Chapter II

REVIEW OF RELATED LITERATURE

For any specific research project to occupy a place in the development of a discipline, the researcher must be thoroughly familiar with both previous theory and research. To assure this familiarity, every research project in the behavioural sciences may be reviewed.

The literature related to any problem helps the scholar to discover what is already known, which would enable the investigator to have a deep insight, clear perspective and a better understanding of the chosen problem and various factors connected with the study. So a number of books, journals, and websites are referred. In the following pages, an attempt has been made to present briefly a few of the important researches and studies conducted abroad and in India, as they have significant bearing on the present study.

The literature in any field forms the foundation upon which all future work will be built. If we fail to build upon the foundation of knowledge provided by the review of literature, the researcher might miss some work already done on the same topic.
Stubbe et al (1983) in their study refer to eighteen healthy sedentary males who took part in supervised bicycle training for 50 minutes three to five times a week. Twelve subjects (group A) were trained for 6 weeks at heavy intensity, and six subjects (group B) were trained for 12 weeks at moderate intensity. Maximal oxygen uptake increased by about 20% (P less than 0.01). Body weight and composition as well as diet remained unchanged. After 6 weeks plasma high-density lipoprotein (HDL) cholesterol concentrations had increased by 7% (P less than 0.05) in all subjects. The increase was marked more in group B at 14% (P less than 0.05) compared to 3% in group A (ns). Apolipoprotein AI (apo AI) was increased by about 7% in both groups (P less than 0.01). After 12 weeks HDL cholesterol and apo AI levels had almost returned to initial values. Measurements of HDL components showed increases of 6% to 12% in free cholesterol, cholesteryl ester (P less than 0.05), and phospholipid (P less than 0.01); whereas, the minor triglyceride fraction decreased by 20% (P less than 0.01). Zonal ultracentrifugation in four subjects revealed a preferential rise of about 35% in the HDL2 subfraction, increasing the HDL2/HDL3 ratio by about 20%. In parallel, the composition of the lipoprotein classes changed. The protein moiety of all classes,
except low-density lipoprotein (LDL), expanded at the expense of the core components cholesteryl ester and triglyceride. Hepatic lipase (HL) activity decreased by 6% (P less than 0.05), and lipoprotein lipase (LPL) activity in adipose tissue increased by about 50% (P less than 0.05) during the first 6 weeks of training, while LPL activity in postheparin plasma and skeletal muscle did not change. The transient rise in HDL cholesterol levels was correlated (P less than 0.05) to the elevation of adipose tissue LPL activity. The alterations in HDL concentration were also related to changes in body composition and diet, especially to an increase in fat intake.

Wasserman (1984) conducted a study to determine the anaerobic threshold measurement to evaluate exercise performance. During exercise, the oxygen consumption above which aerobic energy production is supplemented by anaerobic mechanisms, and which results in a significant increase in lactate, is termed the anaerobic threshold (AT). This power output has important functional implications because it is a demarcation of the work rate above which metabolic acidosis accelerates the stimulation to breathing, and exercise endurance becomes reduced. The justification for relating lactate increase to tissue anaerobiosis during exercise is presented, and the gas
exchange methods for measuring the AT are described. The form of work affects the AT, treadmill being about 10% greater than cycling in sedentary subjects. It is useful for predicting the ability of the subject to sustain a given work rate for a prolonged period and for determining the VO$_2$ above which there is cardiovascular insufficiency in meeting tissue O$_2$ requirements.

Stein et al (1989) studied eight elite triathlon athletes who participated in a laboratory study of the effects on endurance exercise on protein and energy metabolism. It consists of 3h of cycling and 5h of treadmill running, 3.5h before beginning the exercise, a primed constant in fusion of 1-13C leucine and 6,6-24 glucose was begun. Serial blood samples were collected during the rest and exercise periods for isotopic analysis. Respiratory gas exchange was determined every half-an-hour. It was concluded that the plasma urea concentration was unchanged during the study. The leucine flux decreased during the first fourth of exercise attained a new plateau about 20 percent lower than the pre-exercise value indicating an adaptive reduction in protein turnover.

Tanaka et al (1991) investigated the effects of different modes of exercise on oxygen uptake (VO$_2$), the heart rate and the levels of lactate and pyruvate in venous blood. For this,
untrained male subjects performed three modes of exercise with a treadmill (TR), a bicycle ergometer (UP) and a supine leg ergometer (SU). The percentage of maximal oxygen uptake (%VO₂ max) and VO₂/weight for TR were significantly higher than those for UP or SU at lactate levels of 2, 3 and 4 mmol/l. The heart rate was also higher for TR than for SU at these lactate levels. The correlations of blood lactate with % VO₂ max, VO₂/weight and the heart rate were significant for TR and SU, but not for UP. Blood lactate levels were lower for TR than for SU or UP at 60, 70, 80% VO₂ max, whereas the values for UP were lower than those for SU only at 60% VO₂ max. Blood pyruvate levels were always lower for TR than for SU. The ratios of lactate/pyruvate differed for TR and SU only at 60% VO₂ max. For a given mode of exercise, blood lactate and the ratio of lactate/pyruvate increased with an increase in % VO₂ max, but those of pyruvate did not. These results reveal that the relationships between any two of lactate, pyruvate, VO₂ max and the heart rate are different at different modes of exercise, and that blood lactate depends on adaptation of muscles to a mode of exercise rather than on the quantity of muscles mobilized.

