CHAPTER-II

REVIEW OF RELATED LITERATURE

The study of relevant literature is an essential step to get a clear idea of what has been done, with regard to the problem under study. Such a review brings about a deep and clear perspective of the overall field. The research for reference material is a time consuming but fruitful phase of the research 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. A serious and scholarly attempt has been made by the scholar to go through the related literature and a brief review of the studies related to the present problem is described in this chapter.

The reviews were classified and presented under following headings

2.1 Studies on resistance training

2.2 Studies on morphological Variables

2.3 Studies on skill related Physical fitness

2.4 Summary of Review of related Literature

2.1 STUDIES ON RESISTANCE TRAINING

James Fisher, et al. (2011) Stated that Resistance training produces an array of health benefits, as well as the potential to promote muscular adaptations of strength, size, power and endurance. The American College of Sports Medicine (ACSM) regularly publish a position stand making recommendations for optimal achievement of the desired training goals. However, the most recent position stand (as well as previous ones) has come under heavy criticism for misrepresentation of research, lack of evidence and author bias. Therefore this paper proposes a set of scientifically rigorous resistance training guidelines, reviewing and summarising the relevant research for the purpose of proposing more logical, evidence-based training advice. They recommend that appreciably the same muscular strength and endurance adaptations can be attained by performing a single set of ~8-12 repetitions to momentary muscular failure, at a repetition duration that maintains muscular tension throughout the entire range of motion, for most major muscle groups once or twice each week. All resistance types (e.g. free-weights, resistance machines, bodyweight, etc.) show potential for increases in strength, with no significant difference between them, although resistance machines appear to pose a lower risk of injury. There is a lack of evidence to suggest that balance from free weights or use of unstable surfaces shows any transference to sporting improvement, and explosive movements are also not recommended as they present a high injury risk and no greater benefit than slow, controlled weight training. Finally, we consider genetic factors in relation to body type and growth potential.

Mei-Hwa Jan, et al. (2008) compared the effects of high- and low-resistance strength training in elderly subjects with knee OA. One hundred two subjects were randomly assigned to groups that received 8 weeks of high-resistance exercise (HR group), 8 weeks of low-resistance exercise (LR group), or no exercise (control group). Pain, function, walking time, and muscle torque were examined before and after intervention. Significant improvement for all measures was observed in both exercise groups. There was no significant difference in any measures between HR and LR groups. However, based on effect size between exercise and control groups, the HR group improved more than the LR group. Both high- and low-resistance strength training significantly improved clinical effects in this study. The effects of high-resistance strength training appear to be larger than those of low-resistance strength training for people with mild to moderate knee OA, although the differences between the HR and LR groups were not statistically significant.

Harries, ubans and Robin Callister,(2012) determined the effectiveness of resistance training programs on muscular power on and sports performance in adolescent athletes. A systematic search of Medline, Embase, and Sport Discus databases was conducted 21st

March 2011 to identify studies evaluating resistance training programs on power and sports performance in adolescent athletes. Thirty-four studies were identified. All but two of the studies reported at least one statistically significant improvement in an alactic muscular power outcome. The most common indicators of alactic power were vertical jump (25 studies) and sprint running (13 studies) performance. Fourteen studies provided data to allow for pooling of results in a meta-analysis. A positive effect was detected for resistance training programs on vertical jump performance (mean difference 3.08 [95% CI 1.65, 4.51], $Z = 4.23$ [$P < 0.0001$]). There is sufficient evidence to conclude that resistance-training interventions can improve muscular power in adolescent athletes. A positive effect on sports performance attributable to participation in resistance training was reported by almost half the included studies, however limited objective evidence to support these claims was found. Improvements in motor performance skills, such as jumping, are widely stated as indicators of improvements in sporting performance.

Simon, Lubans and Robin Callister, (2012) determined the effectiveness of resistance training programs on muscular power and sports performance in adolescent athletes. A systematic search of Medline, evaluating resistance training programs on power and sports performance in adolescent athletes. Thirty-four studies were identified. All but two of the studies reported at least one statistically significant improvement in an alactic muscular power outcome. The most common indicators of alactic power were vertical jump (25 studies) and sprint running (13 studies) performance. Fourteen studies provided data to allow for pooling of results in a meta-analysis. A positive effect was detected for resistance training programs on vertical jump performance (mean difference 3.08 [95% CI 1.65, 4.51], $Z = 4.23$ [$P < 0.0001$]). There is sufficient evidence to conclude that resistance-training interventions can improve muscular power in adolescent athletes. A positive effect on sports performance attributable to participation in resistance training was reported by almost half the included studies, however limited objective evidence to support these claims was found. Improvements in motor performance skills, such as jumping, are widely stated as indicators of improvements in sporting performance.

