Chapter II

REVIEW OF RELATED LITERATURE
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Review of literature reviews the crucial points of present knowledge including the findings of both theoretical and methodological contributions to the exact topic. The ultimate goal review of literature is to update the current information to the reader thus forms the basis future research that may be needed in this area. Review of literature gives an overview of the previous findings, authors information, their existing theories and hypothesis, the methodologies adopted in the study and the questions frequently asked during their investigation.

The study of the appropriate literature is an important process to obtain a full picture of what has been done previously in connection with the problem. It brings new idea and helps the development of research procedure. The investigator had gathered the related studies from research quarterly, journals, magazines and thesis and listed down such studies in this chapter to add further dimensions and scope for this study. The present review is based upon the available literature in respect to the study under investigation and therefore confined to the studies to which the investigator has accessed. All the relevant literature thus obtained by the researcher had been presented in this chapter to furnish necessary background material to evaluate the significance of the study.

The scholar had gone through the literatures of allied studies that are related to this study to collect the necessary information for making a proper shape of the study.

The reviews of the literature have been classified under the following headings:

2. Studies on Plyometric Training.
3. Studies on Hockey
4. Summary of the literature.

2.1 STUDIES ON RESISTANCE TRAINING

Bartolomei, et al. (2014) examined a study “To compared two different periodization models in strength and power athletes”. For this twenty four trained men
were randomly assigned to block periodization training program and to a traditional periodization program. They performed 4 training sessions per week. Both strength and power were tested before and after 15 weeks of training. Results reveal that the block periodization training program was better in upper body power expression than traditional periodization program. And no differences were found on lower body performance and body composition.

Carlson, et al. (2014) conducted a “Meta analysis in isometric resistance training on systolic blood pressure, diastolic blood pressure and mean arterial pressure”. The total subjects n=223 were healthy adults and underwent 4 weeks of isometric exercises. The result reveals that isometric resistance training has reduced systolic blood pressure, diastolic blood pressure & mean arterial pressure.

Santhana & Shanmuganathan (2013) studied the “Effects of theraband training and weight training and on strength parameters”. For this, 36 male athletes from Department of Physical Education and Sports, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India were selected as subjects and divided into theraband training group (12), weight training group (12) and control group (12). The training period was one hour per day with three days in a week for eight weeks. Maximum strength was tested by 1 RM bench press test and 1 RM squat test. It was concluded that the significant difference in improvement was found among weight training and theraband training in maximum strength.

Lowrance & Anbalagan (2013) studied the “Effect of progressive resistance training on arm explosive power, leg explosive power and speed among school level players”. For this, 30 boys from Lisieux Matric Higher Secondary School, Coimbatore, Tamilnadu, India were selected as subjects and divided into progressive resistance training (15) and control group (15). After twelve weeks of training period the collected data were analysed using dependent ‘t’ test. The progressive resistance training produced significant improvement in leg explosive power.

Romano, et al. (2013) experimented the “Acute effect of different resistance exercise on ratings of perceived exertion”. For this, thirteen male adolescents without previous experience in resistance training were selected and made
to perform incline leg press, dumbbell lunge, bench press and lying barbell triceps extension. The exercise sequences were performed with a rest interval of 72 hours between sessions. The results suggest that the main exercises should be performed in the beginning of training programme in adolescents.

Harries, et al. (2012) found the effectiveness of resistance training programs on muscular power and sports performance in adolescent athletes. The studies evaluating resistance training programs on power and sports performance in adolescent athletes were searched systematically from the databases. In that thirty four identified, among that a positive effect was observed for resistance training on vertical jump. Finally there were sufficient evidences to conclude that in adolescent athletes, the muscular power can improve due to resistance training.

Alcaraz, et al. (2011) experimented “Eight weeks of high resistance circuit training and traditional strength training on physical performance parameters and body composition”. For this 33 healthy men were randomly assigned into three groups namely, high resistance circuit training, traditional strength training and control group. Before and after the training period, 1RM strength, peak power, body composition, shuttle run and 30 second Wingate tests were completed. The high resistance circuit training was as effective as traditional strength training for improving weight lifting 1RM, peak power, shuttle-run performance and lean mass.

Elayaraja (2011) studied the “Effect of strength training programme on leg strength and balance among women cricketers”. For this, 20 University women cricketers from Department of Physical Education and Sports Sciences, Annamalai University, Tamilnadu, India with the age group of 18 to 23 years were selected as subjects and divided into strength training and control and was given training for eight weeks, for three days per week Maximum strength was tested by 1 RM bench press test and 1 RM squat test. It was concluded that the significant difference in improvement was found on strength training programme on leg strength and balance among women cricketers.

