When possible, give the specific name of the item, e.g., Fresca or Coca Cola, rather than soft drink; McDonald's hamburger; whole milk, skim milk, half and half, rather than just milk. Indicate the amount you ate or drank in terms of cups (200 ml), tablespoons, teaspoons, ounces, numbers and approximate size, e.g., small, large, medium for fruits, vegetables, etc.

You may list meats either in ounces or size of pieces: one hamburger patty (3" diameter x 1" thick) weighs 3 oz.; an average serving of steak (3" x 3" x ½") weighs 3 oz. Be sure to include everything you ate or drank yesterday — candy, liquor, coffee (list sugar and cream, if used), popcorn, potato chips, etc., as well as your regular meals. To help you estimate sizes, a rule is marked off on the edge of this page.

Breakfast		Morning Snacks	
Item	Amount or Size	Item	Amount or Size

Lunch		Afternoon Snacks	
Item	Amount or Size	Item	Amount or Size

Dinner		Evening Snacks	
Item	Amount or Size	Item	Amount or Size

A. Check date of diet record: Sun. ☐ Mon. ☐ Tues. ☐ Wed. ☐ Thurs. ☐ Fri. ☐ Sat. ☐

B. Did yesterday's meals include any special or unusual event, e.g., party, birthday, anniversary, picnic, etc.? Yes ☐ No ☐ 1. If yes, what was it? _____

C. Does the above represent your usual day's food intake? Yes ☐ No ☐

1. If no, how did it differ from your usual intake? _____

D. Check the column which indicates the approximate frequency with which you consume each food.

Food	Daily	Weekly	Never	Food	Daily	Weekly	Never
Whole milk				Fish			
Cream or half and half				Beef			
Ice cream (not ice milk)				Cream or custard pies			
Cheese (other than cottage)				Cream puddings			
Butter				Sugar: in coffee, tea, etc.			
Margarine				Sugar: on cereal			
Sour cream				Sugar: on fruits, vegetables			
Salad dressings (not low calorie)				Frosted cakes, brownies,			
Eggs				sweet rolls, etc.			
Gravy				Soft drinks (other than			
Fat around meat				low or non-calorie)			
Pork				Honey			
Veal				Jelly, jam, preserves, marmalade			
French-fried potatoes				Syrups (on pancakes, waffles, etc.)			
Fried meat, fried potatoes, etc.				Molasses			
Other deep-fat fried foods				Sweetened fruit juices, syrups, etc.			

E. Do you drink coffee? Yes ☐ No ☐ (If yes, answer question A; if no, go on to question 8)
A. What is the average number of cups per day? 1-3 ☐ 4-6 ☐ 7-9 ☐ more ☐

SMOKING HABITS

8. Do you smoke at the present time? Yes ☐ No ☐ (If yes to question 8 answer A and B; if no, answer C)

A. What is the average number of cigarettes ___, cigars ___, and/or pipefulls ___ you smoke per day?
B. Have you stopped at any time between 1968 and now? Yes ☐ No ☐ If yes, how long did you stop? _____

C. Did you smoke regularly any time between 1968 and now? Yes ☐ No ☐ If no, go on to question 9.
If yes, how long? _____ How many cigarettes ___, cigars ___, pipefulls ___ did you smoke per day?

DRINKING HABITS

9. Do you drink alcoholic beverages at the present time? Yes ☐ No ☐ (If yes to question 9, answer A and B: if no, answer C)

A. Please check the amounts you usually drink.

Beer	Wine	Liquor
☐ Occasional bottle	☐ Occasional glass other than for religious use	☐ Occasional glass
☐ 1 to 3 bottles per day	☐ Daily, but less than ½ bottle	☐ 3 to 6 shots per day
☐ over 3 bottles per day	☐ Over ½ bottle per day	☐ over 6 shots per day

B. Had you stopped drinking at any time between 1968 and now? Yes ☐ No ☐ If no, go on to question 10. If yes, for how long a period did you stop? _____

C. Did you drink regularly at any time between 1968 and now? Yes ☐ No ☐
If no, go on to question 10. If yes, for how long a period did you drink? _____
How much? (Please check the amounts.)

