Chapter II

REVIEW OF RELATED LITERATURE

A careful exploration of the related literature studies to the present study is essential to have insight into the work already done in the related field. In our country very little research work has been undertaken to improve the standard of Table Tennis in India.

The researcher has given deep thinking to the related studies and has gained valuable hints from their procedures and findings which are of great aid in developing research work.

The research scholar has gone through all the literature available on Internet and in the library of Lakshmibai National Institute of Physical Education (Deemed University), Gwalior. The literature, which he found relevant to the present study, has been abstracted in this chapter to provide the background material to evaluate the significance of this study as well as to interpret its findings.
A Table Tennis test was developed by Mott and Lockhart\(^1\). For the test, a table-tennis table is needed, hinged in the middle and arranged so that one-half of it is propped against a post or wall above and perpendicular to the playing surface, to serve as a backboard. A chalk line is marked on the perpendicular half of the table, six inches above the playing surface of the table; a kitchen match box is thumb tacked to the edge of the table and even to its end (place on the left side for left handed players). A stopwatch, table-tennis racket, and three table-tennis balls are also necessary.

The testing procedure is as follows: At the signal "Go," the player drops a ball to the table and rallies it against perpendicular table surface as many times as possible in 30 seconds. Any numbers of bounces on the playing surface are permitted. If the player loses control of the ball,

another may be taken from the matchbox, dropped to the playing surface and played. Hits on the perpendicular surface do not count if the ball is volleyed (that is, the ball must bounce at least once), the player put the free hand on the table during or immediately preceding a hit, or the ball strikes the perpendicular surface below the chalk line. The test score is the best score of three trials.

A reliability coefficient of 0.90 for the table-tennis backboard test with college women as subjects was obtained. A validity coefficient of 0.84 is also reported, but the criterion is not given. T-scales for college women were constructed.

Dyer2 Tennis Test has been designed to measure ability in tennis for classification purpose. It consists of rallying a tennis ball against a backboard, attempting to score as many hits as possible within a thirty-second time limit.

The initial study contains 736 cases, from representative women's tennis groups in nineteen colleges. Validity of the test was determined by

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two methods: correlating the test scores with judgments of three experts; and correlating the test scores with standings of the subjects in a number of round-robin tournaments. A coefficient of 0.85 was obtained in the first study and coefficients ranking from 0.85 to 0.92 were obtained in the second validity study.

Reliability of the test was determined first by correlating chance halves of the test that resulted in an r of 0.85; secondly, reliability was computed by the test-retest method, which resulted in a range of coefficients from 0.86 to 0.92. T-score and Percentile rank norms for this test as applied to women physical education students have been prepared by Miller.\(^3\)

Hewitt\(^4\) constructed tests of four tennis skills for university men and women. The skills are forehand drive placement, backhand drive placement, service placement and speed of service. Special markings on a tennis court are necessary for these tests. Test-retest reliability coefficients for the four skill tests were service placement, 0.94; speed of


service, 0.84; backhand drive placement, 0.78; forehand drive placement, 0.75. Achievement scale norms for Hewitt's Service Placement Test according to performance level i.e. Advance, Advance Intermediate, Intermediate, Advance Beginner and Beginner was constructed based on a limited number of beginning students in tennis.

Avery, Richardson and Jackson\(^5\) proposed a tennis service test for college students which measure both the placement of a served ball and the power or speed of the service. The test consists of five services into each of the following four areas: left half and right half of the right service area and left half and right half of the left service area. Each service is scored twice on the same serve: location of the ball in the specified court and its location on the second bounce. Court markings are needed to divide the service areas vertically in half, with score values of 1 and 2, and to designate second bounce zones horizontally, with score values from 1 to 4.

By analysis of variance, high F ratios for differences between means were obtained as follows: 30.18 between beginning and

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intermediate men and 48.39 between beginning and intermediate women players. Further, the means of intercollegiate tennis team men and women members were significantly higher than the beginning and intermediate players of the same sex. Test-retest reliability coefficients based on the sum of two trials for the four groups separately ranged from .64 to .81. As a consequence of these rather low coefficients, the investigators recommended that two trials of the test be given and that the sum of the two trials constitute each student's score. Both T and Percentile scores for each of the four groups were designed.

French⁶ constructed a short serve test in badminton to measure ability to serve accurately and low. A regulation badminton court was used with the specific marking. A validity coefficient of 0.66 was reported using a criterion of tournament rankings. The reliability was 0.96. The reliability will not hold up well for beginning players. A rating of the serve might be a better measure of serving skill for beginning players. For this purpose, T-score norms for the French Short Serve Test were reported twice based on the performance of 385 and 46 college

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women after a 25-lesson and 30-lesson beginning course in badminton respectively. This test is appropriate for intermediate players.

Lockhart and McPherson\(^7\) devised a volleying testing in badminton for classification purposes with college women. The test consists of three 30 second trials of volleying a shuttlecock against a wall area (10 feet high and 10 feet wide) from behind a 3 feet restraining line after initiating the play from 6 feet 6 inches starting line. Validity is reported as .71 with criterion of judges rating and reliability as .90. T-scale for college women was also designed.

