



ISSN Print: 2664-7559
ISSN Online: 2664-7567
IJSHPPE 2023; 5(2): 01-08
www.physicaleducationjournal.in
Received: 01-05-2023
Accepted: 07-06-2023

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International Journal of Sports, Health and Physical Education

Hatha yoga: A way of improving performance of functional line and BMI of obese children

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DOI: <https://doi.org/10.33545/26647559.2023.v5.i1b.70>

Abstract

Context: Yoga is an excellent exercise for improving core muscle and back strength and stimulates growth and energy.

Aim: The present study aimed to determine the effect of six weeks of hatha yoga training on the performance of functional lines and BMI (Body Mass Index) of obese children.

Methods and Materials: In this randomized controlled trial, ten (10) male children aged 12 to 18 years from Bolpur, Birbhum, West Bengal, India have been randomly selected by their BMI level and divided into two groups, i.e., Hatha Yoga Training Group (HYG) (N=05) and Control Group (CG) (N=05) according to WHO BMI Index. The HYG received a six-week Hatha Yoga training program, and the CG did normal physical activities. The performance of functional lines is tested by the 'Bunkie Test' before and after the training program.

Results: Significant improvement in the performance of functional lines and BMI was found by analysing and comparing the pre-test and post-test scores through descriptive analysis and ANCOVA among the obese children of HYG and CG. We also find out the improvement percentage of both two groups.

Conclusions: Six weeks of Hatha Yoga training program effectively improves functional lines' performance and reduces fatness and BMI among obese children.

Keywords: Hatha yoga training, BMI, bunkie test, core muscles, performance of functional lines

Introduction

Strength is a prerequisite for every person to do any activity or work. Strength means a person's maximum force to apply against any load ^[1]. An adequate amount of core muscle strength is needed to do daily and sporting activities to reduce the chances of injuries ^[2]. Weak core muscles also have more fatigue and less muscular strength and endurance ^[3].

Core muscles, namely transverse abdominis, multifidus, diaphragm etc., provide spine stability, so the core muscles' strength plays a vital role in maintaining proper body balance and providing good posture ^[4]. The exercises, namely forearm plank, butterfly sit-ups, high boat to low boat, forearm plank rock, etc., help to improve the core muscles' strength ^[5]. Obese children generally have excess body fat and less core muscle strength, affecting their physical health ^[6].

The main reason behind obesity is consuming more calories than expenditure and not doing regular physical activities ^[7]. Everyday physical activities help to gain core muscle strength ^[8]. Day by day, obesity has become an international health issue, mainly among children and adolescents ^[9].

People of all ages need to involve themselves in physical activity programs to improve their physical health by improving their core muscle strength ^[10]. Various testing tools, namely the abdominal curl test ^[11], prone plank, side plank ^[12], and Bunkie test, ^[13], ^[14] etc., measure the fitness of core muscles.

Every person and child need to do physical activity to improve core muscle strength and health ^[10]. Many testing tools are available to measure fitness and core muscle strength, like the abdominal curl test ^[11], prone plank, side plank test ^[12], and Bunkie test ^[13]. Bunkie plays a vital role in measuring the core muscle strength and the performance of the functional line ^[13]. Bunkie plays a vital role in measuring core muscle strength by testing the performance of functional lines and 'Bunkie' means a little bench derived from the Afrikaans word 'BANKIE' ^[14]. Pioneers of this test de Witt & Venter ^[13] framed this testing technique to measure some specific facial lines with the help of the shoulder and feet.

The body fascia line maintains the body's neutral position by being attached to the muscles [15]. Five testing items of the Bunkie test measure the core muscle strength by testing the performance of five power lines, namely the Anterior power line, Posterior power line, Posterior stabilizing line, Lateral stabilizing line, and Medial stabilizing line for both sides (Right and Left) of the body [14, 16].

Yoga is an excellent exercise for improving core muscle and back strength and stimulates growth and energy [17]. There are different types of yoga, namely Jana yoga, Karma yoga, Ashtanga yoga, Hatha yoga, etc. [18] Hatha yoga is vital for improving core muscle strength [19].

