A COMPARATIVE STUDY OF THE ARMY AIR FORCE PHYSICAL FITNESS RATING AND THE McCLOY PHYSICAL FITNESS INDEX

by

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INTRODUCTION

During the spring semester of 1943 the Army Air Forces established a training detachment at Kansas State College. The cadets were required to participate in physical training one hour each day, six days a week. The Army prescribed the physical training program, including the use of a physical fitness rating test to measure the progress of the cadet's physical condition. This physical fitness rating record was sent with the cadet to his advanced training base. The question immediately arose--does this physical fitness test measure physical fitness. In an attempt to answer this question the investigator has made use of the McCloy Physical Fitness Index Test, a well known physical fitness test, as a criterion to determine the validity of the Army Air Forces Physical Fitness Rating Test.

The physical fitness rating test used by the Army Air Forces is for convenience called the P.F.R. test. The P.F.R. test is a battery of three tests of strength and endurance. The tests are: (a) the sit-up; (b) the pull-up; and (c) the 300-yard run. The raw score on each test is converted into a percentile rank score. The sum of these percentile rank scores is then converted into a percentile rank score known as the P.F.R.

The McCloy Physical Fitness Test is for convenience called the P.F.I. test. It is a strength test battery consisting of six tests to measure muscular strength. The tests are: (a) left hand grip; (b) right hand grip; (c) back lift; (d) leg lift; (e) dips; and (f) chins. The sum of the scores of these tests

yields the strength index. This strength index divided by the normal strength and multiplied by 100 produces the P.F.I.

"Physical Fitness" is the term about which this whole problem hinges. Both of the tests used in this study purport to measure physical fitness. McCloy (9) has the following to say:

> Since strength is the most important element in motor performance, it is felt that strength relative to age and weight, expressed in the form of a Physical Fitness Index, is an excellent measure of an individual's general ability to work. We believe that strength tests should be used as a routine measure of general physical status of individuals, both in youth and as adults.

The AAF Regulation No. 50-14 (1) gives the following definition:

> Physical fitness is that degree of fitness which permits one to expend physical effort for a maximum period, with a minimum amount of fatigue. The degree of physical fitness will be determined by the amount of muscular work one can perform in a certain amount of time.

It is the opinion of the investigator that the authors of both of these tests do not have the same concept of physical fitness, and in attempting to measure physical fitness each is using a different technique. McCloy using the P.F.I. test is measuring the maximum amount of work or pounds of force exerted in a relatively short period of time, while the authors of the P.F.R. test are measuring the maximum amount of work or effort that can be maintained over a relatively much longer period of time. It is generally agreed that without strength there can be no endurance, and that endurance is strength exerted with reserve over a relatively longer period of time. However, neither of the batteries contains a test which must be completed within a prescribed amount of time. The amount of time required for

strength to be exerted is relatively much longer for the P.F.R. than for the P.F.I. test. For this reason the P.F.I. test is referred to as a strength test while the P.F.R. test is chiefly an endurance test. However, the P.F.R. does not represent the extreme in endurance testing since it is only a short battery of three tests to be executed within a one hour class period. Therefore it may be justifiable to say that the P.F.R. test is a test of strength and endurance as described in the AAF Regulation No. 50-14 (1).

The P.F.R. test has a number of advantages over the P.F.I. test that make it a desirable tool for testing large groups. It takes only a short period of time to administer the test. It requires no equipment that is not already in every gymnasium. There are no calculations necessary to arrive at the P.F.R. at the close of the test. It does not interfere with the cadet's physical conditioning progress since the tests of the P.F.R. battery are in his daily exercises as explained in the materials and method of procedure. If the P.F.R. test proves to show validity comparable to the P.F.I. test it should be a desirable physical fitness test.

The group tested, consisting of three flights of 30 men each, was stationed at Kansas State College for a period of training for 13 weeks.

The nature of the problem was such that it required the gathering of three sets of data for each fitness test. One set of data was gathered for each test at the beginning of the physical training course; one set six weeks later; and the third set still

another six weeks later, which was at the close of the course. In gathering these three sets of data the Physical Fitness Rating Test was given one week ahead of the Physical Fitness Index Test in each case so as not to destroy the validity of either test.

In the following section the investigator shows by a review of the related investigations the history and significance of the two tests involved in this study. In the third section of the study the investigator describes the subjects tested, the apparatus used, the tests used, the administration of tests, and the assembling of the data. In the fourth section the investigator presents the analysis of the data and makes a subjective evaluation of the P.F.R. as a test of physical fitness. In the final section is found a brief summary, conclusions drawn, and recommendations for further study.

REVIEW OF RELATED INVESTIGATION

In reviewing the literature related to this study the investigator finds that test makers have concentrated on tests designed to predict athletic ability and success rather than tests to determine physical fitness. Building physical fitness for war and fitness for athletics are two somewhat different tasks. However, the men who are in charge of building fitness for war are from the field of physical education and athletics. These men are using the knowledge and experiences gained in their respective fields together with the information supplied by the military authorities to develop fitness for survival.

In reviewing the studies bearing on the P.F.I. it seems a brief history of this test will help to show its relation to fitness testing as viewed in this study. Strength testing was made popular in this country in the period from 1860-75 by Dr. George B. Winship. In the late '80's the intercollegiate strength test was developed by Dudley A. Sargent. It included (a) lung strength; (b) sum of left and right hand grips; (c) the back lift; (d) the leg lift; (e) and arm strength. This test was modified from time to time until in 1925 Frederick Rand Rogers in his doctoral dissertation presented a revised strength test known as the Physical Fitness Index, commonly called the P.F.I. (11). Rogers' test was very similar to the Sargent test, but the administration and scoring were modified. Rogers' P.F.I. includes the following tests: (a) left hand grip; (b) right hand grip; (c) back lift; (d) leg lift; (e) dips; (f) chins; and (g) lung capacity. The sum of the scores of these tests yields an individual's strength index. This strength index divided by the normal strength index for an individual's age and weight multiplied by 100 yields the P.F.I. Rogers strongly supports the use of the P.F.I. as indicator of physical fitness. He states:

> When determined by technically well trained and physically strong specialists the Physical Fitness Index is one of the most reliable indices in educational use.
>
> Primarily the tests measure certain important phases or manifestations of physical fitness which are susceptible of improvement through physical activity.
>
> A prime objective of the physical education pro-

> gram is improvement of pupil's physical fitness: their power or capacity to live physically, to perform physical acts, to manipulate the limbs and external objects. Such powers are expressed in muscular activities, which in turn depend on muscular strength, and therefore power to perform physical acts; in a word, to live, on the physical plane at least.

According to Rogers, low P.F.I. scores indicate poor health. "An individual with a high strength index is capable of making a varsity team."

McCloy (9) in 1932 suggested a new formula for scoring chinning and dipping strength. He also suggests that lung capacity be eliminated as it is not a test of strength. The following tests are included in McCloy's P.F.I.: (a) left hand grip; (b) right hand grip; (c) back lift; (d) leg lift; (e) dips; and (f) chins. The sum of the scores resulting from the above tests produces the individual's strength index. The strength index divided by the individual's normal strength index and multiplied by 100 yields the P.F.I. This test as revised and scored by McCloy is the test used by the investigator in this study. It differs in a few respects from Rogers' P.F.I. It does not include the test for measuring lung capacity, it does not include the measurement of height, and McCloy uses a different formula for computing chinning and dipping strength. The use of a belt is permissible in performing the leg lift. The belt was used in this study.

