CHAPTER-V
SUMMARY, CONCLUSION AND RECOMMENDATIONS

SUMMARY

Plyometric Exercises are specialized high intensity training technique used to develop strength and speed. Plyometric movements are those in which a muscle is loaded and then contracted in rapid, sequence, use the strength, elasticity and innervations of muscle and surrounding tissues to jump higher, run faster or hit harder, depending on desired training goal. Plyometrics was first known as “Jump training”? Plyometric training is also known as "shock training." Plyometric training is when a person performs explosive movements which generate large amounts of force quickly. The aim of these exercises is to increase concentric power output, by lengthening the muscle prior to the contraction. Plyometrics training is when a person performs explosive movements which generate large amount of force quickly. Plyometrics also may enhance strength because muscles are trained under tensions greater than normal maximum tension due to the SSC. The effectiveness of plyometric in combination with resistance training at improving lower body power has been investigated. To achieve plyometric effect, an athlete can jump of a height and bounce back up, with minimal absorption time, to create a greater stretch reflex. Advanced athletes may only train at maximal heights and not beginners. Performing Plyometrics at high amounts and intensity is very dangerous. The muscle spindles are involved in the stretch reflex and are triggered by rapid lengthening of the muscle. Fast twitch muscle fibers are responsible for short explosive movements despite; this condition can harness the growth of slow twitch fibers. To clear things up so far, plyometric will result in growth in fast twitch and pro-longed activities will result in slow twitch muscle fiber growth. Plyometric exercises should only be performed when an athlete is sufficiently warmed up. To perform Plyometric jumps you have to be 100% and not fatigued because that can cause many injuries so don't jump when tired or
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directly after a leg training sessions with weights. Plyometric refers to exercise that enables a muscle to reach maximum force in the shortest possible time. It also examines the research that demonstrates why, as a form of power training, plyometric training is very effective.

All plyometric movements involve three phases. The first phase is the pre-stretch or eccentric muscle action. The third and final phase is the actual muscle contraction. In practice, this is the movement the athlete desires the powerful jump or throws. A combination of plyometrics and resistance training during a training cycle should be structured to allow maximal efficacy and physical improvement. To our knowledge, no randomized studies have compared the effects of combined plyometric training and prospective resistance training in children and adolescents.

Resistance training, also known as strength or weight training has become one of the most popular forms of exercise for enhancing and individual's physical fitness as well as for conditioning athletes. Resistance training has been used extensively to increase fitness and sport performance. It has been demonstrated to augment maximum strength, power, and jumping ability. It is well known that a variety of resistance training programs can stimulate an increase in one repetition maximum strength. However, only few studies have attempted to make direct comparisons of different styles of resistance training programs to determine adaptation differences. With short-term training, compared high intensity versus low intensity aerobic/circuit resistance training in women who were U.S. Naval recruits. After 8 wk, bench press performance was significantly greater in the high-intensity group, whereas no difference was observed between groups in 1-RM leg press performances. American College of Sports Medicine (ACSM) recommends split routines to maximize strength gains among intermediate-advanced resistance-trained individuals and athletes. With split routine training paradigm, individuals train different body parts on each training session within a week to allow proper muscle recovery and to maximize training
loads. The ACSM expands this recommendation suggesting that split training routines should also require the periodization of the training load. This has been shown to be an effective initial frequency whereas appears to be an effective maintenance frequency for those individuals already engaged in a resistance training program.

To our knowledge, no randomized, prospective studies have compared the effects of combined plyometric training and resistance training with resistance training and static stretching in children and adolescents. In previous reports involving youth, the effects of plyometric training were compared to a ‘control’ condition which consisted of sport training or physical education class or the study did not have a control group. Since young athletes are often encouraged to perform static stretching prior to resistance exercise, it is intriguing as to whether plyometric training and resistance training (without pre-event static stretching) can provide combinatory effects in younger populations. Given the growing popularity of youth strength and conditioning programs, and the perception among most youth coaches that pre-event static stretching is beneficial, it is important to ascertain the most efficacious method for Enhancing fitness performance in children and adolescents. This information would be useful to physical educators, sport coaches and health care providers.

