

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.

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 works already done on the same topic. The review of the literatures has been classified under the following headings.

- 2.1 Studies Related with Asanas Practice
- 2.2 Studies Related with Aerobics
- 2.3 Studies Related with Proprioceptive Training
- 2.4 Studies Related with other Training
- 2.5 Summary of Related Literature

2.1 STUDIES RELATED WITH ASANAS PRACTICE

Amit Kauts et al. (2009) studied the effect of stress on 159 high stress students and 142 low stress students on the basis of scores obtained through Bisht Battery Stress scale. ANOVA was employed to study high and low stress students. Data displayed in the tables show significant 0.01 level confidences, indicating that the experimental group and control group differ in the gain scores of academic performance, (in mathematics, science and social science). The Standard Deviations of combined academic performance in three subjects showed M_{exp} (=32.63) greater

than M_{cont} ($=22.4$) indicating that students who experienced the yoga module performed better than those who never experienced it. F ratio for mean difference between high and low level stress groups shows significant 0.05 level confidence, stating that low stress level students performed better than those with high stress ($M_{\text{LS}}=30.24$, $M_{\text{HS}}=24.83$). Results are in tune with the inverted 'U' model of stress of learning. When stress is perceived negatively, students experience physical and psychological impairment, interfering with the working skill of the person. The researcher has concluded from the study that intervention with yoga improves academic performance by optimizing stress levels, and has suggested that yoga modules should become regular a feature in schools.

Ray U.S et al. (2001) studied the effect of yoga practice for 5 and 10 months, on randomly selected (54) trainees of 20-25 years age, divided into yoga and control groups. Initially there was increase in the physiological and psychological parameters in both groups. Body Balance yoga program was then given. ANCOVA demonstrated significant decrease in Post hoc test in experimental group; body mass $1.10 \pm 1.02\%$ ($t=4.44$; $P<0.01$); girth 4.40 ± 5.80 cm ($t=3.13$; $P<0.01$) and back strength increased by 17.12 ± 15.39 kgf ($t=4.59$; $P<0.01$). Flexibility was also significantly enhanced with performance of the modified sit and reach test, increasing by 5.90 ± 2.56 cm ($t=9.50$; $P<0.01$), hip flexion by $9.84 \pm 8.41^\circ$ ($t=-4.82$; $P<0.01$), hip extension by $7.65 \pm 4.48^\circ$ ($t=-7.04$; $P<0.01$), hip abduction by $10.00 \pm 4.91^\circ$ ($t=-8.40$; $P<0.01$) and lateral trunk flexion by $3.06 \pm 5.72^\circ$ ($t=-2.21$; $P<0.05$). Finally, state-anxiety (STAI) was notably reduced intra-class at weeks 1, 6 and 12 by 9.24 ± 9.46 ($t=4.02$; $P<0.01$), 6.59 ± 6.26 ($t=4.34$; $P<0.01$) and 7.18 ± 5.50 ($t=5.38$; $P<0.01$), respectively. The findings of this study suggest mind–body exercise programs like Body Balance could

significantly benefit State-Anxiety as well as strength, flexibility and anthropometry around the trunk.

Jadhav S.G et al. (2009) studied the effect of yoga intervention on the State-Trait Anxiety scale and Subjective well being Inventory on 25 girls and 25 boys, studying in first year on Naturopathy and Yogic sciences. In the one-year study, post results reveal that the mean difference between before and after practice of yoga on State Anxiety is highly significant at $P < 0.001$. Subjective well being inventory showed general well being (positive effect and negative effect) confidence coping, transcendence, social support, inadequate mental master, perceived ill health, deficiency in social contacts, primary group concern, etc. $P < 0.001$ a significant improvement after the yoga session. The researcher has done a single group study and no control group study is made.

Steven T Rosenzweig U et al. (2003) studied the effectiveness of a 10-week program on Mindfulness-Based Stress Reduction (MBSR) on a non-randomized study of 140 medical college students and a control group ($n=162$). A variety of mindfulness meditation practices were taught including body scan, breath awareness, guided imagery, eating and walking meditations. These were recorded for 20 minutes on an audiocassette for daily practice 6 days a week. The control group participated in a seminar that surveyed contemporary and alternative medicine. The Profile of Mood States (POMS) was administered pre- and post-test to both the groups. Univariate ANOVA revealed a decrease in the Tension-Anxiety and confusion-Bewilderment subscales of the MBSR group. The research gives good reasons for choosing the techniques and also discusses the limitations of the study. MBSR is relevant and can be practiced throughout the lifetime of the physician and is arguably a core

characteristic of clinical practice. Historically, mindfulness has been a foundation practice of major spiritual traditions and is uniquely suited to support medical professionals. In this study students who self-selected themselves for the MBSR intervention reported greater overall mood disturbances at baseline compared with parallel cohort controls. They reported significant improvement in mood states and significantly lower psychological distress after MBSR compared with controls. The researchers conclude that MBSR may be an effective stress management intervention for medical students.

Chaya M.S et al. (2006) investigated the net change in the (Basal Metabolic Rate) BMR of individuals actively engaged in residential yoga (asana, pranayama and meditation) practices (N=55) for a period of 6 months, and also in a control group (N=49) who did not practice yoga but led a similar life style. All the subjects selected were healthy and did not suffer from any chronic diseases; women did not practice yoga during menstruation. Before BMR measurement, the subjects had an early dinner and 8 hours sleep; they rested in supine posture for 20 minutes before the reading. Measurement was by indirect calorimetry using a facemask breath by breath analysis of oxygen consumption and carbon dioxide production for a period of 20 minutes. The respiratory quotient and energy expenditure were calculated using these variables. The readings showed that the BMR of yoga practitioners was significantly lower than that of the non-yoga group; it was lower by about 13% when adjusted for body weight ($P<0.001$). This difference persisted when the groups were stratified by gender; however the difference in BMR adjusted for body weight was greater in women than men (about 8 and 18% respectively). In addition, the mean BMR of the yoga group was significantly lower than their predicted values while the mean BMR

of non-yoga group was comparable with their predicted values that were derived from the 1985 WHO/FAQ/UNU predictive equations. The research finally concluded that the reduced BMR could be due to reduced arousal, due to the long-term practice of yoga using a combination of stimulatory and inhibitory yogic practices.

Madanmohan et al. (2009) has reported the effect of a 6 month yoga training (30-40 min/day) on school children studying in standard eight. The report submitted to the Department of Science and Technology and Environment of Pondicherry is systematic and elaborate. Eight Four students of age group selected and randomly divided into 4 groups of 21 each, and assigned as Group I –yoga group, Group II – fast suryanamaskar, Group III-slow suryanamaskar and Group IV – control group. Results showed that the height and weights of the students increased significantly ($p<0.001$) in the first three groups except the control group ($p<0.05$). The isometric hand grip the in yoga group was $p<0.05$ where as in the fast and slow groups it was $p<0.001$. The Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV_1) in the yoga group was $p<0.001$ and in the fast and slow suryanamaskar group it was $p<0.01$. Yoga training decreased the systolic and diastolic pressures where as both the suryanamaskar groups showed an increase. Both the yoga and suryanamaskar groups produced significant improvement in BMI handgrip strength, endurance and pulmonary function. Exercise induced increase in heart rate and blood pressure was blunted after yoga training. In general, the study shows that yoga training of six months duration improves body weight and BMI increases Isomeric Hand Grip and endurance. It also improves pulmonary function as indicated by increase in FVC, FEV_1 , Peak Expiratory Flow Rate, Maximum Expiratory Pressure and Maximum

Inspiratory Pressure. Further it enhances the ability of the cardiovascular system to withstand stressful stimuli.

