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A comparison of arm and shoulder strength of college men today with that of college men sixteen years ago

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A COMPARISON OF ARM AND SHOULDER STRENGTH OF COLLEGE MEN TODAY WITH THAT OF COLLEGE MEN SIXTEEN YEARS AGO

by

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INTRODUCTION

"Flaccid, flabby, soft and weak,"[1] was a typical description of American youth provided by coaches at the Annual N.C.A.A. gymnastic championships in April, 1958 at Michigan State University. Charles P. Pond,[2] Illinois gymnastics coach, made this assessment:

> It's not the fault of the youngsters. It's just that there's not enough emphasis in our school programs on physical fitness. I've had football players come to my classes who couldn't even chin themselves once.

The President of the United States has become concerned over the fitness of the Nation's youth, and has established a Council on Youth Fitness headed by the Vice President and including five Cabinet officers.[3] In addition, the President has appointed a commission of 120 leading citizens to lay out a plan in an attempt to reverse the trend toward softness among young people in this country.

This increasing concern at Federal level over the fitness of American youth was initiated by a report on the results of the Kraus-Weber Test[4] designed to determine minimum muscular fitness, given to 4,264 United States school children and to approximately 3,000 European children of the same age group. The results showed that 57.9 per cent

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[1] Associated Press Dispatch, The Missoulian (Missoula, Montana), April 13, 1958.

[2] Loc. cit.

[3] "Is American Youth Physically Fit?" U.S. News and World Report, 43:66, August 2, 1957.

[4] Loc. cit.

of the American children failed to meet the minimum muscular fitness standards, and all but 8.7 per cent of the European children passed the test with flying colors.

Kraus,[5] associate professor of physical medicine and rehabilitation at New York University, and Prudden,[6] a physical training expert, warn parents that their children who are taken to school in buses, chauffeured to activities, freed from muscle building chores, and entertained in front of television sets are getting soft and flabby.

The Surgeon General[7] of the United States Army reports that in the period of six and one-half years starting from July 1, 1950, 4.7 million draft registrants were examined by the armed forces at induction centers. Of these youths examined, an alarming total of 1.6 million, almost exactly one-third, were found to be unfit for military duty.

On the other hand, there are many experts who contend that there is very little difference between the physical fitness of the youth today with the youth of yesterday. Karpovich,[8] an M.D. and professor of physiology, does not believe the test that was given to the United States and European children was a valid test of physical fitness.

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[5]"Muscular Fitness and Health," The Journal of Health, Physical Education, and Recreation, 24:17-19, December, 1953.

[6]Loc. cit.

[7]"Is American Youth Physically Fit?" U.S. News and World Report, 43:69, August 2, 1957.

[8]Ibid., p. 72.

Bauer,[9] director of the bureau of health education of the American Medical Association and a member of the President's citizens advisory commission on youth fitness, does not agree with those who say the American youth is soft. "When you put American youth to the test, American youth comes through . . . it has never failed, and I don't believe it's going to fail now."[10]

Many medical officers in the armed forces say that the men entering the service get "hard as nails" in a short period of training. McCloy[11] contends that almost none of the rejections from draft into the Armed Services is attributable to lack of physical condition. He maintains that any normal man can be conditioned in a matter of a few weeks.

The Vice President of the United States[12] states that we are not a nation of softies, but could become one if proper attention is not given to the trend of our times toward the invention of all sorts of work-saving gadgets and neglect of the opportunity for normal, health-giving exercise.

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[9]"President's Conference on Fitness of American Youth," The Journal of Health, Physical Education, and Recreation, 27:8-10, September, 1956.

[10]Loc. cit.

[11]C. H. McCloy, "The Significance of Draft Statistics," The Physical Educator, 14:47-49, May, 1958.

[12]"President's Conference on Fitness of American Youth," The Journal of Health, Physical Education, and Recreation, 27:10, September, 1956.

In summary, although there is broad agreement that the fitness of American youth should be a matter of national concern, there is considerable debate over just how fit, or unfit, this country's youth really are.

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

In view of the recent and growing concern and controversy over whether American youth are growing weaker, the author felt that research was needed which might confirm or reject this presumption. A statistical comparison of performance of modern youth on physical fitness test items with performances of similar groups in the same items some years back might bring forth evidence of a changing status in fitness.

A problem faced by the author was to determine what factors of fitness should be considered and what devices could be used to measure these factors. These measuring devices would have to be the same as those used in any previous tests in order to make statistical comparisons reliable.

