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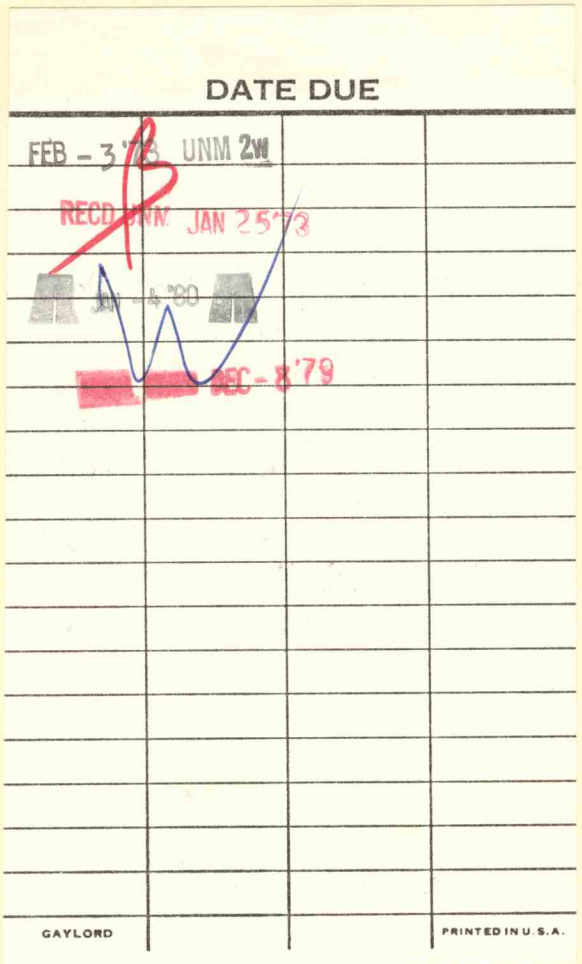
A Comparison of Certain Sports Groups Through the Air Force Physical Fitness Rating Test

Paul F. Arata III

COMPARISON OF SPORTS' GROUPS - ARATA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A COMPARISON OF CERTAIN SPORTS' GROUPS THROUGH THE AIR FORCE PHYSICAL FITNESS RATING TEST

By

Paul F. Arata, III

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Physical Education

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1962

This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Committee of the University of New Mexico in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Stuart A. Northrop
Dean

May 10, 1962
Date

Thesis committee

Lloyd R. Bailey
Chairman

Patrick D. Lyons

Arnold H. Smith

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Invariably, statements of objectives for physical education include the development of physical fitness. Frequently these statements lack a definition of physical fitness. Many persons assume that an individual who participates in a certain sport is physically fit. However, at the present time, evidence is lacking to substantiate any such assumption concerning any one sport.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to compare performance of Air Force athletes participating in eleven different sports as measured by the United States Air Force Physical Fitness Rating Tests to determine which sport or sports contributed the greatest amount of fitness and to rank each of the sports on the basis of the test results.

Importance of the study. It seemed important to study the influence of different sports' groups to produce qualities of physical fitness as measured by the United States Air Force Physical Fitness Rating Tests. In addition, it seemed important to determine whether there were differences between individual and team sports in the production of qualities of physical fitness as measured by the above test.

It was the purpose of this study to take the mean physical fitness scores of eleven sports groups and determine the significance of the differences among them.

Delimitation. This study is restricted to the personnel of the United States Air Force stationed at Manzano Base, Albuquerque, New Mexico. This study does not include members of the Army, Navy, or Marines who are assigned to Field Command Units. A number of Air Force personnel were not included in this study because they had unremediable defects from wartime service.

Limitation. Several of the sports groups used in this study had been out of season for from two months to ten months. These long layoffs probably affected the test scores achieved in softball, baseball, volleyball, swimming, and tennis. This test was conducted during the season in which a great number of Air Force personnel played basketball. The physical condition achieved by these players may have affected the test scores achieved by the basketball players.

II. DEFINITIONS OF TERMS USED

Physical Fitness. Physical fitness was considered as the development and maintenance of the human biological qualities of organic efficiency, strength, coordination, speed, agility, flexibility, and balance. The minimum level of development of these qualities would permit reasonable overloads of physical activity without undue fatigue in an individual who was physically fit.

It was the purpose of this study to [illegible]

scores of Marine [illegible] differences among them.

Delimitation. This study is limited to [illegible] at the United States Air Force [illegible] Albuquerque, New Mexico. This [illegible] Navy and Marines who are assigned to [illegible] Air Force personnel were [illegible] because they [illegible]

Limitations. Several [illegible] had been out of [illegible] layoffs [illegible] ball, volleyball, swimming, and tennis. [illegible] during the season in which [illegible] played basketball. The physical [illegible] may have affected [illegible]

II. DEFINITION OF TERMS USED

Physical Fitness. [illegible] ment and maintenance of [illegible] ciency, [illegible] The minimum level of [illegible] reason [illegible] individual whose [illegible]

Physical Education. Physical education was considered as that essential component of education which consists of carefully selected and planned movement experiences. Physical activities cause desirable growth and development of all boys and girls according to their readiness, needs, and interests.

