Chapter-II

REVIEW OF RELATED LITERATURE

A brief account of literature related to the present study is enumerated in this chapter. The chapter is organized into three heads; (i) studies relating to Continuous Running (ii) studies relating to Mental Training and (iii) allied literatures.

(i) Studies Relating to Continuous Running:

Currie et al., (2013), compared the effects of 12-weeks of HIT, and higher-volume moderate-intensity endurance exercise (END), on brachial artery flow-mediated dilation (FMD) and cardio respiratory fitness (VO2peak) in patients with CAD. Methods: Twenty-two patients with documented CAD were randomized into HIT (n=11) or END (n=11) based on pre-training FMD. Both groups attended 2 supervised sessions per week for 12-weeks. END performed 30-50 minutes of continuous cycling at 58% peak power output (PPO), while HIT performed 10, 1-minute intervals at 89% PPO separated by 1-minute intervals at 10% PPO per session. Results: Relative FMD was increased post-training (END: 4.4 ± 2.6% vs. 5.9 ± 3.6%; HIT: 4.6 ± 3.6% vs. 6.1 ± 3.4%, p≤0.001 pre- vs. post-training) with no differences between groups.
A training effect was also observed for relative VO (END: 18.7 ± 5.7 ml·kg·min vs. 22.3 ± 6.1 ml·kg·min; HIT: 19.8 ± 3.7 ml·kg·min vs. 24.5 ± 4.5 ml·kg·min, p<0.001 for pre vs. post-training), with no group differences. Conclusions: Low-volume high-intensity interval exercise training provided an alternative to the current, more time intensive prescription for cardiac rehabilitation. HIT elicited similar improvements in fitness and FMD as END, despite differences in exercise duration and intensity.

Sijie et al., (2012) evaluated the effects of a high intensity interval training (HIIT) program on the body composition, cardiac function and aerobic capacity in overweight young women. Sixty female university students (aged 19-20, BMI≥25kg/m2 and percentage body fat ≥ 30%) were chosen and randomly assigned to each of the HIIT group, the moderate intensity continuous training (MICT) group and the non-training control group. The subjects in both the HIIT and MICT groups underwent exercise training five times per week for 12 weeks. In each of the training sessions, the HIIT group performed interval exercises at the individualized heart rate (HR) of 85% of VO2max and separated by brief periods of low intensity activity (HR at 50% of VO2max), while the MICT group did continuous walking and/or jogging at the individualized HR of 50% of VO2max. Both of these exercise training programs produced significant improvements in
the subjects' body composition, left ventricular ejection fraction, heart rate at rest, maximal oxygen uptake and ventilatory threshold. However, the HIIT group achieved better results than those in the MICT group, as it was evaluated by the amount of the effect size. The control group did not achieve any change in all of the measured variables. The tangible results achieved that the HIIT program was an effective measure for the treatment of young women who were overweight.

*Moen et al (2012)*, evaluated two treatment regimens for medial tibial stress syndrome (MTSS); a graded running programme and the same running programme with additional shockwave therapy (extracorporeal shockwave therapy; ESWT). For this study 42 athletes with MTSS were included. Patients from one hospital were treated with a graded running programme, while patients from the other hospital were treated with the same graded running programme and focused ESWT (five sessions in 9 weeks). Time to full recovery (the endpoint was being able to run 18 min consecutively without pain at a fixed intensity). The time to full recovery was significantly faster in the ESWT group compared with the patients who only performed a graded running programme, respectively $59.7 \pm 25.8$ and $91.6 \pm 43.0$ days ($p=0.008$). This prospective observational study showed that MTSS patients might benefit from ESWT in addition to a graded
running programme. ESWT as an additional treatment warranted further investigation in a prospective controlled trial with the addition of randomization and double blinding.

