EFFECT OF ISOLATED AND COMBINED GAME SPECIFIC CIRCUIT AND TRX SUSPENSION BAND TRAINING ON SELECTED PHYSIOLOGICAL PARAMETERS OF HANDBALL PLAYERS

Lyoid Christopher K., [1] ***Dr. A. Karthikeyan,*** [2]

1. *Research Scholar, Department of Physical Education, Annamalai University.*
2. *Assistant Professor, (Research Guide) Department of Physical Education, Annamalai University.*

ABSTRACT

The rationale for this research was to determine the isolated and combined effect of game specific circuit and TRX suspension band training on selected physiological parameters of Handball players. To accomplish the reason for the examination 60 handball players from St. Aloysius College Thrissur, Aquinas College Edakochi, Christ College, Thrissur were chosen as subjects and their age extends between 18 to 23 years. They were divided into four equal groups by random sampling method. Group-I acted as Experimental Group-I – isolated game specific circuit Training, Group-II acted as Experimental Group II – isolated TRX suspension band training, Group-III acted as Experimental Group III – combined training and Group – IV acted as Control. The training duration for all three groups was restricted to 12 weeks (3days/week). The Vo_2max and forced vital capacity were preferred as dependent variables. The data collected from the experimental and control groups on selected dependent variables was statistically analyzed by paired 't' test. Additionally, percentage of changes was also calculated. Further, the data were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Whenever the obtained 'F' ratio value was found to be significant for adjusted post test means, the Scheffe's test was applied as post hoc test. In all the cases the level of confidence was fixed at 0.05 level for significance. In response to game specific circuit, TRX suspension band and combined training men handball player's Vo_2max and forced vital capacity were improved significantly.

Key Words: *Game specific circuit training, TRX suspension band training, Physiological parameters and Handball players*

INTRODUCTION

Handball is an intermittent sport, characterized by an alternation of high- and low-intensity activities, including sprints, jumps, and many changes of direction. However, players also need strength and power for running, jumping, and catching the ball before an opponent can score (Hermassi et al., 2017) Therefore, optimal conditioning programs should include specific training sessions. These may include isometrics, dynamic constant external resistance training, and isokinetic. Other options include complex training (an alternation of high-load weight training with plyometric exercises) and contrast training (an alternation of high and low loads).

Handball is a dynamic sport that requires players to continuously shoot and adapt to changing circumstances as a team and as individuals. Although it is a team game, players have ample opportunities to display their skills through individual performance as well as

strategic teamwork. The game is known for its speed, as it is one of the fastest sports in the world, making it easily accessible and thrilling. The familiarity of strategic moves make every play unpredictable. Strength is crucial for handball players as consistent shooting can only be achieved with the help of strong arms and legs. Since the game takes about an hour to complete, players need good cardiorespiratory endurance to perform efficiently even during the last minutes of the game.

Hence, specific training is necessary for players who want to excel in handball. Handball is a complex sport that requires a combination of physical and mental abilities, including agility, coordination, strength, endurance, speed, and tactical intelligence. Here are some reasons why specific training is essential for handball players ie; Handball players need to master specific techniques and skills such as throwing, catching, dribbling, and shooting. Specific training can help players improve their technique and perfect their skills, leading to better performance on the court. Handball is a physically demanding sport that requires players to be in excellent shape. Specific training can help players improve their endurance, strength, and speed, which are all essential for performing at a high level in handball.

The field of suspension training is a form of resistance training that includes bodyweight exercises in which a variety of multi-planar, compound exercise movements could performed, these done with the aim of developing strength, balance, flexibility, and joint stability simultaneously (Amr, 2008). Suspension training develops physical strength while using functional movements and dynamic positions. TRX Suspension Training is a new sling training for an intense full-body workout in a short time. By the versatile exercises, not only power, but also coordination, stability and mobility can work effectively. They also bend sport typical injuries such as ligament and cruciate ligament still useful. Also for the comprehensive and effective strengthening the core muscles, that Sling training is ideally suited. As an aid is a noose that simply fastened to the ceiling or other strong subject. This uses the exerciser by leaning it supports or mounts during the exercises. Using the own body strength allows the spine to stabilize in all body positions and positions and consolidate. Familiar exercises like lying or side support, thanks to the free hanging loops for unfamiliar challenge.