United States Air Force. This term will apply to that distinct branch of the Armed Services that was created from the Army Air Forces by an act of Congress known as the "National Defense Act of 1947". The United States Air Force was formed to supply strategic and tactical support to the other branches of the armed forces through the medium of manned aircraft and unmanned missiles in the defense of the United States.

Army Air Force. The Army Air Force will be the term used to define that portion of the army that supplied tactical and strategic support to the ground forces from the medium of aircraft before the "National Defense Act of 1947".

Sit-ups. This test item was used to measure the strength and endurance of the abdominal muscles. This test item was performed from the initial position of lying on the back with the feet spread comfortably and the hands clasped behind the head. The trunk was then raised until arriving at the sitting position and the left elbow was touched to the right knee. Then the trunk was lowered to the starting position. The test was continued without pause or rest,

alternating the right elbow to the left knee, and the left elbow to the right knee as long as possible.

Push-ups. This was a test used to measure strength and endurance of arm extensor and shoulder flexor muscles. This test item was begun by lying on the mat, face down. The hands were placed beside the shoulders. The trunk was then raised until the arms were straight. The trunk was maintained in a straight position at all times as it was raised and dipped to the point where the chest touched the mat as often as possible.

Chin-ups. This was a test item used to measure strength and endurance of arm flexor and shoulder extensor muscles. This test item was performed from the full arm hang on the horizontal bar with the palms facing away from the body. The body was pulled up until the chin was over the bar, it was then lowered until the arms were straight. This action was repeated as long as possible. Jumping or swinging was not allowed in the performance of this test.

Shuttle-run. This was a test item used to measure cardiovascular-respiratory endurance and speed. Turning blocks were placed at each end of the twenty-five yard course. The subject ran from one block to the other the ten times required. The subject always touched the blocks and used them as a turning aid.

Air Policemen. In the United States Air Force, "Air Policemen" are generally assigned to one of two types of duty. "Air Policemen",

alternating the right elbow to [illegible] knee and [illegible] elbow to the right knee as long as possible.

Push-ups. This was a standard test of strength and endurance of arm extensor and shoulder girdle muscles. The exercise was begun by lying on the mat, face down. The hands were placed beside the shoulders. The trunk was raised until the arms were straight. The trunk was maintained in a straight line [illegible] as it was raised and lowered to the point where the chest touched the mat as often as possible.

Chin-ups. This was a test of strength and endurance of arm flexor and shoulder girdle muscles. This test item was performed from a hanging position on the horizontal bar with the palms facing away from the body. The body was pulled up until the chin was over the bar. It was then lowered until the arms were straight. This action was repeated as long as possible. Jumping or swinging was not allowed in the performance of this test.

Shuttle-run. This test was used to measure cardiovascular-respiratory endurance and speed. [illegible] blocks were placed at each end of the twenty-five yard course. The subject ran from one block to the other [illegible] as required. The [illegible] the blocks [illegible].

Air Pollutants. [illegible] United States Air [illegible] are generally assigned to one of five [illegible] (19[illegible]) [illegible]

referred to in this study, were those men in the Air Force performing duty as security guards on an around the clock basis.

Night shift. Air Policemen worked around the clock on either a three shift or four shift basis. For the purpose of this study, the night shift was part of the four shift schedule between 2400 hours and 0600 hours.

Strategic Air Command. The branch of the United States Air Force that acts as a deterrent to a possible aggressor due to its counter-attack potential.

Air Materiel Command. The branch of the United States Air Force that was assigned the task of logistical support.

III. SOURCES OF THE DATA

The data for this study were obtained from the following sources: Air Force Physical Fitness Tests conducted at the base gymnasium of the unit involved; from a form that was filled in by the test registrar; and from the pertinent manuals published by the United States Air Force. The testing was done under the supervision of the author.

Methods of conducting the investigation. After the thesis problem had been selected, a review of the literature revealed that a study similar to this one had not been published. However, this review did reveal that the Army Air Force's Physical Fitness Test had been conducted in many instances and that statistics

had been recorded for other purposes. The research planning for this thesis was not affected by any of the Strategic Air Command or Air Materiel Command changes to this test, since Manzano Base is not a member of either of these commands. The results of the fitness tests published were reviewed for possible use in the conduct of this study. This review indicated that although there were many studies in this area that not one of them would be of value to this study other than those associated with the Army Air Forces Physical Fitness Test.

A program was established whereby the Air Force Physical Fitness Test was administered to approximately thirty Air Policemen a day. (See Table I). This testing period took place on seven different days spread over a three week period until 210 different men had been tested. Although there were approximately 260 men available for the testing, about fifty were not tested due to interference of either their duty schedule, (night shift), or due to their possession of unremediable defects that would preclude their participation in parts of the test. The men possessing unremediable defects were excused from participation by the base physician.