Shirley Telles et al (2006) identified 291 (21-40 yrs) persons from a software company in Bangalore with dry-eye symptoms who worked on computers for a long time. They were divided into a control group (n=145) and a yoga group (n=146) for yoga therapy, and were given practices of asanas, pranayama, exercises for joints, visual cleansing techniques *trataka* and guided relaxation. The researcher points out that the psychological support given by the yoga instructor could have contributed to the improvement in the yoga group. She has attributed the betterment to the reduction of anxiety due to yoga especially to *trataka* practice, visual cleansing for better visual perception. She also notes that the blinking rate increased when the person was relaxed and reduced he/she was while mentally alert with focused gaze. Yoga practice helped to bring about alertful rest, which showed in the reduction of peripheral cutaneous blood flow, decrease in heart rate and oxygen consumption. The limitations of the study are that the researchers could not do the semi-qualitative estimation of the superficial lipid layer and tear break up time. Contact lens wearers were not assessed differently as they experienced more dryness. The yoga group showed an average increase of 1.8 Hz in the Critical Flicker Fusion (CFF) compared with an average decrease of 1.1 Hz of the control group. This may suggest that the control group might have remained prone to visual fatigue whereas the yoga group was not. The results suggest that sixty days of yoga practice may have reduced visual fatigue based on the self-rated symptoms presented in this study and the CFF findings reported earlier. Hence the practice of yoga can be a potential non-pharmacological

intervention for visual discomfort related to working at visual display terminals (VDTs).

Rangan H.R et al. (2009) compared the verbal and spatial memory of (a) students of a Residential Gurukula Education Society (GES) based on yoga modules of life and Vedic chanting of mantras and meditation and pooja with (b) Modern Education System (MES) n=49 a conventional modern education programme the paper gives a detailed daily routine of the GES group. The test for spatial memory in which students reproduced geometrical shapes and the test for memory recall in the form of slides were held before and after the academic year. One to one matching of students was done under the guidance of a statistician; the spatial and verbal memory test assessments were carried out under the guidance of a psychologist. The Wilcoxon signed rank test comparing pre-and post values within the groups showed that the improvement in both the groups were significant at $p < 0.05$. GES boys showed greater improvement than MES boys in both spatial and verbal memory scores ($p < 0.05$) memory enhancement in GES – 31.02%; MES – 20.134%. Base line data showed the scores on spatial memory increasing with age. Re-test scores showed that the improvement increased with age - GES boys scored significantly better than MES boys in both verbal and spatial memory, verbal memory increased at 12 and 13 years of age compared to that at 11 years. The author extensively discusses the possible reasons for improvement and non-improvement in both the groups and highlights the vedic methods of learning Sanskrit. The limitation of the study was that the students were assessed only twice, periodic assessments could not be conducted and long-term effect was not worked upon. The paper concludes that the GES system aimed at holistic personality development where the students are exposed to vedic mantra

chanting had higher scores on verbal and spatial memory . The MES system where the students were exposed to arts TV and other media had lower scores on verbal and spatial memory compared with GES system boys.

Balaram Pradan et al. (2009) investigated the possible improvement in memory and selective attention, as measured by the Digit Letter Substitution Task (DLST), due to the practice of Cyclic Meditation (CM) a yoga relaxation technique as compared to Supine Rest (SR). 156 boys and 97 girls of age 13-16 years were selected for the 10-day study during summer vacation. They were allocated into 2 groups and tested on DLST, immediately before and after 22.5 minutes of CM on one day, and before and after an equal period of SR on the other day. The first group had CM on day, 9 and SR on day 10, and for the second group the order was reversed. Within each group pre-post test differences were significant for both the relaxation techniques. The magnitude of net score improvement was greater after SR (7.85%) compared to CM (3.95). significance levels were $P < 0.4 \times 10^{-9}$ for SR and $P < 0.1 \times 10^{-3}$ for CM. Both CM and SR lead to improvement in performance on the DLST.

Pailoor Subramanya et al. (2009) have found that during the yoga posture phase sympathetic activation predominates whereas after CM the parasympathetic nervous system becomes dominant. The overall result is greater reduction in energy expenditure than in the SR. CM has also been found to enhance the P300 wave in the evoked potential, a fundamental cognitive process involving attention and immediate memory. The results showed differences on DLST net scores between sessions for the same group and between groups for the same session. For the whole group the increase in net the score mean was 7.85% after SR and 3.95% after CM. SR sessions produced better performance than CM. The author suggests further studies to

understand mechanisms to improve task performance, and predicts that anxiety reduction during CM and SR may have contributed in some way to the observed improvement in the performance. Moreover, he proposes studies on the effect of age, gender and lengthened training programmes.

Sudheer A Deshpande D et al. (2008) worked on a randomized control trial of the effect of yoga on the Gunas (yogic personality measures) and general health of normal healthy volunteers. The control group practised mild to moderate Physical Exercises (PE) and the Yoga (Y) group practiced an integrated yoga module that included asanas, pranayama, meditation, notional correction and devotional sessions. Both the groups had supervised practice sessions for one hour daily by trained experts six days a week for eight weeks. Guna (yogic personality) was assessed before and after eight weeks using the self-administered Vedic Personality Inventory (VPI), which assesses Sattva (gentle and controlled), Rajas (violent and uncontrolled) and Tamas (dull and uncontrolled). The general health status (total health) that includes four domains namely somatic symptoms (SS), anxiety and insomnia (AI), social dysfunction (SF) and severe depression (SP) was assessed using a General Health Questionnaire (GHQ). Results showed that the baseline scores in all the domains for both the groups did not differ significantly ($P > 0.05$, independent sample t tests). Sattva showed a significant difference within groups and the effect was more in the Y than in the PE group. Rajas showed a notable decrease within and between the groups with a higher effect in the PE group. Tamas showed a significant reduction in the PE group alone. The GHQ revealed that there was a significant decrease in SS, AI, SF and SP in both Y and PE groups (Wilcoxon Signed Rank Test). There was a significant difference between the groups (Mann Whitney U test).

In conclusion, there was an improvement in Sattva in both the Y and PE groups with a trend of higher effect in Yoga Group. Rajas reduced in both but significantly better in PE than in Y and Tamas reduced in PE. The general health status improved in both the groups.

Yi-Yuan W Tang Z et al. (2007) studied the effect of Integrative Body-Mind Training (IBMT) on randomly selected students (mean age=21.8 yrs) for 20 minutes for 5 days. The control group was given a western method of relaxation. The IBMT method is described in the paper as Chinese method of meditation with music in the background. But the method outlined in the paper is similar to the Yoga Nidra practices. The participants learn it in one day, and were given a compact disc with guided instructions and asked to practice with in for 5 days. The method involved body relaxation, breath adjustment, mental imagery and mindfulness training. Pre- and Post-tests for both the groups consisted of: the Attention Network Test (ANT) – responding to an arrow target; the Raven's Standard Progressive Matrix – standard for culture fair intelligence test; the POMS, stress challenge of mental arithmetic task, followed by cortisol and secretary IgA. The paper is well written with graphical representation of each test. ANOVA analysis of POMS reveals the effects of anger hostility ($p<0.05$), tension-anxiety ($p<0.01$), vigour-activity ($p<0.01$), negative moods reduction and enhancement of positive moods in the experimental group and not in the control group. Cortisol and sIgA indicates the amount of stress induced by cognitive challenge, the experimental group had a significantly lowered cortisol response to the mental stress after the training than the control group. To summarize the IBMT is an easy and effective way of improving self-regulation, cognition, emotion and social behaviour.