It is the opinion of the investigator that McCloy is more conservative than Rogers in proclaiming the value of the P.F.I. as a valid measure of physical fitness. McCloy (9) makes the following assertion:

> Strength tests in the form of the physical fitness index contribute much to the estimation of present health. They are not infallible and leave much to be desired, but correlate highly with physicians' estimates of health status and it must be remembered that physicians' estimates of health have in themselves only a reliability of about .6. The Physical Fitness Index as a measure of health is a very desirable supplement to the medical examination. Where a low P.F.I. is found, the individual should be carefully examined by a competent physician before being assigned to strenuous physical activities.

The statement that the P.F.I. is a desirable supplement to the medical examination is the same stand taken by the AAF for the P.F.R. Along with this brief history of the development of the P.F.I. test the investigator wishes to make reference to a most comprehensive study of strength testing by two prominent physical educators.

Cureton and Larson (3) review a bibliography consisting of 101 studies related to strength testing as an approach to physical fitness. They state:

> Hundreds of studies have developed showing the results of the strength testing program. Confusion has resulted in the interpretation of these and certain errors in norming and in testing have been brought to light. It has been exceedingly hard to prove the assumed relation between the strength test scores and health indices, except in the area of power types of athletic performance.

They also point out that the P.F.I. does not correlate well with tests of running, swimming, endurance, circulatory-respiratory indices, flexibility, posture, or specific types of disease immunities. However, they go on to say:

> Strength is dominant in power types of athletic performance. The strength or power indices of Rogers, MacCurdy, McCloy, Cozens, and Larson are all valuable devices for measuring strength and power capacity from which dynamic types of athletic performances may be predicted with considerable efficiency.

Cureton and Larson (3) report that Cozens in his study of strength as a measure of General Athletic Ability in college men found that the factors of age and weight so prominent in Rogers' Strength Index for high school boys have no significance in a strength index designed to predict general athletic ability in college men. The factor of height, however, becomes rather prominent in an index for college men. For rough estimations of general athletic ability, the index of chins plus dips plus height is stated to be the most useful because of the factor of speed in administration. The index of chins plus dips plus height when correlated with general athletic ability produced a correlation coefficient of .686.

The factor of height is not included in the P.F.I. score nor the P.F.R. score, indicating that it is not an important factor effecting physical fitness, but does play a prominent part in predicting athletic ability as pointed out by Cozens. However, the factors of age and weight which Cozens says are not significant for predicting athletic ability are useful in the McCloy P.F.I. for indicating physical fitness. Age and weight are not taken into consideration in the P.F.R., but the AAF does recognize that these two factors effect the scores. Since the age and weight of the group used for this study were limited by AAF Regulations these factors are not as important as they would be in a more heterogeneous group.

Among the short strength tests, Cureton and Larson (3) point out that McCloy's formula for chinning when correlated with total strength produces a correlation coefficient of .954.

It is apparent from the studies by Cureton and Larson that test makers have attempted to devise short strength test batteries to predict athletic ability. This same concept seems to be held by the AAF authorities who devised the P.F.R. They, too, are depending on a short battery of tests to measure the physical fitness of Army flyers.

Curaton and Larson's conclusions are as follows:

1. Strength is one type of physical fitness which is high in mesomorphic types.

2. Strength can be improved within limits of physical build but extreme changes from one major type to another are not to be expected.

3. Much confusion exists over the interpretation attached to strength scores, not all of which is reconcilable with the research evidence at hand.

4. The various strength batteries of Rogers, MacCurdy, McCloy, Cozens, and Larson correlate from .500 to .700 with composite batteries of dynamic athletic activities and are useful devices for classification of groups.

5. Specific types of skills, such as swimming, tennis, golf, riding, shooting, etc., are not predictable from strength scores with a high degree of efficiency.

6. Strength scores are functions of external leverage, internal leverage, educability, psychical states, constitutional type, neuromuscular conditioning, and nutritive state in the muscle fibers. What they mean exactly is difficult to tell in an individual case.

7. Strength scores do not correlate well with muscle girth or thickness measures, circulatory-respiratory measurements, flexibility scores, posture scores, Brace motor ability scores, or incidence of disease (within the limits of the data at hand). Epidemics sweep through the strong as well as the weak.

8. Specific case studies show that the Rogers P.F.I. (Physical Fitness Index) is not normed so that it is meaningful to the authors' concepts of health. It is a hazardous device upon which to base a program as a single indicator of "fitness".

9. It may be safely concluded that current scientific opinion cannot grant that physical fitness may be deduced from one set of measurements alone or that muscular strength is either an accurate or a valuable index of physical fitness.

The AAF physical training program was developed by specialists in tests and measurements from the field of physical education. The only information available to the physical training staff at Kansas State College concerning the instructional and testing program for the AAF was a bulletin--AAF Regulation No. 50-14 and the direct information received from the Commanding Officer of the local unit. The application and function of the P.F.R. is perhaps best explained by quoting from AAF Regulation No. 50-14 (1) as follows:

1. This physical fitness test is designed to measure those aspects of physical fitness to be accomplished by the physical activities program, namely;

   (a) Abdominal Muscular Strength and Endurance (Sit-ups)

   (b) Shoulder Girdle Muscular Strength and Endurance (Pull-ups)

   (c) Speed and Cardio Respiratory Endurance (Shuttle-run)

2. The above-mentioned aspects of Physical Fitness may be developed through a Physical Fitness Program which places emphasis on exercises of speed, muscular strength power and endurance, running endurance, agility, coordination and flexibility.

3. The P.F.R. - PHYSICAL FITNESS RATING is interpreted in the form of a score indicative of the physical condition of the testee.

4. This test has two functions:

   (a) The measurement of the trainee's status and the amount of improvement accomplished.

   (b) The measurement of the effectiveness of the physical fitness program.

5. The test is applicable to all age groups. Age corrections are not made because war fitness is determined by what one can do. Five standards are provided without age corrections; they are: excellent, very good, good, poor, and very poor. Those trainees who fall in the very poor and poor categories are considered as being in an unsatisfactory condition according to AAF standards

6. It is permissible for the testee to remove fatigue suit or T.I. shoes for lighter clothing if he so desires, in either case the final score will be altered only slightly.

7. Information resulting from this testing program serves as a basis for program of adjustments with respect to:

   (a) Time

   (b) Physical activities

   (c) Personnel

   (d) Equipment

   (e) Facilities

   (f) Health conditions and practices

   (g) Trainee assignments

8. The AAF Physical Fitness Test does not prevent a Director of Physical Training from giving other tests, but it is recommended that the AAF Physical Fitness Test and the additional test items be administered on separate days, in order not to destroy the validity of either test.

The bulletin goes on in detail to explain the administration of the testing program, which the investigator has included in the section dealing with subject, materials and administration of this study. In view of the literature just cited the P.F.R. is designed to measure the trainee's progress in a specific physical conditioning program. The trainee's program of conditioning is then regulated according to the needs shown by his test results.

The Army Air Forces Physical Fitness Research Program carried on by the Headquarters, Army Air Forces, Washington, D. C. (6) has produced results of significance to this study. They re-

port that, "There is a gradual but steady decline in the state of physical fitness (of personnel entering the AAF) from the age of 18 to the age of 45." They also report that, "No relationship is found between the state of physical fitness and cardiovascular-respiratory ratings." The AAF does not allow age to influence the P.F.R. score, but recognizes that it effects the results of the test. The statement that no relationship is found between the state of physical fitness and cardiovascular-respiratory ratings lends support to McCloy's contention that lung capacity is of very little, if any, value as a measurement to be used in a strength test.

