CHAPTER II

REVIEW OF RELATED LITERATURE

The research for reference material is a time consuming but fruitful phase of the graduate programme. A familiarity with the literature in any problem area helps the students to discover what is already known, what others have attempted to find out, what methods have been promising, disappointing, and what problems remain to be solved.

The literature in any field forms the foundation upon which all future work will be built." The reviews of literature are generally used as a basis for inductive reasoning for locating and synthesizing all the relevant literature on a particular topic.

The present chapter covers the available literature pertaining to the studies made on various aspects of assessment of fitness profiles. The review of literature has been collected from a number of pertinent studies undertaken by the physical educationists, sports scientists, coaches and sports administrators. Considering the purpose of the present study the reviews have been mainly classified into the following aspects:

1. Yogic practices on physiological variables

2. Yogic practices on psychological variables

3. Physical Exercises on Physiological variables.

4 Physical Exercises on Psychological variables

2.1 YOGIC PRACTICES ON PHYSIOLOGICAL VARIABLES

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 before the exercise and at 1, 2, 3, 4, 5, 7 and 10 minutes after the exercise. Rate-pressure product [RPP = (HR × SP)/100] and double product (Do P = HR × MP), which are indices of work done by the heart were also calculated. Exercise produced a significant increase in HR, systolic pressure, RPP and 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 milder cardiovascular response, suggesting better exercise tolerance.

Madanmohan et.al (2005) undertook a comparative study of the effect of three weeks training in savitri (slow breathing) and bhastrika (fast breathing) pranayams 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 pranayam that involves slow, rhythmic, and deep breathing. Group II was given training in bhastrika pranayam, which is bellows-type rapid and deep breathing. Parameters were measured before and after three week training period. Savitri pranayam produced a significant increase in respiratory pressures and respiratory endurance. In both the groups, there was an insignificant shortening of reaction time. Heart rate, rate-pressure product and double product decreased in savitri pranayam group but increased significantly in bhastrika group. It is concluded that different types of pranayams produce different physiological responses in normal young volunteers.

Mohan, M. et.al.(2004) studied the effect of inspiratory and expiratory phases of normal quiet breathing, deep breathing and savitri pranayam type breathing on heart rate and mean ventricular QRS axis was investigated in young, healthy untrained subjects. Pranayam type breathing produced significant cardio acceleration and increase in QRS axis during the inspiratory phase as compared to eupnea. On the other hand, expiratory effort during pranayam type breathing did not produce any significant change in heart rate or QRS axis. The changes in heart rate and QRS axis during the inspiratory and expiratory phases of pranayam type breathing were similar to the changes observed during the corresponding phases of deep breathing.

Joshi, et.al. (1996) selected thirty three normal male and forty two normal female subjects, of average age of 18.5 years and they underwent six weeks course in 'Pranayam' and their ventilatory lung functions were studied before and after this practice. They had improved ventilatory functions in the form of lowered respiratory rate (RR), increase forced vital capacity (FVC), forced expiratory volume at the end of 1st second (FEV1%), maximum voluntary ventilation (MVV), peak expiratory flow rate (PEFR-lit/sec), and prolongation of breath holding time.

Makwana et.al. (1988) selected 25 normal male volunteers undergoing a ten weeks course in the practice of yoga by selected parameters of ventilatory functions tests. The observations recorded at the end of ten weeks of the course have shown improved ventilatory functions in the form of lowered respiratory rate, increased forced vital capacity, FEV1, maximum breathing capacity and breath holding time, while tidal volume and %FEV1, did not reveal any significant change. Thus, a combined practice of yoga seems to be beneficial on respiratory efficiency.

Chaya et.al (2006), investigated the net change in the basal metabolic rate (BMR) of individuals actively engaging in a combination of yoga practices (yogic postures, meditation and pranayama) 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 of practices was compared with that of control subjects who did not practice yoga but led similar lifestyles. This study shows that there was a significantly reduced BMR, probably linked to

reduced arousal, with the long term practice of yoga using a combination of stimulatory and inhibitory yogic practices.

Satyanaranaya, (1992) conducted a study on Santhi Kriya is a mixture of combined yogic practices of breathing and relaxation. Preliminary attempts were made to determine the effect of Santhi Kriya on certain psycho physiological parameters. Eight healthy male volunteers of the age group 25.9 +/- 3 (SD) years were subjected to Santhi Kriya practice daily for 50 minutes for 30 days. The volunteer's body weight, blood pressure, oral temperature, pulse rate, respiration, ECG and EEG were recorded before and after the practice on the 1st day and subsequently on 10th, 20th and 30th day of their practice. They were also given a perceptual acuity test to know their cognitive level on the first day and also at the end of the study i.e., on the 30th day. Results indicate a gradual and significant decrease in the body weight from 1st to 30th day (P less than 0.001) and an increase in alpha activity of the brain (P less than 0.001) during the course of 30 days of Santhi Kriya practice. Increase of alpha activity both in occipital and pre-frontal areas of both the hemispheres of the brain denotes an increase of calmness. This study also revealed that Santhi Kriya practice increases oral temperature by 3 degrees F and decreases respiratory rate significantly (P less than 0.05) on all practice days. Other parameters were not found to be altered significantly. It is concluded that the Santhi Kriya practice for 30 days reduces body weight and increases calmness.