Hamid Arazi and Abbas Asadi, (2011) determined the effects of short-term equal-volume resistance training with different workout frequency on maximal strength, endurance, and body composition in novice subjects. Thirty-nine healthy males comprised four groups; total-body resistance training (12 exercises for one session per week) (part I=10), total-body resistance training (12 exercises for two sessions per week) (part II=10), lower-body, upper-body, and upper-body resistance training (12 exercises for three sessions per week) (part III=9), and control group (CG=10). Assessments of body composition, leg and arm circumferences, body weight, strength (one repetition maximum in bench and leg press) and endurance (bench and leg press) were determined before and after 8 weeks of training. One repetition maximum in bench and leg press was improved significantly in all training groups ($P < 0.05$). All groups increased body weight, body composition, and bench and leg press endurance ($P < 0.05$), but PIII group showed a little improvement rather than other groups ($P > 0.05$). The PIII group not only increased thigh circumference but also improved arm circumference, whereas the PI and PII groups changed either arm circumference or thigh circumference ($P < 0.05$). It is concluded that in healthy young men, whole and split weight training routine produce similar results over. The first 2 months of training, with minimal differences among groups.

Anil Kumar, (2014) Conducted a study on the effect of resistance exercise on strength of Kabaddi players. For this study experimental design was used on ten Kabaddi players of Bhiwani District of Haryana. A three weak training program was organized after taking pre-test of the players, then post-test was done for testing strength of players. Only Dead lift and Leg Extension was selected for the study. For statistical analysis of the data, mean, S.D, S.E.D and t-test was applied. In this study the results were found to be significant at 0.05 levels. It was found that there is a significant difference in the strength of Kabaddi player before and after training.

Fereshteh Shahidi, et al, (2012) compared the effects of two resistance training types—i.e. low repetition/high resistance vs. low resistance/high repetition—on muscle fitness and anaerobic capacity of 16-18 Years Old male soccer players. The research was quasi-experimental and the population consisted of all the 16-18 Years Old male soccer players. Thirty soccer players invited to a local team's camp in Minudasht were selected as sample. The subjects were randomly divided into three groups—two experimental groups and a control group (Experimental A group: 17.19±0.73 years, 59.49 ± 9.82 kg, 171.50 ± 6.93cm; Experimental B group: 171.10 ± 0.55 years, 56.32 ± 6.75 kg, 172.10 ± 6.13 cm ; and the control group: 17.40 ± 0.42 years, 52.64± 4.41 kg, 170.10 ± 6.93 cm). The independent variables of the research were two types of resistance trainings and the dependent variables were lower-body explosive power, lower-body muscle endurance, running speed, maximum lower-body strength, agility, and abdominal muscle endurance. First, the subjects took the pretest, and then the two experimental groups performed the selected exercises along with technical soccer exercises, while the control group only performed thetechnical soccer exercises for 8 weeks. Finally, all the subjects took the posttest. The obtained data were analyzed using descriptive and inferential (correlated t-test and ANOVA) statistics. The results showed that except for agility, both resistance training types led to change in lower-body explosive power, lower-body muscle endurance, running speed, maximum lower-body strength, and abdominal muscle endurance. The results of correlated t-test showed that there was no significant difference between the two types of resistance trainings. Thus, considering the results of the research, resistance training is probably effective for improving lower-body explosive power, lower-body muscle endurance, running speed, maximum lower-body strength, and abdominal muscle endurance in 16-18 Years Old male soccer players.

Kraemer William, Ratamess Nicholas and French Duncan, (2002)

Resistance training is recommended by national health organizations for incorporation into a comprehensive fitness program that includes aerobic and flexibility exercise. Its potential benefits on health and performance are numerous; it has been shown to reduce body fat, increase basal metabolic rate, decrease blood pressure and the cardiovascular demands to exercise, improve blood lipid profiles, glucose tolerance, and insulin sensitivity, increase muscle and connective tissue cross-sectional area, improve functional capacity, and relieve low back pain. Many improvements in physical function and athletic performance are associated with the increases in muscle strength, power, endurance, and hypertrophy observed during resistance training. The key element to effective resistance training is supervision by a qualified professional and the proper prescription of the program variables. Proper program design, *ie,* that which uses progressive overload, variation, and specificity, is essential to maximize the benefits associated with resistance training.

2.2 STUDIES ON MORPHOLOGICAL VARIABLES

Rahman Rahimi (2006) determined the effect of 12 weeks of high intensity versus moderate intensity weight training of equal work output on body composition in overweight men (BMI = 25-29.9 kg/m2). Twenty sedentary men (age: 27 ± 0.5 year; Body weight: 84 ± 1.43 kg; BMI: 28.23 ± 1.11 kg/m) were randomized in two equal groups (n = 10): 1) moderate intensity exercise (MI; 5sets*6reps [60% (1RM-1repetition maximum)]; and 2) high intensity exercise (HI; 5sets*6reps [85% 1RM]). The weight training program was performed three days per week. Relative body fat (%BF) was assessed by a skin-fold caliper. Significant differences between and within the groups were analyzed using a two-way split-plot analysis of variance (ANOVA). Statistical significance was accepted at $p<0.05$. The two-way ANOVA showed statistically significant differences between HI and MI groups, therefore, the Scheffe's Post-Hoc Test showed that there was a significant decrease ($p<0.05$) in the relative body fat (BF) (D = 27%), percent of body fat (%BF) (22%), BMI (D = 9.34%), and body weight (BW) (D = 6.51%) in the HI group during the course of the study than in the MI group Also, comparison of means between the pre/post test showed statistically significant decreases in skin fold thickness (HI = 45%, p = 0.001; MI = 25%, p = 0.02),percent of body fat (HI = 41%, p = 0.001; MI = 23%, p = 0.04), BMI (HI = 21.5%, p = 0.001; MI = 13.7%,p = 0.03), and body weight (HI = 21.58%, p = 0.001; MI = 13.82%, p = 0.01) after participation in a 12-week weight training program. It is concluded that 12 weeks of HI weight training may be more effective in improving body composition than MI weight training in overweight young men with physical characteristics similar to the ones found in the present study.

