CHAPTER II

REVIEW OF RELATED LITERATURE

“The literature in any field forms the foundation upon which all future work will be built” (Aggarwal, 1975)

The study of relevant literature is an essential step to get a clear idea of what has been done, with regard to the problem under study. Such a review brings about a deep and clear perspective of the overall field.

A serious and scholarly attempt has been made by the scholar to go through the related literature and a brief review of the studies related to the present problem is described in this chapter.

The reviews were confined to the literatures of YMCA college of Physical Education, Karpagam Engineering College Coimbatore, Indira Group of Institutions Thiruvallur, Alagappa University College of Physical Education, Department of Physical Education, Annamalai University and the Library, University of Madras. The reviews have been classified into the following Sub-Sections.

2.1 STUDIES ON BOXING PERFORMANCES

Warnick and Warnick (2007) reported that compared to other sports, very little research has been conducted on which variables can predict victory in the sport of boxing. This investigation examined whether boxers’ age, weight change from their preceding contest, country of origin, total number of wins, total number of losses, performance in their preceding contest, or the possession of a championship title was predictive of a winning performance in a given bout. A 1-mo. sample of male
professional boxing records for all contests held in the USA (N = 400) was collected from the BoxRec online database. Logistic regression analysis indicated that only boxers' age, total number of wins and losses, and the performance in the preceding contest predicted significant variance in outcome.

Katić R, Blazević S, and Zagorac N. (2006) analyzed the relations of cognitive processors and conative regulators with specific motor abilities of elite boxers. Three sets of variables including 3 cognitive and 6 conative variables as predictors, and 6 specific motor (boxing) variables as criteria were used in a sample of 92 boxers. A series of regression analyses between the set of cognitive variables and particular criterion variables revealed a predominant impact of serial processor on specific motor abilities based primarily on specific speed (frequency of boxing technique performance). The series of regression analyses also showed a predominant negative impact of dysregulation of the organ function regulators from the set of conative variables on the manifestation of specific motor abilities in boxers. The data obtained in the study were used to develop an alternative model of the motor - cognitive - conative processes in boxing.

Gulashan lal khanna (2006) made two studies on morphological, physiological and biochemical characteristics of Indian national boxers as well as to assess the cardiovascular adaptation to graded exercise and actual boxing round. In the first study (N=60 junior boxers below 19 years -30, senior boxer-30) differed morphological, physiological and biochemical parameters were measured. In the second study light weight boxers, (54kg N=7; medium weight category 64 kg, N=7 and medium and medium having weight category 75 kg, N=7. Cardiovascular responses were studied during graded exercise protocol and actual boxing bouts. Results showed a significantly
Higher stature, body mass, LBM, body fat and strength of back and grip in senior boxers compare to juniors. The senior boxers possessed mesomorphic body conformation whereas the juniors possessed metamorphic body conformation. Significantly lower aerobic capacity and anaerobic power were noted in junior boxers compared to seniors. The senior boxers showed a significantly elevated levels of Hemoglobin, blood urea and peak lactate as compared to junior boxers. In the senior boxers significantly lower level of total cholesterol and LDLC were observed as compared to junior boxers. No significant change has been noted in HDLC between the groups. This study has been helpful to observe the cardiovascular adoption in boxers.

Nishiyama Takeshige (2006) made a study on skill learning process of boxing and reported that Jab is one of the most fundamental punching-techniques, which should be acquired in the early stage of the skill learning process. To develop the effective coaching method for the jab technique, assessment of the skill and analytical method for the skill learning process were developed. The former observed motional differences between novices and experts, and assessed practical results and their reasons. In the skill learning process, motional difference and its relationship to the parameters of our method was evaluated by jab coaching to novices and their fixed-periodical measurement.