Beer	Wine	Liquor
☐ Occasional bottle	☐ Occasional glass other than for religious use	☐ Occasional glass
☐ 1 to 3 bottles per day	☐ Daily, but less than ½ bottle	☐ 3 to 6 shots per day
☐ over 3 bottles per day	☐ Over ½ bottle per day	☐ over 6 shots per day

HEREDITARY HISTORY

10. As of 1968, the individuals listed were still alive. Will you please bring this information up-to-date.

RELATIONSHIP	If Living		If Deceased	
	Age	Ailment, if any	Age at Death	Cause of Death

A. Father's occupation (when working) _____

MEDICAL HISTORY

11. In 1968 you indicated you had the following conditions. Will you please bring this information up-to-date. Make any correction or addition in the data we listed below.

Ailment	Age at Onset	Are you still troubled with this condition?		Are you taking medication or treatment for it?	
		Yes	No	Yes	No
High Blood Pressure	_____	☐	☐	☐	☐
Angina Pectoris	_____	☐	☐	☐	☐
Stroke (Cerebral Thrombosis)	_____	☐	☐	☐	☐
Heart Attack (Coronary Thrombosis)	_____	☐	☐	☐	☐
Rheumatic Heart Disease	_____	☐	☐	☐	☐
Cancer	_____	☐	☐	☐	☐
Diabetes	_____	☐	☐	☐	☐
Tuberculosis	_____	☐	☐	☐	☐
Ulcer	_____	☐	☐	☐	☐
Liver Ailment	_____	☐	☐	☐	☐
Arthritis	_____	☐	☐	☐	☐
Gout	_____	☐	☐	☐	☐
Other	_____	☐	☐	☐	☐

APPENDIX B

STATISTICAL ANALYSES

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UNIVARIATE 1-WAY ANOVA  CASES=YEARDX:60-76*KENDATA2:YES

ANALYSIS OF VARIANCE OF 89.TOTACT  N= 273 OUT OF 298

SOURCE              DF SUM OF SQRS  MEAN SQR  F-STATISTIC SIGNIF

BETWEEN             16    9.0167     .56355     .93961      .5243
WITHIN             256    153.54     .59977
TOTAL              272    162.56     (RANDOM EFFECTS STATISTICS)

ETA= .2355  ETA-SQR= .0555  (VAR COMP= -.22701 -2  %VAR AMONG= -0.)

YEARDX        N     MEAN     VARIANCE   STD DEV

(60)         11  1.6364      .65455      .80904
(61)         16  1.6250      .51667      .71880
(62)         19  1.7368      .64912      .80568
(63)         20  1.7500      .61842      .78640
(64)         16  1.6875      .76250      .87321
(65)         13  1.6154      .58974      .76795
(66)         18  1.3333      .23529      .48507
(67)         21  1.7143      .61429      .78376
(68)         17  1.8824      .48529      .69663
(69)         27  1.7037      .52422      .72403
(70)         12  1.7500      .93182      .96531
(71)         12  2.0000      .54545      .73855
(72)         17  1.8235      .52941      .72761
(73)         19  1.7368      .64912      .80568
(74)         15  1.9333      .63810      .79881
(75)         18  2.1111      .81046      .90025
(76)          2  2.5000      .50000      .70711