Functional training is becoming increasingly popular balance. Definitions describing what functional training Functional fitness have body in each movement. Thought that functional exercise programs should be authors describe functional training as being beneficial improving muscular fitness. Traditional exercise programs are commonly thought. Traditional exercise program is to increase the strength. In muscular fitness benefits of functional training is limited and focused specifically on improving function in older adults. Exercise training programs that are deemed to be training adaptations more transferable. These results suggested that functional task exercises situations, whereas functional programs resembling. Functional exercise
training can improve fitness levels of older adults. Aging adults; thus, creating exercise programs that improve functional fitness and contribute to prolonged the acute physiologic and metabolic responses to functional training participate in a functional training program; however, functional training has similar effects on muscular anthropometric measures in young adults as traditional resistance training. Training will improve anthropometric and performance measures more effectively than traditional resistance training.

Marked evidence indicates that regular participation in a resistance training program or a plyometric training program can improve measures of strength and power in adults. Studies also suggest that changes in motor performance skills resulting from the performance of combined resistance training and plyometric training are greater than with either type of training alone. Thus, both resistance training and plyometric training are typically recommended for adults when gains in motor performance are desired.

In children and adolescents, it is well-established that training-induced gains in strength and power are indeed possible following participation in a resistance training program. More recent observations suggest that plyometric training may also be safe and effective for children and adolescents provided that age-appropriate training guidelines are followed. However, plyometric training is not intended to be a stand-alone exercise program. As previously observed in adults, significantly greater gains in performance may be observed when plyometric training is combined with resistance training.

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The purpose of the study was to compare the \textit{Effects of Plyometric, Resistance Training and Their Combination on the Fitness Level and Performance of Basketball Players}.

The study had the following objectives:

1. To examine the effect of plyometric training on the fitness level of school national level female basketball players.

2. To draw out the effect of plyometric training on the performance of school national level female basketball players.

3. To observe the effect of resistance training on the fitness level of school national level female basketball players.

4. To find out the effect of resistance training on the performance of school national level female basketball players.

5. To examine the effect of combination of both (Plyometric & Resistance Training) on the fitness level of school national level female basketball players.

6. To examine the effect of combination of both (Plyometric & Resistance Training) on the performance of school national level female basketball players.
7. To know the comparative effect of Plyometric, Resistance and combination of both Plyometric & Resistance Training on the fitness level of school national level female basketball players.

8. To study the comparative effect of Plyometric, Resistance and combination of both Plyometric & Resistance Training on the performance of school national level female basketball players.

On the basis of literature reviewed and scholar's own understanding of the problem, the following research hypotheses were formulated.

1. There would be significant effect of plyometric training on the fitness level of school national level female basketball players.

2. There would be significant effect of plyometric training on the performance of school national level female basketball players.

3. There would be significant effect of resistance training on the fitness level of school national level female basketball players.

4. There would be significant effect of resistance training on the performance of school national level female basketball players.

5. There would be significant effect of combination of both (Plyometric & Resistance Training) on the fitness level of school national level female basketball players.

6. There would be significant effect of combination of both (Plyometric & Resistance Training) on the performance of school national level female basketball players.

7. There would be significant effect of Plyometric, Resistance and combination of both Plyometric & Resistance Training on the fitness level of school national level female basketball players.

8. There would be significant effect of Plyometric, Resistance and combination of both Plyometric & Resistance Training on the performance of school national level female basketball players.
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The study had the following delimitations:

1. The study was delimited to the female basketball players in the age group of 16 to 19.

2. The study was further delimited to School National level female basketball players.

3. The study was delimited to the duration of eight weeks training programme only.

Random Group Experimental Design was adopted for this study. Equal numbers of subjects were assigned randomly to four groups, of fifteen subjects each. The experimental treatments were also assigned randomly to the three groups and one group served as the control. The three experimental groups were administered three different types of training programmes for the development of fitness level and performance of female basketball players. Plyometric Training was given to Group-I, Resistance Training to Group-II, and a combination of both (Plyometric and Resistance Training) to Group-III as mentioned in Table I, II & III. A proper warming up period of 15-20 minutes duration was given before training sessions in Experimental groups on alternative days. The control group was not allowed to participate in any of the training programme except in their daily routine practice. Measurements of fitness variables and basketball performance variables were taken before and after an experimental training period of eight weeks. During data collection period, the subjects were not allowed to participate in any training competition.