Hatha is a Sanskrit word that means 'stubborn' so, the stubborn practice of yoga is called Hatha yoga. Hatha yoga involves the rigorous practice of any Pranayama, Dhyana, and Asana to achieve the subline of the stage of Samadhi. Hatha yoga improves our breathing techniques and body posture and strengthens our body muscles [20]. Here the asana plays the most crucial role in improving body posture and core muscle strength [21]. The asana, which emphasizes the hold poses for extended periods, help to strengthen the body structure and core muscle strength [19].

So, it is clear from most of the investigations and research that the performance of functional lines can be improved by strengthening the core muscles and reducing body fat. With this understanding, the present researcher intended to determine the effect of the hatha yoga training program on

the performance of functional lines and BMI of obese children.

Purpose: The purpose of the present study was to determine the effect of six weeks of hatha yoga training on the performance of functional lines and BMI of obese children.

Materials & Methods

Participants

We have selected ten obese (10) children aged 12 to 18 years from Bolpur, Birbhum, West Bengal, India through convenient random sampling and divided them in two equal groups i.e. Hatha Yoga Group (HTG, N-05) and the Control Group (CG, N-05).

Table 1: Inclusion and exclusion criteria of the participants

Inclusion Criteria	
Children from Bolpur, Birbhum, West Bengal, India.	
Children aged 12 to 18 years male.	
Children who are eligible as per as BMI score comes ≥ 28 (WHO criteria).	
Exclusion Criteria	
Children not from Bolpur, Birbhum, West Bengal, India.	
Children aging ≤ 12 years or ≥ 18 years.	
Children who are not eligible as per as BMI score comes ≤ 28 (WHO criteria)	

Table 2: BMI of Training and Control Group

Criteria	Subject	Training Group	Control Group
BMI	1	30.26	30.02
	2	30.18	28.26
	3	30.08	28.16
	4	30.04	28.13
	5	30.02	28.04

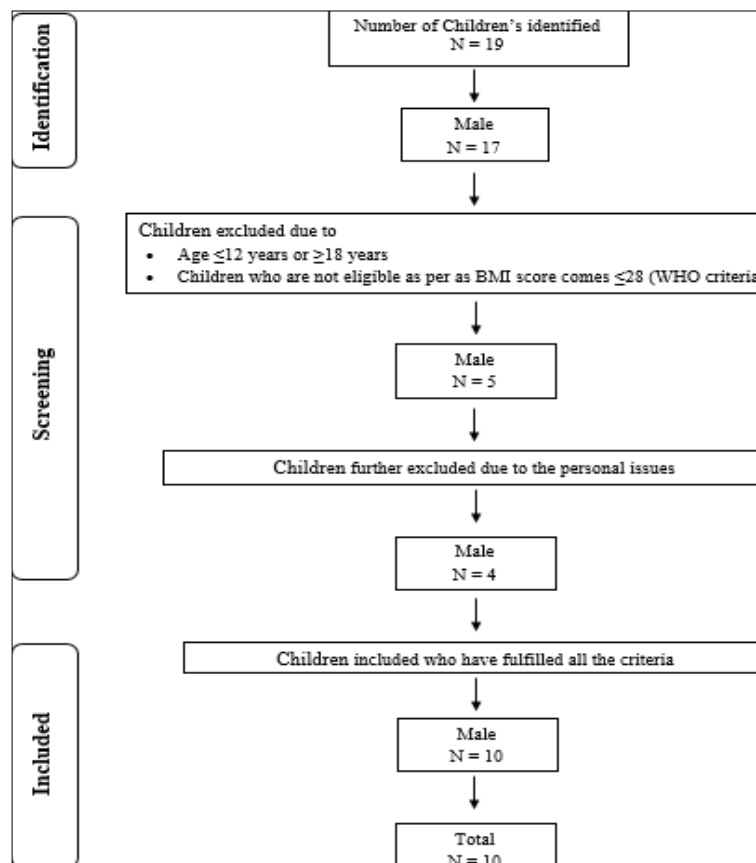


Fig 1: Flow chart of Inclusion and Exclusion Criteria of the participants

Criterion Measures

By reviewing the available literature, the following variables are selected as the criterion measures (see table 3) to determine the effect of hatha yoga training on the performance of functional line and BMI of obese children.