George, et al. (2011) analysed the “Effects of moderate intensity resistance training on strength endurance among under graduate students”. Thirty under graduate
students were selected as subjects with the age group of 15 – 17 years and divided into moderate intensity resistance training (15) and control group (15). After twelve weeks of training period the collected data were analysed using analysis of covariance. The moderate intensity resistance training produced significant improvement in abdominal strength endurance.

**Kell, et al. (2011)** conducted a study to “Assess the traditional periodized strength training on strength”. Sixty subjects were divided into three groups with 20 subjects each. To assess the strength of the subjects 1 repetition maximum test was used. The result reveals that both the experimental groups have shown significant improvement on strength. Further the female training group increased strength better than the male training group. It was found that after twelve weeks of traditionally periodized resistance training there was an improvement in strength among women.

**Hermassis, et al. (2010)** conducted a study on “Influence of eight week resistance training on peak power and sprint development of male hand ball players”. Twenty four male subjects were selected and their age was between 20-27. They were given resistance training programme. The test used was dynamometer. The result of resistance training group was better than control group in handball player. After the training sessions movement speed and strength increased the upper and lower body of handball players.

**Colado & Triplett (2009)** conducted a study “To assess the functional capacity and body composition”. Forty five healthy sedentary middle aged women were randomly selected and divided into three equal groups. 21 subjects underwent elastic bands training, 14 subjects underwent weight machine training and 10 subjects were kept as control. Both the training groups underwent 10 weeks period of periodized muscular endurance program. Functional capacity was measured using knee push up, and body composition was measured using bioelectrical impedance analyzer. The result reveals that the fat mass decreased, fat free mass and functional capacity has increased on both the experimental groups.

**Brentano (2008)** analyzed the “Impact of high intensity strength training and circuit training on isometric strength, upper & lower limb dynamic strength, muscle
activation, maximal oxygen uptake, exhaustion time and bone mineral density”. To achieve this, twenty eight postmenopausal women were selected and divided into three groups namely, strength training group (n=9), circuit training group (n=10) and control group (n = 9) with 0.05 as significant level. Before and after 24 weeks of training period the data were collected. The results revealed that strength training and circuit training improved muscular strength, muscular activation and cardiorespiratory fitness among postmenopausal women.

Chtara, et al. (2008) examined the “Influence of high intensity endurance training and circuit training on muscular strength and anaerobic power”. To achieve this purpose, forty eight students who were studying physical education were selected and assigned into 5 groups. The groups namely control group (n = 9), circuit training (n = 9), endurance training (n = 10), endurance before circuit training (n = 10) and circuit before endurance training (n = 10). The subjects underwent their respective training for 12 weeks. Maximal strength, strength endurance, explosive strength and power were measured. Result reveals that the circuit training significantly improved the strength and power than the combined resistance and endurance training.

Harris & Holly (1987) investigated the circuit weight training program on male subjects. The subjects were experimental (n=10) and control (n=16) groups. Resting blood pressure and heart rate were measured before and after 9 weeks of circuit training programme. The result reveals that the circuit weight training can elicit remarkable difference in muscular strength and modest improvements in body composition and cardio respiratory endurance.

2.2 STUDIES ON PLYOMETRIC TRAINING

Nageswaran & Ravichandran (2014) analysed the “Effects of weight training, plyometric training and complex training on speed performance”. Thirty school boys from SDAT, Thanjavur unit, Tamilnadu, India were selected as subjects with the age group of 16 to 19 years and divided in to weight training (10), plyometric training (10) and complex training (10). Speed was assessed by 50 metres run and acceleration was assessed by 30 metres fly run After eight weeks of training period the collected data were analysed using ‘t’ test and analysis of co-variance. The weight
training, plyometric training and complex training produced significant improvement in speed performance.

Campillo, et al. (2013) examined the “Plyometric training on different volume and training surfaces on neuromuscular performance”. To achieve this purpose twenty nine subjects were divided into 4 groups namely, moderate volume group (n = 9), moderate volume hard surface group (n = 8), high volume group (n = 7) and control group (n = 5). Maximum strength, squat jump, countermovement jumps, 20 m sprint, agility, body weight and height were measured before and after 7 weeks. The results reveal that high training volume significantly increased the explosive performance. Further, the plyometric training on hard surface and moderate training volume significantly improved the explosive performance, maximal strength and speed.

