Chapter II

REVIEW OF RELATED LITERATURE

The review of related literature was collected from some of the richest libraries in India as far as the literature related to physical education and sports is concerned. The review of related literature was mainly confined to the library of Lakshmibai National College of Physical Education, Gwalior. The other libraries were, library of Sports Authority of India, Jawaharlal Nehru Stadium, New Delhi and the library of Netaji Subhas National Institute of Sports, Patiala. The researcher has gleaned through almost every source like Research Quarterlies, Dissertation Abstracts, Journals of various kinds, Periodicals, Micro-films, Encyclopaedias and relevant books to pick-up the material and has gone through it properly, carefully, critically and has then jotted down the required excerpts for inclusion in the thesis.

Lewis\(^{1}\) conducted a study on male college students (N=90) who participated in a 12-week training and conditioning programme. The subjects were randomly placed in 3 groups and were identified as the traditional group, usually characterized by conventional exercise, the resistive-exercise group, utilizing a combined

isometric-isotonic technique of exercise using the exer-genic exer-
ciser, and the control group in which no formal conditioning took
place. The post test findings showed a significant difference on
the scores made by the resistive exercise group as compared
with the other two groups on all four criterion variables indicating
that the combined isometric-isotonic method of conditioning was
effective.

Scott\textsuperscript{2} conducted an investigation on thirty two basketball
players at Highline High School, Seattle. They were made to
run to exhaustion on the treadmill and then had seven weeks of
pre-season basketball conditioning exercises. Twenty nine subjects
improved their all-out treadmill run time on the post conditioning
test. The mean time increased from 6.63 to 11.93 minutes. The
gain was significant at the .01 level of confidence. Inclusion of
cardio-respiratory measurements and a follow-up after a season
of basketball were recommended to determine whether endurance
was maintained.

\textsuperscript{2}Charles Howard Jr. Scott, "The Effect of a Pre-season
Conditioning Programme on the Endurance of Selected Male
Candidates for Inter-scholastic Basketball Teams," Completed
Malhotra and Subramanian's study indicated that compared to pre-competitive training, the off-season training had a significant effect on the general physical fitness and skill in basketball players. The study also indicated that the combined training (training for the general fitness, the specific game fitness and techniques and tactics) did not result in any improvement in strength, agility, flexibility or explosive power. On the contrary it resulted in drop in values of most of the tests, specially flexibility and speed endurance to a significant level. Only in endurance running there was an observed improvement. On the other hand there was significant improvement in speed, endurance, strength, flexibility, explosive power and dynamic strength of arm and shoulders as a result of the off-season training.

Nicolau conducted a study through 9 basic fitness tests developed by Fleishman which were administered to the 1964 varsity football squad at the University of Bridgeport before and after the preseason conditioning programme as an index of football

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fitness. Half of the players used the traditional programme consisting of a short jog, stretching exercises, push-ups, sit-ups, leg-raises, toe touching, neck bridging, grass drills, and running in a circle at top speed over players who were lying down. The other half used the circuit training principle with vertical jump, push-ups, leg lifts, squat trust, step-ups, bent arm hangs, grass drills and dips at the 8 stations. The circuit training group improved significantly while the traditional group did not, but the difference in improvement was not significant.

Sayed studied on 9th grade boys (N = 149) who were assigned to four treatment groups (circuit training, weight training, swedish exercises, and non-conditioning control). The conditioning programmes were administered during the 1st 10 minutes of each of 20 physical education class periods (3 times a week over 7 weeks). Activity for the rest of each class period consisted of volleyball, wrestling, and street hockey. ANOVA revealed within group improvements and differences among the groups. There was no difference in cumulative performance and no difference in cumulative standard scores. The post "no conditioning" test revealed a decrease in pull-ups performance.

Carr\(^6\) conducted a study on three badminton classes for beginners at the University of Washington and were given initial and final tests of physical fitness (squat trust, toe touch, curl-up, pull-up and modified Illinois agility run) along with the Miller Wall Volley, the Scott-French Badminton serve and the Fox Beginning Badminton written examination to determine badminton skill of knowledge achievement. During 10 instructional periods, one group had progressive body conditioning exercise for 15 minutes and the second group had isometric exercise for five minutes followed by badminton instruction. The third class had the regular instructional unit in badminton for the full period. Body conditioning exercises produced the greatest improvement in physical fitness but isometric and body conditioning exercises did not affect significant improvement than the badminton instruction alone. The time devoted to these programmes caused little or no effect of badminton achievement.