Table 3: Criterion Measures

Tool	Variables	Scoring
Bunkie Test	Right Anterior power line [APL (R)]	Second
	Left Anterior power line [APL (L)]	
	Right Lateral stabilizing line [LSL (R)]	
	Left Lateral stabilizing line [LSL (L)]	
	Right Posterior power line [PPL (R)]	
	Left Posterior power line [PPL (L)]	
	Right Posterior stabilizing line [PSL (R)]	
	Left Posterior stabilizing line [PSL (L)]	
	Right Medial stabilizing line [MSL (R)]	
Left Medial stabilizing line [MSL (L)]		
Body Mass Index (BMI)	Height	Meter
	Weight	Kg

Design of the Study

At first, researchers randomly selected the fatty children by seeing their physique. Then the height is measured by a Stadiometer, and a weight machine measures the weight. Based on height and weight, we calculated the BMI and selected those children with a BMI score ≥ 28 (WHO criteria) for the study. Accordingly, we found ten (10) children and divided them into two equal groups, namely the Hatha Yoga Group (HYG, N - 05) and Control Group (CG, N-05) (see table 2). We oriented them about the testing procedure and benefits of the Bunkie test and hatha yoga a week before the pre-test. The training program was administered to the Hatha Yoga Group for three days a week of forty minutes per session and continued for six weeks. We took pre-test measurements of the selected variables before the training started and at the end of 6 weeks for both groups. For the detailed training program, see table 4.

The researchers finalized and prepared the Hatha yoga exercise program for obese children by going through many articles, journals, and research papers, surfing many YouTube videos and web portals (see table 4), and also in consultation with the experts.

Table 4: Hatha Yoga Training Programme

Day	Exercise Name	Repetition		Recovery	Set
		Right	Left	Each side	
Day-1	1) Tadasana (22)	20		30	3
	2) Vrikshasana (23)	20	20	30	
	3) Halasana (24)	20		30	
	4) Paschimottanasana (25)	20		30	
	5) Sarvangasana (24)	20		30	
Day-2	1) Vrikshasana (23)	20	20	30	3
	2) Bhujangasana (24)	20		30	
	3) Boat Pose (26)	20		30	
	4) Salabhasana (27)	20		30	
	5) Virabhadrasana (28)	20	20	30	
Day-3	1) Vrikshasana (23)	20	20	30	3
	2) Adho Mukha Svanasana (23)	20		30	
	3) Sarvangasana (24)	20		30	
	4) Dhanurasana (28)	20		30	
	5) Eka Pada Adho Mukha Svanasana (29)	20		30	

Statistical Tools Used

In this study, the researcher used descriptive statistics like mean and standard deviation to get information on pre-test and post-test performance scores. Also, to find out the effectiveness of hatha yoga on the performance of functional lines and BMI of obese children, we used Analysis of covariance (ANCOVA). 0.05 was the level of significance for all the analyses. We have calculated the percentage to show the improvement of BMI and Performance of functional line between Pre and Post-test scores of both the groups separately. The graphical representation shows the difference between Pre-test and post-test performance.

Results

The researchers intended to determine the effectiveness of six weeks of hatha yoga training program on the performance of

functional lines and BMI of obese children. We analysed and interpreted the pre-test and post-test data through descriptive Analysis and ANCOVA.

Table 5: Descriptive Analysis of BMI

Variable	Hatha Yoga Group				Control Group			
	Pre-Test		Post-Test		Pre-Test		Post-Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BMI	30.11	0.10	28.18	0.38	28.58	0.84	28.4	0.58

The descriptive analysis through mean and SD on the pre-test and post-test data of BMI shows a noticeable decrease in the mean score of post-test BMI in HYG but not much in CG (see table 5 & Fig. 1).

