Chapter II

REVIEW OF RELATED LITERATURE

The present chapter consists of various research studies relevant to the study under investigation. A search for the reference materials would assist the investigator to determine the effectiveness of the various combinations of the variables, methodology used and the results obtained. Study of the Related Literature comprises loading, reading and evaluating reports of research as well as reports of casual observation and opinion that are related to the individuals planned research report. A study of relevant Literature is an essential step to get a full picture of what has been done with regard to the problem under study. The investigator has made an attempt to bring a brief review of research related to the present study to form the background for the present study.

2.1. STUDIES ON YOGA

Kosuri M and Sridhar GR. (2009) conducted a study of Yoga Practice on Physical and Psychological Outcomes. The aim of this study was to examine the effect of Yoga practice on clinical and psychological outcomes in subjects with type 2 diabetes mellitus (T2DM). In a 40-day yoga camp at the Institute of Yoga and
Consciousness, ambulatory subjects with T2DM not having significant complications (n=35) participated in a 40-day yoga camp, where yogic practices were overseen by trained yoga teachers. Clinical, biochemical and psychological well-being were studied at baseline and at the end of the camp. At the end of the study, there was a reduction of body mass index (BMI) (26.514 +/- 3.355 to 25.771 +/- 3.40; P < 0.001) and anxiety (6.20 +/- 3.72 to 4.29 +/- 4.46; P < 0.05) and an improvement in total general well-being (48.6 +/- 11.13 to 52.66 +/- 12.87; P < 0.05). Participation of subjects with T2DM in yoga practice for 40 days resulted in reduced BMI, improved well-being, and reduced anxiety.

**Hafner-Holter, Kopp and Gunter (2009)** conducted a study on Effects of fitness training and yoga on well-being, social competence and body image. It describes and compares influences from physical activity program and a yoga program on well-being, mood, stress coping, body-image and social competence in healthy people. 18 persons attending a gym and 21 taking part in a yoga program answered following questionnaires before entering the program and taking part for 20 units: Body-Image-Questionnaire (25), Symptom – Checklist – 90 R (8), Complaint-List (31), Adjective Mood-Scale (32) and a Visual Analogue Scale for assessing stress-level (10). Statistical analyses show significant improvement in social
competence in both training groups; the gym-group show a reduction in summarization and body-related anxiety as well as an improvement in physical and emotional well-being. Our findings support the evidence that physical activity in general improves psychological well-being, however, gym and yoga seems to have different psychological impacts. Future research should focus on comparing the psychological effects of different physical activity interventions in prevention programmes as well as exercise prescriptions in patients with mental illness.

**Chen T.L. et.al (2009)** conducted a study on the effect of yoga exercise intervention on health related physical fitness in school-age asthmatic children to investigate the effect of yoga exercise on health-related physical fitness of school-age children with asthma. The study employed a quasi-experimental research design in which 31 voluntary children (exercise group 16; control group 15) aged 7 to 12 years were purposively sampled from one public elementary school in Taipei Country. The yoga exercise program was practiced by the exercise group three times per week for a consecutive 7 week period. Each 60-minute yoga session included 10 minutes of warm-up and breathing exercises, 40 minutes of yoga postures, and 10 minutes of cool down exercises. Fitness scores were assessed at pre-exercise (baseline) and at the seventh and ninth week after intervention
completion. A total of 30 subjects (exercise group 16; control group 14) completed follow-up. Results included: 1. Compared with children in the general population, the study subjects (n = 30) all fell below the 50th percentile in all physical fitness items of interest. There was no significant difference in scores between the two groups at baseline (i.e., pre-exercise) for all five fitness items. 2. Research found a positive association between exercise habit after school and muscular strength and endurance among asthmatic children. 3. Compared to the control group, the exercise group showed favorable outcomes in terms of flexibility and muscular endurance. Such favorable outcomes remained evident even after adjusting for age, duration of disease and steroid use, values for which were unequally distributed between the two groups at baseline. 4. There was a tendency for all item-specific fitness scores to increase over time in the exercise group. The GEE analysis showed that yoga exercise indeed improved BMI, flexibility, and muscular endurance. After 2 weeks of self-practice at home, yoga exercise continued to improve BMI, flexibility, muscular strength and cardio-pulmonary fitness.

Kim Y, Lee S. (2009) stated that childhood obesity continues to escalate despite considerable efforts to reverse the current trends. Childhood obesity is a leading public health concern because overweigh-obese youth suffer from comorbidities such as type
2 diabetes mellitus, non-alcololic fatty liver disease, metabolic syndrome, and cardiovascular disease, conditions once considered limited to adults. This increasing prevalence of chronic health conditions in youth closely parallels the dramatic increase in obesity, in particular abdominal adiposity, in youth. Although mounting evidence in adults demonstrates the benefits of regular physical activity as a treatment strategy for abdominal obesity, the independent role of regular physical activity alone (e.g., without calorie restriction) on abdominal obesity, and in particular visceral fat, is largely unclear in youth. There is some evidence to suggest that, independent of sedentary activity levels (e.g., television watching or playing video games), engaging in higher-intensity physical activity is associated with a lower waist circumference and less visceral fat. Several randomized controlled studies have shown that aerobic types of exercise are protective against age-related increases in visceral adiposity in growing children and adolescents. However, evidence regarding the effect of resistance training alone as a strategy for the treatment of abdominal obesity is lacking and warrants further investigation.

Brown R.P. and Gerbang P.L. (2009) stated that Yoga breathing is an important part of health and spiritual practices in Indo-Tibetan traditions. Considered fundamental for the development
of physical well-being, meditation, awareness, and enlightenment, it is both a form of meditation in itself and a preparation for deep meditation. Yoga breathing (pranayama) can rapidly bring the mind to the present moment and reduce stress. In this paper, they review data indicating how breath work can affect longevity mechanisms in some ways that overlap with meditation and in other ways that are different form, but that synergistically enhance, the effects of meditation. They also provide clinical evidence for the use of yoga breathing in the treatment of depression, anxiety, post-traumatic stress disorder, and for victims of mass disasters. By inducing stress resilience, breath work enabled them to rapidly and compassionately relieve many forms of suffering.

**Benavides S. and Caballero L. (2009)** stated that the objective of this pilot study was to determine the effect of yoga on weight in youth at risk of developing type 2 diabetes. Secondarily, the impact of participation in yoga on self-concept and psychiatric symptoms was measured. A 12-week prospective pilot Ashtanga yoga program enrolled twenty children and adolescents. Weight was measured before and after the program. All participants completed self-concept, anxiety, and depression inventories at the initiation and completion of the program. Fourteen predominantly Hispanic children, ages 8-15, completed the program. The average weight loss
was 2 kg. Weight decreased from 61.2+/-20.2kg to 59.2+/-19.2kg (p=0.01). Four of five children with low self-esteem improved, although two had decreased in self-esteem. Anxiety symptoms improved in the study. Ashtanga yoga may be beneficial as as weight loss strategy in a predominantly Hispanic population.

