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Survey of the health knowledge level of selected freshman and sophomore students at Montana State University

Glenn Alvin Kozeluh

The University of Montana

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A SURVEY OF THE HEALTH KNOWLEDGE LEVEL OF SELECTED
FRESHMAN AND SOPHOMORE STUDENTS AT
MONTANA STATE UNIVERSITY

by

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B. A. Eastern Montana College of Education, 1952

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requirements for the degree of

Master of Arts

MONTANA STATE UNIVERSITY

1957

Approved by:

[Signatures]

Chairman, Board of Examiners

Dean, Graduate School

AUG 19 1957

Date
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. THE PROBLEM</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>2</td>
</tr>
<tr>
<td>Analysis of the Problem</td>
<td>2</td>
</tr>
<tr>
<td>Basic Assumptions</td>
<td>3</td>
</tr>
<tr>
<td>Definitions</td>
<td>4</td>
</tr>
<tr>
<td>Health knowledge</td>
<td>4</td>
</tr>
<tr>
<td>Sub-divisions of health knowledge</td>
<td>5</td>
</tr>
<tr>
<td>Level of health knowledge</td>
<td>5</td>
</tr>
<tr>
<td>Selected male students</td>
<td>5</td>
</tr>
<tr>
<td>Formal health experience</td>
<td>5</td>
</tr>
<tr>
<td>Montana school districts</td>
<td>5</td>
</tr>
<tr>
<td>Bi-serial correlation</td>
<td>5</td>
</tr>
<tr>
<td>Limitations of the Study</td>
<td>5</td>
</tr>
<tr>
<td>Need for this study</td>
<td>7</td>
</tr>
<tr>
<td>II. REVIEW OF PREVIOUS RESEARCH</td>
<td>9</td>
</tr>
<tr>
<td>III. PROCEDURE</td>
<td>14</td>
</tr>
<tr>
<td>Development of Test</td>
<td>14</td>
</tr>
<tr>
<td>Development of Testing Procedure</td>
<td>20</td>
</tr>
<tr>
<td>IV. ANALYSIS OF DATA</td>
<td>22</td>
</tr>
<tr>
<td>Mathematical Analysis</td>
<td>22</td>
</tr>
<tr>
<td>Statistical Analysis</td>
<td>25</td>
</tr>
<tr>
<td>CHAPTER</td>
<td>PAGE</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS</td>
<td>33</td>
</tr>
<tr>
<td>Summary</td>
<td>33</td>
</tr>
<tr>
<td>Conclusions</td>
<td>34</td>
</tr>
<tr>
<td>Recommendations</td>
<td>36</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>38</td>
</tr>
<tr>
<td>APPENDIXES</td>
<td>41</td>
</tr>
<tr>
<td>TABLE</td>
<td>PAGE</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>I. Statistical Data Used for the Bi-Serial Correlation Between Testees Checking Yes or No to the Inquiry &quot;Did You Have Any Health Courses in High School?&quot;</td>
<td>29</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE PAGE

1. Percentage of Correct Responses for Various Test Items 23
2. Percentage of Correct Responses for Various Test Items 24
3. Percentage of Questions Used in Each Sub-division of the Test 26
4. Percentage of Questions Correct in Each Sub-division of the Test 27
5. Comparison of the Mean Scores of Montana High School Graduates with Out-of-State High School Graduates and Total Test Scores 31
CHAPTER I

THE PROBLEM

Introduction

The principal aim of school health instruction is to secure favorable behavior in all situations involving an individual's health. Broadly put, the aim of health instruction is to teach people to live well, scientifically, economically, and happily.¹

Health knowledge is the framework upon which are built attitudes and behavior. It is the grist out of which judgments and decisions are made. Knowledge forms the basis for action, and, if the principal aim of health instruction is healthful behavior, knowledge must be acquired and given freely and plentifullly by health educators as part of the experimental base from which a course of action is chosen.²

Since health knowledge is, therefore, a vital part of one's health education, and is a conducive part of a general education, a university is obligated to provide ways and means for students to acquire any needed health information.

It then becomes necessary to determine the general health knowledge level of students at Montana State University. The study

²Ibid., p. 49.
proceeded by administering a general health knowledge test to a sample group of students during the fall quarter of 1956.

**Purpose of the Study**

The purpose of this study is to determine the general health knowledge level of a selected group of male students at Montana State University and determine the extent of influence selected factors will have on test scores.

**Analysis of the Problem**

An extensive survey of the literature was undertaken to determine whether existing standardized tests would adequately measure health knowledge. Recent publications in the health education area were analyzed to determine the main sub-divisions of health knowledge. These sub-divisions were then compared with the author's evaluation of other standardized health knowledge tests. It was found that existing tests are not completely comprehensive in all sub-divisions of health knowledge. To assure a more complete evaluation of health knowledge, it was necessary to devise a new test. This was accomplished by revising, combining, and adding to existing standardized health knowledge tests.

Other problems related to this study lay in the determination of the extent to which selected factors affect the general health knowledge of this freshmen and sophomore group.

One of these factors was whether these students had completed any previous formal health experience in high school. This information was obtained from the cover sheet of the test.
Other factors considered were the size and location of high schools from which students had been graduated. Space was provided on the answer sheet for the students to write down the name of the high school from which they graduated. Careful inspection of this information revealed that, for purposes of comparison in this study, the students should be divided into four groups, three from Montana and one out-of-state. Montana high schools were distributed into three groups as classed by the Montana Educational Directory.\(^3\)

All out-of-state students were put in one evaluation division regardless of the size of high school from which they graduated.

**Basic Assumptions**

This study will proceed on the supposition that the 436 students tested are an adequate sample of the male freshmen and sophomore students at Montana State University during the fall quarter of 1956. This group represents 44.7 per cent of the total number of freshmen and sophomore male students enrolled during this fall term.

The reliability of the mean or standard deviation depends upon the size of the sample from which the standard error is based. Standard errors vary inversely as the square root of sample size, so if the number increases, the standard error decreases. The larger the number, the larger the standard deviation of the

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sample and the more inclusive the sample becomes of the general popu-
lation. The range covered by a sample between 200 and 1,000, when all are drawn from a normal population, is plus or minus three stan-
dard deviations. In a normal population of 10,000 students, this would include 99.75 per cent of all cases.\(^4\)

It will be assumed that health knowledge can be measured. Many tests have been standardized, and as one authority says, "It is relatively easy to measure the pupils' health knowledge."\(^5\)

It will be assumed that existing health knowledge tests have faults which make them unsatisfactory for measuring the health knowledge of freshmen and sophomore college students. A survey of several standardized health knowledge tests showed a general weak-
ness in questions pertaining to health hazards. Other faults discovered were poorly worded statements and technicality of terms used.