Study of the literature revealed that authorities consider muscular strength to be a vital factor in physical fitness. Larson and Yocum[1] state that "muscular strength is an important component of physical fitness for normal daily living." The following is an

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[1]Leonard A. Larson and Rachael D. Yocum, Measurement and Evaluation in Physical, Health, and Recreation Education (St. Louis: C. V. Mosby Company, 1951), p. 100.

excerpt from Clarke's book on the Development of the Sub-Strength Individual.[2]

> Extensive studies of sub-strength individuals during the past quarter-century have shown unmistakably the basic relationship of adequate strength to organic functions: to stamina for long continued activity; to proper mental attitudes, to good social relationships; in fact to almost every desirable phase of mental health, physical fitness, and social efficiency.

Study of the literature also revealed that measures of arm and shoulder strength have been frequently used in strength testing and physical fitness testing. Chinning, dips, and push-ups have been commonly used to determine such strength. Considering the availability of data pertaining to these strength factors of fitness, the author proceeded to seek a comparison of performances in chinning, dips, and push-ups, using records on present-day college men and records on college men as far back as data could be secured.

Purpose of This Study. The purpose of this study was to compare the results of arm and shoulder strength tests given to male students in physical education classes at Montana State University in 1958 with results of the same test items that were included in college physical fitness tests of 15 to 18 years ago in an attempt to test the hypothesis that American male adults are growing weaker.

Basic Assumptions. This study proceeded on the assumption that arm and shoulder strength is a component of total strength and has a

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[2]H. Harrison Clarke, Development of the Sub-Strength Individual (St. Louis: Fred Medart Products Inc., 1951), p. 100.

relationship to physical fitness. Clarke[3] states that body strength reflects the basic fitness status of the body.

It was assumed that the published results of previous tests provided reliable data. For this study it was assumed that the groups of male college students were similar as to age, school experience, and physical education backgrounds. This study assumed that the test items used were valid measures of arm and shoulder strength and endurance, and that the testing procedure, techniques, and equipment used were similar enough to provide a valid comparison between the various test groups.

Definitions.

Montana State University Students. Freshman and sophomore male students enrolled in the required physical education program at Montana State University, Spring Quarter, 1958.

Arm and Shoulder Strength. For this study these terms indicate the degree of ability of the arm and shoulder flexor and extensor muscles to raise the body weight and propel it upward. It includes the strength of the hand, wrist, and forearm.

Endurance. This is considered as the ability to continue successive performance of muscular strength and/or power at a maximum rate of speed over an unlimited time span.[4] Chins, dips and push-ups were considered items of muscular endurance in this study.

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[3] Ibid., p. 3.

[4] Larson and Yocum, op. cit., p. 78.

Fitness. For this study, this term refers to the status or degree of development of the physical condition of the upper arms and shoulders.

Critical Ratio. The relationship of the obtained difference between two scores and the standard error of the difference.

Level of Significance. In this study the .01 level and above are considered as significant, the .01 level meaning that 99 times out of 100 times, the difference between the two factors being compared is an actual difference and not due to chance. The .01 level is indicated by a critical ratio of 2.58.

Limitations of the Study. This study was limited to the use of three test items, chinning, dips, and floor push-ups, as the means for determining the strength and endurance of the arms and shoulders. It was recognized that arm and shoulder strength is only a part of total strength and no attempt was made to determine the total strength of an individual or total fitness.

The author realized that certain factors such as effort, circulatory-respiratory organic condition, body-build factors, and total strength influence performance in strength tests, but these factors were omitted in this study as being either too extensive or too difficult to measure.

This study recognized that the Montana students' backgrounds and experience might be somewhat different than college men of more urban areas.

It was recognized that a 15 to 18 year span was not a sufficiently great length of time to indicate a real change in physical

fitness status, however, this study was limited to using those studies in which statistical data was available.

The level of significance applied to differences between groups in this study was taken at the .01 level. This would mean that a difference between two groups would be significant, that is, not due to chance, if this difference was at the .01 or higher level of confidence.

Need for the Study. The introduction to this study indicates the increasing concern over the evidence of declining strength of American youth. However, the statements made are often merely opinions, without substantiation.

The author felt more research was needed on the fitness status of the arms and shoulders. The lack of strength in the arms and shoulders has been found to be the greatest weakness of the American male, as indicated by Karpovich and Weiss.[5]

> It may be concluded that personnel entered the Army Air Forces in fairly poor condition . . . the men were found to be lacking in running speed and endurance, and endurance of the abdominal muscles, but were most deficient in arm and shoulder strength.

Physical Education instructors, coaches, teachers, and all persons concerned with the development of youth need specific statistical information for the purpose of pupil guidance. The information as to the individual strength status would be of value as a guide in the selection of benefiting activities for the individual students. Those

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[5]Peter V. Karpovich and Raymond A. Weiss, "Physical Fitness of Men Entering the Army Air Forces," The Research Quarterly, 17:192, October, 1946.

concerned with teaching physical education can use the information for the evaluation of the existing programs of instruction.