Neha Recca (2004) has attempted to bring out the significance of Gayathri Mantra (GM), which is concerned with the relation between man and the universe, and the reality that underlies both. The power of Psycho kinesis (PK) to influence a Random Event Generator (REG) from a distance was investigated. Earlier researchers have carried out this investigation in emotional culturing sessions. It is said in yogic sciences that mantras are specifically designed patterns of resonant sound waves that can influence the body-mind complex. This investigation was done on 30 healthy male volunteers of age 18-25 years, evoking the capacity to influence REG and comparing with Random Thinking (RT). Each session consisted of 10 trials each of pre-, during and post chanting. The experiment was repeated twice (set 1 and set 2) for all the 30 subjects. Analysis using SPSS version 10 package was used. There was a significant increase in the REG value recorded during the GM compared to its baseline values ($p < 0.052$ tailed). There was also a significant increase in the REG values of GM compared to RT session in the 'during' phase ($p < 0.001$). However the pre-post values showed no significant different in both GM and RT sessions. The Chi square Test showed that the number of GM trials in which the subjects influenced the REG significantly (mean REG values > 101.00 for 5 significant) was significantly higher than in the RT sessions ($p < 0.01$). Thus, it can be concluded that GM develops a capacity to influence the REG indicative of a possible increased psychokinetic power. The null hypothesis - that mantras cannot generate a subtle mind featured by calmness, balance and rhythm, endowed with greater a power of psycho kinesis compared to a normal randomly thinking mind - is disproved.

Vijayalakshmi P et al. (2004) studied the effect in yoga on stress of hypertensive subjects using Rate Pressure Product (RPP), an index of myocardial

oxygen consumption and cardiac work. It correlates well with the myocardial consumption of normal subjects as well as patients with angina pectoris. No study has been made previously on the effect of yogasanas on RPP in essential hypertension; this work shows the effect of training on Blood Pressure (BP), Heart Rate (HR) & RPP. The researchers have studied the cardio vascular response to stress using the isometric hand grip (IHG) test. This was done, before and after yoga training, on 13 male patients (age: 41-60yrs) with essential hypertension for 3 to 17 years and who were under treatment of atenol. The duration of the yogasanas and pranayama sessions was 1 hour daily, 5 days a week for 4 weeks. A pilot study was done and the test for IHG standardized. The HR and BP were recorded before the yoga training and at weekly intervals during the 4 week training period. The response to IHG test was measured before and at the end of 4 week study period. The results were systematically tabulated and analyzed using ANOVA. Student's 't' test was used to compare the parameters after the hand grip exercise, and also for resting values and percentage changes before and after yoga training. All comparisons $P < 0.05$ were considered statistically significant. There was an insignificant rise in BP from 2nd week onwards; and progressive decrease in HR and RPP. Third week values in SP, DP and MP are in agreement with other findings indicating that yoga produces noteworthy stress reduction in hypertensive subjects. After yoga training HR, as well as DP increased significantly in response to the IHG test; this contradicts the other researchers' work. The result suggests that the vasoconstrictor and cardiac acceleratory responses to IHG test are subnormal in hypertensive patients, and that yoga training improves these reflex regulatory mechanisms - this needs to be studied further.

Michael Speca SS et al. (2000) studied the effect of participation in a mindfulness meditation – based stress reduction programme, on the moods, disturbance and symptoms of stress in heterogenous (in type and stage) of cancer out patients. A randomized and wait list controlled design was used. Patients (n=90; mean age =51 yrs) completed the POMS and symptoms of stress inventory (SSI) before and after the intervention; which consisted of 1.5 hours practice per week for 7 weeks plus home meditation practice. The paper gives the detailed weekly programme of yoga practice for 7 weeks. It also discusses the reasons for dropouts - only about 73.6% of patients attended all the sessions. Dropouts were noted as having more mood disturbance on the subscale of anxiety. Statistical scores have been calculated very well for stress score, emotional irritability and habitual behaviour in the experimental and control groups; results indicate greater improvements over time in the treatment group compared to the control group.

2.2 STUDIES RELATED WITH AEROBICS TRAINING

McMillan K et al. (2004) studied the Physiological adaptations to soccer specific endurance training in professional youth soccer players. Eleven youth men soccer players with a age of 20 to 25 years performed high intensity aerobic interval training sessions twice per week for 10 weeks in addition to normal soccer training. The specific aerobic training consisted of four sets of 4 min work periods dribbling a soccer ball around a specially designed track at 90–95% of maximal heart frequency, with a 3 min recovery jog at 70% of maximal heart frequency between intervals. Mean $V_{O_{2max}}$ improved significantly from 63.4 (5.6) to 69.8 (6.6) ml kg⁻¹ min⁻¹, or 183.3 (13.2) to 201.5 (16.2) ml kg^{-0.75} min⁻¹ (p<0.001). Squat jump and counter

movement jump height increased significantly from 37.7 (6.2) to 40.3 (6.1) cm and 52.0 (4.0) to 53.4 (4.2) cm, respectively ($p < 0.05$). No significant changes in body mass, running economy, rate of force development, or 10 m sprint times occurred. Performing high intensity 4 min intervals dribbling a soccer ball around a specially designed track together with regular soccer training is effective for improving the $\text{Vo}_{2\text{max}}$ of soccer players, with no negative interference effects on strength, jumping ability, and sprinting performance.

Chamari K et al. (2004) studied the appropriate interpretation of aerobic capacity: allometric scaling in adult and young soccer players. Twenty four male adult (mean (SD) age 24 (2) years, weight 75.7 (7.2) kg, $\text{Vo}_{2\text{max}}$ 66.6 (5.2) ml/lbm/min, where lbm is lean body mass in kg) and 21 youth (14 (0.4) years, 60.2 (7.3) kg, 66.5 (5.9) ml/lbm/min) elite soccer players took part in the study. Allometric equations were used to determine the relation between maximal and submaximal oxygen cost of running (running economy) and body mass. Maximal and submaximal oxygen uptake increased in proportion to body mass raised to the power of 0.72 (0.04) and 0.60 (0.06) respectively. The $\text{Vo}_{2\text{max}}$ of adult players was similar to that of the youth players when expressed in direct proportion to body mass—that is, ml/kg/min—but 5% higher ($p < 0.05$) when expressed using appropriate procedures for scaling. Conversely, compared with seniors, youth players had 13% higher ($p < 0.001$) energy cost of running—that is, poorer running economy—when expressed as ml/kg/min but not when expressed according to the scaling procedures. Compared with the youth soccer players, $\text{Vo}_{2\text{max}}$ in the seniors was underestimated and running economy overestimated when expressed traditionally as ml/lbm/min. The study clearly shows the pitfalls in previous studies when aerobic capacity was evaluated in subjects with

different body mass. It further shows that the use of scaling procedures can affect the evaluation of, and the resultant training programme to improve, aerobic capacity.