When the men arrived at the gymnasium at 0730 each morning, they were directed to the bleachers where they were briefed on what was expected of them in the test and the methods to be used in the conduct of the test. The men then reported to the registrar where

TABLE I

AIR FORCE PHYSICAL FITNESS RATING TEST

SIT-UPS	PULL-UPS	SHUTTLE-RUN	PUSH-UPS	POINT SCALE
114	24	40	60	100
111			56	99
108	23		54	98
106			52	97
102	22		50	96
98	21		48	95
96		41	46	94
93	20		44	92
90	19		43	90
87			42	88
84	18	42	41	86
81			40	84
78	17		39	82
75			38	80
73	16	43	37	78
72			36	
70			35	77
69	15	44	34	76
66			33	74
63	14		32	72
60		45	31	70
57	13	46	30	68
54	12	47	29	66
52		48	28	64
		49	27	63
51	11	50	26	62
48		51	25	60
45	10		24	58
		52	23	56
42				55
39	9		22	54
36		53	21	52
33	8		20	50
31		54	19	48
				47
30	7	55	18	46
		56	17	44
27	6	57	16	42
		58	15	40
24	5	59	14	38
		60	13	36
21	4	61	12	34
		62		33
20	3	63	11	32
18		64	10	30
15		65	9	28
12	2	66	8	26
9		67	7	22
6	1	68	6	18
3		69	5	14
1		70	4	10

[1]United States Air Force, Physical Conditioning. Air Force Manual, 1956, p. 1.

they were weighed and measured. At this point, they selected the one sport in which they considered themselves to be most proficient. The sport selection of each respondent was checked by the officer in charge of the experiment since he knew all of the subjects personally. He was satisfied with all of the selections with the exception of five. He felt that these five men were more proficient in some other sport, however, he did not change their selections.

Four monitored stations were established in the gymnasium. The men proceeded from the registrar to their choice of sit-ups, push-ups, or pull-ups. At the briefing, the men had been told that they would have one hour to complete the test, and that they must complete two of three tests and that all must perform the shuttle-run which was the one test required. In addition, they were told that the shuttle-run would be the last of their three tests, starting about ninety seconds before completion of their hour. In order to maintain stability in the testing situation, this schedule was strictly followed. Reliability is affected by a host of major and minor factors. In the Air Force, such factors as night shift, guard duty, day to day fatigue, body health, inspections, promotion expectation, motivation, mental condition for the given day, letters from home, might all affect test reliability.

After the completion of the entire testing program, the test forms were separated into the different sport groups and the scores were

recorded in numerical rank. These scores were totaled in each group and the mean was computed in preparation for the statistical analysis.

CHAPTER II

REVIEW OF THE LITERATURE

Many Physical Fitness Tests exist today. Opinions are existent that many of these do not test fitness. The feeling among educators has often been that these tests in many cases merely test skills and that their reliability as skill tests can be questioned.

Feldt and McKee[2] found in their study that individuals vary from day to day thus affecting reliability.

> Given two bowlers of equal skill, one may be hot and achieve relatively high scores and the other may be cold and achieve relatively low scores. The overall effect of this factor is to add to the variability of the scores of the group as a whole and to magnify the individual differences which already exist.

Bucher and Taddanio[3] used a questionnaire prepared by Captain Herbert Crowley, director of Physical Training at Maxwell Field, Alabama, during World War II. This questionnaire was administered to 1226 aviation cadets who:

> (1) Attended public, private, and parochial high schools,
> (2) Did and did not experience a required physical education program in the elementary school,

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[2]Leonard S. Feldt and Mary Ellen McKee, "Estimation of the Reliability of Skill Tests," Research Quarterly, 29:281, October, 1958.

[3]Charles A. Bucher and Dominick Taddanio, "The Relationship Between the Physical Fitness Ratings of Aviation Cadets and Certain Early Life Experiences Pertaining to Physical Activity," Research Quarterly, 30:139, May, 1959.

(3) Preferred one "favorite" activity to another in the elementary school,

(4) Attended public, private, and parochial school,

(5) Did and did not participate in varsity sports in high school,

(6) Did and did not experience required physical education programs in high school,

(7) Participated in various varsity sports in high school,

(8) Did and did not attend college,

(9) Lived in various geographical areas in the United States, and

(10) Lived the greater part of their childhood and boyhood in a rural environment as opposed to an urban environment.

This study attempted to determine the physical fitness of cadets who responded to the above part of Crowley's questionnaire.

The Army Air Force Physical Fitness Test (sit-ups, pull-ups, and 300 yard shuttle-run) of that time was used. The test was administered to the entire cadet personnel of several squadrons. Bucher and Taddanio did not discover an appreciable difference in any of the areas studied. However, no attempt was made to investigate the quality of the wartime and prewar physical education programs that produced these cadets.

Larson,[4] in 1946, systematically evaluated the Army Air Force Physical Training Program that took place during World War II. His research indicated that there appeared to be a definite correlation between physical fitness and military duties.

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[4]Leonard A. Larson, "Some Findings from the Army Air Forces Physical Training Program," Research Quarterly, 17:161, May, 1946.

Larson reviewed a sufficient number of records so that he was able to ascertain that retrogression in physical performance begins following the eighteen year old group, that the AAF Physical Fitness Test met the major objective of the AAF Physical Fitness Program in providing an optimum degree of physical fitness, and that it is not only necessary to prepare norms for AAF personnel, but also standards of achievement for the various personnel groups.