The subjects were explained the purpose of the tests and way of executing the test by demonstration of the tests before the subjects and all efforts were made to ensure accuracy, uniformity and standardization in the administration of the tests at the fields. The control group was not allowed to participate in any of the training programme except in their daily routine practice.
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The present study was conducted on sixty (60) School National level female basketball players ranging between 16-19 years of age. The subjects were randomly selected and training was conducted at Government Senior Secondary Girls School, Mall Road, Amritsar. The subjects were divided into two groups namely: Control Group (15 subjects) and Experimental Group (45 subjects in total). The Experimental group was further subdivided into three groups of 15 subjects in each group. Group I was given (Plyometric Training), Group II (Resistance Training) and Group III was given both training in combination (plyometric and resistance training). All the subjects were local residents.

The following variables were selected for the purpose of the study.

- Flexibility Test (Sit and Reach Test)
- Strength Test (Vertical Jump Test)
- Speed Test (50m dash test)
- Coordinative Ability Test (Shuttle Run Test)
- Cardio-vascular Fitness Test (Cooper 12 minute Run-Walk Test)
- Performance (Johnson Basketball Test, C. Meyers, 1974)
  a) Field Goal Speed Test
  b) Basketball Throw For Accuracy
  c) Dribble Test

Eight weeks training program was prepared. Before testing, the subjects were oriented the purpose of the study and the importance of the training programme. The technique of performing the training sessions was explained to the subjects by means of demonstration and instructions by the investigator in order to handle them and get their full cooperation so as to ensure reliable data. The training program designed for each group was demonstrated to the respective groups. This was done to ensure a good orientation and exposure. The investigator with the help of Coach and Assistants verified the timings & efficiency of subjects at the training sessions.
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The difference between the initial (pre-test) and final (post-test) scores in each of the criterion were tested for significance by applying ‘t’ test in order to find out the effects of the experimental variables on criterion measures. In order to find out the differential effects of the three treatment groups (Plyometric, Resistance and Combined Plyometric & Resistance) and one control group, Analysis of Covariance (ANCOVA) test was computed with the help of SPSS computer software. To know the direction of the differences the LSD Post-hoc test was applied. The level of significance chosen was .05.

To investigate the significance of mean differences between fitness level and performance among three experimental groups (plyometric, resistance and combined) and control group, t-test was applied at 0.05 level of significant.

The calculated mean and SD values of pre-test in case of fitness level on sit and reach for all experimental and control group obtained were 2.19, 2.05, 2.04, 1.94 and .588, .645, .936, .963. The calculated mean and SD values in case of post-test on sit and reach obtained were 2.46, 2.09, 2.75, 2.08 and .560, .803, .881, .941.

The calculated mean and SD values of pre-test in case of fitness level on vertical jump for all experimental and control group obtained were 6.95, 8.53, 7.93, 6.18 and .930, .763, .963, 1.09. The calculated mean and SD values in case of post-test on vertical jump obtained were 8.00, 9.23, 9.21, 6.32 and 1.03, .809, .999, 1.00.

The calculated mean and SD values of pre-test in case of fitness level on 50m dash for all experimental and control group obtained were 8.97, 8.97, 8.92, 8.85 and .532, .433, .462, .260. The calculated mean and SD values in case of post-test on 50m dash obtained were 8.25, 8.57, 8.43, 8.61 and .525, .404, .336, .334.

The calculated mean and SD values of pre-test in case of fitness level on shuttle run for all experimental and control group obtained were 11.95, 11.90, 11.87, 11.92 and .407, .503, .457, .472. The calculated mean and SD values in case of
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The calculated mean and SD values of pre-test in case of fitness level on cooper 12 m run walk for all experimental and control group obtained were 1902.67, 1857.33, 1849.33, 1806.67 and 174.21, 181.95, 234.84, 153.56. The calculated mean and SD values in case of post-test on cooper 12m run walk obtained were 1990.00, 2012.67, 2146.67, 1820.67 and 181.93, 198.69, 253.17, 191.74.

The calculated mean and SD values of pre-test in case of Basketball performance on dribble for all experimental and control group obtained were 21.00, 20.00, 20.00, 20.47 and 1.00, .756, .756, .743. The calculated mean and SD values in case of post-test on dribble obtained were 23.40, 22.27, 22.67, 20.87 and 1.30, .884, 1.05, .743.

The calculated mean and SD values of pre-test in case of Basketball performance on field goal speed for all experimental and control group obtained were 10.47, 10.47, 9.67, 9.93 and 1.41, .990, .724, 1.62. The calculated mean and SD values in case of post-test on field goal speed obtained were 12.87, 12.20, 13.47, 10.47 and 1.30, .941, .915, .743.