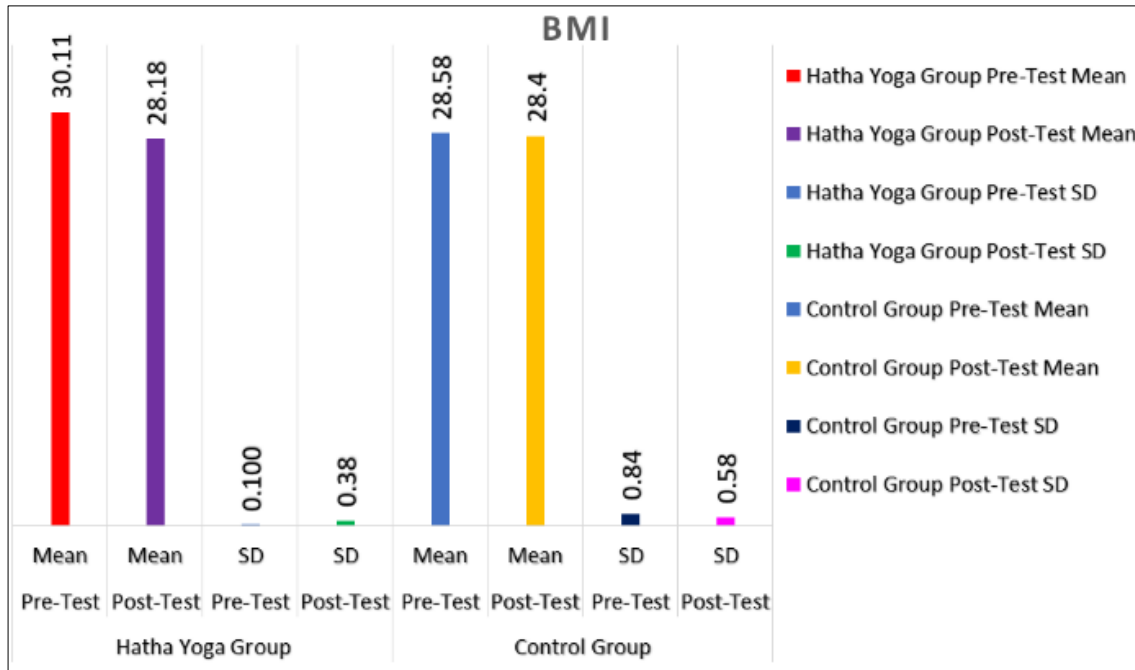


Fig 2: Descriptive Analysis of BMI

To determine whether the Hatha Yoga training has significantly affected the reduction of BMI score, we have calculated ANCOVA at 0.05 level of significance. The result of the Analysis of covariance (ANCOVA) shows that six

weeks of hatha yoga training have significantly reduced the BMI score in HYG as the cal. 'F' value is greater than the tab. 'F' value at 0.05 level of significance (see table 6).

Table 6: Analysis of Covariance of BMI score

Variables	Sources of Variance	D.F	Sum of Squares	Mean Square	F-ratio
BMI	Between Groups	1	2.90	2.90	6.64*
	within Groups	7	3.06	0.44	

* Significant at 0.05 Level. Tab 'F' (1,7) = 5.59

We found significant effect of Hatha Yoga training on BMI score in HYG. We calculated the percentage (%) of improvement for both the groups (See table 5 & Fig 2). The improvement in HYG is much more than the CG.

Table 7: Percentage of Improvement in BMI

Variable	Hatha Yoga Group				Control Group			
	M*	M**	MD^	Impr.^	M*	M**	MD^	Impr.^
BMI	30.11	28.18	1.93	7.47%	28.58	28.4	0.18	0.62%

* Pre-Test Mean **Post-Test Mean ^Mean Difference ^^ % of Improvement

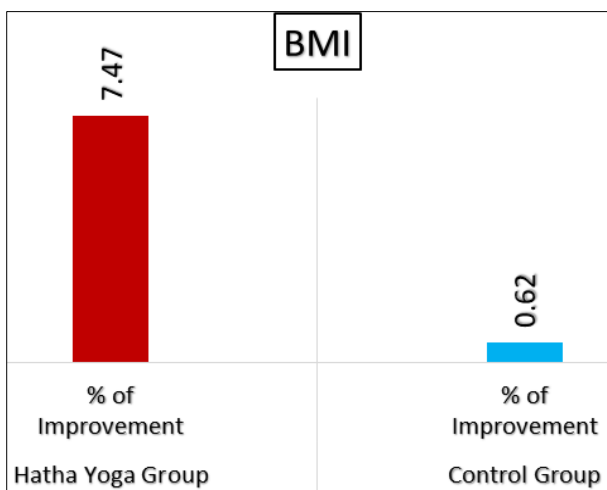


Fig 3: Percentage of Improvement in BMI

We did the descriptive analysis (mean and SD score) of all the functional lines based on the pre-test performance score. We found that the obese children of HYG performed best in MSL (L) and the least in PPL (R); in CG, the subjects' performed best in MSL (R) and the least in PPL (L) (see table 7A & Figure 3).