The Army Air Forces[5] in their report found that there are specific implications that affect physical fitness tests:

> a. Activities must be graded and graduated according to chronological age and state of physical fitness. In the age groups found in the AAF on the adult level, the time required for the achievements of physical fitness increases with age.
> b. Participation must be intense. Personnel must be motivated to go "all out" when participating.
> c. Participation must be of sufficient duration to approach physical fatigue.
> d. The activities selected for the program must demand vigorous effort in performance.
> e. Participation in the physical fitness program must be supplemented by good health practices.

Karpovich and Weiss[6] collected data in 1943 on 4172 men entering the Army Air Forces who were administered the AAF Physical Fitness Test before they had one month of service. The mean scores

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[5]Army Air Force Headquarters, "The Army Air Force Physical Fitness Research Program," Research Quarterly, 15:14, March, 1944.

[6]Peter V. Karpovich and Raymond A. Weiss, "Physical Fitness of Men Entering the Army Air Force," Research Quarterly, 17:186, October, 1946.

of the entering personnel were 34.1 sit-ups, 6.0 pull-ups, 56.3 seconds in the 300 yard shuttle-run and 44.5 points for the physical fitness rating. On the basis of their overall findings, they decided that enlisted and aircrew personnel entered the Army Air Force in fairly poor condition.

Wells[7] tested 426 athletes over a period of twenty years, many through their college careers and some even longer. He found that when an athlete approaches contest time, just the thought of the impending competition is enough to start his heart beating at a faster rate. The only conclusion is that this response is emotion caused by anticipation. However, a few of the champion athletes appeared to be unaffected emotionally over their entire college careers.

The study by Wells indicated that emotion caused by anticipation caused a variance in the flow index in his study. Wells discovered that the flow index decreased from test to test, indicating familiarity lessens emotion.

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[7]Phillip V. Wells, "Emotion in Fitness Tests," Research Quarterly, 26:358, October, 1955.

CHAPTER III

I. ANALYSIS OF THE DATA

A method had to be selected for a design that would permit a valid estimate of error. Of consideration in this problem was the smallness of some of the groups which led to large score differences from sport group to sport group. It was not possible to get large groups to take the test in a restricted situation and area. Therefore, the method selected had to be one for handling small samples that provided a valid estimate of error.

In satisfaction of this requirement, it seemed that the method known as the Analysis of Variance would be appropriate. The Analysis of Variance was used to determine whether the differences between groups and within groups variances were significant.

> . . . the essentials of the logic involved in the method of analysis of variance. The basic proposition was that from any set of r groups of n cases each, we may on the hypothesis that all groups are random samples from the same population, derive two independent estimates of the population variance, one of which is based on the variance of group means, the other on the average variance within groups.[8]

II. PRESENTATION OF THE DATA

The first of these estimates of variance was based on the group means. Since the groups in this study were of different size, it was

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[8]E. F. Lindquist, Statistical Analysis in Education Research. (Cambridge: Houghton Miflin Company, 1940), p. 91.

necessary to multiply the total score of Group One times the mean score of Group One plus the total score of Group Two times the mean of Group Two, etc., through Group Eleven. These scores can be found in Table II. The total had subtracted from it the product of the grand total times the general mean. The score derived from this computation was 27,795.6 and appears opposite Groups in Table III.

The second of these estimates was based on the variance within groups. This figure was computed by getting the sum of all the scores squared and then subtracting from this figure the grand total times the general mean. The result derived was 151,379.4. The sum of squares for within groups was gotten by subtracting the sum of squares for groups from the sum of squares for total. There were 199 degrees of freedom for within groups. This number divided into the sum of squares for within groups produced the quotient 621.02, which was the variance for Within Groups.

The F ratio of the between groups and within groups variances was found by dividing the smaller variance into the larger variance. The significance of this ratio was determined by entering the Table for F with 10 and 199 degrees of freedom. It was found that the F ratio for the ten and 199 degrees of freedom was significant at the five per cent level of confidence. This indicated that differences existed among the groups being studied but did not indicate where the differences were. The application of the F test and the significance

TABLE II

ELEVEN SPORTS AS RANKED BY THE MEANS OF PARTICIPANTS' SCORES ON THE AIR FORCE PHYSICAL FITNESS TEST

RANK	SPORT	CASES	TOTAL POINTS	MEAN SCORE
1	Track	11	2408	218.91
2	Swimming	12	2589	215.75
3	Football	25	5365	214.60
4	Basketball	27	5693	210.34
5	Judo	9	1888	209.77
6	Tennis	12	2394	199.50
7	Volleyball	18	3519	195.50
8	Softball	36	7026	195.20
9	Golf	10	1947	194.70
10	Baseball	29	5429	187.20
11	Bowling	21	3868	184.19
Totals		210	42126	

The Mean Score for 210 Participating Personnel Was 200.6

TABLE III

VARIANCES

	df	SUM OF SQUARES	VARIANCE
GROUPS	10	27,795.6	2779.5
WITHIN GPS	199	123,583.8	621.02
TOTAL	209	151,379.4	

of the F ratio does not necessarily indicate that all of the group differences were significant.

