CHAPTER 3
CHAPTER - III

REVIEW OF THE LITERATURE

The survey of the related literature is a crucial aspect of planning a research study and the time spent on such a survey is a wise investment. The review of literature is an exacting task calling for a deep insight and a closer perspective of the overall field. Emphasizing the importance of the survey of the related literature C.V. Good and others have pointed out that "survey of the related literature help to show evidence already available to solve problem. It contribute by providing ideas, theories and explanations valuable for formulating the problem and may also suggest the method of research".

The review of literature in this study is concerned with physical fitness, fitness and games and sports and norms of physical fitness. Quite a good number of fitness tests have been conducted in different countries and particularly in U.S.A. Efforts have also been made in India. Review of the literature on fitness tests will augement our knowledge in this field and to take guideline for further development of the programme of fitness.

INDIANA MOTOR FITNESS TEST FOR HIGH SCHOOL AND COLLEGEMEN:

A popular test of physical fitness devised in 1944 was Indiana Motor Fitness Test for high school and collegemen. Test consisted of 12 items involving two measures each of strength, velocity, motor ability and endurance. Test items were staddle chining, push ups (for boys) push ups for girls. Squat thursts (Burpe test) vertical jump, standing broad jump.
test is a three items test consisting vertical jump, chining and 100 yards shuttle run i.e., a subject run 10 yards course ten times. The validity of the test items were:

<table>
<thead>
<tr>
<th>Group</th>
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<th>J.C.R.</th>
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<td>A</td>
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<td>B</td>
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This test is easy to be conducted and is very practical.

ARMY AIR FORCE PHYSICAL FITNESS TEST

The Second World War necessitated promotion of physical fitness in the forces. As a result physical fitness test specially designed to measure fitness of forces were devised. The AAF test is based on major organic constituent of fitness. The purpose of the test is to measure the type of fitness required for war times. The seven major components of fitness, i.e., muscular endurance, muscular explosive power, agility, speed, body coordination, speed and endurance were selected for the tests. The test items were:

A. Muscular Endurance:
   (i) Chinning, (ii) Dipping, (iii) sit ups, (iv) Leg lift, and (v) Floor push up.

B. Muscular Explosive Power:
   (i) Vertical Jump, (ii) Three standing broad jump, (iii) Shuttle run.

Agility - purpose test

Speed - 60 yards dash.
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   **Agility - purpose test**

   **Speed - 60 yards dash.**

Speed and Endurance - 360 Yards Run.

The norms were constituted by use of T. scale five S.D. below and above mean.

**Navy Standard Physical Fitness Test**

In order to determine the fitness status of Navy personnel, a five item fitness test was develop. The items of the test are squat thrust, sit ups, push ups, squat jump and pull ups.

**Oregon Motor Fitness Test**

Motor fitness test for Oregon school grade 4 to 12, boys and girls were developed in 1962 at Oregon. This test was established for realization of-

1. Physical fitness status according to grade level.

2. To identify those who are below standard and so as to prescribe a programme of physical fitness for them.

3. To determine effectiveness of the physical education as regard to fitness objectives.

4. To motivate yougesters to improve their fitness the test battery includes following items:-

   1) Standing Broad Jump
   2) Push ups
   3) Sit ups
   4) Jump and Reach
5) Pull ups
6) Potato race

7) Hanging in arm flexed position
8) Standing Broad jump.

9) Cross arm curl up

Norms based on T-test were framed of the above test items.

Kirchner’s Motor Fitness Test

This test was designed for boys and girls from 6 to 12 years of age. A five items test battery consisting of following items were conducted in this test: i) Standing broad jump; ii) Bench push ups; iii) Curl-ups; and iv) Squat jump; v) 30 yards dash.

T-scale norms were made. Classification for fitness was being made as- superior- good- average- below average and poor.

Hunt (1975) studied the relationship between age, height, weight, and ability to perform Manilobas physical and Motor performance test for junior high school students. He concluded that the age, height, weight are of little value as far performance is concerned.

Wear and Miller studied the relationship of physique and development level as determined by performance in fitness tests of junior high school boys. They found subjects with medium physique and normal in development were the best performer and the subject of heavy physique were the poorest performers.

Ross (1966) found significant gain in abdominal strength, power, co-ordination, flexibility, speed as result of participation in physical fitness programme. Alexander, Martin, and Metz (1968) in their study on 17 karate
players from the University of Minnesota observed participation in a four week training programme, significantly improved muscular strength and endurance of the subjects.