Badminton Smash Test\(^8\) was designed to measure ability in the overhead smash skill in badminton utilizing the Johnson Badminton Setup Machine. Test was constructed over junior high school through college level. This test is satisfactory for both boys and girls. A Johnson badminton set-up machine should be placed 13 feet from the net, with the arm rotating belt parallel to the net. A tightly strung badminton racket and several birdies were needed. Lines and points should be marked with


chalk and tape on the court. The subject will stand below the dropping point of the machine and facing the net. After seven practice trials, the student is to smash the bird into the scoring areas along either side line. Ten trials are allowed for score and the maximum score possible is ten points. A coefficient of correlation of .77 was reported by Bill Parker. Correlation of .94 was also obtained between the scoring of an experienced tester and an inexperienced tester. Percentile scores of Badminton smash test were constructed for boys and girls based on scores of 50 college men and 52 college women as reported by Bill Parker in 1973.

Hensley, East and Stillwell⁹ proposed short and long volley tests in order to evaluate, respectively, the fundamental racquetball components of speed and power. Their subjects were 113 men and 99 women in beginning-level coed racquetball classes. A criterion for validity was established as instructors' evaluation of students' ability to sustain a volley utilizing the following scale: 5, excellent; 4, good; 3, average; 2, weak; and 1, poor. The validity coefficients for men and women combined were .79 for the short volley and .86 for the long volley. If

only one test is given, the long wall volley was recommended by the investigators. T-score norms are provided separately for each volley test and for each sex. It should be noted that data for the norms were obtained from beginning racquetball classes and may not be appropriate for advanced players.

Russell and Lange\(^{10}\) studied the two test items recommended by French and Cooper, serving and repeated volleys, as applied to girls in Grade seven, eight and nine. They concluded that these tests, with slight modifications, were adequate for use with girls in the junior high school. Validity and reliability ratings were about the same as those reported by French and Cooper. Russell and Lange have provided Sigma scale scoring tables for these two tests applied to junior high school girls.

In 1969, America Alliance for Health, Physical Education and Recreation constructed a more comprehensive Volleyball Skill Test\(^{11}\) consisting of four test items so as to measure volleying, serving, passing and set-up skills of the game. The tests were designed to cover the


fundamental skills of volleyball. The validity coefficient for this test was 0.80. Percentile rank norms for boys and girls ages ten through eighteen for each test are available in single AAHPERD Volleyball test Manual.

AAHPERD softball skills test manuals\textsuperscript{12} are available separately for boys and girls. The same eight skills appear in both manuals, as follows; throw for distance, overhand throw for accuracy, underhand pitching, speed throw, fungo hitting, base running, fielding ground balls and catching fly balls. After field trials at twenty-eight colleges and universities, these final eight tests were selected. The minimum reliability coefficients accepted were .80 for events scored by distance and .70 for events scored by accuracy and form. Percentile norms for the individual tests were based on 600 to 900 scores for each sex at each age ten through seventeen years.

In a factor analysis study of the primary components of selected basketball tests for college women, Leilich\textsuperscript{13} found four factors to be


basic for these test; basketball motor ability, speed, ball handling involving passing accuracy and speed, and ball handling involving accuracy in goal shooting. On the basis of this analysis, the following three tests were proposed: bounce and shoot, half-minute shooting and push-pass. Both percentile and T-score achievement scales on those tests were constructed for physical education majors by the Professional Studies and Research Committee of the Midwest Association of College Teachers of Physical Education for Women.

Stroup\textsuperscript{14} used the scores made by competing teams as a criterion for validating his basketball skill test. The subjects were 121 students enrolled in college physical education service courses. They were randomly placed in basketball teams, 82 such teams were formed throughout the study. These teams played a total of 41 ten-minute basketball games. At the end of this competition, they were given tests of goal shooting, wall passing and dribbling. Scale scores with letter grade equivalents for performances on each item were proposed based on population divisions of the normal curve. Each subject's raw scores on

\textsuperscript{14} Francis Stroup, "Game Result as a Criterion for Validating a Basketball Skill Test," Research Quarterly 26, No. 3 (October 1955), p. 353.
the three items were converted to scale scores, which were then averaged to obtain his basketball skill score.

American Alliance for Health, Physical Education, Recreation and Dance developed a norm-referenced basketball skill test in 1984. This test is applicable to both boys and girls and separate norms, age-wise and sex-wise, have been prepared for one yearly age groups ranging in age from 10 years to 15 years; 16-17 years and college age students. A committee of experts identified the essential skills of basketball and suggested performance tests to measure four basketball skills namely speed shot shooting; passing and recovering the basketball accurately while moving; handling and dribbling the ball while moving and defensive movement skill. Fifth to eighth grade boys and college men were used as subjects for conducting the pilot studies. Large numbers of reliability coefficients for the four test items by test retest method were computed on elementary, junior high school, senior high school and college range males and females. Quite high values of reliability coefficients were recorded and all the values ranged between 0.84 to 0.98. AAHPERD developed basketball skill testing percentile norms on

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ten thousand pupils for the testing of American School children and adult men and women.

Harrison\textsuperscript{16} developed a four-item basketball test for boys in grades seven through ten. The four items are field goal shooting, speed pass, dribble and rebounding. The subjects were one hundred boys in each of the grades. Test-retest correlations for the separate tests ranged from .72 to .96; for the total battery, the coefficients clustered between .91 and .96. The validity of the test was established as correlations between scores of the test and three criterion measures, as follows: .82 with the Johnson Basketball Test; .86 with peer ratings of basketball playing ability; and .77 with expert jury ratings. A correlation of .89 was reported between the test and the average of the three basketball criterion measures.