**McKay et al., (2009)**, examined the effects of high-intensity interval (HIT) and lower-intensity continuous endurance (END) training. Twelve male volunteers underwent eight sessions of either HIT (8-12 x 1-min intervals at 120% maximal O(2) uptake separated by 1 min of rest) or END (90-120 min at 65% maximal O(2) uptake). Subjects completed step transitions to a moderate-intensity work rate (approximately 90% estimated lactate threshold) on five occasions throughout training, and ramp incremental and constant-load performance tests were conducted at pre-, mid-, and post training periods. Vo(2)(p) was measured breath-by-breath by mass spectrometry and volume turbine. Deoxygenation (change in deoxygenated haemoglobin concentration; Delta[HHb]) of the vastus lateralis muscle was monitored by near-infrared spectroscopy. The fundamental phase II time constants for Vo(2)(p) (tauVo(2)) and deoxygenation kinetics {effective time constant, tau' = (time delay + tau), Delta[HHb]} during moderate-intensity exercise were estimated using nonlinear least-squares regression techniques. The tauVo(2) was reduced by approximately 20% (P < 0.05) after only two training sessions and by approximately 40% (P < 0.05) after eight
training sessions (i.e., post training), with no differences between HIT and END. The tau'\Delta[HHb] (approximately 20 s) did not change over the course of eight training sessions. These data suggested that faster activation of muscle O(2) utilization was an early adaptive response to both HIT and lower-intensity END training. That \Delta[HHb] kinetics (a measure of fractional O(2) extraction) did not change despite faster Vo(2)(p) kinetics suggested that faster kinetics of muscle O(2) utilization were accompanied by adaptations in local muscle (microvascular) blood flow and O(2) delivery, resulting in a similar "matching" of blood flow to O(2) utilization. Thus faster kinetics of Vo(2)(p) during the transition to moderate-intensity exercise occurred after only 2 days HIT and END training and without changes to muscle deoxygenation kinetics, suggesting concurrent adaptations to microvascular perfusion.

Torres et al. (2009), found out the acute effects of exercise on blood lipids are not well known, and there have been few studies comparing different kinds of exercise in the same population. The concentration of blood lipids was evaluated in this study at the end and at post-24 h of two 14 km/90 min single exercise sessions: continuous exercise (CE) at 44.5 ± 5.6% \text{VO}_{2\max} and intermittent exercise (IE) at 39–72% \text{VO}_{2\max}, in subjects with high levels of aerobic training. Fourteen male
athletes (endurance runners) took part in this study and each completed a 24 h dietary record. The $O_2$ uptake and $CO_2$ production were recorded, and blood lactate and blood lipids were measured. The results showed that triacylglycerols were not modified by any kind of exercise. Total cholesterol was increased at the end of both exercises: 7.04% for CE ($p < 0.001$) and 4.23% for IE ($p = 0.001$). High-density lipoprotein cholesterol was increased at the end of IE: 11.38% ($p = 0.03$) and low-density lipoprotein cholesterol was increased only at the end of CE: 7.45% ($p = 0.006$). The increase of lipids for CE was negatively correlated with aerobic fitness indicators (heart rate and %HRmax at lactate threshold), and was positively associated with energy expenditure. For IE, %HRmax and lactate were negatively correlated, and the respiratory exchange ratio was positively correlated, with the lipid increase. We conclude that in trained male athletes, a 14 km run in 90 min induced different changes of lipid profile if the exercise was done continuously or intermittently, and that in CE the extent of these increases was influenced by aerobic fitness.

*Gharbi et al., (2008)* assessed the effects of continuous and intermittent exercise training on lactate kinetic parameters and maximal aerobic speed (MAS) using field tests. Twenty-four male sport students were equally divided into continuous (CT) and intermittent (IT) physically trained groups. Another six
participants acted as non-trained controls (CG). The trained participants practiced 6-days per week for 6 weeks. Before and after training, all participants completed an incremental exercise test to assess their MAS, and a 30-second supramaximal exercise followed by 30 minutes of active recovery to determine the individual blood lactate recovery curve. It was found that exercise training had significantly increased MAS (p< 0.001), the lactate exchange and removal abilities as well as the lactate concentrations at the beginning of the recovery ([La]- (0)); for both CT and IT groups; this was accompanied by a significant reduction of the time to lactate-peak. Nevertheless, the improvement in MAS was significantly higher (p < 0.001) post-intermittent (15.1 % ± 2.4) than post-continuous (10.3 % ± 3.2) training. The lactate-exchange and removal abilities were also significantly higher for IT than for CT-group (P<0.05). Moreover, IT-group showed a significantly shorter half-time of the blood lactate (t-½-[La]) than CT-group (7.2 ± 0.5 min vs 7.7 ± 0.3 min, respectively) (p < 0.05). However, no significant differences were observed in peak blood lactate concentration, time to reach and [La]- (0) between the two physically-trained groups. It was concluded that both continuous and intermittent training exercises were equally effective in improving t-[La]peak and [La]peak, although intermittent training was more beneficial in
elevating MAS and in raising the lactate exchange ($\gamma_1$) and removal ($\gamma_2$) indexes.