Murugesan, Govindarajulu and Bera (2000) selected thirty three 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 experimental group-1 underwent selected yoga practices, experimental 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 training was imparted in the morning and in the evening with 1 hour per session, 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 drug) were effective in controlling the variables of hypertension.

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 and 50 subjects who had been practicing 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 and 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 also found to be significantly higher in yoga practitioners than in controls ($P<0.001$). The results indicate that yoga reduces the age related deterioration in cardiovascular functions.

Stancak, et.al. (1991) studied cardiovascular and respiratory changes during yogic breathing exercise kapalabhati in 17 advanced yoga practitioners. The exercise consisted in fast shallow abdominal respiratory movements at about 2 Hz frequencies. Blood pressure, ECG and respiration were recorded continuously during three 5 minutes periods of kapalabhati and during pre- and post- kapalabhati resting periods. The beat-to-beat series of systolic blood pressure (SBP) and diastolic blood pressure (DBP), R-R intervals and respiration were analysed by spectral analysis of time series. The mean absolute power was calculated in three frequency bands--band of spontaneous respiration, band of 0.1 Hz rhythm and the low-frequency band greater than 15 s in all spectra. The mean modulus calculated between SBP and R-R intervals was used as a parameter of baroreceptor-cardiac reflex sensitivity (BRS). Heart rate increased by 9 beats per minute during KB. SBP and DBP increased during KB by 15 and 6 mmHg respectively. All frequency bands of R-R interval variability were reduced in KB. Also the BRS parameter was reduced in KB. The amplitude of the high-frequency oscillations in SBP and DBP increased during KB. The low-frequency blood pressure oscillations were increased after KB. The results point to decreased cardiac vagal tone during KB which was

due to changes in respiratory pattern and due to decreased sensitivity of arterial baroreflex. Decreased respiratory rate and increased SBP and low-frequency blood pressure oscillations after kapalabhati suggest a differentiated pattern of vegetative activation and inhibition associated with KB exercise.

The purpose of Virtanen et.al. (2003) study was to determine whether psychological factors 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) were studied. Five-minute supine recordings of ECG and beat-to-beat photo plethysmographic finger systolic arterial pressure and diastolic arterial pressure were obtained during paced breathing. Power spectra were computed using a fast Fourier transform for low-frequency (0.04-0.15 Hz) and high-frequency (0.15-0.40 Hz) powers. BRS was calculated by cross-spectral analysis of R-R interval and systolic arterial pressure variables. Psychological factors were evaluated by three self-report questionnaires: the Brief Symptom Inventory, the shortened version of the Spielberger State-Trait Anger Expression Inventory, and the Toronto Alexithymia Scale. It was found anxiety and hostility are 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.

Raghuraj et.al. (1998), studied on the heart rate variability (HRV) is an indicator of the cardiac autonomic control. Two spectral components are usually recorded, viz. high frequency (0.15-0.50 Hz), which is due to vagal efferent activity and a low frequency component (0.05-0.15 Hz), due to sympathetic activity. The present study was conducted to study the HRV in two yoga practices which have been previously reported to have opposite effects, viz, sympathetic stimulation (kapalabhati, breathing at high frequency, i.e., 2.0 Hz) and reduced sympathetic activity (nadisuddhi, alternate nostril breathing). Twelve male volunteers (age range, 21 to 33 years) were assessed before and after each practice on separate days. The electrocardiogram (lead I) was digitized on-line and off-line analysis was done. The results showed a significant increase in low frequency (LF) power and LF/HF ratio while high frequency (HF) power was significantly lower following kapalabhati. There were no significant changes following nadisuddhi. The results suggest that kapalabhati modifies the autonomic status by increasing sympathetic activity with reduced vagal activity. The study also suggests that HRV is a more useful psycho physiological measure than heart rate alone.

Brown and Gerbarg (2005) found Yogic breathing a unique method for balancing the autonomic nervous system and influencing psychologic and stress-related disorders. Part I of this series presented a neurophysiologic theory of the effects of Sudarshan Kriya Yoga (SKY). Part II will review clinical studies, our own clinical observations, and guidelines for the safe and effective use of yoga breath techniques in a wide range of clinical conditions. Although more clinical

studies are needed to document the benefits of programs that combine pranayama, asanas and meditation, there was 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 alleviate 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.

Yadav and Das (2001) found the effects of yogic practice on some pulmonary functions. Sixty healthy young female subjects (age group 17-28 years.) were selected. They had to do the yogic practices daily for about one hour. The observations were recorded by MEDSPIROR, in the form of FVC, FEV-1 and PEFR on day-1, after 6 weeks and 12 weeks of their yogic practice. There was significant increase in FVC, FEV-1 and PEFR at the end of 12 weeks

Lohan and Rajesh (2002) studied the effect of asanas and pranayamas on physical and physiological components of boys between age group 12-16 years. One hundred and twenty subjects were equally divided into asana, pranayama, combined and controlled groups. Ten weeks training was given to test the abdominal strength, speed, agility, power and endurance by using AAPHER Youth fitness test battery and blood pressure, heart rate, vital capacity and pulse rate. Pre

test and post test scores were analysed by using ANACOVA. It was concluded that physical and physiological fitness were improved by the training of selected yogic exercise. The combined group of asanas and prayanama showed significant improvement in the physical and physiological fitness parameters.