Helgerud J et al. (2001) studied the Aerobic endurance training improves soccer performance. The aim of the present study was to study the effects of aerobic training on performance during soccer match and soccer specific tests Nineteen male elite junior soccer players, age 18.1 +/- 0.8 yr, randomly assigned to the training group (N = 9) and the control group (N = 10) participated in the study. The specific aerobic training consisted of interval training, four times 4 min at 90-95% of maximal heart rate, with a 3-min jog in between, twice per week for 8 wk. Players were monitored by video during two matches, one before and one after training In the training group: a) maximal oxygen uptake (VO₂max) increased from 58.1 +/- 4.5 mL x kg⁽⁻¹⁾ x min⁽⁻¹⁾ to 64.3 +/- 3.9 mL x kg⁽⁻¹⁾ x min⁽⁻¹⁾ (P < 0.01); b) lactate threshold improved from 47.8 +/- 5.3 mL x kg⁽⁻¹⁾ x min⁽⁻¹⁾ to 55.4 +/- 4.1 mL x kg⁽⁻¹⁾ x min⁽⁻¹⁾ (P < 0.01); c) running economy was also improved by 6.7% (P < 0.05); d) distance covered during a match increased by 20% in the training group (P < 0.01); e) number of sprints increased by 100% (P < 0.01); f) number of involvements with the ball increased by 24% (P < 0.05); g) the average work intensity during a soccer match, measured as percent of maximal heart rate, was enhanced from 82.7 +/- 3.4% to 85.6 +/- 3.1% (P < 0.05); and h) no changes were found in maximal vertical jumping height, strength, speed, kicking velocity, kicking precision, or quality of passes after the training period. The control group showed no changes in any of the tested parameters. Enhanced aerobic endurance in soccer players improved soccer performance by increasing the distance covered, enhancing work intensity, and increasing the number of sprints and involvements with the ball during a match

Chamari K et al. (2003) studied the Endurance training and testing with the ball in young elite soccer players. We tested 18 male soccer players (14 years old) both in the laboratory and using the Hoff test before and after 8 weeks of soccer training. The distance covered in the Hoff test correlated significantly with maximum oxygen uptake, and improved by 9.6% during the 8 week training period, while maximum oxygen uptake and running economy improved by 12 and 10%, respectively. Backward multiple regressions showed maximum oxygen uptake to be the main explanatory variable for the distance covered in the Hoff test. The present study demonstrated a significant correlation between laboratory testing of VO_{2max} and performance in the Hoff test. Furthermore, training induced improvements in VO_{2max} were reflected in improved performance in the Hoff test. We suggest that it should be a goal for active U-15 soccer players to cover more than 2100 metres in the Hoff test, as this requires a VO_{2max} of above $200 \text{ ml/kg}^{0.75}/\text{min}$, which should serve as a minimum in modern soccer.

Valeria Leme Goncalves Panissa et al. (2012) This study aimed to analyze the effect of the time interval after high-intensity aerobic exercise on strength performance in individuals with different training backgrounds. Participants ($n = 27$) were divided into three groups according to their training backgrounds (aerobic, strength or concurrent) and submitted to eight sessions: (1) determination of the peak velocity (V_{peak}) during the incremental treadmill test to exhaustion and familiarization of the evaluation of maximum strength (1RM) for the half-squat; (2) 1RM determination; and (3-8) randomly assigned experimental sessions consisting of either a strength exercise (SE), four sets at 80% of the 1RM, in which maximum number of repetitions (MNR) and the total volume performed (TV) was computed, and five sessions consisting of high-intensity intermittent aerobic exercise (100% of V_{peak} - 1

min:1 min) totaling 5 km, followed by a SE with varying recovery intervals between activities (30, 60 minutes, 4, 8, and 24 hours). Comparisons for MNR and TV were made using two-way variance analysis (group and time interval) with repeated measures in the second factor. When significant differences were detected ($P < 0.05$), a Bonferroni and Dunnett post-hoc test were used. There was an effect of group for MNR, with the Aerobic Group performing a higher MNR compared to Strength Group ($P = 0.002$). Moreover, there was an effect of the time interval for MNR and TV, with reduction after 30 ($P < 0.001$ for both variables) and 60 minutes intervals ($P = 0.035$; $P = 0.007$, respectively) compared to the control condition. Thus, it is concluded that the drop in performance related to the SE activity occurred with the same magnitude and time interval for each of the groups.

Lukas Cipryan and Vojtech Gajda. (2011) studied The Influence of Aerobic Power on Repeated Anaerobic Exercise in Junior Soccer Players. The main purpose of the present study is to investigate the relationship between anaerobic power achieved in repeated anaerobic exercise and aerobic power. The study group consisted of 40 soccer players (age 20 to 25). All participants performed 3 tests: a running-based anaerobic sprint test (RAST), a graded treadmill test (GXT), and a multistage fitness test (20mPST). A statistically significant correlation was found among peak power in the GXT and the maximum ($r = 0.365$, $p=0.02$), minimum ($r=0.334$, $p=0.035$) and average ($r=0.401$, $p=0.01$) power in the RAST. No relationships were found between $VO_2\text{max}$ obtained from both aerobic tests and any performance indices in the RAST. A statistically significant correlation was found between the $VO_2\text{max}$ obtained from the spiroergometry examination (GXT) and the calculated $VO_2\text{max}$ of 20mPST ($r=0.382$, $p=0.015$). In conclusion, the level of $VO_2\text{max}$ does not influence the performance indices in the RAST in elite junior soccer players. It is possible that

the modification of anaerobic test protocol or a more heterogeneous study group would influence the results. The estimation of the VO_2 max in the 20mPST is too inaccurate and should not replace the laboratory spiroergometry examination.

Kinislir et al. (2001) studied the effect of step aerobics and aerobics dancing training on blood lipids and lipoproteins. Forty five sedentary male college students were divided into step aerobic group (N-15), aerobics dance group (n=15) and control group (n=15), step aerobics and aerobics training were given to the two experimental groups for eight weeks, 3 days per week, 45 minutes per day with 60 – 70% of their heart rate reserve. The results indicated the following: There was a significant decrease ($p<0.01$) in TC levels of both the groups when compared with the control group. A significant increase ($p<0.05$) in HDL-C levels and a significant decrease ($p<0.01$) in TC: HDL-C ratio were obtained in the step aerobics group. A significant difference was not found in body weight, TG and LDL-C levels among the three groups. It was concluded that step aerobics training is an effective training mode for modifying lipid and lipoprotein profile of male college aged students.

Park et al. (2003) studied the effect of long term aerobic exercise on maximal oxygen consumption, left ventricular function and serum lipids in elderly women. Eight elderly women performed exercise for 40 minutes a day, 3 days a week at 50 – 60% of the heart rate reserve during 36 weeks. The results indicated that : Weight and percent body fat decreased. Cardio respiratory function improved due to the increase in VO_2 max. Systolic blood pressure decreased significantly. There was no significant difference in all left ventricular parameters. Total cholesterol level and triglyceride level decreased after training. HDL-C, apolipoprotein A-1 increased

significantly. LDL-C, atherogenic index and apolipoprotein B decreased after training.

