CHAPTER II

REVIEW OF RELATED LITERATURE

A Study of relevant literature is an inevitable and essential step to get a clear idea and foundation with regard to the problem under study. The investigator has gone through available literature related to the present study from dissertations, journals, magazines, books and articles relevant to Sports and Physical Education. The review of related literature has been presented under the following headings;

1. Studies on circuit, interval and stair case training

2. Studies on physical, physiological and psychological variables

3. Studies on performance variables

2.1 STUDIES ON CIRCUIT, INTERVAL AND STAIR CASE TRAININGS

Rajan, Kasi G. (2018) examined the effectiveness of intensive and extensive interval trainings on selected physical and physiological variables among Kabaddi players. 36 Kabaddi inter-collegiate level players were chosen as subjects from Thottukudi district, Tamil Nadu, India and they were separated into two experimental gatherings and one control gathering. Experimental gathering I involved in intensive interval training, experimental gathering II involved in extensive interval training and control gathering not involved in any special training except their leisure time pursuit as college students. The treatment period was confined to 12 weeks. Data were recorded prior and later the experimental period on chosen dependent variables. Remarkable improvements on selected criterion variables due the trainings were

statistically analyzed with dependent ‘t’ test, ANCOVA and Scheffe’s post-hoc test. The study confirmed that the intensive interval training had remarkable improvement than extensive interval training on speed and explosive power and the extensive interval training had remarkable improvement than intensive interval training on cardio respiratory endurance, resting heart rate, vital capacity and breath holding time among inter-collegiate kabaddi players.

Periadurai V. (2017) attempted to estimate the effects of intensive interval and fartlek trainings on chosen parameter of football school boys. 45 district level football players were chosen as subjects from Tirunelveli district, Tamilnadu, India. The subjects were randomly separated into three gatherings of 15 subjects in each. Experimental gathering I met with intensive interval training, experimental gathering II met with fartlek training and control gathering refrained from any special training except their leisure time pursuit as school students. The treatment period was confined to 12 weeks. Data were recorded prior and later the experimental period on chosen dependent variables. Dependent ‘t’ test, ANCOVA and Scheffe’s post-hoc test were employed as statistical procedure to estimate the remarkable improvement on selected criterion variables due the trainings among the gatherings. The results of the study revealed that intensive interval training group showed remarkable improvement on speed, speed endurance and muscular endurance than fartlek training and both trainings showed equal improvement on resting heart rate and peak flow rate and no improvement on blood pressure among district level school football players.

Naikoo., Khursheed Ahmad., et. al. (2017) initiated to estimate the effect of circuit and resistance exercise on strength endurance among college men. 30 male college students were randomly chosen from the Government Degree College in

Kulgam and the age was fell between 18 and 22 years. The chosen subjects were detached into three gatherings namely circuit exercise gathering, resistance exercise gathering and control gathering. The experimental gatherings executed to their allotted course for 12 weeks and the control gathering did not expose to any specific course. The strength endurance was recorded by applying of bent knee sit-up test. ANCOVA was employed as statistical procedure to analyse the obtained data. The study affirmed that the circuit and resistance training made remarkable gain ($p \leq 0.05$) in physical fitness of the chosen subjects.

Rai S. K. (2017) compared the selected physiological and hematological variables such as the maximum intake of oxygen, vital capacity, resting pulse rate, arterial pressure mean, hemoglobin range, bilirubin, glucose and urea of blood among the soccer players. A sum of 30 players at the level of district, state and university were selected for the study. ANOVA with 'F' ratio at a significance level of 0.05 was applied to determine the significant difference on the selected variables. The result showed significant difference on VO_2 Max of the district players compared to the state and the university players; however, the latter should more or less similar level of VO_2 Max.