Determination of significance of the differences among the group means was the next logical step in the statistical design of this problem. Hence, a t test was applied to test these differences. Each of the group means was studied to determine which groups differed significantly. The significance level chosen was the five per cent level. The variance within groups (621.02) was chosen as the best estimate of the population variance. The standard error of a single group mean was determined by dividing the variance within groups by the number of cases in any one group and then extracting the square root of this quotient. This was the standard error of that particular group mean. The best estimate of the standard error of each group mean is found in Table IV.

The t ratio was then determined by means of the following steps: the standard error of the mean of group one was squared and added to the squared standard error of group two. The square root was then extracted for this sum and divided into the difference between the mean of group one and group two. The result was the t ratio which was compared with the appropriate number of degrees of freedom in the table of t. The pairing of all fifty-five possible combinations was accomplished in a like manner. The results of the t ratio can be found in Table V. Significance resulted at the five per cent level between nineteen pairs of group means.

TABLE IV

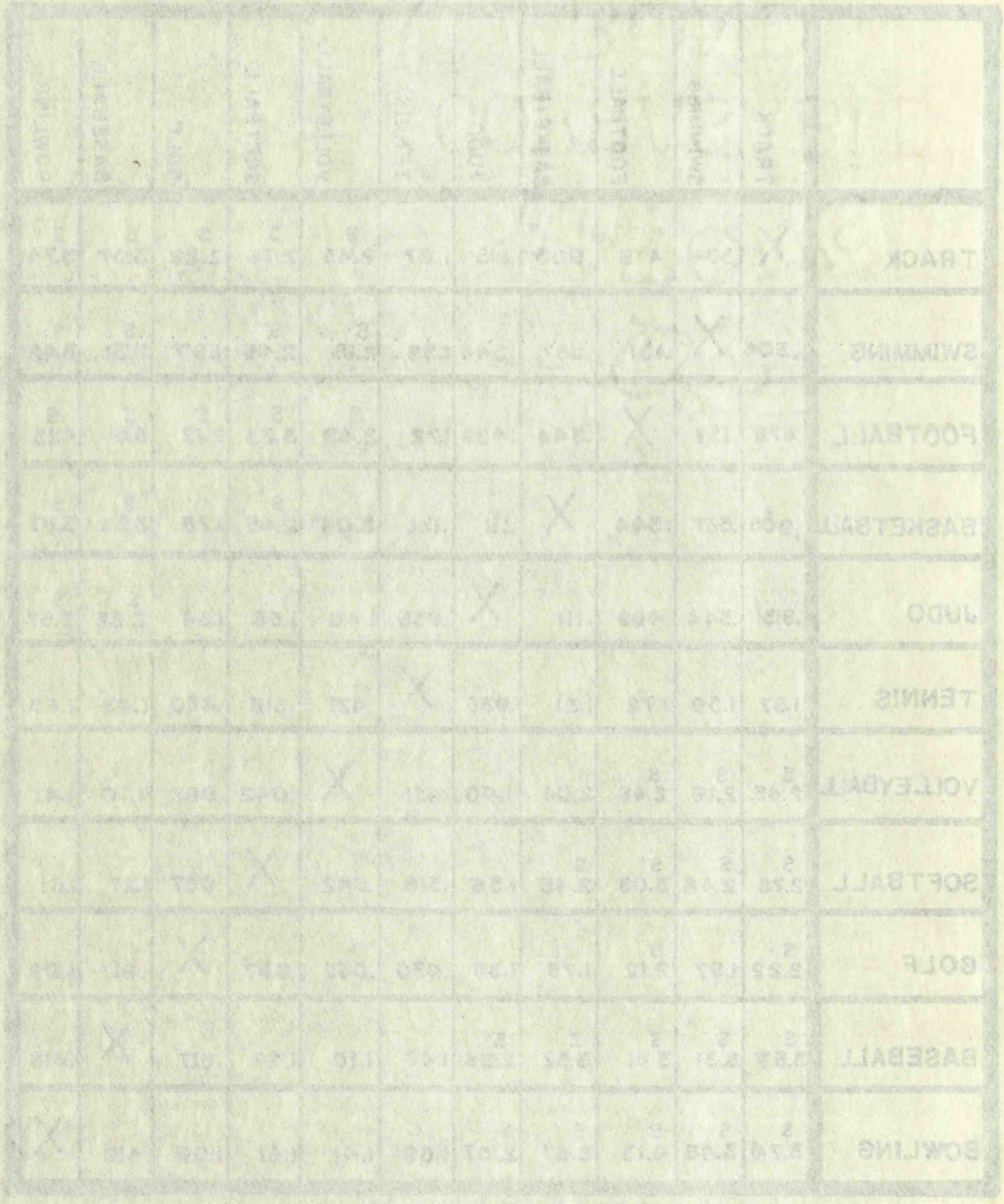
STANDARD ERROR OF MEAN
FOR EACH GROUP

GROUP	STANDARD ERROR OF MEAN
Track	7.51
Swimming	7.20
Football	4.91
Basketball	4.80
Judo	8.31
Tennis	7.20
Volleyball	5.81
Softball	4.16
Golf	7.88
Baseball	4.71
Bowling	5.44