**Javnbakht M., Hejazi Kenari R. and Hisami M. (2009)** stated that Yoga has often been perceived as a method of stress management tool that can assist in alleviating depression and anxiety disorders. This study sought to evaluate the influence of yoga in relieving symptoms of depression and anxiety in women who were referred to a yoga clinic. The study involved a convenience sample of women who were referred to a yoga clinic from July 2006 to July 2007. All new cases were evaluated on admission using a personal information questionnaire as well as Beck and Spielberger tests. Participants were randomly assigned into an experimental and also a control group. The experimental group (n=34) participated in twice weekly yoga class of 90 minutes duration for two months. The control group (n=31) was assigned to a waiting list and did not receive yoga. Both groups were evaluated again after the two-month study period. The average prevalence of depression in the experimental group pre and post Yoga intervention was 12.82+/-7.9 and 10.79+/-6.04 respectively, a statistically insignificant decrease (p=0.13). However,
when the experimental group was compared to the control group, women who participated in yoga classes showed a significant decrease in state anxiety (p=0.03) and trait anxiety (p<0.001). Participation in a two-month yoga class can lead to significant reduction in perceived levels of anxiety in women who suffer from anxiety disorders. This study suggests that yoga can be considered as a complementary therapy or an alternative method for medical therapy in the treatment of anxiety disorders.

Hart C.E. and Tracy B.L. (2008) conducted a study on Yoga as steadiness training effects on motor variability in young adults. Exercise training programs can increase strength and improve sub-maximal force control, but the effects of yoga as an alternative form of steadiness training are not well described. The purpose was to explore the effect of a popular type of yoga (Bikram) on strength, steadiness and balance. Young adults performed yoga training (n = 10, 29+/−6 years, 24 yoga sessions in 8 weeks) or served as controls (n = 11, 26 +/- 7 years). Yoga sessions consisted of 1.5 hours of supervised, standardized postures. Measures before and after training included maximum voluntary contraction (MVC) force of the elbow flexors (EF) and knee extensors (KE), steadiness of isometric EF and KE contractions, steadiness of concentric (CON) and eccentric (ECC) KE contractions, and timed balance. The standard deviation
(SD) and coefficient of variation (CV, SD/mean force) of isometric force and the SD of acceleration during CON and ECC contractions were measured. After yoga training, MVC force increased 14% for KE (479+/-175 to 544+/-187 N, p < 0.05) and was unchanged for the EF muscles (219+/-85 to 230 +/ -72 N p > 0.05). The CV of force was unchanged for EF (1.68 to 1.73%, p > 0.05) but was reduced in the KE muscles, similarly for yoga and control groups (2.04 to 1.55%, p < 0.05). The variability of CON and ECC contractions was unchanged. For the yoga group, improvement in KE steadiness was correlated with pre training steadiness (r=-0.62 to -0.84, p < 0.05); subjects with the greatest reductions with training. Percent change in balance time for individual yoga subjects averaged +228% (19.5 +/- 14 to 34.3 +/- 18 seconds, p < 0.05), with no change in controls. For young adults, a short-term yoga program of this type can improve balance substantially, produce modest improvements in leg strength, and improve leg muscle control for less-steady subjects.

Chaya et al., (2006) investigated the net change in the basal metabolic rate (BMR of individuals actively engaging in a combination of yoga practices (asana or yogic postures, meditation and pranayama or breathing exercises) for a minimum period of six months, at a residential yoga education and research center at Bangalore. The measured BMR of individuals practicing yoga through
a combination was compared with that of control subjects who did not practice yoga but led similar lifestyles. This study shows that there is significantly reduced BMR, probably linked to reduced arousal, with the long-term practice of yoga using a combination of stimulatory and inhibitory yogic practices.

Madanmohan and associates (2005) planned to undertake a comparative study of the “Effect of short term (three weeks) training in savitri (slow breathing) and bhastrika (fast breathing) pranayama on respiratory pressures and endurance, reaction time, blood pressure, heart rate, rate-pressure product and double product”. Thirty student volunteers were divided into two groups of fifteen each. Group I was given training in savitri pranayama that involves slow, rhythmic, and deep breathing. Group II was given training in bhastrika pranayama, which is bellows-type rapid and deep breathing. Parameters were measured before and after three-week training period. Savitri pranayama produced a significant increase in respiratory pressures and respiratory endurance. In both the groups, there was an appreciable but statistically insignificant shortening of reaction time. Heart rate, rate-pressure product and double product decreased in savitri pranayama group but increased significantly in bhastrika group. It is concluded that different types of
pranayama produce different physiological responses in normal young volunteers.

**Brown and Gerbarg (2005)** found Yogic breathing a unique method for balancing the autonomic nervous system and influencing psychological and stress-related disorders. Part I of this series presented a neurophysiologic theory of the effects of Sudarshan Kriya Yoga (SKY). Part II reviewed clinical studies, their own clinical observation, and guidelines for the safe and effective use of yoga breathing techniques in a wide range of clinical conditions. The authors avow that although more clinical studies are needed to document the benefits of programs that combine pranayama (yogic breathing) asanas (yoga postures), and meditation, there is sufficient evidence to consider Sudarshan Kriya Yoga to be a beneficial, low risk, low-cost adjunct to the treatment of stress, anxiety, post-traumatic stress disorder (PTSD), depression, stress-related medical illnesses, substance abuse, and rehabilitation of criminal offenders. SKY has been used as a public health intervention to alleviated PTSD in survivors of mass disasters. Yoga techniques enhance well-being, mood, attention, mental focus, and stress tolerance. Proper training by a skilled teacher and a 30-minute practice every day will maximize the benefits. Health care providers play a crucial role in encouraging patients to maintain their yoga practices.
Barshankar et al., (2003) examined the effect of yoga on cardiovascular function in subjects above 40 years of age. Pulse rate, systolic and diastolic blood pressure and Valsalva ratio were studied in 50 control subjects (not doing any type of physical exercise) and 50 study projects who had been practising yoga for 5 years. From the study it was observed that significant reduction in the pulse rate occurs in subjects practicing yoga (P<0.001). The difference in the mean values of systolic and diastolic blood pressure between study group and control group was also statistically significant (P<0.01 and P<0.001 respectively). The systolic and diastolic blood pressure showed significant positive correlation with age in the study group (r₁ systolic=0.631 and r₁ diastolic =0.610) as well as in the control group (r₂ systolic =0.981 abd r₂ diastolic =0.864). The significance of difference between correlation coefficient of both the groups was also tested with the use of Z transformation and the difference was Significant (Z systolic =4.041 and Z diastolic =2.901). Valsalva ratio was found to be significantly higher in yoga practitioners than in controls (P<0.001). Our results indicate that yoga reduced the age related deterioration in cardiovascular functions.

Virtanen et.al. (2003) The purpose of study was to determine whether psychological factaors are associated with heart rate variability (HRV), blood pressure variability (BPV), and baroreflex
sensitivity (BRS) among healthy middle-aged men and women. A population-based sample of 71 men and 79 women (35-64 years of age) was studied. Five-minute supine recordings of ECG and beat-to-beat photoplethysmographic finger systolic arterial pressure and diastolic arterial pressure were obtained during paced breathing. Power spectra were commuted using a fact Fourier transforms for low-frequency (0.01-0.15 Hz) and high-frequency (0.15-0.10 Hz) powers. BRS was calculated by cross-spectral analysis of R-R interval and systolic arterial pressure variability ties. Psychological factors were evaluated by three self-report questionnaires: the Brief Symptom Inventory, and the Toronto Alexithymia Scale. It was found anxiety and hostility is related to reduced BRS and increased low-frequency power of BPV. Reduced BRS reflects decreased parasympathetic outflow to the heart and may increase BPV through an increased sympathetic predominance.

Selvanayaki (2002) conducted a study on “Effect of selected asana, pranayama, and combination of asana and pranayama on systolic and diastolic blood pressure among college women”. For this study she selected 45 college women ranging between 18 to 22 years, and divided them in three groups that underwent training for six weeks. ANCOVA was applied and it was concluded that systolic and diastolic blood pressure were not
significantly improved by the influence of asana, pranayama and the combination of asana and pranyama.