Katzel M et al. (1997) documented the sequential effects of aerobic exercise training and weight loss on risk factors for coronary disease in healthy, obese, middle aged men and older men. The effects of sequential interventions of 9 month of aerobic exercise training (AEX) followed by weight loss (WL) with continued AEX (AEX+WL) in cardiac risk factors in 21 obese middle aged and older men were examined. The results indicated that AEX increases VO₂ max of these men by 14% (p<0.001) with no significant change in weight. Also AEX did not improve BP or oral glucose tolerance and had no significant effect on lipid concentrations. During the AEX + WL intervention, 21 men lost 8.1 + 0.6 kg compared with AEX, AEX + WL group decreased glucose and insulin responses during the oral glucose tolerance test by 8% (p<0.05) and 30% (p<0.01) respectively. AEX + WL reduced plasma triglycerides by 17% (p<0.05) and LDL-C by 8% (p<0.01) and increases HDL-C by 11% (p<0.01). The sequential interventions resulted in a 20% decreased in the LDL – C /HDL-C ratio. The results denoted that AEX + WL had a more substantial impact than AEX alone on glucose tolerance and lipoprotein concentrations.

2.3 STUDIES RELATED WITH PROPRIOCEPTIVE TRAINING

Carl G. Mattacola et al. (1997) studied the Effects of a 6-Week Strength and Proprioception Training Program on Measures of Dynamic Balance. To examine the effects of a 6-week strength and proprioception training program on clinical measures of balance, and to introduce characteristics of a single-case research design that may be beneficial to the athletic training profession as both a research and a clinical tool.

Three subjects (age 24 to 28) collegiate Athletes. A multiple baseline design across subjects was used to assess the effects of the intervention. The training program was performed three times a week and consisted of manual muscle strengthening and proprioception training for the plantar flexor, dorsiflexor, inversion, and eversion muscle groups. Dynamic balance was tested three times a week using a single-plane balance board (SPBB). Each subject was tested for two double-leg conditions (forward/backward, right/left) and one single-leg condition (forward/backward) for each extremity. The dependent variable was the number of times that the balance board made contact with the floor. Visual inspection was used to evaluate whether the treatment resulted in a change of performance. Although the intervention did not produce obvious improvements in balance for all evaluation criteria for all testing conditions, it is apparent that the strength and proprioception training program positively influenced all three subjects' ability to balance dynamically on an SPBB. A change in mean scores from baseline to intervention phase was evident for all testing conditions. However, a change in slope and level was not as apparent for all testing conditions, especially the single-leg conditions. The results revealed that the strength and proprioception training program produced improvements in the ability to balance as assessed dynamically on an SPBB.

Willardson, Jeffrey M. (2007) studied the Core Stability Training: Applications to Sports Conditioning Programs. In recent years, fitness practitioners have increasingly recommended core stability exercises in sports conditioning programs. Greater core stability may benefit sports performance by providing a foundation for greater force production in the upper and lower extremities. Traditional resistance exercises have been modified to emphasize core stability. Such

modifications have included performing exercises on unstable rather than stable surfaces, performing exercises while standing rather than seated, performing exercises with free weights rather than machines, and performing exercises unilaterally rather than bilaterally. Despite the popularity of core stability training, relatively little scientific research has been conducted to demonstrate the benefits for healthy athletes. Therefore, the purpose of this review was to critically examine core stability training and other issues related to this topic to determine useful applications for sports conditioning programs. Based on the current literature, prescription of core stability exercises should vary based on the phase of training and the health status of the athlete. During preseason and in-season mesocycles, free weight exercises performed while standing on a stable surface are recommended for increases in core strength and power. Free weight exercises performed in this manner are specific to the core stability requirements of sports-related skills due to moderate levels of instability and high levels of force production. Conversely, during postseason and off-season mesocycles, Swiss ball exercises involving isometric muscle actions, small loads, and long tension times are recommended for increases in core endurance. Furthermore, balance board and stability disc exercises, performed in conjunction with plyometric exercises, are recommended to improve proprioceptive and reactive capabilities.

Yaggie et al. (2006) studied the Effects of balance training on selected skills. The purpose of this study was to determine the effect of a 4-week balance training program on specified functional tasks. Thirty-six subjects (age = 22 to 24) were randomly placed into control (C; n = 19) and experimental groups (Tx; n = 17). The Tx group trained using a commercially available balance training device (BOSU). Postural limits (displacement and sway) and functional task (time on ball, shuttle run,

and vertical jump) were assessed during a pretest (T1), a posttest (T2), and 2 weeks posttraining (T3). Multivariate repeated measures analysis ($\alpha = 0.05$) revealed significant differences in time on ball, shuttle run, total sway, and fore/aft displacement after the exercise intervention (T2). T3 assessment revealed that total sway and time on ball remained controlled; however, no other measures were retained. Balance training improved performance of selected sport-related activities and postural control measures, although it is unclear whether the effect of training would transfer to general functional enhancement.

Funk et al. (2003) studied the Impact of Prior Exercise on Hamstring Flexibility: A Comparison of Proprioceptive Neuromuscular Facilitation and Static Stretching. This study compared 5 minutes of static stretching and proprioceptive neuromuscular facilitation (PNF) on hamstring flexibility performed with and without exercise. Forty undergraduate student-athletes participated in a repeated measure, counterbalanced experimental design. Within-group comparisons indicated that PNF resulted in a significant ($p < 0.05$) increase in flexibility after 60 minutes of exercise when compared with baseline (9.6%) and without exercise (7.8%). No differences were observed with static stretching across time. In addition, no differences were observed between the groups at any time point. Results demonstrated that PNF performed after exercise enhanced acute hamstring flexibility, and implementing a PNF stretching routine following exercise may augment current stretching practices among athletes.

Eadric Bressel ED et al. (2007) studied the Comparison of Static and Dynamic Balance in Male Collegiate Soccer, Basketball, and Gymnastics Athletes. Thirty-four male volunteers who competed in National Collegiate Athletic

Association Division I soccer ($n = 11$), basketball ($n = 11$), or gymnastics ($n = 12$). A quasi-experimental, between-groups design. Independent variables included limb (dominant and nondominant) and sport played. To assess static balance, participants performed 3 stance variations (double leg, single leg, and tandem leg) on 2 surfaces (stiff and compliant). For assessment of dynamic balance, participants performed multidirectional maximal single-leg reaches from a unilateral base of support. Errors from the Balance Error Scoring System and normalized leg reach distances from the Star Excursion Balance Test were used to assess static and dynamic balance, respectively. Balance Error Scoring System error scores for the gymnastics group were 55% lower than for the basketball group ($P = .01$), and Star Excursion Balance Test scores were 7% higher in the soccer group than the basketball group ($P = .04$). Gymnasts and soccer players did not differ in terms of static and dynamic balance. In contrast, basketball players displayed inferior static balance compared with gymnasts and inferior dynamic balance compared with soccer players.

Alaj et al. (2007) studied the The Effects of Proprioceptive Training on Jumping and Agility Performance. The purpose of this research was to identify the changes in tests assessing speed-explosiveness abilities after a completed proprioceptive training programme. The research included 75 physically active men divided into the experimental ($n = 37$) and the control ($n = 38$) group. The first group underwent the proprioceptive training programme lasting ten weeks (60 minutes three times a week). The training programme consisted of one-leg and double-leg static and dynamic balance drills. The demands and duration of those exercises increased progressively. The control group continued to carry out their daily activities during the experiment. The explosive jumping strength and agility were estimated by nine tests at the beginning and at the end of the experiment. For each variable the central

and dispersion parameters were calculated as well as the basic metric features. The differences between groups and time points in certain variables were determined by the repeated measure analysis of variance and the post-hoc Tukey test. The results of this research show that there were positive changes in some analysed tests due to the proprioceptive training programme. There were some significant changes in the experimental group under the influence of the proprioceptive training programme in double-leg vertical jump explosive strength tests and in forward agility (20Y test). Minor but positive changes point to the possibility of developing motor abilities by means of proprioceptive training, and not only to prevent injuries, which has already been proved in a number of research studies.