Since the researcher believes that an empirical study is required to distinguish the factors associated with handball performance, he decided to conduct this research. Furthermore, there had been very little research on handball players, which prompted the investigator to pursue this research. The aim was to discover the isolated and combined effect of game specific circuit training and TRX suspension band training on selected physiological parameters of handball players.

METHODOLOGY

Subjects and Variables

To accomplish the reason for the examination 60 handball players from St. Aloysius college Thrissur, Aquinas College Edakochi, Christ college, Thrissur were chosen as subjects and their age extends between 18 to 23 years. They were divided into four equal groups by random sampling method. Group-I acted as Experimental Group-I – isolated circuit Training, Group-II acted as Experimental Group II – isolated TRX suspension band training, Group-III acted as Experimental Group III – combined training and Group – IV

acted as Control. The Vo_2max and forced vital capacity were selected as dependent variables and it was assessed by conducting Cooper Vo_2max test and by using spirometry.

Training Protocol

After the initial measurements the specially designed training programme was given to the subjects of the experimental group-I named as handball game specific circuit training. The training sessions were conducted three days a week i.e. (Monday, Wednesday, and Friday) over a period of twelve weeks. Each experimental session was 30-45 minutes duration excluding warm-up and warm-down. They performed the following handball drills namely Two man passing, Zigzag passing, Chest pass, Wrist pass, Back pass, Long pass, High dribble, Low dribble, 6mts shooting, 9mts shooting, Defense skill respectively. In addition they performed 10 minutes Small Sided game practices. A week schedule was repeated to the proceeding week and the load was adjusted progressively. The training intensity was increased progressively from first week to proceeding week. The frequency of training was thrice in a week. The duration of warm-up and warm-down were fixed at ten minutes respectively. The work rest ratio of 1:1 between exercises and 1:3 between sets was given.

After the initial measurements the specially designed training programme was given to the subjects of the experimental group-II named as TRX suspension band training. The training sessions were conducted three days a week i.e. (Monday, Wednesday, and Friday) over a period of twelve weeks. Each experimental session was 30-45 minutes duration excluding warm-up and warm-down. The training commenced with one week of general physical conditioning for the experimental groups, so that the subjects were ready physically and mentally to take on specific load administrated to them for the purpose of the study. After one week of conditioning the training was administrated to the experimental group, which includes TRX suspension band training drills. The TRX suspension band training sessions were supervised by experienced coaches. The experimental group undertook three TRX suspension band training sessions in a week. They performed exercises such as TRX push-up, TRX chest press, TRX inverted row, Kneeling triceps press, Low row, Single-arm row, Triceps extension, Biceps curl, Squat and Hamstring curl respectively. Sessions were progressively structured to gradually increase intensity over each of the 12 weeks.

The experimental group-III performed combined training (game specific circuit training & TRX suspension band training) alternatively three days a week. The combined game specific circuit training and TRX suspension band training group performed game specific circuit training during every odd numbered week and TRX suspension band training every even numbered week

Collection of the Data

The data on Vo_2max and forced vital capacity was collected prior to the commencement of experiment (pre test) and after twelve weeks of training period (post test). Both the pre and post tests were administered under identical conditions, with same apparatus, testing personal and testing procedures.

Statistical Technique

The data collected from the experimental and control groups on Vo_2max and forced vital capacity was statistically analyzed by paired ‘t’ test to find out the significant differences if any between the pre and post test. Further, percentage of changes was calculated. The data collected from the three groups prior to and post experimentation on

Vo_2max and forced vital capacity was statistically analyzed, by applying the Analysis of Covariance (ANCOVA). Since, three groups were involved, whenever the obtained 'F' ratio value in the adjusted post test mean was found to be significant, the Scheffe's test was applied as post hoc test. The level of confidence is fixed at 0.05 for significance.