**Greiget et al., (2007)** examined the interaction of physical and cognitive responses during soccer-specific intermittent exercise. Ten semi-professional soccer players completed a 90-minute laboratory-based treadmill protocol replicating the activity profile of soccer match-play. Two separate trials were performed in randomised order, with and without the added stressor of a continuous grid-based vigilance task. The exercise task comprised six repetitions of a 15 minute activity profile, separated by a passive 15 minute half-time interval. The vigilance task required continual attention and sporadic target response within a letter grid. Physical response (RPE, heart rate, blood lactate, salivary cortisol) and cognitive performance (response time, response accuracy) were quantified at 15 minute intervals. Completing the exercise task with the vigilance task resulted in decreased physiological (heart rate, blood lactate) response. This may be attributed to externally directed attention, resulting in association with the cognitive task and subsequent dissociation from the physical effort. Response speed generally improved with exercise duration, while there was evidence of impaired accuracy in the early stages of the first half and the latter stages of the second half. The interaction of physical and mental work was not
additive in nature. The mental task had a masking effect on the physical response. Performing physical exercise tasks without due regard for appropriate psychological stimuli may therefore overestimate the physiological response.

*Chamari et al., (2004),* determined if there are correlations between the physical fitness of young soccer players assessed by field and laboratory testing. Thirty four male soccer players took part in the study (mean (SD) age 17.5 (1.1) years, height 177.8 (6.7) cm, weight 70.5 (6.4) kg). Maximal oxygen uptake (VO$_2$MAX) during treadmill running and vertical jump height on a force platform were measured in the laboratory. Field tests consisted of a soccer specific endurance test (Bangsbo test) and 30 m sprint with 10 m lap times. The Bangsbo test correlated with the lowest velocity associated with VO$_2$MAX ($v_{VO_2\text{MAX}}$; $R^2= 0.55$, $p<0.001$), but not with VO$_2$MAX. Sprint times at 30 m and 20 m were related to peak extension velocity and peak extension force measured during vertical jumping, but not to vertical jump height per se. The jumping force and velocity could explain 46% of the 30 m sprint performance ($R^2= 0.46$, $p<0.001$). The Bangsbo test and 30 m sprint test correlated with $v_{VO_2\text{MAX}}$ and vertical jump force and velocity respectively. The Bangsbo test did not give a good estimate of VO$_2$MAX in young soccer players.
Buyukyazi et al., (2003) found out the effects of two different eight-week aerobic training programs consisting of continuous (CR) or extensive interval running (IR) on serum growth (GH) and cortisol hormones in 33 male basketball players aged 15-16 were assessed. The CR group ran 4.8 km and the IR group ran 4 x 1.2 km, using equal work-to-rest ratio, three times per week. Aerobic power scores of all subjects and anaerobic power marks of the training subjects increased (p<0.01). Upon exertion, though serum GH levels increased in both exercise groups (p<0.01) prior to and following training; cortisol levels increased only in the IR group prior to training, and in both exercise groups following training (p<0.05). Following the eight week period, resting cortisol levels rose in the training (p<0.05) and control (p<0.01) groups. It was concluded that, an 8-week training program consisting of continuous or extensive interval running had been effective on acute GH and cortisol secretion in 15-16 year-old male athletes.