The calculated mean and SD values of pre-test in case of Basketball performance on throw for accuracy for all experimental and control group obtained were 15.60, 11.60, 16.47, 12.07 and 3.56, 3.98, 3.96, 4.06. The calculated mean and SD values in case of post-test on throw for accuracy obtained were 17.93, 13.67, 19.73, 12.80 and 3.10, 3.44, 3.71, 3.41.

The calculated F values in case of pre-test mean, post-test mean and adjusted mean on sit and reach for all the four groups(plyometric, resistance, combined and control) the value obtained were .240 , 2.38 and 4.07. (p<0.05, F-value being 2.77).

The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups( plyometric, resistance, combined and control)
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on vertical jump the value obtained were 18.27, 30.37 and 16.94 (p<0.05, F-value being 2.77).
The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups (plyometric, resistance, combined and control) on 50m dash the value obtained were 0.256, 2.305, 13.21 (p<0.05, F-value being 2.77).
The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups (plyometric, resistance, combined and control) on shuttle run the value obtained were 0.080, 5.85 and 13.83 (p<0.05, F-value being 2.77).
The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups (plyometric, resistance, combined and control) on cooper 12m run walk the value obtained were 0.653, 6.19 and 58.05 (p<0.05, F-value being 2.77).
The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups (plyometric, resistance, combined and control) on dribble the value obtained were 5.05, 16.53 and 20.27 (p<0.05, F-value being 2.77).
The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups (plyometric, resistance, combined and control) on field goal speed shot the value obtained were 1.57, 16.53 and 42.25 (p<0.05, F-value being 2.77).
The calculated F values in case of pre-test mean, post test mean and adjusted mean for all four groups (plyometric, resistance, combined and control) on throw for accuracy the value obtained were 5.97, 14.25 and 9.147 (p<0.05, F-value being 2.77).
CONCLUSIONS

In the light of limitations and delimitation imposed by the subjects, the experimental conditions, and based on the analysis of data, the following conclusions have been drawn:

1. Resistance group demonstrated maximum effect on the flexibility with improved performance in sit and reach than other three groups. Whereas combined group was the next effective treatment group on flexibility than Plyometric group and control group.

2. Combined (Plyometric and Resistance) training proved to be most effective experimental method for improving explosive leg strength as compared to other two experimental groups. The other two groups namely Plyometric and Resistance group also improved their explosive leg strength significantly than control group. Plyometric group was the next effective treatment to improve performance in vertical jump followed by Resistance group.

3. Plyometric group, the increment performance in 50m dash is most significant as compared to Resistance group, combined group and control group. Combined group also performed their running time in 50m dash significantly better than Resistance and control group.

4. Combined (Plyometric and Resistance) training is best treatment to improve the agility in the body. Next treatment to improve agility is Plyometric group followed by Resistance group.

5. Combined group proved maximum effect on cooper 12 min run walk than other groups. Whereas Plyometric group was the next effective treatment group to improve endurance level followed by Resistance group.

6. Plyometric group demonstrated maximum effect on dribbling ability as compare to other groups whereas combined group was the next effective group to improve dribble ability followed by resistance group that showed least effect on dribbling ability as compared to control group.
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7. Combined group (plyometric and resistance) demonstrated maximum effect on field goal speed shot ability as compared to other groups where as plyometric group was the next effective group to improve speed shot ability followed by resistance group that showed least effect on dribbling ability as compared to control group.

8. Combined group (plyometric and resistance) demonstrated maximum effect on throw for accuracy as compared to other groups where as plyometric group was the next effective group to improve throw accuracy followed by resistance group that showed least effect on accuracy as compared to control group.

RECOMMENDATIONS

In the light of the finding of the present study, the following recommendations can be made by the coaches and Physical Education teachers for improving fitness level and performance of the players in their respective games. Following recommendation seems to be warranted for further studies.

1. Similar study may be conducted on males of same age group.
2. Similar studies may be undertaken with age group other than those employed in this study.
3. Similar studies may be undertaken by increasing the duration of the training programme.
4. Similar studies may be conducted on subjects belonging to different other games.
5. Similar study may be conducted for different levels of players i.e College level, State level, University level, National and International level.
6. A large number of samples may be taken in further studied to achieve more authenticity.
7. Through, present study was limited three experimental groups, more experimental group may be taken further study.