RESULT

The obtained results through the application of paired 't' test statistical technique, in order to estimate the effectiveness of game specific circuit, TRX suspension band and combined training among men handball player's VO_2max performance is put on view in table-I.

Table – I: Obtained 't' Test Result on VO_2max Level of GSCT, TRXSBT, CT & CG Men Handball Players

Group	Test	N	Mean	SD	DM	't' - ratio	%
Game Specific Circuit Training (GSCT)	Pre	15	34.135	6.8616	2.67	7.78*	7.82%
	Post		36.807	6.3617			
TRX Suspension Band Training (TRXSBT)	Pre	15	33.771	5.2847	1.64	5.65*	4.85%
	Post		35.415	4.8672			
Combined Training (CT)	Pre	15	34.713	5.4654	2.92	6.59*	8.41%
	Post		37.633	5.0819			
Control(CG)	Pre	15	33.414	4.5754	0.53	2.87	1.59%
	Post		32.881	4.7242			

*Table value for df 14 is 2.14(*significant)*

The derived results through the application of paired 't' test statistical technique proved that the mean difference found between initial(pre) and final(post) data of game specific circuit, TRX suspension band and combined training (GSCT, TRXSBT & CT) group's vary clearly, as the paired 't' values 7.78(GSCT), 5.65 (TRXSBT) and 6.59(CT) are more than table(df14=2.14) value required. In response to game specific circuit (GSCT =7.82%), TRX suspension band (TRXSBT =4.85%) and combined training (CT= 8.41%) men handball player's VO_2max was enhanced considerably.

In table-II, the derived ANCOVA statistic results on VO_2 Max ability of game specific circuit, TRX suspension band and combined training and control group's men handball players are displayed.

Table – II: Obtained ANCOVA Results on VO_2 Max of GSCT, TRXSBT, CT & CG Men Handball Players

	Game Specific Circuit Training (GSCT)	TRX Suspension Band Training (TRXSBT)	Combined Training (CT)	Control (CG)	SoV	SS	df	MS	'F' ratio
Adjusted	36.69	35.63	36.99	33.43	B	116.210	3	38.737	26.65*

Mean		W	79.937	55	1.453

*(Table value for df 3 & 55 is 2.77)*Significant (.05 level)*

The resultant 'f' ratio of 26.65 derived through ANCOVA statistics proved that the adjusted (posttest) mean values on VO_2max of game specific circuit (GSCT =36.69), TRX suspension band (35.63), combined training (CT= 36.99) as well as control groups (CG=33.43) men handball players differ from one another. Because the obtained ANCOVA 'F' value (26.65) on VO_2max of TRX suspension band, GSCT, CT and CG is more than 2.77 (table value) degrees of freedom (df) 3 and 55.

In table-III, the derived Scheffe's Test (post hoc) results on VO_2max ability of game specific circuit, TRX suspension band and combined training (GSCT, TRXSBT & CT) and control group's men handball players are displayed.

Table – III: Obtained Scheffe's Test Result on VO_2 Max of GSCT, TRXSBT, CT & CG Men Handball Players