**Karuppasamy (2002)** conducted a study on “Effect of physical training and asanas on selected physiological variable and motor ability component among college men”. For this study, he selected 30 college men age ranging between 18 to 19 years and divided them in three groups, which underwent six weeks training programme of asana and physical training and a control group that did not do any training. He used ANCOVA and found out that there was significant effect of asana on pulse rate but there is no change in speed.

**Ray, et.al. (2001)** undertook a study to observe the beneficial effects of yogic practices during training period on the young trainees. 54 trainees of 20-25 years age group were divided randomly in two groups i.e. yoga and control group. Yoga group (23 males and 5 females) was administered yogic practices for the five months of the course while control group (21 males and 5 females) did not perform yogic exercises during this period. From the 6th to 10th months of training both the groups performed the yogic practices. Physiological parameters like heart rate, blood pressure, oral temperature, skin temperature in resting condition: responses to maximal and sub maximal exercise, body flexibility were recorded. Psychological
parameters like personality, learning arithmetic and psychomotor ability and mental well being were also recorded. Various parameters were taken before and during the 5th and 10th month of training period. Initially there was relatively higher sympathetic activity in both the groups due to the new work/training environment but gradually it subsided. Later on at the 5th and 10th month, yoga group had relatively lower sympathetic activity than the control group. There was improvement in performance at sub maximal level of exercise and in anaerobic threshold in the yoga group. There was improvement on various psychological parameters like reduction in anxiety and depression and a better mental function after yogic practices.

Murugesan, Govindarajulu and Bera (2000) selected thrity-three (N=33) hypertensives, aged 35-65 years, from Govt. General Hospital, Pondicherry, and examined with four variables viz., systolic and diastolic blood pressure, pulse rate and body weight. The subjects were randomly assigned into three groups. The exp. Group-I underwent selected yoga practices, exp. Group-II received medical treatment by the physician of the said hospital and the control group did not participate in any of the treatment stimuli. Yoga imparted in the morning and in the evening with 1 hr/session, day-1 for a total period of 11-weeks. Medical treatment comprised drug intake every
day for the whole experimental period. The result of pre-post test with ANCOVA revealed that both the treatment stimuli (i.e. yoga and drugs) were effective in controlling the variables of hypertension.

Madan Mohan, et al., (2000) studied the effects of yoga training on cardiovascular response to exercise and the time course of recovery after the exercise. Cardiovascular response to exercise was determined by Harvard step test using a platform of 45 cm height. The subjects were asked to step up and down the platform at a rate of 30/min for a total duration of 5 min or until fatigue, whichever was earlier. Heart rate (HR) and blood pressure response to exercise were measured in supine position exercise and at 1,2,3,4,5,7 and 10 minutes after the exercise. Rate-pressure product (RPP = (HR x SP)/100) and double product (Do P = HR x MP), which are indices of work done by the heart were also calculated. Exercise produced a significant increase in HR, systolic pressure, RPP & DoP and a significant decrease in diastolic pressure. After two months of yoga training, exercise induced changes in these parameters were significantly reduced. It is concluded that after yoga training a given level of exercise leads to a midler cardiovascular response, suggesting better exercise tolerance.
Schell, Allolio and Schoake (1994) conducted a study on physiological and psychological effects of Hatha-Yoga exercise in healthy women. They measured heart rate, blood pressure, the hormones cortisol, prolactin and growth hormones and certain psychological parameters in a yoga practicing group and a control group of young female volunteers prior and after the experimental period. There were no substantial differences between the groups concerning endocrine parameters and blood pressure. The heart rate was significantly different in yoga group having a significant decrease in heart rate during the yoga practice. In the personality inventory the yoga group showed markedly higher scores in life satisfaction and lower scores in excitability, aggressiveness, openness, emotionality and somatic complaints. Significant differences could also be observed concerning coping stress and mood at the end of the experiment. The yoga group had significant higher scores in high spirits and extra variedness.

2.2 STUDIES ON MOTOR ABILITY COMPONENTS

Kell et al., (2001) conducted study on Effects of hydraulic circuit training on cardiovascular function consists of 3 components: muscular strength, endurance and flexibility. Muscular strength (dynamic) is defined as the maximum force a muscle or muscle group can generate at a specific velocity.
Flexibility has 2 components, dynamic or static. Many health benefits are associated with musculoskeletal fitness, such as reduced coronary risk factors, increased bone mineral density (reduced risk of osteoporosis), increased flexibility, improved glucose tolerance, and greater success in completion of activities of daily living (ADL). With aging, the performance of daily tasks can become a challenge.

**W.A. Braun et al., (2005)** conducted Acute (Elevated post-exercise oxygen consumption) EPOC response in women to circuit training and treadmill exercise. Eight untrained females (31.3 ± 9.1 years; 2.04 ± 0.26 l min⁻¹ estimated VO₂ max; BMI = 24.6 ± 3.9 kg/m²) volunteered to participate in the study. Exercise of matched oxygen consumption. Subjects performed two exercise sessions approximately 28 days apart. Resting, supine energy expenditure was measured for 30 min preceding exercise and for 1 h after completion of exercise. CT consisted of three sets of eight common resistance exercises. Analysis of EPOC data revealed that CT resulted in a significantly higher (p<0.05) oxygen uptake during the first 30 min of recovery (0.27±0.01 l min⁻¹ vs 0.23±0.01 l min⁻¹); though, at 60 min, treatment differences were not present. CT was associated with a greater metabolic disturbance and cost during the early phases of EPOC.
Chatra et al., (2005) has conducted Effects of intra-session concurrent endurance and strength training sequence on aerobic performance and capacity. Forty eight male sport students age 21.4 (1.3) years) were divided into five homogeneous groups according to their maximal aerobic speeds (VO$_2$MAX). Four groups participated in various training programmes for 12 weeks (two sessions a week). E (n = 10), running endurance training; S (n = 9), strength circuit training; E+S (n = 10) and S+E (n = 10) combined the two programmes in a different order during the same training session. Group C (n = 9) served as a control. All the subjects were evaluated before (T0) and after (T1) the training period using four tests: (1) a 4 km time trial running test; (2) an incremental track test to estimate VO$_2$MAX; (3) a time to exhaustion test ($t_{lim}$) at 100% VO$_2$MAX; (4) a maximal cycling laboratory test to assess VO$_2$MAX. Training produced significant improvements in performance and aerobic capacity in the 4 km time trial with interaction effect (p<0.001).

Baquet et al., (2006) has conducted ‘Endurance Training and Aerobic Fitness in Young People.’ Training-induced adaptations in aerobic fitness have been extensively studied in adults. Scientists have recommended similar training programmes for young people. From 51 studies reviewed, 22 were finally retained. The procedures applied to protocol design and training methods to
highlight the real impact of aerobic training on the peak oxygen uptake (V-dotO_2) of healthy children and adolescents. In most of the studies, there was a considerable lack of research regarding circum pubertal individuals in general, and particularly in girls. The results suggest that methodologically listed parameters will exert a potential influence on the magnitude of peak V-dotO_2 improvement.

**Jones et al., (2000)** studied ‘The Effect of Endurance Training on Parameters of Aerobic Fitness.’ The Endurance exercise training results in profound adaptations of the cardio respiratory and neuromuscular systems that enhance the delivery of oxygen from the atmosphere to the mitochondria and enable a tighter regulation of muscle metabolism. These adaptations effect an improvement in endurance performance that is manifest as a rightward shift in the ‘velocity-time curve’. This shift enables athletes to exercise for longer at a given absolute exercise intensity. There are 4 key parameters of aerobic fitness that affect the nature of the velocity-time curve that can be measured in the human athlete. The velocity at V-dot2max (V-V-dot2max) and the maximal lactate steady state or critical power. The effect of endurance training on the key parameters of aerobic (endurance) fitness and attempts to relate these changes to the adaptations seen in the
body's physiological systems with training. The importance of improvements in the aerobic fitness parameters to the enhancement of endurance performance is highlighted.