DeWitt (5) in making a study of one of the tests of the P.F.R. battery, the sit-up, found very little correlation between abdominal strength and endurance of abdominal muscles in performing the sit-up. He also concluded that heavier and taller men appear to be handicapped in performing tests of the sit-up type. The investigator will point to similar evidence in the portion of the thesis dealing with analysis and interpretation of data.

The investigations related to the P.F.I. point out that: (a) Very little correlation exists between strength tests and running; (b) very little correlation exists between strength tests and cardio-respiratory measurements; (c) strength tests correlate from .500 to .700 with power types of athletic performance; (d) strength tests alone are not adequate measures of physical fitness; (e) short tests are desirable for ease of administration; (f) individuals making very low scores on strength tests should be given careful attention by a physician; and (g) the factors of

age, height, and weight definitely influence the strength test scores.

The investigations related to the P.F.R. point out that: (a) The P.F.R. alone is not an adequate measure of physical fitness; (b) age is a handicap in making a good P.F.R. score; (c) height is a handicap in making a good P.F.R. score; (d) weight is a handicap in making a good P.F.R. score; (e) no relationship is found between the stats of physical fitness and cardiovascular-respiratory ratings; and (f) short tests are desirable for ease of administration and scoring.

Since the AAF of World War II are the first to use the P.F.R. there is very little research available to be investigated. The P.F.I. has been used in various forms for a number of years, but not to test physical fitness for war purposes. For these reasons it is difficult to find studies related to the kind of "Physical Fitness" the AAF is attempting to build.

The findings in this section will be referred to again in the section dealing with analysis and interpretation of data and be compared to the findings of this study.

SUBJECTS, MATERIALS, AND ADMINISTRATION OF TESTS

The group of air corps cadets used in this study consisted of three flights of 30 men each. Each flight reported to physical training class at a different hour, which made it easier to administer the tests. For various reasons class attendance was not as regular as might be expected for a group selected largely because of the physical qualifications necessary for an individual to be

in the AAF. Consequently the investigator was able to get only 63 men who completed all of the tests. The AAF did not make available to the physical training staff of Kansas State College any of the physical qualifications of an Air Corps Cadet except age, height, and weight. These the investigator has included in Table 1.

Table 1. Mean, range, and standard deviation of subjects.

Item	Mean	Range	S.D.
Age	20.67	18-26	1.99
Height	70.30	66-74	2.01
Wgt. 1st test	159.00	130-195	14.85
Wgt. 2nd test	157.85	130-190	13.85
Wgt. 3rd test	157.16	130-190	13.80

In Table 1 it will be noted that the mean age for the group is 20.67 years. Their ages range from 18 to 26 years. The mean height for the group is 70.30 inches. Their heights range from 66 to 74 inches. The slight change that occurred in age and the slight change that might have occurred in height was not recorded because it would not have been of any significance to the study. However, weight was recorded for each test. It will be noticed that the mean weight decreased 1.15 pounds from the first to the second test and decreased only .69 pounds from the second to the third test. This is evidence that men not in condition carry excess weight and at the beginning of a physical training program lose it more rapidly than later.

The upper limit of the range decreased five pounds from the first to the second test, but remained constant from the second to the third test. The standard deviation of the distribution of weights decreased one pound from the first to the second test and decreased only .05 pounds from the second to the third test. This would also indicate that the training program causes a more rapid loss of weight at the beginning than later when the cadets become conditioned.

The apparatus for the P.F.I. test consisted of one hand grip dynamometer, one dynamometer with adjustable chain and belt to measure back and leg strength, one set of parellel bars, one high horizontal bar, and some towels and magnesium to keep the hands dry when gripping the instruments.

Score sheets were prepared containing blank spaces for name, flight number, test number, date, age, weight, scores for each test of the battery, strength index, normal strength index, and P.F.I. For sample score sheet, see page 3 of Appendix.

The P.F.I. test consists of a battery of six physical performance tests. The first test of the battery is the grip strength of the left hand measured with a hand grip dynamometer. The second test is the grip strength of the right hand measured in the same way. To facilitate gripping, dry towels and magnesium were available and used. The subjects were allowed extra trials, but the first trial usually produced the best score.

The third test is back lifting strength measured by having the subject grasp a bar fastened to an adjustable chain which was anchored to a dynamometer on whose platform the subject stood. The chain was adjusted so that the arms hung straight

from the shoulders with hands in front of the thighs. The back was bent about 25 degrees forward at the waist and the subject then lifted by attempting to straighten his back while keeping his knees straight. There were slight differences in the degree of back bend because of inability exactly to adjust the chain to individual differences in height.

The fourth item is the leg lift, which is performed with the same dynamometer as used for the back lift. This time the subject kept his back straight but his knees were bent to an angle of about 120 degrees. A wide webb belt was placed around his back and fastened to the bar on the chain; he also grasped the bar with his hands. He then lifted by attempting to straighten his legs. Here again slight differences occurred in the angle the knees were bent because of the inability to make proper adjustments in chain length.

The fifth test of the battery is dipping on the parallel bars. This was done by having the subject mount to the cross rest position at the end of the bars. He then proceeded to lower his body between the bars by bending the elbows until the shoulders were as low as the elbows, and then returned to the starting position, repeating this performance as many times as possible. In executing this movement the body and legs of the subject were approximately in a straight line and he was not allowed to kick or jerk. If the subject did not go all of the way up or down he was given a half credit. He was stopped if he committed four half credits in succession. The subject was allowed to perform the dips as rapidly as he wished.

The sixth and last test of the battery is chinning as many times as possible. The subject was allowed to use either grasp on the bar. Hanging with arms at full length, he was required to lift himself until his chin was over the bar, and return to the starting position. In executing this movement the body and legs of the subject were approximately in a straight line and he was not allowed to kick or jerk. He was stopped if he committed four half credits in succession.

The P.F.I. test was introduced to the group as a supplement to the P.F.R. test for research purposes. Each of the six tests was explained and demonstrated to the group before anyone was tested. As the subject came to each station he was coached and encouraged to do his level best by the attendant in charge. They were told in advance the approximately score to expect on each dynamometer test. The dynamometer tests being new to the group, they were anxious to repeat if a poor score was made. Cadets were much more enthusiastic about the P.F.I. test than they were about the P.F.R. test.

The apparatus for the P.F.R. battery consisted of four high horizontal bars for the pull-up so as to test four or more subjects at the same time; a set of eight running lanes two yards wide and sixty yards long, parallel and adjacent to each other, with an 18-inch stake in the middle of each end of each lane around which the subject must run to participate in the 300-yard run; and a gym floor equipped with enough floor mats for eight stations on which to perform the Army sit-up.

Score sheets for the P.F.R. test were furnished by the AAF.

(See Appendix, pages 1 and 2.) On the front side of the sheet is found a space for each of the following: name, age, height, weight, test number, date, and P.F.R. score. On the back side of the score sheet are found spaces for tabulating raw scores and scales for converting them into percentile rank scores, the sum of which produces the P.F.R.

The P.F.R. test consists of a battery of three physical performance tests. The individual is first required to perform the Army sit-up by lying on his back with hands clasped behind his neck. With someone holding his ankles to the floor he then bends forward at the waist and touches either elbow to the opposite knee and returns to the starting position. The next time he bends forward he touches the other elbow to the other knee and continues to alternate in this manner as long as possible. He is not allowed any rest or pause when his body is either in a reclining or sit-up position, nor is he allowed to use his elbow or bounce his body against the floor. He is cautioned not to work too fast for best results. Each sit-up is counted aloud by an assistant and the number recorded when the subject finishes.