CHAPTER II

REVIEW OF THE LITERATURE

Muscular strength underlies most of our daily activities. Therefore, strength testing becomes important to the teacher concerned with the development of this strength if they are to effectively accomplish their work. Strength testing is not a modern technique. Cureton[1] cites evidence of strength testing as early as 1702, by De la Hire and Amontons.

In America Sargent[2] first worked out his strength test idea in 1873 at Yale while he was still a medical student and later developed it in more detailed fashion at Harvard, beginning about 1880. His original plan in measuring strength "was to test the efficiency of men in handling their weight by their arms as a preliminary qualification for proficient work in gymnastics."[3] He concluded that it was capacity for physical performance and not size alone which would be of the greatest practical value and that tape measurements really did not tell much.

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[1]Thomas K. Cureton, Physical Fitness Appraisal and Guidance (St. Louis: C. V. Mosby Company, 1947), p. 358.

[2]Dudley A. Sargent, "Twenty Years Progress in Efficiency Tests," American Physical Education Review, 18:452, October, 1913.

[3]Loc. cit.

Bovard and Cozens[4] cite the work of Rogers who scientifically showed that such tests were valid as measures of general athletic ability and can be used readily to classify boys for purposes of competition.

To assure a better understanding of this study, it must be pointed out that the author sought to uncover studies which would date back as early as possible in order to provide a more significant comparison. The greater the span in years between tests, the more sound would be any conclusions concerning changes in physical fitness status. Numerous text books and periodicals were investigated by the author. Every issue of The American Physical Education Review from 1905 to 1929 was consulted as were the early and recent publications of The Research Quarterly.

A review of the literature failed to find tests that dated back beyond 1940 which gave sufficient statistical information to provide a valid comparison. Tests were found which were administered 40 to 50 years ago but the data provided were insufficient for use in this study.[5] In several instances, only average performance was indicated with no evidence of how the scores deviated from average. In other instances the test groups were not similar.

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[4]John F. Bovard and Frederick W. Cozens, Tests and Measurements in Physical Education (Philadelphia: W. B. Saunders Company, 1930), p. 21.

[5]Jay W. Seaver, Anthropometry and Physical Examination (New Haven, Conn: Curtiss-Way Company, 1909), p. 68 and George L. Meylan, "The Value of Physical Examinations of College Students," American Physical Education Review, 13:250-252, April 1908.

Cureton[6] administered a motor fitness test consisting of chinning, dipping, and the vertical jump to all service classes for men at the University of Illinois during 1940-41 and again during 1941-42. His purpose for testing was for the computation of improvement in these items of motor fitness and also in the Larson Composite Score[7] to show the influence of physical education on the motor fitness of young men. In the two school years, approximately 2,600 male physical education students were tested. Gross improvements were noted in all events, and were associated with the concomitant conditioning work experience in physical education courses and physical fitness clinic.

In 1942 Bookwalter[8] set up a measurement program for physical education activities at Indiana University to evaluate the new physical fitness program brought about by World War II. A survey of existing factor analysis studies was made prior to setting up the measurements program. From them it was disclosed that the prime essential factor in determining successful performance in physical education activities is strength. The items chosen for measuring the strength of the arms and total body were chins, dips, push-ups and the Larson Dynamic Strength Test. A total of 1,008 students were given the test. One of the

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[6]Thomas K. Cureton, "Improvement in Motor Fitness Associated with Physical Education and Physical Fitness Clinic Work," The Research Quarterly, 14:153-157, May, 1943.

[7]Leonard A. Larson, "A Factor and Validity Analysis of Strength Variables and Tests with a Test Combination of Chinning, Dipping, and Vertical Jump," The Research Quarterly, 11:82-96, December, 1940.

[8]Karl W. Bookwalter, "A Critical Analysis of Achievements in the Physical Fitness Program for Men at Indiana University," The Research Quarterly, 14:184-193, May, 1943.

conclusions of the testing program was that strength was gained rapidly between test periods due to conditioning but was below standard in the upper shoulder girdle work. One recommendation was for more activities to be included in the program for the development of the arms and shoulders.

Hughes[9] presented an analysis of the results of a series of physical performances given at the University of Michigan in 1942. The report was concerned with the test results of the physical conditioning program in operation at that institution. "The purpose of the tests was to obtain data which would permit an appraisal of the amount of change in physical performance with the inference that these changes would be attributable to activities which constitute the program and would provide an estimate of the progress toward better or adequate physical condition."[10]

A group of 1,141 male students was tested at the beginning and end of a 16 week period and the results were compared. The results showed an average gain of approximately 20 per cent in all events. The events used to measure arm and shoulder strength and endurance were chins and floor push-ups.