Carter (1959), Coker (1965) and Weiny (1967) worked with subjects of different ages and sexes and concluded that as a result of participation in different kinds of training programme and also as a result of participation in different games and sports, the physical fitness level of the subjects is significantly increased.

Glover (1962) developed a physical fitness test for the primary grade children. The items of the test were: i) Standing Broad Jump; ii) 400 feet shuttle run. iii) Sit ups; and iv) Seal Crawl.

Keithly (1939) found that increase in strength of boys during adolescent period is greater than expectation. Dimock also stated that physical strength as measured by Roger's test increase rapidly throughout the adolescent years.

Astrand (1970) and Wilmore (1974) have reported that women have substantially less strength than man. Burley (1961) studied the difference among 7th, 8th and 9th grade subjects is power, speed and flexibility and relation between power and flexibility and speed and flexibility. They reported that power, speed and flexibility did not increase or decrease with the increased age and grade of the subjects. They also reported low degree of relationship between flexibility and power and flexibility and speed.

Phillips (1956) employing Kraus Weber test two boys and girls of 6 to 12 years of age found that both sexes tend towards a rapid decrease in
flexibility with increasing age. The flexibility in girls decreases more rapidly. 
Hupprich and Sigerson (1950) found that flexibility increases in most joints 
until the age of 12 years and it decreases gradually as adolescence is 
reached.

Cocoenough (1935) reported that reaction time improves with age 
in early childhood and Hodkins (1962) reported that it improves with age 
from 6 years to 19 years. Noble (1964) reported that reaction time improves 
from 8 years to late teens. Hodkins (1963) studied the reaction time and 
speed of movement of boys and girls from 6 to 12 years of age and reported 
the effect of age on these performances. He reported that upto 12 years 
there are no marked differences between their performance. After 12 years 
males show superiority in performance over females. Rarick (1973) reported 
that speed increases with age in both sexes upto the age of adolescence. 
The girls decline in speed whereas boys continues to improve.

Gutteridge (1933) reported that boys increases their jumping ability 
from 5 years of age to 17 years of age. Boys have been found better than 
girls in running, jumping and throwing abilities.

Henry and Nelson (1956) compared the performance of 10 and 15 
years old boys in a motor skill task. The result clearly indicate superior 
performance of the older boys although the younger group improved more 
with practice than the older boys. Seils (1951) in a study reported the 
effect of age on running, throwing, balancing, striking and jumping. Jenkin 
(1930) and Latshaw (1954) had also reported similar results.

Espenshade (1947) administered the brace motor ability test on 
325 girls and 285 boys ranging in age from $10^{12}$ to 16 years. Among the
conclusions boys were found to increase in ability to perform the varied activities. Girls improved in agility upto 14 years and performance declined thereafter. Changes were also observed in the test items of flexibility, balance and control in case of girls. Boys and girls were quite similar in performance upto 14 years of age but after this period boys superiority increased rapidly at each successive age level.

Cozen remarked that age should be a base of physical fitness comparison. He also advised classification on the basis of height and weight within each age group. Mc Clon also indicated that age and weight were the most influential factors in physical education performance among elementary and high school pupils.

Falck prepared percentile norms of physical fitness in the age group of 12, 13, 14 and 15. He prepared norms for each of the following items.

1. Sit ups.
2. Side stepping.
4. Standing Broad jump.
5. Modify pull ups.

Barrow constructed a test of motor fitness for collegemen. First an analysis of a number of recognised test of motor performance was made to determine the test items found to be most valid measures of motor ability. Finally, two test batteries were devised one short battery for indoor and other for out-door. Norms were prepared for collegemen and school boys.

**Test number one: The first test is a six items battery of standing**
broad jump, soft ball throw, zig zag run, wall pass, medicine ball put, and 60 yards dash.

**Test number two:** This battery consisted of 13 items for indoor testing. The items are standing broad jump, medicine ball put, and zig zag run.

Ponthiew, Barker and Hettinger compared black and white students on a test of power. Similar, type of studies were conducted by Hipple and Rholes on different age groups. John N. Dowatzby and Charles J. Mdney devised Oregon fitness test. This test was conducted on 3400 boys and girls in grace 4th to 12th.

