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AN INVESTIGATION OF THE
VALIDITY OF QUESTIONNAIRE RESPONSES
PERTAINING TO THE MORTALITY OF
ATHLETES

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

Earl L. Mahoney

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AN INVESTIGATION OF THE VALIDITY OF QUESTIONNAIRE
RESPONSES PERTAINING TO THE
MORTALITY OF ATHLETES

by
EARL L. MAHONEY

A THESIS

Submitted to the College of Education of Michigan
State University of Agriculture and Applied
Science) in partial fulfillment of the
requirements for the degree of

MASTER OF ARTS

Department of Health, Physical Education, and Recreation

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I am also indebted to Dr. Wayne VanHuss for his interest and suggestions; Mr. Robert Mooney of the Michigan State Public Health Department for his valuable assistance, and to my wife, Vera, for her patience and support throughout the preparation of this study.

E.L.M.

AN INVESTIGATION OF THE VALIDITY OF QUESTIONNAIRE
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AN ABSTRACT OF A THESIS

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Approved Henry J. Montoya

1. The first part of the report is a general
introduction to the subject of the study.
It is followed by a description of the
methodology used in the study.

2.

3. The second part of the report is a
description of the results of the study.

4.

5. The third part of the report is a
discussion of the results of the study.
It is followed by a conclusion and
recommendations for further research.

6.

7. The fourth part of the report is a
summary of the findings of the study.

8. The fifth part of the report is a
conclusion and recommendations for further research.

Purpose of the Study

To investigate the validity of selected factual questionnaire data from the Michigan State University Study of Longevity and Morbidity of Former College Athletes. Also, as a subordinate purpose, the interpretation and coding of the questionnaire causes of death by the investigators in the Michigan State University Study was studied.

Methodology

Death certificates were used as the criteria to determine the validity of the questionnaire data. The death certificates were located for 104 of the 123 reported deaths in the Michigan State Study. The questionnaire data pertaining to date of birth, age of death, and cause of death were compared to the corresponding data on the death certificates.

After the data were obtained, they were analyzed by conventional statistical techniques.

Results

The dates of birth as reported on 104 investigated questionnaires appear to be accurate. The correlation coefficient for the death certificates date of birth and the questionnaire date of birth was 0.99. The critical ratio was 0.75, for the difference in means.

EARL L. MAHONEY

ABSTRACT

The ages of death as reported on the 104 investigated questionnaires also appear to be accurate. The correlation for these data was 0.98, and the critical ratio was 0.13 for the difference in the means.

A total of nineteen errors were observed when the questionnaire causes of death were compared to the death certificate causes of death. The errors constituted 18.3 per cent of the total 104 cases investigated. The causes of death appear to be valid data when classified in general categories. The nineteen errors were classified as to their magnitude. Two of the errors were classified as major error, thirteen as minor, and four as insufficient information.

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
Statement of the problem.	2
Importance of the study	2
Limitations of the study.	4
II. REVIEW OF LITERATURE.	6
Summary.	11
III. METHODOLOGY	13
Selection of data to be investigated.	13
Investigative procedures.	14
Classification of causes of death.	16
Methods of analyzing the data	18
IV. RESULTS	21
Validation of the dates of death	21
Validity of ages of death	22
Validity of the causes of death	22
Coding errors	28
V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS.	30
Summary.	30
Conclusions	30
Recommendations.	31
BIBLIOGRAPHY.	33
APPENDIXES	37

LIST OF TABLES

TABLE	PAGE
I. A Comparison of Causes of Death as Reported on the Questionnaires and as Recorded on the Death Certificates	24
II. Comparison of All Causes of Death Before and After Correction of Coding Errors	27
III. Effect of Coding Errors When Causes of Death are Coarsely Grouped.	28

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LIST OF FIGURES

FIGURE	PAGE
1. A Comparison of Causes of Death as Reported on the Questionnaires and as Recorded on the Death Certificates in Semi-Coarse Categories. .	25
2. A Comparison of Causes of Death as Reported on the Questionnaires and as Recorded on the Death Certificates in Coarse Categories . . .	26

CHAPTER I

INTRODUCTION

The use of the questionnaire as an adequate investigative technique is in general acceptance by the social scientist. The assumptions basic to this technique must be taken for granted, for there are few objective data substantiating its validity. Data collected through the use of the questionnaire are subject to criticism, which is mainly centered about the reliability and the validity of the instrument.^{1,2,3} Kelly,⁴ however, calls attention to the fact that many times the only instrument available for the collection of data, pertinent to a problem, is the questionnaire.

Basically there were two types of data for which the questionnaire is employed: (1) Factual data, such as age,

¹F. P. Whitney, "The Questionnaire Craze," Educational Review, 68:139-140, 1924.

²L. V. Koos, The Questionnaire in Education (New York: The Macmillan Company, 1929), p. 2-3.

³Frederick L. Whitney, The Elements of Research (New York: Prentice-Hall, Inc., 1947), p. 135.

⁴T. L. Kelly, Scientific Method: Its Function in Research and in Education (New York: The Macmillan Company, 1932), p. 122.

sex, weight, and height; (2) Subjective data, such as opinions, attitudes, beliefs, and values. The former are subject to verification, while the latter may or may not be subject to verification.⁵ In the Michigan State University Study of Longevity and Morbidity of Former College Athletes,⁶ the more important data pertinent to final generalities involves factual data.

Statement of the Problem

It was the purpose of this study to determine the validity of selected factual questionnaire data of the Michigan State University Study of Longevity and Morbidity of Athletes and Non-Athletes. The selected data to be investigated for validity are cause of death, age of death, and date of birth. The criteria used to measure the degree of validity were Public Health Department records, namely, death certificates.