Each of the test items is performed for thirty seconds; two trials are given with the score recorded as the best of the twos. T-scale norms of Harrison Basketball Test were constructed for each of the four test items for each of the four grades, seven through ten. The subjects tested for the

norms had received a unit of basketball instruction prior to the administration of the battery.

Crew\textsuperscript{17} related several soccer skills to the soccer ability of college men. The criterion of soccer ability consisted of the opinions of competent judges formed during competitive play. Correlations of test items with this criterion were .96 for ball control, .95 for aerial accuracy, .92 for dribbling and .88 for wall volley. A multiple correlation of .97 was reported with the ball control and dribbling tests. T-scores for these tests were prepared.

An AAHPERD test manual\textsuperscript{18} was devoted to ten basic fundamentals of football; the usual percentile norms were presented for each skill. The skills were: forward pass for distance, 50- yard dash with football, blocking, forward pass for accuracy, football punt, ball-changing zig zag run, catching the forward pass, pull-outs, kick-off and dodging run.


Borleske\textsuperscript{19} has proposed Touch Football test designed to measure ability to play touch football composed of five items, as follows: forward pass for distance, catching forward passes, punting for distance, 50-yard dash carrying the ball and zone pass defense. In constructing the test, Borleske experimented with eighteen individual objective tests, obtaining a validity coefficient of .85 with the opinion of experts using a check sheet for subjectively rating performance. The battery of five test finally selected has a correlation of .93 with the larger objective battery, of which the five tests were a part. A short battery of three tests (forward pass for distance, punting for distance and 50-yard dash carrying the ball) correlated .88 with the criterion. A T-Score table for the three tests is also available.

Singh\textsuperscript{20} constructed soccer playing ability test on the basis of skill performance of the players. The nine test items namely, WM dribbling, receiving a bouncing ball with sole of the foot, repeated wall rebounds (5 feet), dribbling and kicking for distance, 30 yards dribbling, dribbling and ground pass (15 yards), shooting a stationary ball in the goal (25

\textsuperscript{19} Clarke and Clarke, Comp. "Application of Measurement to Physical Education," 6\textsuperscript{th} Ed., p. 252-53.

yards), heading for accuracy (12 yards) and aerial pass a stationary ball (20 yards) were included in the soccer playing ability test battery. Hull scale was employed for all the nine test items included in the soccer playing ability test battery, to develop the norms. All the raw scores of selected nine test items for 108 soccer players were converted into norms scores and added together separately for each other. These scores were also interpreted by developing grading scale, i.e. excellent, good, average, satisfactory and poor, based on the 6-sigma scale.

Singh and Kumar\textsuperscript{21} prepared the norms for each important specific skills of handball game at school, university and senior national level of performance. Total 586 players of handball were examined, during school national championship 200, All India Inter University championship 195 and senior national championship 191. The specific skill test battery for male handball players, standardized by Jaspal Singh (2006), was used to record the specific skills of handball players for the purpose of preparing the norms. The percentile values were computed through SPSS.

Phillips and Summers\textsuperscript{22} developed six-sigma bowling scores based on initial levels of ability for college women, scores were obtained from 3,634 women in twenty-two colleges. Norms were designed for eight ability groups. Ratings were established for the different levels of ability as to progress at various stages up through twenty-five lines of bowling.

Martin and Keogh\textsuperscript{23} established bowling norms separately for inexperienced and experienced men and women in elective physical education classes at the University of California, Los Angeles. Students were classified as non experienced if they had bowled ten lines or less and had received no previous formal instruction; all other students were classified as experienced. Norms are presented for both initial and final performances. Initial scores were obtained after four to six class periods for the inexperienced bowlers and after four class periods of regular games for the experienced bowlers; for all other groups final scores were taken at the end of one semester of bowling instruction. Each set of norms consist of five categories, each based upon 1.2 standard deviations


\textsuperscript{23} John Martin and Jack Keogh, "Bowling Norms for College Students in Elective Physical Education Classes," Part I, research Quarterly, 35, No. 3 (October 1964), p. 325.
of the distribution. Categories are designated as superior, good, average, poor and inferior.

Hyde\textsuperscript{24} established norms for archery achievement of college women in shooting the Columbia Round, a standard event in archery competition. The Columbia Round consists of shooting twenty-four arrows at a 48-inch target at three distances: 30, 40 and 50 yards. The target values are: gold, 9; Red, 7; Blue, 5; Black, 3; White, 1; outside of white or missing target, 0. The archery achievement scale based on the six-sigma scale.

In the AAHPER skill test manual\textsuperscript{25}, the distances for the archery shoot are 10 and 20 yards for both boys and girls and an additional distance of 30 yards for boys. The same distances were originally proposed for both sexes. However, when the scores obtained from the preliminaries trials were analyzed, shooting at 30 yards was found to be too difficult for many girls, so that distance was dropped for them. 65% of girls at ages seventeen and eighteen were unable to score at that


distance. The target was the standard 48-inch size with the centre, 4 feet from the ground. Each subject shoot two ends of six arrows at each distance. 4 practice shots were allowed at each distance. Percentile tables were provided for each distance and for all distances combined at the following ages: 12-13, 14, 15, 16 and 17-18 years. These skill tests were regarded as "practice test", as they were intended for use in improving ability in the fundamentals skills of archery. Girls and boys were urged to practice the skill tests and chart their own progress from the percentile scales.