This study will proceed on the supposition that a test can be constructed to adequately measure health knowledge.

**Definitions**

**Health knowledge.** Knowledge of such facts and procedures as will make intelligent health practices possible.


Sub-divisions of health knowledge. The following five headings were selected as major sub-divisions of health knowledge: (a) personality factors; (b) diet and nutrition; (c) general operation of body; (d) health hazards—prevention and care; and (e) reproduction and heredity.

Level of health knowledge. The percentage of items correct on the health knowledge test.

Selected male students. Those male students who were enrolled in regular physical education classes during fall quarter, 1956.

Formal health experience. That type of health education which is obtained by participation in an organized high school health class.

Montana school districts. A classification of Montana schools which separates them into the following three districts: (1) a first class district is one which has a general population of eight thousand or more; (2) a second class district is one that has a population of one thousand or more and less than eight thousand; and (3) a third class district is one with a population of less than one thousand.

Bi-serial correlation. A correlation between traits or attributes, when members of a group can be given scores in one variable, but can only be classified into two categories in the second variable.

Limitations of the Study

This study is limited to the male freshmen and sophomore students participating in physical education classes during the fall quarter of 1956.
Eight standardized tests are used as guides in constructing a health knowledge test. They are as follows: Health Education Pre-Test\(^6\); Trusler-Arnett\(^7\); Brewer-Schrammel\(^8\); Health Inventory for High School Students\(^9\); Kilander\(^10\); Michigan Health Knowledge Test\(^11\); Acorn National Achievement Tests\(^12\); Dearborn's Health Knowledge Test\(^13\).

The test covers five sub-divisions, based on review of existing tests, and has approximately the same number of questions in each division.

Factors that may influence the knowledge level will be limited to previous formal health experience, and size and location of high schools from which the students were graduated.

\(^6\)Health Education Pre-Test for College Freshmen (Author and publishing company unavailable).

\(^7\)V. T. Trusler, C. E. Arnett, and H. E. Schrammel, Trusler-Arnett Health Knowledge Test (Emporia, Kansas: Bureau of Educational Measurements, 1940).

\(^8\)H. E. Schrammel and John W. Brewer, Brewer-Schrammel Health Knowledge and Attitude Test (Emporia, Kansas: Bureau of Educational Measurements, 1935).

\(^9\)Gerwin Neher, Health Inventory for High School Students (Los Angeles: California Test Bureau, 1942).


\(^11\)Michigan Health Knowledge Test for Adults--1938 (Author and publishing company unavailable).


Need for This Study

There have been no scientific studies to determine the level of general health knowledge of male students entering Montana State University.

Diehl and Shepard, in their report for the American Council on Education, make the following observations:

Every college student should learn to correct erroneous thinking and develop rational and intellectual discrimination. In no area is need for this more evident than health teaching, since the most important single health problem of college students revolves around health ignorance.\(^{14}\)

Since health knowledge tests aid in determining the status of students, it is hoped that the final tabulation of results from this study will indicate whether there is a need for more formal health training in high school or for a required health course for students entering Montana State University.

W. W. Patty, in a report on evaluating health education outcomes, states that it is desirable for the school to make every effort possible to insure that each student possess the essential knowledge concerning health.\(^{15}\)

The results of the study can be of value to students, supervisors, teachers, and administrators, since tests measuring the knowledge of health facts and principles have many important uses.

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\(^{15}\)Willard W. Patty, "Evaluating Health Education Outcomes". (Publisher and date of publication unavailable), pp. 4-5.

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Among these are the following: (1) a health education test may be given at the beginning of a course to convince students of their need for the course; (2) a test may be given at the organizational meeting of a course to help the teacher select units of knowledge to be stressed, or to be excluded; (3) the teacher may use preliminary and final test differences to measure his own teaching efficiency; (4) the teacher may use tests to diagnose individual needs of pupils and to do remedial teaching; (5) test results may serve as a partial basis for pupils' marks; (6) supervisors and administrators may use such tests as aids in comparing efficiency of various teachers of health education; and (7) the school staff may be interested in comparing local pupil test results with national norms, providing such are available.¹⁶

This study, which is an attempt to determine the health knowledge level of a group of students, is the first of its kind at Montana State University. Because of the ever-increasing importance of students' needs for health information in this rapidly changing world of today, future studies must be made.

¹⁶Ibid.
CHAPTER II

REVIEW OF PREVIOUS RESEARCH

To determine methods of evaluating health knowledge, it was necessary to glean the literature to find ways and means of establishing the status of health knowledge.

In 1935, Roland Rooks made a study of the college freshmen's knowledge of personal hygiene. He stated that at least two fundamental questions confront those interested in the teaching of personal hygiene to college freshmen. First, is the knowledge received in the health education area from the secondary school sufficient to meet present day needs, or should this knowledge be supplemented by college courses? Second, at what level and in what area should one begin in the teaching of health education?¹

The above questions are still important issues today and good reasons for attempting to evaluate the health knowledge level of Montana State University students.

Mr. Rooks made the following comments in his summary: (1) there is a serious lack in knowledge of simple structure and normal functioning of the human body; and (2) there is a serious lack in knowledge of hygienic facts and principles.²

²Ibid., p. 65.
In conclusion, Mr. Rooks states that until high schools adequately meet health education objectives, college freshmen should be required to take a health education course.³

A comparison between Mr. Rooks' findings and the investigator's own study is made in the last chapter.

Willard W. Patty's study on the reading difficulty differences of health knowledge tests has attempted to analyze measuring devices in the field of health education. Mr. Patty asks this question, "Should we improve our health education tests?" He states the answer must be affirmative unless we take the position that the tests now in use are faultless. Obviously, the first steps toward improvement would be concerned with the discovery of weaknesses in construction of the tests in which we are interested.⁴

Mr. Patty went on to conclude there was a reading-vocabulary difficulty difference in commonly used health education tests. He concludes that words used in presenting questions in health education tests should be chosen from the vocabulary common to pupils of that degree of general educational advancement.⁵

This opinion is supported by the fact that one of the criticisms made by the major group of students who took the writer's

³Ibid., p. 66.