Thomas, (2011) determined the effect strength training frequency of equal volume has on improvements in lean mass and strength. Participants were 7 women and 12 men, age (x= 34.64 years ± 6.91 years), training age (x = 51.16 months ± 39.02 months). Participants were placed into one of two groups. High frequency training group (HFT) trained each muscle group 3 times per week. Low frequency training group (LFT) trained each muscle group one time per week. HFT increased lean mass 1.06 kg ± 1.78 kg, (1.9%), LFT increased lean mass .99 kg ± 1.31 kg, (2.0%). HFT strength improvements on chest press 9.07 kg ± 6.33 kg, (11%) and hack squat 20.16 kg ± 11.59 kg, (21%). LFT strength improvements on chest press 5.80kg ± 4.26 kg, (7.0%) and hack squat 21.83 kg ± 11.17 kg, (24 %). No mean differences between groups were significant. HFT and LFT result in similar improvements in lean mass and strength, following 8 weeks of strength training.

Aranga Panbilnathan and Balamurugan (2011) Conducted a study was to find out the effect of changes during different phases of training on body composition variables such as body mass index and per cent body fat. 30 University level men Kabaddi players were selected and given resistance training under different phases, conditioning, intensive, in season, and off season by manipulating the load, intensities and frequencies of selected weight training exercises. Results proved that different phases of training altered body mass index and there was significant differences between initial and in-season phase. Though per cent body fat showed reduction but they were not significant at 0.05 level at any stage. It was concluded that the different phases of training can be utilized for improving body composition variables by university level men Kabaddi players.

Devaraju & Kalidasan (2012) conducted a study which was to predict the kabaddi playing ability from selected anthropometrical and physical variables among college level players. 144 male inter college kabaddi players were randomly selected from various colleges in Tamilnadu state and their age ranged between 18 and 28 years. The subjects had past playing experience of at least 3 years in kabaddi. A series of anthropometrical measurements was carried out on each participant. These included standing height, body weight, arm length, leg length. Physical fitness components of 50m dash, flexibility, leg explosive strength, muscular power and muscular endurance were taken. The playing ability taken as the performance factor was subjectively assessed by three qualified kabaddi coaches. All testing was done 2 days before inter-college competition. Mean and standard deviations were calculated for each of the selected variables. The inter-relationship among the selected anthropometrical, Physical variable and kabaddi playing ability were computed by using person product-moment correlation coefficients. The result revealed that the inter-relationship exists significantly between the anthropometrical, physical and performance variables among male inter-college kabaddi players. The result also revealed that speed, agility, weight and flexibility become the common characteristics which can predict the playing ability in kabaddi players.

Mahdi Majlesi, Elahe Azadian and Hosein Rashedi, (2012) determined the correlation between anthropometric and physical fitness traits. The agility, dynamic balance, Vo_2 Max and body composition measure for determined kabaddi player. Research was carried out on a sample of 18 teen age Hamedan kabaddi players (aged 18.1± 1.5). Significant relationships were found between balance test and length of leg and hand (r=0.381), as well as a negative relation with body fat (r= -0.461). The result showed that the Players right and left sides have better agility than the other players. Generally Hamadan kabaddi team members were found to have good body compositions but did not assess in an ideal amount in the physical fitness components especially aerobic capacity and agility.

Granacher et al, (2014) investigated the effects of core strength training performed on stable surfaces (CSTS) compared to unstable surfaces (CSTU) on physical fitness in school-aged children. Twenty-seven (14 girls, 13 boys) healthy subjects (mean age: 14 ± 1 years, age range: 13–15 years) were randomly assigned to a CSTS (n = 13) or a CSTU (n = 14) group. Both training programs lasted 6 weeks (2 sessions/week) and included frontal, dorsal, and lateral core exercises. During CSTU, these exercises were conducted on unstable surfaces. Significant main effects of Time (pre vs. post) were observed for the TMS tests (8-22%, f = 0.47-0.76), the jumping sideways test (4-5%, f = 1.07), and the Y balance test (2-3%, f = 0.46-0.49). Trends towards significance were found for the standing long jump test (1-3%, f = 0.39) and the stand-and-reach test (0-2%, f = 0.39). We could not detect any significant main effects of Group. Significant Time x Group interactions were detected for the stand-and-reach test in favour of the CSTU group (2%, f= 0.54). Core strength training resulted in significant increases in proxies of physical fitness in adolescents. However, CSTU as compared to CSTS had only limited additional effects (i.e., stand-and-reach test). Consequently, if the goal of training is to enhance physical fitness, then CSTU has limited advantages over CSTS.