GRAND       273  1.7546      .59764      .77307

 COMMAND
?CORRELATE V=89,10 C=* S=NONE

 CORRELATION MATRIX  CASES=YEARDX:60-76*KENDATA2:YES

 N= 273  DF= 271  R@ .0500= .1187  R@ .0100= .1557

 CORRELATION BETWEEN 89.TOTACT AND 10.YEARDX =   .1431
```

UNIVARIATE 1-WAY ANOVA CASES=KENDATA2:YES

ANALYSIS OF VARIANCE OF 99.ADJAGE N= 298 OUT OF 298

SOURCE	DF	SUM OF SQRS	MEAN SQR	F-STATISTIC	SIGNIF
BETWEEN	16	3344.5	209.03	1.7417	.0391
WITHIN	281	33725.	120.02		
TOTAL	297	37069.	(RANDOM EFFECTS STATISTICS)		

ETA= .3004 ETA-SQR= .0902 (VAR COMP= 5.1109 %VAR AMONG= 4.08)

YEARDX	N	MEAN	VARIANCE	STD DEV
(60)	11	70.818	162.76	12.758
(61)	19	69.158	100.92	10.046
(62)	21	69.095	186.29	13.649
(63)	22	66.909	84.753	9.2062
(64)	16	73.313	97.563	9.8774
(65)	14	69.286	120.37	10.971
(66)	18	68.611	54.605	7.3895
(67)	22	67.409	142.82	11.951
(68)	21	63.857	138.83	11.783
(69)	29	64.655	123.66	11.120
(70)	15	62.800	136.74	11.694
(71)	13	64.462	94.936	9.7435
(72)	19	64.053	113.50	10.654
(73)	20	64.250	150.20	12.256
(74)	16	62.563	92.662	9.6261
(75)	20	59.800	111.69	10.710
(76)	2	59.500	60.500	7.7782
GRAND	298	66.077	124.81	11.172

COMMAND
?CORRELATE V=99.10 S=NONE C=V95:1#V10:60-76

CORRELATION MATRIX CASES=KENDATA2:YES*YEARDX:60-76

N= 298 DF= 296 R@ .0500= .1136 R@ .0100= .1490

TWOWAY CROSS-TABULATION CASES=KENDATA2:YES

44. AVOCACT		1.ATHYN (1)	(2)
N=	786		
TOTAL=	827	410	376
COL%			
MISS	41	22	19
COL%			
SED	532	247	285
COL%	67.7	60.2	75.8
LIGHT	201	132	69
COL%	25.6	32.2	18.4
MEDPLS	53	31	22
COL%	6.7	7.6	5.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 786
MAXIMUM LIKELIHOOD	22.864	.0000	CRAMER'S PHI=	.1694
CHI-SQUARE	22.560	.0000	CONTINGENCY COEFF=	.1670

TWOWAY CROSS-TABULATION CASES=KENDATA2:YES

45. OCCACT		1.ATHYN (1)	(2)
N=	776		
TOTAL=	827	406	370
COL%			
MISS	51	26	25
COL%			
SEDRET	368	192	176
COL%	47.4	47.3	47.6
LIGHT	283	159	124
COL%	36.5	39.2	33.5
MEDPLS	125	55	70
COL%	16.1	13.5	18.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 776
MAXIMUM LIKELIHOOD	5.1692	.0754	CRAMER'S PHI=	.0816
CHI-SQUARE	5.1653	.0756	CONTINGENCY COEFF=	.0813

```
TWOWAY CROSS-TABULATION  CASES=KENDATA2:YES

89.                1.ATHYN
TOTACT             (1)     (2)

     N=   775
 TOTAL=   827     406     369
  COL%

  MISS    52      26      26
  COL%

   (1)   256     120     136
  COL%  33.0    29.6    36.9

   (2)   260     145     115
  COL%  33.5    35.7    31.2

   (3)   259     141     118
  COL%  33.4    34.7    32.0


TESTS OF INDEPENDENCE  STATISTIC  SIGNIF  DF= 2      N= 775

  MAXIMUM LIKELIHOOD   4.7480      .0931  CRAMER'S PHI=        .0783
  CHI-SQUARE           4.7484      .0931  CONTINGENCY COEFF=   .0780
TWOWAY CROSS-TABULATION  CASES=KENDATA2:YES

9.                 1.ATHYN
DEATHYN            (1)     (2)

     N=   827
 TOTAL=   827     432     395
  COL%

   YES   296     156     140
  COL%  35.8    36.1    35.4

    NO   531     276     255
  COL%  64.2    63.9.   64.6


TESTS OF INDEPENDENCE  STATISTIC  SIGNIF  DF= 1      N= 827

  MAXIMUM LIKELIHOOD   .40078 -1   .8413  CRAMER'S PHI=        .0070
  CHI-SQUARE           .40073 -1   .8413  CONTINGENCY COEFF=   .0070
  BINOMIAL TEST OF SYMMETRY        .0000  FISHER EXACT PROB=   .4494
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TWOWAY CROSS-TABULATION  CASES=KENDATA2:YES

96.                1.ATHYN
AGEGRPS            (1)     (2)