Importance of the Study

The longevity and morbidity of former college athletes has long been a problem of extreme interest. As a result of this interest many investigators have conducted studies in

⁵George A. Lundberg, Social Research (New York: Longmans, Green and Co., 1942), p. 183.

⁶The Pilot Study of a National Study of Longevity and Morbidity of Athletes in Colleges and Universities, sponsored by Phi Epsilon Kappa fraternity, [a national, professional physical education honorary fraternity, inaugurated in 1951.

this area.⁷ Some of the methods employed in the Michigan State University Study of Longevity and Morbidity of College Athletes were the results of an analysis of the methods other investigators have used. Some of the faults other investigators have made in this area of research are poor sampling procedures, no control group, and no method to test the validity of the data.

This study takes into consideration only one aspect of the foregoing criticism, namely, validity. Although this study is concerned only with the validity of cause of death, age of death, and date of birth, the precise evaluation of these data, indirectly, pertains to the validity of the study as a whole. If the stigma of "unvalidated evidence," which usually accompanies most questionnaire studies, is removed the data becomes more meaningful.

Another aspect of this study which may be taken into account is the development of an investigative technique, which may be used to validate certain factual data. Although the use of public records involves a great deal of tedious work, it is the belief of this investigator that a satisfactory systematic approach may be formulated to expedite this technique of investigation.

⁷Thomas K. Cureton, Physical Fitness Appraisal and Guidance (St. Louis: C. V. Mosby and Company, 1947), 309-311.

Limitations of the Study

In the classification of causes of death on the death certificates there might have been discrepancies due to the following reasons:

- (1) Physicians who practiced medicine thirty or forty years ago did not use the same methods of diagnosis, nor the same nomenclature, as the physicians of today.⁸
- (2) Many places in the United States have a county coroner who is not a professional medical man, and his certification as to cause of death is subject to question.
- (3) Medical entries on the death certificate are many times made to concur with the legal aspects in regard to cause of death and are not concerned with the specific pathology involved.⁹

⁸Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (Sixth revision; Geneva, Switzerland: World Health Organization, 1949), Vol. 1, p. xiii.

⁹Office of Vital Statistics, Physicians Handbook on Death and Birth Registration (Washington, D.C.: U. S. Government Printing Office, 1949), p. 4.

- (4) Difficulty in determining the most important cause of death, where two or more entries were made on the death certificate.¹⁰

Although the use of death certificates as validating criteria may be subject to the former criticisms, Dublin states:

Registration of deaths is relatively accurate because of the legal importance of the event of death and the stress accordingly laid on the enforcement of certification requirements.¹¹

There was much variability among the death certificates in regard to basic design and methods of recording data due to differences in the various state health department regulations and chronological eras.

Due to the lack of information, i.e., service number, rank, service unit, place and date of death; war deaths could not be validated. If these war deaths could have been investigated, it is assumed that the percentage of correct questionnaire response would have been higher.

¹⁰Alan Rook, "An Investigation into the Longevity of Cambridge Sportsmen," British Medical Journal, 4865; 773-777, April, 1954.

¹¹Louis I. Dublin, et al, Length of Life (New York: Ronald Press Co., 1949), p. 306.

CHAPTER II

REVIEW OF LITERATURE

Much research has been done in regard to the longevity, morbidity, and mortality of athletes. A survey of the methods the various investigators used to gather their data is given.

Morgan,¹ in 1873, investigated the longevity of two hundred and ninety-four former oarsmen from Oxford and Cambridge Universities. The data used in this study were records from the universities which are kept on all former students.

In 1904 Meylan² studied the effects of exercise and competition on the longevity and morbidity of former Harvard oarsmen. He attempted to see every former oarsman personally and examine him, when this was not possible he sent a card and asked the subject to have his family physician perform the examination. Thirty-two of his one hundred and fifty-two subjects had died. He stated the causes of death for twenty-two cases were definitely ascertained. The technique used to

¹John E. Morgan, "Critical Inquiry into the After-Health of the Men Who Rowed in the Oxford and Cambridge Boat Race from the Year 1829-1859," University Oars, p. 330, cited by Peter V. Karpovich, "Longevity and Athletics," Research Quarterly, Vol. 12, (May, 1941), pp. 451-455.

²George L. Meylan, "Harvard University Oarsmen," Harvard Graduates Magazine, 9:355-356, March, 1904.

ascertain the causes of death was not mentioned in the study. He was unable to learn the exact cause of death in the other ten cases.

Anderson³ made a study of the longevity of former Yale athletes in 1916. With the aid of a statistician he secured his data from the records of the secretary of the university; i.e., files of the college publications, and obituary reports. Among the eight hundred and eight former athletes for which data were collected, there were only fifty-eight deaths. No attempt was made to validate the causes of death listed in the records, although they were reported as factual data.

Greenway and Hiscock⁴ made an analysis of the longevity and morbidity of former athletes and other graduates of Yale University in 1929. Again the class and obituary records, kept at the secretary's office, were used to gather the material for the investigation.

In 1927, Hill⁵ studied the longevity of former cricket players in England. The source of data for his study was

³William G. Anderson, "Further Studies in the Longevity of Yale Athletes," Mind and Body, 23:374-375, December, 1916.

⁴James C. Greenway and Ira V. Hiscock, "Mortality Among Yale Men," Yale Alumni Weekly, 35:1086, June, 1926.

⁵A. Bradford Hill, "Cricket and Its Relation to the Duration of Life," Lancet, 2:994, 1927.

"Wisden's Cricketers Almanac" which devoted a section to biographical details of former cricket players.

Bickert⁶ carried out a study in Germany concerning the effects of competitive sports on the longevity and cause of death of former champion athletes. Names of all his deceased subjects were collected from yearbooks and periodicals. Questionnaires were sent out to the deceased persons' athletic clubs. If the membership in an athletic club could not be determined, questionnaires were sent to the registrars' office of the communities in order to find the address of the person who had given the announcement of death. This person was then sent a questionnaire to answer questions concerning the deceased. The cause of death as reported in the study were not investigated for validity.