TABLE V

t RATIOS

	TRACK	SWIMMING	FOOTBALL	BASKETBALL	JUDO	TENNIS	VOLLEYBALL	SOFTBALL	GOLF	BASEBALL	BOWLING
TRACK	X	.304	.478	.905	.815	1.87	S 2.45	S 2.76	S 2.22	S 3.57	S 3.74
SWIMMING	.304	X	.131	.567	.544	1.59	S 2.18	S 2.46	1.97	S 3.31	S 3.48
FOOTBALL	.478	.131	X	.544	.499	1.72	S 2.48	S 3.03	S 2.12	S 3.61	S 4.13
BASKETBALL	.905	.567	.544	X	.111	.131	2.04	S 2.45	1.75	S 3.52	S 3.67
JUDO	.815	.544	.499	.111	X	.935	1.40	1.56	1.34	S 2.36	S 2.57
TENNIS	1.87	1.59	1.72	1.31	.935	X	.431	.516	.450	1.43	1.69
VOLLEYBALL	S 2.45	S 2.18	S 2.48	2.04	1.40	.431	X	.042	.082	1.10	1.41
SOFTBALL	S 2.76	S 2.46	S 3.03	S 2.45	1.56	.516	.042	X	.057	1.27	1.61
GOLF	S 2.22	1.97	S 2.12	1.75	1.34	.450	.082	.057	X	.817	1.09
BASEBALL	S 3.57	S 3.31	S 3.61	S 3.52	S 2.36	1.43	1.10	1.27	.817	X	.418
BOWLING	S 3.74	S 3.48	S 4.13	S 3.67	S 2.57	1.69	1.41	1.61	1.09	.418	X



UNIT I. TRACK

The mean Physical Fitness Score of the Track Group was highest. It surpassed at the five per cent level of confidence the five sports having the lowest mean fitness scores: Volleyball, Softball, Baseball, Golf, and Bowling. Differences may have been influenced by the playing seasons of the sports. At the time of the test, Volleyball was a month in the future and had not been played competitively for eight months; Softball and Baseball were three months in the future and had not been in season for five months; Golf was played by older men and a recent spell of poor weather may have influenced the Golf mean. Bowling was in season, but this Group had the highest mean age of all the sport groups. Those participants who were over 40 years of age were Bowlers and they earned three of the four lowest Air Force Physical Fitness Test scores. Nevertheless, the Track Group surpassed all the other sports groups in fitness scores and was significantly better than the five lowest scoring groups. From the above findings, it might well be classed as a superior physical conditioning activity as far as the eleven sports studied are concerned. The eleven groups are ranked by mean ages in Table VI.

UNIT II. SWIMMING

The mean Physical Fitness Score of the Swimming Group was second highest. It surpassed at the five per cent level of confidence

TABLE VI

ELEVEN SPORTS AS RANKED
BY THE PARTICIPANTS' MEAN AGES

RANK	SPORT	NUMBER MEN	TOTAL AGE	MEAN AGE
1	Bowling	21	569	27.1
2	Golf	10	263	26.3
3	Tennis	12	298	24.8
4	Softball	36	878	24.3
5	Swimming	12	283	23.5
6	Track	11	266	22.4
7	Basketball	27	596	22.1
8	Football	25	546	21.9
9	Baseball	29	633	21.8
10	Volleyball	18	380	21.1
11	Judo	9	190	21.1
Totals		210	4902	

The Mean Age for 210 Participating Personnel Was 22.4

four of the five sports having the lowest means: Volleyball, Softball, Baseball, and Bowling. The explanations for the differences between Swimming, Volleyball, Softball, Baseball, and Bowling are perhaps identical with those for Track. Golf narrowly fell within the five per cent level of significance for Track and barely missed being significant at the five per cent level when compared with Swimming. Swimming surpassed nine of the sports groups in mean fitness scores and was significantly better than four of the five lowest scoring groups. From the above findings, Swimming might well be classed as one of the superior physical conditioning activities as far as the eleven sports studied are concerned.

UNIT III. FOOTBALL

The mean Physical Fitness Score of the Football group was third high on the list. It surpassed at the five per cent level of confidence the five sports having the lowest means: Volleyball, Softball, Baseball, Golf, and Bowling. The explanations for these five significant differences would parallel those for Track. The relationships between Track, Swimming, and Football were so close that the t scores obtained among their means were insignificant. Football had been out of season for a little over a month and the fitness carryover was probably still operating. Football surpassed eight of the sport groups in the mean fitness scores and was significantly better than the five

four of the five sports [illegible] Football, Baseball, and Bowling. [illegible] differences between Swimming, Volleyball, [illegible] are [illegible] identical with those for Track [illegible] per cent level of significance for Track and [illegible] signifi- cant at the five per cent [illegible]. Swim- ming surpassed nine of the sports [illegible] was significantly better than [illegible] sports [illegible]. From the above findings, [illegible] the superior physical conditioning activities so far as the [illegible] studied are concerned.

UNIT III. FOOTBALL

The mean Physical Fitness [illegible] the Football group was [illegible] high on the list. It surpassed at the five per cent level of [illegible] the five sports having the lowest means: Volleyball, [illegible] Golf, and Bowling. The explanation for these [illegible] differ- ences would parallel those for Track. [illegible] Track, Swimming, and Football [illegible] tained among their [illegible] of season for a little [illegible] prob- ably still operating. Football surpassed [illegible] the mean fitness scores [illegible]

lowest scoring groups. From the above findings, Football might well be classed as one of the superior physical conditioning activities as far as the eleven sports studied are concerned.