Decicco and Fisher (2005) was to compare the effects of the contract-relax-contract (CRC) and hold-relax-contract (HRC) proprioceptive neuromuscular facilitation (PNF) stretching programs against a control, on external range of motion (ROM) of the shoulder in apparently healthy athletes. The subjects also had been involved in at least one overhand throwing sport (tennis, baseball, quarterback in football, etc.) in the past year. There were 30 participants whom were randomly assigned to 1 of 3 groups (CRC PNF, HRC PNF, control) with 10 subjects per group. Measurement of ROM for external rotation of the shoulder was performed prior to and after 6 weeks of training using a goniometer. The CRC and HRC PNF stretches were performed on subjects twice a week for 6 weeks. The statistical analysis conducted involved a 3x2 analysis of variance with the criteria for statistical significance set at $p < 0.05$. Post hoc testing included paired t-tests and Tukey tests to pinpoint significant differences relative to the interaction between group and time. There was any increase in ROM however, was similar between the HRC and CRC

groups. The CRC and HRC PNF stretching techniques are effective at increasing external shoulder ROM when consistently performed 2 times a week for 6 weeks.

Cornelius et al. (1999) was to determine the effects of modified proprioceptive Neuromuscular Facilitation (PNF) flexibility techniques on hip flexion in college males and to determine if local application enhances the effectiveness in these techniques. Male subjects (N=120), with an average age of 21.5±2.7 years, were randomly assigned to one of four different kinds of stretching treatments with cold application (15 per group). Range of motion (ROM) in degrees was determined following four stretching techniques: three modified PNF (PCP, 3-PIECP, 3-PIFCP) and a passive stretch (P). Data were analyzed using a 2 (conditions) x 4 (treatments) ANOVA. There were no significant differences in ROM between cold and no cold conditions. Significant differences existed among ROM techniques (p less than .05). Post hoc analyses revealed that the passive stretch technique.

Ferber, Osternig and Gravelle (2000) examined the effects if proprioceptive neuromuscular facilitation (PNF) stretch techniques on older adults are unknown and the physiological changes associated with aging may lead to differential responses to PNF stretch techniques and EMG activity in older adults. Three PNF stretch techniques: static stretch (SS), contract-relax (CR), and agonist contract-relax (ACR) were applied to 24 older adults aged 50-75 years. The subjects were tested for knee extension range of motion (ROM) and knee flexor muscle EMG activity. The results indicated that ACR produced 29-34% more ROM and 65-119% more EMG activity than CR and SS, respectively. It was concluded that PNF stretch techniques can increase ROM in older adults. However, a paradoxical effect was observed in that PNF stretching may not induce muscular relaxation even though ROM about a joint

increases. Care should be taken when applying PNF stretch techniques to older adults due to age-related alterations in muscle elasticity.

Borghuis et al. (2008) studied the importance of sensory-motor control has implications for the development of measurement and training protocols. It has been shown that challenging proprioception during training activities, for example, by making use of unstable surfaces, leads to increased demands on trunk muscles, thereby improving core stability and balance. Various tests to directly or indirectly measure neuromuscular control and coordination have been developed and are discussed in the present article. Sitting balance performance and trunk muscle response times may be good indicators of core stability. In light of this, it would be interesting to quantify core stability using a sitting balance task, for example by making use of accelerometry. Further research is required to develop training programmes and evaluation methods that are suitable for various target groups.

Loudon (2008) studied the functional ankle instability (FAI) is a term used to describe an ankle that easily 'gives way' with activity. There have been many proposed causes of FAI including joint proprioceptive deficiency, muscle weakness, balance control impairments, and delayed muscle reaction time, none of which has proven to be the exclusive cause of FAI. Treatment becomes difficult when the causative factor of the injury is obscure. This systematic review evaluates the clinical trials involving conservative exercise interventions in FAI and examines the changes induced by the exercise treatments to the various potential FAI factors. Sixteen articles describing the active exercise treatment of FAI were analysed using Sackett's levels of evidence and were examined for scientific rigor. From this review, it can be concluded that conservative treatment interventions including balance, proprioceptive and muscle strengthening exercises are effective for patients with FAI in decreasing

the incidence of giving-way episodes, improving balance stability, and improving function.

Evert Verhagen WA et al. (2004) studied about the ankle sprains which are the most common injuries in a variety of sports. A proprioceptive balance board program is effective for prevention of ankle sprains in volleyball players. Prospective controlled study. There were 116 male and female volleyball teams followed prospectively during the 2001–2002 season. Teams were randomized by 4 geographical regions to an intervention group (66 teams, 641 players) and control group (50 teams, 486 players). Intervention teams followed a prescribed balance board training program; control teams followed their normal training routine. The coaches recorded exposure on a weekly basis for each player. Injuries were registered by the players within 1 week after onset. Significantly fewer ankle sprains in the intervention group were found compared to the control group (risk difference = 0.4/1000 playing hours; 95% confidence interval, 0.1–0.7). A significant reduction in ankle sprain risk was found only for players with a history of ankle sprains. The incidence of overuse knee injuries for players with history of knee injury was increased in the intervention group. History of knee injury may be a contraindication for proprioceptive balance board training. Use of proprioceptive balance board program is effective for prevention of ankle sprain recurrences.

Paul A Borsa et al. (1997) studied a group of anterior cruciate ligament-deficient athletes to identify whether joint position and direction of joint motion have a significant effect on proprioception. Twenty-nine anterior cruciate ligament-deficient athletes were tested for their threshold to detect passive motion at both 15° and 45° moving into the directions of both flexion and extension. The single-legged hop test was used to identify function in the deficient limb. Results demonstrated

statistically significant deficits in threshold to detect passive motion for the deficient limb at 15° moving into extension. For the deficient limb, threshold to detect passive motion was significantly more sensitive moving into extension than flexion at a starting angle of 15°; at a starting angle of 15° moving into extension threshold was significantly more sensitive than at a starting angle of 45° moving into extension. We conclude that in deficient limbs proprioception is significantly more sensitive in the end ranges of knee extension (15°) and is significantly more sensitive moving into the direction of extension. To effectively restore reflex stabilization of the lower limb we recommend a rehabilitation program emphasizing performance-based, weight bearing, closed kinetic chain exercise for the muscle groups that act on the knee joint.