⁵Ibid., p. 215.
constructed test was the technicality of some of the test items. Particularly, physiological and anatomical terms relating to general operation of the body were said to be too technical. These test items had been previously chosen from eight standardized health knowledge tests.

In 1952, James Humphrey made a study of health problems interesting to college men. A group enrolled in a personal and community hygiene course were asked to write out some of the problems which they felt would be of most interest to them for discussion in this course. The results from the above inquiry were combined to determine health issues of most importance. The ten problems listed most frequently were as follows: nutrition and foods; communicable diseases; exercise, sleep and rest; sex education; narcotics and stimulants; mental hygiene; home hygiene; responsibility in community hygiene; cancer; and heart disease.  

These ten sub-divisions were evaluated in the test constructed to measure the health knowledge of Montana State University students.

In 1953, Marie A. Hindrichs made an analytical study of the results of a hygiene proficiency test given to freshmen students entering college. A multiple-choice type test item was used with an adequate sampling of questions in the following

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six sub-divisions: public health and consumer health; general bodily hygiene; mental health; nutrition and diet; reproduction, sex and heredity; and personal health problems.  

The investigator used multiple-choice type test items and noticed a close relationship between the test sub-divisions employed in Marie Hindrichs' study and those used in his own study.

Another study taken into consideration to further establish the status of health knowledge was one in which W. A. Mason tried to ascertain the health education knowledge level of one hundred senior high school students.  

The instrument used was the Acorn Health Education Test which consists mostly of multiple-choice type questions.  

The Acorn test was one of the eight standardized tests used as a guide and the multiple-choice type test item was used exclusively in constructing the author's test.

Mr. Mason concluded that, in high school health instruction, more emphasis should be placed on safety and first aid; health in the home, school and community; and nutrition.


9 Ibid., p. 59.

10 Ibid., p. 63.
The four above-mentioned weaknesses have been evaluated in the investigator's study and further comparison will be made in the last chapter.

A survey of the literature thus indicates the need for more research in the health education area. Needed improvements in evaluating health knowledge were stressed and presents a basis for constructing one's own test.
CHAPTER III

PROCEDURE

This chapter has been divided into two separate parts.
The first part is designed to give the reader a detailed explanation of how and why a new health knowledge test was developed.
The second part explains the procedure used in applying the test to a sample group of students.

Development of Test

Before selecting a test of health knowledge for this study, it was necessary to review nationally accepted high school health texts to determine the scope of course content. By comparing tests and course content it was possible to determine the extent to which tests evaluated material included in the course.

To evaluate the possible areas of strength or weakness it was necessary to sub-divide the general health area into a number of meaningful and workable health sub-divisions. The sub-divisions of health knowledge were listed from three publications, namely:

Modern Health by Otto, Julian, and Tether\(^1\); Life and Health by Wilson, Bracken, and Almack\(^2\); and Health Instruction in Oregon


Secondary Schools by the Oregon State Department of Education. It was found that health knowledge was most frequently divided into the following areas: personality; physiology of exercise and body mechanics; prevention and control of diseases; hygiene of special organs; first aid and safety; social and biological background; hygiene of environment; medical care and advice; excretion and body cleanliness; nutrition; and mental health.

Further examination revealed that for simplicity and clarity in this study, the above eleven divisions could be combined into five major divisions as follows: mental health, bodily cleanliness, and personality as personality factors; nutrition as diet and nutrition; excretion, physiology of exercise and body mechanics, and hygiene of special organs as general operation of body; prevention and control of disease, medical care and advice, first aid and safety, and hygiene of environment as health hazards—prevention and care; and social and biological background as reproduction and heredity.

This separation of health knowledge into five subdivisions gave the investigator workable criteria to analyze critically the comprehensiveness of existing health knowledge tests.

Other criteria, administrative and statistical, were established to evaluate the tests.

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Administrative criteria considered were: students' time available for taking test; author's time available to complete study; author's expense; ease of administering; and ease of correcting.

Because the constructed test was not standardized, statistical criteria were limited. However, curricular validity was employed in development of the test. Curricular validity, as used in this study, depends upon three major factors: (1) that the material covered is representative of what the student should know; (2) that the proper emphasis is assigned to the comprehensive evaluation of each sub-division of the test; and (3) that the items in the test are carefully constructed.4

Eight standardized health knowledge tests, as listed in chapter one, were selected for this critical analysis. Each of these standardized tests was carefully examined. During this examination, the author kept in mind that number of questions does not necessarily mean coverage of material.

The investigation of tests indicated that existing tests do not adequately evaluate all the major sub-divisions of health knowledge. Particular weaknesses were found in the health hazard—prevention and care division of health knowledge.

To assure a more complete evaluation of all major sub-divisions of health knowledge and to meet previously mentioned

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administrative and statistical criteria, it was necessary to revise, combine, and add to existing tests of health knowledge.

Criteria used for test construction were the following principles as presented by Conrad and Meister:

(a) The practice of positive health should be emphasized rather than negative.

(b) Knowledge related to local needs of an environmental, racial, or social nature should be included.

(c) Knowledge of functional significance rather than knowledge of terms should be stressed.

(d) All elements in the wording of the questions that reduce objectivity should be carefully eliminated.

(e) Harmful misinformation contained in the distracting or "not true" elements should be guarded against.

(f) Tests should be more than a collection of questions. The questions should show some vestige of connection which integrates the whole test.

The writer decided to use the multiple-choice test items exclusively after reviewing the text by Remmers and Gage, in which the following statement was made:

The charge is often leveled at short-answer tests that the restricted number of alternatives which they present enables the student to achieve a higher score than is warranted by his true achievement. That is, in a test of 100 items each presenting two choices, pupils could on the average make fifty correct responses by following the advice of the tossed coin. For multiple choice test items the guessing is

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obviously negligible. Various statistical formulae have been offered to correct this chance factor. However, the problem of guessing cannot be entirely eliminated by such mechanically applied statistical corrections, since they are based on either theorems of probability or on statistical studies of average effects, both of which sources of reasoning cannot determine and correct for the individual pupil’s spurious achievement.6

Using the preceding background material as a guide, the writer proceeded to construct a health knowledge test. The test was composed of 100 multiple-choice items with four possible choices for each statement. Questions were selected from the eight standard health knowledge tests and placed in the various sub-divisions of the constructed test. It was necessary to revise, combine, and add several questions to assure comprehensiveness in all sub-divisions of the test.