Benjamin Waller, et al, (2013) investigated the effect of an aquatic resistance exercise intervention on cartilage inpostmenopausal women with mild knee osteoarthritis. A minimum of 80 volunteers who meet the inclusion criteria will be recruited from the local population through newspaper advertisements. Following initial assessment volunteers will be randomised into two groups. The intervention group will participate in a progressive aquatic resistance exercise program of 1-hour duration 3 times a week for four months. The control group will be asked to maintain normal care during this period. Primary outcome measure for this study is the biochemical composition of knee cartilage measured using quantitative magnetic resonance imaging; T2 relaxation time and delayed gadolinium-enhanced magnetic resonance imaging techniques. In addition, knee cartilage morphology as regional cartilage thickness will be studied. Secondary outcomes include measures of body composition and bone traits using dual energy x-ray absorptiometry and peripheral quantitative computed tomography, pain, function using questionnaires and physical performance tests and quality of life. Measurements will be performed at baseline, after the 4-month intervention period and at one year follow up. This randomised controlled trial will investigate the effect a progressive aquatic resistance exercise program has on the biochemical composition of cartilage in post-menopausal women with mild knee osteoarthritis. This is the first study to investigate what impact aquatic exercise has on human articular cartilage. In addition it will investigate the effect aquatic exercise has on physical function, pain, bone and body composition and quality of life. The results of this study will help optimize the prescription of aquatic exercise to persons with mild knee osteoarthritis.

Ronenn Roubenoff, et al. assessed the efficacy of progressive resistance training (PRT) in increasing strength and lean body mass (LBM) in HIV-infected adults. Twenty-five adults with HIV infection were trained using a highly intensive PRT regimen for 8 weeks, followed by an additional 8 weeks of observation under ad libitum physical activity conditions. Twenty-four of the 25 patients completed the first phase of the study. They had significant increases in strength on all four exercises tested ($P < 0.0001$), and an increase in LBM of 1.75 ± 1.94 kg (mean ± SD, $P < 0.0002$), with a concomitant decline in fat of 0.92 ± 2.22 kg ($P < 0.05$), and no significant change in weight or bone mineral content. Twenty-one of the patients returned for follow-up 8 weeks after completing the PRT. Compared with their baseline values, their mean lean mass remained 1.40 ± 1.8 kg higher ($P < 0.003$). Among those who continued to train to some extent, lean mass increased by a mean of 1.1 ± 1.6 kg ($n = 9$, $P < 0.05$ versus end of PRT), whereas those who did no further training showed an increase in lean mass of 0.28 ± 1.4 kg ($n = 12$, P = NS versus end of PRT). The difference between the two groups was not, however, significant ($P = 0.25$). Among six patients with AIDS wasting, the increase in LBM was larger than among non-wasted patients (2.8 versus 1.4 kg, $P < 0.06$), and there was an increase in both weight (+3.9 versus –0.2 kg, $P < 0.002$) and fat mass (+ 0.95 versus –1.5 kg, $P < 0.002$) at 8 weeks, which persisted at 16 weeks (weight: +4.0 versus –1.6 kg, $P < 0.0002$; fat: +1.6 versus –1.9 kg, $P <$

0.01). This preliminary study suggests that short-term, high intensity PRT can significantly increase LBM and strength in HIV infection, and may be used as an alternative or adjunct to harmacological anabolic treatments in this disease.

Devaraju and Needhiraja, (2013) conducted a study to predict the playing ability in Kabaddi from selected Anthropometrical, Physical, physiological and psychological variables among College level Players. One hundred and twenty six male inter collegiate Kabaddi players were randomly selected from various colleges in Tamilnadu state, India and their age ranged between 18 and 28 years. The subjects had past playing experience of at least three years in Kabaddi and only those who represented their respective college teams were taken as subjects. A series of anthropometrical measurements was carried out on each participant. These included Standing height measured by Stadiometer; Body weight measured by weighing machine, Two Length measurements - Arm length, Leg length, measured by Lufkin Anthropometric Tape. The data were collected by following standard testing protocol of International Society for the Advancement of Kinanthropometry. Physical fitness components were measured by the following tests. Speed were assessed by 50 meter dash, Flexibility assessed by Sit and reach test, Leg explosive strength assessed by Standing broad jump, Muscular power assessed by Modified sit – ups and Muscular endurance assessed by 2.4 km run. The Physiological parameters namely

Resting heart rate by Digitalized heart rate monitor, Peakexpiratory flow rate was assessed by Peak flow meter and Breath holding time was assessed by Manual nose clip method.

Jorge Perez-Gomez , et al.(2013) investigated the effect of 10-week of endurance training or resistance training on regional and abdominal fat, and in the lipid profile, examining the associations among the changes in body composition, weight, waist circumference and lipid profile. Body composition, waist circumference and lipid profile were analyzed in 26 volunteers healthy young men (age 22.5 ± 1.9 yr), randomly assigned to: endurance group (EG), resistance group (RG) or control group (CG). The EG significantly decreased after training the body weight, body mass index, total body fat and percentage of fat, fat and percentage of fat at the trunk and at the abdominal region and High-Density Lipoprotein. The RG significantly increased total lean mass and decreased total cholesterol, High-Density and Low- Density Lipoprotein. Close relationship were found among changes in weight, total lean mass, regional fat mass, waist circumference and changes in lipid profile (all $p < 0.05$). We concluded that 10-week of endurance training decreased abdominal and body fat in young men, while 10-week of resistance training increased total lean mass. These types of training had also effects on lipid profile that seem to be to some extent associated to changes in body composition; however it requires additional investigation.