Chan, et al. (2001) made a study to determine the relationship between the psychometric profile and health related fitness of Chinese youths in Hong Kong. They selected 1,615 Chinese school boys as subjects. The physical self description questionnaire suggested by Marsh et al (1994) was used to provide psychometric profiles. Anaerobic fitness estimated from mile run, flexibility scores from sit and reach test, push up scores, curl up scores and percentage of body fat were also collected as health related fitness factors. The results indicated that health related fitness is highly related to psychometric items such as perceived sport competence, perceived activity level, perception of body fat and global physical self concept. These results indicated the promotion of psychometric self perception of youth. The fact that male adolescents have more positive physical self perception than female signify the need to reevaluate the social values concerning physical fitness and perception that were placed on youth.

2.2 YOGIC PRACTICES ON PSYCHOLOGICAL VARIABLES

Ray, et.al. (2001) undertook a study to observe any beneficial effect 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 was administered yogic practices for the first five months of the course while the control group did not perform yogic exercises during this period. From the 6th to 10th month of training both the groups performed yogic practices. Physiological parameters like heart rate, blood pressure, oral temperature, skin temperature in resting condition, responses to maximal and sub maximal exercise and body flexibility were recorded. Psychological parameters like personality, learning, arithmetic and psychomotor ability, 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 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. Shoulder, hip, trunk and neck flexibility improved in the yoga group. There was improvement in various psychological parameters like reduction in anxiety and depression and a better mental function after yogic practices.

Schell, Allolio and Schonake (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 hormone 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 with stress and mood at the end of the experiment. The yoga group had significant higher scores in high spirits and extravertedness.

Berger and David (1988) experimented stress reduction and mood enhancement in four exercise modes, swimming, body conditioning, hatha yoga and fencing. Students voluntarily enrolled in co-educational fencing, body conditioning, swimming and yoga administered the POMS, a measure of mood states and the state anxiety subscale of the STM before and after class on three different days, students were significantly more fatigued than before. In body conditioning, the interaction between pre and post means was significant. Yoga participants felt significantly better after exercising on four POMS subscales.

Berger, Owen and Man (1993) determined the exercise and mental health literature and then examined the influence of rational difference on the acute mood benefits of swimming on women college students (N=70) from Czechoslovakia and the United States. They completed the POMS before and after class on three occasions. The United States swimming classes met for 50 minutes twice a week through out a 14 weeks semester. Czechoslovakian swimming classes met for 90

minutes once a week throughout a bi-week semester in comparison with their respective controls. Czechoslovakian swimmers reported greater mood changes than the United States swimmers. The Czechoslovakian and United States swimmers reported mood improvement on tension, depression, anger, vigor and confusion.

Chan, et al. (2001) made a study to determine the relationship between the psychometric profile and health related fitness of Chinese youths in Hong Kong. They selected 1,615 Chinese school boys as subjects. The physical self description questionnaire suggested by Marsh et al (1994) was used to provide psychometric profiles. Anaerobic fitness estimated from mile run, flexibility scores from sit and reach test, push up scores, curl up scores and percentage of body fat were also collected as health related fitness factors. The results indicated that health related fitness was highly related to psychometric items such as perceived sport competence, perceived activity level, perception of body fat and global physical self concept. These results indicated the promotion of psychometric self perception of youth. The fact that male adolescents have more positive physical self perception than female signify the need to reevaluate the social values concerning physical fitness and perception that were placed on youth.

Harinath et. al.(2004) had conducted the study on effects of Hatha yoga and Omkar meditation on cardio respiratory performance, psychological profile, and melatonin secretion. Thirty healthy men in the age group of 25-35 years volunteered for the study. They were randomly divided in two groups of 15 each. Group 1

performed body flexibility exercises for 40 minutes and slow running for 20 minutes during morning hours and played games for 60 minutes during evening hours daily for 3 months. Group 2 subjects practiced selected yogic asanas (postures) for 45 minutes and pranayama for 15 minutes during the morning, whereas during the evening hours these subjects performed preparatory yogic postures for 15 minutes, pranayama for 15 minutes, and meditation for 30 minutes daily, for 3 months. Orthostatic tolerance, heart rate, blood pressure, respiratory rate, dynamic lung function (such as forced vital capacity, forced expiratory volume in 1 second, forced expiratory volume percentage, peak expiratory flow rate, and maximum voluntary ventilation), and psychologic profile were measured before and after 3 months of yogic practices. Serial blood samples were drawn at various time intervals to study effects of these yogic practices and Omkar meditation on melatonin levels. Yogic practices for 3 months resulted in an improvement in cardio respiratory performance and psychologic profile. The plasma melatonin also showed an increase after three months of yogic practices. The systolic blood pressure, diastolic blood pressure, mean arterial pressure, and orthostatic tolerance did not show any significant correlation with plasma melatonin. However, the maximum night time melatonin levels in yoga group showed a significant correlation ($r = 0.71$, $p < 0.05$) with well-being score. These observations suggest that yogic practices can be used as psycho physiologic stimuli to increase endogenous secretion of melatonin, which, in turn, might be responsible for improved sense of well-being.