Chaouachi, et al. (2013) compared the “Effectiveness of plyometric and its combination with balance training on balance and power parameters in children”. The subjects were divided into three groups namely, plyometric training group (n=14), combined balance and plyometric training group (n=14) and control group (n=12). Strength, power, speed, static and dynamic balance and agility were tested during 8 weeks of training. The combined group showed better improvement in leg stiffness, speed, agility than the other groups.

Pienaar & Coetzee (2013) conducted a study to “To assess the rugby conditioning program and its combination with plyometric training on selected physical, motor performance and anthropometric measurements”. The players were selected from the under 19 rugby teams of the North West University, South Africa. The selected players were divided into experimental group (n=19) and control group (n=16). Anthropometric measurements were taken on twenty six sited and a battery test for measuring the physical and motor performance tests were conducted. The data was processed by dependent t-test and results showed that the experimental group had significant improvement in wrist breadth, speed, agility and power than the control group.
Vaczi, et al. (2013) investigated the “effects of plyometric training on power, agility and knee extensor strength”. The subjects were male soccer players from a third league team and assigned into an experimental and control groups. Depth vertical jump height, agility and maximal voluntary isometric torque in knee extensors were evaluated before and after six weeks of experiment. Results reveal that the plyometric training had remarkable improvements in lower extremity power and maximal knee extensor strength and agility.

Yeeriswamy & Saikumar (2013) studied the “Effect of plyometric training on selected skill performance variables of junior college level football players”. For this, 40 junior football players from Kurnool district, Andhra Pradesh, India were selected as subjects and divided into plyometric training (20) and control (20). The training period was three days in a week for twelve weeks. The skill performance variables were kicking for distance right and left foot, ball control and dribbling. It was concluded that the significant improvement was found on plyometric training in skill performance variables.

Ashok, et al. (2012) studied the “Effect of skill training and its combination of plyometric with skill training on jumping ability, anaerobic capacity and skill performance among volleyball players”. For this, sixty male volleyball players from various colleges in Coimbatore District, Tamilnadu were selected as subjects and divided into plyometric and skill training (20), skill training (20) and control (20). Jumping ability, anaerobic capacity and skill performance were tested during 12 week of training programme. The results reveal that the skill training with plyometric significantly improved jumping ability, anaerobic capacity and skill performance among volleyball players.

Rajesh (2012) studied the “Effect of plyometric exercises on speed among football players”. To achieve this forty male football players from various colleges of Osmania University, Hyderabad were selected. The subjects were made into experimental and control groups. Speed was assessed by 30 meter run. After six weeks of training the plyometric exercise showed improvement on speed than the other group.
Ingebrigtsen, et al. (2011) investigated aerobic capacities and anthropometric characteristics among soccer players at elite level. For this purpose 29 elite soccer players were selected and assessed anthropometrical variables, \( \dot{V}O_2\text{max} \) and anaerobic threshold. One way analysis of variance was computed and results showed that there were no differences in anthropometric and aerobic capacities. It also found that there were only few anthropometric and physiological differences were existed between the playing positions.

Rubley, et al. (2011) assessed the “Effect of plyometric training vertical jump and kicking distance among adolescent soccer players”. For this, sixteen adolescent female soccer players were selected and divided into control group (6) and plyometric training group (10). The control group practiced only their regular soccer training and the experimental group practiced soccer training along with plyometric exercise. The duration of training period was 14 weeks. The data were analyzed using 2×3 ANOVA with repeated measures. The plyometric training group had significantly improved on kicking distance and vertical jump heights after 14 weeks.

Roopchand & Lue (2010) investigated the “Effect of plyometric training on jump and agility”. Eighteen subjects were selected from Jamaican national netball players and tested using the vertical & broad jump test and Illinois agility run. The duration of training was 3 weeks. The data were analysed using Kolmogorov Smirnov test and paired samples t-test. Result reveals that due to the effect of plyometric training significant outcome was found on jump and agility.

Abbas (2009) evaluated the “Effect of plyometric training with three modes on leg muscle strength”. Forty subjects were from untrained male University students within the age ranged from 18 to 27 years. The subjects were randomly selected and divided into three experimental and one control groups. The data was collected during the twelve weeks of training period and analyzed using descriptive measures, ANCOVA and Scheffe post hoc analysis. It was found that plyometric exercises with depth rebound jumping improved the leg muscle strength.