**Yamamoto, et.al. (2001)** has conducted ‘Effects of endurance training on resting and post-exercise cardiac autonomic control.’ Endurance training induces reductions in both resting and post exercise heart rate (HR). If adaptation in cardiac autonomic regulation is a contributing factor in these reductions, changes in cardiac autonomic nervous system (ANS) should correspond to those in HR during an endurance-training program. The changes in resting and post exercise HR variability’s over a 6-wk training program. HR variability was measured five times in an endurance-training group (N = 7) and four times in a control group (N = 5) during the course of study. Endurance training decreased HR and increased indices of parasympathetic modulation measured both at rest and during post exercise recovery periods.

**Russell S. Deane et al., (2005)** has conducted “Effects of Hip Flexor Training on Sprint, Shuttle Run, and Vertical Jump Performance”. This study aimed to determine whether a hip flexor resistance-training program could improve performance on a variety of tasks. Thirteen men and 11 women hip flexion resistance-training group, Eleven men and 13 women served as
control group. Training period completed an 8-weeks. Isometric hip flexion strength, 40-yd dash time and the time for the first 10-yds, 4 × 5.8-m shuttle run time, and vertical jump height were evaluated at the beginning and end of the training and control period. Improvements were observed in the training group but not in the control group. The training group improved hip flexion strength by 12.2% and decreased their 40-yd and shuttle run times by 3.8% and 9.0%, respectively. An increase in hip flexion strength can help to improve sprint and agility performance.

**Banday and Irion (1994)** has conducted ‘The effect of time on static stretch on the flexibility of the hamstring muscles.’ The length of time the hamstring muscles should be placed in a sustained stretched position to maximally increase range of motion (ROM). Fifty-seven subjects (40 men, 17 women), ranging in age from 21 to 37 years and with limited hamstring muscle flexibility (ie, 30 degrees loss of knee extension measured with femur held at 90 degrees of hip flexion), were randomly assigned to one of four groups. The fourth group, which served as a control group, did not stretch. The data analysis revealed a significant group x test interaction, indicating that the change in flexibility was dependent on the duration of stretching. Further post hoc analysis revealed that 30 and 60 seconds of stretching were more effective at
increasing flexibility of the hamstring muscles. The results of this study suggest that a duration of 30 seconds is an effective time of stretching for enhancing the flexibility of the hamstring muscles.

**Borms et al., (1987)** has conducted ‘Optimal duration of static stretching exercises for improvement of coxo-femoral flexibility.’ The experimental group, consisting of 20 sedentary women (20-30 years of age), participated in an exercise programme of static stretching exercises with emphasis on the hamstring muscles. The programme lasted for 10 weeks and consisted of two 50-min sessions per week. A control group of 15 sedentary women did not participate in the programme. Hip flexibility was determined before, during and at the end of the programme. Three sub-groups were formed. The ANOVA tests showed that for all groups- the control group excepted - the hip flexibility had improved significantly after 10 weeks (P less than 0.05).

**Wallin et al., (1985)** has conducted ‘Improvement of muscle flexibility. A comparison between two techniques. Forty-seven male subjects were randomly assigned to 4 different groups. Three groups of 10 subjects trained three times a week with a modified contract-relax (CR) method for improving muscle flexibility. Seventeen subjects trained during the same time with a traditional ballistic stretch (BS) method. After 30 days (14 training sessions)
the latter group switched over to the CR method. The results showed that the CR method was significantly better than the BS method for improving muscle flexibility in the four different, bilateral muscle groups studied. After the initial 30 days the three groups of 10 subjects trained one, three, and five times a week, respectively, for another 30 days. The results showed that once a week was enough to maintain improved flexibility, while three and five times a week increased it further.

2.3. STUDIES ON PHYSIOLOGICAL VARIABLES

Orso et al., (2009) conducted a study on heart rate in coronary syndromes and heart failure. In the past 2 decades, there have been growing evidences that resting heart rate might be a marker of risk or even a risk factor for cardiovascular morbidity and mortality. This article reviews current evidences concerning the relation between heart rate and patients' outcome in different clinical settings such as acute coronary syndromes, left ventricular systolic dysfunction, and heart failure. The relationship between resting heart rate and the development of coronary artery disease, as well as all-cause and cardiovascular mortality has been found to be strong, graded, and independent from other risk factors. Several lines of research indicate that heart rate plays an important role in the pathophysiology of atherosclerosis and in the clinical manifestations of coronary artery disease and that it is an
independent prognostic factor in all coronary syndromes. The prognostic value of elevated heart rate in patients with heart failure has been tested in several clinical trials evaluating pharmacologic heart rate-lowering agents (e.g. beta-blockers). It is difficult to determine which percentage of the clinical benefit obtained with beta-blockers is related to induced bradycardia because cardiac slowing is only one of the effects of these drugs. In the BEAUTIFUL trial, a subgroup analysis conducted in patients with resting HR more than 70 beats per minute showed that treatment with ivabradine was able to improve outcome. According to the results presented in this review, we can conclude that heart rate is a predictor of death in both stable coronary artery disease and acute coronary syndromes. Elevated heart rate is also able to negatively predict clinical outcomes in patients with heart failure. However, it is still unclear if heart rate reduction per se can improve prognosis.

Zhang (2009) conducted study on Heart rate, lifespan, and mortality risk. An increasing body of scientific research and observational evidence indicates that resting heart rate (HR) is inversely related to the lifespan among homeothermic mammals and within individual species. In numerous human studies with patients stratified by resting HR, increased HR is universally associated with greater risk of death. The correlation between HR and maximum lifespan seems to be due to both basal metabolic
rate and cardiovascular-related mortality risk. Both intrinsic and extrinsic factors are already postulated to determine how the biological clock works, through regulating and modulating the processes such as protein oxidation, free radical production, inflammation and telomere shortening. Given the remarkable correlation between HR and lifespan, resting HR should be seriously considered as another possible cap on maximum lifespan. Future research is needed to determine whether deliberate cardiac slowing, through methods like lifestyle modification, pharmacological intervention, or medical devices, can decelerate biological clock of aging, reduce cardiovascular mortality and increase maximum lifespan in humans in general.

Thorin and Thorin-Trescases (2009) conducted study on Vascular endothelial ageing, heartbeat after heartbeat. The vascular endothelium starts to age at the first heartbeat. There is no longer a need to demonstrate that an increased resting heart rate--above 70 b.p.m.--is associated with the onset of cardiovascular events and reduces lifespan in humans. Each cardiac cycle imposes a mechanical constraint on the arteries, and we would like to propose that this mechanical stress damages the vascular endothelium, its dysfunction being the prerequisite for atherogenesis. Consequently, reducing heart rate could protect the
endothelium and slow the onset of atherosclerosis. The potential mechanisms by which reducing heart rate could be beneficial to the endothelium are likely a combination of a reduction in mechanical stress and tissue fatigue and a prolongation of the period of steady laminar flow, and thus sustained shear stress, between each systole. With age, irreparable damage accumulates in endothelial cells and leads to senescence, which is characterized by a pro-atherogenic phenotype. In the body, the highest mechanical stress occurs in the coronary vessels, where blood only flows during diastole and even reverses during systole; thus, coronary arteries are the prime site of atherosclerosis. All classical risk factors for cardiovascular diseases add up, to accelerate atherogenesis, but hypertension, which further raises mechanical stress, is likely the most damaging. By inducing flow through the arteries, the heart rate determines shear stress and its stability: mechanical stress and the associated damage induced by each systole are efficiently counteracted by the repair capacities of a healthy endothelium. The maintenance of a physiological, low heart rate may be key to prolonging the endothelial healthy lifespan and thus, vascular health.