Reed and Love⁷ made a study of the longevity of army officers in relations to physical fitness in 1931. The source of their data were the official physical and medical records of 5,021 individuals. The use of this type of data would lend a very high degree of validity to a study of this nature.

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F. W. Bickert, "Einfluss, des Wettkampfmassig Betriebenen Sports Auf die Lebensdauer und Todesursache," Deutsche Medizinische Wochenschrift, 55:23-24, 1929.

7

Lowell J. Reed and Albert G. Love, "Longevity of Army Officers in Relation to Physical Fitness," The Military Surgeon, 69:380, October, 1931.

Between the years 1938 and 1940, Knoll⁸ and Llewellyn⁹ made independent investigations of the longevity of the former Oxford and Cambridge oarsmen. The centennial history of the rowing teams was used to collect the data for their studies. It is stated in the studies that this history contained exact data on the private lives and the ages of the participants.

In 1928,¹⁰ and again in 1932,¹¹ Dublin made two investigations related to the longevity of college athletes, from ten eastern universities. He used college records to secure his data for the first study. In the second study in which he used college graduates other than athletes as controls, actuary statistics from the Metropolitan Life Insurance Company were used to make comparisons. Presumably the data for both the athletes and controls were obtained from college records. This, however, is not clear in the report.

⁸W. Knoll, "Welches Lebensalter Erreichen die Ruderer von 'Oxford-Cambridge'?" Medizinische Klinik, 34:464-466, 1938.

⁹Percival H. Hartley and Geoffrey F. Llewellyn, "A Study of Those Who Rowed in the Oxford and Cambridge Boat Race from 1829 to 1928," British Medical Journal, 1:658, April, 1939.

¹⁰Louis I. Dublin, "Longevity of College Athletes," Harpers Monthly Magazine, 157:230-231, 1928.

¹¹Louis I. Dublin, "College Honor Men Long-Lived," Statistical Bulletin of the Metropolitan Life Insurance Co., 13:5-6, 1932.

Wakefield,¹² in 1944, completed a study of 2,900 former athletes who had played in the finals of the Indiana state high school basketball tournaments. His study was mostly concerned with the causes of mortality and age of death. The data for determining causes of death and ages of death were obtained from official sources such as State Board of Health Records, County Board of Health Records, Cemetary Records, and Records of Morticians.

A study of the longevity of 400 former Czechoslovakian athletes was performed by Schmid in 1952.¹³ This study was mainly concerned with comparing the age of death of athletes with the normal life span of the general population. The data were obtained through questionnaires sent out to relatives and friends of the deceased athletes. Hospital archives and physicians records were also used as a source of data.

In 1954, Rook¹⁴ studied the longevity of Cambridge oarsmen. He first used the "Alumni Cantabrigienses," a biographical list of former Cambridge students, to obtain such data as date of birth, economic, social, and when

¹²Mark C. Wakefield, "A Study of Mortality Among the Men Who Have Played in the Indiana High School State Final Basketball Tournaments," Research Quarterly, 15:3-5, 1944.

¹³L. Schmid, "How Long the Sportsmen Live," Sport and Health (Oslo, Norway: Royal Norwegian Ministry of Education, 1952), pp. 106-107.

¹⁴Alan Rook, "An Investigation into the Longevity of Cambridge Sportsmen," British Medical Journal, 4865:777, April, 1954.

causes of death for one-half of the total group. No comparisons were made of death certificate causes of death with questionnaire causes of death. Rook also made the following statement in reference to the use of death certificates for the verification of causes of death:

The use of death certificates as the basis for a statistical analysis of this nature is not entirely satisfactory and numerous difficulties are encountered. Diagnoses are often vague; fashions in diagnosis even on the death certificates change with the years, possibly capriciously or possibly as a result of more accurate methods and greater knowledge of pathological causes. Sometimes when two or more possible causes of death figure on a certificate it is difficult to choose the most important one.¹⁵

Summary

In reviewing the studies concerned with the longevity of athletes there seems to be a definite change in trends regarding the methods used in collecting and analyzing the data. In the early studies the trend was to use college files as the primary source of data. In the later studies other methods of investigation have been used, such as questionnaires, actuary tables, and death certificates. In these later studies more emphasis was placed on the accuracy of the data. Also, the importance of ascertaining the

¹⁵Ibid., p. 777.

validity of the data cannot be over emphasized. Koos has stated: "It would be highly beneficial to the use of the questionnaire as an instrument of research if all those who use it would assume some responsibility for its validation."¹⁶

¹⁶L. V. Koos, The Questionnaire in Education (New York: The Macmillan Company, 1929), p. 167.

CHAPTER III

METHODOLOGY

Selection of Data to be Investigated

The data which were investigated for validity were selected from the returned questionnaires of the Michigan State University Study of Longevity and Morbidity of College Athletes.¹ The questionnaires were from athletes and non-athletes, who had formerly attended Michigan State University.² The names and addresses of these former students were obtained from the files of the Athletic Director, Student Directories, The Registrars' Records, and from the Alumni Office. Questionnaires were sent out to 1,130 former athletes and 1,130 non-athletes.³ Of the 2,260 questionnaires sent out, a total of 1,212 were returned with sufficient data

¹H. J. Montoye, W. VanHuss, H. Olson, and A. Hudec, "A Study of the Longevity and Morbidity of College Athletes," unpublished study, Michigan State University, East Lansing, Michigan. Presented at the Third Annual Meeting of the "American College of Sports Medicine," March, 1956.

²As defined in Michigan State University study--An athlete is one who has earned a major sports letter and a control is a former student who attended M.S.U. during the time of attendance of the athlete, but who did not earn a major letter in any sport.