Yonezawa (1991) studied the effect of blood hemoglobin concentration on anaerobic threshold and (AT) has been
advocated as an objective method of evaluating exercise capacity in patients with chronic congestive heart failure. The factors that determine anaerobic threshold, however, remain still unclear. To assess the influence of oxygen transport capacity on anaerobic threshold, patients with iron deficiency anemia were studied before and after treatment with iron. Twenty-nine female subjects were studied. They were divided into the following 3 groups: 1) iron deficiency anemia consisting of 4 athletes and 6 non-athletes, 2) latent iron deficiency consisting of 4 athletes, and normal consisting of 15 athletes and 6 non-athletes. It is concluded from these results in iron deficiency anemia that oxygen transport is a determinant of anaerobic threshold.

Urstad et al (1994) undertook a study to explore the effect of muscle mass on lactate formation during exercise in humans. Eight men were assessed during one leg (1 LE) and two leg (2 LE) exercise, approximately 11 minutes cycling using the catheterization technique and muscle biopsies (quadriceps femoris muscle). Additional experiments were performed on four of the eight subjects with infusion of adrenaline during 1 LE (1 LEE), Average plasma adrenaline concentration increased during 1 LE and reached 2.4 times higher levels than during 2 LE. Post-exercise muscle lactate and glucose contents were higher
during 1 LEE than during 1 LE and were similar to those during 2 LE.

Wasserman et al (1994) conducted a study to determine the anaerobic threshold by gas exchange: biochemical considerations, methodology and physiological effects. This paper explains the physiological and biochemical basis of the anaerobic threshold (AT), achieved during physical exercise. The lactate concentration is approximately the same at rest in relatively fit adults, in normal sedentary subjects in adult patients with heart disease. But during exercise, the increase of lactate is inversely related to the physical fitness of the individual. During incremental work, the lactate concentration increases initially very little until a distinct metabolic rate (VO$_2$ AT) is reached at which lactate starts to increase steeply (anaerobic threshold/AT; VO$_2$ AT). Above the anaerobic threshold, accelerated glycolysis increases muscle lactic acidosis. This acidosis is buffered primarily by bicarbonate. The bicarbonate-derived CO2 causes an increased alveolar CO2 output relative to O$_2$ uptake. Oxygen uptake is increased virtually linearly with work rate in healthy subjects with a slope of approximately 10 ml O$_2$/min/Watt. VCO$_2$ starts to increase more steeply in the mid-work-rate range after an initial linear
behavior. This steepening is caused by an increased CO$_2$ production from the HCO$_3$-buffering of lactic acid for the range of work rates above the AT. Below the AT, the slope of increase in VCO$_2$ is 1 or slightly less, averaging 0.95. Above the AT, it is greater than 1. The submaximal exercise protocol for the determination of AT includes a period of 2-3 min of unloaded cycling, a ramp program with x Watt increase/minute and a recovery period of 2 min. X is the rate of work rate increase per min, so that the incremental period of the exercise test lasts 8-10 min, stressing the patient for only a short time. The anaerobic threshold can be determined during the ramp program using the following four parameters: 1) steeper increase of VCO$_2$ as compared to VO$_2$ (V-slope-method); 2) respiratory exchange ratio $= 0.95$; 3) PETO$_2$ increase; 4) VE/ VO$_2$ increase. The V-slope-method can be successfully applied, not only in healthy volunteers, but also in patients suffering from cardiac and/or pulmonary (breathing abnormalities) diseases.