An objective test of swimming power for the front crawl and sidestroke was developed by Fox\textsuperscript{26}. The reliability coefficients for the two tests were .95 and .97, respectively. T-scores were prepared based on the performance of college women ranging in ability from beginning to advanced swimmers.

Reddy\textsuperscript{27} conducted a study on computation of AAHPER volleyball skill test norms for college students. The subjects were 60 male students

\textsuperscript{26} Margaret G. Fox, "Swimming Power Test" Research Quarterly 28, No. 3 (October 1957), p. 233.

\textsuperscript{27} N.V. Swammy Reddy, "Computation of AAHPER Skill Test Norms for College Students", Unpublished Master's Thesis, Jiwaji University, June 1982.)
from Sri Venkanteshwara University in Andhra Pradesh. The subjects were administered AAHPER volleyball skill test items namely, volleyball serving, set-ups and passing. For establishing the reliability, 20 students were selected randomly and test was repeated after a gap of one day. The reliability co-efficient obtained for the two tests, were significant at .01 level, for the purpose of providing norms, t-scale and hull scale norms were computed.

Corner and Cureton\(^{28}\) developed a motor fitness test for high school girls. The test consisted of two forms- a single paired test of 6 items and a double paired test of 12 items. The test comprised of following paired items- foot and toe balance and dizziness recovery, trunk extension and trunk flexion, kneeling and jump and Illinois agility run, sit-ups and kneeling push-ups, basketball throw and standing broad jump and squat thrust (30 seconds) and Brouka step test. Test item correlation with the composite item scores ranged from .39 to .62. Percentile norms on a limited sample are available.

Elizabeth\textsuperscript{29} prepared percentile norms for girls' age 12 to 15 years on the North Carolina AAHPER test. The norms were prepared for each of the five test items, sit-ups, side-stepping, standing broad jump, modified pull-ups and squat thrust. The sit-ups item provided effective differentiation on the percentile scale for each age group. The concentration of scores in the middle of the distribution for the side stepping test and the squat thrust test resulted in effective discrimination in the centre of the ranges for all age groups. The standing broad jump test provided the greatest ranges and the test differentiated the lower end of the distribution for all age groups but did discriminate above the 20\textsuperscript{th} percentile.

John\textsuperscript{30} prepared National Norms for the One Minute Basketball Throw for goal, Pull-ups, Potato race, Standing hop step and jump, Push-up, Standing broad jump and Softball target throw, items of the Y.M.C.A. National Athletic Achievement Programme. Different centres of Y.M.C.A. tested 2000 boys in each age group of 8, 9 and 10 years throughout the United States.


\textsuperscript{30} J. Miatkavi John, "Norms for Eight, Nine and Ten Year Old Boys on Y.M.C.A. Athletic Achievement Test", Completed Research In Health Physical Education and Recreation 8 (1965), p. 101.
Bitcon\textsuperscript{31} undertook a normative study for high school boys in the state of IOWA. The four items test and the AAHPER youth fitness test were conducted on eighty-four high school boys. The degree of relationship between the two tests was found by computing and correlating the composite scores. The reliability of the four items test was determined by test-retest technique. The co-efficient of correlation between AAHPER physical fitness test and composite score, and between the test-retest composite scores of the four items test were 0.934 to 0.961 respectively. Percentile norms were constructed for each of the item and composite scores.

Box\textsuperscript{32} prepared percentile norms and tables for measures of strength, power, agility, flexibility, body composition, cardiovascular and muscular endurance from data collected in five schools of the unity Christian School system of Hudson Ville.


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Neely\textsuperscript{33} cable tension strength tests 25 and 36 Anthropometrics measures were obtained from girls in each grades from 4 to 12. The following strength tests were selected that would adequately reflect the total musculature for upper elementary school girls’ shoulder extension, hip extension and trunk flexion, for junior high school girls, shoulder extension, hip flexion and ankle plantar flexion. In the study, scores on the selected strength tests, age and weight were obtained from 124 girls in each grade, 372 at each school level and 1116 over all. Norms were constructed following Roger’s method of constructing strength index norms.

Veerawani\textsuperscript{34} conducted a study to evolve physical fitness norms for boys in higher secondary schools of greater Gwalior. Two hundred twelve male students from four higher secondary schools and seven hundred ninety three male students from remaining twenty-three schools were selected and AAHPER youth fitness and ICHPER physical fitness tests were administered on them respectively. The percentile norms for each test item were evolved for the boys of age group 13-17 years. It was


also concluded that in all items except pull-ups of the AAHPER youth fitness, the mean scores of Indian boys in all age groups were lower than 50th percentile of American norms. There was a positive, but low order of relationship between physical fitness and participation in physical activities. There was a positive correlation through low (r = 0.13) between physical fitness and academic achievement.