Williams, (2000), investigated the effects of two contrasting eight week training programmes on the aerobic performance of 39 prepuberscent boys (mean age 10.1 years). All boys were volunteer subjects from three city schools and the schools were matched by a health related behaviour questionnaire. All boys were assessed as Tanner stage one for genitalia and pubic hair
development. Criterion laboratory tests included peak VO\(_2\) as assessed by an incremental discontinuous treadmill test to voluntary exhaustion. Submaximal measurements of heart rate, minute ventilation (VE) and VO\(_2\) were also recorded during the treadmill test. One of the schools provided the control group (n = 14), and boys from the other schools followed two contrast training programmes. The first was a sprint interval running programme (n = 12) comprising 10 second and 30 second sprints, and the second a continuous cycle ergometer programme (n = 13) maintaining a heart rate in the range 80–85% of maximum for 20 minutes on a Monark cycle ergometer. After eight weeks training three times a week, the three groups were retested. There were no significant differences in peak VO\(_2\) (p>0.05) with training in either of the groups. There were no significant changes in any of the submaximal variables VO\(_2\), VE, or heart rate (p>0.05). The findings of this study indicated that neither eight week sprint interval running nor continuous cycle ergometer training programmes significantly improve maximal or submaximal indicators of the aerobic performance of prepubertal boys.
Karabatsas et al.,(1998) compared postoperative astigmatism induced by two different suturing techniques in penetrating keratoplasty (PKP). For this purpose A total of 95 eyes undergoing PKP were randomized into 2 groups. Of these, 51 eyes were allocated to the combined interrupted and continuous suturing group (ICS) and 44 eyes to the single continuous adjustable suturing (SCAS) group. In the ICS group, suturing was with a combination of 12 interrupted 10-0 nylon and 1 continuous 11-0 nylon sutures. Eyes in the SCAS group had been sutured with a single running 24-bite 10-0 nylon. Selective suture removal started no earlier than 10 weeks after surgery; suture adjustment could start as soon as possible after surgery. Astigmatism was measured by topography, keratometry, and refraction at 3-, 6-, 9-, and 12-month postoperative intervals. The difference in mean time of suture manipulation between groups was significant ($P = 0.0001$), with the SCAS starting earlier. A significant decrease in astigmatism occurred by either interrupted suture removal ($6.69 \pm 3.11$ diopter [D] before to $4.76 \pm 2.99$ D after, $P = 0.0002$) or suture adjustment ($7.18 \pm 3.12$ D before to $4.46 \pm 3.24$ D after, $P = 0.0001$). However, the net astigmatic reduction in the SCAS group was not significantly greater ($P = 0.250$) than in the ICS group. Vector change was $7.40 \pm 4.17$ D and $6.28 \pm 4.14$ D for SCAS and ICS, respectively ($P = 0.13$). At no
interval (3, 6, 9, or 12 months) was there significant difference in astigmatism between the two groups. Refractive astigmatism (cyl, D) at 1 year was 2.66 ± 1.70 for the ICS and 3.12 ± 2.62 for the SCAS, but there was no significant treatment effect ($P = 0.945$). Furthermore, 66% of the ICS eyes and 58% of the SCAS eyes ($P = 0.295$) were within the astigmatic target of the study (<3.5 D). Post keratoplasty astigmatism can be decreased similarly with either adjustment of a single running suture or selective removal of interrupted sutures. No advantage of the SCAS over ICS in terms of fewer manipulations or less astigmatism was seen as suggested previously.

**Chatterjee and Bandyopadhyay (1993),** investigated the endurance training on a group of 41 East Indian boys aged 10-14 years and was compared with 25 untrained boys of the same age. A continuous slow-running method was adopted for 12 weeks. The intensity of the training was 80-85% of maximum heart rate and frequency was 3 days per week. The boys were trained for a 1500-m event and therefore they covered three to five times their racing distance. The investigations included different physical and motor fitness tests: measurement of flexibility, agility, speed, leg muscle strength etc. Their performance times were also recorded before and after training. From statistical analysis it was concluded that this particular type of training programme did not
produce any detrimental effects on 10-14-year-old boys. On the other hand, this type of training did have some influence on improving physiological parameters in this age group of boys when compared with untrained boys of the same age.

(ii) Studies Relating to Mental Training:

Sponholz (2012), conducted with nine divers at a Division III college matched for age, experience level, sex, and skill level, to investigate the effect of mental-skills training on divers’ overall performance and perception of success. The athletes were part of a study where in addition to their diving practices they were exposed to training in three different psychological skills: goal setting, self-talk, and visualization. Program effectiveness was evaluated through two different measures, anxiety and performance. The mental-skills measures consisted of pre and post results on (a) the Test of Performance Strategies (TOPS), (b) the Sport Competition Anxiety Test (SCAT-A), and (c) the Trait Sport Confidence Inventory (TSCI). The performance measures consisted of (a) the athletes recorded scores for each meet, and (b) the Questionnaire A: The Athlete’s Perceptions of Quality of Performance during Practice.
Wolfram and Micklewright (2011) investigated the effects of mental skills training on precompetitive anxiety and performance in nonelite equestrian dressage riders. The intervention comprised mental training techniques, such as goal-setting, relaxation techniques, self-talk, concentration training, and imagery, which were commonly used in sports. Ten Dutch nonelite dressage riders were recruited for the study and used as their own controls. Riders had to participate in an initial competition approximately 6-8 weeks before the beginning of the study. They participated in the second competition approximately 1-2 weeks before the intervention, and in the third, and last, competition upon completion of the 6-week intervention training program. Intervention training took place for 2 hours per week for a period of 6 weeks. A one-way repeated measure analysis of variance with post hoc paired samples t-tests revealed a significant difference between competitive results before and after the intervention. Findings suggested that mental skills training have a positive effect on competitive dressage performance in nonelite riders.