Nummela and Rusko (1995) investigated the time course of aerobic and anaerobic energy yield during supramaximal exhaustive running on the treadmill in sprint and endurance athletes. In addition, the relationships between O$_2$ deficit, excess post-exercise O$_2$ consumption (EPOC) and peak post-exercise
blood lactate concentration (peak BLa) values were examined,
Oxygen uptake during the exhaustive run and 15 min recovery
period was measured using a breath-by-breath method. The
accumulated O₂ deficit was calculated by an extrapolation
procedure. Total running time was the same for eight male sprint
runners and for six male endurance athletes. The sprint group
had significantly higher O₂ deficit during the run as well as
higher peak BLa and EPOC after the run than the endurance
group. The relative contribution of anaerobic energy yield
decreased from 80% to 60% during the first 15s of the
exhaustive run in both groups. The VO₂ peaked and was almost
unchanged from 25th to 40th s of the run in both groups,
although only 79% of their VO₂ max was attained. The relative
contribution of aerobic energy yield was significantly higher in
the endurance than in the sprint group during the second half of
the run. No correlation was found between the O₂ deficit and
EPOC but peak BLa correlated significantly with the O₂ deficit
and EPOC. In conclusion, the energy release of the sprint and
endurance athletes was different only during the second half of
the exhaustive supramaximal run, when the sprinters used more
the anaerobic and endurance athletes aerobic pathways for
energy production.
Temple et al (1995) determined the intra subject reliability and repeatability of the blood glucose response to prolonged exercise in adolescents with insulin-dependent diabetes mellitus (IDDM) when pre-exercise meal, exercise, and insulin regimens are kept constant. Nine IDDM adolescent boys with diabetes duration of 9.7 +/- 4.8 years participated in two testing sessions 5-17 days apart. Carbohydrate intake, subcutaneous insulin injections, exercise bouts, and their timing were identical in both sessions. Exercises were started 1 h after breakfast and they consisted of six 10-min cycling bouts at moderate intensity (heart rate 145-150 beats/min), separated by 5-min rest periods. During rest periods, blood samples for glucose were taken and a supplemental carbohydrate beverage was consumed. Subjects were asked periodically to guess their own blood glucose levels. Intersession observations demonstrated that the intrasubject blood glucose responses to prolonged moderate-intensity exercise were reliable and repeatable when pre-exercise meal, exercise, and insulin, regimens were kept constant. This is an important finding for implementing and evaluating educational strategies for improving the metabolic control associated with prolonged exercise, as well as for future research on means for preventing exercise-induced hypoglycemia.
Kingwell et al (1996) investigated a change in vascular reactivity as a potential adaptive mechanism to chronic exercise. The study consisted of 2 separate protocols with 10 male athletes and 10 age-matched sedentary male control subjects participating in each. Protocol 1 investigated forearm blood flow responses to intra-arterial infusions of acetylcholine and sodium nitroprusside by use of venous occlusion plethysmography. Protocol 2 used identical techniques to study responses to norepinephrine, angiotensin II (ANG II), and NG-monomethyl-L-arginine (L-NMMA). The percent reduction in forearm vascular resistance to acetylcholine was significantly greater in the athletic compared with the sedentary group (multivariate analysis of variance for repeated measures, P = 0.03). Covariance analysis suggested that the lower total cholesterol level of the athletic group (P = 0.03) might contribute to their enhanced responsiveness to acetylcholine. There were no differences between athletic and sedentary groups in the forearm vascular resistance responses to norepinephrine, ANG II, sodium nitroprusside, or L-NMMA. These data support the hypothesis that long-term endurance training is associated with enhanced endothelium-dependent dilator reserve due to altered lipoprotein levels in athletes. This finding may have therapeutic application.
in conditions of elevated cholesterol and impaired vasodilator capacity including hypertension, hypercholesterolemia, atherosclerosis, and cardiac failure.

Zorbas et al (1996) determined serum urate and cholesterol concentrations in endurance trained volunteers during exposure to acute (abrupt restriction of muscular activity) and rigorous bed rest conditions of seven days. The studies were performed on 30 long distance runners aged 22-25 who had a peak of VO$_2$ of 65.5 +/- 2.7 ml.kg-1.min-1 on the average prior to their participation in the study. The volunteers were divided into three equal groups: the volunteers in the 1st group were under normal ambulatory conditions (control subjects), the volunteers of the 2nd group subjected to an acute bed rest regime (acute bed rested subjects) and the volunteers of the 3rd group were submitted to a rigorous bed rest regime (rigorous bed rested subjects). It was concluded that the increase in uric acid and cholesterol concentrations in serum appeared to reflect more stresses that associated with acute than rigorous bed rest conditions in endurance trained volunteers.

Kargotich et al (1997) assessed the effects that exercise-induced plasma volume changes, have on the interpretation of biochemical and hormonal parameters in the blood of athletes
after high-intensity exercise. Two different exercise modes employing two different high-intensity acute exercise protocols were investigated. Eight male swimmers performed an interval training session (ITS) consisting of 15 x 100-m freestyle efforts at 95% of their maximal exercise intensity, and eight male runners performed a multistage discontinuous treadmill test (MSD) to volitional exhaustion. Blood samples obtained before, immediately after, and 30, 60, and 120 min during recovery were analyzed for plasma volume changes, urea, uric acid, creatinine, albumin, calcium, iron, transferrin, testosterone, cortisol, and sex hormone-binding globulin (SHBG). It is recommended, when sampling biochemical and hormonal parameters in blood following an acute bout of exercise, that corrections for PVCs should be conducted. Apparent changes in blood solutes may reflect PVCs. PVCs should be taken into consideration when interpreting results regardless of exercise protocol and exercise mode performed.