Krishnaleela V., et. al. (2015) examined the impact of various powers of alternative pace run, interval training and detraining on cardio respiratory endurance. Sixty subjects were chosen and they were partitioned into four gatherings namely low intensity interval gathering, medium intensity interval gathering, alternative pace run gathering and control gathering. After the completion of interval training period, the subjects of gathering I, II and III were physically detrained for thirty days. The pre and posttest information on cardio respiratory endurance was measurably examined

by using ANCOVA. Significant improvement on cardio respiratory endurance among alternative pace run and decline during detraining period among all the gatherings was observed.

Ohta M et al. (2015) documented that work ability is partly determined by physical and mental fitness. Bench step exercise can be practiced anywhere at any time. The aim of this study was to determine the effects of a bench step exercise on work ability by examining cardiovascular risk factors and oxidative stress. Thirteen volunteers working in a warehousing industry comprised the bench step exercise group (n = 7) and the control group (n = 6). The participants in the step exercise group were encouraged to practice the step exercise at home for 16 weeks. The step exercise improved glucose metabolism and antioxidative capacity and increased work ability by reducing absences from work and improving the prognosis of work ability. The improvement in work ability was related to a reduction in oxidative stress. These results suggest that a bench step exercise may improve work ability by reducing cardiovascular risk factors and oxidative stress.

Nishida Y et al. (2015) investigated the effects of a 12-week home-based bench step exercise program on inflammatory cytokines and lipid profiles in elderly females. Sixty-two postmenopausal females (65-85 years of age) were randomized to either the bench step exercise group (n=31) or the control group (n=31). The subjects in the bench step exercise group were instructed to perform bench step exercises at the exercise intensity corresponding to lactate threshold (LT), three times per day 10-20min each session, for a goal of ≥140min/week at home for 12 weeks. At baseline and 12 weeks, circulating levels of nine inflammatory cytokines (high-molecular-weight adiponectin, interleukin-4 [IL-4], IL-5, IL-6, IL-8,

IL-15, tumor necrosis factor-α [TNF-α], TNF-β and interferon-γ [IFN-γ]) and serum lipids including high-density lipoprotein cholesterol (HDL-C) were measured. The bench step training at the LT significantly increased HDL-C levels and decreased IFN-γ concentrations in the subjects with lower (< 63mg/dL) baseline HDL-C levels ($p<0.05$). The change in IFN-γ inversely correlated with the change in HDL-C in the exercise group ($\rho=-0.56$, $p<0.01$), whereas this association was not observed in the control group. Additionally, principal component analysis-derived index of what we called "inflammatory status factor" was inversely associated with the changes in HDL-C in the exercise group. The bench step exercise-induced reduction in the IFN-γ levels may partially explain the degree of improvement in the HDL-C levels with the exercise program.

Babu R. C., et. al. (2014) attempted to estimate the impact of interval training on cardio respiratory endurance among football players. Thirty football players with age ranging from 18 to 25 years were randomly chosen from Malapuram, Kerala. They were separated into two gatherings of 15 players each. Pre-tests were taken for all the subjects prior the training. Gathering I involved in interval training for 8 weeks on alternative three days in a week and post-tests were conducted. Gathering II acted as the control gathering. The Cardio respiratory endurance was measured by using Cooper's 12 minutes run and walk test and paired 't'-value determined the contrast between two gatherings. The findings showed the significant influence of eight weeks of interval training on cardio respiratory endurance of the soccers.

Deol N. S. (2013) was attempted to evaluate the effectiveness of continuous and interval training on endurance ability of the soccers. It also showed the comparison between the chosen training methods in terms of effectiveness. All 45

players of JCT Academy at Phagwara, were grouped into 3 with 15 each and were named A B and C respectively. Group A involved in Continuous training, B in interval training, C did usual training (Control Group). The twelve minute's run walk test of Cooper (1968) was utilized for testing the endurance ability of soccers. The pre and post-tests were carried out prior and after the training period of eight weeks. SPSS software helped in the application of ANCOVA and LSD post-hoc test. The adjustment of the F-value to 15.88 in the outcome was found to be at the significant level of 0.05. The result of LSD Post –hoc measure exposed the effect of continuous and interval training in improving the endurance ability of the soccers. It also showed the highest impact of interval training over continuous running in terms of improvement of the endurance ability of the players.