Baker et al., (2009) conducted study on Resting heart rate and the development of antisocial behavior from age 9 to 14: genetic and environmental influences. The genetic and
environmental basis of a well-replicated association between antisocial behavior (ASB) and resting heart rate was investigated in a longitudinal twin study, based on two measurements between the ages of 9 and 14 years. ASB was defined as a broad continuum of externalizing behavior problems, assessed at each occasion through a composite measure based on parent ratings of trait aggression, delinquent behaviors, and psychopathic traits in their children. Parent ratings of ASB significantly decreased across age from childhood to early adolescence, although latent growth models indicated significant variation and twin similarity in the growth patterns, which were explained almost entirely by genetic influences. Resting heart rate at age 9-10 years old was inversely related to levels of ASB but not change patterns of ASB across age or occasions. Biometrical analyses indicated significant genetic influences on heart rate during childhood, as well as ASB throughout development from age 9 to 14. Both level and slope variation were significantly influenced by genetic factors. Of importance, the low resting heart rate and ASB association was significantly and entirely explained by their genetic covariation, although the heritable component of heart rate explained only a small portion (1-4%) of the substantial genetic variance in ASB. Although the effect size is small, children with low resting heart
rate appear to be genetically predisposed toward externalizing behavior problems as early as age 9 years old.

Palatini (2009) conducted study on Elevated heart rate: a "new" cardiovascular risk factor. A number of epidemiologic studies and several experimental lines of research point to high heart rate as a main risk factor for cardiovascular disease. However, translating research into clinical practice has been a challenge throughout medical history. From the present symposium, it appears clear that this is particularly the case for heart rate. The complex nature of atherogenesis makes it difficult to establish the role of a putative risk factor because of the correlations and complex interactions among factors. The pathogenetic mechanisms for the connection of resting heart rate with atherosclerosis and cardiovascular morbidity have been elaborated extensively in the chapter papers of this symposium, suggesting that there is a causal relationship between heart rate and cardiovascular mortality. The benefit of heart rate reduction has been proved in patients with coronary artery disease or congestive heart failure. Until now it has been difficult to determine whether modulation of heart rate is beneficial also in patients free of cardiac diseases. This concern, however, does not in any fashion suggest that health care professionals should pay less attention to this clinical variable. The impressive amount of available epidemiologic data show support for
the continued effort to raise awareness of the clinical importance of resting heart rate among health care professionals.

Aronow (2009) conducted a study on Management of atrial fibrillation in the elderly. Atrial fibrillation (AF) is associated with a higher incidence of mortality, stroke, and coronary events than is sinus rhythm. AF with a rapid ventricular rate may cause a tachycardia-related cardiomyopathy. Immediate direct-current (DC) cardioversion should be performed in patients with AF and acute myocardial infarction, chest pain due to myocardial ischemia, hypotension, severe heart failure, or syncope. Intravenous beta blockers, diltiazem, or verapamil may be administered to slow immediately a very rapid ventricular rate in AF. An oral beta blocker, verapamil, or diltiazem should be used in persons with AF if a fast ventricular rate occurs at rest or during exercise despite digoxin. Amiodarone may be used in selected patients with symptomatic life-threatening AF refractory to other drugs. Digoxin should not be used to treat patients with paroxysmal AF. Nondrug therapies should be performed in patients with symptomatic AF in whom a rapid ventricular rate cannot be slowed by drugs. Paroxysmal AF associated with the tachycardia-bradycardia syndrome should be treated with a permanent pacemaker in combination with drugs. A permanent pacemaker should be implanted in patients with AF and symptoms such as dizziness or
syncope associated with ventricular pauses greater than 3 seconds which are not drug-induced. Elective DC cardioversion has a higher success rate and a lower incidence of cardiac adverse effects than doe’s medical cardioversion in converting AF to sinus rhythm. Unless transesophageal echocardiography has shown no thrombus in the left atrial appendage before cardioversion, oral warfarin should be given for 3 weeks before elective DC or drug cardioversion of AF and continued for at least 4 weeks after maintenance of sinus rhythm. Many cardiologists prefer, especially in older patients, ventricular rate control plus warfarin rather than maintaining sinus rhythm with antiarhythmic drugs. Patients with chronic or paroxysmal AF at high risk for stroke should be treated with long-term warfarin to achieve an International Normalized Ratio of 2.0 to 3.0. Patients with AF at low risk for stroke or with contraindications to warfarin should be treated with aspirin 325 mg daily.

**Nummila Amero and Rusko (1992)** had supported the study to investigate whether the sprint training, induced changes in the different components of aerobic performance capacity can be determined by the maximal anaerobic running power test. During the training period, VO$_2$ max increased, the correlation analysis revealed that the high volume of speed endurance training
influenced negatively VO$_2$ max and blood lactate concentration. The volume of the interval training at low intensity correlated positively with the change of VO$_2$ max. The volume of speed training was found to be advantages for the changes in VO$_2$ max. It was concluded that the results of the test reflect the sprint training, induced changes in the anaerobic performance capacity.

**Shaver (1982)** stated that anaerobic power is required to a high intensity exercise of short duration. That does not depend upon the body’s ability to supply oxygen. Anaerobic power is generally characterized by strong contraction from activities that requires energy at such rates from the breakdown at ATP, CP and Glycolysis systems that aerobic metabolism cannot provide. The varied intensities and frequencies of circuit training would have increased the breakdown of the ATP, CP and Glycolysis systems. The increased capacity of the ATP and CP is due to the increased storage of both ATP and CP that is found in the muscles following the different intensities and frequencies of circuit training. Also there was increase in the level of enzyme activity in the ATP and CP systems. This enzyme is called as creatine kinese and it is responsible for the oxidation of CP. Which, when it is broken down, release energy for resynthesis of ATP.
The maximal intensities of strength will increase activity in Aerobic enzymes such as PKF and LDH. It is assumed that PKF participates in the regulation of blood flow of substance through the glycolytic pathways. The athlete with the great demand of an aerobic power had a significantly higher buffer in the skeletal muscles than the sedentary people. It may be due to sufficient intensities to increase the above physiological process. Hence there is significant improvement in aerobic power.

2.4. STUDIES ON HEMATOLOGICAL VARIABLES

Carlone et al., (1982) studied the behaviour of the oxyhemoglobin curve was studied in ten patients with respiratory alkalosis (arterial [H+] less than 37nm, p\text{co2} less than 32 mmHg and HCO-3 less than 2200 mEq/L) and ten patients with metabolic alkalosis [H+] less than 34nm, p\text{co2} greater than 37 mmHg and HCo-3 greater than 28.0 MEq/L) to determine whether different alkolotic states similarly affect the red blood cell [H+] and 2,3 - diskosphoglycerate interaction and the thus the oxygen affinity of hemoglobin. The findings were statistically indistinguishable in respiratory alkalosis and metabolic alkalosis. a) Low plasma [H+], normal red blood cell [H+], and high transmembrane [H+] gradient; b) Elevated red blood cell 2, 3 - disphospho glycerate inversely proportional to low arterial plasma [H+]; c) decrease in oxygen
affinity of hemoglobin when normalized for plasma [H+], but less decreased when normalized for red blood cell [H+] other factors capable of affecting the oxygen affinity of hemoglobin were mean corpuscular hemoglobin concentration; red blood cell adenosine triphosphate; carboxyhemoglobin; and Methemoglobin were not significantly different between groups.