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[9]Byron O. Hughes, "Test Results of the University of Michigan Physical Conditioning Program June 15 - - - September 26, 1942," The Research Quarterly, 13:498-511, December, 1942.

[10]Ibid, p. 489.

At the College of the City of New York in 1943, Wilber[11] conducted a study of physical fitness indices as measured by two programs of physical education: the sports method and the apparatus method. The study was concerned with measuring each individual's physical fitness in terms of the test selected, at three different periods, and of taking these differences for each method and comparing them with each other for improvement and rate of change.

The test battery consisted of seven items. Arm and shoulder girdle strength was measured by the number of chins on the horizontal bar and the number of dips on the parallel bars. A total of 366 male students were used in this investigation.

The conclusions reached showed superior improvement by the sports method over the apparatus method in the total physical fitness, as measured by the items in this study.

Yale University[12] conducted a ten-year study of physical fitness of their undergraduates from 1947-1956. Approximately 10,000 students were tested. Pull-ups, push-ups, fence-vault, sit-ups, standing broad jump, and vertical jump comprised the test battery. Averages of these test items were available on over 3,000 Army, Navy, and Air Force trainees who had been stationed at Yale during World War II. The approximate average scores achieved by these men at the start of their

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[11]Ernest A. Wilber, "A Comparative Study of Physical Fitness Indices as Measured by Two Programs of Physical Education: the Sports Method and the Apparatus Method," The Research Quarterly, 14:326-332, October, 1943.

[12]T. E. Erwin Blesh and Alfred E. Scholz, "Ten-Year Survey of Physical Fitness Tests at Yale University," The Research Quarterly, 28:321-326, December, 1957.

training period were used as the standard for the entering male freshmen for passing the test. This study could not be used for comparison, as it did not list the standard deviations.

In an unpublished Master's thesis, Anderson[13] presented a study on the comparison of the physical fitness status of athletic award winners and non-athletic award winners at Montana State University in 1956. The Rogers Strength Test, which includes chins and dips, was employed for the testing.

From the preceding literature, the Illinois, Indiana, Michigan, and College of the City of New York studies provided means and standard deviations of their test results, which could be used for comparison with the present day Montana students.

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[13]George R. Anderson, "A Study of the Physical Fitness Status of a Selected Group of Male Freshmen and Sophomore Students at Montana State University 1956," (unpublished Master's thesis, Montana State University, Missoula, 1956.)

CHAPTER III

PROCEDURES OF THE STUDY

This study was primarily concerned with the determining of the arm and shoulder strength and endurance of a selected group of students at Montana State University, and the comparison of the results of these tests with results obtained by similar groups at other colleges approximately 16 years earlier. The comparison was to be used in an attempt to test the hypothesis that American youth are growing weaker.

Chinning, dipping, and floor push-ups were used to determine the strength and endurance of the arms and shoulders, as these items were found to have high validity in measuring these factors by consensus of authorities. In selecting test items for an Army Air Force physical fitness test, Larson[1] administered many test items to a representative sample of AAF personnel. The tests were intercorrelated, and each was correlated with the criterion measure, which was the sum of all tests. The results showed that, as indicators of physical fitness and muscular endurance of the arms and shoulders, chinning, with a .6447 correlation, dipping, .6323, and floor push-ups, .4970, correlated highest. All the studies used for comparison included two or all of these test items for measuring arm and shoulder strength.

After selecting the test items, a plan for administering the tests to Montana State University students was developed. A sheet was

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[1]Leonard A. Larson, "Some Findings Resulting From AAF Physical Training," The Research Quarterly, 14:148, May, 1946.

prepared which provided for recording information concerning the student and for the recording of test scores.[2]

A trial test was organized and administered to a small class to determine the best testing station arrangement, the maximum number of students that could be tested during a single class period, and any changes which would aid in the explanation, demonstration, administration of the test, and scoring.

Due to the strenuous muscular activity and maximum endurance called for by each test item, it was decided to give only one event each day. This eliminated the necessity of giving tests in any specific order.

Each group tested comprised a separate class taken from the required physical education program at the University. Class periods were approximately 45 minutes in length. It was found by the trial test that about 30 students could be tested in ten minutes. Two students could be tested at the same time on the chinning bar and also on the parallel bars. Because the classes were of different sizes, it was possible to schedule more than one class for some of the testing sessions.

The author supervised all of the testing personally. When the author did not administer the test personally, he met with the class instructor prior to the day of testing. Information sheets, and the directions for their completion and the administering of the test were given to the instructors.

