RESEARCH PAPER

Effects of High-Intensity Resistance Training and Small-Sided Games On Aerobic Fitness for College-Going Badminton Players

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ABSTRACT

AIM: The aim of the study is to compare the effects of High Intensity resistance training and Small Sided Games on aerobic fitness in college going badminton players.

OBJECTIVE: To find out the effects of High Intensity Resistance Training and Small Sided Games on aerobic fitness in college going badminton players.

BACKGROUND: Yining Lu, concluded that high intensity functional training was effective in improving aerobic capacity among healthy inactive females.

Ana Filipa Silva, concluded that Small Sided Games and High Intensity Interval Training are both effective for improving vertical and horizontal jumping ability, change of direction and aerobic capacity

OUTCOME MEASURES: Vertical Jump Test, Horizontal Jump Test (Single hop test, Triple hop test).

METHOD: The total 30 samples who fulfilled the inclusion and exclusion criteria were recruited for the study. Written informed consent was obtained from the samples. The procedures were explained to the samples, they were divided into two groups namely group A -15 samples and group B -15 samples. High Intensity Resistance Training [HIRT] were given for the 15 samples (group A) and Small Sided Gmes [SSGs] were given for the 15 samples (group B).

RESULT AND CONCLUSION: Aerobic fitness exhibited a significant superior improvement in Group A (HIRT) as compared to Group B (SSG). Therefore, intense training could benefit in body fat percentage reduction as suggested by this study.

KEYWORDS: High Intensity Resistance Training (HIRT), Small Sided Games (SSGs), Low Density Lipoprotein(LDL), Triglycerides (TG), Jigh Density Lipoprotein (HDL)

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INTRODUCTION:

Physical activity is crucial fpr maintaining a healthy weight and muscular fitness, which can be challenging for college badminton players due to external factors such as academic stress. High Intensity Resistance Training (HIRT) is one of the most effective training methods and is frequently used to improve the players cardiorespiratory and metabolic function [1-2]. HIRT appears to help physically inactive individuals overcome a major time and participation barrier to maintaining a healthier lifestyle [3].

HIRT was used to improve the performance of endurance athletes [4]. Cycling, running, and rowing are traditional exercise modalities that adopted the use of HIRT protocols, while for individuals who perform exercise for health and recreation, these traditional modalities seem boring and do not engage individuals because of the repetitive nature of the exercise combined with repetition [5].

HIRT appears to be an efficient pathway to enhance physical activity and improve health[6].

HIRT involves repeated bouts of high intensity exercise [7]. Recent studies had indicated that HIRT has a similar, or even greater positive, effect on physical fitness, especially on body composition and cardiorespiratory health [8-.11].

HIRT plays an important role on reducing total cholesterol, LDL-cholesterol, TG and increased HDL cholesterol [12]. The prevalence of overweight and obese population has increased all over the world especially among adults [13].

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Fig.1.1

Fig.1.2

Effective time in exercise protocols may potentially increase individuals compliance with exercise intervention with respect to resistance exercise, a low volume but with high intensity training protocol seem to be most time efficient way to improve muscular parameter compare with high intensity resistance training [14].

The resistance training and aerobic training are prescribed for sedentary and obese population because they can promote improvement in body composition, biochemical markers, blood pressure and heart rate as well as muscular strength and aerobic capacity [15].

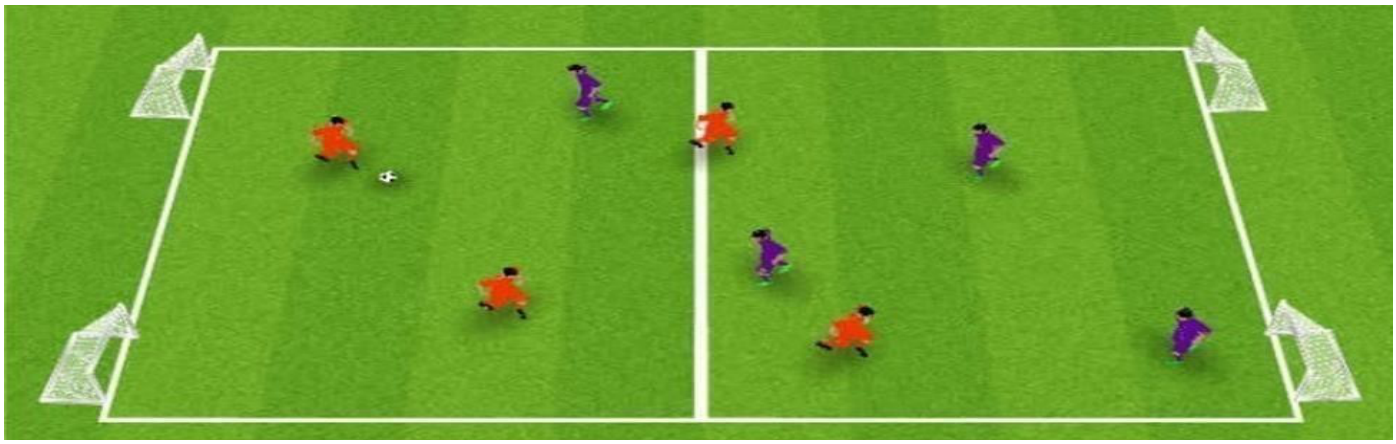


Fig.1.3

Generally, small – sided games (SSGs) used as a training intervention similar to long HIRT [16].

SSGs are also considered a time efficient training method, as they can develop technical skills, physical

performance, and tactical awareness simultaneously [17]. SSGs, which consist of smaller pitch sizes, different rules, and reduced players numbers [18- 19]. The purpose of this study was to investigate the effects of different kinds of training on fitness parameters in untrained college studying badminton players [5].

Aerobic fitness can be defined as the body's ability or capacity to engage the respiratory and circulatory systems to deliver oxygen during an activity [12]. Aerobic fitness and more generally exercise linked to improved learning and memory abilities during adolescence [2022], and may act as a protective factor against physical and mental health problems later in life [23].

Fig.1.4

Aerobic endurance training reduces the activity of glycolytic enzymes and increases the number of intracellular energy storages, the activity of oxidative enzymes, the number of capillaries in muscles, the density of mitochondria [17].

Faced with the health treats of multiple diseases and falls, a study released by the World Health Organization [24] recommends approximately 150 min of moderate intensity physical activity or exercises per week, which can reduce the risk of common chronic illnesses such as breast cancer, type 2 diabetes and stroke [25] besides boosting the immunity. Aerobic exercise as a form of physical activity. Aerobic exercises are the ones that focus on pumping the oxygenated blood from heart to other working muscles. Any exercise that pumps blood to the larger and smaller working muscles can be considered as an aerobic exercise. One of the main benefits of aerobic exercise is the enhancement of cardiovascular health. It has shown that aerobic exercise can reduce the inactivity-induced loss of strength, mobility, balance, and endurance vital for the safe performance of daily activities [26].

AIM OF THE STUDY:

The aim of the study was to study the effect of High Intensity Resistance Training (HIRT) and Small Sided Games (SSGs) on aerobic fitness in college going badminton players.

OBJECTIVES OF THE STUDY:

1. To find out the effects of High Intensity Resistance Training (HIRT) on aerobic fitness in college going badminton players.
2. To find out the effects of Small Sided Games (SSGs) on aerobic fitness in college going badminton players.
3. To find out the effects of High Intensity Resistance Training (HIRT) and Small Sided Games(SSGs) on aerobic fitness in college going badminton players.

BACKGROUND OF THE STUDY:

1. **Yining Lu (2021)** is the study concluded that High intensity functional training (HIFT) reveals strong exercise adherence and more enjoyment which helps for individuals to promote physical activity and the associated benefits of a prolonged healthy life style.
2. **Sinan Nayiroglu (2022)** is the study concluded that SSG and HIIT are both effective in improving vertical and horizontal jumping ability, change of direction, and aerobic capacity

NEED OF THE STUDY:

There is very less study on the HIRT and small sided games on aerobic fitness among the college going badminton players. There is a need to understand the improvement in the physical activity by giving them HIRT and small sided games on aerobic fitness among college going inactive badminton players.

HYPOTHESIS:

NULL HYPOTHESIS:

There is no significance difference in the effectiveness of High Intensity Resistance Training (HIRT) and Small Sided Games (SSGs) on aerobic fitness in college going badminton players.

ALTERNATE HYPOTHESIS:

There is a significant difference in the effectiveness on High Intensity Resistance Training (HIRT) and Small Sided Games (SSGs) on aerobic fitness in college going badminton players.