Fallon (2004) determined the clinical and performance related utility of hematological and iron–related screening in elite athlete. White blood cell count, red blood cell count, hemoglobin, hematocrit, mean cell volume, mean cell hemoglobin concentration, platelet count, percent hypochromic red cell, serum iron, ferritin, transferrin, and percent tranferrin saturation. Eight female athletes (4.6%) had clinically relevant abnormal, 6 with an obvious explanation on clinical history and examination and 1 who was diagnosed with hemochromatosis following genetic testing. Eighty-nine (51.1%) female athletes had abnormal that were not associated with obvious clinical sign or symptoms. Twenty-seven female athletes had a serum ferritin less than 30 mg/ml and were placed on iron supplementation. In male athletes, 5 cases had screening abnormalities that were associated with illness or other factors identified during the clinical consultations. No clinically significant abnormalities in males were generally minor reductions
in hemoglobin and/or hematocrit or minor alterations in red cell parameters. Five male athletes had a serum ferritin less than 30 mg/ml and were placed on iron supplementation. Screening for hematological and iron-related abnormalities in male athletes has a very low yield. Due to the critical nature of the effects of anemia and low serum ferritin on some aspects of performance, it is reasonable to perform a full blood count and serum ferritin on male athletes entering an elite training program. Further testing should be performed on clinical grounds. In females, the yield is greater. Again, it is reasonable to perform a full blood count and a serum ferritin on female athletes entering on elite training program. In view of their greater risk of iron delpletion and to assess the effect of increased training inherent in elite programs, this could be repeated at 6-month intervals, or a desolated measurement of serum ferritin could be performed. Further testing should be performed clinical grounds.

Spodaryk (1993) obtained more information on the effects of long lasting endurance and strength training on the constituents of the blood, several hematological and iron-related parameters were measured at rest in 39 male athletes from the polish team who participated in the Olympics in Seoul in 1988. The athletes were divided into groups, endurance-trained subjects (group E, cyclist,
Canoeists and rowers; n=22) and strength – trained subjects (group S, wrestlers and judo; n=17). The control group was composed of untrained male subjects (n=48). Blood samples were taken from an antecubilal vein with the subject at rest for determinations of hemoglobin concentration ([Hb]), packed cell volume (PCV), erythrocyte (RBC) and reliculocyte count. Plasma free hemoglobin concentration, haptoglobin concentration, Serum iron, transferrin concentration and ferritin concentrations ([Ferr]); red blood cells were used for estimation of glutamatoxalate transaminase (GOT) activity and free erythrocyte protoporphyrin concentration ([FEP]). The mean [Hb], PVC, RBC measured in the E athletes were significantly lower than in the control group but were comparable to those obtained in the S athletes. There were no significantly differences in the hematological indices mean corpuscular volume (MCV), mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration between the groups of athletes and the control group. A significant increase in reticulocytosis and GOT activity was observed in the endurance – trained athletes. No impairment of erythropoiesis was observed as indicated by several sensitive markers of hemoglobin formation (FEP, MCV and inspection of blood smears) in the athletes.
Casoni et al., (1983) examined the hemoglobin concentration of runners has been reported to be often below normal (1). In the present investigation the hemoglobin and Iron concentrations and the haematocrit have been determined in 45 marathon runners examined before and after the 1982 Italian marathon championship and in 79 runners examined before and after the 1982 Firenze Faenza race (107 Km). The obtained suggest that the training programs followed by the marathon runners (unto 260 m per week in the months preceding the race) are accompanied by a significant decrease of the hemoglobin and iron levels and of the hematocrit. Similar have been observed in the participants to the Firenze - Faenza race. Nevertheless, in these ultra marathoners the decreases of the hemoglobin and iron concentration and of the hematocrit are less marked, possibly because their training programs are less intense than those of the marathon runners. The findings obtained are in favour of the hypothesis that the degree of “sport anemia” might be relate to the amount training of the athletes.

Suetta et al., (1996) in 10 female and eight male Danish elite middle and long distance runners, hematological status, including blood volume, was examined. Hemoglobin, hematocrit and Serum (S) - ferrintin concentrations were all within the normal
range. In both men and women, blood volume, plasma volume and erythrocyte volume were increased in relation to various reference values. However, the runners had a low body weight due to a reduced fat level, 9.5% (7.3 – 15.1%) fat for the women, 5.9% (5.0 – 8.8%) fat for the women, 5.9% (5.0-8.8%) fat – (median and ranges) for the men, measured by and dual – energy X-ray obsopliometry (DEXA) scanning. When the runners body weight were ‘normalized’ to a reference population (25% fat women, 15% fat for men) only plasma volume remained increase for the men. This confirms that endurance training induces a true increased plasma volume. The lower erythrocyte volume in the women compared with the men could be a consequence of the generally poorer iron status in the women, indicating that a combination of hemolysis, menstruation and low caloric (iron) intake makes it difficult for trained women to obtain optimal effects on erythrocyte volume equal to those obtained by trained men. Further more, the study emphasizes the importance of considering body composition when comparing well – trained athletes with a reference population.

Weight et al., (1991) state that Exercise- induced hematolysis has been implicated in the sub-optimal iron status of endurance-trained athletes. Accordingly, erythrocyte survival studies using 51C\textsubscript{r} were performed on male and female distance
runners (n=20) and sedentary control subjects (n=10) in order to determine whether the rate of erythrocyte destruction was altered because of repetitive exercise training. 2. The chromium Half-disappearance time of the male (25.4 +/– 36 days, mean +/– SD) but not the female (28.3 +/– 2.6 days) control subjects (P less than 0.01). The mean erythrocyte lifespan of the male and female distance runners (67.2 +/– 22.2 and 72.4 +/– 26.0 days, respectively) was significantly shorter than that of the non-exercising male and female subjects (113.4 +/– 31.0 and 114.1 +/– 29 days, respectively) (P less than 0.01). 3. There was no correlation between the mean erythrocyte lifespan and the hemoglobin concentration, serum territin levels, body mass, weekly training distance, number of years running or daily protein intake. The mean cell volume and reticulocyte count measured in the same athlete before and after completing a standard 42 KM marathon race were within the normal range, where as the plasma hemoglobin levels were elevated (77.0 +/– 50.5 mg/1) and the serum haptoglobin levels were decreased (0.89 +/– 0.4 g/1) at rest, with a further significant decrease after running (0.69 +/– 0.4 g/1) in the latter measurement (P less than 0.05). It is concluded that the demonstrated increase in erythrocyte turnover may be sufficient to precipitate an iron deficiency in endurance athletes.
when dietary intake or absorption does not meet the accelerated erythropoietic demands.