Lambert\(^7\) studied male students (30) between 18 and 28 years of age. They were assigned randomly to 3 groups to compare


the effect of straight leg sit-ups with weights, free-hanging knee raise, and no special exercise programme on developing trunk flexion speed. Isolated exercise of the trunk flexors was accomplished by strapping, which restricted the range of motion of the shoulders to 20° and elbow to 90°. Speed of trunk flexion was measured with the Hale Reaction Performance Timer with the subject approximately in basic throwing position of the finish style of javelin throwing. The 2 exercise groups practiced 4 days a week for 3 weeks. No significant difference between the two exercises and control was found.

McCann studied on 49 women physical education majors who were enrolled in 2 track and field classes. These women participated in 2 separate conditioning programmes twice a week for 7 weeks in addition to their regular class-work. The Harvard Step Test was given before and after the 7 week experimental period. It was concluded that a traditional method of conditioning produced a significant increase in endurance as measured by the Harvard Step Test.

Westering\textsuperscript{9} studied two physical conditioning methods, intense intermittent, and conventional to determine their effect on physical fitness tests and time spent in each conditioning programme. The time spent in conventional conditioning programme was twice that of the intense-intermittent group in a six-week period, while a significantly higher degree of physical fitness was obtained through the use of an intense intermittent conditioning programme. Athletic Coaches who are concerned about tightly scheduled practice sessions and conditioning procedures will find one answer in intense-intermittent conditioning programme. Physical Educator could also develop a higher level of physical fitness and have more time for the instructional phase of their programme.

Dintimen\textsuperscript{10} determined whether flexibility training programme, a weight training programme and the combination of both would affect running speed when used as supplementary training programmes to the conventional method of training sprinters. One hundred and forty five subjects were randomly assigned to five training groups. Groups were tested for flexibility, strength

\textsuperscript{9}Forrest Westering, "A Comparison of Two Types of Physical Conditioning Programmes of High School Athletes," \textit{Completed Research in Health, Physical Education and Recreation} 3 (1961): 37.

and running speed before and after an eight weeks training programme. Results showed that both weight training and flexibility training as supplements to sprint training increased running speed significantly than by sprint training programme alone.

Kinnison\textsuperscript{11} conducted a test on 100 male college students on accuracy in one hand push shot in basketball and speed and accuracy in passing at a target, before and after a 5 weeks' training programme. One group practiced with a regular basketball; another group practiced with regular ball and had supplemental isometric exercises; the third group used a ball with twice the weight and the fourth group used over weighted ball plus isometric exercises. Shooting accuracy improved significantly for the two groups using the regulation ball but not for the two groups using the over weight ball. The difference was due to the ball rather than the isometric exercises or interaction. No significant gains were made in passing accuracy. Passing velocity increased for the group using the regulation ball plus isometric exercises and for the group using the over weighted ball.

\textsuperscript{11}James E. Kinnison, "The Effect of Four Training Programme on the Acquisition of Speed and Accuracy in Motor Performance,". Completed Research in Health, Physical Education and Recreation 9 (1967) : 69.
Harper, Billinge and Mathew\textsuperscript{12} conducted a study of the Effect of two physical conditioning programmes on cardio-respiratory fitness of 25 college men. The subjects were placed into three groups on the basis of maximum oxygen consumption, one group participated in a modified army conditioning programme and second group in interval training involving running. The third group (control) participated in recreational activities. The group met five days per week for seven weeks. Cardio-respiratory efficiency was measured with the help of the Harvard Step Test. The results showed that both interval training and army trained groups improved significantly in their cardio-respiratory efficiency. The control group did not improve significantly.