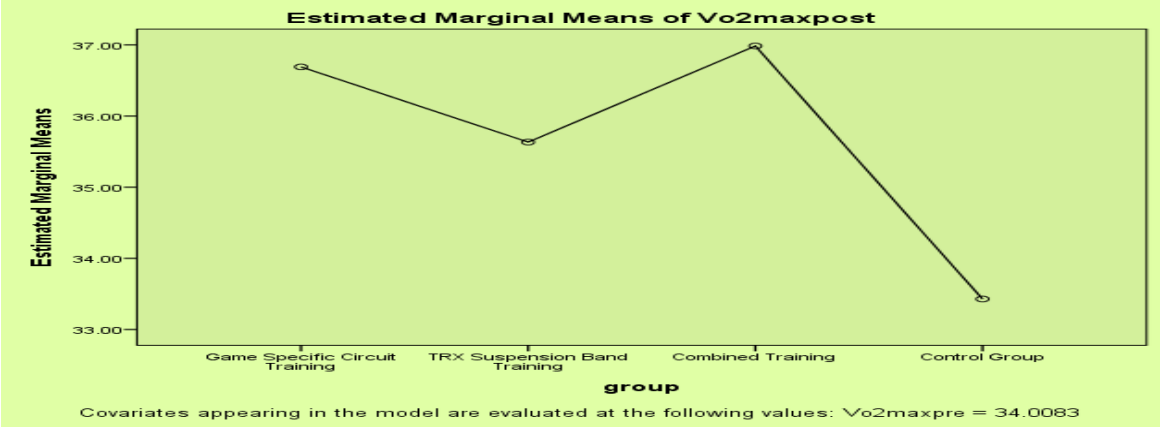
Game Specific Circuit Training (GSCT)	TRX Suspension Band Training (TRXSBT)	Combined Training (CT)	Control (CG)	MD	CI
36.69	35.63			1.06	1.27
36.69		36.99		0.30	1.27
36.69			33.43	3.26*	1.27
	35.63	36.99		1.35*	1.27
	35.63		33.43	2.21*	1.27
		36.99	33.43	3.56*	1.27

**Significant (.05)*

The applied post hoc test (Scheffe's**)** statistics make clear that as a result of game specific circuit, TRX suspension band and combined training the men handball players VO_2 Max was increased to a great extent, because these differences between means (3.26, 2.21 & 3.56) are more than 1.27 (CI value). Though, combined training (CT) was superior to TRX suspension band training (TRXSBT) however, insignificant differences were observed when comparing game specific circuit training (GSCT) with TRX suspension band training (TRXSBT), and combined training (CT).

The below displayed diagram(Figure-I), showing the VO_2 Max mean scores of game specific circuit, TRX suspension band and combined training (GSCT, TRXSBT & CT) and control group's men handball players.

Figure-I: Figure Showing the Vo_2max Mean Scores of Game Specific Circuit, TRX Suspension Band and Combined Training and Control Group's Men Handball Players



Analysis of Forced Vital Capacity

The outcome of 't' test and changes in percentage on Forced Vital Capacity of the chosen 4 groups are mentioned in table-IV.

Table-IV: Obtained 't' Test Result on Forced Vital Capacity of GSCT, TRXSBT, CT & CG Men Handball Players

Group	Test	N	Mean	SD	DM	't' - ratio	%
Game Specific Circuit Training (GSCT)	Pre Post	15	3.720 4.513	0.3746 0.2973	0.79	12.06*	21.24%
TRX Suspension Band Training (TRXSBT)	Pre Post	15	3.853 4.140	0.3643 0.3641	0.29	4.39*	7.53%
Combined Training (CT)	Pre Post	15	3.880 4.353	0.4346 0.3871	0.47	10.99*	12.11%
Control(CG)	Pre Post	15	3.920 3.820	0.3404 0.4507	0.10	1.42	2.55%

*Table value for df 14 is 2.14(*significant)*

The chosen 4 group's initial and final (pre & post) test scores on Forced Vital Capacity of TRX suspension band (3.720 & 4.513); GSCT (3.853 & 4.140); CT (3.880 & 4.353) vary noticeably because the dependent 't' test results of TRX suspension band (TRXSBT=12.06), game specific circuit (GSCT=4.39) as well as combined training (CT=10.99) groups were better than the needed table value *[df 14=2.14 (0.05 level)]*. Subsequent to 12 weeks of TRX suspension band, game specific circuit (GSCT) and combined (CT) training 21.24%, 7.53% and 12.11% of increase in Forced Vital Capacity was observed. Further, all the 4 group's FVC data (pre&post) was analyzed through ANCOVA and the results are exhibited in table number–V.