REVIEW OF LITERATURE:

1. **Rio Zelino 2024** the results suggested that fartlek training was more effective than small sided games training at increasing players vo2 max.
2. **Filipe Manuel Clemente 2024** this survey successfully characterized the implementation of SSGs by Portuguese and Brazilian soccer coaches, shedding light on when, how, and why these training drills are utilized.
3. **Noris Strada Sanjaya 2024** there was no significant difference in the effect of small sided games and dynamic passing on cognitive intelligence and vo2 max ability.
4. **Ouddak Mohamed 2024** training through small sided games emerges as a specialised form of training that effectively enhances physical capabilities, akin to the benefits associated with interval training. The selection of an appropriate format in terms of player numbers and playing area is deemed sufficient for achieving the intended goals.
5. **YongXing Zhao 2024,** SSG-based training is effective in significantly enhancing aerobic performance and change of direction, comparable to alternative approaches. However, the effects on repeated sprint ability and sprint performance are not consistently demonstrated.
6. **Lu Ying, Duan Wei, Luo Xiaoqi et al 2023**, conducted a experimental study on the impacts of aerobic exercise on cardiovascular health in college badminton players. This study included 20 healthy boys from the school of physical education. The study concluded that compared with moderate intensity continuous exercise (MICT), high intensity intermittent exercise (HIIT) mode is more efficient, but also safer.
7. **Ridho Bahtra 2023** the results of this study demonstrate that small sided games 5v5 training can improve the aerobic endurance of young football players.
8. **Ali Onur Cerrah 2023** that the coaches and sports scientists are advised to choose CT for more efficient training, considering the differences between the MAS training and CT methods.
9. **Aditya Pahlevi 2023** ping game performance is very effective. So that in provided volleyball training programs, especially training programs with a better system, it is given to athletes who have high motor skills. But for low motor abilities, both programs can be used, both block system programs and random system programs.
10. **Shuang Wang 2023,** this systematic review suggested that SSG-based interventions conducted among sedentary youth populations can play a positive role in improving their aerobic fitness.
11. This improvement in aerobic fitness could have potential positive impacts on their overall health and quality of life.
12. **Aji Khotibul Umam 2023**, concluded that there was an influence of SSG exercise methods on increasing anaerobic endurance and fatigue index of players. The choice of the SSG method was highly recommended, because the method accommodates all the conditions of the real football game when competing, so the application of this method caused training adaptations that greatly affected the ability of players in matches. Along with increasing cardiovascular or cardiopulmonary endurance, it can reduce the fatigue index in football.
13. **Filipe Manuel Clemente 2023,** Statistical analyses did not reveal significant differences in maximal oxygen uptake between the SSGs-based training group and the control group. However, when employing SSGs-based training, statistically significant differences were found in repeat sprint ability within this group compared with the HIIT group. This study demonstrated that a nine-week period of training sessions, including SSGs, can enhance aerobic capacity, repeat sprint ability, and agility in youth soccer players to a comparable extent as high-intensity interval training sessions. Importantly, SSGs demonstrated superior effects on RSA. Both training methods, when applied over nine weeks, induced a similar effect on VO2MAX, as evidenced by the increased performance from pre-test to post-test. Consequently, during the in-season, coaches of amateur teams should consider favoring the use of SSGs training over interval exercises to optimize training.
14. **Karel Hulka 2023** the SSGT method had a positive effect on female players' MAT, ball-throwing velocity and YoYo IR1 results, and the CERT method had a significant effect only on the YoYo IR1 results. Handball SSGs are a more suitable training method due to exercise specificity.
15. **Sinan Nayiroglu, Ali Kerim Yilmaz, Ana Filipa Silva, Rui Silva, Hadi Nobari, Filipe Manuel elemente** et al **2022,** conducted a comparative study on the effects of small sided games and running based high intensity interval training on body composition and physical fitness. This study taken 24 players and divided into 2 groups. They concluded that SSG and HIIT are both effective for improving jumping ability, change of direction and aerobic capacity status.
16. **Rares – mihai pop, vald Teodor grosu, 2022** this study ought to assess the effect of two types of SSGs intervention on multiple physical and motivational outcomes of youth soccer players for physical outcomes the results suggest that adding a behavioural benefit to training intensity we believe that this could contribute to aerobic capacity training using SSGs.
17. **Ersan Arslan, Gamze erikoglu orer and Filipe Manuel clementecorresponding 2020** the study led to a considerable increase in aerobic capacity through HIIT performed 2 days a week for a period of 5- week during the prepation period of the season while causing a considerable improve in

speed- based demands such as 1000m running time (-6.1%) and total duration of repeated sprint ability (-9.5%)

18. **Martin Pacholek, Erika Zemkova, Keith Arnolds, Peter Sagat et al 2021**, conducted a experimental study on the effect of combined aerobic and resistance training and volleyball training on fitness variable and body composition on STEAM badminton players. There are 28 physically inactive male badminton players were taken. This study concluded that combined resistance and aerobic training are more effective in improving the explosive power of lower limb and aerobic endurance that an intermittent type sport.
19. **Chao Lan, Yujie Liu, Yan Wang et al 2021**, conducted a study on the effects of different exercise programs on cardiorespiratory fitness and body composition in college badminton players. A total of 50 non – smoking, healthy and physically inactive badminton players and randomly assigned to 4 groups. This study showed that LICT-BFR and HIIT groups has showed greater absolute VO_2 max improvements than MICT groups.
20. **Amir Hossein Haghighi, 2Morteza Hajinia, Roya Askari, Sadegh Abbasian, Gary Goldfied et al 2021**, conducted a study on effect of high intensity resistance training on irisin and fibroblast growth factor in men with overweight and obesity.This study taken 50 participants and 18 participants were excluded for various reasons. Therefore, 32 eligible men with overweight and obesity aged 30-45 years were included. This study concluded that HIRT and HIIT may be safe and effective training modalities to promote favourable changes in the body composition in men living with overweight and obesity.
21. **Yining Lu, Huw D. Wiltshire, Julien s. Baker and Qiaojun Wang et al 2021,** conducted a comparative study on the effects of running compared with functional high intensity interval training on body composition and aerobic fitness in female university badminton players. There were taken
22. 20 healthy, untrained female badminton players and duration is 12 weeks. this study concluded that HIFT was equally effective compare to HIIT-R in promoting body composition and aerobic fitness.
23. **Filipe manuel clemente Rodrigo Ramirez – campillo 2021** this systematic review and meta – analysis revealed a significant beneficial effect of using SSGs training programs for enhancing techining execution in young and youth players the benefits were similar despite the various numbers of training sessions applied
24. **Tatiano Moro, Giuseppe Marwlin, Antonino Bianco, Francesco Bolzetta, Linda Berton, Giuseppe Sergi, Antonio Paoli** et al **2020,** conducted study on the effects of 6 weeks of traditional resistance training or high intensity interval resistance training on body composition, aerobic power and strength in healthy young subjects. There totally included 21 young healthy subjects. The total duration of this study and 6 weeks. The results of the present study suggest HIIRT seems to be a good training alternative for those who do not have much time to exercise.
25. **Asfarina Jitwill, Patricia Pawa Pitil, Wan Juliana, Emeih Wahed** et al **2019**, conducted a experimental study on the high intensity training and high intensity resistance training on body fat percentage and aerobic fitness among female overweight adults. There are 14 sedentary female and assigned to two groups. This study concluded that both HIIT and HIRT were effective in reading body fat percentage and improving aerobic fitness among overweight female adults.
26. **Philipp kunz, Florian Azad Engel Hans – Christer Holmberg 2019** the present meta-analysis indicates that HIIT and SSG have equally beneficial impacts on variables related to the endurance and soccer – specific performance on neuromuscular performance
27. **Ben Drury 2019** small sided games are as effective as conventional endurance training for increasing aerobic endurance performance in male youth soccer players.
28. **Shane Malone 2017,** The current study suggests that small-sided games are a time efficient and effective method of improving fitness characteristics within hurling cohorts.

METHODOLOGY:

STUDY DESIGN : Comparative experiment study.
SAMPLE SIZE : 30 subjects
GROUP A (15), GROUP B (15).
SAMPLE METHOD : Convenient sampling
STUDY DURATION: 4 Weeks
STUDY SETTING : VISTAS,THALAMBUR.

SELECTION CRITERIA:

INCLUSION CRITERIA

- AGE GROUP: 18 to 25 years
- College studying badminton players.
- Untrained healthy badminton players.
- Physically inactive badminton players.
- Both males and female badminton players are taken.

2. EXCLUSION CRITERIA

- Deformities.
- Fracture.
- Musculoskeletal disorder
- Recent surgeries
- Open wounds
- Non smokers and Non alcoholic

PARAMETER FOR ANALYSIS

- Height (cm)
- Body mass (kg)
- Inch Tape

OUTCOME MEASURES
- Vertical Jump Test
- Horizontal Jump Test
- Single hop Jump Test
- Triple hop Jump Test

VERTICAL JUMP TEST
Vertical Jump Test, especially when incorporating variations like the counter movement jump with arms on hips and a free arm, is commonly used to assess lower body power and explosive strength. To be undergoing, including the vertical jump test with variations. Clear communication helps ensure their understanding and cooperation, contribution to the accuracy and reliable of the test results.

1.Equipment Needed:
- A wall or a vertical measuring device (like a Vertec).
- Chalk or marker to mark the highest point touched.
-A measuring tape or ruler.

2.Setup:
- Stand next to the wall or measuring device with your side facing it.
- Ensure your feet are flat on the ground and shoulder-width apart.
- Extend your arm upward as high as possible, reaching with your fingertips.

3.Measurement:
- From the standing position, jump as high as you can, reaching up with your arm to mark the highest point you touch on the wall or measuring device.
- Ensure you don't use any steps or additional movements other than the upward jump. -Land back down softly on both feet.

4. Recording:
- Measure the distance from the highest point you touched to the ground.
- This distance is your vertical jump height.