Bolt\textsuperscript{13} conducted a study on 71 volunteers and randomly assigned them to one of the two jogging regimens, namely, slow jog regimen and fast jog regimen and the third group, that was non-jog, continued their sedentary habits. The subjects trained thrice a week for twelve weeks. It was concluded that slow jog regimen and fast jog regimen of training significantly improved cardio-vascular fitness.


\textsuperscript{13} S.M. Bolt, "Two Jogging Programmes of Different Speed Related to the Cardio-vascular Fitness of Middle Aged Men," Dissertation Abstracts International 33:8 (Nov., 1972): 2149-A.
Stockton\textsuperscript{14} studied 9th and 10th grade girls at Bellingham High School and were randomly assigned to four different conditioning programmes; Calisthenic/Aerobic (N =19), Aerobic (N=26), Calisthenic/Shuffling (N=31), and Calisthenic (N = 26). The effectiveness of these conditioning programmes in developing cardiovascular efficiency as measured by the Cotton Modified Step Test and muscular strength and muscular endurance as measured by the Oregon simplification of the PFI was determined, statistical procedure included ANOVA, Scheffe's Post-hoc Analysis and 't' ratio. Conclusions were: Aerobic conditioning produced significant performance (P .05) in muscular strength and muscular endurance.

McKibben\textsuperscript{15} compared the effects of three different workloads of varying intensities and distances on cardio-vascular endurance. Group I, trained at a heart rate of 150 beats/minute for 15 minutes. Group II, trained at a heart rate varying from 120 beats - 180 beats/minute for 15 minutes, Group III, trained at the rate of 150 beats/minute over a distance run by group II.


Subjects were trained five days a week for seven weeks. An analysis of variance of the pre and post-test and gain correlation, coefficient analysis and Tukey's Range Test were used to test significance. Running for 15 minutes a day at a heart rate of 150 beats/minute for seven weeks will produce cardio-vascular improvement. When expending equal amount of energy during a given time is no difference in continuous running and interval running in the development of cardio-vascular endurance.

Bell\textsuperscript{16} had conducted and formulated a pre-season program for institutions, without access to an in-door Tennis Court. The programme provides for work-outs five days a week, consisting of a wide variety of training and conditioning exercises. A weight-training programme was recommended for alternate days, three times each week, to aid in strengthening areas of the body most involved in playing tennis.

McCabe\textsuperscript{17} studied 36 students who were members of an Inter-collegiate Lacross programme. They were randomly assigned to three groups. One group trained by rope jumping at a

\textsuperscript{16}Dudley S. Bell, "A Proposed Pre-season Tennis Programme," Completed Research in Health, Physical Education and Recreation 5 (1963) : 75.

height of 10 inches. Rope jumping was done 3 minutes per week for 6 weeks. Both groups as well as third group (control) participated in regular Lacrosse practice sessions. All the students were pretested in the 25 yard dash. ANCOVA showed no differences (P .05) in speed among the three groups.

Santo\(^{18}\) selected 76 college men to study the effect of physical conditioning programmes on cardio-respiratory fitness of college men, the subjects were divided into four different groups, three of which participated in different conditioning programmes. One was a control group which had no formal physical conditioning programme. The different physical conditioning programmes were: i) Cooper's Aerobic Programme, (ii) Interval Conditioning Programme, (iii) Regular Physical Education Programme and fourth was control group. Cardio-respiratory fitness was measured by using the Harvard Step Test, the twelve minute run/walk, a three minute shuttle run and a one minute lateral jump. It was concluded that interval conditioning, aerobic conditioning and regular physical groups improved significantly in cardio-respiratory fitness in comparison to the control group.

Oliver\textsuperscript{19} conducted a study to determine the relationship of conditioning exercises to performance in Rope Climbing. One group trained with weights twice a week and other with gymnastics three times a week for eight weeks. Both groups made gains in the McCloy Athletic Strength Index which were significant at the .001 level of confidence. Improvement in rope climbing was slight and non-significant although slightly greater in the gymnastics group which had an initial experimental advantage. Weight training exercises for the muscle groups involved in rope climbing should prove advantageous.

Anderson\textsuperscript{20} conducted a study on male college students (n=86) who were equally divided into an experimental and a control group to determine the effect of a 9 week physical conditioning programme on total body fat, and body density. The physical conditioning programme decreased body fat, increased body density, and reduced subcutaneous fat at specific body sites on the abdomen, chest, and upper arm, changes in body weight were not found significant.