Moriarity J (2004) determined whether participation in a 7-day amateur boxing tournament is associated with acute deterioration in cognitive test performance. A prospective study was done of 82 collegiate amateur boxers participating in a 7-day single elimination tournament and a group of 30 matched nonboxing control participants. No participants had a history of recent concussion or past history of brain injury. For boxers, cognitive assessment using a computerized test battery was
performed before the tournament and within 2 hours of completing each bout. Tests of simple and choice reaction time, working memory, and learning were administered. Analysis of variance was conducted to compare the serial performance of control participants with that of boxers participating in one, two, and three bouts. The 82 boxers fought 159 times. Cognitive testing was performed after 142 of these bouts. On simple reaction time, choice reaction time, and working memory tasks, the serial performance of boxers participating in three bouts (n = 22) was equivalent to that of boxers participating in two bouts (n = 22) and one bout (n = 32) and to nonboxing control participants (n = 30). An improvement in performance was observed on the learning task in boxers participating in three bouts. Boxers whose bout was stopped by the referee (n = 7) displayed significant slowing in simple and choice reaction time. With the exception of boxers whose contest is stopped by the referee, amateur boxers participating in multiple bouts during a 7-day tournament display no evidence of cognitive dysfunction in the immediate post bout period.

Porter MD (2003) tested the hypothesis that there is an association between amateur boxing and chronic traumatic encephalopathy using neuropsychologic assessments. Twenty randomly selected, actively competing, male amateur boxers and 20 age-matched, socio-economic controls were considered for the study. The boxers participated in amateur competition and sparring. Raw scores and changes in scores over time were recorded in the following neuropsychologic tests: Trail Making Tests A and B, Digit Symbol, Finger Tapping (dominant and nondominant hands), modified versions of the Finger Tapping Tests, Paired-Associate Learning, Digit Span, Rey-Osterrieth Complex Figure Tests A and B, and Serial Addition. Raw scores and changes in scores for the two groups were compared, and a regression analysis was
performed to detect any association between these values and exposure to boxing. The boxers showed superior performance in the Trail Making Tests A and B at all time points and an inferior performance in both standard Finger Tapping Tests at all time points except baseline for the dominant hand. This inferior performance was not found in the modified versions of the tests. The controls showed significant deterioration in their performance in the Rey-Osterrieth Complex Figure Tests A and B. In this small controlled, prospective study of competitive amateur boxers, there was no evidence of neuropsychologic deterioration over 9 years. The amateur boxers demonstrated relative preservation and/or improvement of some neuropsychologic skills relative to the socioeconomic controls.

Lane AM. (2002) made a study on relationships between performance toward accomplishment and self-efficacy in amateur boxing. It was found that combined ratings of magnitude and strength of self-efficacy by 59 (20-yr.-old) amateur boxers in a multiple regression were predicted only by Perceived Performance, i.e., their working toward successful performance.

Butler RJ. (1994) reported that amateur boxing is faced with criticism over the potential damage the sport inflicts on those who participate. The most sensitive measure of early neurological dysfunction is neuropsychological investigation. Ten studies employing such assessments on 289 amateur boxers were reviewed. The forms of analysis undertaken include controlled comparison with other sportsmen, of both active and former boxers, detailed pre- and post-bout analysis, analysis of the influence of within-boxing variables, length of career, level of competition and prospective longitudinal investigation. Amateur boxers were found to exhibit no signs of neuropsychological dysfunction in any analysis. However, some trends emerged
suggesting a long career in amateur boxing might reduce fine motor reactions, although such findings are within the normal range and do not represent central neuropsychological functioning. Thus amateur boxing does not appear to expose individuals to neurological dysfunction.