Wong P C., et.al. (2008) conducted a study on the effects of a 12-week twice weekly additional exercise training which comprised a combination of circuit-based resistance training and aerobic exercises, in additional to typical physical education sessions, on aerobic fitness, body composition and serum C-reactive protein (CRP) and lipids were analysed in 13- to 14-year-old obese boys contrasted with a control group. Both the exercise group (EG, n = 12) and control group (CG, n = 12) participated in the typical 2 sessions of 40-minute physical education (PE) per week in schools, but only EG participated in additional 2 sessions per week of 45 to 60 minutes per session of exercise training, which comprised a combination of circuit-based resistance training and aerobic exercises maintained at 65% to 85% maximum heart rate (HRmax = 220 - age). Body composition was measured using dual energy X-ray absorptiometry (DEXA). Fasting serum CRP and blood lipids were analysed pre- and postexercise programme. Aerobic fitness was measured by an objective laboratory submaximal exercise test, PWC170 (Predicted

Work Capacity at HR 170 bpm). Exercise training significantly improved lean muscle mass, body mass index, fitness, resting HR, systolic blood pressure and triglycerides in EG. Serum CRP concentrations were elevated at baseline in both groups, but training did not result in a change in CRP levels. In the CG, body weight increased significantly at the end of the 12-week period. This study supports the value of an additional exercise training programme, beyond the typical twice weekly physical education classes, to produce physiological benefits in the management of obesity in adolescents, including prevention of weight gain.

Westcott W L., et.al. (2007) conducted a study on the effects of a longer and more frequent aerobic exercise protocol with a shorter and less frequent circuit strength-training protocol for improving U.S. Air Force physical fitness test scores of subjects who previously failed to achieve a passing point total. 83 men and women of the U.S. Air Force (M age = 32.7 yr.) participated in either the unsupervised standard conditioning program, which recommended approximately 60 min. of aerobic activity 4 to 5 days per week (n=26), or the supervised circuit strength-training program, which required approximately 25 min. of alternating strength and endurance exercises 3 days per week (n=57). Subjects were assessed on a 2400-m (1.5-mile) run, abdominal circumference, push-ups completed in 1 min., and abdominal crunches completed in 1 min. Dependent t tests with Bonferroni adjustment indicated that significant improvements were attained by the circuit strength-training group only on each of the aforementioned measures. Significantly more participants in the circuit strength-training group (26%) achieved a passing point total than in the standard conditioning group (19%) at Wk. 12 (chi1(2) =3.96, p = .05). Implications for enhancing physical fitness in poorly conditioned adults were discussed.

Nash M S., et.al. (2007) examined the effects of circuit resistance exercise (CRT) training on muscle strength, endurance, anaerobic power, and shoulder pain in middle-aged men with paraplegia. Academic medical center. Seven men (age range, 39-58y) with motor-complete paraplegia from T5 to T12 and confirmed shoulder pain occurring during daily activities. Not applicable. Subjects underwent a 4-month CRT program using alternating resistance maneuvers and high-speed, low-resistance arm exercise. One-repetition maximal force was measured before training and monthly thereafter. Pre training and post raining peak oxygen uptake (VO_2 peak) was measured by graded arm testing. Anaerobic power was measured before and after training using a 30-second Wingate Anaerobic Test. Shoulder pain was self-evaluated by an index validated for people with spinal cord injury (Wheelchair Users Shoulder Pain Index [WUSPI]). Strength increases ranging from 38.6% to 59.7% were observed for all maneuvers (P range, .005-.008). VO_2 peak increased after training by 10.4% (P=.01), and peak and average anaerobic power increased by 6% (P=.001) and 8.6% (P=.005), respectively. WUSPI scores +/- standard deviation were lowered from 31.9+/-24.8 to 5.7+/-5.9 (P=.008), with 3 of 7 subjects reporting complete resolution of shoulder pain. CRT improves muscle strength, endurance, and anaerobic power of middle-aged men with paraplegia while significantly reducing their shoulder pain.