Sadeghi et al. (2010) identified the kind of mental skills training needed by the university soccer players. Eight male university football players (aged 25 to 36) from one large
university in Kuala Lumpur agreed to participate in this study. On average, they have 10 years of playing experience. All of them have signed the informed consent letter to be tape-recorded. The interview transcripts were then hierarchically content analyzed to identify the themes. The findings revealed four themes emerged which were imagery, goal setting, self-talk, and relaxation. These four themes were the most needed psychological skill training by the respondents.

_Shalaby (2010)_ found out the effectiveness of a mental training program on improving the shooting level of basketball beginners. A sample of 30 players of age under 16 years old of Young Muslims Club in Port Said had been selected (15.404±0.794 years and 4.313±0.769 years). They have been divided into two groups (experimental and control). The experimental group was subjected to a mental training program of eight weeks at five units of training each week at a rate of 15 to 30 minutes. The results have indicated to remarkable progress in the various research variables: the perception of time and distance, the ability to relax, performance level, visual spatial perception and the percentage of shooting while there was no significant progress compared to what was achieved when the mental training program preceded the implementation of the sports training program.
*Lutz et al., (2009)* investigated three months of intensive meditation training reduced variability in attentional processing of target tones, as indicated by both enhanced theta-band phase consistency of oscillatory neural responses over anterior brain areas and reduced reaction time variability. Furthermore, those individuals who showed the greatest increase in neural response consistency showed the largest decrease in behavioral response variability. Notably, it was also observed that reduced variability in neural processing, in particular in low-frequency bands, regardless of whether the deviant tone was attended or unattended. Focused attention meditation might affect both distracter and target processing, perhaps by enhancing entrainment of neuronal oscillations to sensory input rhythms, a mechanism important for controlling the content of attention. These novel findings highlighted the mechanisms underlying focused attention meditation and support the notion that mental training could significantly affect attention and brain function.

*Nelson et al., (2008)* studied the effects of video and cognitive imagery on throwing performance of baseball pitchers. A sample of pitchers (n=30) were asked to take the Movement Imagery Questionnaire–Revised; study participants were randomly selected from the highest and lowest twenty percent of the group. The participants were obtained from high school and college
teams within southeastern Georgia (n= 6). Following the first week of baseline measurements, two high-ability and two low-ability imagers took part in a three-week video imagery and imagery intervention program. One participant from each group together constituted a control group, which was asked only to try their best when throwing for the study’s accuracy measurements. Results showed that two participants demonstrated an increase in performance, while all participants expressed a desire to continue to use imagery for its various effects.

*John Parthiban et al., (2006)*, analyzed the effects of mental Training on selected psychological variables of University Soccer Players. The study was conducted on thirty two men soccer player who participated in the Bharathidasan University Inter collegiate soccer tournaments. Subjects were randomly assigned equally into two groups, Group –I underwent mental training (n = 16) and Group II (n=16) acted as control. The data collected from the experimental and control groups were statically examined with Analysis of covariance (ANCOVA). Imagery Ability, Mental Preparation, Self Confidence, Anxiety, worry management, Concentration Ability and Relaxation Ability showed significant difference between the groups.
Devonport (2006) explored the views of three high performance kick boxers regarding the contribution of psychology to the development and maintenance of expert performance within kickboxing. The results provided a useful insight into the experiences of high performance kick boxers, identifying those mental skills and psychological attributes that are perceived to contribute to success. Participants identified seven mental skills that they believed to be linked to success in kickboxing; 1) effective use of self-talk, 2) relaxation, 3) heightened concentration, 4) self-regulation of arousal, 5) goal setting, 6) coping with being hit, and 7) imagery. Three psychological characteristics were identified by all participants as contributing to success, 1) high self-efficacy, 2) highly motivated and 3) mental toughness. Although not specifically identified by participants, it was suggested that a fourth psychological characteristic was also apparent. Participants demonstrated varying degrees of emotional intelligence through their ability to monitor and manipulate their emotional states prior to and during competition. Martial artists used a number of long and short-term psychological strategies in preparing for competition. Furthermore, while mental skills were not systematically practiced, all participants endeavored to integrate some form of mental training within physical training. The author concluded that the integration of mental skills
training within physical training might help ensure quality practice, and facilitate the effective transfer of mental skills into competition.