5. Repeating:
- Repeat the jump several times (usually three to five times) to ensure accuracy and to get an average measurement

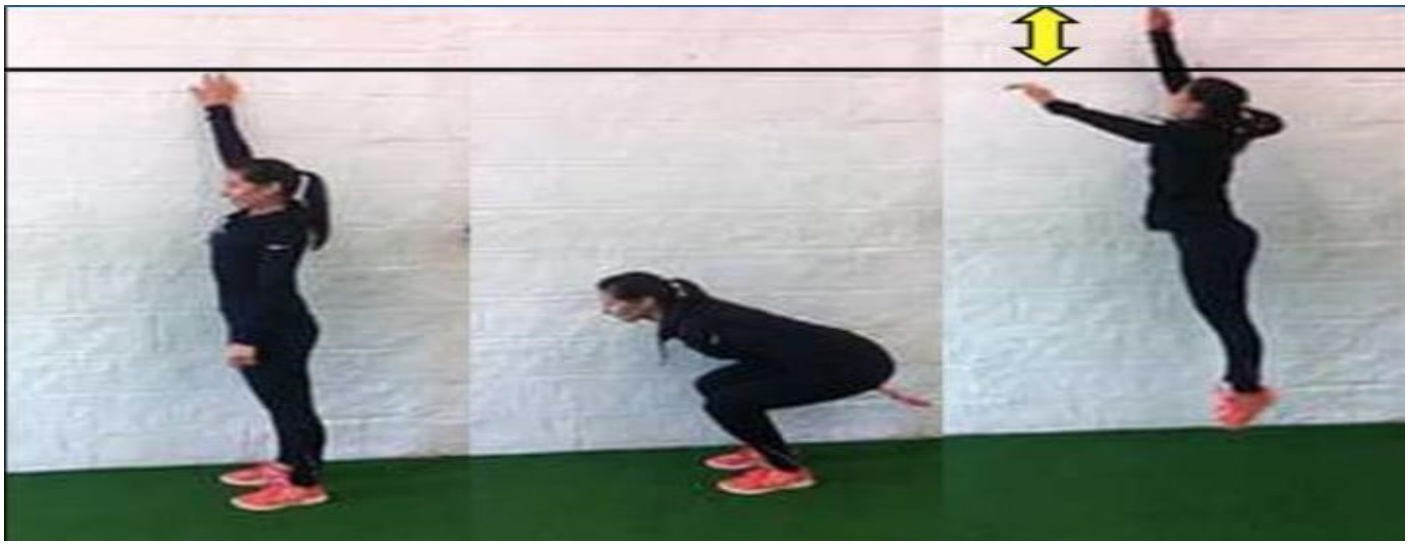


Fig.2.1

HORIZONTAL JUMP TEST:
Horizontal jump test is a common for assessing lower body power in runners. It involves jumping forward from a standing position and measuring the distance jumped. This test can help to evaluate an athlete's explosive strength and leg power.

SINGLE HOP TEST:

1. Equipment Needed:
- Measuring tape or marked floor.
- Clear, flat surface.

2. Setup:
- Stand on one foot with your toes behind the starting line or marker.
- Maintain a slight bend in the knee of the standing leg for balance and stability.
- Keep your arms relaxed at your sides or in a natural position for balance.

3. Execution:
- Hop forward as far as possible, using a single-leg jump.
- Land softly on the same foot you jumped with, maintaining balance.
- Avoid taking any additional steps after landing.

4. Measurement:
- Measure the distance from the starting line to the heel or closest body part that touched the ground upon

landing. This distance represents your single hop distance.

5. Recording:

- Record the distance hopped in centimeters or inches.

6. Repeating:

- Repeat the hop test two to three times, allowing adequate rest between attempts.

Fig.2.2

TRIPLE HOP TEST:

1. Equipment Needed:

- Measuring tape or marked floor.
- Clear, flat surface.

2.Measurement Setup:

- Mark a starting line on the ground.
- Mark three landing zones in a straight line, each approximately 1 meter apart from each other.
- Make sure the surface is appropriate for jumping (e.g., flat and non-slippery).

3.EXERCISE:

- The participant stands with one foot behind the starting line.
- On the "go" command, the participant hops forward three times consecutively on the same foot, attempting to cover maximum distance with each hop.
- Ensure that the participant maintains balance and control throughout the test.

4.Recording:

- Record the distance hopped.

5.Repeat:

-Allow the participant to perform the test three times with each leg,with adequate rest between trials.

TOOLS USED:

• Measuring tape

Fig.2.3

PROCEDURE:

In this study 30 badminton players were taken from Vels college in Chennai. Informed consent were given and received from the badminton players, then the procedure and assessment methods were explained. The badminton players were selected based on inclusion criteria. The badminton players allocated into two groups (Group A and Group B). Group A has 15 badminton players and Group B has 15 badminton players. The study population consists of individuals at age group between 18 to 25.

Before giving training to the student collect the demographic data (height and weight) of the badminton players. Then start to collect the pretest value by using the outcome measures.

GROUP A:

The participants in HIRT groups performed multiple functional exercise using their own body weight. According to the study 5 movements were implemented in each session. Participants were motivated to complete as many repetitions of a given movement as possible over 20s and followed by 10s recovery in the form of low stepping movement. There is no resting period between each movement. The total training time for each session was 2mins.

1. **JUMPING JACKS:**

Stand with your feet together and your arms at your sides. Jump up, spreading your legs out to the sides and raising your arms above your head, forming an "X" shape. Land softly with your feet shoulder width apart and your arms back at your sides. Repeat the motion continuously for a set of time or repetitions.

Fig.3.1

2. **HIGH KNEES:**

Stand up straight with your feet hip width apart. Begin jogging in place, lifting your knees as possible towards your chest. Keep your core engaged and your back straight. Swing your arms in rhythm with your knees, or keep them stationary if your prefer. Continue for a set amount of time or repetitions, aiming for a quick pace to get your heart rate up.

Fig.3.2

3. **MOUNTAIN CLIMBERS:**

Start in a plank position, with your hands directly under your shoulders and your body forming a straight line from head to heels. Engage your core and keep your

back flat throughout the exercise. Begin by lifting your chest, keeping your hips low. Quickly switch legs, bringing your right foot back as you simultaneously bring your left knee towards your chest. Continue alternating legs in a running motion, moving as quickly as you can while maintain proper form. Aim to keep a steady pace and perform the exercise for a set amount of time or repetitions, depending on your fitness level and goals. Remember to breathe steadily throughout the exercise and focus on keeping your core muscle engaged for stability.

Fig.3.3

4. FOREARM PLANK TO HIGH PLANK:

Start in a forearm plank position with your elbows directly beneath your shoulders and your body forming a straight line from head to heels. Press through your palms to straighten your arms, one at a time, lifting your body up into high plank position. Ensure your hands are directly beneath your shoulders, and your body remains in a straight line from head to heels. Hold the high plank position for a moment, engaging your core and keeping your hips level. To return to the forearm plank, lower yourself down onto your forearms one arm at a time, maintaining control and keeping your body in a straight line throughout the movement.

Fig.3.4

5. DEEP SQUAT JUMP:

Start by standing with your feet shoulder width apart or slightly wider, toes pointing slightly outward. Lower your body into a deep squat position by bending your knees and pushing your hips back, keeping your chest up and back straight. Ensure your thighs are at least parallel to the ground, or lower if you have the flexibility. From the deep squat position, explode upwards using your legs, engaging your glutes, quadriceps, and calves. As you jump, extend your hips and knees fully, driving your arms upward for momentum. Land softly back into the deep squat position, absorbing the impact by bending your knees and hips. Immediately transition into the next repetition, focusing on explosive power and maintaining proper form through out the movement.

Fig.3.5

WEEKS	FREQUENCY	EXERCISE	EXERCISE BOUT
WEEKS 1 AND 2	3 SESSIONS PER WEEK	JUMPING JACKS	20 SEC
		STEPPING	10 SEC
		HIGH KNEES	20 SEC
		STEPPING	10 SEC
		MOUNTAIN CLIMBERS	20 SEC
		STEPPING	10 SEC

		FOREARM PLANK TO HIGH PLANK	20 SEC
		STEEPING	10 SEC
		DEEP SQUAT JUMP	20 SEC
		STEPPING	10 SEC

TABLE.1.1

WEEKS	FREQUENCY	EXERCISE	EXERCISE BOUT
WEEKS 3 AND 4	3 SESSIONS PER WEEK	JUMPING JACKS	20 SEC
		STEPPING	10 SEC
		HIGH KNEES	20 SEC
		STEPPING	10 SEC
		MOUNTAIN CLIMBERS	20 SEC
		STEPPING	10 SEC
		FOREARM PLANK TO HIGH PLANK	20 SEC
		STEEPING	10 SEC
		DEEP SQUAT JUMP	20 SEC
		STEPPING	10 SEC

TABLE.1.2

GROUP B:

The players were asked to play soccer after a 5 minutes standard warm up to avoid any minor injuries. The 15 participants were divided into a group 5 with 3 teams. A coach stated the rules of the game and a 5 vs 5-sided game was given. Each team played for 2 sets of 2 minutes each team rest time of 4 minutes before the next set. The aim of the game was for possession of the ball and movement off the ball. the small sided game consisted of an area of 18 x 30m with a small goal post placed on each side for a goal.

Coach intervention was required during the duration of play for each team and set.

Fig.3.6

Fig.3.7

Fig.3.8

Fig.3.9

DATA ANALYSIS:

The collection data were tabulated and analysed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS) version 24.0. Paired t – test was adopted to find the statistical difference within the groups & independent t – test was adopted to find the statistical difference between the groups.