Trabelsi et al.(2013) evaluated the effects of resistance training in a fasted versus a fed state during Ramadan on body composition and metabolic parameters in bodybuilders. Sixteen men were allocated to two groups: Eight practicing resistance training in the late afternoon in a fasted state (FAST), and eight training in the late evening in an acutely fed state (FED) during Ramadan. All visited the laboratory in the morning two days before the start of Ramadan (Bef-R) and on the 29th day of Ramadan (End-R) for anthropometric measurement, completion of a dietary questionnaire, and provision of fasting blood and urine samples. Body mass and body fat percentage remained unchanged in FAST and FED during the whole period of the investigation. Both FAST and FED experienced an increase in the following parameters from Bef-R to End-R: urine specific gravity (1%; $p = 0.028$, $p = 0.004$ respectively), serum concentrations of urea (4%, $p = 0.006$; 7%, $p = 0.004$ respectively), creatinine (5%, $p = 0.015$; 6%, $p = 0.04$ respectively), uric acid (17%; $p < 0.001$, $p = 0.04$ respectively), sodium (1%; $p = 0.029$, $p = 0.019$ respectively), chloride (2%; $p = 0.039$, $p = 0.004$ respectively), and high-density lipoprotein cholesterol (11%, $p = 0.04$; 10%, $p = 0.04$ respectively). Hypertrophic training in a fasted or in a fed state during Ramadan does not affect body mass and body composition of bodybuilders. Additionally, Ramadan fasting induced changes in urinary and some biochemical parameters, but these changes were not different according to when the training occurred.

Bovas and Pradeep, (2014) evaluated the effect of selected physical variables of 18 to 25 years age group of college men Kabaddi players in Kerala. For the purpose of this study, 40 college men Kabaddi players in Kerala state were selected as the subjects. The age of the subjects ranged between 18 to 25 years. The subjects were informed about the nature of the study and their consent also taken before involving them as subjects of this study. The subjects were later randomly assigned to a control group-1, an experimental group-2(circuit training) of equal sizes. The study found that the physical variables like speed, speed endurance, agility, reaction time, abdominal strength and explosive power had improved on both experimental groups, in comparison to control group after a 10 weeks training programme and the circuit training group showed significant improvement in all the above physical variables.

Fleck., Cora Mattie, and Martensen, (2006) conducted a study on the Effect of resistance and aerobic training on regional body composition in previously recreationally trained middle-aged women. Twelve middle-aged women (mean age 41.9 ± 1.6 y) performed variable-cam resistance training and aerobic training 3 times/week for 14 weeks. One repetition maximum (1 RM) significantly increased between pre-training and training week 7 (13.1%–17.8%), between training week 7 and post-training (10.8%–14.1%), and between pre-training and post-training (25.5%–30.9%). Total-body lean soft tissue and total % body fat determined by duel-energy X-ray absorptiometry

(DEXA) significantly increased (2.2%) and decreased (1.4%), respectively. Arm, trunk, and total upper body (arm + trunk) lean soft tissue significantly increased (0.7%–4.6%). Total body fat tissue and all regional measures of fat tissue and % fat showed no significant changes. Significant correlations were shown between pre-testing and post-testing 1 RM in the bench press, lat pull down, and overhead press in all instances, except for post-training bench press and total upper-body lean soft tissue (r = 0.58–0.90). In contrast, non-significant correlations were shown between pre- and post-testing 1 RM of the leg press, with the exception of pre-training and total lean soft tissue and pretraining and leg lean soft tissue. In conclusion, resistance training resulted in consistent strength gains in middle-aged women, which were accompanied by regional changes in upper-body composition, whereas lower-body composition moved in the hypothesized direction, but did not achieve significance.

Neeta Kumari and Samiran Chakraborty (2014) assessed the effect of weight reduction on body mass index (BMI), body fat percent (BF %) and lean body mass (LBM). The subjects for the study were twenty four boxers, ranging in the age group between 16 – 18 years. The data was collected at the time of the training camp held at Jawahar Lal Nehru Stadium, New Delhi, India. The selected parameters such as age, body weight, standing height and skinfold measurements were taken on the day of joining the camp. The body weights of all the subjects were obtained again ten days prior to competition and one day before the competition, ONGCYMCA VIII, International Boxing Championship. For the purpose of the present study the subjects who reduced their body weight more than one percent were selected for the further study and the following parameters such as body weight, standing height their body mass index (BMI) was computed by applying Quetelet Body Mass Index method, and body fat measurement (BF%) and lean body mass (LBM) were calculated by applying Siri, equation. To see the effects of weight reduction on above said parameters the difference change and percent change were applied in pre and post scores of the boxers. The findings of present research were concluded that out of twenty four subjects only ten reduced body weight by -4.68 percent maximum during the camp and weight reduction indicated a gradual pattern. The result indicates that body mass index, fat percentages and lean body mass among the all boxers were reduced simultaneously.