For further analysis, a critical evaluation of the test was undertaken by a group of twenty-five teachers attending summer school who had previous experience in teaching health on the high school level. The constructed test was administered to this group and they gave a written evaluation of the test with reference to the following items: completeness of coverage; clarity of questions; and scoring techniques. The writer also conducted an open oral discussion to determine any other faults of test construction.

From the experienced group's evaluation, the following faults were discovered:

1. Some of the test items were felt to be too technical for freshmen and sophomore students.
   a. For example, the following test item was one pointed out by the experienced group as being too technical for a general health knowledge test: In the tissue cell sugar is burned with the aid of a. Ptyalin b. Adrenin c. Insulin d. Thyroxin.

2. Some of the test items were poorly worded.
   a. It was the opinion of the group that the following statement was not clearly stated: The periodic health examination is valuable in the detection and prevention of all except which one of these diseases.

3. Scoring technique needed improvement.
   a. Rather than just circle the correct answer, it was recommended that space be provided on the left-hand side of the test item to record testees choice.
The test was then reconstructed using written and oral recommendations of the above group.

**Development of Testing Procedure**

This study was primarily concerned with determining the general health knowledge of a selected group of students at Montana State University. The instrument to be used to accomplish this study was the author's revised health knowledge test.

The investigator was now ready to select the students to be tested. For convenience in getting an adequate sample of freshmen and sophomore male students in one location, those enrolled in regular men's physical education classes were chosen to be tested.

Each activity class in the required physical education program was scheduled to be tested during its regular class period. This interfered with a minimum of one period of class work for each student tested.

A mimeographed information and instruction sheet was provided for each student to record his name and high school graduated from, and, whether or not the testee had completed health courses in high school. Also included on this sheet were general directions for taking the test and a sample test item. This constituted the cover of each test booklet.\(^7\)

Preparations were made for a trial test to check room facilities and amount of time for the testing session. The test was

\(^7\)See Appendix A.
administered to forty freshmen and sophomore students. It was predetermined from this trial that a maximum of sixty students could be tested at one sitting. Due to the variation in physical education class sizes, it was necessary to schedule more than one section of students for some of the testing sessions. The time allotted also proved satisfactory and arrangements were made to begin testing the entire selected group.

To assure uniformity, the author administered instructions to all testees, going over the test directions and a sample test item with the students of each section. The testees were oriented as to the purpose of the test and the procedure to be followed during the testing session. The group was then divided into two sections to limit the maximum number of students in each room to thirty. This was done to prevent cheating and to provide ample space for completing the test. An assistant supervisor accompanied one group across the hall to start them on the test together, to proctor, and to collect test papers. Persons acting as assistant supervisors were physical education department staff members and senior physical education majors who were familiar with the testing procedure.

Testing sessions were held every hour during which there was a scheduled activity class. Time limit on the test was set at forty minutes, but testees were allowed to leave if they finished early. Only once during the entire testing sessions did a student require the full period to finish his test. The test was completed by 436 students.
CHAPTER IV

ANALYSIS OF DATA

Two different methods have been employed in analyzing the data. The first part of this chapter presents results by the use of simple mathematics. The last part of chapter four involves statistics, and this analysis has been presented under a separate heading.

Mathematical Analysis

After the tests had been scored, each test was rechecked and the number of correct test items tabulated. Through this tabulation, the percent of correct responses for each of the 100 test items was obtained. Each total was then divided by 436 to show the percentage correct. The percentage of correct responses for each question is presented in figures 1 and 2 on pages 23 and 24.

Figures 1 and 2 provide a comprehensive picture of the test results and show the wide fluctuation of correct and incorrect responses for each question.

To obtain a more specific picture of test results, the test was separated into its major sub-divisions. These five divisions of health knowledge had been determined earlier in the study as part of the criteria for evaluating standardized tests. After a test had been constructed to fulfill the criteria,
a certain number of questions was used for each of the five divisions. Figure 3 on page 26 shows the percentage of questions in each sub-division.

The five major sub-divisions mentioned can be further compared after completed test results have been calculated. Figure 4 on page 27 presents the percentage of test items correct for each sub-division. This information was determined by taking the total number of test items correct for each sub-division and dividing it by the total possible correct for each sub-division.

In comparing tables 3 and 4, the sub-division with the greatest number of questions has the lowest percentage of correct responses. This information indicates a need for more training in the division of health hazards—prevention and care.

**Statistical Analysis**

For a more complete analysis of the data, statistics were employed to produce data which would be too difficult to obtain with ordinary mathematical methods.

The mean and standard error of the mean were computed as explained by Garrett.¹ This will reveal the central tendency of the group.

To find the mean, test scores were charted on a frequency distribution with a range of 57 points using 19 intervals. The

FIGURE 3

PERCENTAGE OF QUESTIONS USED IN EACH SUB-DIVISION OF THE TEST
FIGURE 4

PERCENTAGE OF QUESTIONS CORRECT IN EACH SUB-DIVISION OF THE TEST
assumed mean, calculated to be 70 minus a correction of 1.005, results in a mean of 68.995. The standard deviation proved to be 10.377. The standard error of the mean was found by dividing the standard deviation, 10.377, by the square root of the number of cases, 436. The results showed the standard error of the mean to be .497. Statistics reveal that in 99.97 per cent of cases, the true mean will lie within plus or minus three standard errors of the mean. Applying this information to the investigator's test reveals that in 99.97 per cent of the cases, the true mean will lie between 67.504 and 70.486.

A bi-serial correlation was computed between the test scores of the group who had health courses in high school with the test scores of those who had no previous formal health training in high school.

This correlation is calculated by first finding the difference in the means of the two groups, and dividing it by the standard deviation. Second, one has to multiply the representative proportions of each group and divide the result by the height of the ordinate separating the two proportions in a normal distribution. The two results gained from the first and second steps above are multiplied to produce the bi-serial correlation. Using the material from the information sheet of the test, stating whether or not testees had any previous formal health training in high school, the following statistical data was produced:
TABLE I
STATISTICAL DATA USED FOR THE BI-SERIAL CORRELATION BETWEEN TESTEES CHECKING YES OR NO TO THE INQUIRY "DID YOU HAVE ANY HEALTH COURSES IN HIGH SCHOOL?"