2.2 TRAINING EFFECTS ON BOXING PERFORMANCES

Hristovski R, Davids K, and Araújo D. (2006) studied the effects of participant-target distance and perceived handstriking efficiency on emergent behavior in the martial art of boxing, revealing affordance-controlled nonlinear dynamical effects (i.e. bifurcations) within the participant--target system. The results established the existence of critical values of scaled distances for emergence of first time excitations and annihilations of a diverse range of boxing actions i.e. on the appearance and dissolution of jabs, hooks and uppercuts. Reasons for the action diversity were twofold: (a) topological discontinuous changes (bifurcations) in the number of possible handstrikes, i.e. motor solutions to the hitting task; (b) fine modification of probabilities of emergence of striking patterns. Exploitation of a 'strikeability' affordance available in scaled distance-to-target information by boxers led to a diversity of emergent actions through a cascade of bifurcations in the task perceptual-motor work space. The data suggested that perceived efficiency (E) of an action changed as a function of scaled distance (D) and was correlated with the probability of occurrence of action patterns (P), exhibiting the following dependence $P = P(E(D))$. The implication is that probability of occurrence (P) depends on efficiency (E), which in turn depends on scaled distance (D) to the target. Accordingly, scaled distance-dependent perceived efficiency seems a viable candidate for a contextual (control) parameter to describe the nonlinear dynamics of striking actions in boxing.
According to a study by Mouelhi Guizani S et.al. (2006) the skillful performance in combat and racquet sports consists of proficient technique accompanied by efficient information-processing while engaged in moderate to high physical effort. This study examined information processing and decision-making using simple reaction time (SRT) and choice reaction time (CRT) paradigms in athletes of combat sports and racquet ball games while undergoing incrementally increasing physical effort ranging from low to high intensities. Forty national level experienced athletics in the sports of tennis, table tennis, fencing, and boxing were selected for this study. Each subject performed both simple (SRT) and four-choice reaction time (4-CRT) tasks at rest, and while pedaling on a cycle ergometer at 20%, 40%, 60%, and 80% of their own maximal aerobic power (Pmax). RM MANCOVA revealed significant sport-type by physical load interaction effect mainly on CRT. Least significant difference (LSD) posthoc contrasts indicated that fencers and tennis players process information faster with incrementally increasing workload, while different patterns were obtained for boxers and table-tennis players. The error rate remained stable for each sport type over all conditions. Between-sport differences in SRT and CRT among the athletes were also noted. Findings provide evidence that the 4-CRT is a task that more closely corresponds to the original task athletes are familiar with and utilize in their practices and competitions. However, additional tests that mimic the real world experiences of each sport must be developed and used to capture the nature of information processing and response-selection in specific sports.

Kittel R et.al. (2005) made a study on specific effects of boxing on functional parameters of the locomotor system. Boxers that take part in contests regularly are characterized by high strains on the locomotor system. Especially the area of shoulder
girdle and neck may be overused by the fighting posture and standard techniques that are often associated with non-physiological patterns. Of 11 young boxers (age 14.6 +/- 0.6 years; 7.3 +/- 0.6 training units per week) and a control group (CG) of 52 male pupils (age 15.4 +/- 0.4 years) the static of head, shoulder girdle, and pelvis was detected by somatoscopy. Additionally, cyclical rotations of the cervical spine were measured using the 3-d-motion recording system CMS70 (Zebris, Germany) and the active range of motion was analysed. In comparison to the CG, head and shoulder of the boxers were centralised more often (p < 0.01). Furthermore, highly significant group differences in the bilateral position of the shoulder heights and the iliac crests were detected in the frontal plane. On an average, the active maximal rotation of the boxers was decreased by 17.8 degrees (p = 0.006; d = 0.800). Their study was able to detect significant differences in the analysed functional parameters of the locomotor system that may be explained by boxing specific strains and which are prerequisites of optimal performance. As long-term pathologic effects can not be excluded, adequate compensational exercises should be integrated in the training.

Guidetti L, Musulin A, and Baldari C. (2002) examined, within the middleweight class, the relationship between ranking in boxing competition performance and some physiological factors. Eight elite Italian amateur boxers (first series of AIBA ranking) were assessed in 2 testing sessions, a week apart. In the first testing session all subjects underwent anthropometric measurements from which body fat percentage, upper arm and forearm muscle cross-sectional areas were estimated. In the second testing session all subjects performed grip strength measures and a maximal treadmill test to assess oxygen consumption (VO2), blood lactate and heart rate at maximal effort, at individual anaerobic threshold, and at individual ventilatory
threshold. The athletes were ranked following the criteria of world amateur AIBA ranking. In this ranking the first ranked boxer had the highest score gained participating in international tournaments. A Spearman rho correlation analysis revealed that the VO2 at individual anaerobic threshold (46.0+/−4.2 ml x kg(x-1) x min(-1), r=0.91) and the hand-grip strength (58.2+/−6.9 kg, r=0.87) were highly related (p<0.01) to boxing competition ranking. VO(2max) (57.5+/−4.7 ml x kg(-1) x min(-1), r=0.81) and wrist girth (17.6+/−0.6 cm, r=0.78) were moderately (p<0.05) related. These data suggest that there are two basic factors related to boxing performance: physical fitness as indicated by individual anaerobic threshold and maximal oxygen consumption, and upper-body muscular strength as indicated by hand-grip strength.