1.1. Descriptive Statistics

• Mean & Standard deviation for Continuous variables, namely Vertical jump and Horizontal jump (single hop and triple hop).

1.2. Inferential Statistics

• Intra Group Analysis – Paired Samples t-test

• Inter Group Analysis – Independent Samples t-test

1.2.1 Paired Samples t-test Hypotheses:

Null Hypothesis, H_0: $\mu_d = 0$

• (i.e., there is **no significant effect** of **Treatment A (or B)** in terms of measures, namely Vertical jump and Horizontal jump (single hop and triple hop).

Alternate Hypothesis, H_1: $\mu_d > 0$

• (i.e., there is **significant effect** of **Treatment A (or B)** in terms of measures, namely Vertical jump and Horizontal jump (single hop and triple hop).

In this case, μ_d = mean difference between Pre and Post-test scores; d = difference **d**

□

= Post Test Score - Pre-Test Score

Level of significance, $\alpha = 0.05$

Test to be applied: Paired Sample t-test

1.2.2 Independent Samples t-test **Hypotheses**:

Null hypothesis, H_0: $\mu_1 = \mu_2$

(That is, there is no significant difference between two treatments (A & B) in terms of changes in measures, namely VISA-P, SINGLE LEG HOP TEST.)

Alternative hypothesis, H_1: $\mu_1 \neq$

• (That is, there is significant difference between two treatments (A & B) in terms of changes in measures, namely Vertical jump and Horizontal jump (single hop and triple hop).

Level of significance: $\alpha = 5\%$ or 0.05

Test to be applied: Independent Samples t-test

TABLE 1:REPRESENTS THE MEAN VALUE OF GROUP A IN VERTICAL AND HORIZONTAL JUMP.

S.NO	PARAMETERS	MEAN		SD		t-VALUE	p-VALUE
		PRE TEST	POST TEST	PRE TEST	POST TEST		

1.	VERTICAL JUMP		259.7	266.0	36.28	38.42	6.1414	0.0001
2.	HORIZONTAL JUMP	SINGLE	172.33	179.67	29.63	29.06	8.8764	0.0001
		TRIPLE	506.33	516.67	104.02	104.84	10.0201	0.0001

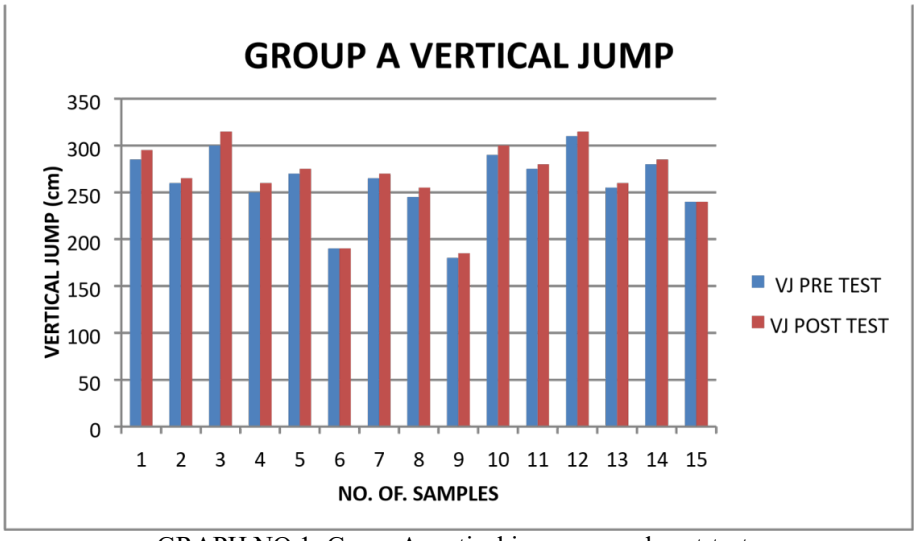
The above table reveals the Mean, Standard Deviation (S.D), t-test, and p – value of group A in pre-test and post-test weeks.

This table shows that significant difference in pre-test (259.7) and post-test (266.0) values of group in vertical jump.

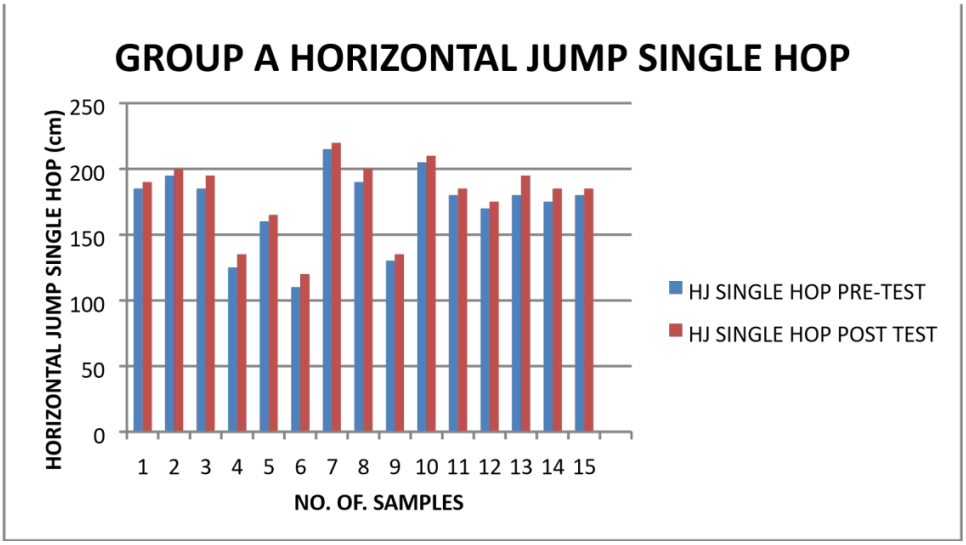
This table shows that significant difference in pretest (172.33) and post-test (179.67) values of group in Horizontal jump (single hop).

This table shows that significant difference in pre-test (506.33) and post-test (516.67) values of group in Horizontal jump (triple hop).

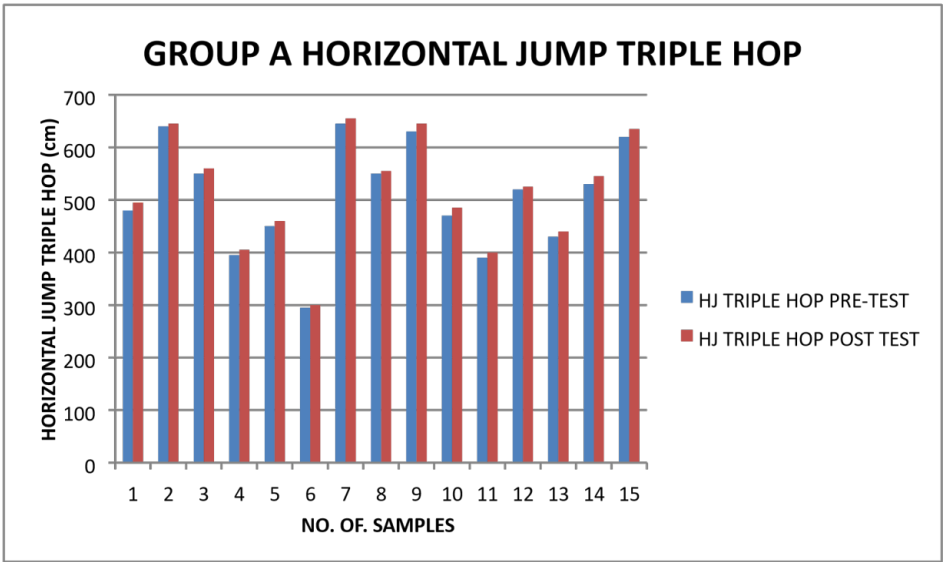
GRAPHS REPRESENTS THE MEAN VALUE OF GROUP A IN VERTICAL JUMP AND HORIZONTAL JUMP:



GRAPH NO 1: Group A vertical jump pre and post-test.



GRAPH NO 2: Group A Horizontal jump single hop pre and post-test.



GRAPH NO 3: Group A Horizontal jump triple hop pre and post-test.

TABLE 2:REPRESTING THE MEAN VALUES OF GROUP B IN VERTICAL JUMP AND HORIZONTAL JUMP.