Table-V: Obtained ANCOVA Results on Forced Vital Capacity of GSCT, TRXSBT, CT & CG Men Handball Players

Group's Adjusted Means on FVC							
Game Specific Circuit Training (GSCT)	**TRX Suspension Band Training (TRXSBT)**	**Combined Training (CT)**	**Control (CG)**	**SoV**	**S.S**	**df**	**M.S**	**'F'**

4.61	4.13	4.32	3.76	B	5.583	3	1.861	35.28*
				W	2.901	55	.053	

*(Table value for df 3 & 55 is 2.77)*Significant (.05 level)*

The resultant 'f' ratio of 35.28 derived through ANCOVA statistics proved that the adjusted(posttest) mean values on Forced Vital Capacity of game specific circuit (GSCT =4.61), TRX suspension band (4.13), combined training (CT= 4.32) as well as control groups (CG=3.76) men handball players differ from one another. Because the obtained ANCOVA 'F' value (35.28) on Forced Vital Capacity of TRX suspension band, GSCT, CT and CG is more than 2.77 (table value) degrees of freedom (df) 3 and 55.

In the below given table (table-VI), the derived Scheffe's Test (post hoc) results on Forced Vital Capacity of game specific circuit, TRX suspension band and combined training (GSCT, TRXSBT & CT) and control group's men handball players are displayed.

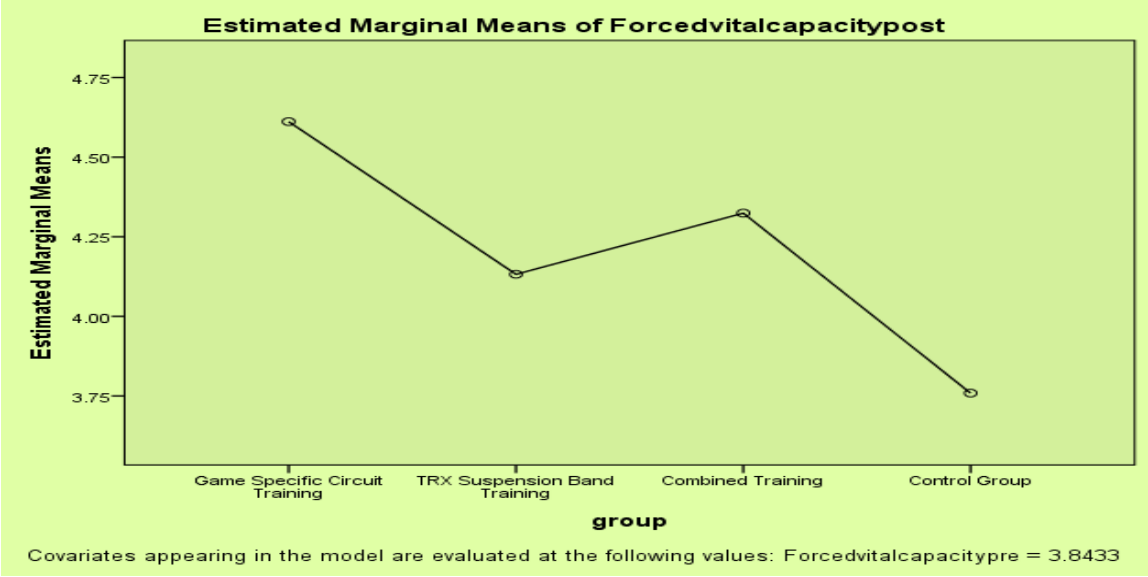
Table-VI: Obtained Scheffe's Test Result on Forced Vital Capacity of GSCT, TRXSBT, CT & CG Men Handball Players