<table>
<thead>
<tr>
<th>Statistical terms</th>
<th>Yes</th>
<th>No</th>
<th>Total sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean of tested group</td>
<td>70.37</td>
<td>67.41</td>
<td>69.00</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>9.93</td>
<td>10.53</td>
<td>10.38</td>
</tr>
<tr>
<td>Standard error of the mean</td>
<td>.63</td>
<td>.78</td>
<td>.50</td>
</tr>
<tr>
<td>Proportional percentage of total sample</td>
<td>58%</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td>Height of ordinate axis separating proportions</td>
<td>.398</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The resultant correlation of .17 showed some degree of positive relationship between participation in high school health courses and achievement in the test. However, this relationship is slight.\(^2\)

Another aspect of the relationship between the two means of the yes and no groups above is found by employing the critical ratio technique. Considering the difference between the mean test scores of the two groups and dividing the difference by the standard error of the difference a ratio of 2.89 is computed.\(^3\) This ratio is highly

\(^2\)See Appendix C.

\(^3\)Ibid.
significant since it is above the .01 level of significance. This indicates that those individuals who had previous formal health experience in high school will, more than 99 out of 100 times, achieve a higher score than those who had no high school health training.\(^4\)

To provide comparisons between the various high school classifications of students who took the test, the means of the following were calculated: three different groups from Montana (1st, 2nd, and 3rd class); and one out-of-state group. The mean scores of the four tested groups mentioned above along with the mean score for the total tested group were compared by use of a bar graph as shown on Figure 5, page 31. Figure 5 shows that 2nd class Montana high school graduates ranked slightly higher on the test than any of the other three groups.

In connection with the above figures, a final computation of mean scores was made to compare test scores of Montana high school graduates with out-of-state high school graduates. The results revealed an insignificant difference between the two tested groups with out-of-state high school graduates ranking .09 of a percentage point higher on the test than the Montana high school graduates.

The analysis of the data revealed the following information: (1) a wide variation of correct responses for each of the test items; (2) the lowest percentage of correct responses in the

\(^4\)Garrett, pp. 213-7.
FIGURE 5

COMPARISON OF THE MEAN SCORES OF MONTANA HIGH SCHOOL GRADUATES WITH OUT-OF-STATE HIGH SCHOOL GRADUATES AND TOTAL TEST SCORES
division of health hazards—prevention and care; (3) a bi-serial correlation of .20 showed a slight degree of positive relationship between participation in high school health courses and achievement on test; (4) a critical ratio technique resulted in a high level of significance, indicating that those individuals who had previous formal health experience in high school will, more than 99 out of 100 times, achieve a higher score on the test than those who had no high school health training; and (5) a comparison between the various high school classifications showed that high school graduates from Montana 2nd class schools ranked higher on the test than three other groups tested, with high school graduates from 1st class Montana schools being the only group whose average grade ranked below the mean.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

For review and termination of the study, this final chapter was separated into three divisions. The first part gives the reader a brief review of how the study proceeded; the second part presents test findings and resulting conclusions; and the last section ends with the author's recommendations.

Summary

The primary purpose of this study was to determine the general health knowledge of a selected group of students at Montana State University. The study proceeded on the following assumptions: (1) that health knowledge can be measured; (2) that existing health knowledge tests are not comprehensive enough to warrant their use as a completely valid means of measuring health knowledge for freshmen and sophomore college students; (3) that a test can be constructed to adequately measure health knowledge; and (4) that the 436 students tested, being 44.7 per cent of the total class, was an adequate sample of the male freshmen and sophomore students at Montana State University during the fall quarter of 1956.

The study continued by presenting material which revealed inadequacies of existing tests, and the need for revision of available standardized tests.

-33-
Administrative and statistical criteria were established for test construction and eight standardized health knowledge tests were selected as guides for the development of a test.

The test, when constructed, was further evaluated by presenting it to twenty-five people who had had previous experience in teaching high school health courses. Written and oral criticisms were used as a basis for improving the original test.

After revision had been completed, a trial test was administered to one of the physical education classes. This proved satisfactory and preparations were made to test the entire sample group.

Determining the general health knowledge level of the students gave rise to the sub-problem of considering factors which might influence the individual's health knowledge level. An attempt was made to ascertain to what degree previous formal health experience in high school might influence the score received on the test. Comparisons were also made between size and location of high schools from which the testees had been graduated.

Conclusions

Scores for the five sub-divisions, based on number of correct answers, showed wide variation. The sub-division evaluating personality factors showed the highest percentage of correct answers, and that devoted to health hazards—prevention and care the lowest, with a percentage of 8.6 separating the two divisions. These results indicate a lack of balance in the health knowledge of the college.
students and show need for a more balanced instructional program in which greater emphasis would be placed on the low-ranking subdivisions.

In comparing the mean scores achieved by students graduating from the three different classes of Montana high schools, it was found that students graduating from second class schools ranked highest and students graduating from first class schools ranked lowest. The students graduating from first class high schools had an achieved average score below the mean score for the total tested group. This comparison indicated a weakness in the health education programs of the larger high schools in Montana.

In comparing the mean scores achieved by Montana high school graduates with out-of-state high school graduates, no prominent difference could be determined.

A comparative analysis between test scores of students who had previous formal health training and students who had none resulted in a high degree of correlation between experience in formal health instruction and health knowledge level. Students who had completed previous formal health experience in high school would, more than ninety-nine times out of one hundred, score higher on the test than those who stated they had completed none. The above results indicate that a formal health course in high school can increase health knowledge.

In the analysis of the health knowledge level of 436 men in the required physical education program, the average score of
the group was found to be 68.995 correct out of a possible 100 test items. If an average grade at the college level is thought of as being approximately 70 to 75 per cent, then the tested group fell below the expected average. To say, however, that the tested group, with a mean score less than 70, is below average would be presumptuous in a single survey.

**Recommendations**

On the basis of the results of this investigation the following recommendations seem justifiable:

1. A more intensive health education program should be recommended to the curriculum coordinators of the larger high schools in Montana.

2. Montana high schools should be informed that formal health experience does increase health knowledge, and that, since health information is a necessary part of modern living, such formal experience should be provided on the secondary school level.

3. Until Montana high schools adequately provide their students with the necessary formal health training, a basic course of health education should be required for students entering Montana State University.

4. Further research should be done to improve validity and establish reliability and norms for the test used in this study.

5. In future studies of this type, a more complete evaluation of previous formal health experience should be considered.
If health knowledge is so important to effective living, then schools must make a supreme effort to insure that each student has every opportunity for the best health education possible.