S.NO	PARAMETERS	MEAN		SD		t-VALUE	p-VALUE
		PRE TEST	POST TEST	PRE TEST	POST TEST		
1.	VERTICAL JUMP	244.33	246.53	37.17	36.05	3.1817	0.0067

2.	HORIZONTAL JUMP	SINGLE	152.00	154.53	40.89	41.36	2.8346	0.0132
		TRIPLE	427.80	428.87	98.78	98.87	16.0000	0.0001

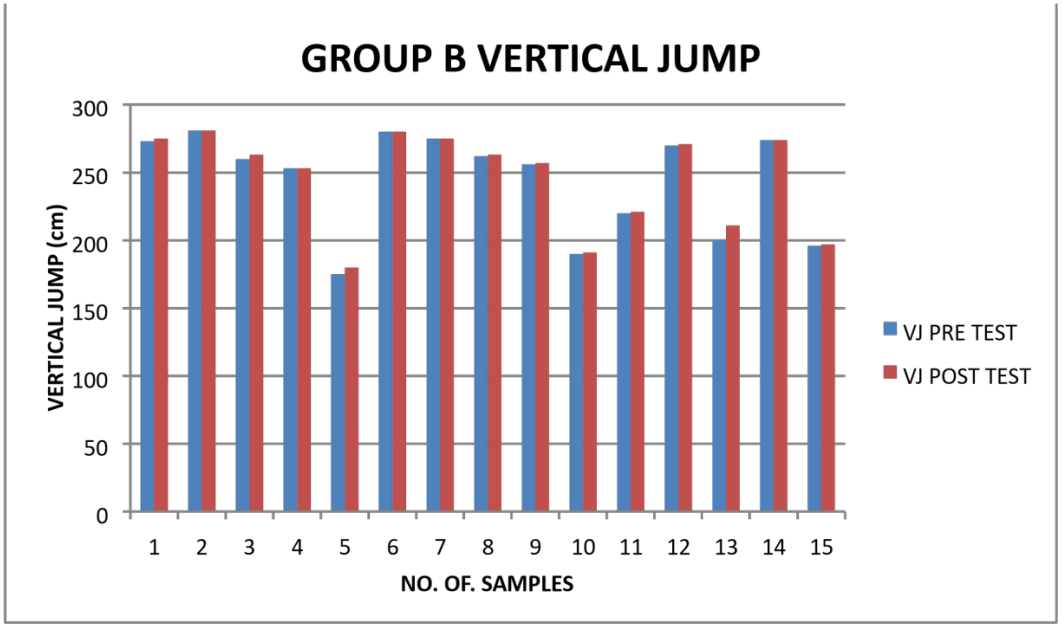
The above table reveals the Mean, Standard Deviation (S.D), t-test, and p – value of group B in pre-test and post-test weeks.

This table shows that significant difference in pre-test (244.33) and post-test (246.53) values of group in vertical jump.

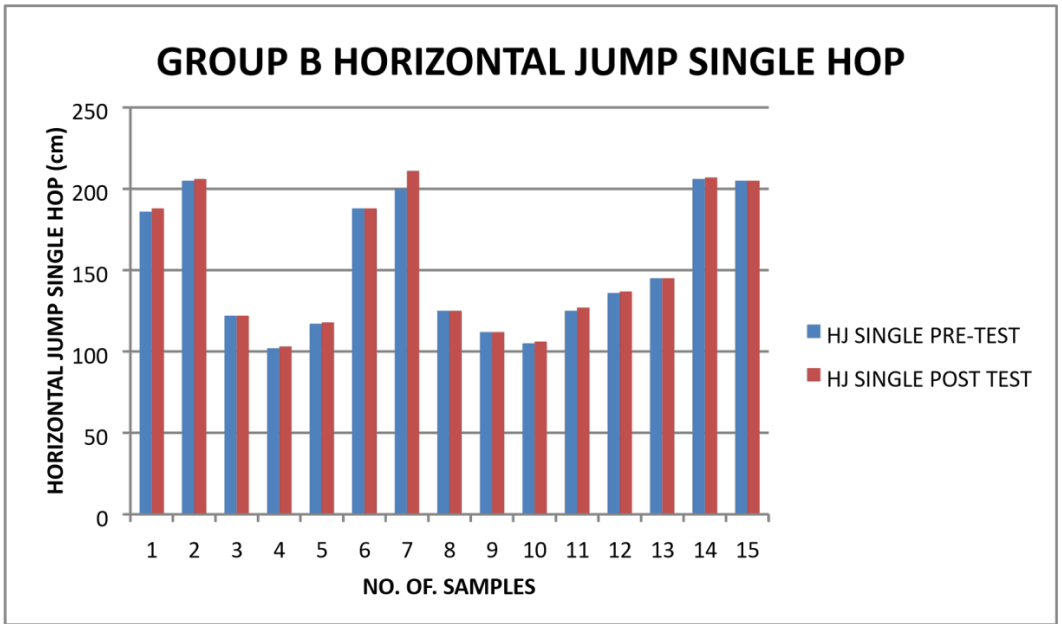
This table shows that significant difference in pretest (152.00) and post-test (154.53) values of group in Horizontal jump (single hop).

This table shows that significant difference in pre-test (427.80) and post-test (428.87) values of group in Horizontal jump (triple hop).

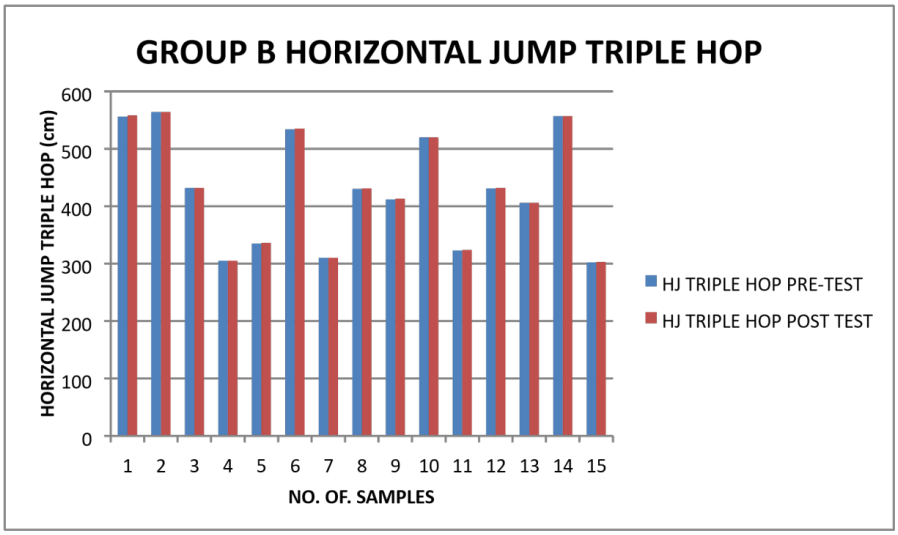
GRAPHS REPRESTING THE MEAN VALUES OF GROUP B IN VERTICAL JUMP AND HORIZONTAL JUMP



GRAPH NO 4: Group B vertical jump pre and post-test values.



GRAPH NO 5: Group B horizontal jump (single jump) pre and post-test values.



GRAPH NO 6: Group B Horizontal jump (triple hop) pre and post-test values.

TABLE – 3 REPRESTING THE MEAN VALUES OF GROUP A & GROUP B IN VERTICAL JUMP AND HORIZONTAL JUMP

S.NO	PARAMETER		GROUP	MEAN VALUE	SD VALUE	t-VALUE	p-VALUE
1.	VERTICAL JUMP		A	266.0	38.42	1.4372	0.1634
			B	246.53	36.05		
2.	HORIZONTAL JUMP	SINGLE	A	179.67	29.06	1.9257	0.0644
			B	154.53	41.36		
		TRIPLE	A	516.67	104.84	2.3597	0.0255
			B	428.87	98.87		

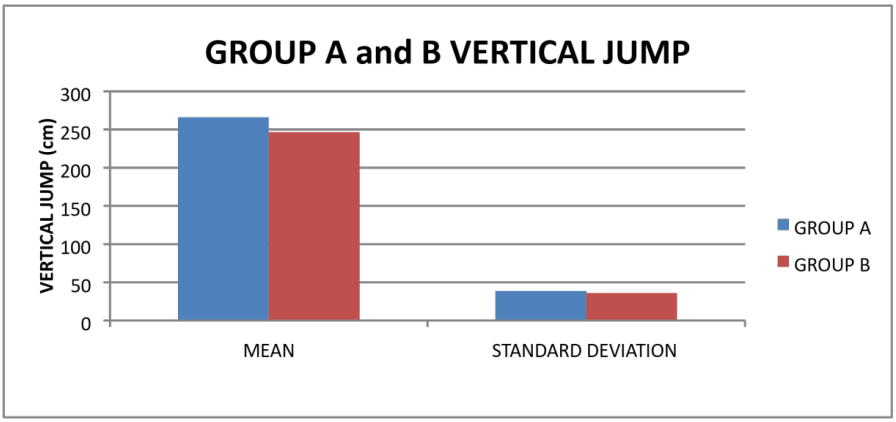
The above table reveals the Mean, Standard Deviation (S.D), t-test, and p – value between (Group A) & (Group B) in pre-test and post-test values.

This table shows that significant difference in post-test values between of group A and group B (266.0 and 246.53) in vertical jump.

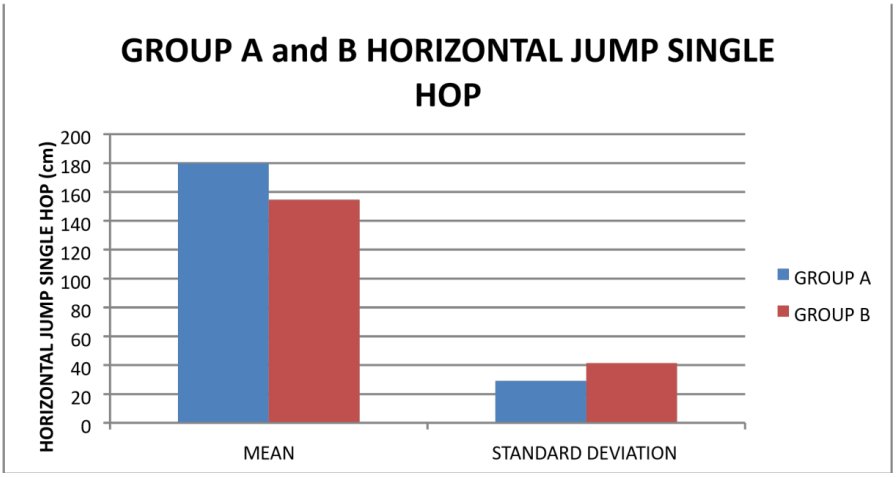
This table shows that significant difference in post-test values between of group A and group B (179.67 and 154.53) in horizontal jump single hop.