Bodary (1999) investigated further the influence of exercise on erythropoietin. We observed the effects of high intensity running on plasma erythropoietin concentration is competitive distance runners. A repeated measure design was used to compare the response of intermittent high intensity (HIGH) exercise to continuous moderate intensity (MOD) exercise and rest (REST). The HIGH treatment consisted of 60 min of exercise alternating 5 min of running at ~90% of $O_2$ max with 5 min of brisk walking. The MOD treatment consisted of a continuous 60-min run on the treadmill at 60% of $O_2$ max. Blood samples were collected immediately before the exercise (PRE), immediately following the exercise (POST) and 4 (heart rate (4 HR), 12 (12 HR), 24 (24 HR) and 48 (48 HR) following the exercise. The variables examined included plasma erythropoietin concentration (EPO), hemoglobin (Hb) concentration ([Hb]), hematocrit(Hct), red blood cell count (RBC), and mean corpuscular volume (MCV). ANOVA revealed the expected treatment-by-time interaction for Hct and [hb] suggesting a hemodilution at 24 and 48 hrs post exercise for the MOD and HIGH treatments. However, no significant treatment by time interactions were observed for [EPo], RBC, or MCV. These indicate that
intermittent high intensity exercise does not have a significant effect on [EPo] in trained distance runners.

Wu et al., (2004) analyzed the detailed changes in hematology and biochemistry tests parameters before and after a long-distance race in ultra marathon runners. Blood samples of II participants were obtained for standard analysis before, immediately after, two days after and nine days after the 2002 international ultra – marathon 24 hrs championship. Total bilirubin (BIT-T), direct bilirubin (BIL-D), alkaline phosphatase (ALP), aspartate aminotransferase (AST), alanine aminotransferase (ALT) and lactate dehydrogenase (LDH) increased statistically significantly (P< 0.05) the race significant declines (P <0.05) in red blood cell (RBC) hemoglobin (Hb) and hematocrit (Hct) were detected two days and nine days d after the race. 2d after the race, total protein (TP), concentration of albumin and globulin decreased significantly. While BIL, BIL-D and ALP recoverd to their original levels. High-density lipoprotein cholesterol (HDL-c) remained unchanged immediately after the race, but it was significantly decreased on the second and ninth days after the race. Ultra-marathon running is associated with a wide range of significant changes in hematological parameters, several of which are injury related. To provide appropriate health care and intervention, the man who receives athletes on high frequent training program high
intensity training programs must monitor their liver and gallbladder function.

Casoni et al., (1985) determined Red blood cell indices, serum iron, and serum ferritin concentration were determined in 45 marathon runners, 56 ultra marathon runners, and 32 healthy sedentary controls. A significant reduction of hemoglobin concentration, hematocrit, mean corpuscular volume, serum iron, and serum ferritin were found in marathon runner compared to control subjects. The same variables were also reduced, but to a lesser extent, in the less trained ultra marathon runner. The decreased hemoglobin concentration demonstrated in the runners examined is related to both a reduced hematocrit and may depend on a reduction of the body iron stores.

Brodthagen et al., (1985) stated the 20 male elite long distance runners were compared to a control group of blood donors to determine the effect of training on red blood cells. The acute effects of exercise on red blood cells were investigated in 11 of the runners following a race of 15-30 km. The runners had elevated resting value of red cell 2,3 – DPG (P less than 0.05) and mean cell volume CP less than 0.01); blood HP and ATP were not different from concentrations in the control group. An increased proportion of young erythrocytes in runners may explain the red cell status of
the athletes. No statistically significant changes in red cell 2,3 DPG, ATP, mean cell volume or blood Hb were found post exercise.

**Ricci et al., (1991)** examined twenty patients with renal and several anemia (hemoglobin range 6.6 – 807 g/dl) on thrice weekly maintenance hemodialysis were treated with recombinant human erythropoietin (rHuEpo). After three months of intravenous (iv) therapy the hemoglobin increase averaged 2g/dl, and was steadily maintained even after two months of subcutaneous (Sc) therapy. The significant increase of macrocyte counts, determined by an automated red blood cell counter after both steps of therapy, suggested the release of young red cells (large cells) into blood circulation. This assumption may be supported by the significant increase of the red cell creatine contents. 2,3 – disphosphoglycerate (2,3 – DPG) levels of the erythrocytes did not significantly change after rHuEpo administration.

**Brodhagen et al., (1985)** 20 male elite long distance runners were compared to a control group of blood donors to determine the effect of training on red blood cells. The acute effects of exercise on red cells were investigated in 11 of runners following a race of 15-30 km. The runners had elevated resting values of red cells 2,3 DPG (P less than 0.05) and mean cell volume (P less than 0.001);
blood Hb and ATP were not different from concentration in the control group. An increased proportion of young erythrocytes in runners may explain the red cell status of the athletes. No statistically significant changes in red cell 2,3-DPG, ATP, mean cell column or blood Hb were found post exercise.

Cade et al., (1984) revealed that increased concentration of red blood cell 2,3-disphosphoglycerate (RBC 2,3-DPG) shifts the hemoglobin – oxygen dissociation curve to the right, thus theoretically allowing better oxygenation of tissue. To determine whether such a shift is physiologically significant, we investigated the effects if oral phosphate loading on several parameters including plasma phosphate concentration, RBC 2,3-DPG, hemotocrit and hemoglobin concentration, maximal oxygen uptake (vo2 max), and degree of lactic acidocia in 10 well – trained distance runners. After control determinations were made, either a phosphate load or a placebo was given for 3d before the athlete was restudied. A placebo and two phosphate – loading studies were performed at weekly intervals, followed by 2 wk of rest and another post-intervention control study. Blood samples for control values were drawn before and after a standard warm-up period, after treadmill exercise at a 10% grade, and at the completion of the (vo2 determination. After oral phosphate loading there was a significant
increase in serum phosphate and RBC 2,3-DPG. Maximal oxygen uptake was significantly increased and correlated with the rise in RBC 2,3-DPG (r=0.81). The increase in blood locate after exercise on the 10% grade was attenuated during sessions, which followed phosphate loading.

2.5. STUDIES ON BIOCHEMICAL VARIABLES

Franceschini et al., (2007) conducted a study on “Comparison of the anthropometric and biochemical variables between children and their parents” carried out with 50 eutrophic and 50 obese children paired according to gender, age, socioeconomics condition, and selected from the nutritional evaluation of 2074 children aged 6 to 8 years, attending public and private urban schools in Vicosa, Minas Gerais, Brazil. The measurements evaluated were weight, height, circumferences (waist and hip) and thickness skin folds (triceps and sub scapular). The serum levels of glucose, total -cholesterol, HDL, LDL, triglycerides and hemoglobin in the children were evaluated. The obese children presented a larger body size and higher percentage for total body fat as well as its accumulation in the central region, and higher serum levels for triglycerides ( p <0.05 ). For all biochemical parameters, except for hemoglobin and HDL, there occurred in a positive correlation with the located fat in the central
region as well as with the total body fat in children (p<0.05). The obese mother showing high percentage of body fat and its accumulation in the central region rather tend to have children with these characteristics (p<0.05).

The highest number of the close relatives who are obese and present dyslipidemia is highlighted in the children (p < 0.05). This study evidences the differences concerning to the distribution of the body fat and lipid profile among eutrophic and obese children, as well as well as the strong influence of the maternal obesity upon child’s obesity.

Corigliano et.al., (2007) done a research on “Blood glucose changes in diabetic children and adolescents engaged in most common sports activities “. Circulating insulin levels decrease and substrate glycogenolysis-mediated conversion into glucose increases just a few minutes after normal subjects start exercising, but during sustained physical activity muscles massively utilize blood glucose, thus causing glycogenolysis to increase further until the end of the session. After that, in order to liver and muscle glycogen stores up to pre-exercise levels again, blood glucose is mostly utilized, thus causing late onset hypoglycemia in the absence of any extra carbohydrate supply and rebound hyperglycemia after a while. This and other patho-physiological
mechanisms are dealt with in the present paper, and practical hints are provided to the clinician to cope with children-specific adaptation phenomena to exercise in t1DM.