Adjusted Means on FVC of				Mean Differences (MD)	Confidence interval(CI)
Game Specific Circuit Training (GSCT)	TRX Suspension Band Training (TRXSBT)	Combined Training (CT)	Control (CG)		
4.61	4.13			0.48*	0.24
4.61		4.32		0.29*	0.24
4.61			3.76	0.85*	0.24
	4.13	4.32		0.19	0.24
	4.13		3.76	0.37*	0.24
		4.32	3.76	0.57*	0.24

Significant

The follow up test **(**Scheffe's**)** results confirmed that due to TRX suspension band (TRXSBT =0.85); game specific circuit (GSCT =0.37) and combined (CT=0.57) training the Forced Vital Capacity level was greatly increased. Though, game specific circuit training (GSCT) was much better than TRX suspension band (TRXSBT =0.48) and combined (CT=0.29) training protocols because the mean differences (MD) are higher than 0.24 (CI). But, insignificant difference found between combined training (CT) and TRX suspension band training (MD=0.19). The 4 group's (GSCT, TRXSBT CT & CG) forced vital capacity scores are displayed in diagram-II.

Figure-II: Figure Showing the FVC Mean Scores of Game Specific Circuit, TRX Suspension Band and Combined Training and Control Group's Men Handball Players



DISCUSSION

The results of the present study reveal that the experimental groups have significantly altered the physiological parameters such as VO_2max and forced vital capacity. The finding of the study is in line with the findings of Mehrotra *et al*., (1998). Positive alterations in aerobic and cardiovascular function may be achieved consequent to high-velocity circuit resistance training (Petersen *et al.,* 1988). Circuit resistance training can improve some pulmonary function factors besides other benefits of this type of training (Khosravi, 2013). Fleck (1988) reported that more dynamic forms of resistance training, such as circuit training, that involve moderate resistance and high repetitions with short rests are associated with reductions in blood pressure. Exercise intensity is directly related to the change in VO_2max (Gossard *et al*., 1986).

Many have reported increased strength with only small to modest increases in maximal aerobic capacity following a traditional circuit weight training (TRAD) program (Gotshalk *et al*., 2004). Studies have shown little to mild improvement in aerobic capacity from participation in circuit weight training (Kass & Castriotta, 1994). Petersen *et al*., (1988) indicated that positive alterations in aerobic and cardiovascular function may be achieved consequent to high-velocity circuit resistance training.

Babalola et al., (2011) conducted a study on the effects of 8-weeks circuit training programme on physiological and performance characteristics of university racket game players. The results show that there was significant difference in the pretest-posttest responses of physiological variables measured resting heart rate and cardio respiratory endurance. Palanisamy (2012) examined the effect of circuit training on aerobic, anaerobic capacity among kabaddi players and found significant improvement. Circuit training program was effective to increase and maintain both muscular and cardiovascular endurance among schoolchildren (Mayorga-Vega & Viciana et al., 2013).

Saranya and Gopinath (2014) conducted a study on the effect of circuit training and interval training on resting heart rate among women cricket players. The results of their study showed that 12-weeks of training program have significantly decreased on resting heart rate level due to circuit training. Minakshi Pathak (2015) observed that circuit training increase lung capacities of players. Ramakrishnan and Gopinath (2014) found that the effect of weight training and circuit weight training were influenced to increase the vital capacity significantly. Circuit training showed significant reduction on resting heart rate (Sakti et al., 2016).

Each researcher utilized components unique to his/her particular program or population that are not easily transferable to other situations. A need exists for combining some basic guidelines and parameters from each study to provide an overall interpretation and discussion on the design and implementation of a safe and effective training program. In combining the findings reported by these other researchers, game specific circuit, TRX suspension band and combined training of different intensities need to be investigated and reported.

CONCLUSION

In response to game specific circuit (GSCT =7.82%), TRX suspension band (TRXSBT =4.85%) and combined training (CT= 8.41%) men handball player's VO_2 Max performance was enhanced considerably. Though, combined training (CT) was superior to TRX suspension band training (TRXSBT) however, insignificant differences were observed when comparing game specific circuit training (GSCT) with TRX suspension band training (TRXSBT), and combined training (CT).