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[2]See Appendix.

During the scheduled testing periods, the testees were orientated as to the purpose of the test and procedure to be followed. A demonstration of the event being tested was given to assure complete understanding as to the proper execution of each event by the testees.

Persons participating as testors, besides the author, were physical education department staff members and student instructors. The entire testing program required a total of seven days; this included make-up sessions for absentees. The complete test was administered to a total of 365 students.

After the administration of the tests, the test results were tabulated in terms of the range, mean, standard deviation, and standard error of the mean for the Montana State University college men in each event. The mean, standard deviation, and standard error of the mean were determined by using the statistical methods outlined by Garrett.[3]

It was the purpose of this study to compare the test results of Montana State University students with results of the same test items obtained from similar test groups of male college students approximately 16 years ago. Statistics were available on test results of students of the University of Illinois, University of Michigan, Indiana University, and the College of the City of New York.

In the comparison of the test results, the following steps were carried out: the author first determined the standard error of the mean of each test group. The standard error of the difference between the mean of the Montana students and the mean of each of the other test

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[3]Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1958), pp. 53-54.

groups was then calculated. The critical ratio between the observed difference between the means for each of the paired groups and the standard error of the difference was computed and evaluated in terms of the .01 level of confidence in order to determine whether the existing difference between groups was real or perhaps due to chance.

Finally, on the basis of evidence revealed in the comparisons, the author sought to determine whether the hypothesis, that American men are growing weaker, could be supported or discounted with regard to the items in this study.

CHAPTER IV

ANALYSIS OF THE DATA

In analyzing the data, the author compiled the statistical data of the four studies that were to be used for comparison with the Montana group. These test groups were of the University of Illinois, Indiana University, the University of Michigan, and the College of the City of New York. All of these studies provided information concerning the number of students tested, the mean, and the standard deviation for each test item used in their study.

I. COMPARISON OF CHINNING PERFORMANCE

The author compared the chinning performance of the Montana State University students with each of the four test groups. The mean, standard deviation, and standard error of the mean of each group is shown in Table I.

TABLE I

STATISTICAL DATA OF EACH TEST GROUP FOR CHINNING

COLLEGE GROUP	MEAN	STANDARD DEVIATION	STANDARD ERROR
Montana (1958)	6.30	3.42	.179
Illinois (1940)	7.37	3.18	.063
Indiana (1942)	7.02	3.24	.11
Michigan (1942)	7.45	3.46	.08
CCNY (1943)	5.06	3.41	.178

Comparison of Montana - Illinois in Chinning.

In comparing the University of Illinois students of 1940 with the 1958 Montana students in chinning, the mean for the Illinois group of 2,577 men was 7.37 as compared to a mean of 6.30 for the 364 Montana students. The observed difference was 1.07. In order to determine whether this difference was a significant difference or due to sampling errors, the author first computed the standard error of each mean, then obtained the standard error of the difference between the two means. This standard error of the difference between the means was found to be .19. The critical ratio was calculated by dividing the observed difference of the two means by the standard error of the difference. The resultant critical ratio was 5.67. A critical ratio of 2.58 is required to establish the .01 level of confidence, which indicates that in 99 times out of 100, the difference between the two means would be a real difference and not due to chance. Therefore, the 5.67 critical ratio is clearly significant at far above the .01 level. From these

findings, it appears that the Illinois students in 1940 possessed greater arm and shoulder strength and endurance than the Montana students of 1958 as measured by chinning.

Comparison of Montana - Indiana in Chinning.

The 896 students tested at Indiana University in 1942 had a mean of 7.02 in chinning, as compared to 6.30 for the Montana group. After computing the standard error of the means, the standard error of the difference was found to be .21. By dividing this standard error of the difference into the observed difference of .72, a critical ratio of 3.43 was found. This ratio was also clearly significant at above the .01 level. As determined by chinning, this indicates greater arm and shoulder strength and endurance of Indiana male students in 1942 than 1958 Montana students.

Comparison of Montana - Michigan in Chinning.

The Michigan study of 1942, which tested 1,141 men, showed a mean of 7.45 chins. This represented an observed difference of 1.15 greater than the mean of the Montana students. The resultant critical ratio of 5.87 was also found to be significant at greater than the .01 level. This information would seem to indicate that the students tested at Michigan in 1942 were superior to the Montana students of 1958 in arm and shoulder strength and endurance as determined by chinning performance.

Comparison of Montana - College of the City of New York in Chinning.

The mean of the 366 CCNY students tested in 1943 was 5.06 which fell 1.24 chins below the Montana mean. The critical ratio of 4.91

indicated this difference to be a real difference and not due to chance. On the basis of this evidence, it would seem that the Montana students in 1958 were superior, in chinning ability, to the 1943 students tested at CCNY.