2.3 PHYSICAL EXERCISES ON PHYSIOLOGICAL VARIABLES

Joshi and Joshi (1998) studied ventilatory functions were studied in 36 male and 35 female subjects (mean age 18.5 years), who underwent six weeks course in forced breathing. Ventilatory functions were studied in the form of Forced Vital Capacity (FVC), Forced Expiratory Volume at the end of one second as % of FVC (FEV1%), Maximum Voluntary Ventilation (MVV), Peak expiratory flow rate (PEFR) and Breath Holding Time. Some of these ventilatory functions were found to be increased after a course of forced breathing.

Welsman, J.R. et.al. (1996) had conducted study on aerobic training in 10 year old and adult females. The physiological responses of healthy, untrained 10 year old and adult females to an eight weeks aerobic training programme were examined. Adult peak VO_2 increased and peak heart rate (HR) declined. Reduction in HR and lactate accumulation (LA) were observed at four sub maximal intensities. In children peak VO_2 did not change but peak HR did. No changes in HR were observed in sub maximal intensity work but LA was reduced. Improved aerobic functioning was only exhibited in young girls at sub maximal intensities, and it was concluded that the female children respond to aerobic training in a different manner to adult female in both heavy and sub maximal work. Children only exhibit physiological changes at sub maximal levels.

Benelli, Ditroilo, Vito (2004) conducted a study on Physiological responses to fitness activities: A comparison between land-based and water aerobics exercise.

This study compared the heart rate (HR) and blood lactate (BL) responses in young healthy women performing the same routine of aerobics exercise in 3 different conditions: on land, in shallow water (0.8 m), and in deep water (1.4 m). The average age and body mass index (BMI) of the group were 27.4 years and 22.6 $kg \cdot m^{-2}$, respectively. The highest HR and BL values were reached during land aerobics (median HR values were 138.0 and 161.5 $b \cdot min^{-1}$, and lactate values were 3.10 and 5.65 $mmol \cdot L^{-1}$ at slow and at faster pace, respectively). These parameters were progressively reduced going from shallow water (121.5 and 154.0 $b \cdot min^{-1}$, 1.75 and 3.15 $mmol \cdot L^{-1}$) to deep water (97.5 and 113.5 $b \cdot min^{-1}$, 1.70 and 1.75 $mmol \cdot L^{-1}$). The HR measured as percentage of maximum HR varied from 48.43% to 77.53% depending on the water depth and the pace. These data indicate that exercise in water significantly reduces HR and BL production compared with the same exercise performed on land.

Hoeger et al. (1992) directly examined the training effects of an identical aerobics programme performed on land (low-impact) and in the water. Forty-nine untrained female subjects (water n = 20; land n= 15; control n = 14) participated in the 8-week study with the experimental groups exercising 3 times per week. The aerobic portion of the training session was 20 minutes in duration with exercise intensity maintained between 70-85% of HRR. Both the land-based (low-impact) and shallow water aerobics groups made similar gains in aerobic fitness, with a 14.8% relative improvement in estimated VO2max using a Bruce protocol (pre = 31 ± 6.8, post = 35.6 ± 7.0 ml/kg/min) observed in the shallow water aerobics group.

Total treadmill time was also significantly increased (by one minute) following shallow water training. In agreement with Hoeger et al., a smaller yet significant 5.6% increase in VO2max (34.8 ± 4.1 to 36.7 ± 5.2 ml/kg/min) and an improved run time to exhaustion (pre = 15.8 ± 3.7 min, post = 19.4 ± 5.0 min) was also observed by Abraham (1994) following eleven weeks of shallow water aerobics.

Morrow, Jensen and Peace (1996) divided 11 subjects into either DWR (female = 3, males = 3) or land-based (female = 2, male = 3) exercise groups. Subjects trained three days a week for 35 minutes a session at 80% of HRmax as determined by mode specific VO2max tests. Additionally, subjects performed a timed 2.4-k run. Both training groups significantly improved in VO2max ($p < 0.01$). DWR training also decreased run time ($p = 0.06$). No mode specific differences between the two training methods (land vs. water) were observed indicating that DWR can improve VO2max in a similar fashion as land-based exercise.

Baillie , Wyon and Head (2007) studied the physiological effects of performance in Highland-dance competition to consider whether the traditional methods used during class and rehearsal provide an appropriate training stimulus toward this performance. Nine championship standard, female Highland dancers (age 14.2 +/- 1.47 years) had their heart rate and blood lactate concentrations measured before and after 3 dances during a championship competition. Heart rate was also measured during the same 3 dances in rehearsal and during class. Repeated-measures analysis of variance showed significant differences in predance

lactate concentrations between the first dance (Highland Fling, 1.4 +/- 0.3 mM/L), the second dance (Sword dance, 2.3 +/- 0.8 mM/L), and the third dance (Sean Truibhas, 3.5 +/- 1.8 mM/L; $F2,16 = 11.72$, $P < .01$. This, coupled with a significant rise in lactate concentration during the dances ($F1,8 = 76.75$, $P < .001$), resulted in a final post dance lactate concentration of 7.3 +/- 2.96 mM/L. Heart-rate data during competition, rehearsal, and class (195.0 +/- 6.5, 172.6 +/- 5.4, and 151.9 +/- 7.4 beats/min, respectively) showed significant differences between all 3 ($F2,16 = 107.1$, $P < .001$); these are comparable to research on other dance forms. Given the disparity between the anaerobic predominance of competition and the aerobic predominance during class, it is suggested that the class does not provide an appropriate training stimulus as preparation for competitive performance in Highland dance.