Muller S M., et.al. (2006) examined the effects of exercise on indices of emotional well-being of 584 college students enrolled in either a lecture-only health course or one of six health-fitness courses, each using a different mode of exercise including cross-training, aerobics, yoga, circuit weight training, swimming, and walk/jog. Each participant completed the Self-perception Profile for College Students developed by Neeman and Harter. Analysis yielded significant differences on five

indices of emotional well-being (Global Self-worth, Appearance, Romantic Relationships, Social Acceptance, and Athletic Competence) between pre- and posttest scores of participants enrolled in the health-fitness courses, while no differences were found between pre-and posttest scores of participants enrolled in the lecture-only health course. Of the seven subscales examined, a significant interaction effect was found between sex/time and Romantic Relationships/Athletic Competence, with women reporting greater gains than men.

2.2 STUDIES ON PHYSICAL, PHYSIOLOGICAL AND PSYCHOLOGICAL VARIABLES

Arul S. (2014) examined the impact of sand running on chosen criterion variables. Thirty men whose age ranged from the years of 18-24 were selected randomly as subjects from physical education department of Annamalai University, Annamalai Nagar, Tamil Nadu. The students were grouped into two such as sand running group and control group with 15 each. Group-I was exposed to sand running for a period of 12 weeks. Control group was not exposed to any practice programme other than physical education activities. Everyone in both groups were tested on speed and cardio respiratory endurance by standard tests. The researcher used ANCOVA to test the remarkable dissimilarity where “F” ratio obtained was analyzed at 0.05 confidence level. There was significant difference between the groups on selected parameters.

Sathishkumar S. (2011) attempted to evaluate the effectiveness of sand and offshore training on chosen criterion variables amid inter engineering collegiate football participants. To attain the purpose, 45 engineering college football participants were chosen and they were separated into three gathering. Gathering I

and II were executed sand and seashore exercises respectively and the other gathering executed as gathering of control. Tests were taken earlier to and after conclusion of six weeks of course. ANCOVA was employed as statistical technique to analyze the data. The findings disclosed that sand training showed remarkable gain on chosen dependent variables particularly speed, agility, endurance, resting pulse rate, breath holding time and blood pressure than offshore training amid inter engineering collegiate football players.

Jacob S. (2010) examined the effectiveness of sand and seashore training on chosen physical fitness variables namely speed, endurance, power, flexibility, cardiovascular endurance, agility and performance variables among school volleyball players. To accomplish the purpose, 30 volleyball players were chosen from different schools in Chennai and they were randomly separated into three gatherings. Gathering I and II were executed sand and seashore exercises respectively and the other gathering executed as gathering of control. Tests were taken prior to and after completion of six weeks of course. The obtained data was exposed to ANCOVA statistical procedure to attain the results. It was observed that remarkable gain on speed, endurance, agility and flexibility and no remarkable gain on volleyball playing ability due to six weeks of sand and seashore training. The results of the study revealed that remarkable improvement on speed, endurance, agility and flexibility and no remarkable gain in playing ability among school volleyball players.

Paul, C. Godwin (2010) examined the effectiveness of weight and resistance training on chosen bio motor, physiological and skill variables among state level hockey players of Tamil Nadu. To achieve this purpose, 60 state level men hockey players from different colleges of Tamil Nadu were randomly chosen and their age

was between 18 and 25 years. The subjects were separated into three gathering. Gathering I and II were executed weight and resistance training respectively and the other gathering assigned as control gathering. Pre and Post-tests were conducted prior and after 12 weeks of training for all the subject on chosen dependent variables namely speed, leg strength, shoulder strength, cardiovascular endurance, resting pulse rate, breath holding time, vital capacity, dribbling, passing, hitting and scooping. 'F' test was done using ANCOVA. The findings revealed that both training significantly gained the selected bio motor, physiological, skill variables among state level hockey players.