Hall CJ, and Lane AM. (2001) examined the effects of rapid weight loss on mood and performance among amateur boxers. Participants were 16 experienced amateur boxers. In stage 1, structured interviews were used to assess the type of strategies that boxers used to reduce weight and the value of performing at their desired weight in terms of performance. In stage 2, boxers completed a 4 x 2 minute (1 minute recovery) circuit training session. Boxers completed the circuit training session on three different occasions with a week between each. The first test was used to familiarise the boxers with the circuit training task; the second and third tasks were at their training weight and championship weight, respectively. Participants were given one week to reduce their body weight to their championship weight using their preferred weight making strategies; boxers reduced their body weight by an average of 5.16% of body weight. Boxers typically lost weight by restricting fluid and food intake in the week leading to competition. Repeated measures multivariate analysis of variance results indicated that rapid weight loss among boxers was associated with poor performance,
increased anger, fatigue, and tension, and reduced vigour. Strategies used to make weight by boxers are associated with poor performance and a negative mood profile.

Smith M, et.al. (2001) examined the effects of serial reductions in energy and fluid intake on two simulated boxing performances separated by 2 days recovery. Eight amateur boxers (age: 23.6 +/- 3.2 years; height 175 +/- 5 cm; body mass [BM] 73.3 +/- 8.3 kg [Mean +/- SD]) performed two simulated boxing bouts (BB) under normal (N-trial) and restricted (R-trial) diets in a counterbalanced design over 5 days. The trials were separated by a 9-day period of normal dietary behavior (X-trial). BM was recorded on days 1, 3, and 5 of each trial. Simulated bouts of three, 3-min rounds with 1-min recovery were completed on days 3 (BB1) and 5 (BB2) of each 5-day trial. Punching force (N) was recorded from 8 sets of 7 punches by a purpose-built boxing ergometer. Heart rate (fC) was monitored continuously (PE3000 Polar Sports Tester, Kempele, Finland), and blood lactate (BLa) and glucose (BG) were determined 4-min post-performance (2300 StaPlus, YSI, Ohio). Energy and fluid intakes were significantly lower in the R-trial (p < .05). Body mass was maintained during the N-trial but fell 3% (p < .05) during the R-trial. There were no significant differences in end-of-bout fC or post-bout BG, but BLa was higher in the N- than the R-trial (p < .05). R-trial punching forces were 3.2% and 4.6% lower, respectively, compared to the corresponding N-trial bouts, but the differences did not reach statistical significance. These results suggest that energy and fluid restrictions in weight-governed sports do not always lead to a significant decrease in performance, but because of the small sample size and big variations in individual performances, these findings should be interpreted with care.
Hemmings B, Smith M, Graydon J, Dyson R. (2000) investigated the effect of massage on perceived recovery and blood lactate removal, and also to examine massage effects on repeated boxing performance. Eight amateur boxers completed two performances on a boxing ergometer on two occasions in a counterbalanced design. Boxers initially completed performance 1, after which they received a massage or passive rest intervention. Each boxer then gave perceived recovery ratings before completing a second performance, which was a repeated simulation of the first. Heart rates and blood lactate and glucose levels were also assessed before, during, and after all performances. A repeated measures analysis of variance showed no significant group differences for either performance, although a main effect was found showing a decrement in punching force from performance 1 to performance 2 (p<0.05). A Wilcoxon matched pairs test showed that the massage intervention significantly increased perceptions of recovery (p<0.01) compared with the passive rest intervention. A doubly multivariate multiple analysis of variance showed no differences in blood lactate or glucose following massage or passive rest interventions, although the blood lactate concentration after the second performance was significantly higher following massage (p<0.05). These findings provide some support for the psychological benefits of massage, but raise questions about the benefit of massage for physiological restoration and repeated sports performance.