**Ramachandran (2005)** examined the effect of various imagery modalities on pre-competitive anxiety, self-confidence and archery performance. Twenty-four male archers, were randomly assigned to one of the following four groups: Group A, the written script group, received a personalized proposition led script; Group B, listened to an audio tape; Group C, watched an internal – perspective video tape of themselves performing; and Group D, the control group received no imagery training, and spent an equivalent amount of time reading archery literature. The subjects had archery practice sessions thrice a week for six weeks period, during which the experimental groups underwent the different modalities of imagery intervention programme. The programme effectiveness was evaluated through the Competitive State Anxiety Inventory - 2 (CSAI - 2) and actual performance points in archery. The pre-test post test data were statistically analysed for comparisons in pre-competitive anxiety, self-confidence and archery performance among the various groups. The results indicated an increase in the direction decision of somatic anxiety, cognitive anxiety and self-confidence for the imagery intervention groups as compared to the control groups.
The results also revealed that the video and audio groups performed significantly better than the written script group in archery performance.

_Mamassis and Doganis (2004)_ studied the effects of mental training programme on junior’s pre-competitive anxiety, self-confidence and tennis performance. This investigation reported the impact of a season-long Mental Training Program (MTP) on two elite junior tennis players. The two reported cases were part of a study in which MTP players \((n = 5)\) in addition to their tennis practice were exposed to 5 different psychological skills: goal setting, positive thinking and self-talk, concentration and routines, arousal regulation techniques, and imagery. Another group of elite junior tennis players \((n = 4)\) followed the same amount and quality of tennis practice but received no mental training practice. Program effectiveness was evaluated through (a) the Competitive State Anxiety Inventory - 2 (CSAI-2), (b) the athletes’ appraisal on 8 aspects of tennis performance, and (c) tennis-specific statistical data of two selected cases. The results indicated an increase in the direction dimension of the somatic anxiety, cognitive anxiety and self-confidence for the intervention group at the post test. Moreover, the intensity of self-confidence, as well as the overall tennis performance, was greater for all the participants of the intervention group after the MTP.
Results on two selected cases were reported which clearly demonstrated the effectiveness of the MTP in eliminating specific performance problems.

*Eli and Blumenstein, (2004)*, found the relationship between mental training with biofeedback and swimmers’ performance. The Wingate five-step approach was used as a mental preparation technique for enhancing the performance among 16–18 year-old pre-elite swimmers. Participants (n=40) were randomly assigned to one of two conditions: (a) experimental regular training plus the Wingate 5-step mental training program (adapted for swimming), and (b) control - regular training plus relaxing activities. After a baseline measurement, participants were tested on running and swimming five times during a 10-week period. Results indicated that the experimental group improved its performance over time on both running and swimming, with improvement being most substantial during transformation and realization (steps 4 and 5). In contrast, the control group remained relatively stable on both dependent measures.

*Bar-Eli et al*(2002) investigated the relationship between mental training with biofeedback and performance. An adapted version of the Wingate five-step approach was used as a mental preparation technique for enhancing the swimming performance
among 11–14-year-old children swimmers. Participants \((n=38)\) were randomly assigned to one of two conditions: (a) experimental—regular training plus three stages of the Wingate mental training program, and (b) control—regular training and relaxing activities. After a baseline measurement, participants were tested on evaluation scores and actual performance twice during a 14-week period. Results indicated that the experimental group exhibited a greater increase in performance, although the control group displayed some improvements.

*Rogerson and Hrycaiko (2002)*, examined the effectiveness of two mental skills on the performance of ice hockey goaltenders during league games. The mental skills utilized were relaxation, in the form of centering, and self talk. The participants were five male junior A hockey goaltenders. A single–subject multiple baseline across individuals design was employed to evaluate the use of mental skill. The results demonstrated that the mental skill training was effective in producing improvements in the save percentage of the goaltenders. The social validation results indicated that the participants enjoyed using the mental skills and were satisfied with the results obtained. Furthermore, the coaches were very satisfied with the results and felt that the mental skill training was an important ingredient for improving performance, in particular performance consistency.
Carboni et al., (2002) conducted a study that sought to examine the effects of brief (5-minutes or less) imagery training on free throw performance of college athletes. In this single subject, multiple baseline investigation, the authors used the previous season’s free throw percentage and compared that percentage to the percentage established throughout the intervention for each of the five participants in the study. One athlete was used as the control for this investigation and did not take part in any of the imagery training during the study. The proper use of imagery was taught to each of the five participants in the study and asked to engage in a brief imagery session prior to shooting any set of free throws once the intervention phase began. Results of this study did not show any consistent increases or decreases in free throw shooting percentage. However, there were increases in the ability to concentrate on the task after the imagery intervention was implemented.