The second test of the battery is the pull-up on the horizontal bar using the reverse grasp. Hanging with arms at full length, the cadet was required to lift himself until his chin was over the bar, and then return to the starting position. In executing this movement the body and legs of the subject were approximately in a straight line and he was not allowed to kick or jerk. He was stopped if he committed four incomplete pull-ups in succession. These incomplete pull-ups were each counted as

one half credit. The assistant counts aloud so the subject may know the score as he participates.

The third and final test of the battery is to run the 300-yard shuttle-run over a 60-yard course. Each subject has a course 60 yards long and two yards wide with an 18-inch stake in the middle of each end of the course around which he must run. To run 300 yards the subject must run five lengths of the course going around the stakes at each end and finishing at the opposite end of the course from which he started. He runs against time, which is called out by an assistant with a stop-watch. The time is recorded to the nearest second. The assistant with the stop-watch reads in a loud voice the number of seconds that have elapsed as the runners come over the finish line. An assistant stands near the finish line for each course and records the time for the runner on that course.

The cadets understood that the P.F.R. became a part of their cumulative record that was sent to the advanced base with them. The detailed description of the test was read to them the day before the test was administered. The tests were also demonstrated and they were allowed to practice them. This procedure was necessary to insure proper form by the testee. It was also necessary from the standpoint of the time element when handling large classes. This procedure also attracted more attention to the testing program and aided the testee in being mentally and physically ready. The subject knew in advance about what score he could make, because the exercises (closely related to the individual tests) were participated in daily, but

not with an "all-out" effort. The cadets were much more familiar with the mechanics and function of the P.F.R. test than they were with the P.F.I. test. The P.F.I. test was before them only on the day of the test and of the six tests of the battery, only chinning and dipping were participated in during the physical training period. The other four tests, left hand grip, right hand grip, back lift, and leg lift were not subjected to closely related physical training exercises. The investigator was allowed only the one hour each time the P.F.I. test was administered.

The P.F.I. test was administered by the investigator, assisted by members of the physical education staff and members of the senior class majoring in physical education. Two men measured and recorded weight, height, and grip strength; two men did the same for back and leg strength; and two men measured and recorded dips and chins. Calculations necessary to compute the total scores for each subject were completed by the investigator at another time.

The computation of each individual's P.F.I. was no small chore. Before the scores on the separate tests could be added, the back and leg strength scores had to be converted from kilograms to pounds; a correction table had to be consulted for the leg lift because of the use of the belt around the waist; the number of chins and dips were added together and then a chinning and dipping scoring table consulted to ascertain the value in pounds of strength. After the score on each test was converted to pounds of strength, these scores were added together to ob-

tain the subject's strength index. The strength index divided by the normal strength index (McCloy's Tables), multiplied by 100 produced the Physical Fitness Index (P.F.I.) for each cadet.

All of the above scores in pounds of strength for each test of the P.F.I. battery were transferred to a data sheet which also included the scores for each test of the P.F.R. battery.

The P.F.R. was administered by the physical training instructors with the aid of assistants who were selected from the flights a few days before the tests were given. These boys were trained in the technique of scoring the subjects. This procedure was required by the AAF. The usual practice was for eight assistants to do the scoring, with one man at each station, while the instructors acted as supervisors. All members of the flight would complete one test of the battery before anyone would start on the next. This afforded some rest between tests.

On the back side of the test sheet the assistant looks up the raw score and circles the corresponding percentile rank score. When all three test items are completed the sum of the percentile rank scores is converted to the P.F.R. score. The P.F.R. score is then placed on the front of the record sheet for the cumulative record. (See sample test sheet, page 1, Appendix.)

The P.F.R. test was given during the first week of training and was followed in one week by the administration of the P.F.I. test so that neither test would interfere with the validity of the other. Six weeks later this procedure was repeated in the same manner for the second set of data gathered. In another six weeks, which was at the end of the period of training for this

group, the third and final set of data was gathered in the same manner as before. Thus there were intervals of six weeks between the three administrations of both the P.F.R. and P.F.I. batteries.

For assembling the data the investigator constructed separate record sheets for each flight and for each pair of tests. The first P.F.I. test records and the first P.F.R. test records were placed on the same sheet by flights. Thus three sheets of data were compiled for each of the three pairs of tests. The following data were recorded: date, age, height, weight, left hand grip, right hand grip, back lift, leg lift, dips, chins, arm strength, strength index, normal strength index, the P.F.I., number of sit-ups, sit-up score, number of pull-ups, pull-up score, and the P.F.R. score.

From the assembled data the investigator developed the following section of this study.

ANALYSIS AND INTERPRETATION OF DATA

In this section the investigator first compares the two tests from the standpoint of the statistical findings. Then he makes an evaluation of the validity of the P.F.R. based primarily on a subjective appraisal of the content of the test and its apparent relation to physical fitness.

Statistical Comparisons

Table 2 shows that in both the P.F.R. and the P.F.I. the mean improvement was greater from the first to the second test

Table 2. Mean, range, standard deviation, and standard error of the mean, of the scores for the P.F.R. and the P.F.I.

Tests	Mean	Range	S.D.	S.E. of M.
1st P.F.R.	53.70	38-66	6.35	.807
2nd P.F.R.	58.57	42-75	7.5	.953
3rd P.F.R.	60.81	46-81	7.4	.940
1st P.F.I.	100.16	87-117	6.87	.876
2nd P.F.I.	104.67	90-116	5.83	.741
3rd P.F.I.	105.65	93-119	5.25	.666

than from the second to the third test. Assuming equal effectiveness of the physical fitness program during the two six-weeks periods between tests, it can be said that as cadets become more physically fit the rate of increase in the physical fitness score decreases. The difference between the means of the first P.F.R. and the third P.F.R. is 7.11. The standard error of this difference is .55. The ratio of the difference to the standard error of the difference is 12.93. We can conclude that the difference is highly significant since the significance ratio is greater than the 3.33 required for the 0.1 per cent level of confidence. The difference between the means of the first P.F.I. and third P.F.I. is 5.49. The standard error of this difference is .58. The significance ratio is 9.46, which enables us to conclude that this difference is also highly significant.

The highly significant differences between the means of first and third applications of both the P.F.I. and P.F.R. enable us to

further conclude that the two tests were equally sensitive to the improvement in physical fitness over the entire period of 12 weeks. However, it will be later shown that the two tests differ in their sensitivity to improvement in different portions of the range of physical fitness.

In Table 2 the standard deviations of the P.F.R. increased 1.15 points from test 1 to test 2, but decreased .1 point from test 2 to test 3. For the P.F.R. the standard deviation decreased 1.04 points from test 1 to test 2 and .58 points from test 2 to test 3. The over-all increase from test 1 to test 3 for the P.F.R. was 1.05 points, while for the P.F.I. there was an over-all decrease of 1.62 points from test 1 to test 3. The fact that the standard deviation increased for the P.F.R. and decreased for the P.F.I. over the 12-weeks training period is evidence that the physical fitness program is causing the scores of the P.F.R. to become more heterogeneous and for the P.F.I. more homogeneous.

Table 3. Percentile scores.