Bolboli L, et.al. (2008) examined the effect of height in the predicted VO_2max by the Queens Step test among short and tall young girls. A sample of 38 individuals was selected in two stages from a total of 500 individuals and was assigned to two groups of short (n = 20) and tall (n = 18). In order to examine the effect of height in the predicted VO_2max, the Queens step protocol and the incremental treadmill speed test were used. Respiratory exchange was measured continuously throughout the test by an automated open-circuit gas analysis system. The study results showed that tall girls revealed a higher VO_2max on the Queen's step and treadmill tests than short girls (Queen's: 44.09+/-2.66 vs. 38.96+/-1.65; Treadmill: 34.03+/-7.26 vs. 28.15+/-5.09 mL/kg/min). Based on the obtained findings it can be concluded that the higher VO_2max seen in tall girls on the both protocols, may be due to their physiological and physical properties; therefore, it seems that designing of the adjustable steps to the height of subjects for optimizing the estimation of VO_2max is not necessary and other physiological factors may be involved, which require further investigation.

Keogh J W., et.al. (2003) attempted to develop an effective testing battery for female field hockey by using anthropometric, physiological, and skill-related tests to distinguish between regional representative with 35 and local club level with 39 female field hockey players. The regional representative players were significantly leaner and recorded faster times for the 10-m and 40-m sprints as well as the Illinois Agility Run (with and without dribbling a hockey ball). The regional representative players also had greater aerobic and lower body muscular power and were significantly ($p < 0.05$) more accurate in the shooting accuracy test. No significant differences between groups were evident for height, body mass, speed decrement in 6 x 40-m repeated sprints, handgrip strength, or pushing speed. These results indicate that percent body fat, sprinting speed, agility, dribbling control, aerobic and muscular power, and shooting accuracy can distinguish between female field hockey players of varying standards. Therefore, talent identification programs for female field hockey should include assessments of these physical parameters.

2.3 STUDIES ON PERFORMANCE VARIABLES

Anis Chaouachi, et.al. (2009) conducted a study on the anthropometric, physiological, and performance characteristics of an elite international handball team. Twenty-one elite handball players were tested and categorized according to their playing positions such as goalkeepers, backs, pivots, and wings. Testing consisted of anthropometric and physiological measures of height, body mass, percentage body fat and endurance, performance measures of speed (5, 10, and 30 m), strength (bench press and squat), unilateral and bilateral horizontal jumping ability, and a 5-jump horizontal test. Significant differences were found between player positions for some anthropometric characteristics (height and percentage body fat) but not for the

physiological or performance characteristics. Strong correlations were noted between single leg horizontal jumping distances with 5-, 10-, and 30-m sprint times ($r = 0.51$-0.80; $P < 0.01$). The best predictors of sprint times were single leg horizontal jumping with the dominant leg and the distance measured for the 5-jump test, which when combined accounted for 72% of the common variance associated with sprint ability. In conclusion, performance abilities between positions in elite team-handball players appear to be very similar. Single leg horizontal jumping distance could be a specific standardized test for predicting sprinting ability in elite handball players.

Oxyzoglou N., et.al. (2008) documented that high performance in team sports depends to a great extent on the motor abilities of all players according to their position in the team. Assessing the motor abilities of elite athletes according to their playing position in the team was the aim of the study. The sample consisted of 46 handballers aged 18-21 years (M=19.5, SD=.4.5), belonging to national teams from Greece and Serbia. Afterward, the sample was divided into subgroups, representing their unique position in the team. More specifically the subgroups consisted of eight goalkeepers, fourteen extreme players, sixteen peripheral players and eight pivotal players. The motor abilities of power, agility and flexibility were assessed. The Kruskal-Wallis and Mann-Whitney U analysis were used for the comparison among groups. The results revealed that the goalkeepers have a highly developed level of pelvis flexibility and a well-developed level of explosive force. The peripheral players have high vertical jump and a high degree of wrist flexibility. Extreme players have a developed level of explosive force and big width of wrist movement. Finally, pivotal players are less flexible but very agile. Every playing position developed specific motor abilities which contribute to team performance.