Mero et al (1997) examined the effects of leucine supplementation on the amino acid and hormone profile during training. The study was a randomised double-blind cross-over study during 10 weeks of training. Twenty adult male track and field power athletes participated in the study. The subjects were
given leucine (50.0 +/- 3.3 mg/ kg body weight per day) or placebo tablets. The measurements were carried out before, in the middle of, and after 10 weeks. The present findings indicate that on a daily protein intake of 1.26 g/kg body weight the serum concentrations of amino acids are lowered considerably. This happened earlier than the decrease in the serum testosterone concentration during the training season in adult male power athletes. The leucine supplementation of 50 mg/kg body weight per day appears to prevent the decrease in the serum leucine concentration during intensive training.

Nioka et al (1998) conducted a study to determine the muscle deoxygenation in aerobic and anaerobic exercise. It has been generally accepted that the use of oxygen is a major contributor of ATP synthesis in endurance exercise but not in short sprints. In anaerobic exercise, muscle energy is thought to be initially supported by the PCr-ATP system followed by glycolysis, not through mitochondrial oxidative phosphorylation. However, in real exercise practice, it is not known how much of this notion is true when an athlete approaches his/her maximal capacity of aerobic and anaerobic exercise, such as during a graded VO2 max test.
Carter et al (1999) assessed the sensitivity of the lactate minimum speed test to changes in endurance fitness resulting from a six week training intervention. Sixteen participants completed six weeks of endurance training. Another eight participants acted as non-training controls. Before and after the training intervention, all participants completed: (1) a standard multi-stage treadmill test for the assessment of VO$_2$ max, running speed at the lactate threshold and running speed at a reference blood lactate concentration of 3 mmol x l$^{-1}$; and (2) the lactate minimum speed test. This involved two supramaximal exercise bouts and an 8 min walking recovery period to increase blood lactate concentration before the completion of an incremental treadmill test. Additionally, a subgroup of eight participants from the training intervention completed a series of constant-speed runs for determination of running speed at the maximal lactate steady state. The control group showed no significant changes in VO$_2$ max, running speed at the lactate threshold, running speed at a blood lactate concentration of 3 mmol x l$^{-1}$ or the lactate minimum speed. The results demonstrate that the lactate minimum speed, when assessed using the same exercise protocol before and after 6 weeks of
aerobic exercise training, are not sensitive to changes in endurance capacity.

Szots et al (1999) studied the effect of a single bout of oral glucose administration on the blood glucose level during three hours of observation and it was studied at rest in 6 physical education students and in 6 elite walkers with different physical condition. The influence of the physical condition on the observed data was also investigated. The evaluation of the glucose tolerance test (OGTT) was first built on a mathematical model and it was developed by a new method. The point of the brand-new method is the interrelationship between the relative percentage differences of blood glucose values, which is analysed as a function of time. The data of the new method better reflects the alterations of blood glucose regulation after oral administration of glucose. The new method contributes to the more accurate analysis of OGTT curves far beside estimation of the absolute values and it considers the relative differences. Thus a thorough examination of the glucose metabolism can be carried out. It opens new potentialities in the analysis of the individual, absorptive, hormonal and fitness-dependent effects of different carbohydrates that are used abundantly by athletes.
Carter et al (2000) assessed the responses of blood lactate and pyruvate during the lactate minimum speed test. Ten participants completed: (1) the lactate minimum speed test, which involved supramaximal sprint exercise to invoke a metabolic acidosis before the completion of an incremental treadmill test; (2) a standard incremental exercise test without prior sprint exercise for determination of the lactate threshold; and (3) the sprint exercise followed by a passive recovery. The lactate minimum speed was significantly slower than running speed at the lactate threshold, but there were no significant difference in VO2, heart rate or blood lactate concentration between the lactate minimum speed and running speed at the lactate threshold. During the standard incremental test, blood lactate and the lactate-to-pyruvate ratio increased above baseline values at the same time, with pyruvate increasing above baseline at a higher running speed. The rate of lactate, but not pyruvate, disappearance was increased during exercising recovery compared with passive recovery. This caused the lactate-to-pyruvate ratio to fall during the early stages of the lactate minimum speed test, to reach a minimum point at a running speed that coincided with the lactate minimum speed and that was similar to the point at which the lactate-to-
pyruvate ratio increased above baseline in the standard incremental test.

Smorawinski et al (2000) tried to find out (1) whether the effect of 3-day bed rest on blood glucose (BG) and plasma insulin (IRI) responses to glucose ingestion depended on preceding physical activity and (2) whether plasma adrenaline (A), noradrenaline (NA) and cardiovascular changes following a glucose load are modified by bed rest. These effects were most pronounced in the endurance athletes. Bed rest did not influence HR or BP in any group. It was concluded that (1) the athletes had more adequate compensation for the bed-rest-induced decrement in insulin sensitivity than sedentary men; (2) three-day bed rest diminishes basal sympathetic activity and attenuates sympathoadrenal response to oral glucose; (3) endurance athletes had greater sympathetic inhibition than strength athletes or sedentary men.