Summary on the Analysis of Data on Chinning.

The statistical comparison of the 1958 Montana State University test group, with the four college groups of approximately 16 years ago, revealed that the Montana students' performances were inferior to three of the four college groups and superior to one. The University of Illinois, Indiana University, and the University of Michigan testees all showed to be significantly stronger in the arms and shoulders than Montana students on the basis of chinning, and the Montana students indicated greater arm and shoulder strength than the group at CCNY, as measured by chinning. Table II shows the four college groups as compared to Montana students in chinning.

TABLE II

COMPARISON OF THE FOUR COLLEGE GROUPS OF ABOUT 16 YEARS AGO WITH THE 1958 MONTANA GROUP IN CHINNING

COLLEGE GROUP	MEAN	OBSERVED DIFFERENCE OF THE MEAN	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
Montana (1958)	6.30			
Illinois (1940)	7.37	1.07	.190	5.67
Indiana (1942)	7.02	.72	.21	3.43
Michigan (1942)	7.45	1.15	.196	5.87
CCNY (1943)	5.06	1.24	.252	4.91

II. COMPARISON OF DIPPING PERFORMANCES

For the analysis of the dipping performances, only Illinois, Indiana, and CCNY could be used for comparison with Montana. Dips were not included in the Michigan study. Table III shows the mean, standard deviation and standard error of the mean of each group used.

TABLE III

STATISTICAL DATA OF EACH TEST GROUP FOR DIPPING

COLLEGE GROUP	MEAN	STANDARD DEVIATION	STANDARD ERROR
Montana (1958)	7.40	4.35	.229
Illinois (1940)	7.15	3.89	.075
Indiana (1942)	4.86	3.27	.12
CCNY (1943)	5.34	4.04	.211

Comparison of Montana - Illinois in Dipping.

The same statistical methods were employed to determine the significant difference in dipping performances as in chinning. The Illinois mean, obtained from 2,583 testees, was 7.15 as compared to the 362 Montana students' mean of 7.40. There was an observed difference of .25. The standard error of the difference between the means was found to be .261. The critical ratio was found to be .97 which falls short of the 2.58 critical ratio needed for the .01 level. In other words, a critical ratio of .97 indicates that approximately 33 times out of 100, the difference between the two means may be due to chance. Therefore, it is considered not significant. It appears that there is no real difference in the strength and endurance of the arms and shoulders between the Montana students of 1958 and the Illinois group of 1940, as indicated by performance in dipping.

Comparison of Montana - Indiana in Dipping.

A large observed difference of 2.54 was noted between the Montana mean of 7.40 and the mean of 4.86 obtained from 708 Indiana students tested in dipping. After the standard error of the difference between the means was computed, a critical ratio of 9.81 was obtained. This is highly significant at far beyond the .01 level of confidence indicating the 1958 Montana group as possessing greater ability in dipping than the 1942 Indiana test group.

Comparison of Montana - College of the City of New York in Dipping.

The CCNY study of 1943, which utilized 366 students, showed a mean of 5.34. This represented an observed difference of 2.06 below

the mean of the Montana testees. The resultant critical ratio of 6.62 was also highly significant at far above the .01 level. The arm and shoulder strength and endurance of the Montana college students, as measured by dipping, appears superior to that of the CCNY group.

Summary on the Analysis of the Data on Dipping.

The results determined from the data on dipping performance contradict the chinning performance results. As determined by dipping, the Montana group exhibited as high a degree of arm and shoulder strength and endurance as one of the three college groups and showed to be superior to the others. The data for the comparison in dipping is shown in Table IV.

TABLE IV

COMPARISON OF THREE COLLEGE GROUPS OF ABOUT 16 YEARS AGO WITH THE 1958 MONTANA GROUP IN DIPPING

COLLEGE GROUP	MEAN	OBSERVED DIFFERENCE OF THE MEAN	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
Montana (1958)	7.40			
Illinois (1940)	7.15	.25	.261	.97
Indiana (1942)	4.86	2.54	.259	9.81
CCNY (1943)	5.34	2.06	.311	6.62

III. COMPARISON OF PUSH-UP PERFORMANCE

Only two of the college groups of approximately 16 years ago, used in this study, employed push-ups as a measure of arm and shoulder strength and endurance. The groups were of the Indiana and the

Michigan students. The critical ratio technique was again used to establish whether the observed difference was significant. The data used in this treatment is shown in Table V.