The AAHPER youth fitness test\textsuperscript{35} was devised in 1967 by a committee of the research council of AAHPER as a means of surveying the fitness of American youth as revealed by what a nation wise sampling of boys and girls in the various grades could do relatively to selected aspects of fitness. During the 1957-58 school years, 8500 children in grades 5-12 in 28 states were tested. In 1968, percentile norms were prepared for college men based on approximately 2200 students in eight institutions located through out the USA. Similarly norms were derived for college women from over 4800 freshmen and sophomores in 57 institutions through out the country. In 1965 new percentile norms were developed both on age and on Neilson Cozens (California) classification index, based on administration to nationally survey of 9200 boys and girls.

of age 10-17 years. The same test items were used for norms revision, except for inclusion of flexed arm hang, instead of modified pull-ups for girls.

Backford 36 conducted a research to evaluate the physical fitness level of Navajo girls through AAHPER Youth Fitness Test. The Navajo girls of 14 to 16 years were selected from seven schools to measure physical fitness level. Also percentile norms were established on the basis of scores obtained from test results. These norms were compared to national norms found in the manual accompanying the AAHPER Youth Fitness Test. The results gave an indication of the overall fitness level of 14, 15 and 16 years old Navajo girls of the seven test items. The Navajo norms were found to be below the national norms on 5 items and above on the softball throw and 600 yard run/walk.

Zuti and Corbin37 constructed physical fitness norms for college freshmen in which 3000 freshmen of Kansas State University, within the age from 17 to 19 years were taken into consideration. The study was


conducted to measure the strength, flexibility, body composition and cardio-vascular fitness. Percentile values were derived from means and standard deviation. The results indicate that the college freshmen at the university were above average than the standards, which were appropriate for use by the Americans.

Physical fitness norms for Nigerian boys and girls of 11 to 18 years of age were constructed by Anyanwu\textsuperscript{38}. The test items were Shuttle-run, Push-ups, Chair Push-ups for girls, Flexed knee sit-ups, 45 meters dash, Standing long jump, Pull-ups for boys, Flexed arm hang for girls, 9 min. run for subjects 11-12 years and 12 min. run for subjects 13-18 years. A comparison of the mean scores of the United States and the Nigerian youth showed that of the upper age levels, the United States youth had a better physical fitness status than their Nigerian counterparts, where as at the lower level there was not much difference.

Robson and his colleagues\textsuperscript{39} constructed a simple fitness test battery for elementary school children. They selected 152 boys and 150

\textsuperscript{38} Sunuel Uwazuruonye Anyanwu, "Physical Fitness of Nigerian Youth", Dissertation Abstract International 38 (November 1977) 2642-A.

girls of K.V. Gwalior. The test battery is practicable and simpler than the existing physical fitness test and measure most of the essential motor qualities of elementary school children. The norms were prepared for the selected items and can be used for classifying the children in to ability groups by assessing their physical fitness. The following items were included in this test- 50 meter dash, 600 meter run / walk, straight legs sit-ups, 40 meter shuttle run, modified push-ups and vertical jump.

Watson\textsuperscript{40} prepared test items for the physical fitness tests consisting of long jump or vertical jump, 50-yard dash, sit-up, stick jump and 300-yard distance run. The norms were established for each test item for girls and boys according to chronological age. Percentile tables were constructed based on the results of investigation. Watson further recommended that in elementary level, there should be a test item and norms to evaluate shoulder girdle strength.

Krus and Ceurvorst\textsuperscript{41} described procedure which allows for transfer of a minimal amount of a mass-storage based information,

\textsuperscript{40} Rick E. Watson, "The Establishment of Norms for the Nebraska Physical Fitness Test", Completed Research in Health, Physical Education and Recreation 19 (1978), p. 102.

necessary for norm-referenced interpretations of a test and for continuous updates of the norm group. Unlike related algorithms for inclusion or withdrawal of a vector from a data set (cf. Clarke, 1971), the present routine does not necessitate a test for an empty norm group set of scores. It precludes the mass storage of the whole norm-data set and provides an unlimited expansion of the test norms. As such, it represents a useful technique for construction of norm-interpretative computerized measurement instruments.

Das42 prepared physical fitness norms for classes 9 through 11 of Delhi Administration Schools. In each school 10% of students were tested on the items of AAHPER youth fitness test and N.P.F.P. battery "A". The items in the N.P.F.P. Battery "A" were the same as included in the syllabus of Central Board of Secondary education. Percentile norms were prepared and were statistically analyzed which concluded that abdominal strength of Indian students seems to be very poor compared to that of American students. The performance of students of class IX was very poor in all items of fitness tests and there was a remarkable

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performance of class X and XI, though still lower than that of students in American except in pull-ups measuring shoulder girdle strength.

Sittmann\textsuperscript{43} developed norms for 372 male and 648 female students enrolled in the health and physical fitness concept classes of North East Missouri State University. The subjects were tested for the sum of six skin folds, predicted fat percentage, predicted VO2 max, grip strength, leg strength, back strength, vertical jump distance and vertical jump power. Means, standard deviations and range for all variables were calculated. Percentiles norms were constructed for each variable in each classification.

Norms for general physical fitness for various sports were prepared by the Netaji Subhash National Institute of Sports, Patiala\textsuperscript{44}. These norms were made for sportsmen/women in general and no differentiation was made regarding different sports. In gymnastics, physical fitness norms were prepared for women and the different motor traits selected were standing broad jump, standing vertical jump, push ups, flexed arm hang,


\textsuperscript{44} Physical Fitness Norms for National Sportsmen and Sportswomen, Netaji Subhash National Institute of Sports, Patiala, 1982.
sit-ups, grip strength, back strength, 60-M. dash trunk flexibility and shuttle (6 x 10 M.). The norms were classified as poor, average, good and very good.