Laukkanen, et.al. (2001) measured heart rate during floor and step aerobic classes at three intensity levels. A group of 20 female occasional exercisers [mean age 33 (SD 8) years, mean body mass index 21 (SD 2) kg.m-2 volunteered to participate in six aerobic classes (three floor classes, three step classes) and in a laboratory test as members of one of two groups according to their pre-study regular participation in aerobics classes. Subjects in group A had participated four or more times a week and those of group B less than twice a week. The characteristics of the groups were as follows: group A, n = 10, mean maximal oxygen uptake (VO2max) 38.7 (SD 3.6) ml.kg-1.min-1, mean maximal heart rate (HRmax) 183 (SD 8) beats.min-1; group B, n = 10, VO2max 36.1 (SD 3.6) ml.kg-1.min-1, HRmax 178

(SD 7) beats.min-1. Each class consisted of a warm-up, a 20 min period of structured aerobic exercise (cardiophase) and a cool-down. The cardiophase was planned and guided as light, (rate of perceived exertion, RPE 11-12), moderate (RPE 13-14) or heavy (RPE 15-17) by an experienced instructor. The mean heart rates during the light classes were 72 (step) and 74 (floor) %HRmax in group A and 75 (step) and 79 (floor) %HRmax in group B; during the moderate classes, 84 (step) and 80 (floor) %HRmax in group A and 82 (step) and 83 (floor) %HRmax in group B, and during the heavy classes 89 (step and floor) %HRmax in group A and 88 (step) and 92 (floor) %HRmax in group B. Differences in heart rate and %HRmax were not statistically significant between the groups. However, differences in heart rate and %HRmax between the intensities (light vs moderate, moderate vs heavy and light vs heavy) were significant within both groups (all, $P < 0.01$). Based on the results, we conclude that intensity management during the aerobics classes was generally successful regardless of the participants' prior participation in aerobics.

La Torre, et.al. (2005) determined the cardiovascular responses during aerobic step dance using an overload strategy not yet investigated: appendicular overload. Ten healthy and moderately trained women (mean+/-SD: age 27+/-3.4 years, height 167.8+/-4.6 cm, body mass 55.7+/-4.7 kg, body mass index 19.8+/-1.6, VO2max44.4+/-6.1 mLxkg-1xmin-1) performed an incremental treadmill test to determine VO2peak, the VO2-heart rate (HR) and rating of perceived exertion (RPE)-HR relationships. Within 1 week from the laboratory test, the subjects performed two identical aerobic step dance routines: one using a track suit with

loads placed in pockets close to the legs and arms and another without overload. The appendicular overload (10% of body mass) significantly increased the exercise intensity from 84.5% to 89.8% of HRmax corresponding to 68.9% and 78.3% of VO2peak, respectively ($P<0.01$). Similarly, RPE increased from 12.1 to 15.7 ($P<0.001$). The estimated VO2 and the caloric expenditure rose from 30.3 to 34.7 mLxkg-1xmin-1 and from 251 to 288 kcal, respectively. This study shows that the use of appendicular overload significantly increases the energy cost of aerobic step session similarly to other overload strategies already reported in the literature.

Grier, et.al. (2002) examined the metabolic and cardiovascular responses of aerobic dance bench stepping (ADBS) at commonly used cadences and bench heights, 30 women (19-47 years of age) performed a graded maximal treadmill test and four 8-minute sub maximal ADBS routines. Subjects followed identical videotape sequences of basic ADBS movements at cadences of 125 and 130 beats.min(-1) at bench heights of 6 and 8 in. Physiological measurements were taken during each minute of each test. Mean values calculated from the last 3 minutes were used for data analysis. Although there were no physiological differences between ADBS at the 2 cadences, there were significant physiological differences between ADBS at the 2 bench heights. On average, a 2-in. increase in bench height, increased heart rate, VO2, and rating of perceived exertion by 10 beats.min(-1), 3.09 ml.kg (-1) min(-1), and 1.53, respectively. In conclusion, it appears that bench height is more of a factor than cadence in increasing metabolic cost of ADBS. From this study provide information about the energy cost of ADBS

at the common bench heights and cadences used in this study and, therefore, may be used to help aerobic participants select the proper bench height and cadence combination to control body weight and develop cardio respiratory fitness safely and effectively.

2.4 PHYSICAL EXERCISES ON PSYCHOLOGICAL VARIABLES

Salmon (2001) reported until recently, claims for the psychological benefits of physical exercise tended to precede supportive evidence. Acutely, emotional effects of exercise remain confusing, both positive and negative effects being reported. Results of cross-sectional and longitudinal studies are more consistent in indicating that aerobic exercise training has antidepressant and anxiolytic effects and protects against harmful consequences of stress. Details of each of these effects remain unclear. Antidepressant and anxiolytic effects have been demonstrated most clearly in subclinical disorder, and clinical applications remain to be exploited. Cross-sectional studies link exercise habits to protection from harmful effects of stress on physical and mental health, but causality is not clear. Nevertheless, the pattern of evidence suggests the theory that exercise training recruits a process which confers enduring resilience to stress. This view allows the effects of exercise to be understood in terms of existing psychobiological knowledge, and it can thereby provide the theoretical base that is needed to guide future research in this area. Clinically, exercise training continues to offer clinical psychologists a vehicle for nonspecific therapeutic social and psychological processes. It also offers a

specific psychological treatment that may be particularly effective for patients for whom more conventional psychological interventions are less acceptable.