Ajeet Jaiswal, (2014) compared the anthropometric measurements, body composition and somatotyping differences among female Kho- Kho players and controls. 99 young female subjects (Kho-Kho players: N=49 and controls: N=49) of age group 18-24 years were randomly selected from the participant of South zone interuniversity Kho-Kho tournament for women, 2011-12, organized by Physical education and sports department, Pondicherry University, India. All the participants were assessed for height, weight, breadths, girths and skinfold thickness. The independent samples t-test revealed that Kho-Kho players had significantly higher height ($p<0.05$), as compared to controls. The Kho-Kho players were also found to have significantly greater lean body mass ($p<0.01$) and ectomorph component ($p<0.05$) as compared to controls. Controls had significantly greater percent body fat and total body fat ($p<0.05$) as compared to Kho-Kho players. The Kho-Kho players of this study were found to have higher percentage body fat with lower body height and body weight than their international counterparts. Further investigations are needed on above studied variables along with fitness and physiological variables to assess relationship among them and with performance in Kho-Kho. The findings of the present study might be useful in future investigation on player selection, talent identification in the game of Kho-Kho and its training programmed development.

Willis et al., (2012) compared aerobic training, resistance training, and a combination of the two to determine the optimal mode of exercise for obesity reduction. Participants were 119 sedentary, overweight or obese adults who were randomized to one of three 8-mo exercise protocols: *1)* RT: resistance training, *2)* AT: aerobic training and *3)* AT/RT: aerobic and resistance training (combination of AT and RT). Primary outcomes included total body mass, fat mass and lean body mass. The AT and AT/RT groups reduced total body mass and fat mass more than RT ($P < 0.05$), but they were not different from each other. RT and AT/RT increased lean body mass more than AT ($P< 0.05$). While requiring double the time commitment, a program of combined AT and RT did not result in significantly more fat mass or body mass reductions over AT alone. Balancing time commitments against health benefits, it appears that AT is the optimal mode of exercise for reducing fat mass and body mass, while a program including RT is needed for increasing lean mass in middle-aged, overweight/obese individuals.

2.3 STUDIES ON SKILL RELATED PHYSICAL FITNESS VARIABLES

Eskandar Taheri, Asghar Nikseresht and Ebrahim Khoshnam,(2014) investigated the effect of plyometric and resistance training on agility, speed and explosive power in soccer players. 30 male soccer players who aged 18-25 voluntarily participated in the study. They were randomly assigned in plyometric (n=15) and resistance (n=15) groups. Both groups performed selected soccer-specified plyometric and resistance training for 8 weeks. Data was analyzed using paired t-test, independent t-test, and covariance statistical methods. The results showed that levels of agility, speed, and explosive power in plyometric training group (p=0.0001), and agility and explosive power in resistance training group (p=0.0001) were significantly improved in post-test compared to pre-test. Between-groups comparison showed better records in agility, speed and explosive power for plyometric compared with resistance training group after eight weeks (respectively p=0.032, p=0.0001 and p=0.002). According to the results, it can be concluded that both plyometric and resistance training exercises increase agility and explosive power and reduce sprint time in football players. Plyometric exercises also showed more favorable effects on study variables compared with resistance exercises. Therefore, these types of training methods are suggested to soccer players and coaches for improving speed and performance skill.

Granacher,et al.(2011) investigated the impact of a short term ballistic strength training (BST) followed by detraining on measures of strength and postural control in adolescents. Twenty-eight high-school students participated in this study and were assigned to either an intervention (n = 14, age 16.7 6 0.6 years, body mass index [BMI] 21.1 6 1.7 kg_m^2) or a control group (n = 14, age 16.8 6 0.7 years, BMI 19.9 6 1.7 kg_m^2). The intervention class participated in a short-term (8 week) lower extremity BST program 2 times a week integrated in their regular physical education lessons. Pre, post, and follow-up tests included the measurements of maximal isometric force (MIF) and rate of force development (RFD) of the leg extensors on a leg press with the feet resting on a force platform, vertical jumping height (countermovement jump [CMJ]) on a force plate and the assessment of static (1-legged stance on a balance platform), and dynamic (mediolateral perturbation impulse on a balance platform) postural control. Ballistic strength training resulted in statistically significant improvements in MIF (p = 0.001) and CMJ height (p , 0.001), which were still present after detraining for MIF (p = 0.04). Furthermore, tendencies in terms of small to medium interaction effects yet not statistically significant improvements were found for RFD (p = 0.38), and measures of static (p = 0.15) but not of dynamic postural control. In adolescents, lower extremity BST is a suitable training modality for the application in a school setting (particularly during physical education lessons) that produced transient improvements in strength variables. These results could have an impact on improving the performance level in various motor fitness skills and sports activities in physical education.