Tests	P_0	P_{25}	Mdn.	P_{75}	P_{100}
1st P.F.R.	38	50	54	58	66
2nd P.F.R.	42	54	60	63	75
3rd P.F.R.	46	55	60	65	81
1st P.F.I.	87	95	100	106	117
2nd P.F.I.	90	101	105	109	116
3rd P.F.I.	93	101	106	108	119

The function of Figs. 1 and 2 is to show the shift in the

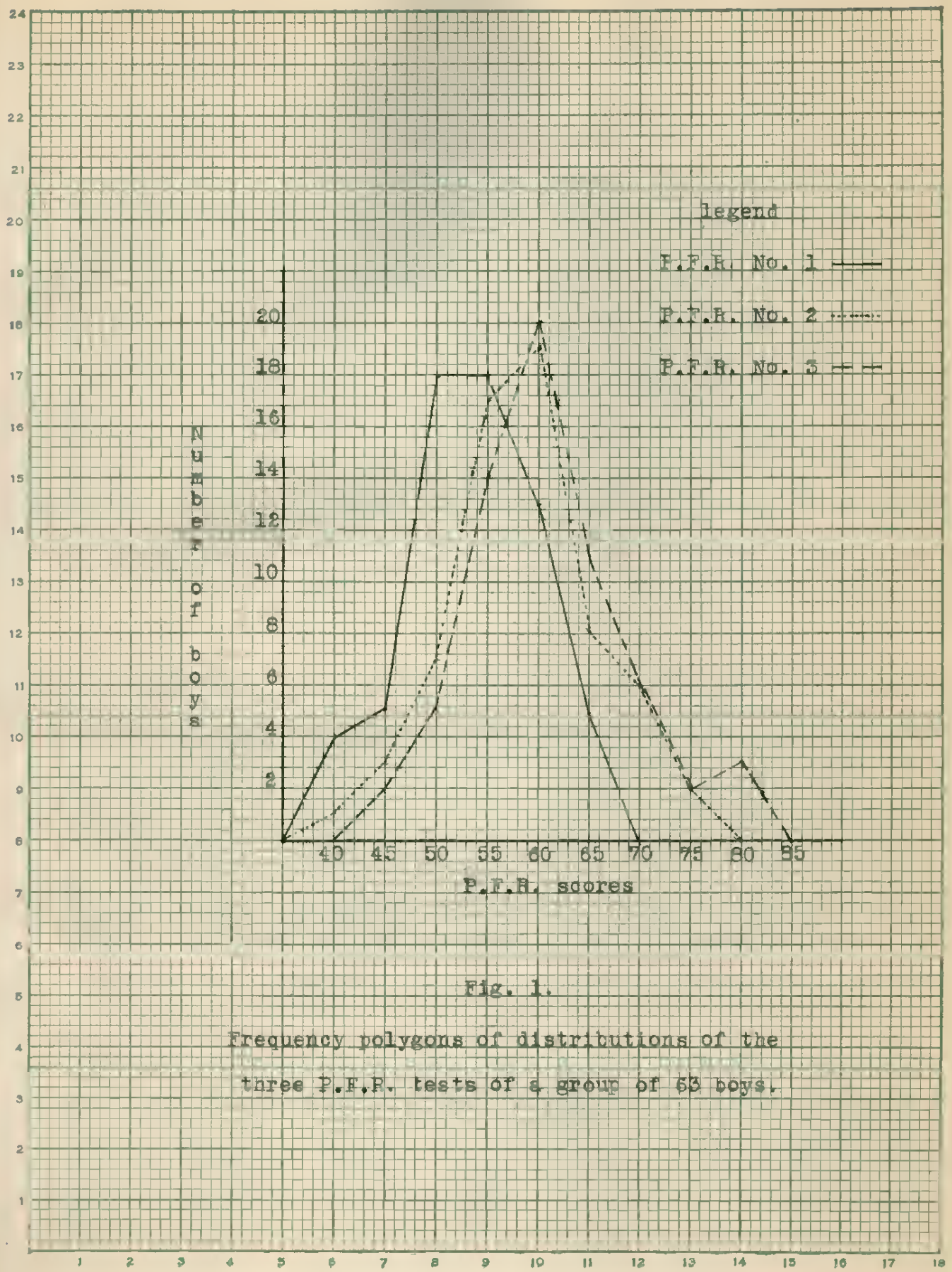

Fig. 1.

Frequency polygons of distributions of the three P.F.R. tests of a group of 53 boys.

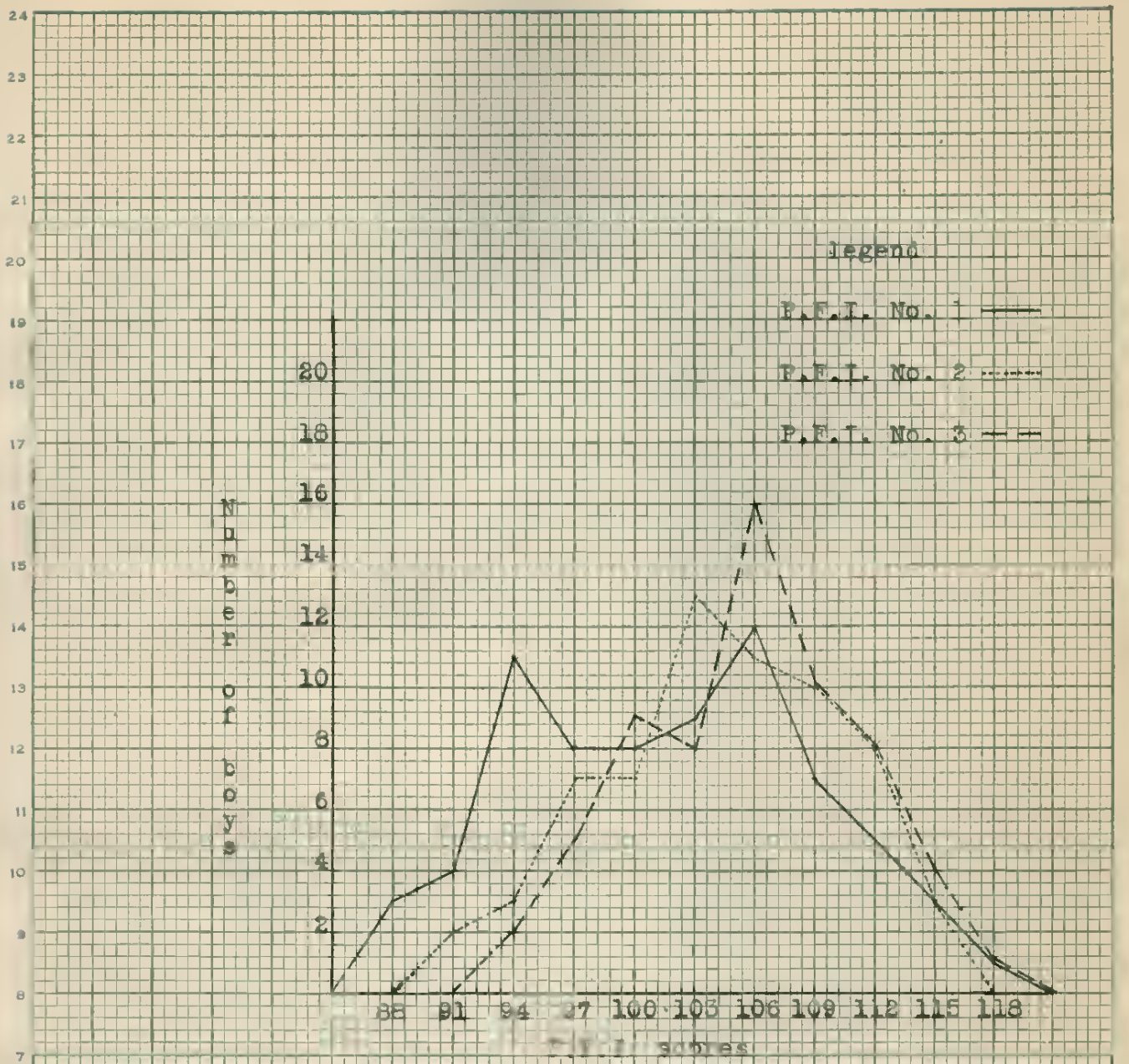

Fig. 2.