³See sample of questionnaire, Appendix A.

to be included in the study. The total percentage of returns, excluding those which were returned unopened due to incorrect addresses, etc., was 65.22 per cent. Of the 1,212 returned questionnaires 629 were from the athlete group and 583 from the control group.⁴

All the questionnaires which indicated the subjects to be deceased were separated from the questionnaires which denoted the subjects still living. The number of questionnaires for the deceased group, which were filled out by relatives and friends of the deceased, numbered 123 or 9.85 per cent of the total returned questionnaires. There were sixty-seven athletes and fifty-six controls in this group.

Investigative Procedures

The dates of birth, ages of death, and causes of death were abstracted from the 123 questionnaires and tabulated.⁵ Four by six information cards were designed and printed, to be used in abstracting information from the death certificates.⁶ On the cards, blanks were left for information which

⁴For further information of methods used in M.S.U. study refer to theses of: A. Hudec, "A Study of the Longevity and Morbidity of Football and Basketball Athletes at Michigan State University," (unpublished Master's thesis, Michigan State University, East Lansing, Mich., 1956) passim. H. Olson, "A Study of Longevity and Morbidity of Track Athletes at Michigan State University," (unpublished Master's thesis, Michigan State University, East Lansing, Mich., 1956) passim.

⁵See Appendix B for tabulation sheet.

⁶See Appendix C for sample of card.

appeared on both the questionnaire and the death certificate. Other entries, for information not appearing on the questionnaire, such as race, occupation, and kind of business or industry, were also made. An abbreviated list of fifty causes of death for the tabulation of mortality was also entered.⁷ Five of the fifty causes of death on the original abbreviated list were eliminated as not being applicable to this study. The causes of death eliminated were those resulting from childbirth, birth injuries, and diseases peculiar to early infancy.

Information regarding the subject's former state of residence, was obtained from the questionnaires. Where necessary, personal letters were sent to the individuals who had filled out the questionnaire to obtain more definite information in regard to date and place of death.⁸ If the individual had been killed in the armed services, the branch of service and service number were requested. Personal letters and information cards were mailed to the appropriate Directors of the State Health Departments.⁹ The letter requested the information cards be completed in accordance with the death certificate data, or that a non-certified copy of

¹See Appendix D for abbreviated list of fifty causes of death cited from Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (Sixth revision; Geneva, Switzerland: World Health Organization, 1949), Vol. 1, p. xiii.

⁸See Appendix E, letter.

⁹See Appendix F, letter.

the death certificate be returned in lieu of filling out the card. This information was provided free by all the states participating in the study except Mississippi. The Michigan State Department of Health made available to this investigator the death certificates of the subjects who had died in this state. Of the total number of subjects sixty-three were checked by the use of the Michigan State Health Department records.

When the cards or death certificates were returned they were checked against the original questionnaire data. When there was disagreement, the death certificate data were tabulated in additional columns so that comparisons could be readily made. The most difficult part of the study was encountered in the classification of causes of death.

Classification of Causes of Death

The purpose of a statistical classification of causes of death is primarily to furnish quantitative data which will answer questions about groups of cases.¹⁰ The authority used for the classification of causes of death in this study and the Michigan State University Study was the Manual of International Statistical Classification of Diseases, Injuries, and Causes of Death.¹¹ This manual has three special lists

¹⁰Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, op. cit. p.xi.

¹¹Ibid., passim.

for tabulating morbidity and mortality.¹² List B was used in the Michigan State University Study and the present study for classification of causes of death.

In regard to methods used in classifying causes of death Farr states:

Classification is a method of generalization. Several classifications may, therefore, be used with advantage; and the physician, the pathologist, or the jurist, each from his own point of view may legitimately classify the diseases and causes of death in the way that he thinks best adapted to facilitate his inquiries, and to yield general results.¹³

Early records of death usually contained a single cause, and only a few simple rules were in effect to secure uniform selection of the cause of death.¹⁴ Many of the death certificates dealt with in this study contained multiple causes of death, and the problem of selecting one primary cause of death became very important. The authority used in this study stated that the underlying cause of death should be used in selecting the cause of death for classification purposes.¹⁵ This authority also stated:

¹³ Ibid., p. xii.

¹⁴ Ibid., p. xxxiv.

¹⁵ Ibid., p. 345.

A cause of death is the morbid condition or disease process, abnormality, injury or poisoning leading directly, or indirectly, to death. Symptoms or modes of dying such as heart failure, asthenia, etc., are not considered to be causes of death for statistical purposes.¹⁶

The two principles which were followed in determining the primary cause of death were; (1) to use the disease or injury which initiated the train of morbid events leading directly, or indirectly to the cause of death; (2) or the circumstances of the accident or violence which produced the fatal accident.¹⁷

Methods of Analyzing the Data

When all the data had been collected and tabulated, the Pearson Product Moment method to determine the correlation coefficient of the questionnaire responses and the death certificate data, for the dates of birth and ages of death were used. The means were analyzed and the standard deviation and the critical ratio were computed for both the dates of birth and the ages of death data.

The inconsistencies which appeared between the questionnaires and the death certificates regarding causes of death were recorded as errors. These errors were analyzed

¹⁶Ibid., p. 345.

¹⁷Ibid.

in terms of percentages, magnitude, and the effect the errors had on the total distribution of the causes of death. Three classifications were formulated for the grouping of errors.

1. Major Error--Questionnaire response was not pathologically related to the death certificate cause of death.
2. Minor Error--Questionnaire response was pathologically related to the death certificate cause, but would not be classified in the same specific category.
3. Insufficient Information--Questionnaire response did not give enough information for a separate classification of the cause of death.