     N=   794
 TOTAL=   827      416     378
  COL%

  MISS     33       16      17
  COL%

  F6T7     91       41      50
  COL%   11.5      9.9    13.2

  F8T9    165       88      77
  COL%   20.8     21.2    20.4

F10T11    278      150     128
  COL%   35.0     36.1    33.9

F12T13    260      137     123
  COL%   32.7     32.9    32.5


TESTS OF INDEPENDENCE  STATISTIC  SIGNIF  DF= 3      N= 794

  MAXIMUM LIKELIHOOD     2.3031     .5119  CRAMER'S PHI=        .0539
  CHI-SQUARE             2.3049     .5116  CONTINGENCY COEFF=   .0538
```

TWOWAY CROSS-TABULATION <1> AGEGRPS:F6T7 CASES=KENDATA2:YES

9. DEATHYN		44.AVOCACT MISS	SED	LIGHT	MEDPLS
N=	87				
TOTAL=	91	4	69	16	2
COL%					
YES	78	4	64	13	1
COL%	89.7		92.8	81.3	50.0
NO	9	0	5	3	1
COL%	10.3		7.2	18.8	50.0

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 87
MAXIMUM LIKELIHOOD	3.7810	.1510	CRAMER'S PHI=	.2474
CHI-SQUARE	5.3240	.0698	CONTINGENCY COEFF=	.2401

TWOWAY CROSS-TABULATION <2> AGEGRPS:F8T9 CASES=KENDATA2:YES

9. DEATHYN		44.AVOCACT MISS	SED	LIGHT	MEDPLS
N=	160				
TOTAL=	165	5	112	44	4
COL%					
YES	78	4	57	20	1
COL%	48.8		50.9	45.5	25.0
NO	82	1	55	24	3
COL%	51.3		49.1	54.5	75.0

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 160
MAXIMUM LIKELIHOOD	1.3463	.5101	CRAMER'S PHI=	.0901
CHI-SQUARE	1.3002	.5220	CONTINGENCY COEFF=	.0898

TWOWAY CROSS-TABULATION <3> AGEGRPS:F10T11 CASES=KENDATA2:YES

9. DEATHYN		44.AVOCACT MISS	SED	LIGHT	MEDPLS
N=	262				
TOTAL=	278	16	187	61	14
COL%					
YES	62	8	52	9	1
COL%	23.7		27.8	14.8	7.1
NO	200	8	135	52	13
COL%	76.3		72.2	85.2	92.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 262
MAXIMUM LIKELIHOOD	7.3877	.0249	CRAMER'S PHI=	.1584
CHI-SQUARE	6.5734	.0374	CONTINGENCY COEFF=	.1564

TWOWAY CROSS-TABULATION <4> AGEGRPS:F12T13 CASES=KENDATA2:YES

9. DEATHYN		44.AVOCACT MISS	SED	LIGHT	MEDPLS
N=	245				
TOTAL=	260	15	141	71	33
COL%					
YES	26	4	15	8	3
COL%	10.6		10.6	11.3	9.1
NO	219	11	126	63	30
COL%	89.4		89.4	88.7	90.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 245
MAXIMUM LIKELIHOOD	.11586	.9437	CRAMER'S PHI=	.0215
CHI-SQUARE	.11276	.9452	CONTINGENCY COEFF=	.0214

TWOWAY CROSS-TABULATION <1> AGEGRPS:F6T7 CASES=KENDATA2:YES

9. DEATHYN		45.OCCACT MISS	SEDRET	LIGHT	MEDPLS
N=	87				
TOTAL=	91	4	72	6	9
COL%					
YES	78	4	67	5	6
COL%	89.7		93.1	83.3	66.7
NO	9	0	5	1	3
COL%	10.3		6.9	16.7	33.3

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 87
MAXIMUM LIKELIHOOD	4.6907	.0958	CRAMER'S PHI=	.2688
CHI-SQUARE	6.2844	.0432	CONTINGENCY COEFF=	.2596

TWOWAY CROSS-TABULATION <2> AGEGRPS:F8T9 CASES=KENDATA2:YES

9. DEATHYN		45.OCCACT MISS	SEDRET	LIGHT	MEDPLS
N=	160				