John D. Whitelay and Leon E. Smith studied the effect of Isometric and Isotonic exercises on strength and speed of the lateral arm movement on 26 collegemen. Reliability of co-efficient for both speed and strength of movement were found to be high. There were significant improvement in speed with both the exercises. However, the difference in speed gain between two conditions was non-significant.

The effect of isometric and isotonic strength training on strength and speed on single movement were studied by Chui. He found that the significant gain in limb strength resulting from performing resistive and non-pressive exercise in a specific range of movement were accompanied by significant gains in speed of the movement.

Smith observed a strength increase of 17 percent and speed increase of 8 percent while using a combination programme of isometric and isotonic
strength training. Similarly, in another study Smith and Whitley found a strength increase of 22 percent and speed increase of 6 percent using both the isometric and isotonic training method.

Benard, Gutin and Dominick (1966) reported that physical fitness improves in those who take regular physical activities. The New York State Physical fitness test is designed to provide school with a convenient instrument of periodic evaluation of status and progress in the fitness of boys and girls in grade 4 to 12. The test items are:

1. Side stepping.
2. Sit ups.
3. Shuttle run.
4. Squat thrusts.

A north Carolina fitness test was developed for the elementary and secondary school boys of North Carolina. The test consist of 5 items which are as follows:

1. 30 seconds bent knee sit ups.
2. 30 seconds side stepping.
3. Standing Broad Jump.
4. 30 seconds Squat thrusts for boys and girls.
5. pull ups for boys and girls for 30 seconds.

Kirchner (1970) devised a test for elementary school children with five items battery.
1. Standing broad jump,

2. Bench push ups,

3. Curls ups (Bent knee sit up)


5. 30 yards dash.

Employing AAPHER Youth Fitness test battery, Ronald J. Saunders, Henry, J. Montoye; David, A. Cunningham and Andrew J. Kozetr in their study on physical fitness of high school students and participation in physical education classes concluded that the girls (juniors and seniors) who had elected physical education during all semesters were marked superior to age matched girls who had never enrolled in physical education or had partially enrolled in physical education.

Jacques Vrijens studied the influence of the interval circuit exercises on physical fitness of adolescent. Favourable effect on both functional and morphological group of 11 who participated in a circuit training (10 exercises) programme of six weeks with three training sessions per week. Improvement of oxygen intake, pulse rate, and cardiovascular system, muscular development was noticed in the experimental group.

Richard, A. Berjer and Rober, A. Layne observed a favourable attitude towards physical education among collegemen on the basis of muscular strength and motor ability. Studies by Tinkle and Montoye and Wessel and Nelson also found that strength was significantly related to physical achievement and attitude towards physical education. Elmer A. Gross and Jerome A. Cascinai studied “the value of age, height and weight as a
classification device for secondary school students in the seven AAPHER Youth Fitness Tests”. Simple correlations, multiple correlations and regression coefficients for the ten variable of age, height and weight and seven tests for each four groups of senior high school girls, junior high school boys, were calculated. In general, age, height and weight have negligible value for classification purposes in all four groups.

D.McCritt Jones, Chadwick Squires and Kaare Rodahl in their study on “effect of rope skipping on physical work capacity” observed that there was significant improvement in physical work capacity as judged by pulse response, oxygen uptake by participating in rope skipping exercise for 5 minutes daily for a period of four week period.

Robert L. Compbell studied the effect of supplemental weight training on the physical fitness of athletic squads. In general, the resulting statistics show that weight training add significantly to the physical fitness produced by normal training.

Efforts have also been made in our country to assess physical fitness and to standardize norms of physical fitness. A national plan of physical education and recreation we finalised in 1956. Tests items under this scheme were as follows:

**Boys 10 to 12 years**

1. 50 metres run.
2. High jump.
3. Long jump.
Boys of 13 to 17 years

1. 100 metres run.
2. High jump.
3. Long jump.

Girls 10 to 12 years

1. 50 metres run.
2. Skipping 30 seconds.
3. Ball bouncing 30 seconds.
5. Sit ups 30 seconds.

Girls 13 to 17 year

1. 100 metres run.
2. Cricket ball throw.
3. Long jump.
4. High jump.
5. Sit ups (one minute)

THE BOMBAY SCHOOL ACHIEVEMENT TEST

Joseph, P.M. a well known physical educationist in India devised a test for Bombay school boys. The events included in the test for boys are:-
1. a) 50 yards run for elementary and sub-junios.
   
   b) 75 yards run for sub-senior and senior.