Thiruppatti\textsuperscript{45} computed physical fitness norms for boys of the 15 junior colleges in Solapur District. From each junior college twenty boys from class XI and XII were taken as subjects for this study. AAHPER youth fitness test was administered on them. The two scales namely T-scale and Hull scales were constructed for the combined samples of the junior colleges and separately for classes XI and XII.

Taddnio\textsuperscript{46} constructed national norms based on the 1975 National Survey of Youth Fitness. The measure of physical fitness was the AAHPER youth fitness test. Twelve school districts participated in the study from which 75 schools, 146 classrooms and 779 students were selected. The study concluded that-

\textsuperscript{45} V. Thiruppatti, "Computation of Physical Fitness Norms for Boys of the Junior Colleges in Solapur District", (Unpublished Master's Thesis, Jiwaji University, Gwallor, 1982).

1. There was no difference in the physical fitness of boys and girls from the economically deprived sample and boys and girls represented by the 1975 national norms and

2. Within the sample there was no difference in physical fitness of boys and girls from high poverty areas and boys and girls from low poverty areas.

Barbanti\textsuperscript{47} established physical fitness norms for Brazilian school children and to determine if difference existed between norms for Brazilian and American boys and girls in selected physical fitness measurements. In the physical fitness test battery Sit and reach test, Modified sit-ups test, Nine minute run, Twelve minute run, Two tests of athletic ability, 50 meters dash and Standing long jump were included. The test was administered to 2,342 school boys and girls. The comparison between norms for Brazilian and American boys and girls in general, American children were taller and heavier, and they scored higher in the sit and reach test, modified sit-ups, 50 meters dash and standing broad jump test. Brazilian children had higher scores on the nine minutes run test than American children.

\textsuperscript{47} Valdir Jose Barbanti, "A Study of Selected Anthropometrics and Physical Fitness Measurements of Brazilian School Children", Dissertation Abstract International 43 (June, 1983): 3840-A.
Sree Devi\textsuperscript{48} constructed motor fitness norms for secondary school girls. For this purpose, she selected 80 students of Central School No.1, Gwalior, from grades eight and nine as subjects for this study. Based on mean and standard deviation values, T-scale, 6 Sigma scale and Hull scale were prepared for each test items. It was concluded that a common scale of AAHPER youth fitness test could be used for grades eight and nine and 6 Sigma scale and Hull scale were more suitable than T-scale.

Guruvaammal\textsuperscript{49} constructed norms in selected physical fitness test items for secondary school girls in Madras city. Ten girls from each ten randomly selected schools were taken as subjects and tested on the selected physical fitness test items, consisting of sit-ups, vertical jump, flexed arm hang, 4 x 10 meter shuttle run, 50 meter dash, and 600 meter run. The percentile scales were computed for the combined samples of the girl students. It was also concluded that performance of the girl students was very poor in the selected test items.


Robins\textsuperscript{50} conducted a normative study for Alabama students. AAHPER youth fitness test (YFT) and AAHPER health related fitness test (HRFT) were given to 2,545, six to fourteen years old boys and girls. Percentile norms tables were constructed for each item based on age and sex. Alabama and national norms were compared. Alabama students scored better on events measuring Agility, Speed and Cardio-vascular endurance but the national score in abdominal muscular endurance and flexibility was better.

Walia\textsuperscript{51} conducted study on 50 gymnasts to prepare the norms pertaining to physical and physiological abilities in gymnastics for men section. He conducted the following tests to form norms.

I. Strength Endurance

A) Pull-ups on Horizontal Bar (Maximum Numbers)

B) Push-ups on Parallel Bars (Maximum Numbers)

C) Leg Raising on Wall Bars (Maximum Numbers)

D) Static Grip Strength

E) Left Grip Strength

F) Right Grip Strength


2. Explosive Strength
   A) Medicine Ball Throw
   B) Jack Knife (Maximum Number in 10 Seconds)
   C) Sargent Jump

3. Flexibility
   A) Shoulder Flexibility
   B) Trunk Flexibility
   C) Hip Flexibility

4. Technical Tests
   A) Round-off on Floor
   B) Scissors on Pommel Horse
   C) Forward Up rise on Parallel Bars
   D) Hip Circle to Hand-stand on Horizontal bars
   E) Hand-spring on Vaulting Horse
   F) Kip to “L” on Rings.

Walia formed norms for all these tests in five categories i.e. very poor, poor, average, good and very good. He had also reported that best group was better than mediocre and the poor groups in Sargent Jump, Leg Raising on wall Bars and Hip Flexibility and reported a non-significant difference in all other variables.
Singh\textsuperscript{52} prepared physical fitness norms for high school boys of Punjab state. The test items were administered on 5000 subjects from various schools. The test items were standing broad jump, sit and reach test, agility run, bent knee sit-ups, 50 meter dash, push-ups (chair), cricket ball throw, 600 meter run/walk. The percentile norms for physical fitness test were found to be valid and suitable to assess the physical fitness level of the high school boys between the ages of 12 to 15 years.