Gorostiaga, et al. (2006) examined the effects of an entire season of play on physical fitness and throwing velocity. One repetition maximal bench press (1RMBP), jumping explosive strength, power–load relationship of the leg and arm extensor muscles, 5- and 15-m sprint running time, endurance running, and handball throwing velocity (standing and three-step running throw) were assessed on four times (T1, T2, T3, and T4), during a 45-wk season. Individual volumes and intensities of training and competition were quantified for 11 activities. From T1 to T3, significant increases occurred in free fatty mass (1.4%), 1RMBP (1.9%), standing throwing velocity (6.5%), and three-step throwing velocity (6.2%). No significant changes were observed throughout the season in endurance running and explosive strength-related variables. Significant correlations (P G 0.05–0.01) were observed between strength training time and changes in standing throwing velocity as well as between high-intensity endurance training time and changes in endurance running. In addition, linear inverse relationships were observed between low-intensity endurance training time and changes in muscle power output of the lower extremities. The handball season resulted in significant increases in maximal and specific strength of the upper-extremity but not in the lower-extremity actions. The correlations observed suggest that training time at low intensity should be given less attention, whereas the training stimuli for high-intensity endurance running and leg strength training should be given more careful attention in the full training season program.

Ognjen Andrejic, (2012) compared the effects of two short-term off-season conditioning training programs on fitness performance in young basketball players. Twenty-one young basketball players, aged 12-13 years, volunteered to participate in this study. The participants were randomly assigned to a strength training group (ST, n = 10) or a combined plyometric and strength training group (CT, n = 11). The ST group performed free full court basketball play followed by strength training, whereas the CT group performed plyometric exercises followed by the same strength training program. Young basketball players were assessed before and after a six-week training period on the vertical jump, long jump, medicine ball toss, 20 m sprint, 4 x 15 m standing start running and stand and reach flexibility. The CT group made significantly ($p < 0.05$) greater improvements than the ST group in the vertical jump (3.2 cm vs. 0.6 cm), long jump (10.3 cm vs. 2.2 cm), 20 m sprint (-0.2 sec vs. 0.0 sec), 4 x 15 m standing start running (-0.41 sec vs. -0.05 sec) and the medicine ball toss (40.7 cm vs. 18.2 cm) following the training. The results of this study demonstrate that a short-term plyometric and strength training program significantly increases motor performance skills in young basketball players.

Ralph, Robert and Richard, (2004) American College of Sports Medicine (ACSM) published a Position Stand entitled Progression Models in Resistance Training for Healthy Adults. The ACSM claims that the programmed manipulation of resistance-training protocols such as the training modality, repetition duration, range of repetitions, number of sets, and frequency of training will differentially affect specific physiological adaptations such as muscular strength, hypertrophy, power, and endurance. The ACSM also asserts that for progression in healthy adults, the programs for intermediate, advanced, and elite trainees must be different from those prescribed for novices. An objective evaluation of the resistance-training studies shows that these claims are primarily unsubstantiated. In fact, the preponderance of resistance-training studies suggest that simple, low-volume, time-efficient, resistance training is just as effective for increasing muscular strength, hypertrophy, power, and endurance—regardless of training experience—as are the complex, high-volume, time-consuming protocols that are recommended in the Position Stand. This document examines the basis for many of the claims in the Position Stand and provides an objective review of the resistance training literature.

Kala,(2000) conducted a study to compare physical, physiological and psychological variables of Kabaddi, Kho-Kho and wrestlers on a total of 158 male players drawn from different universities, 54 each in Kabaddi, Kho-Kho and Wrestling in the age group between 18 to 25 years. The following tests were administered and data was collected. Standing broad jump. Zig-Zag Run, 6lb medicine ball put, 50 yards run, Kraus Weber Floor Touch Test, 12 minute Run Walk Test and different psychological and Physiological variables. Mean, standard deviation and t test was used to see the significance of difference between the Kabaddi, Kho-Kho and Wrestlers. It was concluded that Kabaddi players found to be better in arm strength, lung function and aggression than Kho-Kho players. Similarly when compared to wrestlers, Kabaddi players were better than wrestlers in leg power, agility, arm strength, speed, heart rate.

Singal et al. (2002) Studied anthropometrically 697 athletes and 699 controls to assess their body fat and lean body mass. All the body components increased from 10 to 18 years in both boys and girls of sports group and controls. The body fat is lesser in athlete's boys and girls. The lean body mass is large in athlete boys only 14 years of age. While studying sex differences it has been noticed that athletes as well as control girls have significantly more fat and lesser lean body mass as compared to male athletes and male controls. The magnitude of increase in fat as well as lean body mass is more in boys as compared to girls.

Selvam and Raja (2003) conducted a study on twenty five youth and junior basketball players in the age group of 16-18 years. Following physical fitness variables such as speed, agility, explosive power, cardio respiratory endurance and flexibility were selected as dependent variables and skill performance, like dribbling ability, passing ability and defensive ability were selected as independent variables. The result of the study indicated that there was a significant relationship between (a) speed with dribbling ability and (b) defensive ability and insignificant relationship with passing ability. Further the study showed that there was a (c) significant relationship between agility and explosive power with all skill ability and there was a (d) significant relationship between cardio respiratory endurance and flexibility with passing ability and (e) defensive ability and insignificant relationship with dribbling ability.