Visnapuu, et.al. (2007) reported that in handball and basketball the longer the finger length the better the accuracy of the shot or throw. All shots and throws are finished with the wrist and fingers. It can be proposed that athletes with longer fingers and greater hand surface parameters also probably have greater grip strength. The aim of this study was to investigate the influence of general body and hand-specific anthropometric dimensions on handgrip strength in boys participating in handball and basketball training. In total, 193 boys aged 10-17 years participated in this study. They were divided into 6 groups: 10-, 11-, 12-, 13-, 14-15-, and 16-17-year-olds. The body height and body mass were measured and body mass index was calculated as general anthropometric parameters. The outlines of the hands of the boys were drawn on paper with a thin marker. Three groups of hand anthropometric parameters were measured: 5 finger spans, 5 finger lengths, and 5 perimeters of the hand. Handgrip strength was measured on the dominant hand with a Lafayette dynamometer. As a rule, general anthropometric parameters determined the maximal handgrip strength more accurately than did specific hand anthropometric parameters. From the specific hand anthropometric parameters, finger lengths and perimeters of the hand significantly correlated with the maximal handgrip strength. In summary, fingers are the smallest, lightest parts of the motor apparatus, and, therefore, they represent the parts most easily deflected by force from the ball, but at the same time, finger control is especially important for the accuracy of different shots, both in handball and basketball. Thus, it is especially necessary to measure finger length and perimeters of the hand for practical reasons.

Schorer, et.al. (2007) examined the movement patterns of 5 left-handed handball players (ranging from beginner to national level) who threw a handball to

different sections of a goal as if a goalkeeper were present. The authors used time-continuous, 3-dimensional kinematic data to assess interindividual movement patterns and considered participants' intraindividual differences relative to different targets. Cluster analysis yielded the highest assignment rates for level of expertise; a mean of 92% of trials was correctly assessed. The authors observed an interaction with expertise for the intraindividual movement patterns. Variability in the novice throwers was increased, whereas (a) advanced throwers experienced a period of stability, and (b) the expert thrower's variability was increased. The results indicate that random variability characterizes novice motor performance, whereas active functional variability may exemplify expert motor performance.

Vatromir, et.al. (2006) assessed the basic motor abilities that determine top performance in women's handball, and to identify test panel for primary selection at handball school. The study included 155 female attendants of the Split Handball School, mean age 12.5 years. Differences in the basic motor abilities between the subjects that developed into elite handball players after 7-year training process and those that abandoned handball for being unable to meet the competition criteria were evaluated by use of discriminative analysis. The former was found to have also been superior initially in all variables analyzed, and in arm coordination, overall body coordination, throw and jump explosive strength, arm movement frequency and repetitive trunk strength in particular. Motor superiority based on the abilities of coordination, explosive strength and speed determines performance in women's handball, qualifying these abilities as reliable selection criteria. Based on this study results, a new model of selection in women's handball, with fine arm coordination as the major limiting factor of performance, has been proposed.

2.4 SUMMARY OF REVIEW OF RELATED LITERATURE

The investigator has reviewed related literature on the effect of varied capsules of fitness training namely circuit training, interval training and stair case training on selected physical, physiological, psychological and skill performance variables. It was found that there was scope for further research in finding out the effect of varied capsules of fitness training consisting of circuit, interval and stair case trainings on selected physical, physiological, psychological and skill variables among college level men handball players. Hence, the investigator undertook this research. Based on the experience gained through the review of related literature, the investigator formed suitable methodology to be adopted for this research which is presented in Chapter III.