Larun et.al. (2006) assessed the effects of exercise interventions in reducing or preventing anxiety or depression in children and young people up to 20 years of age. He found that whilst there appears to be a small effect in favour of exercise in reducing depression and anxiety scores in the general population of children and adolescents, the small number of studies included and the clinical diversity of participants, interventions and methods of measurement limit the ability to draw conclusions. It makes little difference whether the exercise is of high *or low intensity. The effect of exercise for children in treatment for anxiety and depression is unknown as the evidence base is scarce.*

Trejo et.al. (2008) reported Knowledge about the effects of physical exercise on brain is accumulating although the mechanisms through which exercise exerts these actions remain largely unknown. A possible involvement of adult hippocampal neurogenesis (AHN) in the effects of exercise is debated while the physiological and pathological significance of AHN is under intense scrutiny. Recently, both neurogenesis-dependent and independent mechanisms have been shown to mediate the effects of physical exercise on spatial learning and anxiety-like behaviors. Taking advantage that the stimulating effects of exercise on AHN depend among others, on serum insulin-like growth factor I (IGF-I), we now examined whether the behavioral effects of running exercise are related to

variations in hippocampal neurogenesis, by either increasing or decreasing it according to serum IGF-I levels. Mutant mice with low levels of serum IGF-I (LID mice) had reduced AHN together with impaired spatial learning. These deficits were not improved by running. However, administration of exogenous IGF-I ameliorated the cognitive deficit and restored AHN in LID mice. We also examined the effect of exercise in LID mice in the novelty-suppressed feeding test, a measure of anxiety-like behavior in laboratory animals. Normal mice, but not LID mice, showed reduced anxiety after exercise in this test. However, after exercise, LID mice did show improvement in the forced swim test, a measure of behavioral despair. Thus, many, but not all of the beneficial effects of exercise on brain function depend on circulating levels of IGF-I and are associated to increased hippocampal neurogenesis, including improved cognition and reduced anxiety.

Sjiigren et.al. (2006) examined the effects of a workplace physical exercise intervention on subjective physical well-being, psychosocial functioning and general well-being. The study was a cluster randomized-controlled trial with the department (n=4) as the unit of randomization. The subjects (n=90) were office workers [mean age 45.7 (SD 8.5) years]. Psychosocial functioning and well-being variables were measured by descriptive visual rating scales. The cross-over design consisted of one 15-week intervention period of light resistance training and guidance and another 15-week period of no training and no guidance. The statistical analysis was based on linear mixed models. The active component of the intervention, light resistance training, resulted in a slight, but statistically

significant, increase in subjective physical well-being (P=0.015). At the average training time of 5 min/working day (25 min/week) the average increase during the 15-week period was 4 units (95% confidence interval (CI) 1-7) and 5% (95% CI 1-9). The physical exercise intervention had no effect on somatic symptoms, anxiety, self-confidence, mood, mental stress at work, working atmosphere, life satisfaction or meaning of life. Daily light resistance training, conducted during the working day, had a positive direction on subjective physical well-being among office workers.

Guszkowska M (2004) made a meta-analyses of correlational and experimental studies reveal positive effects of exercise, in healthy people and in clinical populations (also in patients with emotional disorders) regardless of gender and age. The benefits are significant especially in subjects with an elevated level of anxiety and depression because of more room for possible change. The most improvements are caused by rhythmic, aerobic exercises, using of large muscle groups (jogging, swimming, cycling, walking), of moderate and low intensity. They should be conducted for 15 to 30 minutes and performed a minimum of three times a week in programmes of 10-weeks or longer. The results confirm the acute effect of exercise i.e. the reductions in anxiety and depression after single sessions of exercise. The changes in anxiety, depression and mood states after exercise are explained most frequently by the endorphin and monoamine hypotheses. Exercise may also increase body temperature, blood circulation in the brain and impact on hypothalamic-pituitary-adrenal axis and physiological reactivity to stress. The

possible psychological mechanisms include improvement of self-efficacy, distraction and cognitive dissonance.

Paluska SA, and Schwenk TL. (2000) found Physical activity may play an important role in the management of mild-to-moderate mental health diseases, especially depression and anxiety. Although people with depression tend to be less physically active than non-depressed individuals, increased aerobic exercise or strength training has been shown to reduce depressive symptoms significantly. However, habitual physical activity has not been shown to prevent the onset of depression. Anxiety symptoms and panic disorder also improve with regular exercise, and beneficial effects appear to equal meditation or relaxation. In general, acute anxiety responds better to exercise than chronic anxiety. Studies of older adults and adolescents with depression or anxiety have been limited, but physical activity appears beneficial to these populations as well. Excessive physical activity may lead to overtraining and generate psychological symptoms that mimic depression. Several differing psychological and physiological mechanisms have been proposed to explain the effect of physical activity on mental health disorders. Well controlled studies are needed to clarify the mental health benefits of exercise among various populations and to address directly processes underlying the benefits of exercise on mental health.

Fox (1999) reported that the case for exercise and health has primarily been made on its impact on diseases such as coronary heart disease, obesity and diabetes.