This table shows that significant difference in post-test values between of group A and group B (516.67 and 428.87) in horizontal jump triple hop.

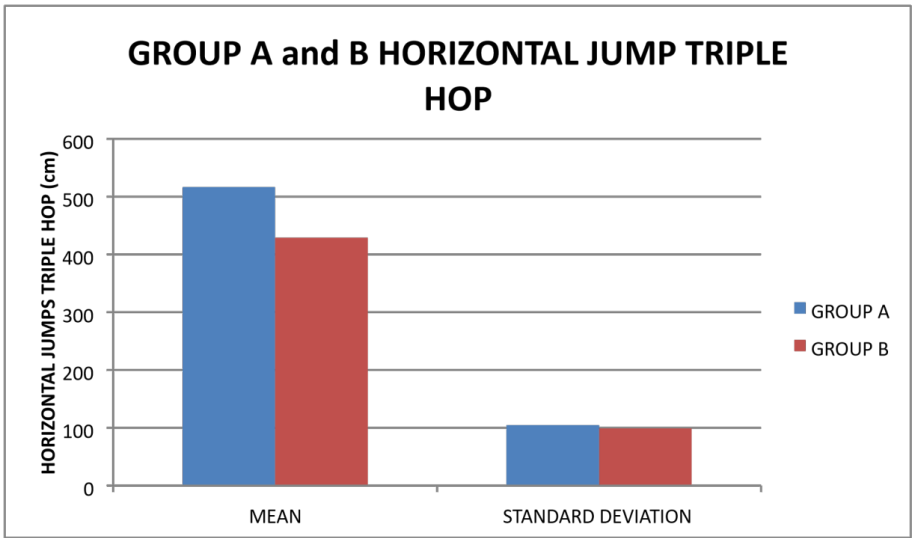
GRAPHS REPRESTING THE MEAN VALUES OF GROUP A & GROUP B BY USING VERTICAL JUMP AND HORIZONTAL JUMP



GRAPH NO 7: Group A&B Vertical Jump post-test values



GRAPH NO 8: Group A&B Horizontal Jump- Single Hop post-test values



GRAPH NO 9: Group A&B Horizontal Jump- Triple Hop post-test values

RESULTS:

TABLE - 1:

- The mean value of Vertical jump for pre and post-test shows 259 and 266 standard deviations of pre and post-test is 36.28 and 38.42 and p value is 0.0001 and t values is 6.1414
- The mean value of Horizontal Jump (SINGLE) for pre and post-test is 172.33 and 179.67; standard deviation (SINGLE) of pre and post-test is 29.63 and 29.06 and p value (SINGLE) is 0.0001 and t value (SINGLE) is 8.8764
- The mean value of Horizontal Jump (TRIPLE) for pre and post-test is 506.33 and 516.67; standard

deviation (TRIPLE) of pre and post-test is 104.02 and 104.84 and p value (TRIPLE) is 0.0001 and t value (TRIPLE) is 10.0201

- It shows significance between the pre and post-test values within the GROUPA.

TABLE – 2:

- The mean value of Vertical Jump for pre and post-test shows 244.33 and 246.53 standard deviation of pre and post-test is 37.17 and 36.05 p value are 0.0067 and t value is 3.1817
- The mean value of Horizontal Jump (SINGLE) for pre and post-test shows 152.00 and 154.53 standard deviation (SINGLE) of pre and post-test 40.89 and 41.36, pvalue (SINGLE) is 0.0132 and t value (SINGLE) is 2.8346
- The mean value of Horizontal Jump (TRIPLE) for pre and post-test shows 427.80 and 428.87; standard deviation (TRIPLE) of pre and post-test is 98.78 and 98.87; pvalue (TRIPLE) is 0.0001; t value (TRIPLE) is 16.0000
- It shows significance between the pre and post-test values with the GROUP-B.

TABLE – 3:

- The post mean value of GROUP -A and GROUP-B is in Vertical jump is 266.0 and 246.53, standard deviations is 38.42 and 36.05, p value is 0.1634, t value is 1.4372
- The post mean value of GROUP-A and GROUP-B is in Horizontal Jump (SINGLE) is 179.67 and 154.53, standard deviation (SINGLE) is29.06 and 41.36 and t value (SINGLE) is 1.9257; p value (SINGLE) is 0.0644
- The post mean of GROUP-A and GROUP-B is in Horizontal Jump (TRIPLE) is 516.67 and 428.87; standard deviation (TRIPLE) is 104.84 and 98.87; t value is (TRIPLE) is 2.3597; p value (TRIPLE) IS 0.0255
- It shows significant between the GROUP -A and GROUP-B with the post-test values.

DISCUSSION

Both high intensity resistance training and small-sided games have been shown to have positive effects on aerobic fitness in college badminton players. A previous study **Racil, G; Coquart, J.B, et al 2016** showed improved body mass, BMI, and percent body fat among obese females after a total of 108 min HIIT-R.

Similarly, previous research **Tjønna, A.E.; Stølen, et al 2009** found that HIIT-R was effective in reducing BMI and body fat percentage in overweight adults. Running-based

HIRT has been shown to increase aerobic capacity in numerous previous investigations. Furthermore, a systematic review also showed that HIRT was beneficial for aerobic fitness improvements among healthy young people.

On the contrary, recent research has only found aerobic capacity improvement in underweight and overweight boys, with no changes being found among normal weight people. Although high-intensity running and functional training were both beneficial for aerobic capacity promotion, few studies have compared the effectiveness of these two exercise modalities in terms of aerobic capacity enhancement.

Moreover, significant interaction effects were observed in terms of the effects on

Abdomen and lower limb strength duration. High intensity resistance training involves lifting heavy

weights or performing challenging bodyweight exercises with minimal rest between sets.

This type of training can increase cardiovascular fitness by improving heart and lung function,

as well as enhancing muscular endurance. In addition, it can help burn calories and improve metabolism, leading to better overall aerobic fitness.

Small-sided games, on the other hand, are a form of high-intensity

interval training that involves playing sports or games in a small group. These games typically involve continuous movement, changes in direction, and high

intensity bursts of activity. This type of training can improve cardiovascular fitness by challenging the heart and lungs, as well as enhancing agility, speed, and coordination.

Combining high intensity resistance training with small-sided games can be an effective way to improve aerobic fitness in college badminton players. This combination of exercises can target different energy systems in the body, leading to comprehensive improvements in overall fitness levels. Additionally, the variety and intensity of these workouts can help keep badminton players engaged and motivated to continue training regularly. Overall, incorporating both high intensity resistance training and small-sided games into a college student's

fitness routine can lead to significant improvements in aerobic fitness, helping

them to stay healthy total body fat loss (**Ali, El-Refay & Ali, 2015; Okura, Nakata, Lee, Ohkawara & Tanaka, 2005**), body

however, in this study, the resistance training (HIRT) demonstrated a greater improvement in fat.

Paoli, Moro, Marcolin, Neri, Bianco, Palma & Grimaldi 2012, the HIRT might

Improve lipid metabolism at rest as supported by a study examining the respiratory ratio 22 hours after HIRT.

The respiratory ratio appeared to be lowered 22 hours after the HIRT indicated a greater usage fat as energy supply.

Exercise induced adaptations in mitochondrial function depend on the intensity of

training and appear to be explained predominately by increased expression of mitochondrial enzymes that facilitate aerobic metabolism (**Lundby & Jacobs 2016**).

High intensity training is responsible in these adaptations.

CONCLUSION:

It is noteworthy that the present study which had demonstrated four weeks of high intensity resistance

training and small sided games training produced significant improvement in and aerobic fitness among college going badminton players. Aerobic fitness exhibited a significant superior improvement in Group A (HIRT) as compared to Group B (SSG). Therefore, intense training could benefit in body fat percentage reduction as suggested by this study. HIRT helps to improve physiological effects like cardiorespiratory and musculoskeletal effects. Those who want to benefit in aerobic fitness should undergo Group A (HIRT) as it facilitates more muscle activation and development. This study concluded that Group A(HIRT) has improved effect on aerobic fitness as compared to Group B (SSG) in college going badminton players.

LIMITATION AND RECOMMENDATION:
LIMITATIONS:

- The study was done among particular age group.
- The study was taken under both the genders.
- The sample size was small.
- Lack of long term follow up.

RECOMMENDATION:

- The study can be conducted with large number of samples.
- The sample size can be increased.
- Long term follows up plan can be recommended.