Frequency polygons of distributions of the three P.F.I. tests of a group of 63 boys.

entire distributions of scores from test 1 to test 2 to test 3. Table 3 shows the same phenomenon in a different way by listing five points in each distribution, namely: P_0, P_{25}, Mdn., P_{75}, and P_{100}. P_0 and P_{100} are the low and high scores, respectively.

The frequency polygons of the three distributions of P.F.R. scores of Fig. 1 and P_0 of each P.F.R. distribution in Table 3 show that the lower limit of the range moves up four points with each successive test. From Fig. 1 and Table 3 we see that the upper limit of the range increases nine points from test 1 to test 2 and six more points from test 2 to test 3. This is an increase of seven points in the total range from the first P.F.R. to the third P.F.R.

Figure 2 and Table 3 show that the lower limit of the range for the P.F.I. increased three points from test 1 to test 2 and three points from test 2 to test 3. The upper limit of the range decreased one point from test 1 to test 2 and increased three points from test 2 to test 3. This represents a decrease of four points in the total range from the first P.F.I. to the third P.F.I.

Table 3 also shows that Q increases for each successive distribution of P.F.R. scores and decreases for each successive distribution of P.F.I. scores.

The above observations which proceed from the data presented in Figs. 1 and 2 and Table 3, bring out a very important difference between the P.F.R. and the P.F.I. As the physical training proceeds and the physical fitness of the group increases, P.F.R. scores become more heterogeneous and P.F.I. scores become more

homogeneous. In other words, the same program of physical training increases individual differences in the P.F.R. and decreases individual differences in the P.F.I. This is a result of the fact that the P.F.R. test is more sensitive in the upper portion of the range of physical fitness, while the P.F.I. test is more sensitive in the lower portion of the range.

Table 4. Coefficients of reliability.

Tests	Tests	r
1st P.F.R	2nd P.F.R.	.82
1st P.F.R.	3rd P.F.R.	.81
2nd P.F.R.	3rd P.F.R.	.81
1st P.F.I.	2nd P.F.I.	.87
1st P.F.I.	3rd P.F.I.	.75
2nd P.F.I.	3rd P.F.I.	.83

Rogers (11) states that the P.F.I. test, if properly administered to a group at intervals of not more than two weeks, should yield reliability coefficients of .91 to .99. From the data collected in this study it was possible to study the reliability of both batteries of tests by computing the coefficients of correlation between the first and second, first and third, and second and third administrations of each test. This is not exactly comparable to Rogers' method because instead of intervals of two weeks, the intervals here are six weeks, 12 weeks, and six weeks respectively. The three reliability coefficients for the P.F.R. are .82, .81, and .81 respectively; for the P.F.I. are .87, .75, and .83 respectively. In general there seems to be

no significant difference between these two sets of coefficients. Therefore we may conclude that in this particular study the P.F.R. test is as reliable as the P.F.I. test. However neither set of coefficients were as high as Rogers'. This probably was due to the intervals of time between tests in this study, being six weeks and 12 weeks as compared to the two weeks suggested by Rogers. With relisbility coefficients as high as were found in this study it was not deemed necessary to make a separate evaluation of relisbility.

Table 5. Coefficients of correlation.

Tests	Tests	r	S.E. r
1st P.F.R.	1st P.F.I.	.43	.103
2nd P.F.R.	2nd P.F.I.	.55	.089
3rd P.F.R.	3rd P.F.I.	.51	.093

The most important question of the study is the validity of the P.F.R., utilizing the P.F.I. as a criterion. Three validity coefficients were computed, one for each administration of the tests. The correlation between the first P.F.R. and the first P.F.I. is .43 with a standard error of .103. The correlation between the second P.F.R. and the second P.F.I. is .55 with a standard error of .089. The correlation between the third P.F.R. and third P.F.I. is .51 with a standard error of .093. These correlations compare favorably with those reported by Cureton and Larson (3). They report correlations of physical fitness test with other strength tests ranging from .50 to .70. However correlations as low as .43 to .55 mean that more factors of physical fitness are

not common to the two tests than are common to them. In other words, we may conclude that the two tests are for the most part measuring different factors in physical fitness. We may also conclude that, accepting the P.F.I. as a criterion of physical fitness, the P.F.R. is not a very valid measure of physical fitness.

Table 6. Correlations of the P.F.I. with the tests of the P.F.R. battery.

Tests	Tests	r
3rd P.F.I.	sit-ups	.36
3rd P.F.I.	pull-ups	.66
3rd P.F.I.	300-yd. run	.14
3rd P.F.I.	height	-.36
3rd P.F.I.	weight	.37

For further study the investigator has chosen to correlate the third P.F.I. test scores with height, weight, and the parts of the third P.F.R. test battery as shown in Table 6. It is the opinion of the investigator that the data gathered at the close of the physical training program are the most representative of the results of the physical training program. When correlating the third P.F.I. test scores with the scores of the three tests of the third P.F.R. battery--300-yard run, sit-ups, and pull-ups--the following correlation coefficients resulted: .14, .36, and .66 respectively. The 300-yard run is considered chiefly an endurance type test, the sit-up, both strength and endurance, and the pull-up chiefly a strength test. It will be noted from the correlations just cited that the P.F.I. when correlated with other

tests yields higher correletions with tests requiring strength end lower correletions with tests requiring endurance. Cureton and Larson (3) cite similer results.

When correleting parts of e test with the whole bettery one cen expect spuriously high r's (Table 7). With this qualification in mind the investigator has made further study of the relationship of the sit-ups, pull-ups, and the 300-yard run to the totel P.F.R. test battery. The sit-ups with r = .83 produced the highest correlation of sny of the tests with the total P.F.R. test battery. It is interesting to note that the physical training program prescribed by the AAF placed most of its emphasis on building sbdominal muscouler strength and endurance. This test was elso the first test of the battery to be performed by the cedet. The sit-up test meesures both strength and endurance es does the totel P.F.R. test battery. Considering these fects it is reesonable to expect the sit-up test to correlete most highly with the totel score.

Table 7. Correletions of the P.F.R. with the tests of the P.F.R. battery.

Tests	Tests	r
3rd P.F.R.	sit-ups	.83
3rd P.F.R.	pull-ups	.76
3rd P.F.R.	300-yd. run	.22
3rd P.F.R.	height	-.29
3rd P.F.R.	weight	-.39

The correlation between pull-ups end the total P.F.R. score is .76, indicsting thet pull-ups sre elmost ss closely releted

to the P.F.R. as sit-ups. However, pull-ups being a strength test, a somewhat lower correlation is to be expected. McCloy (9) has pointed out that chinning is the best single test of strength as an indicator of physical fitness. Pull-ups having a comparatively high correlation among the tests of the P.F.R. battery when correlated with the total P.F.R. and having the highest correlation among the tests of the P.F.R. battery when correlated with the P.F.I., tend to support McCloy's statement.