Degoutte et. al., (2006) examined the effects “Food restriction, performance, biochemical, psychological, and endocrine changes in judo athletes” of Twenty male judoka were randomly assigned to one of two groups (Group A : called diet, n=10; height approximately 5% of their body weight through self-determined means during the week before the competition; Group B: called control, n=10; height 176.4+/- 1.1 cm, body weight 73.3 +/- 6.3 kg maintained their body weight during the week before the competition). A battery of tests was performed during a baseline period (T1), on the morning of a simulated competition (T2) and 10 min after the end of the competition (T3). The test battery included assessment for body composition. Performance test. Evaluation of mood. Determination of metabolic and hormonal responses. Dietary data were collected using a 7-day diet record. The nutrient analysis indicated that all the athletes followed a low carbohydrate diet whatever the period of the investigation. For the Group A, the food restriction (- 4 MJ per day) resulted in significant decreases of the body weight and altered the mood by increasing Fatigue, Tension and decreasing Vigour. Dietary restriction had also a significant
influence on metabolic and endocrine parameters and was associated with poor performance. After the competition, significant decreases of the levels in testosterone, T/C ratio, alkali reserve, and free fatty acid were observed in both groups, whereas the plasma concentrations in insulin, ammonia, urea, and uric acid were increased. In conclusion, our results suggest that the combination of energy restriction and intense exercise training, which causes weight reduction before a competition, adversely affects the physiology and psychology of judo athletes and impairs physical performance before the competition including five 5- min bouts induced the same changes of physiological and psychological variables and performance whatever the dietary intake (dietary restriction or not) during the seven days before the competition.

Buchanan et al., (2002) examined the “effect of exercise on the biochemical, biochemical and structural properties of tendons.” Chemical composition and/or mechanical properties of tendon. Studies that have examined mechanical changes of tendon in response to endurance training. Available reports indicate that increases in collagen concentration or with tendon hypertrophy the paucity of data render it impossible to evaluate the response of other structural, chemical and mechanical parameters to training. Furthermore, few investigators have included discrete measures of structural, biomechanical and biochemical variables within a single
study. The lake of integrative studies makes it difficult to definitively associate changes in the mechanical properties of tendon with chemical composition and structure.

Tokmakidis et al. (2002) investigated “pre-exercise glucose ingestion at different time periods and blood glucose concentration during exercise” the effects of glucose ingestion (GI) at different time periods prior to exercise on blood glucose (BG) levels during prolonged treadmill running. Eight subject \((X+/-SD)\), age \(20+/-0.5yr\), body mass \(70.7+/-4.1\ kg\), height \(177+/-4\ cm\), \(\text{VO}_{2}\text{max}\) \(52.8+/-7.8\text{ml x kg}^{-1}\ x\ \text{min}^{-1}\) who underwent different experimental conditions ingested a glucose solution \((1\ g/kg\ at\ 350\ ml)\ 30\ min (\text{gl}-30),\ 60\ min (\text{gl}-60),\ 90\ min (\text{gl}-90),\ and\ a\ placebo\ one\ 60\ min\ (\text{pl}-60)\ prior\ to\ exercise\ in\ a\ counterbalanced\ design.\) Afterwards they ran at 65% of \(\text{VO}_{2}\text{max}\) for 1 hour and then at 75% of \(\text{VO}_{2}\text{max}\) till exhaustion. Fingertip blood samples \((10\ micron)\) were drawn every 15 min before and during exercise for the determination of BG levels. Oxygen uptake \((\text{VO}_2)\), heart rate \((\text{HR})\), and blood lactate \((\text{La})\) were also measured every 15 min during exercise. Peak BG values were reached within 30 min after GI but were different \((p<0.01)\) at the onset of exercise \((\text{gl}-30: 147+/-22, \text{gl}-60: 118+/-25, \text{gl}-90: 109+/-22, \text{pl}-60: 79+/-5\text{mg/dl})\). The two-way ANOVA repeated measures and the turkey post-hoc test revealed a
higher BG concentration (p<0.05) for the gl-30 and the pl-60 as compared to the gl-60 and gl-90 during running (e. g. 15 min run: 82+/−11.68+/−5.64+/−3.78+/−7, and 60 min run: 98+/−12, 85+/−12, 83+/−11.94+/−11 mg/dl for gl-30, gl-60, gl-90, and pl-60, respectively). However, this did not significantly affect the duration of treadmill running. The La levels were higher (p<0.05) after GI as compared to placebo throughout exercise (values at exhaustion: 4.6+/−0.2, 5.0+/−1.5, 4.8+/−1.7 mmol/l for gl-30, gl-60, gl-90, and 3.5+/−0.8 mmol/l for placebo). The gl-30 and the placebo fluctuated closer to normoglycaemic levels. The glucose ingestion (60 to 90 min) prior to exercise lowered the blood glucose levels without affecting the duration of running performance at 75% VO2max. Thus, in order to maintain normoglycaemic levels, pre exercise glucose supplementation should be given 30 min before the onset of exercise.

**Tarigopula veeraiah choudary (1999)** conducted a study abut analysis of circuit training variations on selected bio-chemical variables on college men athletes. For the purpose of the study 60 male subjects from SRVBSJB Maharani autonomous college, Peddapuram. Andhra Pradesh was selected, and their age ranged from 17 to 21. The subjects were divided into three equal groups of 20 each. Two experimental and one control group. The researcher selected blood sugar, cholesterol, pyruvic acid and lactic acid as the
variables for the study. To compare the statistical data ANACOVA was adopted. It was find out that there was no effect on blood sugar level because of circuit training. At the same time circuit training had significantly reduced blood cholesterol.

**Devathunai Sundararaj** conducted a study on effect of aerobic and anaerobic exercises on selected bio-chemical variables of college men non-athletes. For the purpose of the study ninety male subjects from Madras Veterinary College, Madras were selected. The age of the subjects selected was between seventeen and twenty years. The subjects were divided into three groups of thirty each. Among the three groups one was control group and the other two were experimental groups namely aerobic exercise group. The investigator selected the variables such as blood lactic acid, serum cholesterol, blood glucose and red blood cells count and ANCOVA technique was used for the statistical purpose. It was found that groups. Which did aerobic and anaerobic exercise groups, have significantly reduced cholesterol level than the control group. It was also found that there was no significant difference in serum cholesterol level between the aerobic and anaerobic exercise groups. It was also found that there was no significant difference between the aerobic and anaerobic exercise groups in red blood cells count.
Haskell (1981) conducted a study to determine the distribution plasma lipoprotein in middle aged male runners. In this study the subjects were active men ages 35-49 years and done average 39 miles of running per week. They reached the conclusion that chronic exercise training causes decreased in total blood cholesterol than the person who just started participating in physical exercise at their age. After an 8 to 18 months period of systematic exercise it was observed lowering (general) blood cholesterol and a tendency for normalizing in various fractions of serum proteins lipids. The beta globulin and that lipoprotein content decreases the level of albumin and alpha protein increase and correspondingly there was a rise in the ratio of albumin to globulin and also a return to partial of the previously increased a return to partial of the previously increased content of the natural fat and ketenes of the blood.

**SUMMARY OF THE LITERATURE**

In this chapter, fifty nine reviews were presented which gives the clear picture about the present study. The reviews were collected from the areas of yoga (20) motor ability components (10), physiological (8), hematological (13) and bio chemical variables (8) through journals, periodicals, abstracts, unpublished master and Doctoral theses on Physical Education and Sports Sciences besides various relevant books. Hence, the present investigation assumes greater prove the concept on selected motor ability components, physiological, hematological and bio chemical variables due to significance in this field.