Tables and figures were made to show the distribution of the causes of death before and after correction of errors.¹⁸ Two separate categories of causes of death were formed; semi-coarse and coarse. The purpose of a semi-course and a coarse category of the data was to illustrate the effect the errors made when the causes of death are grouped this way. These two categories are the most common used in reporting mortality data.^{19,20}

¹⁸Tables and figures are presented in Chapter 4.

¹⁹Rook, op. cit., p. 777.

²⁰L. I. Dublin, A. Lofka, M. Spiegelman, Length of Life (New York: Ronald Press, 1949), p. 83.

When the errors encountered in the questionnaire data were corrected on the original tabulation sheets, certain irregularities were found in the initial interpretations of the causes of death as reported on the questionnaires. The number and kind of erroneous interpretations were recorded. These coding errors were corrected in the original data. A table was made to compare the data before and after correction of the errors. Another table was made which compared the data before the correction of coding errors, after the correction of coding errors, with the causes of death coarsely grouped.

CHAPTER IV

RESULTS

Validation of the Dates of Death

The questionnaire dates of birth were compared with the death certificate dates of birth and a total of ten discrepancies noted. The average error for the ten discrepancies was 1.4 years. The average error for the 104 investigated cases was .35 years. The magnitude of the discrepancies ranged from three years to one year.

The mean date of birth for the questionnaire data was 1884.38, and for the death certificate data 1884.23. The difference in the two means was .15 years. The standard deviation for the questionnaire dates of birth was 2.78 years and for the death certificate data 2.79 years. The investigated years of birth ranges from 1856 to 1912. The critical ratio was computed for the difference in the means [C.R.=.75], and the difference was not significant at the five per cent level.

The correlation coefficient obtained for the two sets of data was 0.99. That the questionnaire responses investigated, in regard to date of birth, were valid is evident by the very high correlation between the questionnaire dates of birth and the death certificate dates of birth.

Validity of Ages of Death

In regard to ages of death, twenty-two discrepancies were found when the questionnaires' ages of death was compared to the death certificate ages at death. The average error for the twenty-two discrepancies was 1.5 years, and the average error for the 104 cases was .32 years. The errors range from three to five years. The ages at death ranged from eighty-six to twenty-eight years.

The mean age of death on the questionnaires was 60.16 and on the death certificates 60.26. The standard deviation for the questionnaire data was 13.95 years and for the death certificate data 13.90 years. When the critical ratio of this difference [.10] was computed [C.R.=.125], it was found that the difference in the two means was not significant at the five per cent level.

The correlation coefficient of the death certificate ages of death and the questionnaires ages of death was 0.98. A correlation of this magnitude indicates that the questionnaire response pertaining to ages of death to be valid.

Validity of the Causes of Death

Of the 104 causes of death investigated eighty-five, or 81.7 per cent of the questionnaires listed the same cause of death as the death certificates. Nineteen or 18.3 per cent of the questionnaires did not agree with the death certificates in regard to cause of death. Of the questionnaire

responses that did not agree, two were classified as major errors, thirteen as minor errors, and four as insufficient information. The major errors constituted 10.5 per cent, the minor 68.0 per cent, and insufficient information 21.5 per cent of the total errors. The percentages of errors for the 104 cases were: [1] major errors 1.9 per cent; [2] minor errors 12.5 per cent, and [3] insufficient information 3.8 per cent.

Table I illustrates the distribution of the causes of death before the investigation and after the investigation when all the errors had been corrected. The distribution on Table I indicates that most of the errors were concerned with deaths due to heart disease. The difference in the number of deaths due to senility and unknown causes [five before and two after the investigation] was brought about by specific causes of death obtained from the death certificates.

Figures 1 and 2 illustrate the effect the errors have on the total distribution when the cause of death are coarsely grouped. It will be noted that many of the errors cancel each other out. For instance, the questionnaire response may have stated the cause of death as cerebral hemmorage and the death certificate as coronary thrombosis. This procedure may have been reversed on another questionnaire and death certificate and thus the two errors are not noted on Tables I, II, or III, or Figures 1 and 2.

TABLE I

A COMPARISON OF CAUSES OF DEATH AS REPORTED ON
THE QUESTIONNAIRES AND AS RECORDED
ON THE DEATH CERTIFICATES

Causes of Death	Number of Cases	
	Questionnaire Data	Death Certificate Data
Tuberculosis of respiratory system	1	1
All diseases classified as infective and parasitic	1	1
Malignant neoplasms, including neoplasms of lymphatic and hæmatopoietic tissues	19	19
Diabetes mellitus	2	2
Vascular lesions affecting central nervous system	11	12
Chronic rheumatic heart disease	0	2
Arteriosclerotic and degenerative heart disease	26	32
Other diseases of heart	16	8
Pneumonia	2	3
Intestinal obstruction and hernia	0	1
Gastritis, duodenitis, enteritis and colitis, except diarrhoea of the newborn	1	1
Cirrhosis of liver	0	1
Senility, ill-defined and unknown causes	5	2
All other diseases	5	5
Motor vehicle accidents	4	6
All other accidents	9	7
Suicide and self-inflicted injury	2	2
TOTAL	104	104