2.3 STUDIES ON AEROBIC TRAINING

Gopinath (2008) conducted a study on the effect of aerobic training(sub maximal) on biochemical parameters for the purpose of the study. The role of training is fast gaining an important place in the management metabolic derangements such as diabetes mellitus, obesity, hypertension, CHD, etc. Studies have been conducted on the
Training induced alterations in the level of blood sugar Tg, HDL, LDL, S.protien etc. However not much has been reported about the responses of bl.urea, S.creatinine, S.bilirubin, S.uric acid, SGOT(AST) and SGPT level (ALT) to training. Moreover studies are scarce on this topic as far as Indian athletes are concerned. The objective of present study was to determine the biochemical alteration following sub maximal treadmill run and to examine the effects of 20 minutes rest period. The athletes in this study on exercise exhibited an increase in value of S.Tg, S.HDL, blood urea, S creatinine, S protein, SGOT and SGPT and a depression in blood sugar levels and no significant change in S.cholestral, S.bilirubin and S.uric acid concentration.

Selvam, and Sudha (2008) conducted a study on selected effect of aerobic exercise on selected physiological variables among college girls. For this study aerobic exercise uses large muscle groups rhythmically and continuously and elevates the heart rate and breathing for a sustained period. Common examples include walking, jogging/running, swimming, rowing, stair climbing, bicycling, cross country skiing, step and dance exercise classes, roller skating, and the more continuous forms of tennis, racquet ball and squash. To achieve this purpose, 60 girls were selected from Theivannai Ammal College for women, Villupuram. The age group of the subjects ranged between 18 to 20 years. The selected subjects were divided into two groups. The groups first trained for aerobic exercise. The training group underwent the training for 5 days in a week for eight weeks and group second acted as control group to make adjustments for differences in the initial means and test the adjusted post test means for significant differences. The researcher used analysis of covariance(ANCOVA) for interpreting the results. The results for the study revealed that aerobic exercise had a
significant effect in the improvement of the physiological variables such as resting pulse rate, breath holding time, vital capacity and respiratory rate.

Selvalakshmi (2007) conducted a study on the effect of varied aerobic training programmes on obese women working in IT companies for the purpose of the study. Aerobic refers to a variety of exercises that stimulate heart and lung activity for a time period sufficiently long to produce beneficial changes in the body (Cooper, 1970). Aerobic is a system of exercises designed to promote the supply and use of oxygen in the body. In this study, the investigator was interested in carrying out the experiment on two randomized groups of obese women working in IT companies and the effects of aerobic training on cardio respiratory functions. For this study, the obese women were grouped into three namely, control, floor aerobic and step aerobic group. The collected data on the cardio respiratory parameters prior to and after 12 weeks of varied aerobics training were statistically analyzed using Analysis of covariance (ANCOVA) as recommended by Clarke and Clarke (1972) best and Khan (1986) and result on vital capacity showed significant improvement due to varied aerobic exercises, as where no significant improvement was found in resting heart rate.

Nilsson and Hellens (2001) conducted a study on group based aerobic interval training in patients with chronic heart failure. Purpose: The purpose this case report is to describe the responses of 4 patients with chronic heart failure (CHF) to a naval rehabilitation program: a group based high intensity, high interval training program that includes aerobic resistance, flexibility and balanced activities. Case description: four patients (55-71 years of age) with CHF (New York heart association classIII) participated in the rehabilitation program twice per week for 16 weeks; Outcome measures include a 6 minute walk test (6MWT), a cycle ergo meter test (aerobic
capacity) and a quality of life questionnaire. Outcomes: patients 1, 2, and 3 increased their aerobic capacity (17%, 25% and 52% respectively). Patient 4 did not complete the cycle the ergo meter test because of limitations associated with his pacemaker. All patients increased their 6MWT distance (117, 66, 135 and 143m for patients 1, 2, 3, and 4 respectively). No adverse events were reported. Discussion: The Norwegian Ullevaal Model of cardiac rehabilitation is a novel high intensity, high interval training program. The 4 patients with CHF in this case series who participated in this program experienced improvements in physical capacity and quality of life and had no adverse events. These results are consistent with recent evidence supporting the efficiency of high intensity interval training in people with CHF. Randomized clinical trials are needed to evaluate the clinical efficiency of this group based, high intensity, aerobic interval training program for patients with CHF.