Amy Fu et al. (2005) studied the deficiencies in ankle proprioception and standing balance in basketball players with multiple ankle sprains have been reported in separate studies. However, the question of how ankle proprioceptive inputs and postural control in stance are related is still unclear. Ankle repositioning errors and the amount of postural sway in stance are increased in basketball players with multiple ankle sprains. Controlled laboratory study. Twenty healthy male basketball players and 19 male basketball players who had suffered bilateral ankle sprains within the past 2 years were examined. Both groups were similar in age. Passive ankle joint repositioning errors at 5° of plantar flexion were used to test for ankle joint proprioception. The Sensory Organization Test was applied with dynamic posturography to assess postural sway angle under 6 sensory conditions. A significant increase in ankle repositioning errors was demonstrated in basketball players with bilateral ankle sprains ($P < .05$). The mean errors in the right and left ankles were increased from 1.0° (standard deviation, 0.4°) and 0.8° (standard deviation, 0.2°), respectively, in the healthy players to 1.4° (standard deviation, 0.7°) and 1.1°

(standard deviation, 0.5°) in the injured group. A significant increase in the amount of postural sway in the injured subjects was also found in conditions 1, 2, and 5 of the Sensory Organization Test ($P < .05$). Furthermore, there were positive associations between averaged errors in repositioning both ankles and postural sway angles in conditions 1, 2, and 3 of the Sensory Organization Test ($r = 0.39\text{--}0.54$, $P < .05$). Ankle repositioning errors and postural sway in stance increased in basketball players with multiple ankle sprains. A positive relationship was found between these 2 variables.

Scott M Lephart et al. (1997) found that rehabilitation continues to evolve with the increased emphasis on patient management and proprioceptive training. Proprioception can be defined as a specialized variation of the sensory modality of touch that encompasses the sensation of joint movement (kines thesia) and joint position (joint position sense). Numerous investigators have observed that afferent feedback to the brain and spinal pathways is mediated by skin, articular, and muscle mechanoreceptors. Examining the effects of ligamentous injury, surgical intervention, and proprioceptively mediated activities in the rehabilitation program provides an understanding of the complexity of this system responsible for motor control. It appears that this neuromuscular feedback mechanism becomes interrupted with injury and abnormalities, and approaches restoration after surgical intervention and rehabilitation. Rehabilitation programs should be designed to include a proprioceptive component that addresses the following three levels of motor control: spinal reflexes, cognitive programming, and brainstem activity. Such a program is highly recommended to promote dynamic joint and functional stability. Thus far, current knowledge regarding the basic science and clinical application of

proprioception has led the profession of sports medicine one step closer to its ultimate goal of restoring function.

Feland J B et al. (2003) had undergone the research to determine if submaximal contractions used in contract-relax proprioceptive neuromuscular facilitation (CRPNF) stretching of the hamstrings yield comparable gains in hamstring flexibility to maximal voluntary isometric contractions (MVICs). Randomised controlled trial. A convenience sample of 72 male subjects aged 18–27 was used. Subjects qualified by demonstrating tight hamstrings, defined as the inability to reach 70° of hip flexion during a straight leg raise. Sixty subjects were randomly assigned to one of three treatment groups: 1, 20% of MVIC; 2, 60% of MVIC; 3, 100% MVIC. Twelve subjects were randomly assigned to a control group (no stretching). Subjects in groups 1–3 performed three separate six second CRPNF stretches at the respective intensity with a 10 second rest between contractions, once a day for five days. Goniometric measurements of hamstring flexibility using a lying passive knee extension test were made before and after the stretching period to determine flexibility changes. Paired *t* tests showed a significant change in flexibility for all treatment groups. A comparison of least squares means showed that there was no difference in flexibility gains between the treatment groups, but all treatment groups had significantly greater flexibility than the control group. CRPNF stretching using submaximal contractions is just as beneficial at improving hamstring flexibility as maximal contractions, and may reduce the risk of injury associated with PNF stretching.

Kofotolis TM et al. (2005) compared the effects of proprioceptive neuromuscular facilitation (PNF) and isokinetic training on fibre type distribution and cross sectional area of the vastus lateralis muscle. Twenty four

male university students were divided into two equal groups: PNF training and isokinetic training (ISO). The training regimen for the PNF group consisted of three sets of 30 repetitions against maximal resistance, alternating two patterns of sequential movements of the right lower extremity: (a) toe flexion and ankle plantar flexion and eversion; (b) knee extension and hip extension, abduction, and internal rotation. The ISO group performed three sets of 30 repetitions alternating knee extension and flexion of the right leg at angular velocities of 180 and 90°/s in an isokinetic dynamometer (Cybex). Both groups trained three times a week for a total of eight weeks. Muscle biopsy specimens were obtained from the right vastus lateralis muscle before and after training. The mean percentage area of type IIB fibre was significantly decreased ($p < 0.01$) after eight weeks of PNF training, whereas that of type IIA fibre was significantly ($p < 0.05$) increased. The mean percentage area of ISO trained type IIAB fibres exhibited an augmentative pattern ($p < 0.01$) with a parallel reduction ($p < 0.05$) in type IIA. Percentage fibre type distribution exhibited a similar pattern. Both PNF and ISO training alter fibre type distribution and mean cross sectional area. These changes occur in the type II fibre sub group.

Verhagen (2005) evaluated the cost effectiveness of a proprioceptive balance board training programme for the prevention of ankle sprains in volleyball. A total of 116 volleyball teams participated in this study which was carried out during the 2001–2002 volleyball season. Teams were randomly allotted to an intervention group (66 teams, 628 players) or a control group (52 teams, 494 players). Intervention teams followed a prescribed balance board training programme as part of their warm up. Control teams followed their normal training routine. An ankle sprain was recorded if it occurred as a result of volleyball and caused the subject to stop volleyball activity. The injured player completed a cost diary for the duration of the ankle sprain.

Analyses were performed according to the intention to treat principle. Mean direct, indirect, and total costs were calculated and were compared between the two groups. The total costs per player (including the intervention material) were significantly higher in the intervention group (€36.99 (93.87)) than in the control group (€18.94 (147.09)). The cost of preventing one ankle sprain was approximately €444.03. Sensitivity analysis showed that a proprioceptive balance board training programme aimed only at players with previous ankle sprains could be cost effective over a longer period of time. Positive effects of the balance board programme could only be achieved at certain costs. However, if broadly implemented, costs associated with the balance board programme would probably be lower.

2.4 STUDIES RELATED WITH OTHER TRAINING

Bal AT et al. (2012) determined the effects of 6-week rope mallakhamb training on speed of movement, Vital capacity and peak expiratory flow rate. The research population included 30 inter college girls (Mean \pm SD: age 21.33 ± 1.43 years, height 1.67 ± 0.036 m, body mass 62.50 ± 3.55 kg) of Guru Nanak Dev University, Amritsar, Punjab. They were purposively assigned into rope mallakhamb (M) and control (C) groups, $n = 15$ each. The M group was subjected to 6-week training consisting of various asanas (i.e., Bajrang pakad, Padamasana, Dhanurasana, Needle, Nidrasana, Paschimottanasana, AARI and Simple cross) the control group participated in the routine yoga mallakhamb training not containing the asanas mentioned. The level of $p \leq 0.05$ was considered significant. The 6-week rope mallakhamb training brought about significant improvement in speed of movement ($t = 3.45$), vital capacity ($t = 2.98$) and peak expiratory flow rate ($t = 1.82$) in Group (M)

as compared with the control one. The 6-week rope mallakhamb training had significant effect on speed of movement, vital capacity and peak expiratory flow rate. Thus, such mallakhamb training may be recommended to improve speed of movement, vital capacity and peak expiratory flow rate may contribute to enhance concentration based performance and voluntary control of breathing.