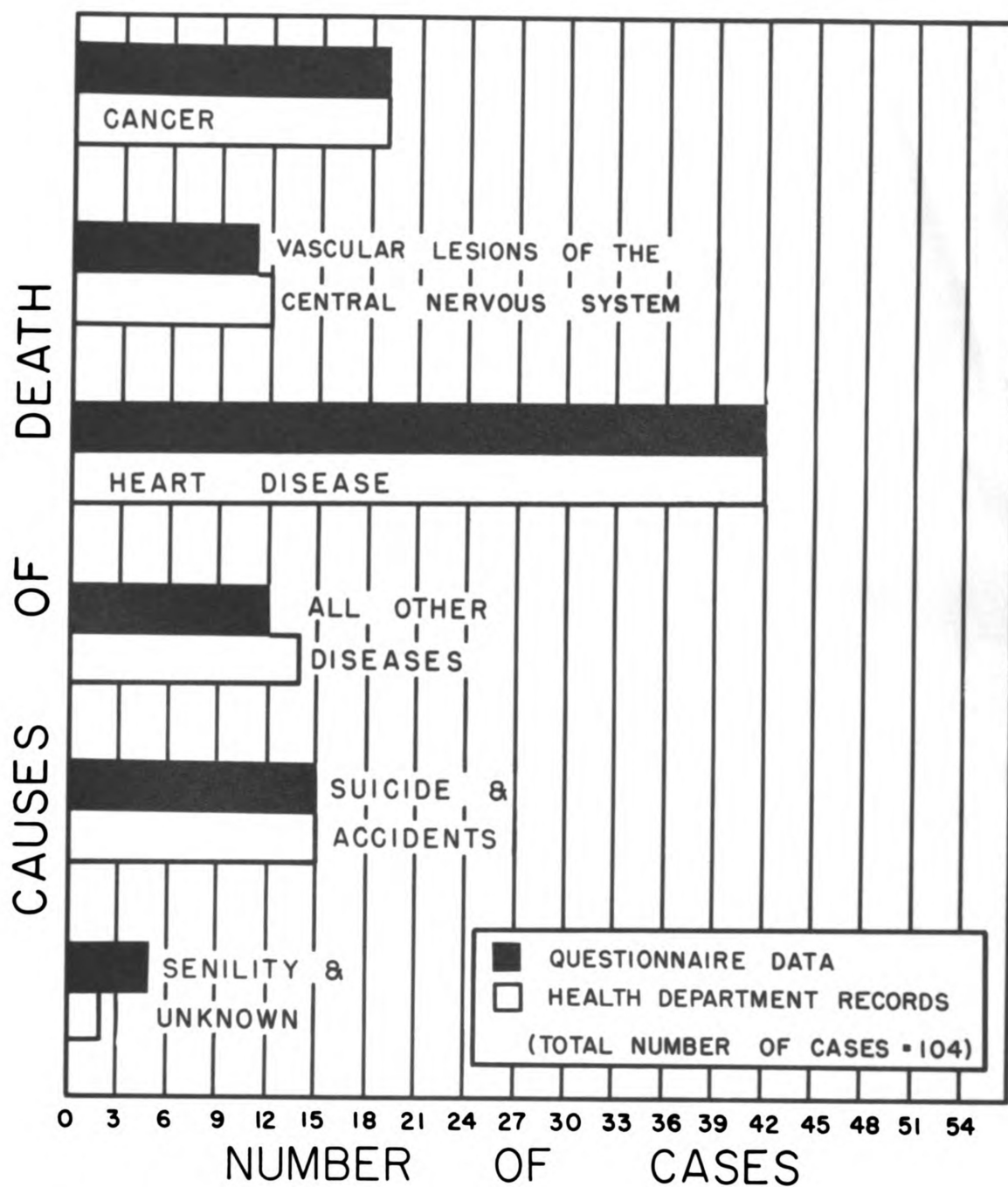


Fig. 2. A Comparison of Causes of Death as Reported on the Questionnaires and as Recorded on the Death Certificates in Coarse Categories.

TABLE II
COMPARISON OF ALL CAUSES OF DEATH BEFORE AND
AFTER CORRECTION OF CODING ERRORS

Causes of Death	Number of Cases	
	Correction of Errors	
	Before	After
Tuberculosis of respiratory system	1	1
Meningococcal infections	3	0
All diseases classified as infective and parasitic	3	1
Malignant neoplasms, including neoplasms of lymphatic and hæmatopoietic tissues	16	19
Diabetes mellitus	3	2
Visceral lesions affecting central nervous system	5	11
Chronic rheumatic heart disease	6	1
Arteriosclerotic and degenerative heart disease	21	29
Other diseases of heart	22	16
Hypertension without mention of heart	1	0
Pneumonia	3	4
Appendicitis	1	1
Intestinal obstruction and hernia	1	0
Gastritis, duodenitis, enteritis and colitis, except diarrhoea of the newborn	0	1
Cirrhosis of liver	0	0
Nephritis and nephrosis	1	1
Hyperplasia of prostate	1	0
Senility, ill-defined and unknown causes	8	7
All other diseases	8	8
Motor vehicle accidents	5	5
All other accidents	9	11
Suicide and self-inflicted injury	2	2
Homicide and operations of war	3	3
TOTAL	123	123

TABLE III
EFFECT OF CODING ERRORS WHEN CAUSES OF
DEATH ARE COARSELY GROUPED

Causes of Death	Number of Cases	
	Correction of Errors	
	Before	After
Cancer	16	19
Vascular lesions of the central nervous system	5	11
Heart disease	43	46
All other diseases	32	19
Suicide and accidents, homicide and war	19	21
Senility and unknown causes	8	7
TOTAL	123	123

Coding Errors

Thirty-two cases, or twenty-six per cent, of the 123 reported causes of death were found to have been incorrectly interpreted by the investigators in the original Michigan State University Study.²¹ These coding errors were not judged as to their magnitude. Tables II and III show the

²¹Michigan State University Study, op. cit.

distribution of the causes of death before and after corrections had been made. Table II illustrates the effect the coding errors had on the causes of death when they are listed in specific categories. It can be seen that most of the difficulty in coding the causes of death were encountered in the categories of cancer, vascular lesions of the central nervous system, the three categories of heart diseases, and meningococcal infections. When the data are coarsely grouped it is evident that the coding errors distort the data much more than the errors of the questionnaire responses. A comparison of Tables II and III will illustrate this point.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the validity of selected factual questionnaire data from the Michigan State University Study of Longevity and Morbidity of Former College Athletes. Also, as a subordinate purpose, the interpretation and coding of the questionnaire causes of death by the investigators in the Michigan State University Study was studied.