UNIT IV. BASKETBALL

The mean physical fitness score of the Basketball Group was fourth high on the list. It surpassed at the five per cent level of confidence three of the four sports having the lowest mean fitness scores: Softball, Baseball, and Bowling. At the time of the test, Basketball was in season and the Basketball players had been practicing for about three months. Softball and Baseball had not been in season for five months, and the Bowlers, although in season, were on the average five years older. Basketball surpassed seven of the sport groups in mean fitness scores and was significantly better than three of the four lowest scoring groups. From the above findings, Basketball might well be classed as one of the superior physical conditioning activities as far as the eleven sports are concerned.

UNIT V. JUDO

The mean physical fitness score of the Judo Group was fifth on the list. It surpassed at the five per cent level of confidence the two sports having the lowest mean fitness scores: Baseball and Bowling. Although Bowling was in season, it had the highest average age of

any group while Judo had the lowest mean age. A six year age difference probably had much to do with the significant t score. Baseball had been out of season for five months and the majority of these players made poor mean fitness scores in the shuttle-run test that was required of all participants. Although an age difference of only seven-tenths of a year existed, the Judo players ran the shuttle-run an average of one and five-tenths seconds faster than Baseball players. The difference in the performance of these two groups in this test of cardio-vascular endurance and speed indicates that Judo players were in better physical condition than Baseball players. The eleven groups are ranked by shuttle-run performance in Table VII. Judo surpassed six of the sport groups in mean fitness scores and was significantly better than the two lowest scoring groups. From the above findings, Judo might well be classed as one of the superior physical conditioning activities as far as the eleven sports studied are concerned.

UNIT VI. TENNIS

The mean physical fitness score of the Tennis Group was sixth on the list. When Tennis was compared by the t test with each of the other sports, it failed to indicate significance in any of the pairings. The conclusion is that Tennis is more nearly like each of the other sports on the list in its ability to produce the physical fitness components measured. To add some strength to this conclusion, the

TABLE VII

PARTICIPANTS IN ELEVEN SPORTS AS RANKED BY THE RESULTS OF THE SHUTTLE-RUN TEST

RANK	SPORT	NUMBER MEN	TOTAL SECONDS	MEAN SCORE
1	Basketball	27	1240	45.9
2	Track	11	510	46.3
3	Football	25	1167	46.6
4	Swimming	12	569	47.4
5	Judo	9	434	48.2
6	Volleyball	18	870	48.3
7	Softball	36	1751	48.6
8	Tennis	12	596	49.6
9	Baseball	29	1443	49.7
10	Golf	10	498	49.8
11	Bowling	21	1065	50.7
Totals		210	10143	

The Mean Score for 210 Participating Personnel Was 48.3

physical fitness score of the Tennis Group fell midway on the list of mean scores. Although Tennis was not in season, most of the players were playing the game during fair weather.

UNIT VII. VOLLEYBALL

The mean physical fitness score of the Volleyball Group was seventh on the list. It was surpassed at the five per cent level of confidence by the three sports having the highest mean fitness scores: Football, Swimming, and Track. The Volleyball season had not begun on a competitive basis although the players had begun to practice. Perhaps the conditioning effect of practice had not been extensive enough to match that maintained by the Track men and the Swimmers, and the condition carried over by the Football players. Since the physical fitness scores of Volleyball players did not significantly surpass scores made by other groups, it might be classed as less able to produce physical fitness than the sports ranking above it.

UNIT VIII. SOFTBALL

The mean physical fitness score of the Softball Group was eighth on the list. It was surpassed at the five per cent level of confidence by the four sports having the highest mean scores: Track, Swimming, Football, and Basketball. Basketball was in season and the Swimmers and Track men were practicing, whereas Softball had been out of

physical fitness score of the Tennis group fell [illegible] on the list of mean scores. Although Tennis was not in season, most of the players were playing the game during the weekends.

UNIT VII. VOLLEYBALL

The mean physical fitness score of the Volleyball group was seventh on the list. It was surpassed at the five per cent level of confidence by the three sports having the highest mean scores: Football, Swimming, and Track. The Volleyball [illegible] had not played on a competitive basis although the players had been [illegible]. Perhaps the conditioning aspect of [illegible] was not sufficient to match that maintained by the Track men and the Swimmers, and the condition carried over by the Football players. Since the physical fitness scores of Volleyball players did not significantly surpass scores made by other groups, it might be concluded that [illegible] physical fitness than the sports ranking above it.

UNIT VIII. BASEBALL

The mean physical fitness score of the Baseball group was eighth on the list. It was surpassed at the five per cent level of confidence by the four sports having the highest mean scores: Track, Swimming, Football, and Basketball. Baseball was in season, and the Swimmers and Track men were practicing, whereas not all the [illegible]

season for five months. Football had been out of season for just one month and the carryover of conditioning probably had some influence on the men. The mean scores of the shuttle-run test ranked all four of these sports ahead of Softball, indicating that differences could have been caused by low cardio-vascular-respiratory endurance and speed since all of the participants took this test. Nevertheless, Softball does not appear to be a good producer of physical fitness components as measured here.