This study was primarily designed to ascertain the health knowledge of Montana State University students. Results indicate that there is a wide variation in the student's health knowledge level. More research is needed in this area and it is the author's desire that future investigators will further develop the test used and data collected in this study.
BIBLIOGRAPHY

Books


Periodicals


Others


*Health Education Pre-Test for College Freshmen*. (Author and publishing company unavailable).


*Michigan Health Knowledge Test for Adults-1938*. (Author and publishing company unavailable).


Patty, Willard W. *Evaluating Health Education Outcomes*. (Publisher and date of publication unavailable).


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APPENDIXES
APPENDIX A.

HEALTH KNOWLEDGE TEST FOR
COLLEGE FRESHMEN AND SOPHOMORE MEN

Name________________________________________

High School Graduated From________________________

Did you have any health courses in high school? Yes____ No____

The purpose of the test is to determine Health Knowledge of college Freshmen and Sophomores on the basis of answers to questions selected from standard tests. Individual identities will not be published in relation to test scores. The results of the test may be used to determine the need for general health courses at the college level.

DIRECTIONS: There are four possible answers for each of the test items. More than one of the choices may fit the statement, but there is a BEST answer. Choose the one answer you believe to be BEST and put the capital letter of the correct answer in the space provided. If you are not sure of the correct answer, guess. Answer all questions. There are 100 questions and 40 minutes will be allowed for completion.

EXAMPLE: (14) Which of the following is a sense organ?

   D       A. Heart       C. Stomach
   B. Lung       D. Eye

The BEST answer is item "D", the "eye"; therefore, "D" is placed in the blank space before the question.

Ask questions before the test begins. No questions will be answered during the test.
1. The main function of perspiration is to:
   A. lubricate the skin  
   B. eliminate wastes  
   C. help regulate body temperature  
   D. remove excess water

2. Usually the best treatment for acne is:
   A. skin lotions  
   B. proper diet and cleanliness  
   C. special soap  
   D. frequent laxatives

3. Alcohol taken internally:
   A. is a depressant  
   B. is a stimulant  
   C. relieves fatigue  
   D. increases body temperature

4. Wholesome mental attitudes can be:
   A. suddenly acquired  
   B. easily won  
   C. developed through consistent right thinking  
   D. inherited

5. The general function of the endocrine secretions (hormones) is:
   A. digestion of food  
   B. regulation of body processes  
   C. production of red blood cells  
   D. supplementing lymph

6. Feeble-mindedness is often the result of:
   A. thymus deficiency  
   B. poor inheritance  
   C. poor schools and teachers  
   D. early home environment

7. The maintenance of good mental health requires that one:
   A. withdraw from unpleasantness  
   B. habitually face reality  
   C. perform difficult mental tasks daily  
   D. dwell frequently on past successes

8. When a person feels faint he should:
   A. go for fresh air  
   B. get some water to drink  
   C. lower his head  
   D. massage his temples
9. Most baldness:
A. is the result of dry hair and scalp due to too much washing
B. is the result of carelessness
C. can be prevented if treated early
D. has no established prevention or cure

10. Posture:
A. is important for its own sake
B. is unrelated to personality
C. can be ignored by healthy people
D. often reflects mental and emotional states

11. The effect of recreational interests or hobbies on mental health is:
A. beneficial
B. negligible
C. not known
D. of questionable benefit

12. To clear up a case of "athlete's foot" one should:
A. apply boric acid daily
B. see a physician
C. refrain from swimming
D. use a nationally advertised product

13. The best way to prevent constipation is to:
A. take a cathartic or laxative frequently
B. get plenty of rest
C. drink a quart of milk daily
D. eat a balanced diet containing some raw food

14. Brushing the hair:
A. prevents baldness
B. prevents gray hair
C. cleanses the scalp
D. stimulates circulation and growth of hair

15. A person should have his teeth checked by a dentist:
A. once a month
B. twice a year
C. once a week
D. once a year

16. Which individual is best fitted to examine the eyes:
A. an oculist
B. a chiropractor
C. an optician
D. an osteopath
17. Handling toads and frogs is a cause of warts:
   A. this is true  
   B. this is true only for toads  
   C. this is true only for frogs  
   D. the handling of neither animal will cause warts

18. Girls' participation in strenuous physical activity:
   A. should be similar to boys  
   B. should be discouraged because it is unladylike  
   C. is desirable if carefully planned and supervised  
   D. is detrimental to health

19. The unit of heat used in determining the energy value of a food is the:
   A. calorie  
   B. international unit  
   C. gram  
   D. standard unit

20. It should be required that every public milk supply:
   A. irradiate its milk  
   B. homogenize its milk  
   C. clarify its milk  
   D. pasteurize its milk

21. The foods which repair and build body tissues are the:
   A. carbohydrates  
   B. proteins  
   C. vitamins  
   D. fats

22. Foods containing iron should be included in the diet for:
   A. the formation of hemoglobin  
   B. the building of bone  
   C. the repair of body tissue  
   D. the supply of energy

23. For the average growing child the amount of milk recommended for daily consumption is:
   A. one pint  
   B. one quart  
   C. one-half gallon  
   D. one gallon

24. Irradiation of milk, cereals, and other foods increases the:
   A. mineral content  
   B. vitamin A content  
   C. vitamin D content  
   D. iron content
25. Starchy foods are frequently called:
   A. fats   C. vitamins
   B. minerals   D. carbohydrates

26. Vitamin C can be easily supplied daily by:
   A. cod liver oil   C. one quart of milk
   B. tomato juice   D. sunshine

27. The ultimate source of human energy is:
   A. food   C. proteins
   B. activity   D. sunshine

28. Protein foods are essential because they supply the element:
   A. oxygen   C. carbon
   B. iron   D. nitrogen

29. The function of vitamin D in the body is to:
   A. control the appetite   C. regulate the utilization of calcium and phosphorous
   B. develop strong muscles   D. prevent general muscular weakness

30. The term, "ptomaine poisoning" is really:
   A. a misnomer   C. the same as botulism
   B. the same as food poisoning   D. decomposed protein food