Death certificates were used as the criteria to determine the validity of the questionnaire data. The death certificates were located for 104 of the 123 reported deaths in the Michigan State University Study. The questionnaire data pertaining to date of birth, age of death, and cause of death was compared to the corresponding data on the death certificates; discrepancies were then noted.

After the data were obtained, they were analyzed by conventional statistical techniques.

Conclusions

On the basis of the evidence presented in this study, the following conclusions are set forth:

1. The dates of birth as reported on 104 investigated questionnaires appear to be valid data. [Correlation coefficient = 0.99, critical ratio = 0.75.]
2. The ages of death as reported on 104 investigated questionnaires appear to be valid data. [Correlation coefficient = 0.98, critical ratio = 0.13.]
3. The causes of death as reported on the 104 investigated questionnaires appear to be valid when classified in general categories.
4. The coding errors which were found in the Michigan State University Study of Longevity and Morbidity of College Athletes contributed to an erroneous distribution of the true causes of death.
5. The interpreting and coding of the questionnaires causes of death distorted the data much more than the errors inherent in the questionnaire responses.

Recommendations

The following recommendations are made for future questionnaire studies concerned with the longevity and morbidity of athletes:

1. The questionnaire should include a modified list of causes of death with explanatory statements to clarify the different pathological conditions.
2. Places for information such as date of death, place of death, armed service number and armed

service unit, race, occupation or kind of business, avocation or hobbies, should be included on the questionnaire.

3. The questionnaire data should be investigated for validity.
4. The interpretations of the causes of death and any other data that involves interpretation should be done by one trained person to expedite standardization of coding techniques.

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APPENDIXES

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	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 _____	

(OVER)

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, irregu-
larity, heart failure, etc). _____

3. Hypertension (Mention complications such as strokes, coro-
nary 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, harm-
ful, 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 dur-
ing 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 _____"

APPENDIX B

TABULATION SHEET

DATE OF TABULATION 1955

TOPIC Validity of Questionnaire Data

TABULATED BY Earl Mahoney

Case Number	Year of Birth Questionnaire	Year of Birth Death Certificate	Age of Death Questionnaire	Age of Death Death Certificate	Cause of Death Questionnaire	Cause of Death Death Certificate	Case Number	Year of Birth Questionnaire	Year of Birth Death Certificate	Age of Death Questionnaire	Age of Death Death Certificate	Cause of Death Questionnaire	Cause of Death Death Certificate
2	1877		73		22		621	1901		50		26	
7	1897		51		26		528	1989		64		18	
11	1878		72		18		638	1901		31		27	
10	1880	1877	54	56	18		651	1969		83		27	
11	1871		81	80	46		655	1885		47		26	
14	1906	1907	45		26		659	1989		62		22	
16	1906		42		18		682	1982		69		22	
64	1906		43		25		689	1900		49		26	
68	1898		47	48	26	25	692	1870		75		45	
72	1868	1867	71		26		702	1887		67	63	22	
82	1866		85		26		1006	1882		69		48	47
110	1883		52		26		1014	1872		80		27	
126	1884		69		18		1019	1892	1890	60	61	46	
149	1875	1874	68	66	27	26	1025	1891		68		22	
152	1878		67	68	20	26	1032	1891		71		26	45
156	1878		72		27		1058	1864		96		26	
193	1865		75	75	25	22	1060	1874		75		18	
196	1893		39	40	47		1065	1876		59		18	
201	1898		54		26		1067	1875		72		48	
210	1880		70		48		1077	1900		51		47	
512	1894		59		18		1081	1902		29		48	
516	1885		30		18		1084	1874		70		26	
522	1881		68		26		1091	1869		76	77	22	
525	1882		70		27	26	1560	1909		28		47	
510	1886		65		27	31	1570	1895	1896	65	64	27	26
515	1880		62		27	26	1579	1890		68		18	
553	1883		67		17		1580	1905		46		26	
554	1898		54		26		1610	1964		78	77	00	27
570	1883		63	62	22		1615	1879		72		27	26
571	1866		81	82	48		1619	1887	1888	63		48	
590	1878		50		18		1639	1873		69		26	
598	1878		62		26		1640	1881		30	29	42	
602	1883		61		31		1655	1871		81		22	
603	1892		37		27		1669	1909		39	37	48	
609	1900		40		16		1678	1868		69		27	26
							Total	10-Date of Birth	10-Date of Birth	22-Age of Death	22-Age of Death	19-Cause of Death	19-Cause of Death
							3280	1887	1888	66	64	64	31
							3285	1871	1871	56	55	26	37
							3251	1888		59		01	
							3247	1871		66		46	
							3232	1866		68		26	
							3213	1997		56	55	19	
							3212	1856		94		18	
							3211	1907		56		47	
							3106	1868		80		22	
							3110	1861		64		27	26
							3095	1912		42	43	27	
							3091	1874	1873	74	75	27	
							3087	1894		70		20	20
							3081	1857		60		00	35
							3074	1897		61		45	
							3067	1906		45		18	
							3059	1883		52		18	
							3046	1858		76		46	
							3037	1862		74		22	
							3027	1874		73		18	
							3006	1890		53		48	
							3005	1886		64		27	26
							3004	1901		59		46	
							2531	1909		43		18	
							2523	1905		44		26	25
							2090	1905	1903	50	45	00	26
							2088	1908		42		48	
							2008	1918		34		18	
							1710	1879		67		26	
							1693	1883		45		26	
							1689	1875		69		22	