2. Jump and reach (vertical jump)

3. Ball throw for distance.

4. Pull ups.

5. Running Broad jump.

The Bengal athletic test for physical efficiency of high school students included following items. Those who qualify the standard were given merit certificates.

- 100 yards run = 13.4 seconds
- 50 yards run = 7 seconds
- 880 yards run = 3 minutes 30 seconds
- High jump = 4"
- Running Broad Jump = 14"
- Press ups = 8 times
- Pull ups = 5 times

Students were also required to know cycling and swimming.

The Bengal physical efficiency test for college students included the following items:

1. 100 yards run
2. Shot put.
3. High Jump.
4. Long Jump.

7. Cricket Ball throw.

Abraham C. C. Ribon test is a well known test and very rekuavke for Indian school and colleges. The introduction of the name of the colours in place of standard has a great appeal to students. The events are as follows:

**SUB-JUNIOR:**

1. 50 metres run 2. High jump
3. Long jump 4. Cricket Ball jump
5. Pull ups

**JUNIORS**

1. 75 metres run 2. High jump
3. Long jump 4. Cricket Ball throw
5. Hop step and jump 6. Pull ups

**INTERMEDIATE**

1. 100 metres run 2. High jump
3. Long jump 4. Shot put 8 pounds
5. Hop step and jump 6. Pull ups

**SENIORS**

1. 1000 metres run 2. High jump
3. Long jump 4. Shot put 12 pounds
5. Hop step and jump

6. 100 metres hurdles.

7. Pull ups.

The National Physical Efficiency Drive was first launched in the country in 1959-60 by the Minister of Education to make our country fitness conscious and to arouse among people a desire to achieve higher standard of physical efficiency. Although the scheme was welcomed, it did not make much head way during the first two years of its inauguration. The pattern of the scheme was revised in 1961-62 and there was a substantial improvement over the achievement in previous two years.

It was hoped that the drive would arouse interest in young and old men and women, to check their performance abilities and the stimulate in them a keenness for physical fitness. The drive was organised throughout the country in first two years on experimental basis. The response from all quarters exceeded all expectations. However, certain difficulties were experienced while conducting the test battery on the recommendations of the experts in the field.

The test items are different for men and women are further classified into tests for juniors and tests for seniors. Juniors are those who are below 18 years. Each item of test has three standards laid down from moderately easy to fairer and difficult. The highest standard are the three stars, and next two stars and easiest one star. The idea is that those who pass all the prescribed items at the three star level will be awarded three stars and so on for two star and one star. The details are given in appendix. Norms for national award were also prepared. Percentile norms were prepared under
the guidance of Laxmibai National College of Physical Education, Gwalior under the National Physical fitness programme. Standard for one star, two stars, three stars were also prepared for different age groups. The detail of the great items and fixed for stars are as under:

**BATTERY-A**

**Sub-Junior Boys - 14 to 16 Years.**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Event</th>
<th>1 star</th>
<th>2 star</th>
<th>3 star</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>100 mts run</td>
<td>16.5 sec.</td>
<td>15.00 sec.</td>
<td>13.5 sec.</td>
</tr>
<tr>
<td>2.</td>
<td>Long Jump</td>
<td>3.30 mts</td>
<td>3.90 mts</td>
<td>4.50 mts.</td>
</tr>
<tr>
<td>3.</td>
<td>Shot put (5.45 kg)</td>
<td>4.50 mts</td>
<td>6.00 mts</td>
<td>7.50 mts.</td>
</tr>
<tr>
<td>4.</td>
<td>High Jump</td>
<td>1.00 mts</td>
<td>1.20 mts</td>
<td>1.35 mts.</td>
</tr>
<tr>
<td>5.</td>
<td>600 mts run</td>
<td>3.30 min</td>
<td>3:00</td>
<td>2:40</td>
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</table>

**Juniors Boys 16 to 18 Years**

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<th>3 star</th>
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<tr>
<td>1.</td>
<td>100 mts run</td>
<td>15.5 sec.</td>
<td>14.00 sec.</td>
<td>13.0 sec.</td>
</tr>
<tr>
<td>3.</td>
<td>Shot put</td>
<td>5.50 mts</td>
<td>7.00 mts</td>
<td>8.50 mts.</td>
</tr>
<tr>
<td>4.</td>
<td>High jump</td>
<td>1.10 mts</td>
<td>1.30 mts</td>
<td>1.45 mts.</td>
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<tr>
<td>5.</td>
<td>800 mts run</td>
<td>3.20 min.</td>
<td>2.50 min.</td>
<td>2.30 min.</td>
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</table>
Senior 18+ to 35 Years