Pritipal and others\textsuperscript{21} conducted a study to know the effect of strength improvement on technical skills of Basketball players. They found that improvement in strength in the case of poorly and moderately conditioned sportsmen was a significant positive effect on other components of physical fitness and also on simple technical skills like passing in basketball, but there was a negative effect on complex technical skills like shooting in basketball.

Gregor\textsuperscript{22} studied the effect of progressive weight training programme on the performance of swimming the 100 yard crawl stroke of male and female competitive swimmers between the ages of ten and sixteen. The 40 subjects were divided into two groups, the experimental group and control group. The experimental group was exposed to nine weeks of training in competitive swimming and progressive weight training. The control group participated in an identical competitive swimming programme. The groups were tested on 100 yard crawl stroke and to evaluate weight training programme sixteen cable tension strength test was administered. It was concluded that the subjects who par-


ticipated in the progressive weight training programme significantly increased their performance in swimming the 100 yard distance using crawl stroke.

Barker\textsuperscript{23} studied the effects of an isotonic and a combination isometric - isotonic exercise training programme upon push-up performance. Thirty four male university students were divided into 3 groups based on pre test push-up performance. Group I performed maximum repetition push-ups; group II performed maximum repetition combination isometric-isotonic push-ups and group III served as the control. All subjects met twice a week for 6 weeks. Analysis of variance on post-test push-up performance was found significant at .01 level. Maximum repetition push-up performance was improved at nearly the same rate for both the maximum repetition push-up exercise programme and the maximum repetition combination isometric-isotonic push-up exercise programme.

Waddle\textsuperscript{24} conducted a study on male students who participated in a training programme of 3 days per week for 8 weeks.


\textsuperscript{24} Benjamin Waddle, "A Study Comprising the Effect of Training Programmes using Isotonic Exercises, Isometric Exercises and the Exer-genic and Cardio-vascular Endurance and Muscular Strength," Completed Research in Health, Physical Education and Recreation 10 (1968) : 34.
The exer-genic and isometric programmes contained exercises which used back, leg, arm and trunk muscles. The isometric exercises used were sit-ups, curls and running in place. The cable tensio-meter was used on pre and post tests to measure strength of the knee, elbow, back and hip flexors and extensors; and the Harward step test was used to measure cardio-vascular endurance. All programmes produced significant increase in cardio-vascular endurance and in strength measurement. The exer-genic programme was found to be significantly better than the isotonic programme for building strength in the back and hip flexors, but not in the other muscle groups.

Thornton\textsuperscript{25} conducted a study on sixteen boys in grade VI who exercised five times a week for 6 weeks on either an isometric training apparatus or a horizontal bar (isotonic) to find the effects of isotonic and isometric strength training on pull-ups achievement. Each group was divided initial into four sub-groups on the basis of chinning ability. They were re-tested midway and at the end of training. Both highest and-groups made significant gains but the difference between the methods was not significant.

\textsuperscript{25}Donald Thornton, "The Effect of Isotonic and Isometric Strength Training on Pull-up Achievement," Completed Research in Health, Physical Education and Recreation 9 (1967) : 82.
Crowder\textsuperscript{26} conducted a study to compare the effects of two methods of strength training on reaction time. Reaction time were measured with Dekan Automatic Performance Timer in three groups of college men who had isometric, isotonic, or no exercises in addition to their regular physical education activities twice a week for 5 weeks. Both supplemental exercise groups improved significantly in reaction time and both became significantly superior to the control group but not different from each other. Specific isometric or isotonic exercise improved reaction time.

Bergeron\textsuperscript{27} studied the effects of state static training at various positions and dynamic strength training through a full range motion on strength, speed of movement, and power. The 96 male subjects were randomly assigned to three experimental groups that trained either isotonically with the supine press through a full range of motion or isometrically at the extended position in the supine press and a control group. All three experimental groups showed significant gains in static strength at both positions.