Singh\textsuperscript{53} constructed physical fitness norms for four thousand male students belonging to pre-university classes of Punjab University, Chandigarh. Fleischmann’s physical fitness battery was administered on them. The 3 scales namely – Percentile scale, Hull scale and T-scale were prepared. It was also concluded that physical fitness improved linearly with age and the students belonging to rural areas were significantly superior in their performance when compared to the students of urban area.


Sharma\textsuperscript{54} constructed and standardised specific physical fitness test for badminton players. He used factor analysis technique on the data of 100 inter-college/district badminton players of northern India. As many as 7 factors of specific physical fitness were obtained, out of which, five were considered as meaningful to select test items from each factor. One test item having the highest loading was included in the test battery, from each factor. The test items thus derived were applied on 500 badminton players to develop the norms. The norms had been presented in Percentile ranks along with T-scores. The selected five factors were Trunk Strength, Flexibility, badminton Agility, Endurance and Arm-Leg Explosive Strength and the test items selected endurance specific physical fitness test for badminton players were Sit-Ups, Court Agility, Trunk Flexion, Six Corners Endurance and Softball Throw. Factor analysis technique was used to select the test items out of twenty variables.

Sandhu\textsuperscript{55} constructed motor fitness test battery for female volleyball players. The subjects of the study were 300 volleyball players representing different colleges of the state of Punjab. They were from


different universities of Punjab and their age ranged from 17 to 21 years. Factor analysis was used to construct motor fitness test. The subjects were tested on 27 different items of motor fitness test through the factor analysis technique. The selected items for test battery, which consisted of seven tests namely, spike jump, W.M. run, W.M. agility, push-ups, 20 meter run, the stick test and bend and reach test. The scientific authenticity of the test was established by computing reliability, objectivity, validity and specificity. For preparation of the norms, 300 female volleyball players were selected. The Hull scale and T-scale were used to prepare the norms for different test items for college female playing volleyball.

Singh\(^{56}\) constructed physical fitness norms for male teenagers of Jammu and Kashmir State. He used AAHPER physical fitness test items to measure physical fitness, which included Pull-ups, Bent knee sit-ups, Standing broad jump, Shuttle run, 50 meter dash, 600 meter run / walk. The study concluded that the subjects belonging to age group 16 to 19 years showed better performance in all the test items, over the other age group 13-15 years. On the average physical fitness improved linearly

according to age. The scales- Percentile scale, Hull scale and T-scale were also prepared for each age group separately.

Singh\textsuperscript{57} constructed and standardized specific physical fitness test for volleyball players. For the compilation of norms, the test battery was administered on 500 volleyball players of Punjab, Haryana, Delhi, Chandigarh and Himachal Pradesh. The data was arranged age-wise so as to calculate the mean and standard deviation. The percentile and hull-scales were constructed and norms for the 14-18 years age group were developed.

Barrow and McGee\textsuperscript{58} have reported that Glover constructed a physical fitness test battery for primary grade children. The battery included four items- standing broad jump, shuttle run, seal crawl and sit-ups. The test was meant for measuring status in physical fitness items. The percentile norms were prepared for four items and were also used for classifying the children into ability groups by assessing the physical fitness.


Tyagi\textsuperscript{59} developed physical fitness norms for boys and girls in grades nine through twelve of Delhi state. Six thousand (3000 boys and 3000 girls) belonging to senior secondary schools of Delhi state acted as subjects for the study. The data was collected by administering the AAHPER youth fitness test. The age wise norms for boys and girls in terms of Percentile scales and 6-sigma scale were constructed for each test items of AAHPER youth fitness test separately. The physical fitness of both boys and girls was separately compared across age by applying Analysis of Variance. The study concluded that there was no significant difference in physical fitness of boys and girls.

Prakash\textsuperscript{60} constructed and standardized physical fitness test for high school boys. The constructed test items were weight, height, tapping by hand, agility test II, standing broad jump and leg raise (Seconds held). The constructed physical fitness test was administered to a fairly large representative sample of N=4666 high schoolboys of the age group of 13 to 15 years, belonging to 96 different high schools of Dakshina Kannada district from eight taluks for assessing the physical fitness standards of


\textsuperscript{60} S. M. Prakash, "Construction and Standardized of Physical Fitness Test for High School Boys" (Unpublished Doctoral Thesis, Jiwaji University, Gwalior, February 1995).
high school boys. Raw scores were converted into standard scores represented by T-scores and T-scale norms have been developed for the high school boys of the age group of 13-15 years. Norms for all the six test items included in the test battery were developed.

Manoj Kumar\footnote{Manoj Kumar, "Development of Norms on Selected Motor Fitness Components in the Age Group of 13 to 17 years Students of Schools of Gwalior District", (Unpublished Master's Thesis, Lakshmibai National Institute of Physical Education, Deemed University, Gwalior, 1996).} developed norms on selected motor fitness components in the age group of 13 to 17 years of Gwalior District Schools. Test items to measure the motor fitness components were 50 meter dash, standing broad jump, sit-ups, one minute stork for balance and 600 meter run / walk. Two types of scales were employed to prepare norms viz., Hull scale and Percentiles. The age wise norms were prepared separately for each test items of physical fitness.