Chandler (1994) aerobic fitness and aerobic endurance are two separate components of aerobic metabolism. Aerobic fitness, best measured by VO2 max, is a measure of oxygen transport and utilizations. Aerobic endurance is not measured in a VO2 max test because it does not measure the ability of the muscle to perform prolonged work. Endurance fitness may be a complimentary measurement to VO2 max, providing additional information regarding the capacity of the muscle and is the primary site where increases in mitochondrial enzymes improve aerobic endurance capacity. Aerobic endurance may be more closely related to health related fitness than aerobic fitness. Conditioning must be specific to the sport or activity, progressing from general aerobic fitness in the off-season to sport specific aerobic fitness/endurance during the playing season. Aerobic fitness/endurance decreases rapidly with detraining. Adequate, aerobic fitness/endurance specific to a particular sport may help present
injury in terms of delaying fatigue and ligaments. A properly initiated sport specific aerobic conditioning program is essential for maximal performance to be reached in any sport.

Rowland (1990) conducted a study on the accuracy of physical working capacity in estimating aerobic fitness in children. For this study 35 children- 18 boys and 17 girls of age 10 and 9 respectively underwent maximal cycle testing. The workload, the heart rate of 17 hpm has been utilized. The measures were closely correlated in absolute terms but the relationship was weak when both were expressed per kg body weight.

When VO2 max calculated from regression equation of VO2 max versus PWC, the mean error from measured VO2 max was 3.4ml/kg/min, for girls and 2.8ml/kg/min for boys. The finding indicated that although mean predictability of VO2 mean from PWC was good, the variability was wide with 10-15% error. PWC provides a crude estimate of VO2 max and should not be used to predicate individual’s maximal aerobic power.

Shepard (1990) conducted a study on the effects of enhanced physical education on long volume of primary school children. 546 students aged 7-12 years from selected class were sampled for study with 4% dropout rate per year. Specialists gave the subjects five hours of additional physical education activities designed carefully. The factors such as gender (m7fm) and environment (rural 7 urban) influenced the treatment and both forced vital capacity (FVC) and (FEV) conform closely to cubic functions of height in meters.
2.4 STUDIES ON ANAEROBIC TRAINING

Bacharach and Davillard (2004) examined a study of intermediate and a long term anaerobic performance of elite Alpine skiers. Many researchers identified that Alpine skiers need muscular strength and complex motor skill abilities. After verifying a variety of tests, short test of anaerobic capacity came into existence. Seventeen Nationality ranked male and female Alpine Ski racers from USA were used. The power was measured in them by keeping 30.5 and 90.5 wingate cycle ergometry tests. Through this study they found that capacity of anaerobic power can be altered.

Williams (2003) conducted a study on children’s and adolescents anaerobic performance during cycle ergometry. The anaerobic test friction braked wingate, other tests such as the fork velocity and isokinetic cycle ergometers were becoming more common. There was unequivocal agreement that children’s and adolescence anaerobic power scores were lower than those of adults. Qualitative muscular differences were often cited for this disparity rather than difference in the quantity of the muscle, but conclusive research was lacking in this area.

Green and Dowson (2002) studied the measurement of anaerobic capacity in human body. The study focused on laboratory measures which attempted to quantify anaerobic capacities. Maximal blood lactate measured was used in both research and athletic settings to decrease anaerobic capacity. Its user was supported by (a) The high correlation observed between maximal blood lactate and short duration exercise performance presumably dependent upon anaerobic capacity and (b) The higher maximal blood lactate values observed in sprint and power athletes (who would demonstrate higher anaerobic capacities) compared with endurance athletes or
untrained people. The later findings may be partially related to the confounding influence of blood volume which such high variability response to short and long term exercise demands. Maximal blood lactate was known to be influenced by the intensity and duration of the preceding exercise bout. Therefore it was plausible that these factors may also influence the degree for which maximal blood lactate accurately reflects an aerobic capacity.