\textsuperscript{27}Philip C. Bergeron, "The Effects of Static Strength Training at Various Positions and Dynamic Strength Training through a Full Range of Motion of Strength, Speed of Movement and Power," \textit{completed Research in Health, Physical Education and Recreation} 9 (1967) : 68.
of measurement, in speed of movement, and in the two tests of power. The control group did not make any significant gains. No difference was found among the three experimental groups.

Simmons and Hille\(^{28}\) prepared a year round strength and conditioning programme for the men and women's basketball teams of the University of Southern California. To build strength and size an intensive cycle programme was incorporated during the off-season, which runs from the end of the NCAA tournament to the end of the school year. The off-season programme is recycled so that the athletes can continue to make progress during summer. Once the school starts up in the fall, a six week cycle is used to lead the athletes into the season at a peak of strength. A maintenance programme is utilized during the season, which is from December to April, so as to keep the gains that the athletes have obtained through hard work.

Hydrick's\(^{29}\) strength and conditioning programme for the Georgia Tech. University Basketball Team consists of (I) a six week pre-season programme in which the aerobic base established during post-season cycle-II; is build up. The an-aerobic


base is developed, Regiment of total body strength and leaping power is done, and solidification of team personality profile into a unified and committed training squad is done. (2) Inseason, non-competitive. This period begins when practice sessions begin and ends approximately five days before first game. The main objective is maintenance for starters and mainstay for back-ups. (3) In-season competitive. The training schedule is dictated by the competitive schedule. Training days are selected on the basis of maximum duration for recovery between competitions. This phase involves individual maintenance prescription based on position, playing time, and injury status. (4) Post-season cycle I non competitive. The objectives are to rehabilitate any in-season injuries, establish solid base in strength, flexibility and aerobic capacity and focus on individual performance opportunities with a variety of training formats, and (5) Post-season cycle II. This cycle involves training during the summer months. Basically athletes will continue training as in cycle I. Adjustments will be made as individuals reach training plateaus, or are ready to move into a more advanced phase. Cardio-vascular sessions are required three time per week.

Reynolds'\textsuperscript{30} programme for strength improvement of

basketball players for off-season consisted of the following 12 exercises: clean and press, jump squat, leg extension, leg curl, calf press, bench press, bent rowing, up-right rowing, reverse curl, wrist curl, reverse wrist curl and leg raise. To help keep up strength and body weight gains made in the off-season an in-season maintenance workout consisting of 8 exercises is as follows: (This should be performed after basketball workouts) clean and press, jump squats, bench press, lats pull-down, side laterals, reverse curl, wrist curl and leg raise.

Berger\textsuperscript{31} in his study has mentioned that a decision with regard to the type of conditioning exercises to be included in a training programme is based on the understanding of the primary physiological system and undergo stress during a game, and the kind of activities which best provide this type of stress during practice. the body adopts itself to the type of stress placed upon it. This physiological adaptation is necessary for physical conditioning to occur. The adaptation made by playing basketball is the best condition for the sport. Likewise, the running of a cross country athlete results in physiological adaptation which is the best way for improving condition in that sport. No matter what

the component of conditioning strength, endurance, flexibility or power, specificity of training applies. The best training to improve best performance is to practice the movements at the same rate and intensity as during an actual game situation.

Fink\textsuperscript{32} conducted a study on the specificity of conditioning in swimming and running. He tested fresh men swimmers and fresh men - varsity runners during the first week of practice and retested them after six weeks. After brief warming-up, the subjects ran at the maximum speed for 30 seconds on one day and swam for 30 seconds the following day. The pulse rate stem-down method was employed to determine how quickly the cardiovascular system recuperated. The experimental results supported the principles of specificity of training that gain in general endurance and cardio-vascular efficiency acquired in training for one sport made only a slight contribution to performance in the other sport.

Hooks\textsuperscript{33} suggested different weight training programmes


for different sports like basketball, football, swimming, track and field events etc. taking into account their different requirements of fitness.