Alonzo (1987) did the study with extent of exercise limitation and the mechanisms for that limitation in 11 patients with primary pulmonary hypertension (PPH) were studied by progressive, upright cycle ergometry. All patients had a mean pulmonary artery pressure of 30 mm Hg or higher (mean, 56 +/- 15), normal pulmonary function testing, normal pulmonary capillary wedge pressure, and pulmonary angiography consistent with the diagnosis. Rest and exercise data obtained from the patients with PPH were compared with data obtained from 11 matched, sedentary control subjects. Mean maximal oxygen consumption (VO_2) was 13 +/- 4 ml/kg/min in the PPH group compared with 28 +/- 7 ml/kg/min in the controls. At maximal VO_2 the minute ventilation (VE) was similar; however, the VE at any level of carbon dioxide production (VCO_2) during rest and exercise was significantly higher in the PPH group. Maximal heart rate and oxygen pulse ($\text{VO}_2/\text{heart rate}$) was significantly higher in the control group (148 +/- 18 vs 180 +/- 24, and 6.3 +/- 2.2 vs 9.9 +/- 3.9, respectively). Anaerobic threshold occurred earlier during progressive exercise in the PPH group and correlated positively with the maximal oxygen pulse achieved in patients with PPH. In conclusion, patients with PPH have severe exertional limitation due to cardiovascular factors with an inability to maintain appropriate oxygen delivery to the body during exercise. No respiratory impairment

was recognized; however, an exaggerated ventilatory response to exercise at any level of VCO₂ was found.

Loni LL et al. (2006) conducted with a view to compare / find out the effect of regular exercise and good nutritious diet among Residential (Sainik) and Non Residential school boys of age group 14 to 17 years (n = 49) who were apparently healthy. The other parameters included were Anthropometric, Physiological, Respiratory and Hematological. Cardiopulmonary fitness parameters were performed by the Harvard's step test. By using the formula, the VO₂ Max and PFI were derived. The Recording spirometer was used to record the respiratory lung function tests. The PEFR (lit/min) was recorded by mini Wright's Peak Expiratory Flow meter. The cardiopulmonary fatnesses assessed were VO₂ Max (ml/kg/min) and PFI (%). Physiological parameters included were SBP (mmHg), DBP (mmHg), MAP (mmHg), PR1 (bpm), PR2 (bpm) and P max (bpm). Respiratory parameters assessed were IRV (ml), ERV (ml), VC (ml), VT (ml), FEV1 (%), PEFR (lit/min), BHT (sec) and ENDT (sec). Anthropometric parameters were Ht (cms), Wt (kgs), MAC (cms), Abd C (cms), CC (cms), BSA (m²) and BMI (kg/m²). And Hematological parameter included in the study was Hb (gm/dl). VO₂ Max is the maximum amount of Oxygen in ml, one can use in one minute per kg of body weight. Those who are fit will have higher VO₂ Max and can exercise more intensely than those who are not well conditioned. The VO₂ Max (ml/kg/min) among the Residential Group I was (54.4 ± 65, SE 9.3) and that in the Non Residential Group II was (29.38 ± 8.74, SE 1.2). VO₂ Max was highly significantly. PFI (%) among the Residential Group I as (64.34 ± 6.86, SE 0.98)} and that in the Non Residential Group II was (62.03 ± 4.43, SE 0.63), and highly significant. It could also be seen that the Residential Group I had an excellent VO₂ Max and a good PFI. This could be due to the regular exercises

performed by the Group I. Other factors like diet, sleep, routine activities performed by them also contribute to have higher VO2 Max, PFI and PEFr. This could be due to regular exercises performed by Group I subjects.

Korkusuz WM et al. (2009) determined if 12 weeks Pilates exercise could improve dynamic balance, reaction time, flexibility, muscle strength, bone density and quality of life in 65+ years old women and to investigate the changes of these parameters in a year follow up. Thirty out of a hundred women living in a Residential House in Ankara were enrolled in the study. Participants attended a 12-week series of one-hour Pilates exercise meeting three times per week. Dynamic balance, flexibility, reaction time, number of falls, muscle strength, bone mineral density, quality of life and anxiety were measured before and after exercise. Results showed that flexibility, balance, simple and choice reaction time, muscle strength, number of falls, quality of life and beck anxiety scores significantly improved in the exercise group. In addition, after a year of follow up, there were prominent decreases in simple reaction time and muscle strength, choice reaction time, number of falls and bone mineral density in control group while there were no evident changes in exercise group. Furthermore, there were significant relationships of balance with muscle strength, choice reaction time and anxiety. V As the result of this study, it can be concluded that Pilates exercise can be efficient for preventing falls, increasing muscle strength and dynamic balance, flexibility, reaction time and decreasing anxiety while increasing quality of life. In the long term, Pilates exercise may have very positive effects on bone mineral density.

Senthil SP et al. (2012) examined to achieve the good performance, the load and recovery is equally important. During any training, prolonged and strong

contraction of a muscle leads to the well-known state of muscle fatigue. Studies in athletes have shown that muscle fatigue increases in almost direct proportion to the rate of depletion of muscle glycogen. Therefore, fatigue results mainly from inability of the contractile and metabolic processes of the muscle fibres to continue supplying the same work output. The intense prolonged muscle activity further diminishes muscle contraction. Interruption of blood flow through a contracting muscle leads to almost complete muscle fatigue within 1 or 2 minutes because of the loss of nutrient supply, especially loss of oxygen. During the training due to the increased body metabolism particularly following vigorous exercise, there will be increased deposition of lactic acid as well as metabolic waste products which leads to the further muscle fatigue. Following the main exercises, it is important to also allow time for a cooling down, to assist with removal of lactic acid and waste products of metabolism. So the researcher motivated to take up the study to find out an effective mode to reduce the lactic acid concentration, increased supply of Oxygen and essential nutrients. The researcher incorporated the asanas and ayurvedic massage as a mean of recovery followed by resistance training to enhance the performance of physical fitness components and physiological variables of men adults.

Astrid Junge W et al. (2002) found the risk factors for soccer injuries and possibilities for prevention have been discussed by several authors, but only a few have investigated the effectiveness of preventive interventions. The aim of the present study was to evaluate the effects of a prevention program on the incidence of soccer injuries in male youth amateur players. Prospective controlled intervention study. Seven soccer teams took part in a prevention program that focused on education and supervision of coaches and players, while seven other teams were instructed to train and play soccer as usual. Over 1 year all injuries were documented

weekly by physicians. Complete weekly injury reports were available for 194 players. The incidence of injury per 1000 hours of training and playing soccer was 6.7 in the intervention group and 8.5 in the control group, which equates to 21% fewer injuries in the intervention group. The greatest effects were observed for mild injuries, overuse injuries, and injuries incurred during training. The prevention program had greater effects in low-skill than in high-skill teams. The incidence of soccer injuries can be reduced by preventive interventions, especially in low skill level youth teams. Coaches and players need better education regarding injury prevention strategies and should include such interventions as part of their regular training.

2.5 SUMMARY OF RELATED LITERATURE

In this chapter, the researcher had given forty five research studies which have been conducted recently in the area of asanas, aerobics and proprioceptive training on selected criterion variables through journals, periodicals, abstracts, unpublished master and doctoral theses on Physical Education and Sports Sciences besides from various relevant books. The review summarized that the effects of asanas, aerobics and proprioceptive trainings would be beneficial to better performance for soccer players. Hence, the present investigation assumes greater prove the concept on different trainings namely asanas, aerobics and proprioceptive trainings.