The descriptive analysis (mean and SD score) of post-test performance in all the functional lines shows that the performance of the obese children belonging to HYG improved appreciably. The best performance given by them was in MSL (L) and the least in PPL (L), but not much improvement could be seen in CG (see table 7B & Figure 4). So, from the descriptive analysis of all the functional lines' performance, it is clear that six weeks of hatha yoga training have improved the performance of functional lines in HYG.

Table 8: Descriptive Analysis of Bunkie Test Performance

Functional Line	Hatha Yoga Group (A)				Control Group (B)			
	Pre-Test		Post-Test		Pre-Test		Post-Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
APL (R)	7.4	1.14	12	1.58	14.8	4.76	16.4	5.98
APL (L)	8.8	1.48	13.2	1.30	10.8	1.30	11	1.22
LSL (R)	10	1.58	14.6	1.82	16.2	1.30	16.6	1.52
LSL (L)	8.4	1.14	13.8	1.79	12.2	0.84	13	1.58
PPL (R)	5.8	1.30	12.4	3.36	10	1.58	10.4	0.89
PPL (L)	7.2	0.84	10.6	1.82	8.4	1.67	10.2	1.92
PSL (R)	8.4	2.07	12.8	1.48	10.2	0.84	11.6	1.34
PSL (L)	8.6	1.14	13.8	1.30	11.8	1.30	12	1.58
MSL (R)	9.4	2.07	14.4	2.61	23	1.58	23.6	3.21
MSL (L)	13	2.12	18	1.87	18.8	3.35	19.4	2.51