Subsequent to 12 weeks of TRX suspension band, game specific circuit (GSCT) and combined (CT) training 21.24%, 7.53% and 12.11% of increase in Forced Vital Capacity was observed. Though, game specific circuit training (GSCT) was much better than TRX suspension band (TRXSBT) and combined (CT) training protocols. But, insignificant difference found between combined training (CT) and TRX suspension band training.

REFERENCES

Amr. S, (2008). The effect of the compound on the training and some physical changes of gene expression and the level of performance of my skills challenged the plane and attack the emerging fencing, *PhD thesis*, Faculty of Physical Education for Boys, Zagazig University.

Babalola (2011). Effects of 8-weeks circuit training programme on physiological and performance characteristics of university racket game players, *Journal of Asian Scientific Research*, 1(4): 143-149.

Fleck, S. J. (1988). Cardiovascular Adaptations to Resistance Training, *Med Sci Sports Exerc*., 20(5 Suppl): S146-51.

Gossard, D., Haskell, W. L., Taylor, C. B., Mueller, J. K., Rogers, F., Chandler, M., Ahn, D. K., Miller, N. H., & DeBusk, R. F. (1986). Effects of low- and high-intensity home-

based exercise training on functional capacity in healthy middle-aged men. *The American Journal of Cardiology, 57*(6), 446–449.

Gotshalk L.A., Berger R.A., Kraemer W.J. (2004) Cardiovascular responses to a high-volume continuous circuit resistance training protocol. *Journal of Strength and Conditioning Research*, 118, 760-764.

Hermassi Souhail., Wollny Rainer., Schwesig Rene., Shephard Roy, J., Chelly Mohamed Souhaiel., (2017). Effects of in-season circuit training on physical abilities in male handball players. *The Journal of Strength & Conditioning Research*.

Kass, J.E., & Castriotta, R.J. (1994). The effect of circuit weight training on cardiovascular function in healthy sedentary males, *Journal of Cardiopulmonary Rehabilitation*, 14.

Khosravi, M. (2013). Effects of eight weeks of circuit resistance training on pulmonary function of inactive women , *Ann Appl Sport Sci.*,1(2): 11-18.

Mayorga-Vega, Daniel., Viciana, Jesús. (2013). Effects of a Circuit Training Program on Muscular and Cardiovascular Endurance and their Maintenance in Schoolchildren, *Journal of Human Kinetics*, volume 37/2013, 153-160.

Mehrotra P.K. *et al.*, (1998). Pulmonary functions in indian sportsman playing different sports, *Indian J Physiol Pharmacol.*, 42(3): 412 – 416.

Minakshi Pathak., (2015). Effect of badminton specific circuit training on selected physiological variables of badminton players, *International Journal of Sports Science Fitness & Lesuire Industry*, 2(1): 85-98.

Palanisamy, K. (2012). *Effect of circuit training on aerobic and anaerobic capacity among kabaddi players,* Unpublished master's thesis. Tamil Nadu Physical Education and Sports University, Chennai, India.

Peterson, S.R., *et al.*, (1988). The influence of high velocity resistance circuit training on aerobic power, *Journal of Orthopedic and Sports Physical Therapy*, 9.

Ramakrishnan, A., & Gopinath, R. (2014). *Effects of weight training and circuit weight training on selected strength and physiological variables. International Journal of Health, Physical Education and Computer Science in Sports, 15*(2), 22–25.

Sakti, Ranjan Mishra., Palas Biswas., and Dhananjoy Banerjee., (2016). Comparative effect of plyometric training and circuit training on selected physiological variables of professional trainees. *International Education and Research Journal.* 2 (2).

Saranya, D., and Gopinath, R. (2014). Effect of circuit training and interval training on resting heart rate among women cricket players. *Journal of Physical education.* 4(9). 475-476.