Stothart\textsuperscript{4} conducted a study on the specificity concept related to muscular endurance. He tested the maximum isometric strength at 130 degree and 160 degree angles of knee extension for 42 university men who averaged 19 years in age, 69.9 inches in height and 159.4 lb. in weight. Muscular endurance of right quadriceps was tested at each angle with load of 30 per cent and 45 per cent of the maximum strength, with one week between the tests. The correlation between isometric strength and muscular endurance were low and negative. Component analysis and inter-correlation of muscular endurance measures showed that although endurance component was common to all measures specific to the angle of testing, yet endurance was not specific to the load. Correlation between the knee angle lengths were moderate, but using these in partial correlation left the original endurance correlations relatively unaltered.

\textsuperscript{34} John Peter Stothart, "Application to the Specificity Concept Four Measures of Muscular Endurance," \textit{Completed Research} \textit{in Health, Physical Education and Recreation} 8 (1966): 34.
Considine\textsuperscript{35} conducted a study on task specificity. He concluded from his study that the data collected from groups of athletes and non-athletes indicated that reflex time was significantly faster than reaction time of non-athletes. A low positive but non-significant correlation between reflex time and reaction time, suggested task specificity.

Roberts and Alspaugh\textsuperscript{36} conducted a study on the specificity of training and found that the group which trained on bicycle, when tested on bicycles ergometer has shown better $\mathrm{VO}_2 \text{max}$ than the treadmill group, and similarly, the group trained on treadmill has shown better gain of max $\mathrm{VO}_2$ than the bicycle group.

Specificity refers to adaptation in the metabolic and physiological systems depending on the type of over load imposed. It is known that "specific exercise stress such as strength - power - training includes specific strength - power adaptations and that specific aerobic or cardio-vascular exercise, elicit specific endurance training adaptations. The specificity principle, however, \\

\textsuperscript{35} William J. Considine, "Reflexes and Reaction Time within and Between Athletes and Non-athletes," Completed Research in Health, Physical Education and Recreation 9 (1967) : 54.

goes beyond this because development of aerobic fitness for swimming, or cycling is most effectively achieved when the exercise trains the specific muscles involved in the desired performance. Truly, specific exercise elicits specific adaptations, creating specific training effects.\textsuperscript{37}

Arther Jones\textsuperscript{38} has stated, "Do not be misled .... and you might be on the subject of specificity .... either you have it, or you do not. A movement is either utterly specific or it is not specific at all."

'This being true, it obviously states that the only possible specific training for basketball is the act of playing basketball ... the only specific training for swimming is swimming itself, and so on."

He further advised that "to build your skills or even to retain your skills you must practice an activity with total specificity" exactly in the same manner, with the same tool.

Strength, in general, contributes to any activity, but


the applied demonstration of strength is specific, and learning to apply strength properly in any activity, requires skill.

Moorehouse and Miller\textsuperscript{39} when defining anatomical fitness, went to the extent of saying, "In order to be fit, the individual must possess all of the body parts essential to the performance of the task and must possess the appropriate body size and shape for the task..... slight individual difference in point of attachment of tendons to bones and difference in lengths of bones results in different mechanical leverage advantages or disadvantages for various events. Thus, one person is fit for weight lifting, another for sprint running and yet another for jumping. If a person enters a competition for which he is anatomically unfit, he does so, with a distinct disadvantage compared to his opponent possessing anatomical features more fit to the event."

They further said that physiological fitness was specific to the activity. Since different activities make different demands upon the organism with respect to neurological, respiratory, circulatory, metabolic, and temperature regulating functions, the physiological systems of the body must be fit to function well enough to support the activity that the individual was performing.

\textsuperscript{39}Lawrence S. Moorehouse and Augustus T. Miller, Physiology of Exercise (St. Louis : The C.V. Mosby Company, 1963), pp. 275-277.
Wilmore\textsuperscript{40} while discussing modes of testing, said "there is an increasing awareness of the importance of selecting the appropriate test mode when testing athletes in various sports, i.e. a mode which must closely approximate the actual sport activity."

The concept of specificity can also be applied to the test protocol. When subjects are trained by hill running, the increase in $\text{VO}_2$ max is greater than when using a treadmill protocol which increases power by increase in grade compared to a protocol which increases power by increase in speed. Thus due care should be taken to match the protocol for the testing mode or device, as closely as possible, to the conditions under which the individual trains.