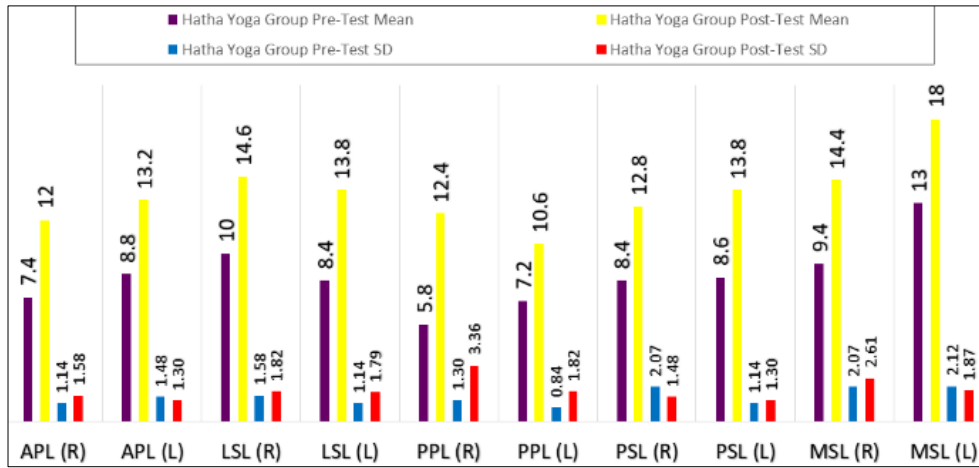


Fig 4: Descriptive Analysis of Bunkie Test Performance in Hatha Yoga Group

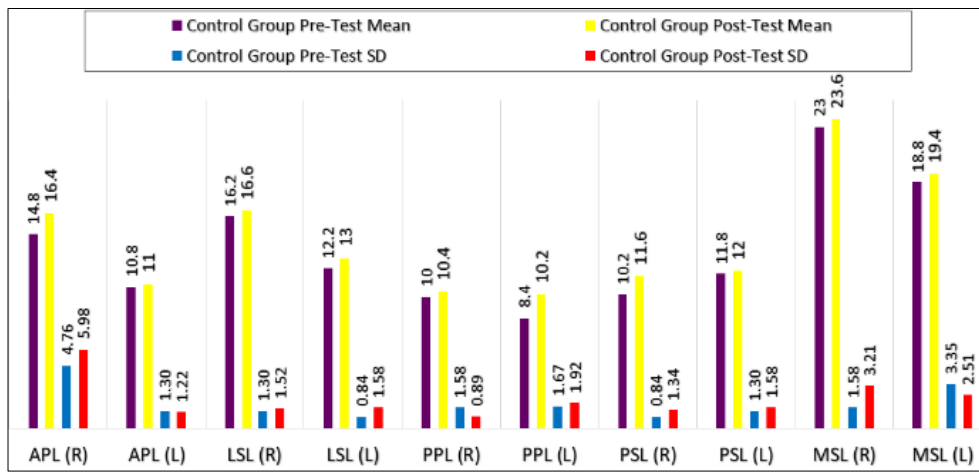


Fig 5: Descriptive Analysis of Bunkie Test Performance in Control Group

The descriptive analysis between the pre-test and post-test scores of Bunkie test performance has established that the six weeks of hatha yoga training have improved the performance of functional lines of obese children. To determine whether the improvement is significant or not, we have calculated ANCOVA by keeping the significance level at 0.05 level of confidence.

The result of the Analysis of covariance (ANCOVA) shows that six weeks of hatha yoga training have significantly improved the performance of functional lines in HYG as the cal. 'F' values of all the functional lines are more significant than the tab. 'F' value at 0.05 level of significance (see table 8).

Table 9: Analysis of Covariance of Bunkie Test Performance

Functional Line	Sources of Variance	D.F	Sum of Squares	Mean Square	F-ratio
APL (R)	Between Groups	1	21.55	21.55	12.50*
	within Groups	7	12.06	1.72	
APL (L)	Between Groups	1	14.86	14.86	10.98*
	within Groups	7	9.48	1.35	
LSL (R)	Between Groups	1	8.54	8.54	26.59*
	within Groups	7	2.25	0.32	
LSL (L)	Between Groups	1	17.52	17.52	18.71*
	within Groups	7	6.55	0.94	
PPL (R)	Between Groups	1	30.04	30.04	7.44*
	within Groups	7	28.25	4.04	
PPL (L)	Between Groups	1	7.51	7.51	10.82*
	within Groups	7	4.86	0.69	
PSL (R)	Between Groups	1	9.84	9.84	8.82*
	within Groups	7	7.81	1.12	
PSL (L)	Between Groups	1	13.37	13.37	8.80*
	within Groups	7	10.64	1.52	
MSL (R)	Between Groups	1	15.02	15.02	8.83*
	within Groups	7	11.91	1.70	
MSL (L)	Between Groups	1	8.90	8.90	12.67*
	within Groups	7	4.92	0.70	

* Significant at 0.05 Level. Tab 'F' (1,7) = 5.59

We found a significant effect of Hatha Yoga training on Bunkie test performance for all the functional lines. We calculated the percentage (%) of improvement for both

groups (See table 9 & Fig 5). The improvement in HYG is much more than the CG.

Table 10: Percentage of Improvement in Bunkie Test Performance

Functional Lines	Hatha Yoga Group				Control Group			
	M*	M**	MD^	Impr.^	M*	M**	MD^	Impr.^
APL (R)	7.40	12.00	4.60	62.16	14.80	16.40	1.60	10.80
APL (L)	8.80	13.20	4.40	50.00	10.80	11.00	0.20	1.90
LSL (R)	10.00	14.60	4.60	46.00	16.20	16.60	0.40	2.50
LSL (L)	8.40	13.80	5.40	64.29	12.20	13.00	0.80	6.60
PPL (R)	5.80	12.40	6.60	113.79	10.00	10.40	0.40	4.00
PPL (L)	7.20	10.60	3.40	47.22	8.40	10.20	1.80	21.40
PSL (R)	8.40	12.80	4.40	52.38	10.20	11.60	1.40	13.70
PSL (L)	8.60	13.80	5.20	60.47	11.80	12.00	0.20	1.70
MSL (R)	9.40	14.40	5.00	53.19	23.00	23.60	0.60	2.60
MSL (L)	13.00	18.00	5.00	38.46	18.80	19.40	0.60	3.20