UNIT IX. GOLF

The mean physical fitness score of the Golf Group was ninth on the list. It was surpassed at the five per cent level of confidence by both Track and Football. These significant t scores may have been influenced by the average age of the participants. The Golfers were three and nine-tenths of a year older than the Track men and four and four-tenths of a year older than the Football players. The playing seasons of Golf, Football, and Track were almost identical and the influence caused by seasons would probably be insignificant. It is a milder form of exercise than Track and Football and did not affect the physical fitness components measured as greatly as these sports.

season for five months. Football can [illegible] month and the carryover of conditioning [illegible] on the men. The mean scores of the [illegible] of these sports ahead of football [illegible] have been caused by low cardio-respiratory [illegible] speed since all of the participants [illegible] ball does not appear to be a good [illegible] components as measured here.

UNIT II. [illegible]

The mean physical fitness score [illegible] the list. It was surpassed at the [illegible] level of [illegible] both Track and Football. These [illegible] influenced by the average age of the participants [illegible] three and nine-tenths of a year older than the [illegible] and four-tenths of a year older than the Football players. [illegible] ing seasons of Golf, Football, and Track were almost identical and the influence caused by seasons would probably be [illegible]. It is a milder form of exercise than Track and Football and [illegible] affect the physical fitness components measured [illegible] as these sports.

UNIT X. BASEBALL

The mean physical fitness score of the Baseball Group was tenth on the list. It was surpassed at the five percent level of confidence by the sports with the five highest means: Track, Swimming, Football, Basketball, and Judo. Track, Swimming, Basketball, and Judo were in season; however, Football had been out of season for only one month. Baseball had been out of season for five months and the lack of conditioning caused by this long layoff may have influenced the comparison of these five highest means with that of Baseball. In addition, the sports with the five highest means had an average score of from one and one-half seconds to three and eight-tenths seconds lower than the mean score for Baseball players in the shuttle-run. As a developer of the physical fitness components measured, it ranks low on the list of sports studied.

UNIT XI. BOWLING

The mean physical fitness score of the Bowling Group was last on the list. It was surpassed at the five per cent level of confidence by the sports with the five highest means: Track, Swimming, Football, Basketball, and Judo. The Bowlers were the oldest group tested. The age range for these five sports, when compared with bowling, ranged from three and six-tenths of a year to six years below the age of the Bowlers. Bowling appears to be the least capable of producing the fitness components measured of the sports groups studied.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. SUMMARY

The purpose of the testing was to compare Air Force athletes from eleven different sports through the media of the United States Air Force Physical Fitness Rating Test; to determine which sport or sports contributed the greatest amount of fitness; and to rank each of the sports on the basis of the test results. A review of related literature was conducted.

Two hundred and ten Air Force athletes were placed into eleven Sports' Groups and were then given the Air Force Physical Fitness Rating Test. The data from this test were compiled and analyzed by the Analysis of Variance. The F ratio proved to be significant. Therefore, the t test was given to each of the possible pairings in order to analyze isolated differences. The t test revealed significant differences between nineteen pairs of means. The Sports' Groups with the five highest means--Track, Swimming, Football, Baseball, and Judo--were much alike in their ability to produce the physical fitness components measured. Conclusions were drawn on the basis of the experimental findings.

II. CONCLUSIONS

1. The Track Group made the highest mean score in the Air Force Physical Fitness Rating Test of the eleven Sports' Groups studied. It significantly surpassed the mean scores made by the five lowest ranking groups: Volleyball, Softball, Golf, Baseball, and Bowling.

2. The Swimming Group made the second highest mean score in the Air Force Physical Fitness Rating Test. It significantly surpassed the mean scores made by four of the lowest ranking groups: Volleyball, Softball, Baseball, and Bowling.

3. The Football Group made the third highest mean score in the Air Force Physical Fitness Rating Test. It significantly surpassed the five lowest ranking groups: Volleyball, Softball, Baseball, Golf, and Bowling.

4. The Basketball Group made the fourth highest mean score in the Air Force Physical Fitness Rating Test. It significantly surpassed the mean scores made by three of the five lowest ranking groups: Softball, Baseball, and Bowling.

5. The Judo Group made the fifth highest mean score in the Air Force Physical Fitness Rating Test. It significantly surpassed the mean scores made by the two lowest ranking groups: Baseball and Bowling.

6. The five sports--Track, Swimming, Football, Basketball, and Judo--making the highest mean scores in the Air Force Physical Fitness Rating Test significantly surpassed the two sports making the lowest mean scores. This would make the top five Sports' Groups more effective producers of physical fitness components as measured than the lowest two scoring sports.

7. Of the top five Sports' Groups means, three were individual and two were team type sports.

III. RECOMMENDATIONS

1. Future studies investigating the problem of influence of Sports' Groups upon physical fitness components should be designed in such a way that:

a. The study will cover each of the Sports' Groups when the sport is in mid-season.

b. The test will be administered to outstanding athletes at the college level.

c. The Sports' Groups will be larger.

d. The ages of the participants will fall within given limits.

e. Two or three different tests can be administered for comparative purposes.

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IMPORTANT!

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