1. 100 mts run 15.00 sec. 13.50 sec. 12.5 secs.
2. Long Jump 3.80 mts 4.50 mts 5.20 mts.
3. Shot put 5.60 mts 7.00 mts 8.50 mts.
4. High jump 1.20 mts 1.40 mts 1.50 mts.
5. 800 mts run 2:50 .0 2: 30.0 2:20.0

BATTERY-A GIRLS
SUB-JUNIOR GIRLS - 14 to 16 Years.

<table>
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<tbody>
<tr>
<td>1.</td>
<td>100 Mts run</td>
<td>18.5 sec</td>
<td>17.0 sec</td>
<td>16.00 secs.</td>
</tr>
<tr>
<td>2.</td>
<td>8 min. run/walk</td>
<td>1200 mts</td>
<td>1400 mts</td>
<td>1600 mts</td>
</tr>
<tr>
<td>3.</td>
<td>Sit Ups</td>
<td>10 nos.</td>
<td>15 nos.</td>
<td>20 nos.</td>
</tr>
<tr>
<td>4.</td>
<td>Long Jump</td>
<td>2.50 mts</td>
<td>3.10 mts</td>
<td>3.70 mts.</td>
</tr>
<tr>
<td>5.</td>
<td>Throwing the ball</td>
<td>9.00 mts</td>
<td>12.0 mts</td>
<td>15 mts</td>
</tr>
</tbody>
</table>

Junior Girls 16 to 18 Years.

1. 100 Mts run 17. sec 16.0 sec 15.00 secs.
2. 8 min. run/walk 1400 mts 1600 mts 1800 mts
3. Sit Ups 15 nos. 20 nos. 25 nos.
4. Long Jump 3.00 mts 3.5 mts 4.00 mts.
5. Throwing the ball 12 mts 15 mts. 18 mts.
**Women Seniors 18+ to 35 Years**

1. 100 Mts run  
   16.5 sec  
   15.5 secs  
   14.5 secs.

2. 8 min. run/walk  
   1600 mts  
   1800 mts  
   2000 mts

3. Sit Ups  
   20 nos.  
   25 nos.  
   30 nos.

4. Long Jump  
   3.25 mts  
   3.75 mts  
   4.25 mts.

5. Throwing the ball  
   15 mts  
   18 mts.  
   21 mts.

**Adult Fitness Programme**

**Men**

1. 12 min run/walk  
   1400 mts  
   1600 mts  
   1800 mts

2. Sit ups  
   10 nos.  
   20 nos  
   30 no.

**Women**

1. 12 min run/walk  
   800 mts  
   1000 mts  
   1200 mts

2. Sit ups  
   5 nos  
   10 nos  
   20 no.

**BATTERY-B**

**Boys-Sub-Junior 14 to 16 Years**

<table>
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<tr>
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<tr>
<td>1.</td>
<td>100 mts run</td>
<td>16.5 secs.</td>
<td>15.00 sec</td>
<td>13.5 secs.</td>
</tr>
<tr>
<td>2.</td>
<td>12 min run/walk</td>
<td>1600 mts</td>
<td>1800 mts</td>
<td>2000 mts</td>
</tr>
<tr>
<td>3.</td>
<td>Dands</td>
<td>15 nos.</td>
<td>20 nos.</td>
<td>25 nos.</td>
</tr>
<tr>
<td>4.</td>
<td>Long jump</td>
<td>3.30 mts</td>
<td>3.90 mts</td>
<td>4.5 mts.</td>
</tr>
<tr>
<td>5.</td>
<td>Cricket Ball throw</td>
<td>30 mts</td>
<td>40 mts</td>
<td>50 mts.</td>
</tr>
</tbody>
</table>
Juniors 16+ to 18 years Boys

1. 100 mts run  15.5 secs.  14.00 sec  13.00 secs.
2. 12 min run/walk  2000 mts  2200 mts  2400 mts
3. Dands  20 nos.  30 nos.  40 nos.
4. Long jump  3.50 mts  4.20 mts  4.85 mts.
5. Cricket Ball throw  40 mts  50 mts  60 mts.