31. Which of the following is a good substitute for meat?
   A. vegetable broth   C. cheese
   B. bread   D. potatoes

32. The cooking of foods decreases the value of:
   A. vitamins   C. calories
   B. proteins   D. fats

33. Milk completely lacks which one of the following food essentials?
   A. carbohydrates   C. minerals
   B. proteins   D. roughage
34. The deficiency which causes susceptibility to certain types of eye infection is:
   A. vitamin A  C. vitamin C
   B. vitamin B  D. vitamin D

35. Of the following methods of preparing food, the least desirable for good digestion is:
   A. boiling  C. broiling
   B. baking or roasting  D. frying

36. Of the following foods the one that should always be cooked very thoroughly before eating is:
   A. tomatoes  C. eggs
   B. pork  D. potatoes

37. Two important substances essential for building strong teeth and bones are:
   A. calcium and phosphorous  C. dentine and iodine
   B. iron and sulphur  D. sugars and starches

38. Milk turns sour because of:
   A. the temperature of the air  C. the cream separating from the milk
   B. dust in the air  D. the action of bacteria

39. A common practice in cooking which greatly reduces the vitamin content of food is:
   A. under-cooking  C. throwing away the juices
   B. over seasoning  D. cooking too rapidly

40. Which vitamin should children eat in order to prevent rickets?
   A. A  C. C
   B. B  D. D

41. The condition which results from the lack of red blood cells is:
   A. diabetes  C. arteriosclerosis
   B. high blood pressure  D. anemia
42. The normal body temperature when measured in the mouth with a thermometer is:
   A. 96.8
   B. 97.6
   C. 98.6
   D. 99.8

43. The blood vessels which return the blood to the heart are called:
   A. arteries
   B. veins
   C. capillaries
   D. arterioles

44. Changing the food so that it can be used by the cells is called:
   A. elimination
   B. absorption
   C. digestion
   D. respiration

45. Man's energy requirement at complete rest is called his:
   A. caloric requirement
   B. daily nutritional needs
   C. basal metabolism
   D. respiration

46. The center of consciousness is the:
   A. cerebrum
   B. cerebellum
   C. pons
   D. spinal cord

47. Red blood cells originate in the:
   A. liver
   B. heart
   C. lung tissue
   D. bone marrow

48. The oxygen taken in by the lungs is carried to the body tissues by which one of the following substances:
   A. white blood cells
   B. blood platelets
   C. red blood cells
   D. autocoid

49. Inability to sleep is called:
   A. anemia
   B. anorexia
   C. anoxia
   D. insomnia

50. During sound, healthful sleep:
   A. metabolism is lowered
   B. digestion ceases
   C. excretory processes stop faster but with less force
   D. the heart beats slightly faster but with less force
51. The most serious type of fatigue is induced by:
   A. physical work  C. emotional strain
   B. mental work  D. social obligations

52. The bladder is connected to the:
   A. intestines  C. uterus
   B. ureters  D. stomach

53. Normal bowel movement is best attained through:
   A. regular use of mineral oil  C. occasional use of a mild laxative
   B. reserving a regular toilet  D. eating bran for breakfast time

54. The main value in the use of a dentifrice (toothpaste or powder) is to:
   A. help scour the teeth  C. neutralize bad mouth odors
   B. kill bacteria in the mouth  D. it has no value

55. Most important in avoiding middle-ear infections and loss of hearing is:
   A. immediate removal of any wax
   B. cold applications for earache
   C. prevention and immediate treatment of colds
   D. insertion of oiled cotton plugs in the ear

56. The tonsils:
   A. secrete saliva
   B. are part of the body's defensive mechanism
   C. should be removed in all children
   D. are part of the digestive system

57. The best procedure to prevent further development of small cavities in the teeth is to:
   A. brush them more often  C. see your dentist
   B. eat more citrus fruit  D. use an antiseptic mouth wash

58. The term, "athlete's heart" means:
   A. an enlarged heart  C. a small heart
   B. a damaged heart  D. a leaking valve
59. Fatigue from sedentary or mental work is best relieved by:
   A. coffee
   B. sleep
   C. a shower
   D. recreation of a physical type

60. Fatigue after strenuous muscular effort is best relieved by:
   A. a sedative
   B. cold shower
   C. rest
   D. food

61. The feeling of fatigue:
   A. should be prevented at all times
   B. may be a normal and desirable experience
   C. increases with interest in a task
   D. always indicates the need for more rest

62. The disease which causes greatest wage loss in industry is:
   A. influenza
   B. the common cold
   C. tuberculosis
   D. pneumonia

63. The leading cause of death in the United States is:
   A. heart disease
   B. cancer
   C. tuberculosis
   D. syphilis

64. Communicable diseases responsible for much blindness are:
   A. syphilis and gonorrhea
   B. measles and scarlet fever
   C. diphtheria and pneumonia
   D. tuberculosis and rheumatism

65. The best advice in treating the common cold is:
   A. go to bed and stay until well
   B. drink quantities of water and fruit juice
   C. take cold pills and capsules
   D. take a good laxative

66. Gonorrhea is frequently a cause of:
   A. arthritis
   B. insanity
   C. baldness
   D. sterility
67. Tuberculosis is best treated by:
   A. change of climate   C. moderate exercise
   B. medicines          D. rest and proper food

68. Cancer is:
   A. frequently inherited   C. frequently cured if found early
   B. not usually contagious  D. decreasing in death rate

69. Iodine is added to the drinking water in some areas to:
   A. kill bacteria          C. prevent goiter
   B. harden the bones       D. reduce tooth decay

70. In all industries where heat cramps, or heat exhaustion may occur due to excessive heat:
   A. plenty of ice water should be provided
   B. salt tablets should be available and used
   C. ventilation should be maintained
   D. temperature should be controlled

71. Which one of the following diseases is transmitted most readily and quickly by personal contact?
   A. cancer               C. nephritis
   B. pellagra              D. diphtheria

72. Sensitiveness to protein contained in pollen, feathers, etc., is called:
   A. tuberculosis         C. arthritis
   B. allergy               D. pyorrhea

73. A function of white cells in the blood is to:
   A. transport carbon dioxide   C. remove waste products
   B. combat invading germs      D. cause fresh wounds to stop bleeding

74. A frequent cause of heart disease is:
   A. rheumatic fever          C. heredity
   B. athletics                D. syphilis
75. Caisson workers, divers, and tunnel workers are subjected to:
   A. lack of oxygen
   B. increased atmospheric pressure
   C. respiration infection
   D. carbon monoxide poisoning

76. The proper living room temperature for the average family is about:
   A. 62 degrees F.
   B. 65 degrees F.
   C. 76 degrees F.
   D. 80 degrees F.