Keogh, et al., (2003) developed an effective testing battery for female field hockey, a testing battery that would clearly distinguish female field hockey players of greater ability. The test battery included anthropometric, physiological, and skill related tests to distinguish between regional representative numbering 35 and local clubs level female field hockey players numbering 39.10 meter sprint, 40 meter sprint, 10 meter repeated sprints, 40 meter repeated sprints, 20 meter multi stage shuttle run, vertical jump, standing broad jump, hand grip strength, Illinois agility test, agility dribbling index, shooting accuracy and push speed accuracy test were administered on all the subjects. It was observed representative players had a significantly lower body fat then club players and significant difference was observed for standing height or body mass between the two groups. It was observed that representative players were significantly faster over 10 m and 40 m sprint as well as Illinois agility test (with and without hockey ball). Representative players also had greater aerobic and lower body muscular power and were more accurate in the shooting test. No significant differences between groups were evident for height, body mass, speed decrement in 6x40 m repeated sprints, handgrip, or pushing speed. These results indicate that that body percent, sprinting speed, agility, dribbling control, aerobic and muscular power and shooting accuracy can distinguish between female field hockey players of varying standards. This suggests that talent identification programme for female hockey should include assessments of these physical parameters.

Karim Salehzadeh and Behrouz Ghorbanzadeh, (2015) investigated the effects of strength training on neuromuscular coordination in poll players. In this study, 30 pool players were randomly assigned into control (n=15) and experimental (n=15) groups. The experimental group participated in a 12-week strength exercise program along with their regular pool training. Exercise regimen consisted of 90 minutes strength training 3 sessions/week. The control group participated merely in pool training. Prior to and following experimental period data were collected using arm ruler, dart and ball tests and electromyography measurements. Data were analyzed using Statistical test of kolmogrov-smirnof, Pierson Correlation Coefficient and independent t-test at significance level of P<0.Results of the study revealed that the relationship between strength training and reaction time, neuromuscular coordination, target tracking and neuromuscular compatibility of dominant hand was significant; however, the relationship between strength training and neuromuscular compatibility and target tracking of non-dominant hand was insignificant. Findings revealed that strength training increase neuromuscular coordination and compatibility in pool players and improve their targeting.

Sudhakar Babu and Paul Kumar,(2014) Conducted a study on the effect of Continuous running Fartlek training and Interval training on Speed and Coordination among male soccer players. To achieve the purpose of the study 60 intercollegiate male football players were selected as subject at random from in an around the Guntur district of Andhra Pradesh and their age ranged of the subject is between 18 to

23years.The subject was divided into four group namely experimental group A, experimental group B, experimental group C and Control group D. Experimental group A underwent to Continuous running training, experimental group B underwent to Fartlek training, experimental group C underwent to Interval training and group D act as a control group they did not participate in any of the training programme other than their regular activates. The data was collected from four groups' pre and post of the experimental period. The raw data on speed and coordination was statistically analyzed by using Analysis of Covariance (ANCOVA). Scheffe's post hoc test was applied to determine the significant differences between the paired adjusted means. In all the cases 0.05 level of significance was fixed. The result of the study showed that there was as significantly improvement was found in speed and Coordination among the experimental group when compared with control group.

Monika Garg, et al,. (2013) determined the effect of aerobic exercise on auditory reaction time (ART) and visual reaction time (VRT). Fifty subjects were enrolled consisting of healthy subjects who were not exercising (n=25; group I) and subjects doing regular aerobic exercisers (n=25; group II). ART and VRT were recorded using digital display response time apparatus equipped with three lights (red, green and yellow) and three auditory stimuli (low, medium and high pitched sounds). The mean VRT of group II subjects (318.24±6.709) was significantly lower than that of group I (505.73±16.961) ($P<0.001$). The mean ART of group II subjects (313.33±8.160) was significantly lower than that of group I (573.09±17.950) ($P<0.001$). Auditory and visual reaction times are better in aerobic exercisers as compared to non-exercisers irrespective of age and gender.

Bareket Falk and Guy Mor, (1996) determined the effect of a 12-week training program on the motor performance of 6- to 8-year-old prepubertal boys ($n = 14$). Each subject participated in a 40-min session twice a week, which included three sets of upper body strength exercises (1 to 15 repetitions1set), unregimented lower body strength exercises, coordination, balance, and martial arts skills. The control group included 15 prepubertal boys in the same age range. All subjects were pre- and posttested on 20-s sit-ups, seated ball put, standing broad jump, sit-and-reach flexibility, 6 x 4-m shuttle run, and a coordination task. The experimental group improved significantly ($p < .05$) more than the control group in the sit-ups and in the long jump. Both groups improved ($p < .05$) in the coordination task. No significant changes were observed in body weight, seated ball put, flexibility, and shuttle run. A twice-weekly training program seems to improve performance in selected motor tasks in 6- to 8-year-old boys.

2.4 SUMMARY OF REVIEW OF RELATED LITERATURE

The investigator has reviewed several journals, research articles and presented the above related studies on the effect of varied resistance training on selected morphological and skill related physical fitness variables. From the reviewed studies it was inferred that there was scope for further research in finding out the effect of varied intensity of Resistance Training on selected morphological and skill related physical fitness variables among college men kabaddi players.