Palanisamy(2002) investigated the effects of mental training on selected bio-motor, psychological variables and soccer skills of university soccer players. For this study, thirty two Inter Collegiate soccer players of Bharathidasan University who participated in the Bharathidasan University inter collegiate soccer tournament held in the year 2001-2002 were selected as subjects. The subjects were assigned at random to one of the two
groups in which Group-I underwent mental training programme (N=16) and group II acted as control (N=16). The mental training period for the experimental groups was ten weeks. Bio-motor variables namely endurance, strength and speed, psychological variables namely imagery ability, mental preparation, self-confidence, anxiety and worry management, concentration ability, relaxation ability and performance variables namely dribbling, kicking and passing were only selected as criterion variables. Twelve minutes run/walk, fifty metres run, push-ups, Hary and Nelson’s mental skills questionnaire, Warner test for soccer skills and Mor - Christian soccer test were used to assess the bio-motor, psychological and soccer skills respectively. The data was collected from the experimental and control groups two days before and after the experimental treatment. The pre test and post test data were statistically examined with dependent ‘t’-test and applying the analysis of covariance (ANCOVA) for each and every variable selected for this study. The results of the study indicate that the experimental group which underwent skill training along with mental training showed significant improvement in all the selected bio-motor, psychological variables and Soccer skills.
Cumming and Hall (2001) examined mental imagery within the context of the deliberate practice framework. Altogether, one hundred and fifty nine athletes from one of three different competitive standards (recreational, provincial and national) completed the Deliberate Imagery Practice Questionnaire, which was designed for the present study to assess the athletes’ perceptions of the importance of imagery along the three deliberate practice dimensions of relevancy, concentration and enjoyment. The results indicated that national athletes perceived imagery to be more relevant to performing than recreational athletes. In addition, athletes of a higher standard (i.e. provincial and national) reported using more imagery in a recent typical week and they had accumulated significantly more hours of imagery practice across their athletic career than recreational athletes. Finally, the relationships among the dimensions of deliberate practice did not lend conclusive support to either the original conception of deliberate practice or a sports-specific framework of deliberate practice.

King (2001) investigated the role exercise intensity in reducing body weight and percent body fat in overweight women. Subjects were randomized to either a high intensity interval training group (IT) or a lower intensity steady state training group (ST). Each group exercised 3 times per week for 8 weeks and
expended 300 kcal per exercise session. VO2max, body composition, and resting metabolic rate (RMR) were measured pre and post training. VO2max and body composition improved in IT but not in ST. Neither group showed a change in RMR from pretest to posttest; however, IT had an increase in RMR 24 hours post-exercise whereas ST did not. These findings showed that high intensity interval exercise produced improvements in body composition, fitness, and acute RMR compared to low intensity steady state training.

Kalidasan (1999) investigated the influence of training with and without psych up strategies on selected bio-motor, physiological, psychological and performance variables among cricket players. Forty-two Sivagangai district cricket players were served as subjects. Psych-up package was given for 20 minutes each day in the morning and evening sessions except on the rest day. The pre test and post test data were statistically examined for significant difference, applying the ANOVA for each and every selected variable. Psych-up strategies shown significant improvement after the completion of training programme of ten weeks in endurance, strength, speed, aerobic power, anaerobic power resting, pulse rate and psychological variables among cricket players.
Collet et al., (1998) conducted a study to assess objectively the processes of mental rehearsing (imagery) by measuring variations of the autonomic nervous system (or ANS responses) during an open-ended complex motor skill in two actual experiments (volleyball) and during mental rehearsing taking place between them. Comparison between pre- and post-test (volleyball) scores related to imagining and non-imagining performances revealed significant improvement in case of the later. The ANS parameters (skin potential and resistance, skin temperature and heat clearance, instantaneous heart rate and respiratory frequency) were quantified by original techniques and indices. Results from a principal component analysis showed a strong correlation between the responses in actual tasks (pre- and post-test volleyball) and during mental imagery, since the same preferential variables appeared on the main axis in 87% of cases. Thus the same autonomic channels seemed to be used during the actual activity and during the mental imagery of this activity. So far as basic results were concerned, the main finding was a differing development of skill between imagining and non-imagining volleyball players. No clear difference was seen between pre- and post-tests in non-imaginers, except an increase in the median of the duration of the response observed in heat clearance. Conversely, for other ANS parameters, a significant
decrease was seen in the post-test responses compared to pre-test responses in the imagining group, while no change was observed in non-imaginers, except in the duration of the heat clearance response where an increase was seen. Compared to the non-imagining group, the latter result was associated with a response decrease in the imagining group. Thus mental rehearsing induced a specific pattern of autonomic response: decreased amplitude, shorter duration and negative skin potentials compared to the control group. Therefore it was suggested that in the case of open-ended motor activity, mental rehearsing may help in the construction of schema which can be reproduced, without thinking, in actual practice. Thus a neural information process might develop in the central nervous system changing from a parallel into a serial treatment.