TABLE V

STATISTICAL DATA OF EACH TEST GROUP FOR PUSH-UPS

COLLEGE GROUP	MEAN	STANDARD DEVIATION	STANDARD ERROR
Montana (1958)	25.48	9.00	.47
Indiana (1942)	16.88	6.66	.21
Michigan (1942)	15.93	6.45	.16

Comparison of Montana - Indiana in Push-Ups.

The 1,008 students tested at Indiana University in push-ups in 1942 had a mean of 16.88. This mean was 8.60 push-ups below the mean of the 363 Montana students. A standard error of the difference of .517 was then computed. The resultant critical ratio was 16.6. This high critical ratio was clearly significant at far beyond the .01 level. As exhibited by push-up performance, it appears the Montana students of 1958 were superior in arm and shoulder strength and endurance to the Indiana test group of 1942.

Comparison of Montana - Michigan in Push-Ups.

The mean of the Michigan test group of 1,141 students in 1942 was 15.93 push-ups. This represented an observed difference of 9.55 push-ups below the Montana mean of 25.48. The obtained critical ratio of 19.5 was even higher than the critical ratio found in the Indiana comparison. This was also highly significant. From these findings,

it would be concluded that the Montana group was superior in push-up performance as compared to the Michigan students. Table VI shows the comparison data for push-ups.

TABLE VI

COMPARISON OF TWO COLLEGE GROUPS OF ABOUT 16 YEARS AGO WITH THE 1958 MONTANA GROUP IN PUSH-UPS

COLLEGE GROUP	MEAN	OBSERVED DIFFERENCE OF THE MEAN	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
Montana (1958)	25.48			
Indiana (1942)	16.88	8.60	.517	16.6
Michigan (1942)	15.93	9.55	.489	19.6

Summary

From the analysis of the data, these results were observed. In chinning, the Montana group of 1958 was significantly inferior to three of the four groups of about 16 years ago used in comparison. In the dips, the Montana students showed superiority in arm and shoulder strength and endurance to the compared groups by indicating as high a degree of strength and endurance as one study and rating higher than the two other studies. In push-ups, the performance of the Montana students was far above that of the two studies which used push-ups as a measure of strength and endurance of the arms and shoulders for their groups. Assuming that chinning, dips, and push-ups are all valid measures of arm and shoulder strength and endurance, and that the test groups and the testing techniques were similar, no conclusions could be

reached as to whether the Montana students of 1958 were stronger or weaker than students of about 16 years ago in arm and shoulder strength and endurance as measured by the combined test results.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the arm and shoulder strength and endurance of a selected group of students at Montana State University in 1958, and to compare the results of these tests with results obtained by similar groups at other colleges approximately 16 years ago. The comparison was to be used in an attempt to test the hypothesis that American men are growing weaker.

Motivation for the undertaking of this study was brought about by the recent and growing concern and controversy over whether American youth are growing weaker. The author felt more research was needed.

The study proceeded on the following assumptions. (1) that arm and shoulder strength is a component of total strength and has a relationship to total fitness, (2) that the test items used were valid measures of arm and shoulder strength and endurance, and (3) that the groups that were used for comparison, and the testing techniques and procedure of the various groups were similar enough to provide a valid comparison.

In order to limit the study, only one area of total strength and fitness was used for comparison. Tests of arm and shoulder strength and endurance were used in this study for several reasons. Literature reveals that the greatest single weakness of the American male is the lack of strength in the arms and shoulders. This statement is supported in the literature referred to in Chapter I. Another reason for using

tests of arm and shoulder strength and endurance is that practically all physical fitness tests and strength tests employ one or more of these test items as a partial index of total fitness or strength. These items are easily administered with respect to time, equipment, and ease of scoring. Also, there was data for these events available from previous studies which could be used for comparison.

By a review of the literature, the author sought to uncover studies which would date back as early as possible in order to provide a more significant comparison. However, research failed to find tests that dated back beyond 1940 which gave sufficient statistical information to provide a valid comparison. Four studies in the early 1940's were found that provided sufficient data with which the author was able to compare the 1958 Montana group.

Chinning, dipping, and floor push-ups were used to determine the strength and endurance of the arms and shoulders, as these items were found to have high validity in measuring this factor. All of the studies used for comparison employed at least two of the items in their tests. Detailed instructions for administering each test item were not provided by all the studies. However, the test items are fairly standardized, and it was assumed that any variations would be minor and should not significantly affect the results.

Standard statistical methods were employed for the analysis of data in this study. The critical ratio technique was the primary method used, and the .01 level of confidence was the minimum standard for acceptance as to whether a difference between two groups was real or due to chance.