Thomas, et al. (2009) compared the “Effects of two plyometric trainings on power and agility”. To achieve this purpose, twelve males from semi professional football club's academy were randomly selected and subjected to plyometric training
for 6 weeks. Pre test and post test were conducted to the subjects belong to depth jump and countermovement jump group. Finally it was concluded that depth jump and countermovement jump plyometrics improved power and agility.

Ronnestad, et al. (2008) compared the “Effect of strength training and its combination with plyometric training on power related measurements among soccer players”. Totally 21 subjects were randomly selected and divided into strength training (6), strength and plyometric training (8) and control groups (7). Pre and post tests were conducted on 1 repetition maximum, half squat, countermovement jump, squat jump, 4 bounce test, peak power, sprint acceleration, peak sprint velocity and speed. The results reveal that there are no significant effects of combined group. Heavy strength training significantly improved strength and power related parameters in professional soccer players.

Vissing, et al. (2008) conducted a study on muscle strength, power and morphology due to conventional strength training versus plyometric training. The young untrained men were divided into conventional resistance training (8) and plyometric training (7). Pre tests and post tests were taken during 12 weeks of training. 1 RM incline leg press, 3 RM knee extension, 1 RM knee flexion, countermovement jump and ballistic inclined leg press were assessed. Plyometric training increased maximum countermovement jump height with high power and ballistic leg press than the conventional resistance training.

Stemm & Jacobson (2007) conducted a study to find out the “Effect of land and aquatic based plyometric training on vertical jump performance”. A convenience sample of 21 college men were selected randomly and assigned into aquatic plyometric group, land plyometric group and control group. The aquatic group performed the exercises in water at the height of knee level, the land group performed exercises in the land for 6 weeks and the control group did not participated in any training. The collected data were analysed using 2x3 ANOVA with repeated measures. It was concluded that aquatic and land plyometric training had produced similar effects on vertical jump.
Miller, et al. (2006) conducted a study on agility among athletes owing to plyometric training. The subjects were divided into plyometric and control groups. The subjects were tested on agility using T agility run and Illinois Agility Test, reaction time using force plate test. Before and after the training period the data were collected and analysed using ANCOVA. The results of this study reveal that plyometric training significantly improved agility.

Moore, et al. (2005) compared the “Effects of traditional resistance training and its combination with Olympic style lifts on novice competitive collegiate athletes”. To accomplish the aim of the study 5 male and 10 female soccer players were selected. Countermovement vertical jump, 4 RM squat, speed and figure 8 drill were conducted before and after 12 weeks of training. Both the groups have improved significantly.

2.3 STUDIES ON HOCKEY

Amrinder (2013) compared the “Effects of four week plyometric training on two different surfaces, sand and grass on muscle soreness and selected sport specific performance variables in national level hockey players”. Subjects were randomly divided into two groups namely grass training group (N=20) and sand training group (N=20). The variables tested were strength, endurance, balance, agility and muscle soreness. After 4 weeks of training with three sessions per week similar improvements in strength, endurance, balance and agility was found in both the surfaces but induces significantly less muscle soreness.

Saminathan (2011) investigated on “Combined and individualized effect of cross training and game specific exercises on selected physical, physiological and performance factors of field hockey players”. In this present study, forty five field hockey players from Ramakrishna Mission Vidhyalaya, Coimbatore district, Tamilnadu were randomly selected as subjects and their age ranged between 18 and 25 years. True randomized group design was used. The subjects (N=45) were assigned to three equal groups of fifteen men students each. The groups were cross training group (CTG), game-specific exercises group (GSEG) and combined cross training with game-specific exercises Group (CMBG) in an equivalent manner. The
selected variables were speed, grip strength, agility, flexibility, cardio respiratory endurance, vital capacity, forced vital capacity, slow vital capacity, maximum voluntary ventilation, resting pulse rate, hit, push, dodging, dribbling and scoop. The experimental groups had shown significant improvement in all the selected physical, physiological and performance factors after undergoing the cross training.

**Xavier (2010)** investigated the effect of specific drills may improve the skill performance variables of field hockey players. 30 field hockey players from Selvam Group of Institutions, Namakkal were selected for this study. Experimental treatment was given to the experimental group. The control group was not given experimental treatment. The training period was six weeks. The specific drills were given thrice a week. After six weeks the final performance of both the control and experimental groups were taken. The data collected were statistically analysed. It was observed that the selected variables of the experimental group showed significant improvement. It was observed that there was significant improvement in the shooting accuracy and speed of dribbling ability of the experimental group with the specific drills. There was no significant difference in the control group. There was no significant improvement in the shooting accuracy and dribbling speed of the control group. The final test of experimental group was greater than the control group.