However, there is a very high cost attributed to mental disorders and illness and in the last 15 years there has been increasing research into the role of exercise) in the treatment of mental health, and) in improving mental well-being in the general population. There are now several hundred studies and over 30 narrative or meta-analytic reviews of research in this field. These have summarised the potential for exercise as a therapy for clinical or subclinical depression or anxiety, and the use of physical activity as a means of upgrading life quality through enhanced self-esteem, improved mood states, reduced state and trait anxiety, resilience to stress, or improved sleep. The purpose of this paper is to provide an updated view of this literature within the context of public health promotion and to investigate evidence for physical activity and dietary interactions affecting mental well-being. He concluded that sufficient evidence now exists for the effectiveness of exercise in the treatment of clinical depression. Additionally, exercise has a moderate reducing effect on state and trait anxiety and can improve physical self-perceptions and in some cases global self-esteem. Also there is now good evidence that aerobic and resistance exercise enhances mood states, and weaker evidence that exercise can improve cognitive function (primarily assessed by reaction time) in older adults. Conversely, there is little evidence to suggest that exercise addiction is identifiable in no more than a very small percentage of exercisers. Together, this body of research suggests that moderate regular exercise should be considered as a viable means of treating depression and anxiety and improving mental well-being in the general public.

Taylor et.al. (1985) reviewed the evidence for this claim and provides recommendations for future studies. Not clear The strongest evidence suggests that physical activity and exercise probably alleviate some symptoms associated with mild to moderate depression. The evidence also suggests that physical activity and exercise might provide a beneficial adjunct for alcoholism and substance abuse programs; improve self-image, social skills, and cognitive functioning; reduce the symptoms of anxiety; and alter aspects of coronary-prone (Type A) behavior and physiological response to stressors. The effects of physical activity and exercise on mental disorders, such as schizophrenia, and other aspects of mental health are not known. Negative psychological effects from exercise have also been reported. Recommendations for further research on the effects of physical activity and exercise on mental health are made.

Mellion MB.(1985) reported that despite the ever-increasing importance placed on exercise in our society today, obtaining sufficient evidence to document its therapeutic role in anxiety and depression has proven to be a formidable task for researchers. A number of studies now provide evidence to justify the recommendation of moderate exercise to alleviate symptoms of anxiety and depression and to improve overall emotional well-being. For anxious or depressed patients, exercise produces a sense of mastery and control, and the positive effects of being successful in an exercise program spill over into other realms of their life.

Suh et.al. (2002) evaluated the effects of an exercise programme on exercise capacity, anxiety, depression and quality of life in maintenance hemodialysis patients. Twenty hemodialysis patients were enrolled in the study. Six patients were later excluded; two due to anemia, one due to nausea with vomiting during exercise, one due to a neurologic problem, and the other two due to noncompliance. Thus, fourteen patients, 3 men and 11 women, aged 42 +/- 10 years, completed the study. The exercise program composed of bicycle ergometer, treadmill or upper limb ergometer, 60 min per session, 3 times per week, for 12 weeks. At the beginning and the end of the exercise program, the exercise capacity was determined by measuring the maximal oxygen consumption and exercise duration. In addition, psychological tests for the assessment of depression, anxiety and quality of life were performed. The results of this study indicate that an appropriate application of exercise program would improve the psychological status in long-term maintenance hemodialysis patients.

2.5 WALKING AND JOGGING ON PHYSIOLOGICAL VARIABLES

Brown M, Holloszy JO (1993) conducted a study on the effects of a moderate intensity endurance training programme on strength, speed of muscle contraction, balance, gait and flexibility were assessed in fifty 60 to 72 year-old men and women who had just completed a 3 month programme of flexibility and strengthening exercise. Subjects trained for approximately 45 minutesper day, 4.1 days a week, for one year. Before and after the endurance exercise programme,

exercise participants underwent isometric and dynamic strength testing (Cybex II), standing balance tests, a gait examination, lower extremity flexibility testing, and a fatigue test for the quadriceps femoris muscle group. Fifteen control subjects were tested at the same time periods as exercise subjects. Gains made during the low intensity strengthening and flexibility programme in strength, range of motion and quadriceps endurance were maintained throughout the year of endurance exercise training. Additional significant improvements in speed of muscular contraction, walking velocity and standing balance occurred with the programme of moderate intensity endurance training which produced 24% increase in VO2max for men and 21% increase for women. These results provide additional evidence that older adults are able to improve their functional capacity in response to exercise training.

Rhodes et al (2007) conducted a study on prediction of leisure-time walking. The purpose of the study was to integrate personality, the perceived environment, and planning into a theory of planned behaviour (TPB) framework to predict leisure-time walking. Participants were a random sample (N = 358) of Canadian adults who completed measures of the TPB, planning, perceived neighbourhood environment, and personality at Time 1 and self-reported walking behaviour two months later. Analyses using structural equation modelling provided evidence that leisure-time walking is largely predicted by intention (standardized effect = .42) with an additional independent contribution from proximity to neighbourhood retail shops (standardized effect = .18). Intention, in turn, was predicted by attitudes toward walking and perceived behavioural control. Effects of perceived

neighbourhood aesthetics and walking infrastructure on walking were mediated through attitudes and intention. Moderated regression analysis showed that the intention-walking relationship was moderated by conscientiousness and proximity to neighbourhood recreation facilities but not planning. Overall, walking behaviour is theoretically complex but may best be addressed at a population level by facilitating strong intentions in a receptive environment even though individual differences may persist.