Kalliokoski, and Nuutila (2001) in their recent study showed good correlation between regional blood flow (BF) and oxygen uptake (VO$_2$) 30 minutes after exhaustive exercise. The question that remains open is whether there is similar good correlation between BF and VO$_2$ also during exercise. We reanalysed our previous data from a study in which BF and VO$_2$ was measured in different quadriceps femoris muscles in seven healthy endurance-trained and seven healthy untrained men at rest and during low-intensity intermittent static knee-extension exercise. When the mean values of each muscle were considered, there was good correlation between BF and VO$_2$ during exercise in both groups ($r^2$ 0.82 in untrained and 0.97 in trained). However, when calculated individually the correlations were poorer and the mean correlation coefficient ($r^2$) was significantly higher in the trained men (0.71±0.07 vs 0.40±0.11, p=0.03). These results suggest that there is large individual variation in matching blood flow to oxygen uptake in human skeletal muscles during exercise, ranging from very poor to excellent. Furthermore, this matching seems to be better in the endurance-trained than in untrained men.

Astrand and Radah (1986) defined lactate systems as anaerobic glycolysis which has essentially the incomplete breakdown of glycogen in the absence of oxygen. It occurred during the period of maximal exercise testing approximately 90 seconds in
duration. The results showed that the corresponding increase in muscle activity caused muscle fatigue due to the accumulation of H⁺. One possible explanation for the fatigue was the inhibition of phosphoro fructo knare (PFK) which is essential for the production of ATP.

Young female track runners (N = 31), at least half of whom were between 9 and 12 years of age, the remainder in the average age range of 14+ years, were classified as sprint (<= 400 m) or middle distance runners (up to 3,200 m). They were well-trained and of national junior level. They were tested on a Cybex II dynamometer for peak torque during leg extension, and on a Monarch bicycle ergometer to determine anaerobic power and capacity as revealed by the Wingate Anaerobic Test. Body composition was determined by underwater weighing. Among physical characteristics, there was a relationship to age but not to event classification. Sprinters were no different from distance runners in stature. Fat-free weight was significantly related to performance measures. When other variables were corrected for fat-free weight variance, their associations with performance variables were reduced considerably. In terms of performance, older subjects were stronger at all Cybex II velocities. Event related differences only occurred at higher speeds (240 degrees per sec). Among anaerobic power values, only older athletes demonstrated substantially higher levels than the other subjects. There were no significant differences in anaerobic capacity.

2.5 STUDIES ON PHYSICAL PARAMETERS

Bames Schilling and Falvo (2007) conducted a study on a relationship of jumping and agility performance in female volley ball athletes. Court sports often require more frequent changes of direction (COD) than field sports. Most court sports
require 180 degree turns over a small distance, so COD in such sports might be best
evaluated with an agility test involving short sprints and sharp turns. The purposes of
this study were to (a) quantify vertical and horizontal force during a COD test,(b)
identify possible predictors of court sport specific agility performance and (c) examine
performance difference between National collegiate Athletic Association Division I,II
and III athletes. 29 collegiate female volley ball players completed a novel agility test,
countermovement (CM) and drop jump tests and an isometric extensor test. The
number of athletes by division was as follows: I(n=9) II(n=11) and III (n=9). The
agility test consisted of 45 meter sprints with 3,180 degrees turns, including I on a
multiaxial force plat form so that the kinetic properties of the COD could be identified.
One way analysis of variance revealed that division III and the effect size comparisons
(Cohen’s d) showed large magnitude differences between divisions I and both
divisions II and III for jump height. No other differences in performances variables
were noted between divisions, although effect sizes reached moderate values for some
comparisons. Regression analysis revealed that CM displacement was a significant
predictor of agility performance, explaining approximately 34% of the variance.