Men 18+ 25 Years

1. 100 mts run  15.00 secs.  13.5 sec  12.5 secs.
2. 12 min run/walk  2400 mts  2600 mts  2800 mts
3. Dands  30 nos.  40 nos.  50 nos.
4. Long jump  3.80 mts  4.50 mts  5.20 mts.
5. Cricket Ball throw  50 mts  60 mts  70 m

(Dands are to be performed continuously)

Chaudhry, G.S. (1980) prepared norms of physical fitness for college-men of 15 to 17 years of Haryana State. This study assess physical fitness in relation to socio-economic status. The test items were as follows:

1. Harvard step test to judge endurance.
2. Zig Zag run to judge to speed and agility.
3. Jump and reach to judge strength, speed and power.
4. Shop put to measure strength and power.

5. Sit ups to measure flexibility and abdominal strength

Norms were prepared in terms of percentile rank for students belonging to different areas (rural and urban) and different socio economic status (high, middle and low).

Malhotra et al (1981) using a test battery of the following items found significant improvement in physical fitness of the basketball player after off-season training.

1. 60 metres shuttle run for agility.

2. 60 metres sprint for speed.

3. 2.4 kilometre for endurance.

4. Standing broad jump for explosive power of legs.

5. Pull ups and push ups for arm and shoulder strength.

6. Sit ups (bend knee for abdominal and back strength).

7. 400 metres run for measuring speed endurance.

8. Medicine ball throw from sitting position to measure arms and shoulder dynamic strength.

Robson M.Thirmeay, Uppal, A.K. and Dutta, A.K. (1978) devised a simple physical fitness test battery for elementary school children. Percentile norms were also worked out. The test items were:-

1. 50 metres dash.

2. 600 metres run/walk.
3. Straight leg sit ups.
4. Vertical jump.
5. 40 metres shuttle run.
6. Modified push up.

Mookherjee, S. employing step test in his comparative study of physical fitness of young boys in the age group of 13 - 17 years belonging to rural and urban areas found that rural non-vegetarian boys showed a significant superiority in all the parameter of physical fitness. The test is easier to perform. For normal healthy young men the scoring is as follows:

1. Score below 50 poor
2. Score 50 to 80 average
3. Score above 80 Good

Mall, T and Mall, N.N. studied the effect of isometric exercises upon the physical fitness status of high school boys of 13 to 16 years. Following items were included in the fitness test:-

1. Vertical jump.
2. Agility run.
3. Endurance hang.
4. 50 metres dash.
5. 400 mts run.

The researchers concluded that participants in isometric exercise for a period of 10 week for 5 times a week contributed more to improvement in measures of physical fitness.
Robson, M.; Uppal, A.K.; Thirumalia, G and Brar, T.S. (1977) in their comparative study of physical fitness of elementary school children (boys and girls) of defence and non-defence personnel conducted following test of physical fitness: i) 50 mts dash; ii) 4 × 10 mts shuttle run; iii) sit ups; iv) modified push ups; v) vertical jump; vi) 600 mts run/walk. It was found that boys and girls belonging to defence personnel had shown higher performance in physical fitness tests.

Uppal, A.K. and Pal, Ramesh studied the relationship of physical fitness to selected anthropometric measurements. AAPHER Youth Fitness Test was administreted to obtain physical fitness index.

Robson, M; Uppal, A.K. and associate studied cardiovascular efficiency of professional students in physical education using 12 minutes run/walk test. They concluded that students of senior classes show better performance level. The cardio-vascular efficiency of track and field group was better than football and basketball.

Malhotra, M.S. and associate in their study of the evaluation of general physical fitness of national level sportsmen (18 - 27 years) conducted following tests of physical fitness.

For strength

1. Bent knee sit ups.
2. Flexed arm hang for women.
3. Pull ups for men.
4. Modified push ups.
studied physical fitness with some physical and socio-psychological variables of school boys (13 to 15 years) possessing high academic achievement.

Robson, M, Uppal, A.K. and Dey, R.N. in their study of comparative effects of different duration of training is a vital factor in improving physical fitness and physiological variables. The study shows that increase in duration of training results in better efficiency.

Bosen, K.O.; Hardyal Singh and Sharma, V.S. studied fitness level of Indian men Javelin thrower and compared their performance with international norms. Uppal, A.K. associate studied effect of different endurance strength frequencies on cardio-respiratory endurance and selected strength variable. They found significant increase in fitness parameters with the use of varied frequency of training. For significant improvement in strength two training unit per week were recommended for beginners, for conditioned sportsmen strength training three days a week can bring better results.