Zorbas et al (2000) investigated to assess the effect of a daily intake of fluid and salt supplementation on biochemical and hormonal changes in endurance trained volunteers aged 19-24 yrs during 30-day bed rest and during 15 days of post bed rest period. The studies were performed on 30 long distance runners aged 19-24 yrs who had a peak oxygen uptake of 66
ml/kg/min and had taken 14.5 km/day on average prior to their participation in the study. The volunteers were divided into three groups: the volunteers in the first group were under normal ambulatory conditions (control subjects); the second group was subjected to bed rest alone unsupplemented (bed rested volunteers); the third group was subjected to bed rest and consumed daily 30 ml water/kg bodyweight and 0.1 g of sodium chloride (NaCl)/kg body weight (supplemented bed rested volunteers). The second and third groups of volunteers were kept under a rigorous bed rest regime for 30 days. During the pre bed rest period of 15 days, during the bed rest period of 30 days and during the post bed rest period of 15 days cyclic adenosine monophosphate, cyclic guanosine monophosphate, prostaglandins of pressor, prostaglandins depressor groups, renin activity in plasma and aldosterone in plasma and in urine were determined. It was concluded that daily intake of fluid and salt supplementation may minimize the biochemical and hormonal changes in endurance trained volunteers from their exposure to bed rest conditions.

Smorawiński et al (2001) investigated to determine the effects of 3-day bed rest on physiological responses to graded exercise in athletes and sedentary men. To test the hypotheses
that short-term bed-rest (BR) deconditioning influences metabolic, cardio respiratory and neurohormonal responses to exercise and that these effects depend on the subjects' training status, 12 sedentary men and 10 endurance- and 10 strength-trained athletes were submitted to 3-day BR. Before and after BR they performed incremental exercise test until volitional exhaustion. Respiratory gas exchange and heart rate (HR) were recorded continuously, and stroke volume (SV) was measured at submaximal loads. Blood was taken for lactate concentration ([LA]), epinephrine concentration ([Epi]), norepinephrine concentration ([NE]), plasma renin activity (PRA), human growth hormone concentration ([hGH]), testosterone, and cortisol determination. These effects were insignificant in the remaining subjects. In conclusion, reduction of exercise performance and modifications in neurohormonal response to exercise after BR depend on the previous level and mode of physical training, which were the most pronounced in the endurance athletes.

Bauer and Weisser (2002) investigated whether submaximal, aerobic exercise induces changes in immune function in elderly subjects. Leukocytes, differential blood count, subsets of lymphocytes, CD4/CD8 ratio and immunoglobulins were studied after submaximal aerobic exercise in 15 elderly
subjects. These parameters were measured before, immediately after and 4 hours after exercise. Mean hemoglobin was unchanged indicating no hemoconcentration. There was a small increase in mean total lymphocytes, while there was a highly significant increase in leukocyte count both immediately and 4 hours after exercise. A significant correlation between the increase in leukocytes and lactate concentration was found. Lactate levels of all subjects were below 4 mmol/l. These results might indicate that the effect of a single bout of aerobic exercise on immune function depended on the intensity and duration of exercise relative to the level of fitness in elderly subjects. There was a highly significant rise \((p < 0.001)\) in \(\text{CD4/CD8}\) ratio 4 hours after exercise. This increase was mainly due to a rise in \(\text{CD4}\) cell number whereas \(\text{T-suppressor}\) cells were almost unchanged.

Martínez et al (2002) determined the effect of both acute exercise and maintained training during a period of competition on iron metabolism in sportsmen on a professional volleyball team. Twelve sportsmen volunteered for this study. The exercise test was performed on a mechanically braked Monark cycle ergometer and consisted of a triangular progressive test. Three blood samples were obtained in each test: at rest, just after
exercise, and after recovery. The following hematological parameters were determined: red blood count (RBC), hemoglobin (Hb) and hematocrit (Hto), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), total proteins (TP), serum iron (Fe) and total iron-binding capacity (TIBC), ferritin (FER), transferrin (TRF), haptoglobin (HPT), and serum cortisol (COR) concentrations. It was found that there were changes in hematological and biochemical variables related to Fe metabolism during the study. The changes observed could be the result of hemoconcentration processes after exercise and, at least in part, to physical stress and muscular damage. It is concluded that athletes, after a period of adaptation, with a good plan of work/recovery series, undergo a biological redistribution on hematological and biochemical parameters concerning Fe metabolism during the training and competition period. Also, daily Fe supplementation could restore and mask the true repercussions of maintained training observed in other sports.

Pitkanen et al (2002) examined power-type athletes to determine changes in amino acid and hormone concentrations in circulating blood following 2 different high-intensity exercise sessions before and after the 5-week training period. Eleven
competitive male sprinters and jumpers performed 2 different running exercise sessions: a short run session (SRS) of 3 x 4 x 60 m (intensity of 91-95%) with recoveries of 120 and 360 seconds, and a long run session (LRS) with 20-second intervals (intensity of 56-100%) with recoveries of 100 seconds to exhaustion. The concentrations of serum amino acids, hormones, and lactate were determined from the blood samples drawn after an overnight fast and 10 minutes before and after both SRS and LRS. The results of the study indicate that the speed and strength training period strongly decreased the fasting concentrations of amino acids in the power-trained athletes in a good anabolic state with the daily protein intake of 1.26g.pdkg(-1) body weight. At the same time the intensive lactic exercise session induced strong decrease, especially in valine, asparagine, and taurine.