The 300-yard run again produced the lowest correlation as it did when correlated with the P.F.I. The shuttle-run is the last test of the battery and the cadet's attitude toward running this test depends on the score he has accumulated on the preceding tests of the P.F.R. battery. Headquarters, Army Air Forces, Washington, D. C. (6) report no relationship between physical fitness and cardiovascular-respiratory ratings. Yet the 300-yard run was designed to measure speed and cardio-respiratory endurance as prescribed by AAF Regulation No. 50-14 (1). The low correlation found by the investigator between the 300-yard run and the total P.F.R. battery compares favorably with the results reported by Cureton and Larson (3).

From Table 1 it will be noted that the mean weight for the group decreases more rapidly at first than later. This is accounted for by the fact that men not in condition carry excess weight which during a period of conditioning is lost and replaced by muscle tissue of better tonus. A conditioning program together with regular hours of sleep, rest, food, and recreation will cause some men to gain weight. However, more men seem to be in poor

condition because of overweight then from underweight.

A change in weight is immediately reflected in the individual's P.F.I. but not in his P.F.R. For example, if a boy loses weight and his strength index remains the same, his P.F.I. will increase because the normal strength index for his new weight will be less. The normal strength index varies with each one pound of weight change.

Correlations from Tables 6 and 7 show that weight is positively correlated with the P.F.I. with a correlation of .37, but negatively correlated with the P.F.R. with a correlation of -.39. It is the opinion of the investigator that this is more evidence that many cadets were not in condition because of overweight rather than underweight.

From Tables 6 and 7 we learn that height correlates negatively with both the P.F.R. and the P.F.I. with correlations of -.36 and -.29 respectively. It is the opinion of the investigator that height is not a handicap in becoming physically fit, but rather a handicap in making a good score on the present physical fitness tests, because of leverages of the various muscle groups involved in the tests performed.

Subjective Evaluation

In the first part of this section the two physical fitness tests were compared through the use of statistical procedures. In general, however, the true quality of a test can rarely be completely described in statistical terms. It is the purpose of this part of the section to show the relationship of the two tests to

each other and to the AAF training and conditioning program from the standpoint of the subjective observations made during the entire course of the study.

The two tests were designed to measure physical fitness, assuming of course, that physical fitness can be isolated for measurement. It is generally agreed that physical fitness is a composite of many traits. The P.F.I. test was designed to measure physical fitness in terms of strength exerted fully for a short period of time, while the P.F.R. test was designed to measure physical fitness in terms of strength exerted conservatively for a much longer period of time. The dipping and chinning tests of the P.F.I. battery are apparently partially testing endurance, even though the method of scoring purports to reduce the scores to strength scores. It is also apparent that the P.F.R. battery is not purely testing endurance since the subjects do not uniformly approach an all-out effort. However it is entirely reasonable to regard the P.F.I. battery as chiefly a test of strength, and the P.F.R. battery as chiefly a test of endurance. It may then be said that each of the two tests is measuring physical fitness, but with different emphasis upon strength and endurance. This agrees with the conclusion arrived at through the statistical analyses.

In a detailed test-by-test comparison of the two batteries, we find that pull-ups or chinning is the only test used in both. In the P.F.R. the number of pull-ups is converted into a percentile rank score, while in the P.F.I. test it is converted into so many pounds of strength. The score derived for the P.F.I. pull-ups represents so many pounds of strength, while the score for

the P.F.R. pull-ups represents an endurence score.

The sit-ups of the P.F.R. battery cannot be compared to any test of the P.F.I. battery since the abdominal muscles are not tested by the P.F.I. test. The sit-up test represents an endurence activity and therefore produces an endurance score.

The 300-yard run of the P.F.R. battery was designed to measure leg endurance plus cardio-respiratory condition. From the standpoint of the muscle group involved the 300-yard run of the P.F.R. battery could be partially compared to the leg lift of the P.F.I. battery. However, the score on the 300-yard run depends largely upon the condition of the cardio-respiretory system. The leg lift test produces purely a strength score registered in pounds, while the 300-yard run produces an endurance score.

Not one test of the P.F.R. battery can be compared to the left hand grip, right hand grip, or the back lift tests of the P.F.I. battery. Actually, then, with one exception, the two tests do not measure the same muscle groups of the body and neither do the derived scores represent the same aspect of physical fitness.

The P.F.I. test was designed to indicate fitness for various sports and programs of activity in physical education. The P.F.R. test was designed to indicate fitness for the Army Air Forces. The P.F.R. test was also designed to measure the effects of the AAF physical conditioning program on the cadet. The tests of the P.F.R. battery were activities representative of the AAF conditioning and training program and at the same time tested the parts of the body that would determine the general physical fitness of the

individual. All of the exercises of the AAF training program contributed daily to the development and conditioning of the muscle groups tested by the P.F.R. battery, but no in the exact manner as during the test nor with an all-out effort. The only tests of the P.F.I. battery affected by practice were the pull-ups and to some extent the dipping test. The other tests of the P.F.I. battery were not touched except on the day of the test.

Effort and attitude certainly affect the P.F.R. score. Pull-ups may be done until the arms absolutely quit and the performer feels no ill after effects. In this particular event nearly all performers did their level best. The sit-up is a more difficult and strenuous exercise and requires a greater determination and effort to get the performers best score possible. The effects of having done sit-ups to exhaustion were felt for several days and were not forgotten when the next testing period arrived. Yet there was something about this event that caused the cadets to attempt to make a good score. They had been told that well developed abdominal muscles would prevent "black-out" and these boys wanted to become pilots. The last test of the P.F.R. battery is the 300-yard shuttle-run and is the most strenuous. A large number of boys lost their last meal and that was not forgotten when the next testing period arrived. It takes fortitude for the cadet to make a good score. A large number of boys did not display any eagerness to do their best. A large number had gone all-out on the other two events to build up a good score to carry them through the 300-yard run with moderate effort. It was also observed that boys who had had track experience in high

school or college sometimes saved up for the 300-yard run to use this event to bring up their total score. There seemed to be a rather wide range of effort, which helps to explain the low correlation previously shown between the 300-yard run and the P.F.R.

Effort and attitude also influenced the P.F.I. scores. Some boys did not like to lift and strain in an all-out effort; even though it was a matter of seconds, others welcomed the chance to show their strength. Some may have had a fear of injury from overstrain. An individual must make up his mind to lift all-out to get a maximum effort. No effort was made by the investigator to rate the effect of effort and attitude on the P.F.I. scores. Nearly all cadets seemed bent on getting the best score possible. It is the opinion of the investigator that greater effort and better attitude were displayed for the P.F.I. than the P.F.R.

Injuries and illness obviously affect the scores on physical fitness tests. Men in the army become ill and receive various degrees of injuries as anyone else. Men return to class after having been in the hospital for various lengths of time, others report to class with minor ills, sprains, or infections that affect the scores. A rugged conditioning program is bound to develop aches and pains of various sorts. American boys have been taught to be able to "take it", so on test day many participate with minor handicaps that affect the scores. Those who have been hospitalized and have been absent from physical training for several days or weeks will suffer on the score card of physical

fitness. It does not take long to get out of condition. It might be added that occasionally injury or illness are faked in order to justify a low score. There was no record kept of the effects of injuries or illnesses except to use only the data from those who completed all of the tests. The P.F.I. test is more easily influenced by injuries than the P.F.R. More parts of the body are exposed to tests where an all-out exertion would produce unbearable pain, whereas an endurance type of exercise could be executed quite fully. It is the opinion of the investigator that the P.F.R. scores suffered more than the P.F.I. from illness. This was especially noticeable when illness caused long periods of absence.