**Bakker and Kayser, (1994),** found out the effect of a mental training programme on several psychological variables and field hockey performance (penalty stroke). Twenty-nine female hockey players, playing at sub national level, were divided into an experimental, a placebo-control and a control group. Subjects in the experimental group received instruction on how to relax, concentrate and imagine making penalty strokes. They also received an audio tape containing these mental training instructions, and were asked to listen to it every day for about 10
minutes over a period of seven weeks. The hockey performance of the experimental group was significantly better on the third test occasion than that of both control groups. Competitive state anxiety prior to performing penalty strokes did not differ between the three groups. However, at the end of the experiment, the experimental group reported their feeling as more confident, more relaxed and better concentrated when making penalty strokes than subjects in either placebo-control or control group. Subjects in the experimental group attributed their feelings to listening to the audio tapes.

(iii) Allied Literatures

Ghosh (2002) conducted a study on selected coordinative abilities on 15 male sprinters and 15 male jumpers of Lakshmibai National Institute of Physical Education, Gwalior with the purpose to find out the coordinative ability between the track events and fields events. The variables selected for the study were orientation ability, differentiation ability, reaction ability, balance ability and rhythm ability. ‘t’ ratio on all the variables was applied and on the basis of the results it was found orientation ability and reaction ability showed significant difference between the sprinters and jumpers, Differentiation ability, balance ability and rhythm ability there was no significant differences between the sprinters and
jumpers and further the results revealed that the sprinters and the jumpers did not differ completely.

**Jinsy (2001)** conducted a study on coordinative abilities on twenty male Hockey players of Lakshmibai National Institute of Physical Education, Gwalior with the purpose to find out the relationship of selected coordinative abilities to shooting performance in Hockey. The variables selected for the study were orientation ability, differentiation ability, reaction ability, balance ability and shooting ability. Pearson’s Product Moment Correlation was applied to find out the relationship of coordinative abilities performance. It was found that there was no significant relationship on coordinative abilities to shooting performance in Hockey. And also further concluded that shooting was not only depending upon coordination but many other factors there might also affect it.

**Hota (2001)** conducted a study on selected coordinative abilities on twenty male football players studying at Lakshmibai National Institute of Physical Education, Gwalior with the purpose to find out the relationship of coordinative abilities (orientation ability, differentiation ability, balance ability, rhythm ability and playing ability). To find out the relationship of coordinative ability to soccer playing ability, the collected data were subjected to
Pearson’s product moment correlation. On the basis of the results, following conclusions were drawn:

1. Co-ordinative abilities namely orientation ability, reaction ability and rhythm ability were significantly related to playing ability.
2. Differentiation ability and balance ability were not significantly related to playing ability.
3. Coordinative ability played a crucial role in football performance.

*Sisodia (2000)* conducted a study on selected coordinative abilities in sixty Judokas studying at various courses at Lakshmibai National Institute of Physical Education and Jiwaji University, Gwalior with the purpose to find out the effects of transcendental meditation on selected physiological variables and coordinative abilities in Judo. The variables selected for the study were reaction ability, orientation, differentiation balance and rhythm ability. The selected physiological variables were an aerobic power, vital capacity, resting respiratory rate, resting heart rate and body composition. ‘t’ test was applied for all the variables. On the basis of the results the following conclusion were drawn:
1. In case of an aerobic performance, transcendental meditation did not improve significantly in comparison to the non meditation group.

2. In case of vital capacity transcendental meditation had not shown any significant improvement among experimental groups as compared to the control group.

3. In case of total body fat percentage, transcendental meditation had not shown any significant change in comparison to non mediation group.

4. The balance ability improved significantly as compared to control group.

5. With regard to lean body weight, transcendental meditation was found to be ineffective for experimental group as compared to control group.