TOTAL=	165	5	82	52	26
COL%					
YES	78	4	43	26	9
COL%	48.8		52.4	50.0	34.6
NO	82	1	39	26	17
COL%	51.3		47.6	50.0	65.4

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 160
MAXIMUM LIKELIHOOD	2.5971	.2729	CRAMER'S PHI=	.1264
CHI-SQUARE	2.5583	.2783	CONTINGENCY COEFF=	.1254

TWOWAY CROSS-TABULATION <3> AGEGRPS:F10T11 CASES=KENDATA2:YES

9. DEATHYN		45.OCCACT MISS	SEDRET	LIGHT	MEDPLS
N=	258				
TOTAL=	278	20	100	102	56
COL%					
YES	60	10	17	28	15
COL%	23.3		17.0	27.5	26.8
NO	198	10	83	74	41
COL%	76.7		83.0	72.5	73.2

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 258
MAXIMUM LIKELIHOOD	3.7005	.1572	CRAMER'S PHI=	.1180
CHI-SQUARE	3.5895	.1662	CONTINGENCY COEFF=	.1171

TWOWAY CROSS-TABULATION <4> AGEGRPS:F12T13 CASES=KENDATA2:YES

9. DEATHYN		45.OCCACT MISS	SEDRET	LIGHT	MEDPLS
N=	241				
TOTAL=	260	19	87	121	33
COL%					
YES	26	4	10	14	2
COL%	10.8		11.5	11.6	6.1
NO	215	15	77	107	31
COL%	89.2		88.5	88.4	93.9

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 241
MAXIMUM LIKELIHOOD	1.0144	.6022	CRAMER'S PHI=	.0607
CHI-SQUARE	.88828	.6414	CONTINGENCY COEFF=	.0606

TWOWAY CROSS-TABULATION <1> AGEGRPS:F6T7 CASES=KENDATA2:YES

9. DEATHYN		89.TOTACT MISS	(1)	(2)	(3)
N=	87				
TOTAL=	91	4	56	18	13
COL%					
YES	78	4	54	16	8
COL%	89.7		96.4	88.9	61.5
NO	9	0	2	2	5
COL%	10.3		3.6	11.1	38.5

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 87
MAXIMUM LIKELIHOOD	10.734	.0047	CRAMER'S PHI=	.3992
CHI-SQUARE	13.862	.0010	CONTINGENCY COEFF=	.3707

TWOWAY CROSS-TABULATION <2> AGEGRPS:F8T9 CASES=KENDATA2:YES

9. DEATHYN		89.TOTACT MISS	(1)	(2)	(3)
N=	160				
TOTAL=	165	5	58	57	45
COL%					
YES	78	4	30	30	18
COL%	48.8		51.7	52.6	40.0
NO	82	1	28	27	27
COL%	51.3		48.3	47.4	60.0

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 160
MAXIMUM LIKELIHOOD	1.9391	.3792	CRAMER'S PHI=	.1098
CHI-SQUARE	1.9281	.3814	CONTINGENCY COEFF=	.1091

TWOWAY CROSS-TABULATION <3> AGEGRPS:F10T11 CASES=KENDATA2:YES

9. DEATHYN		89.TOTACT MISS	(1)	(2)	(3)
N=	258				
TOTAL=	278	20	69	92	97
COL%					
YES	60	10	15	24	21
COL%	23.3		21.7	26.1	21.6
NO	198	10	54	68	76
COL%	76.7		78.3	73.9	78.4

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 258
MAXIMUM LIKELIHOOD	.63515	.7279	CRAMER'S PHI=	.0499
CHI-SQUARE	.64235	.7253	CONTINGENCY COEFF=	.0498

TWOWAY CROSS-TABULATION <4> AGEGRPS:F12T13 CASES=KENDATA2:YES

9. DEATHYN		89.TOTACT MISS	(1)	(2)	(3)
N=	240				
TOTAL=	260	20	54	83	103
COL%					
YES	26	4	4	14	8
COL%	10.8		7.4	16.9	7.8
NO	214	16	50	69	95
COL%	89.2		92.6	83.1	92.2

TESTS OF INDEPENDENCE	STATISTIC	SIGNIF	DF= 2	N= 240
MAXIMUM LIKELIHOOD	4.5566	.1025	CRAMER'S PHI=	.1412
CHI-SQUARE	4.7872	.0913	CONTINGENCY COEFF=	.1398