Weather conditions probably have more influence on the P.F.R. The P.F.I. test was conducted indoors, while the 300-yard run of the P.F.R. test was conducted outdoors. It so happened that good weather prevailed for each of the three testing periods when measurements were recorded for this study. No record was kept of the temperature, wind velocity, and relative humidity, but changes in these conditions did occur. However, the effects on individual cadets would vary depending on their physical condition and the climate he had been in prior to his stay at Kansas State College.

From the standpoint of administration the P.F.R. test has several outstanding advantages. No expensive and rare equipment is necessary for the P.F.R. test. Large numbers may be tested and scored within a class period of one hour. No time is lost from the physical training program as the cadet receives a good workout while participating in the P.F.R. test. Much more test-

ing experience and expertness is necessary to get proper results from the P.F.I. test than from the P.F.R. test.

In actual practice when a football team is being conditioned it is done by practicing football, the basketball team practices basketball, the distance runner runs long distances, the weight lifter lifts weights, and so on with all sports. The AAF conditioning program builds strength but it is to be expended over long periods of time. This continued expenditure of energy is commonly called endurance. It seems logical to assume that an endurance test would be a better measure of the AAF conditioning program than a strength test.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study was prompted by the use of a new physical fitness test by the Army Air Forces stationed at Kansas State College. Physical Fitness has been and is being measured in numerous ways. One of the most widely used tests is the Physical Fitness Index, a strength test devised by Charles H. McCloy. To evaluate the P.F.R. as a test of physical fitness the McCloy Physical Fitness Index was used as a criterion. These tests were each administered three times at six week intervals to three flights of air corps cadets.

A review of the related investigation revealed that hundreds of studies related to physical fitness had been conducted, but most of these were concerned with physical fitness for athletics and not war. Most of the literature available included the use of strength tests as measures of physical fitness. Very little has

as yet been published showing the results of the P.F.R. test.

The data from this study were compared by the use of statistical procedures. In addition to these findings a subjective appraisal of the validity of the P.F.R. test was made from observations by the investigator.

The conclusions of the study are as follows:

(1) The low correlations (.43 to .55) found between the P.F.I. and the P.F.R. indicate that, accepting the P.F.I. as a criterion, the P.F.R. is not a very valid measure of physical fitness.

(2) The low correlation shown between the two tests is evidence that the P.F.R. and P.F.I. are measuring different aspects of physical fitness.

(3) The correlations between the two tests of this study are comparable to the results obtained in other comparisons of different physical fitness tests.

(4) For the group studied and the conditioning program involved, the P.F.R. test is apparently the more valid of the two.

(5) It seems highly probable that the P.F.I. would be a more valid measure than the P.F.R. when used to measure physical fitness of groups that are heterogeneous for age and weight.

(6) In three separate determinations of the reliability of each battery, the P.F.I. and P.F.I. were found to be approximately equal in reliability.

(7) As the training program proceeded and physical fitness increased, individual differences in P.F.R. increased while individual differences in P.F.I. decreased. This is a result

of the fact that the P.F.R. is more sensitive in the upper portion of the range of physical fitness while the P.F.I. is more sensitive in the lower portion of the range.

(8) In both the P.F.R. and P.F.I. there was a highly significant difference between the means of the first and third applications of the test. So far as the mean is concerned, the two tests were approximately equally sensitive to the increase in physical fitness of the group.

(9) From the standpoint of the number of men tested, equipment necessary, and scoring technique involved the P.F.R. is easier and less expensive to administer.

(10) The P.F.I. test was preferred by the cadets because it required much less work and was a more pleasant type of exercise.

(11) The factors of practice, illness, weather conditions, and effort and attitude definitely influenced the P.F.R. more than the P.F.I., while injuries had more influence on the P.F.I.

(12) The P.F.R. and the P.F.I. both showed higher correlations with strength tests than with endurance tests.

(13) The heavier and taller boys were definitely handicapped in competing for P.F.R. scores.

In view of the findings of this study the following recommendations are made:

(1) That further studies be conducted to determine the effects of age, weight, and height on the P.F.R.

(2) That further studies be conducted to determine which test is

more valid when used on subjects who are on military maneuvers for weeks and months at a time, rather than on a one-hour-a-day physical training program.

(3) That studies be conducted to determine the effects of practice and learning on the events that make up the P.F.R. test.

(4) That studies be conducted to determine the effects on the two tests from the use of a program designed to build strength rather than endurance.

It is the humble opinion of the investigator that the above recommended studies would enable a much better comparison of the two tests as measures of physical fitness.

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APPENDIX

(Front)

ARMY AIR FORCES
PHYSICAL FITNESS TEST AND RECORD CARD
(AAF Reg. No. 50-14, Sec. 4, Par. 7 c)

Name _____ Rank or Grade _____
Last First

Age _____ yrs. Height _____ in. Serial No. _____

CUMULATIVE RECORD

TEST NO.	STATION	SQUADRON	DATE	Wt.	P.Physical F.Fitness R.Rating
1	Kansas State College				

(Use the following procedure on opposite side for recording) SCORING PROCEDURE: John Doe makes the following record: He sits-up 39 times, circles score 52 (does not circle performance record); chins 8 times, circles score 47; runs the shuttle-run in 53 seconds, circles score 55; adds the three scores: 52 47 55 = 154; locates 154 (the nearest No. is 155) in "Sum of Scores " in column under P.F.R.; circles the P.F.R. score 52 which is to the right of 155. Thus 52 is the Physical Fitness Rating of John Doe, which places him in the "Good category. Whenever the number which represents the performance record, or sum of scores is not listed, select the nearest number and properly record.

PHYSICAL FITNESS PROFILE: To make profile, connect each circle with a straight line.

3-6527, AF

ACHIEVEMENT SCALES

SIT-UPS		PULL-UPS		SHUTTLE-RUN		SUM of SCORES	P. F. R.
No.	Score	No.	Score	Sec.	Score		
114	100	24	100	34	100	300	100
108	98	23	98	35	98	294	98
102	96	22	96	36	96	288	96
96	95	21	95	37	95	285	95
90	93	20	93	38	93	279	93
85	90	19	90	39	90	270	90
81	85	18	85	40	85	255	85
77	81	17	81	41	81	243	81
73	78	16	78	42	78	234	78
69	75	15	75	43	75	225	75
66	74					222	74
64	73			44	73	219	73
62	72	14	72	45	71	216	72
60	70					210	70
58	68	13	68	46	67	204	68
56	66					198	66
54	65	12	65	47	65	195	65
52	64					192	64
50	63	11	62	48	63	189	63
48	61					183	61
47	60			49	60	180	60
45	58	10	58	50	58	174	58
44	57			51	56	171	57
42	55					165	55
40	54	9	54	52	54	162	54
38	52			53	52	156	52
36	50	8	49	54	50	150	50
33	48			55	48	144	48
31	47					141	47
30	46			56	46	138	46
29	45	7	45			135	45
28	44			57	44	132	44
27	42	6	41	58	42	126	42
26	40			59	40	120	40
25	38	5	38	60	38	114	38
24	36			61	36	108	36
22	35	4	35			105	35
21	34			62	34	102	34
19	33	3	32	63	32	99	33
17	30			64	30	90	30
15	27	2	26	65	27	81	27
12	23			66	23	69	23
9	20			67	20	60	20
6	17	1	17	68	17	51	17
3	15			69	15	45	15
1	10			70	10	30	10

EXCELLENT

VERY GOOD

GOOD

POOR

VERY POOR

THE McCLOY STRENGTH TEST

Name_____ Flight_____

Test No.	1	2	3
Date			
Age			
Weight			
L. Grip			
R. Grip			
Back lift			
Leg lift			
Dips			
Chins			
Strength index			
N. S. index			
P.F.I.			