77. The most dangerous item for the home medicine cabinet is:
   A. boric acid
   B. sodium chloride
   C. epsom salts
   D. bichloride of mercury

78. A pediatrician is:
   A. a foot specialist
   B. a specialist in infant and child care
   C. a bone specialist
   D. a specialist in internal medicine

79. A physician who specializes in the care of the skin is called:
   A. a proctologist
   B. a dermatologist
   C. an epidemiologist
   D. a chiropodist

80. The routine test to determine whether or not a person is infected with syphilis is the:
   A. Wasserman test
   B. Koch test
   C. Schick test
   D. Mantoux test

81. The immunity test for diphtheria is the:
   A. Dick test
   B. Mantoux test
   C. Kahn test
   D. Schick test

82. The best first aid for a turned ankle is:
   A. walking on it
   B. complete rest and elevation
   C. rubbing with liniment
   D. painting it with iodine

83. The most important step in the prevention and treatment of shock is the application of:
   A. a stimulant
   B. external heat
   C. maintain normal body temperature
   D. ammonia to the nose
84. A seriously injured person should:
   A. not be moved unless absolutely necessary
   B. be transported quickly to a doctor
   C. be given something warm to drink
   D. be moved only if a good stretcher is available

85. If a person has cut an artery in his forearm, a tourniquet should be applied:
   A. on the side of the cut toward the wrist
   B. on the side of the cut toward the elbow
   C. either at wrist or elbow
   D. both at wrist and elbow

86. Homosexuality is:
   A. a physical problem
   B. a disease
   C. an emotional problem
   D. a welfare problem

87. Ovulation in the normal female occurs every:
   A. 14 days
   B. 20 days
   C. 28 days
   D. 35 days

88. The dangers of venereal diseases should be explained to children:
   A. when they begin to show interest in the opposite sex
   B. during adolescence as a part of sex education
   C. when the child leaves home for a college or business career
   D. when parents suspect children are thinking of such things

89. When children have the same fears as their parents it is probably due to:
   A. inheritance of the tendency
   B. eating the same foods
   C. learning fears from parents
   D. the mother being frightened during pregnancy

90. The laws of heredity were first discovered by:
   A. Darwin
   B. Pasteur
   C. Mendal
   D. Galton
**91.** Masturbation in adolescence is a sex-emotional disturbance which is:

A. practiced only by boys  
B. a sign of inferiority complex  
C. responsible for little emotional difficulty  
D. an emotional problem needing psychiatric help

**92.** It is desirable to know our inherited characteristics so that we can:

A. strengthen our good characteristics and guard against our weak ones  
B. keep our children from having the same characteristics  
C. compare them with others  
D. avoid them

**93.** A person's health and growth is determined:

A. entirely by heredity  
B. entirely by environment  
C. by both heredity and environment  
D. by the amount of one's intelligence

**94.** The reproductive cells of the female are called:

A. spermatozoa  
B. ova  
C. ovaries  
D. corpus lutea

**95.** During menstruation, in general, most women should:

A. go to bed  
B. reduce usual activities  
C. give up all bathing  
D. carry on as usual

**96.** Seminal emissions in the male are:

A. normal  
B. sign of disease  
C. harmful  
D. caused by excessive protein diet

**97.** True heredity is understood to account for:

A. syphilis  
B. tuberculosis  
C. color blindness  
D. spinal curvature

**98.** The substances in the chromosomes which are called the "bearers of heredity" are:

A. antigens  
B. hormones  
C. genes  
D. spermatozoa
99. The usual age for the onset of menstruation in the female is:
   A. 9-11 years  
   B. 12-14 years  
   C. 15-17 years  
   D. Over 17 years

100. A prospective mother can make her child more musical if she listens to good music:
   A. this is true  
   B. this is probably true  
   C. this is probably false  
   D. this is false
APPENDIX B.

STATISTICAL DATA USED FOR COMPUTING THE MEAN, STANDARD DEVIATION, AND PERCENTILE RANK OF TESTED GROUP

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<td>11</td>
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<td>121</td>
</tr>
<tr>
<td>Totals</td>
<td>436</td>
<td></td>
<td>661</td>
<td></td>
<td>4,266</td>
</tr>
</tbody>
</table>

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\[
\text{Mean}
\]
\[
M = 70 - \frac{146}{436} \times 3.
\]
\[
= 70 - 0.335 \times 3.
\]
\[
= 70 - 1.005.
\]
\[
\text{Mean} = 68.995
\]

<table>
<thead>
<tr>
<th>Percentile Rank</th>
<th>Percentile</th>
<th>Score</th>
</tr>
</thead>
<tbody>
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<td>90</td>
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<tr>
<td>80</td>
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<td>70</td>
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<td>75.1</td>
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<tr>
<td>60</td>
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<td>72.3</td>
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<tr>
<td>50</td>
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<td>69.8</td>
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<td>40</td>
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<td>67.3</td>
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<tr>
<td>30</td>
<td></td>
<td>64.5</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>60.9</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>54.9</td>
</tr>
</tbody>
</table>

\[
\text{Standard Deviation}
\]
\[
= \sqrt{\frac{5266}{436} - (0.335)^2} \times 3
\]
\[
= \sqrt{12.0780 - 0.1122} \times 3
\]
\[
= \sqrt{11.9658} \times 3
\]
\[
= 3.459 \times 3
\]
\[
\text{Standard Deviation} = 10.377
\]
APPENDIX C.

MATHEMATICAL PROCEDURE USED IN COMPUTING THE BI-SERIAL CORRELATION, ITS STANDARD ERROR AND THE CRITICAL RATIO

### Bi-serial Correlation

\[
\text{Bi-serial Correlation} = \frac{70.237 - 67.359}{10.38} \times \frac{(.58)(.42)}{.391} = \frac{2.878}{10.38} \times \frac{.2436}{.391} = .277 \times .623 = .17
\]

### Standard Error of Bi-serial Correlation

\[
\text{Standard Error of Bi-serial Correlation} = \frac{\sqrt{(.58)(.42)}}{.391} - (.17)^2 = \frac{.26 - .0289}{20.881} = .06
\]

### Critical Ratio

\[
\text{Critical Ratio} = \frac{70.237 - 67.359}{\sqrt{(.6255)^2 + (.7763)^2}} = \frac{2.878}{.997} = 2.89
\]