REFERENCE:

1. **Clemente FM, Ramirez-Campillo R, Nakamura Y, Sarmento H**. Effects of high-
2. intensity interval training in men soccer player's physical fitness: a systematic review with meta-analysis of randomized-controlled and noncontrolled trials. J Sports Sci. 2021; 39:1202–22.
3. **Rabbani A, Clemente FM, Kargarfard M, Jahangiri S.** Section III-sports training combined small-sided game and high-intensity interval training in soccer players: the effect of exercise order. J Hum Kinet. 2019; 69:249–57.
4. **Gaesser, G.A.; Angadi, S.S**. High-intensity interval training for health and fitness: Can less be more? J. Appl. Physiol. **2011**, 111, 1540–1541.
5. **Billat, L.V**. Interval training for performance: A scientific and empirical practice. Special recommendations for middle- and long-distance running. Part I: Aerobic interval training. Sports Med. **2001**, 31, 13–31. [CrossRef] [PubMed]
6. **Bartlett, J.D.; Close, G.L.; MacLaren, D.P.; Gregson, W.; Drust, B.; Morton, J.P.** High-intensity interval running is perceived to be more enjoyable than moderate-intensity continuous exercise: Implications for exercise adherence. J. Sports Sci. **2011**, 29, 547– 553.
7. **Gillen, J.B.; Gibala, M.J**. Is high-intensity interval training a time-efficient exercise
8. strategy to improve health and fitness? Appl. Physiol. Nutr. Metab. **2014**, 39, 409–412.
9. **Laursen, P.B.; Jenkins, D.G.** The scientific basis for high-intensity interval training: Optimising training programmes and maximising performance in highly trained endurance athletes. Sports Med. **2002**, 32, 53–73.
10. **Astorino, T.A.; Allen, R.P.; Roberson, D.W.; Jurancich, M**. Effect of high-intensity interval training on cardiovascular function, VO2max, and muscular force. J. Strength Cond. Res. **2012**, 26, 138–145.
11. **Dias, K.A.; Ingul, C.B.; Tjønna, A.E.; Keating, S.E.; Gomersall, S.R.; Follestad, T.;**
12. Hosseini**, M.S.; Hollekim-Strand, S.M.; Ro, T.B.; Haram, M.; et al**. Effect of HighIntensity Interval Training on Fitness, Fat Mass and Cardiometabolic Biomarkers in
13. Children with Obesity: A Randomised Controlled Trial. Sports Med. **2018**, 48, 733–746.
14. **Milanovi´c, Z.; Sporiš, G.; Weston, M**. Effectiveness of High-Intensity Interval Training
15. (HIIT) and Continuous Endurance Training for VO2max Improvements: A Systematic Review and Meta-Analysis of Controlled Trials. Sports Med. **2015**, 45, 1469– 148
16. **Sultana, R.N.; Sabag, A.; Keating, S.E.; Johnson, N.A**. The Effect of Low-Volume
17. HighIntensity Interval Training on Body Composition and Cardiorespiratory Fitness: A Systematic Review and Meta-Analysis. Sports Med. **2019**, 49, 1687–1721.
18. **Corbin, C. B., Pangrazi, R. P. & Franks, B. D.** Definitions: Health, Fitness, and physical activity. President's Council on Physical Fitness and Sports Research Digest (2000).
19. **Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., & Margono, C**. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980 – 2013: a systematic analysis for the Global Burden of Disease Study, *Lance*, 384, 766 – 781.
20. **Kemmler, W., Wittke, A., Bebenek, M., Frohlich, M., & von Stengel, S.** (2016). High intensity resistance training methods with and without protein supplementation to fight cardiometabolic risk in middle-aged males: a randomized controlled trial. Biomed Research International, http://dx.doi.org10155/2016/9705287
21. **Contro, V., Bianco, A., Cooper, J., Sacco, A., Macchiarella, A., Traina, M., & Proia, P.** (2017). Effects of different circuit training protocols on body mass, fat mass and blood
22. parameters in overweight adults. Journal of Biological Research, 90, 7269
23. **Fransson D, Nielsen TS, Olsson K, Christensson T, Bradley PS, et al.** Skeletal muscle and performance adaptations to high-intensity training in elite male soccer players: speed endurance runs versus small-sided game training. Eur J Appl Physiol. 2018; 118:111–21.

24. **Forssell, J.** The Effects of a 10-Week Combined Maximal and Explosive Strength and High Intensity Endurance Training Period on Neuromuscular Performance and 3K Time
25. Trial in Males and Females. Master's Thesis in Science of Sport Coaching and Fitness
26. Testing, University of Jyvaskyla, Finland, 2015.
27. **Sarmento H, Manuel Clemente F, David Harper L, Teoldo da Costa I, Owen A,**
28. **Figueiredo AJ.** Small sided games in soccer-a systematic review. Int J Perform Anal
29. Sport. 2018; 18:693–749.
30. **Hill-Haas SV, Dawson B, Impellizzeri FM, Coutts AJ.** Physiology of smallsided games training in football: a systematic review. Sports Med. 2011; 41:199–220.
31. **Sibley, B. A. & Etnier, J. L.** The Relationship between physical activity and cognition in children: a meta-analysis. Pediatr. Exerc. Sci.15,243-256(2003).
32. **Esteban Cornejo, I., Tejero Gonzalez, C. M., Sallis, J. F. & Veiga, O. L.** physical activity and cognition in adolescents: a systemic review. J. Sci. Med. Sport 18, 534539(2015).
33. **Herting, M. M. & Chu, X.,** Exercise, cognition, and the adolescent brain.Birth Defect Res, 109,1672-1679(2017)
34. **Poitras, V. J. et al.** Systemic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. Appl. Physiol. Nutr. Metab. 41, S197-S239 (2016).
35. **Kyu, H. H., Bachman, V. F., Alexander, L. T., Mumford, J. E., Afshin, A., Estep, K., et al.** (2016). Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: systematic review and dose_ response meta-analysis for the Global Burden of Disease Study 2013. BMJ 354: i3857.
36. **Hojman, P., Gehl, J., Christensen, J. F., and Pedersen, B. K**. (2018) Molecular mechanisms linking exercise to cancer prevention and treatment. Cell Metab.27, 1021.doi:
37. 10.1016/j.cmet.2017.09.015.
38. **Simpson, R. J., Kunz, H., Agha, N., and Graff, R. (2015)**. Exercise and the regulationofimmunefunctions.Prog.Mol.Biol.Transl.Sci. 135, 355– 380 .doi: 10.1016/bs.pmbts.2015.8.001
39. **Ana Filipa Silva,1,2,3 Mohammad Hosein Aghidemand,4 Masoud Kharatzadeh,5,6 Vahab Khan Ahmadi,4 Rafael Oliveira,3,7,8 Filipe Manuel Clemente,1,2,9,* Georgian**
40. **Badicu,10 and Eugenia Murawska-Ciałowicz11** Effects of High-Intensity Resistance
41. Training on Physical Fitness, Hormonal and Antioxidant Factors: A Randomized
42. Controlled Study Conducted on Young Adult Male Soccer Player Published online 2022
43. Jun 13
44. **Daniel Castillo, alejandro Rodriguez fernandez, Fabio yuxo Nakamura, Javier sanchez** Influence of Different Small-Sided Game Formats on Physical and Physiological Demands and Physical Performance in Young Soccer Players November 2021
45. **Buckley, S.; Knapp, K.; Lackie, A.; Lewry, C.; Horvey, K.; Benko, C.; Trinh, J.; Butcher, S.** Multimodal high-intensity interval training increases muscle function and metabolic performance in females. Appl. Physiol. Nutr. Metab. **2015**, 40, 1157–1162.
46. **Menz, V.; Marterer, N.; Amin, S.B.; Faulhaber, M.; Hansen, A.B.; Lawley, J.S.** Functional vs. Running Low-Volume High-Intensity Interval Training: Effects on VO (2) max and Muscular Endurance. J. Sports Sci. Med. **2019**, 18, 497–504.
47. **Weston, K.L.; Azevedo, L.B.; Bock, S.;Weston, M.; George, K.P.; Batterham, A.M**. Effect of Novel, School-Based High-Intensity Interval Training (HIT) on Cardiometabolic Health in Adolescents: Project FFAB (Fun Fast Activity Blasts)—An Exploratory Controlled Before-And-After Trial. PLoS ONE **2016**, 11, e0159116.
48. **Batacan, R.B., Jr.; Duncan, M.J.; Dalbo, V.J.; Tucker, P.S.; Fenning, A.S.** Effects of high-intensity interval training on cardiometabolic health: A systematic review and
49. metaanalysis of intervention studies. Br. J. Sports Med. **2017**, 51, 494–503.
50. **Helgerud J, Christian Engen L, Wisløff U, Hoff J.** Aerobic endurance training improves soccer performance. Med Sci Sport Exerc. 2001; 33:1925.
51. **Tatiana Moro,1 Giuseppe Marcolin,1 Marco Neri,2 Antonino Bianco,3 Antonio Palma,3 and Keith Grimaldi** High-Intensity Interval Resistance Training (HIRT) influences resting energy expenditure and respiratory ratio in non-dieting individuals
52. Published online 2012 Nov 24
53. **Hoffmann JJ, Reed JP, Leiting K, Chiang CY, Stone MH.** Repeated sprints,
54. highintensity interval training, small-sided games: theory and application to field sports.
55. Int J Sports Physiol Perform. 2014; 9:352–7.
56. **Iaia MF, Rampinini E, Bangsbo J.** High-intensity training in football. Int J Sports Physiol
57. Perform. 2009; 4:291–306.
58. **Younesi S, Rabbani A, Clemente FM, Sarmento H, Figueiredo AJ. Sessionto**- session variations in external load measures during small-sided games in professional soccer
59. players. Biol Sport. 2021; 38:185–93.
60. **Buchheit M, Laursen PB.** High-intensity interval training, solutions to the programming puzzle: part ii: anaerobic energy, neuromuscular load and practical applications. Sports Med. 2013; 43:927–54.
61. **Gibala, M.J.; Little, J.P.; Macdonald, M.J.; Hawley, J.A.** Physiological adaptations to low-volume,

highintensity interval training in health and disease. *J. Physiol.* 2012, *590*, 1077–1084, doi:10.1113/jphysiol.2011.224725.