APPENDIX C*

(1) _____ (2) _____ (3) _____
 Name _____ Grad. Date _____ Serial No. _____
 (4) Age _____ (5) Date of Death _____ (6) Date of Birth _____
 State _____
 (7) Martial Status _____ (8) Race _____
 (9) Occupation _____
 (10) Kind of Business or Industry _____
 (11) Dates of Armed Service _____
 (12) Type of Death: Natural _____ Violent _____ Other _____
 (13) Cause of Death - Internal Classification Index
 1-T.B.Resp. _____ 10-Meningococcal Infect. _____
 2-T.B.Other _____ 11-Plague _____
 3-Syphilis _____ 12-Acute Poliomyelitis _____
 4-Typhoid _____ 13-Smallpox _____
 5-Cholera _____ 14-Measles _____
 6-Dysentary _____ 15-Typhus _____
 7-Scarlet F.&Strep.Tht. _____ 16-Malaria _____
 8-Diphtheria _____ 17-Other Parst. & Infect.D. _____
 9-Whooping Cough _____ 18-Cancer _____

[reverse side]

(13) Cause of Death (con't)

19-Other Neoplasm _____	33-Ulcer Stom.& D'od'm _____
20-Diabetes Mellitus _____	34-Appendicitis _____
21-Anemia _____	35-Intest.Obst.& Hernia _____
22-Vasc.Les.Cent.Nerv. _____	36-Gastritis,Deudenitis,Enteritis & Colitis _____
23-Non-Cocc.Meningitis _____	37-Cirrhosis Liver _____
24-Rheumatic F. _____	38-Nephritis & Nephresis _____
25-Chronic Rhum.Heart D. _____	39-Hyperplasia Prostrate _____
26-Art.Scler, & Degen.H.D. _____	45-Senility & Unknown Cause _____
27-Other H.D. _____	46-All Other Diseases _____
28-Hyperten. With H.D. _____	47-Motor Vehicle Accid. _____
29-Hyperten. With No.H.D. _____	48-All other Accidents _____
30-Influenza _____	49-Suicide & Self-inflic. _____
31-Pneumonia _____	50-Homicide & War _____
32-Bronchitis _____	

(14) Duration: Immediate _____ Other _____

(15) If letter-winner, what sports? _____

*Copy of 4 x 6 information card, front and reverse.

APPENDIX D

ABBREVIATED LIST OF 50 CAUSES
FOR TABULATION OF MORTALITY*

1. Tuberculosis of respiratory system
2. Tuberculosis, other forms
3. Syphilis and its sequelæ
4. Typhoid fever
5. Cholera
6. Dysentery, all forms
7. Scarlet fever and streptococcal sore throat
8. Diphtheria
9. Whooping cough
10. Meningococcal infections
11. Plague
12. Acute poliomyelitis
13. Smallpox
14. Measles
15. Typhus and other rickettsial diseases
16. Malaria
17. All other diseases classified as infective and parasitic
18. Malignant neoplasms, including neoplasms of lymphatic and hæmatopoietic tissues
19. Benign and unspecified neoplasms
20. Diabetes mellitus
21. Anæmias
22. Vascular lesions affecting central nervous system
23. Nonmeningococcal meningitis
24. Rheumatic fever
25. Chronic rheumatic heart disease
26. Arteriosclerotic and degenerative heart disease
27. Other diseases of heart
28. Hypertension with heart disease
29. Hypertension without mention of heart
30. Influenza
31. Penumonia
32. Bronchitis
33. Ulcer of stomach and duodenum
34. Appendicitis
35. Intestinal obstruction and hernia
36. Gastritis, duodenitis, enteritis and colitis, except diarrhoea of the newborn

*Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (Six Revision; Geneva, Switzerland: World Health Organization, 1949) Vol. 1, p. 261-62.

APPENDIX D--Continued

37. Cirrhosis of liver
38. Nephritis and nephrosis
39. Hyperplasia of prostate
40. Complications of pregnancy, childbirth and the puerperium
41. Congenital malformations
42. Birth injuries, postnatal asphyxia and atelectasis
43. Infections of the newborn
44. Other diseases peculiar to early infancy, and immaturity unqualified
45. Senility without mention of psychosis, ill-defined and unknown causes
46. All other diseases
47. Motor vehicle accidents
48. All other accidents
49. Suicide and self-inflicted injury
50. Homicide and operations of war

APPENDIX E

Dear

In reference to your reply to our questionnaire form, which you kindly filled out for us, there are a few more items of information we need to complete this national longevity study.

Would you please fill in the following information concerning the death of

Date of death _____

Place of death _____
city county state

Occupation or business _____

If in Armed Services, branch _____ Service Number _____

We wish to express in advance our thanks to you for this information.

Sincerely yours,

Earl L. Mahoney

ELM:cs

APPENDIX F

Director, Bureau of Records and Statistics,
State Department of Public Health
631 J Street
Scaramento 14, California

Dear Sir:

Michigan State University along with a number of other colleges and universities throughout the country has undertaken a research project of extremely great importance to present and future generations. It is a national study of longevity and morbidity of former athletes, as compared with a random sample of students were not active in college sports.

The potential value of such a study for our national health must be evident to all. Literally thousands of boys and girls, youth and adults, participate annually in a variety of vigorous competitive sports. This participation is a result of both a strong national urge and the ever increasing encouragement which is being applied by the schools, colleges, clubs, and other organizations throughout the land.

Would your State Public Health Department be willing to cooperate to the extent of providing us with information on the following deceased persons.

<u>Name of Deceased</u>	<u>Date of Death</u>	<u>Last Known Address</u>
-------------------------	----------------------	---------------------------

An information card has been sent along. On these cards we have checked off the following items which we hope you will be able to complete from your records: marital status, date of death, race, occupation, armed service record, type of death, cause of death, and duration of illness, if any. If it would be more convenient, a non-certified copy of the death record would be acceptable.

We wish to express in advance our thanks for your participation in this study. We are certain when the results are published it will be satisfying to know that your department shared in this project.

Sincerely yours,

Henry J. Montoye
Associate Professor

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