In the analysis of chinning performances, it was found that the 1958 students, as represented by the Montana group, were significantly inferior to three of the four groups of about 16 years ago. On the basis of this evidence alone, it would appear that the presumption of growing weakness in American men could be supported. However, in the analysis of the data on dipping performances, the results contradicted the chinning performances. The Montana group proved to be superior to students tested in the previous studies. This evidence, by itself, would tend to disprove the hypothesis that American youth are growing weaker. In the analysis of the data on push-ups, only two of the four previous studies employed this test item for measuring arm and shoulder strength and endurance; however, the results of the comparison showed Montana students to be decidedly superior in arm and shoulder strength and endurance, as measured by push-ups. To summarize, the statistical comparisons showed the Montana college group of today to be inferior to the college groups of about 16 years ago in chinning, and superior in dipping and push-ups.

It would be difficult, without specific information as to the techniques used in the administration of the earlier tests, to explain the resulting contradictions and large differences that were observed in the comparisons. Because the study was limited by time available for its completion, the explicit techniques and instructions for administering the test items could not be obtained for each of the previous studies. The author relied only upon the published data available.

From the published information, it was assumed that the test groups were similar. The studies conducted at Indiana University and

the University of Michigan did not designate the class standing of the testees; only that "college men" were used. It may be noted that the College of the City of New York study used only freshmen students in their testing program. The Montana students showed superiority to this group in each test item. Perhaps the fact that the Montana study utilized both freshmen and sophomore students might possibly have contributed to the superior performance that was revealed in the comparison. However, the students tested at the University of Illinois were composed of freshmen and sophomore students also. It was revealed in this comparison that the Illinois students significantly exceeded the performance of the Montana men in one event, and no real difference existed between the two groups in the other event. Motivation and effort are factors which could influence performance in the tests, but could not be measured.

The author realizes that a 15 to 18 year span is not a sufficiently great length of time to observe any real change in physical fitness status. For similar studies, it is suggested that other techniques of comparison might be employed that could utilize data available on earlier tests which were not complete enough to permit their use in the critical ratio method utilized in this study.

In summary, due to the conflicting evidence obtained in this study, no definite conclusions on a change of status in arm and shoulder strength and endurance could be reached. The hypothesis that American men are growing weaker could neither be supported nor denied by the results of this study. More research is needed.

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APPENDIX

GENERAL INSTRUCTIONS

INSTRUCTIONS FOR CHINS

INSTRUCTIONS FOR DIPS

INSTRUCTIONS FOR PUSH-UPS

SAMPLE SCORE SHEET

INSTRUCTIONS

TO BE READ IN CLASS

All students at Montana State University participating in physical education activity classes during spring quarter, 1958, will be asked to chin themselves, do push-ups, and dips for the purpose of determining the status of arm and shoulder strength and endurance.

The lack of strength and endurance of the arms and shoulders has been found to be the greatest single weakness in determining physical fitness of American men. It has been claimed that American men are growing progressively weaker. In an attempt to test this hypothesis, the results of this test will be compared with results obtained from physical fitness tests administered 15 to 18 years ago.

Each test item will be given on separate days to allow ample rest in order to insure best results. On the day of testing, students will report to the northwest end of the gym floor, where the testing station will be set up. A score sheet has been made for each activity class which provides for the student's name and his score on each test item.

Absences from a testing period will be made up at a future date. The scores on this test will not affect the student's grade; however, it is extremely important that everyone do his best in each event. Otherwise, a valid comparison cannot be made.

INSTRUCTIONS FOR CHINS

Subject stands below the chinning bar which is high enough from the floor so that the subject's feet do not touch the floor when performing the test. The palms forward grip will be used. Start from a full arm hang, pull up until the chin is even with or above bar and return to a full arm hang. No swinging or kicking is allowed. They must be executed regularly without rest, and no partial or half chins will be counted. Perform as many as possible.

INSTRUCTIONS FOR DIPS

With the parallel bars at shoulder height, the subject stands at the end of the parallel bars and grasps one bar in each hand. The subject jumps to a front support position with the arms straight. This will be counted as one dip. Lower the body until the elbows are bent to a right angle or less and then push up to the starting position. Do not swing, kick, or rest in any position. Partial dips do not count. Perform as many as possible.

INSTRUCTIONS FOR PUSH-UPS

The subject's starting position is lying face down on the floor with the hands placed directly under the chest and about shoulder width apart. Then push your body up by extending your arms, then lower the body until the chest just touches the floor. Keep the back straight throughout and extend arms fully each time. Perform regularly without rest; no partial push-ups will be counted. Do as many as possible.

SAMPLE SCORE SHEET

ACTIVITY

SECTION NUMBER

NAME OF STUDENT	NUMBER OF CHINS	NUMBER OF DIPS	NUMBER OF PUSH-UPS