**Pradeep (2009)** “Compared the balance, core stability and strength among college level Football, Hockey and Kabaddi players”. Forty men Football, Hockey and Kabaddi players each and totally one hundred and twenty players were selected for the study. All the players selected were participants in inter-collegiate competition. The subjects age ranged from 18 to 25 years. The subjects were selected on random basis from affiliated colleges of Bharathidasan University, Tiruchirappalli, Tamilnadu state, India. The variables namely balance, core stability and strength were selected for this present study. Standing balance test, side ramp and sit-ups were used to collect relevant data. In order to compare among Football, Hockey and Kabaddi players on the selected variables, analysis of variance and scheffe’s post – hoc test was used. It was concluded that among college level Football, Hockey and Kabaddi players on balance, core stability and strength significant differences was found. It was also concluded that Hockey players were better in balance and core stability
followed by Football & Kabaddi players. Further it was concluded that Hockey players had better core strength followed by Kabaddi and Football players.

Mosquera et al. (2007) studied the “Tactical actions in penalty corner of men and women field hockey players at international level”. Totally 59 female (n=21) and male (n=38) at international level were selected as subjects for this present investigation. In these games 128 penalty corners were registered which was finished in goals. The researchers captured the information through databases and analysed using cross tabs and Chi-square using SPSS packages. The level fixed was 0.05. This study found significant differences in the use of skill among men and women.

Balamurugan (2006) conducted a study on “Motor ability between cricket and hockey players”. To achieve this purpose twenty cricket and twenty hockey players were selected. The subject’s age ranged between 18 and 23 years. The Barrow motor ability test was selected to assess the motor ability between cricket and hockey players. The data collected from six pound medicine ball throw and zig zag run were analysed using ‘t’ test to compare the difference between cricket and hockey players. In medicine ball throw, there is no significance between the cricket and hockey players. In zig-zag run cricket players are showed better performance than hockey players.

Reyment, et al. (2006) conducted a study to examine the “Effects of plyometric training on vertical jump, speed and anaerobic power”. 17 hockey players between the age group of 18 to 24 were selected and tested on vertical jump, speed and anaerobic power prior and after four weeks of plyometric program. The plyometric training improved significantly in vertical jump and power endurance.

Sunderland, et al. (2006) investigated goal scoring using different patterns of play. A total of 130 goals from 70 women international level field hockey matches were considered. In this study the researcher evaluated the play in three phases; repossession of the ball, passing into the D circle and the D circle phase. During analysis it was observed that in the attacking half of the field outside the D circle most repossession occurred and if the ball was repossessed in the attacking 25 yard the goals were scored faster. Further using hit, deflection and push, more goals were scored.
Boddington, et al. (2003) analyzed the skill performance and game parameters by quantifying match descriptors (n = 20) during league matches (n = 10). The collected data were subjected to Chi square and showed in significant differences. It was concluded that many match descriptors do not have stable profiles before 10 matches and are therefore of little use when trying to predict performance.

Nieuwenhuis, et al. (2002) studied the “Prediction for identifying talent in female field hockey players”. To achieve this purpose female field hockey league players at top level (n = 27) and female field hockey league players at bottom level (n = 25) were selected and tested on kinanthropometric, motor physical and psychological variables. The results indicated those eight variables distinguished between successful and less successful hockey players.

Turner, et al. (1999) experimented two physical education specialists taught. The experimental group underwent field hockey instruction and the control group kept as control. The 71 middle school children were tested on knowledge, skill and game performance. The experimental group scored higher on knowledge and passing execution. There were insignificant differences on accuracy among the two groups. The experimental group recorded faster time in accuracy than the control group.

Hermiston, et al. (1979) compared three hockey skills with expert’s ratings. Totally 90 players were selected and their age ranged between 12 and 20 years. Illinois Agility Skate, Finnish Skills Test, and Hermiston Hockey Ability Test were administered to the subjects. It was concluded that Hermiston Hockey Ability Test is the best to assess the players ability.

2.2 SUMMARY OF THE LITERATURE

The relevant literatures collected after exhaustive review from different sources with regard to resistance training and plyometric training on selected physical, physiological and skill performance variables were arranged accordingly. The research studies presented in this chapter gives additional knowledge to the investigator to design an appropriate training method and for selecting dependent variables.
Based on the experience gained through review of the studies, the investigator formulated suitable methodology to be followed in this research study.