Bhole (1970) found that short term Yogic training improves vital capacity. Gharote (1970) reported significant increase in strength and endurance of the abdominal muscles in case of female as a result of Yogic training for three months. Girl (1966) found significant improvement on the tests performance of national physical efficiency drive as a result of Yogic training. Therrier (1968) compared influence of 5 BX programme and a Hatha yoga training programme for eight week on selected fitness measure and found both programme effective in increasing parameters of Iowa physical fitness test.
Gharote (1973) using Fleishman Battery of Basic fitness tests on adult male and female found that basic fitness improves significantly as a result of short term yogic training.

Rao, V.S.M. and Chakraborty, T.M. found significant improvement on physical fitness as a result as a result of Bratachari dance. The group practising the sind dance showed gain in pull ups, long jumps, shot put and agility run.

Moorthy, A.M. found a significant change on muscular fitness of the elementary school children as a result of regular yogic exercises programme for 6 weeks.

**Endurance Test as Test of Fitness**

**Harvard Step Test:** One of the most important test of cardiovascular fitness is the Harvard step test. This test was developed by Brough and associates in the Harvard Fatigue Laboratory during World War II. The test was constructed for purpose of measuring the ability of the body to adopt itself to hard work and to recover from the same. The test proved useful in knowing the fitness level of young men in three group least fit, fit and most fit. Conditioning programme can be prescribed on the basis of the test result. There are two forms of this test.

1. The Long form; and

2. The Short form.

1. **Long Form:** The subject exercise on a 20" bench for a period as long as possible, maximum upto 5 minutes. The cadence is 30 seconds per minute. The pulse is counted from 1 to 1/2 minutes from 2 to $2^{1/2}$
The testee sits on a chair after the exercise for one minute, and pulse is counted thereafter. The scoring formula is:

\[
\text{Index} = \frac{(\text{Duration of exercise in seconds}) \times 100}{5.5 \times (\text{pulse count})}
\]

The norms are as under:

- **Below 50**: Poor
- **50 to 80**: Average
- **Above 80**: Good

The author tabulated for calculating the index.

Skubic and Hodgkin in 1963 modified the Harvard step for girls and...
women and found that a three minute test using 18 inches bench and stepping rate of 24 per minute is reliable and valid.

Sloan in 1959 also propound a modified Harvard step test suitable for women. Sloan recommended 17 inches high bench and cadence of 30 steps per minute and the pulse is counted three times in thirty seconds, e.g., from 1 to 1 \( \frac{1}{2} \) minute, 2 to \( 2 \frac{1}{2} \) minutes and 3 to \( 3 \frac{1}{2} \) minutes.

\[
\text{Fitness Index} = \frac{(\text{Duration of exercise in seconds}) \times 100}{2 \left( \text{Sum of pulse count in recovery} \right)}
\]

**Norms were:**

- Below 50: Poor
- 56 to 79: Average
- 80 to 89: Good
- Above 90: Excellent

Later Sloan also recommended the short form as followed in Harvard Step Test for his test.

**Gallagher and Broughe Test for High School Boys**

Gallagher and Broughe hold that to evaluate physical fitness, the subject should be observed while performing work. The test is based upon the principle that the rate at which the heart slows down after it has been accelerated by a standard difficult exercise gives an excellent measure of an individual physical fitness. The author divided boys of the age group 12 to 18 in two groups on the basis of weight. Group 1 with surface area below 1.85 are tested on procedure and group-II on 20" platform. The remaining
procedure is just like Harvard Step test with the exception that pulse is counted in different manner, e.g., after 4 minutes, 1 minute rest and pulse count for 30 seconds then after 6 minutes pulse is again counted for 30 seconds and again after 7 minute pulse is counted for 30 seconds. The fitness score is computed by a formula

\[
\text{Physical Fitness score} = \frac{(\text{Duration of exercise in seconds}) \times 100}{2 \cdot (\text{Sum of pulse count})}
\]

The author prescribed a scale for the test.

Other similar tests to determine physical fitness on the similar basis are the Ohio State University test. Callan Modified test for elementary schools, pack test, Schneider test, Tuttle pulse ratio test etc. It is clear from the explanations given in this chapter that quite a good amount of work has been done in U.S.A. There is a need for such research work in our country too as such test serves as basis for improving physical fitness.