Schumacher et al (2002) investigated the characteristics of the red blood cell system and the iron metabolism in athletes of different sporting disciplines and at different levels of performance. It was studied among 851 male subjects about (747 athletes, 104 untrained controls). Hemoglobin (Hb), hematocrit (Hct), red blood cell count (RBC), iron, transferrin, ferritin (Fer), and haptoglobin and they were analyzed in
standardized blood samples, obtained after 2 days of rest, considering levels of performance (internationally, nationally, locally competitive, and leisure time), distinctive sporting category (endurance- (END), strength- (POW), and mixed-trained (MIX)), and, within endurance athletes, distinctive disciplines (cycling (CYC) and running (RUN)). Physical training itself had no significant effect on selected hematological variables in athletes compared with untrained controls. The specific type and duration of exercise was of major importance in the adaptations of the blood cell system and the iron metabolism.

Chwalbińska-Moneta (2003) conducted a study to examine the effect of oral creatine supplementation on aerobic and anaerobic performance was investigated in 16 elite male rowers during 7-day endurance training. Before and after the daily ingestion of 20 g creatine monohydrate for 5 days (Cr-Group, n=8) or placebo (Pl-Group, n=8), subjects performed two exercise tests on a rowing ergometer: (a) incremental exercise consisting of 3-min stage durations and increased by 50 W until volitional exhaustion; (b) an all-out anaerobic exercise performed against a constant load of 7 W/kg. Heart rate and blood lactate concentrations were determined during exercise and recovery. The results indicated that in elite rowers, creatine
supplementation improved endurance (expressed by the individual lactate threshold) and anaerobic performance, independent of the effect of intensive endurance training.

Fujimoto et al (2003) tested whether glucose uptake was enhanced in trained men during low-, moderate-, and high-intensity exercise as compared with untrained men. Seven trained and untrained men were studied without any dietary manipulation during bicycle exercise at relative intensities of 30%, 55%, and 75% of maximal oxygen consumption on three separate days. Glucose uptake in the quadriceps femoris muscle was directly measured using positron emission tomography (PET) and 18F-fluoro-deoxy-glucose ([18F]FDG). [18F]FDG was injected 10 min after the beginning of the exercise. Thereafter exercise was continued for another 25 min. PET scanning was conducted immediately after completion of the exercise. The measured glucose uptake values reflected the situation during exercise due to chemical characteristics of the [18F]FDG. These results showed that skeletal muscle glucose uptake was higher in trained than in untrained men at high relative exercise intensity, although at lower relative exercise intensities no differences were observed. Thus, endurance training improves
the capacity of contraction-induced glucose uptake in skeletal muscle.

Kaciuba-Uscilko et al (2003) conducted a study on Catecholamine responses to environmental stressors in trained and untrained men after 3-day bed rest. Before and after BR, 11 untrained students, 8 endurance athletes, and 10 power/strength athletes were subjected to oral glucose tolerance test (OGTT) and orthostatic stand test (OST). Another 32 men (12 untrained, 10 endurance athletes, and 10 power/strength athletes) underwent cold pressor test (CPT) and graded exercise test (GET) performed until volitional exhaustion. Basal sympathetic activity was diminished after 3 d of BR in physically active men. Although catecholamine responses to glucose load and standing were reduced, the general reactivity and sensitivity of SNS were not attenuated since catecholamine responses to the most (exercise) and least (CPT) powerful stimuli were unchanged.

O'Connor and Crowe (2003) investigated the effects of 6 weeks oral supplementation of beta-hydroxy-beta-methylbutyrate (HMB) and a mixture of HMB and creatine monohydrate (HMBCr) on aerobic and anaerobic capacity in highly trained athletes. It was hypothesised that HMB and HMBCr would have positive effects on aerobic and anaerobic
power. A prospective study involving a repeated measures design was utilised where subjects underwent testing prior to, and immediately after, a 6 weeks supplementation period. Aerobic and anaerobic ability of highly trained male athletes is unaffected by 6 weeks oral supplementation with HMB or a combination of HMB and creatine monohydrate.

Denadai and Higino (2004) investigated to determine the effect of the passive recovery time following a supramaximal sprint exercise and the incremental exercise test on the lactate minimum speed (LMS). Thirteen sprinters and 12 endurance runners performed the following tests: (1) a maximal 500 m sprint followed by a passive recovery to determine the time to reach the peak blood lactate concentration; (2) after the maximal 500 m sprint, the athletes rested eight mins, and then performed 6 x 800 m incremental test, in order to determine the speed corresponding to the lower blood lactate concentration (LMS1) and; (3) identical procedures of the LMS1, differing only in the passive rest time, that was performed in accordance with the time to peak lactate (LMS2). It can be concluded that the LMS is not influenced by a passive recovery period longer than eight mins (adjusted according with the time to peak blood lactate), although blood lactate concentration may differ at this speed.
The predominant type of training (aerobic or anaerobic) of the athletes does not seem to influence the phenomenon previously described.