Duggal\footnote{Amita Duggal, "Study of Relationship Among L.N.I.P.E. Physical Fitness Admission Test Items and Construction of Norms for Boys and Girls", (Unpublished Master's Thesis, Lakshmibai National Institute of Physical Education, Deemed University, Gwalior, 1997).} undertook a study to develop the relationship among physical fitness admission test items and constructed norms for students appearing in admission to the bachelor of physical education programme of L.N.I.P.E., Gwalior. Boys and girls already admitted to B.P.E. programme in the last five years i.e. from 1992 to 1996 were chosen as
the subjects. The selected test items were 50 meter dash, shuttle run, standing broad jump, medicine ball throw, 600 meter run / walk. Product moment correlation was used to compute the relationship between physical fitness test items. The norms were constructed by using 6-sigma scale and hull scale. The year wise norms were prepared separately for each test items of physical fitness.

Ramputy\(^{63}\) constructed norms in selected fitness test items for girls of age group 12-16 years in Gwalior District. She administered the test on 650 students of Kendriya Vidyalaya and public schools of Gwalior District. The test items were flexed arm hang, curl-up, sit and reach, shuttle run, 1 minute run / walk, 50 yards dash, standing broad jump. The data collected by administering the selected physical fitness test were analyzed and percentile scales were computed for female students of 12 to 16 years.

Innaiah\(^{64}\) established the physical fitness norms for Andhra Pradesh teenage population of age ranging from 13 years to 18 years. To


measure the physical fitness level of the subjects, the AAHPER youth fitness test battery was adopted. Six thousand male subjects studying in classes VIII to I year degree (undergraduate) in various government schools and colleges from 10 districts of Andhra Pradesh were selected on random basis. The data on different test items of the test battery was collected in accordance with the standard procedure laid down in the AAHPER youth fitness test manual, with the assistance of three athletic coaches and six physical education teachers / lecturers. The data was statistically analyzed using analysis of variance followed by post-hoc test. For preparation of norms for each of the test items for each age group separately, the scales namely- Percentile, Hull and T-scale were prepared. The mean differences of each age group for different test items were also tested with significant level at .05.

Bhatia\textsuperscript{65} constructed norms on selected motor fitness components for ages between 13 to 17 years, studying in schools of Greater Gwalior. School children between the ages of 13 to 17 years were selected as subjects. The test items were 50 meter. Dash, Standing Broad Jump, Sit-

ups, Stork Stand for Balance and 600 meter Run/Walk. The raw scores was standardised into T-scale, Hull Scale and Percentile scale.

Radadiya\textsuperscript{66} constructed physical fitness norms for the schoolboys of 11-12, 12-13, 13-14, 14-15 and 15-16 years of Gujarat state. Six thousand male students belonging to schools in grades five through nine from various district of Gujarat state acted as subjects for the study. To measure the physical fitness of selected subjects, AAHPER Youth Fitness Test was selected and administered. For the purpose of the study, age with norms for boys in terms of Percentile scale and 7 Sigma scale were constructed for each item of the AAHPER Youth Fitness Test separately. The analysis was done by using Statistical Package for Social Science version 10.1.

Singh\textsuperscript{67} constructed a specific fitness test battery and developed Norms for Judokas of All India Intervarsity level. 150 Judokas of different universities were selected as subjects. The factorial analysis technique was applied to develop a specific fitness test battery for the


university level judokas, further Hull-scale and T-scale were used to prepare the norms.

Thomas\textsuperscript{68} constructed and standardized specific physical fitness test for soccer players. The constructed test battery included 800 meter run, 50 meter run, burpee jump, bridge up test, shuttle run (4X100 meter) and kicking for distance. All the six items of the developed physical fitness test were standardized on three hundred and fifty soccer players of Kerala state and hull scale norms for each test items in the battery was formed.

Debnath\textsuperscript{69} designed the specific fitness norms on the 16 selected variables for female gymnasts belonging to sub-junior, junior and senior categories. The variables were Hand spring on Vaulting Horse, Kip on Uneven Bars, Back hip circle on Uneven Bars, Back roll to Hand stand, Up rise on Uneven Bars, Jump from Board to Roll forward on Beam, Standing scale on Beam, Hand stand on Beam, Back Flip and Hand spring on Floor, Maximum number of kips on uneven Bars, 60 meter


sprint and competition performance. The Percentile scale was computed. The scores were further classified into five categories i.e. very good, Good, average, poor and very poor on the basis of the result in sub-junior, junior and senior sections.

Chaniyara\textsuperscript{70} constructed norms of physical fitness test for the admission in certificate course of physical education for women in Gujarat state. For this study, 1588 women students were selected as the subjects who appeared for the entrance test of certificate course in physical education for the year 2004-05. The age group of these subjects was between 16 to 18 years and 100 meters run, long jump, shot put, high jump, and sit ups were the test items for the subjects. Percentile scale was computed after the analysis of raw scores.

Sadgir and Waghchoure\textsuperscript{71} developed norms of percentile for the selection of Pune university women’s volleyball team. They had conducted morphological tests (height and weight), physical fitness test


(50 meter dash) and skill tests (upper hand pass, under hand pass, service reception, set up and attack). Three sets events (i.e. morphological measurements, fitness measurement and skill measurement) were taken as per zone participant. There were four zones participated in the competition and each team comprised of 12 players. After testing the normality of the item wise performance scores of the subjects, the data were processed for calculation of percentile norms. The item wise normative data were graded on the basis of the principle of Likert’s five-point scale, so that an individual performance in each event is either excellent or good or average or fair or poor can easily be determined.