Cronin and Hansen (2005) conducted a study on strength and power predictors
of sports speed. For this study many sporting activities, initial speed rather than
maximal speed would be considered of greater importance to successful performance.
The purpose of this study was to identify the relationship between strength and power
and measures of first step quickness (5m time), acceleration (10m time), and maximal
speed (30m time). The maximal strength (3RM), power (30 kg jump squat, counter
movement and drop jumps), isokinetic strength measures (hamstring and quadriceps
peak torques and ratios at 60 degrees. S(-1)and 300 degrees.S(-1)and 5m,10m and 30m
sprint times of 26 part time and full time professional rugby league players (age 23.2 +/- 3.3 years) were measured. To examine the importance of the strength and power measures on sprint performance, a correlational approach and a comparison between means of the fastest and slowest players was used. The correlations between the 3RM, drop jump, isokinetic strength measures and the 3 measures of sport speed were non significant. Correlations between the jump squat (height and relative power output) and counter movement jump height and the 3 speed measures were significant (r = -0.43 to -0.66, p<0.05). The squat jump relative power output were the only variables found to be significantly greater in the fast players. It was suggested that improving the power to weight ratio as well as plyometric training involving counter movement and loaded jump squat training may be more effective for enhancing sport speed in elite players.

Rajasekaran (1999) conducted a study on the effect of maximum strength and speed training in series and parallel on elastic strength components among physical education and sports male students. 45 students were selected at random and were divided into three groups. Group I underwent series training. Group II underwent parallel training and group III acted as control. Variables such as Speed, explosive power, strides, frequency, leg strength, back strength and anaerobic capacity were measured. 50 meters run, Sarjent jump and standing broad jump, Leg lifts with dynamometer and Margaria-Kalamen tests were administrated. The results of study indicated that the series training and parallel training groups significantly improved on speed, explosive power, stride frequency, leg strength, back strength and anaerobic capacity when compared with control group. Parallel training groups have significantly increased speed, stride frequency, explosive power and anaerobic capacity when compared with series training group. The leg strength and back strength showed no
significant difference between series and parallel groups. However, the increase in leg strength was in favour of parallel group.

2.6 STUDIES ON PHYSIOLOGICAL VARIABLES

Agnes Princy and Sudan Paulraj (2008) conducted a study on effect of yogasana on temperature and resting heart rate. Twenty students aged between 18 and 22 years were selected as subjects random. They were divided into two equal groups of which one is experimental group and the other control group. Yogasana training was given for experimental group and the control group was not allowed to participate in training program. The subjects were tested on temperature resting heart rate at the beginning (Pre – test) and at the end of the training period of 6 weeks (Post test). The data collected were analyzed by means of analysis of covariance. The result showed that there were significant changes in the temperature; resting heart rate as a result of yogic Asanas training.

Usitalo (2000) conducted a study on heart rate. It is not appropriate to heart rate recovery patterns which were investigated in endurance athletes (M=2, F=3) after three different forms of training; Long slow distance work (2 – 4 hours at < 65% Vo2 max) An intense interval run (5c, km>90% Vo2 max) and a control (30, 60 minutes, 65 % Vo2 max). Heart rate variability was measured during five minutes of standing and 48 hours after each from of exercise. The forms of exercise did not change blood lactate levels, heart rates or heart rate variability. Recovery of heart rates was complete with in 24 hours of exercise and long slow distance work caused the greatest response in heart rate variables. Heart rate responses differ markedly between individuals. However, heart rates recover from endurance exercise with in 24 hours, but long slow distance
work has the greatest effect on compare heart rate recovery response patterns when forms of endurance exercise differ.

Uppal (1990) conducted a study on determining the effects of interval training and two continuous load methods on cardio respiratory and selected physiological parameters. One group was given slow continuous running for a period of ten weeks, five days in a week. The load was increased progressively after every 10 days. He found that (1) all the three groups had equal training effects on maximal oxygen uptake, vital capacity, leg length, positive breath holding and negative breath holding time (2) slow continuous running and fartlek method resulted in significantly higher improvements in cardio respiratory endurance when compared to interval training (3) slow continuous running and interval training were superior to fartlek in reducing the resting pulse rate.

2.7 SUMMARY OF RELATED LITERATURE

In this chapter, selected related studies on assessing boxing performance, effects of training on boxing performance, effects of aerobic training, effects of anaerobic training, effects on physical fitness variables, effects on physiological variables were reviewed. It was found that there was further scope for research to find out the isolated and combined effect of aerobic and anaerobic training on selected physical, physiological and performance variables of college level boxers.

Hence, this research was undertaken. Based on the experience gained through reviewing these studies, the investigator selected suitable methodology to be adopted in this research, which is described in Chapter III.