Ribeiro et al (2004) analysed the validity of glucose minimum speed (GMS) for lactate minimum speed (LMS) assessment during running and their relationship to endurance performance. Eight male trained runners volunteered to take part in this study and they underwent an official 10-km road race and a track lactate minimum test. Lactate and glucose minimum speeds were related to the minimum blood lactate and glucose concentrations respectively attained during the graded phase of LMT. Significant correlations were found between LMS and GMS and LMS and 10-km performance, but not between GMS and 10-km performance. No significant differences were found between LMS, GMS and 10-km mean speed. In conclusion, it was found that GMS to be a good predictor of LMS during track LMT, LMS was well related to endurance running performance.

Weiss et al (2004) assessed the role of circulating nitric oxide (NO) production in glucose homeostasis, plasma nitrate/nitrite (NO(x)). It was assessed during oral glucose tolerance tests (OGTTs) on 64 sedentary subjects and in a subset
40 subjects before and after 6 months of endurance exercise training. NO(x) decreased with the oral glucose load (P </.001 for linear and quadratic effects). OGTT NO(x) response indices (NO(x) response area (NO(x) AREA), change in NO(x) from baseline to the minimum (DeltaNO(x)), and NO(x) time-to-minimum) were not associated with OGTT insulin or glucose areas under the curve (AUCs) or with insulin sensitivity index (ISI). Training did not alter NO(x) AREA, or DeltaNO(x), however, NO(x) time-to-minimum occurred later after training (P =.038). Training-induced insulin AUC and ISI changes were not associated with OGTT NO(x) index changes; however, glucose total AUC changes were associated with changes in NO(x) AREA (r =.42, P =.007) and DeltaNO(x) (r =.37, P =.019). In conclusion, these data suggest that circulating NO production is not involved in glycemic control after an oral glucose load in sedentary adults. In response to endurance training, however, it appears that the time required to reach minimum NO(x) levels after a glucose load is greater after training. Furthermore, although the magnitude of NO(x) response (as indicated by NO(x) AREA and DeltaNO(x)) to an oral glucose load does not appear to change with training for all individuals, individual training-induced
changes in the NO(x) response magnitude are partly explained by training-induced changes in OGTT glucose responses.

Meludu et al (2005) determined the effect of glucose drink on marathon running and on some biochemical parameters. Seven untrained athletes (male students) participated in this study and were engaged in marathon running with and without intake of glucose drink in a double blind procedure. Blood samples were collected at 0, 30, 60 and 150 minutes for serum glucose, triglyceride, cholesterol and PCV estimation. There were significant increases in serum glucose; and triglyceride following pre-exercise glucose drink, while PCV remained unchanged with or without pre-exercise glucose drink. Greater than 80% of the subjects covered more distance with glucose intake, than without glucose drink. It is concluded that carbohydrate intake prior to exercise may enhance exercise performance and spares glycogen and lipid utilization.

Wehrlin and Marti (2006) assessed whether haemoglobin mass increases in world class athletes on LHTL and whether this increase is associated with peak performance at a subsequent important competition. Two Swiss world class runners lived for 26 days at an altitude of 2456 m and trained at 1800 m. This LHTL camp was the preparation for the World Athletic
Championships taking place 27-29 days after the end of the camp. Haemoglobin mass and other haematological variables were measured before and after the LHTL camp. The performance parameter was the race times during that period. The results suggest that LHTL with an adequate dose of hypoxia can increase haemoglobin mass even in world class athletes, which may translate into improved performance at important competitions at sea level.

Christ et al (2006) conducted a study about the effect of increased lipid intake on hormonal responses during aerobic exercise in endurance-trained men. In view of the growing health problem associated with obesity, clarification of the regulation of energy homeostasis is important. Peripheral signals, such as ghrelin and leptin, have been shown to influence energy homeostasis. Nutrients and physical exercise, in turn, influence hormone levels. Data on the hormonal response to physical exercise (standardized negative energy balance) after high-fat (HF) or low-fat (LF) diet with identical carbohydrate intake is currently not available.