ANNEXURE -1
INFORMED CONSENT

I Mr/Ms._____; Age:_____,hereby volunteer me for the study **"EFFECTS OF HIGH INTENSITY RESISTANCE TRAINING (HIRT) AND SMALL SIDEDED GAMES (SSGs) ON AEROBIC FITNESS FOR COLLEGE GOING BADMINTON PLAYERS"** performed by S. Thenmozhi BPT final year SCHOOLOF PHYSIOTHERAPY VISTAS THALAMBUR CHENNAI**.**

She explained all the procedures involved in the study and I clearly understood about, the requirements, benefits and risk factors involved. I express my consent to participate in this study since I have the complete freedom of discontinue the program at any point according to my personal needs or reasons.

DATE:
PLACE:
PARTICIPANT SIGNATURE

ANNEXURE – 2
ASSESSMENT

SUBJECTIVE EXAMINATION:
Demographic Data:
Name:
Age:
Gender:
Occupation:
Address:
Contact Number:
Sports:
Level of play:
Hours of play:
Experience:
Date of Assessment:
HISTORY:
Present Medical history:
Past Medical history:
OBJECTIVE ASSESSMENT:
ON OBSERVATION:
Body built:
Posture:
Gait:
ON EXAMINATION
Vertical jump test:
Horizontal jump test
Single hop test
Triple hop test
Short term goal:
To improve physical fitness and aerobic fitness.
Long term goal:
To improve physical fitness and aerobic fitness.
TREATMENT:
Physical exercise and small sided games like football.

ANNEXURE – 3
VERTICAL JUMP TEST

Vertical Jump Test, especially when incorporating variations like the counter movement jump with arms on hips and a free arm, is commonly used to assess lower body power and explosive strength. To be undergoing, including the vertical jump test with variations. Clear communication helps ensure their understanding and cooperation, contribution to the accuracy and reliable of the test results.

1.Equipment Needed:

- A wall or a vertical measuring device (like a Vertec).
- Chalk or marker to mark the highest point touched.

-A measuring tape or ruler.

2.Setup:

- Stand next to the wall or measuring device with your side facing it.
- Ensure your feet are flat on the ground and shoulder-width apart.
- Extend your arm upward as high as possible, reaching with your fingertips.

3.Measurement:

- From the standing position, jump as high as you can, reaching up with your arm to mark the highest point you touch on the wall or measuring device.
- Ensure you don't use any steps or additional movements other than the upward jump. -Land back down softly on both feet.

4. Recording:

- Measure the distance from the highest point you touched to the ground.
- This distance is your vertical jump height.

5. Repeating:

- Repeat the jump several times (usually three to five times) to ensure accuracy and to get an average measurement

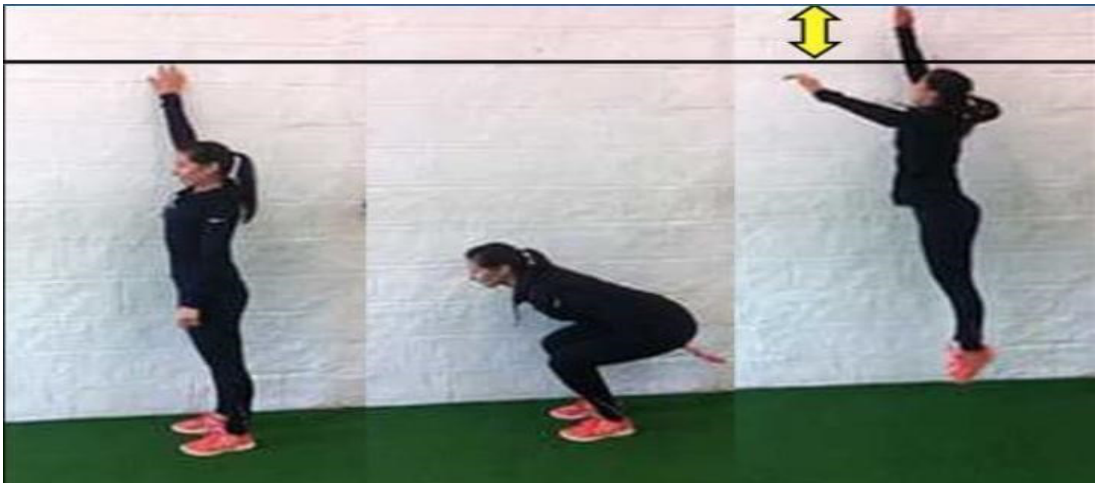


Fig.2.1

HORIZONTAL JUMP TEST

Horizontal jump test is a common for assessing lower body power in runners. It involves jumping forward from a standing position and measuring the distance jumped. This test can help to evaluate an athlete's explosive strength and leg power.

SINGLE HOP TEST:

1.Equipment Needed:

- Measuring tape or marked floor.
- Clear, flat surface.

2.Setup:

- Stand on one foot with your toes behind the starting line or marker.
- Maintain a slight bend in the knee of the standing leg for balance and stability.
- Keep your arms relaxed at your sides or in a natural position for balance.

3.Execution:

- Hop forward as far as possible, using a single-leg jump.
- Land softly on the same foot you jumped with, maintaining balance.
- Avoid taking any additional steps after landing.

4. Measurement:

- Measure the distance from the starting line to the heel or closest body part that touched the ground upon landing. This distance represents your single hop distance

5. Recording:

- Record the distance hopped in centimeters or inches.

6. Repeating:

- Repeat the hop test two to three times, allowing adequate rest between attempts.

Fig.2.2

TRIPLE HOP TEST:

1. Equipment Needed:

- Measuring tape or marked floor.
- Clear, flat surface.

2.Measurement Setup:

- Mark a starting line on the ground.
- Mark three landing zones in a straight line, each approximately 1 meter apart from each other.
- Make sure the surface is appropriate for jumping (e.g., flat and non-slippery).

3.EXERCISE:

- The participant stands with one foot behind the starting line.

- On the "go" command, the participant hops forward three times consecutively on the same foot, attempting to cover maximum distance with each hop.
- Ensure that the participant maintains balance and control throughout the test. - Measure the distance from the starting line to the heel of the foot after the third hop.

4.Recording:
- Record the distance hopped.

5.Repeat:
-Allow the participant to perform the test three times with each leg,with adequate rest between trials.

ANNEXURE 4
MASTER CHART - GROUP A

S.NO	SAMPLES NAME	HEIGHT	WEIGHT	VERTICAL JUMP		HORIZONTAL JUMP			
						SINGLE HOP		TRIPLE HOP	
				PRE-TEST	POST TEST	PRE-TEST	POST TEST	PRE-TEST	POST TEST
1	SHARUK	182	48	285	295	185	190	480	495
2	GLADSON	165	66	260	265	195	200	640	645
3	BHARATH	182	70	300	315	185	195	550	560
4	NAWIN	164	70	250	260	125	135	395	405
5	ESHWAR	182	77	270	275	160	165	450	460
6	BALAJI	140	43	190	190	110	120	295	300
7	SRIRAM	175	68	265	270	215	220	645	655
8	ADITHIYA	167	70	245	255	190	200	550	555
9	SELVAM	150	65	180	185	130	135	630	645
10	PRAVEEN	180	52	290	300	205	210	470	485
11	GUNAL	163	55	275	280	180	185	390	400
12	RIYAZ	160	50	310	315	170	175	520	525

13	YUVARAJ	166	67	255	260	180	195	430	440
14	MAGESH	169	75	280	285	175	185	530	545
15	KRISHNA	170	40	240	240	180	185	620	635

GROUP B:

S.NO	SAMPLES NAME	HEIGHT	WEIGHT	VERTICAL JUMP		HORIZONTAL JUMP			
						SINGLE HOP		TRIPLE HOP	
				PRE-TEST	POST TEST	PRE-TEST	POST TEST	PRE-TEST	POST TEST
1	VIGNESH	170	52	273	275	186	188	556	558
2	DEEPAK	169	55	281	281	205	206	564	564
3	GANGADHARAN	166	50	260	263	122	122	432	432
4	AVINASH	160	67	253	253	102	103	305	305
5	CHARAN	164	75	175	180	117	118	335	336
6	SAMUEL	182	40	280	280	188	188	534	535
7	LOGESHWARAN	140	65	275	275	200	211	310	310
8	RAVI	175	70	262	263	125	125	430	431
9	BABU	167	68	256	257	112	112	412	413
10	MANNIKANDAN	150	43	190	191	105	106	520	520
11	KUMARAN	180	68	220	221	125	127	323	324
12	VASANTH	163	70	270	271	136	137	431	432
13	SHIVA	180	55	200	211	145	145	406	406
14	DARWIN	150	66	274	274	206	207	557	557

15	VINAY	192	42	196	197	205	205	302	303