* Pre-Test Mean **Post-Test Mean ^Mean Difference ^^ % of Improvement

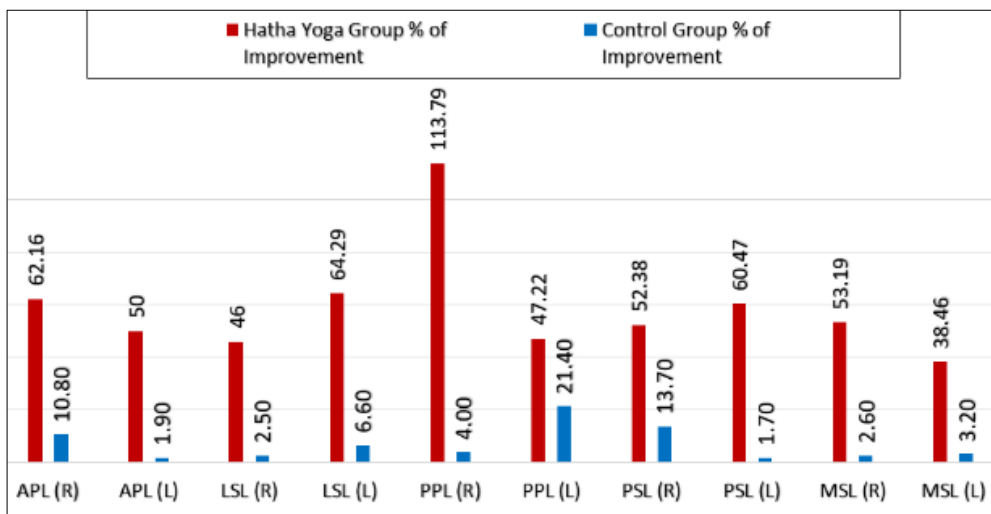


Fig 6: Percentage of Improvement in Bunkie Test Performance

Discussion

We investigated the effect of the hatha yoga training program on the performance of functional lines and BMI, measured by the Bunkie test and height and weight. The study's main finding shows that the six weeks of hatha yoga training lead to significant improvement in the performance of functional lines and a reduction of BMI on HYG. We did not find any substantial improvement in CG. The percentage of improvement between pre and post-test performance shows that the improvement in HYG is much more than the CG for BMI and Bunkie test performance for all the functional lines. The researcher would like to attribute a few reasons behind such findings.

It is a fact that yoga asana reduces body fat percentage, so it improves the BMI level [30, 31]. The asanas like Bhujangasana, Boat pose (Naukasana), Eka Pada Adho Mukha Svanasana, (29) Halasana (Plow pose), Salabhasana (Locust pose), Dhanurasana [32] in the training program practiced by HYG, which are very much helpful in reducing the body fat and obesity level [33] and also increases the flexibility [34]. These asana may have improved the BMI level of HYG after completing six weeks of the hatha yoga training program. This result of the present study is per the findings of Hainsworth [33].

Asana performed by HYG as a part of hatha yoga training program significantly improved the performance of various functional lines in the Bunkie test. The asana like Virabhadrasana (Warrior pose), Bhujangasana (Cobra pose),

Tadasana and Vrikshasana (Tree pose), Adho Mukha Svanasana, Eka Pada Adho Mukha Svanasana (One-Legged Down Dog), Halasana, Paschimottanasana, Salabhasana, Sarvangasana, Boat Pose, Dhanurasana, etc. improved the performance of all the functional lines (both side) namely APL, LSL, PPL, PSL, MSL, [35-43]. Also, it reduces belly fat [44, 45]. and increases shoulder and back flexibility [43, 46, 47, 48, 49, 50].

On the other hand, we also found a slight improvement in BMI and Bunkie test performance in CG, though the gain is much lesser than the HYG. The CG participated in various general kind physical activities regularly; it may be due to this reason the fat percentage of the subjects reduced and the core muscles strength improved, ultimately the BMI level and Bunkie test performance improved a little bit [51].

The result of the present study is per other various investigations where the hatha yoga training program increases the performance of functional lines [52], reduces body fat, and improves BMI [9].

Conclusion

On the basis of the findings of the present study it can be concluded that the six-week hatha yoga training programme is very much effective for the reduction of body fat and improvement of core muscle strength, ultimately improves the BMI and Bunkie test performance. So hatha yoga training is helpful for obese children to improve their BMI and performance of functional lines.

Acknowledgements

We would like to thank Visva-Bharati University, Santiniketan, India for providing required facilities to conduct the hatha yoga training program for the purpose of the study. Furthermore, we are grateful to the Department of Physical Education and Sport Science, Visva-Bharati University, India for their constant support and help in conducting the study. Last but not the least we are thankful to all the participants for their honest participation in the study.

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