Crisafulli et al (2006) studied about haemodynamic and lactate responses during 10 min following 3 bicycle tests. Two tests were performed for 3 min at 70% and 130% of the workload
corresponding to anaerobic threshold (70% W(at) and 130% W(at) tests), and 1 was performed until exhaustion at 150% of the maximum workload achieved during a previous incremental test (150% W(max) test). During the recovery period after the 150% W(max) test it was observed that the highest increases in blood lactate with respect to the baseline: at the 9th minute of recovery lactate concentration increased by +9.3 +/- 2.7, +6.4 +/- 3.1, and +1.1 +/- 0.9 mmol x L(-1) in the 150% W(max) (p > 0.05 with respect to the other protocol sessions), 130% W(at), and 70% W(at) tests, respectively. It was also observed that greater reductions in cardiac pre-load and systemic vascular resistance in the 150% W(max) test were than in the 130% W(at) and 70% W(at) tests. However, the cardiac output response successfully faced the increased vasodilatation occurring during 150% W(max) test so that changes in mean blood pressure were similar in the 3 test conditions. This study shows that exercises that yielded different lactate concentrations also led to greater vasodilatation. Nevertheless, mechanisms controlling the cardiovascular apparatus successfully prevented a drop in blood pressure in spite of the cardiovascular stress.

Healy et al (2006) determined whether r-hGH alters whole-body glucose and glycerol metabolism in endurance-trained
athletes at rest and during and after exercise. This was a 4-wk double-blind placebo-controlled trial. Twelve endurance-trained male athletes were recruited and randomized to r-hGH (n = 6) or identical placebo (n = 6) for 4 week. Whole-body rates of appearance (Ra) of glucose and glycerol (an index of lipolysis) and rate of disappearance of glucose were measured using infusions of d-[6-6-2H2] glucose and 2H5-glycerol. r-hGH in endurance-trained athletes increased lipolysis and fatty acid availability at rest and during and after exercise. r-hGH increased glucose production and uptake rates after exercise. The relevance of these effects for athletic performance is not known.

Lippi et al (2006) conducted study on comparison of the lipid profile and lipoprotein (a) between sedentary and highly trained subjects. To further investigate this topic, an extensive lipid profile, in accordance with the most recent guidelines issued by the American Heart Association (AHA)/American College of Cardiology (ACC) and the National Cholesterol Education Program (NCEP), was evaluated in 60 healthy male sedentary controls and in a wide population of professional endurance athletes, including 40 male professional cross-country skiers and 102 male professional road cyclists. Results
of this case-control study confirm that elevated aerobic energy expenditure might be associated with a highly favorable stabilization of most traditional and emerging cardiovascular risk predictors. Therefore, a substantial increase in aerobic physical activity within the population might be recommended to reverse adverse lipid abnormalities, especially in subjects with a higher cardiovascular risk.

Tansey et al (2006) examined the acute glucose-lowering effects of aerobic exercise in children and adolescents with type 1 diabetes. Fifty children and adolescents with type 1 diabetes (ages 10 to <18 years) were studied during exercise. The 75-min exercise session consisted of four 15-min periods of walking on a treadmill to a target heart rate of 140 bpm and three 5-min rest periods. Blood glucose and plasma glucagon, cortisol, growth hormone, and norepinephrine concentrations were measured before, during, and after exercise. In youth with type 1 diabetes, prolonged moderate aerobic exercise results in a consistent reduction in plasma glucose and the frequent occurrence of hypoglycemia when preexercise glucose concentrations are <120 mg/dl. Moreover, treatment with 15 g of oral glucose is often insufficient to treat hypoglycemia reliably during exercise in these youngsters.
Herrmann et al (2007) determined the effect of endurance exercise-induced lactacidosis on biochemical markers of bone turnover. Stress fractures are frequent injuries among athletes. In vitro, decreases in pH stimulate osteoclasts and inhibit osteoblasts. It was hypothesized that exercise-induced lactacidosis stimulated osteoclasts and reduced osteoblast activity in vivo. A total of 32 volunteers performed three 60-min cycle ergometer tests at 75%, 95% and 110% of their individual anaerobic threshold (IAT). Blood was taken before and at 3 and 24 hour after exercise. Osteocalcin (OC), pro-collagen type I N-terminal peptide (PINP), C-terminal telopeptides of collagen I (CTx) and tartrate-resistant acid phosphatase (TRAP) were measured. Anaerobic exercise does not systemically affect bone turnover, suggesting that exercise-induced acidosis is not involved in the pathogenesis of stress fractures.

Summary of the Literature

This review of literature has helped the investigator to spot out relevant topics and variables. Further the literature has helped the investigator to frame a suitable hypothesis leading to the problems. The latest literature also helps the investigator to support his findings with regard to the problem. The literature
collected in the study will also help the research scholar in understanding similar areas.

The reviews are presented under the sections such as speed training (n=39) variables with chronological and alphabetical order. All the research studies presented in the section prove that the training programme contribute significantly for better development of selected dependent variables. The research studies reviewed are from many journals available in the websites such as www.pubmed.gov, ERIC websites etc.

It is also observed from the review of literature that no research studies are related to aerobic and anaerobic training on the selected variables among athletes and non-athletes. This has motivated the researcher to find out the effect of aerobic and anaerobic training on selected biochemical variables.

The review of literature has helped the researcher from the methodological point of view too. Most of the research studies cited in this chapter on content analysis and experimental design show appropriate methods for finding out the lapses and remediation.