Alex Voukelatos, Dafna Merom, Chris Rissel, Cathie Sherrington, Wendy Watson and Karren Waller Conducted a study whose aims was to determine: if a home-based walking intervention will reduce the falls rate among healthy but inactive community-dwelling older adults (65+ years) compared to no intervention (usual activity) and; whether such an intervention can improve risk factors for falls, such as balance, strength and reaction time. The study uses a randomised controlled trial design. A total of 484 older people exercising less than 120 minutes per week were recruited through the community and health care referrals throughout Sydney and neighboring regions. All participants were randomised into either the self-managed walking programme group or the health education waiting list group using a block randomization scheme. Outcome measures include prospective falls and falls injuries, quality of life, and physical activity levels. A subset of participants (n = 194) was also received physical performance assessments comprising of tests of dynamic balance, strength, reaction time and lower limb functional status. The study concluded that certain types of physical activity can reduce the risk of falls.

Wei-Ya Hao and Yan Chen conducted a study on Backward walking training. Sixteen healthy boys (age: 7.19+/-0.40 y) were randomly assigned to either an experimental or a control group. The experimental group participated in a backward training programme (12-week, 2 times weekly, and 25-min each time) but not the control group. Both groups had five dynamic balance assessments with a Biodex Stability System (anterior/posterior, medial/lateral, and overall balance index) before, during and after the training (week- 0, 4, 8, 12, 24). Six control and six experimental boys participated in a study comparing kinematics of lower limbs between forward walking and backward walking after the training (week-12). The balance of experimental group was better than that of control group after 8 weeks of training ($P<0.01$), and was still better than that of control group ($P<0.05$), when the backward walking training programme had finished for 12 weeks.). It was concluded that backward walking training in school-aged boys can improve balance.

Tiedemann A, Sherrington C, Lord SR. conducted a study on Six-metre walking speed (SMWS) is a commonly used test for measuring functional performance in older people. However, apart from lower limb strength, few studies have examined the range of physiological and psychological factors that influence performance in this test. To investigate the relative contributions of a range of sensorimotor, balance and psychological factors to SMWS in a large sample of older people.668 community-dwelling people aged 75-98 years (mean age 80.1, SD = 4.4) underwent the SMWS test as well as quantitative tests of vision, peripheral

sensation, strength, reaction time, balance, fear of falling, pain and vitality. Many physiological and psychological factors were significantly associated with SMWS in univariate analyses. Stepwise multiple regression analyses revealed that a composite lower limb strength measure (sum of knee extension, knee flexion and ankle dorsiflexion muscle strength scores), postural sway, leaning balance as assessed with the coordinated stability test, reaction time, edge contrast sensitivity, SF12 body pain and vitality scores and age were significant and independent predictors of SMWS. Of these measures, the combined lower limb strength measure had the highest beta weight indicating it was the most important variable in explaining the variance in SMWS. However, the other sensorimotor, balance and psychological measures each provided important independent information. The combined set of variables explained 40% of the variance in SMWS (multiple r = 0.63).The findings indicate that in community-dwelling older people, self-selected walking speed is influenced not only by lower limb strength but also by balance, reaction time, vision, pain and emotional well-being.

Stel F. Van Henk, M. Bogaard Jan, M. Rijssenbeek-Nouwens H. Lous and T Colland Vivian of Asthma centre Heideheuvel, Hilversum, Netherlands conducted a functional exercise tolerance in patients with chronic obstructive pulmonary disease (COPD) is often assessed by the 6-min walking test (6MWT). To assess if the use of multiple factors adds to walking distance in describing performance in the 6MWT, an exploratory factor analysis was performed on physiological measurements and dyspnea ratings recorded during testing. Eighty-

three patients with mild to severe COPD performed repeated 6MWTs before inpatient pulmonary rehabilitation. Factor analysis on 15 variables yielded a stable four-factor structure explaining 78.4% of the total variance. Recorded heart rate variables contributed to factor 1 (heart rate pattern), walking distance, heart rate increase, and decrease contributed to factor 2 (endurance capacity), oxygen desaturation variables contributed to factor 3 (impairment of oxygen transport), and dyspnea and effort variables contributed to factor 4 (perceived symptoms). Walking distance decreased in half of the 53 patients measured posttreatment, but self-perceived change in exercise tolerance improved in 84% and was explained by change in walking distance, by less desaturation, and by less dyspnea ($R^2 = 0.55$, $p = 0.005$). Qualitative analysis showed that 29 of 53 patients improved in three or four factors. Performance in the 6MWT can be described with four statistically independent and clinically interpretable factors. Because clinically relevant changes consist of more than only walking distance, assessment of functional exercise tolerance in patients with COPD improves by reporting multiple variables.

2.6 SUMMARY OF REVIEW OF RELATED LITERATURE

The investigator reviewed the related literature on studies pertaining to yogic practices on physiological and psychological variables and physical exercises on physiological and psychological variables and found that no attempt seem to have been made to find out the effect of yogic practices and the combined effect of physical exercise and yogic practices. Hence, with the experience gained through

the review of the above the investigator found this study justifiable and has formed suitable methodology to be followed for the present study.