

## Effect of Pilates Training on Core Muscles and BMI of Obese Children: A Pilot Study

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### Abstract

The aim of the study was to find out the effect of six weeks pilates training on core muscles and BMI of obese children. Ten (10) male children aged 12 to 18 years from Bolpur, Birbhum, West Bengal, India have been selected and purposively divided into Pilates Training Group (PTG) (N=05) and Control Group (CG) (N=05) according to WHO BMI Index (Rush, 2004). Six weeks pilates training programme has been formulated to see the effectiveness of training programme on core muscles strength and BMI. The core muscles strength has been tested by 'Bunkie Test' through the performance of functional lines before the training starts and after completion of six weeks pilates training programme and BMI has been calculated by height and weight. Significant improvement in core muscles strength as well as on BMI has been found by analysing and comparing the pre-test and post-test score through descriptive analysis and ANCOVA among the obese children of PTG and CG. So it can be concluded that six weeks of pilates training programme is effective in the improvement of core muscles strength as well as in reduction of fatness and BMI among obese children.

**Keywords:** Pilates training, Core muscle strength, Bunkie test, BMI.

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### 1. GENERAL INTRODUCTION

According to WHO Obesity is excess body fat that affects our physical health, which is a serious health problem in the world since 1975 (WHO, 2022). Beside healthy food and drinks regular physical activities are very much required to maintain the ideal body weight and good health (Pataky *et al.*, 2014). Many countries are facing increased amount of excessive body weight among their citizens, resulting one third adults globally coming under obese categories (Kitahara *et al.*, 2014).

Due to the lack of WHO (2010) recommended physical activity the cardiorespiratory (Brage *et al.*, 2004) and muscular fitness level (Thivel *et al.*, 2016) of the children and adolescents are decreasing worldwide (Petrovics *et al.*, 2020), in turn increasing the chances of being overweight and obese (Page *et al.*, 2005 & Livingstone, 2000). The persons having high BMI lacks in overall body activities, in turn the muscle strength decreases and percentage of body fat increases (Multani

*et al.*, 2019). It is evident from various researches that due to the excessive weight obese person are having lesser amount of core muscle strength (Manske *et al.*, 2013; Milton & Martina, 2019).

The core is mainly situated in centre of our body and surrounded around abdomen, hips, back, and chest (Mayo Clinic Staff, 2020). Core muscles provide strength and stability while bending, twisting and rotating our body, supported by various muscles like abdominal muscle, lateral abdominal muscle, deepest back muscle and erector spine muscles (Martin, 2013).

Core strength defined as the ability to produce the muscular force through constrictive forces and pressure of intra-abdominal muscles (Hibbs *et al.*, 2008). During the modern era researchers have identified the significance of core muscle, while performing different sports skills as it helps in the improvement of speed, acceleration and jumping abilities etc. (Bialowas, 2019).

Core muscle strengthening exercises helps to develop muscle imbalances, body posture, cardiovascular fitness, flexibility (Datta *et al.*, 2014), muscle strength (Boyaci *et al.* 2018) as well as decrease muscle mass of overweight persons (Widanita *et al.*, 2019).

There are many testing techniques to measure core muscle strength as well as functional performance line like prone plank, side plank, abdominal curl, trunk extension etc. (Butowicz *et al.*, 2016). Bunkie test found to be such kind of testing tool which measures entire body's core muscle strength, ultimately assessing the performance of functional line (de Witt & Venter, 2009).

'Bunkie' comes from an Afrikaan word 'BANKIE', means little bench. The concept Bunkie grow when the author determined the test efficiency of a specific fascia line by supporting the body on the shoulders and feet (de Witt & Venter, 2009). *This tool test the performance of* Anterior power line, Lateral stabilizing line, Posterior power line, Posterior stabilizing line, Medial stabilizing line for both side of the body (Brumitt, 2015).

The Pilates method, developed by the legendary physical trainer Joseph Pilates, is a full body exercise system emphasize on correct body alignment, proper breathing pattern, development of a powerful core and improvement of coordination and balance (Houglum, 2016).

Pilates exercises has a positive effect on body composition (Aladro-Gonzalvo *et al.*, 2012) as it

reduces BMI, body fatness, body weight and also gain abdominal muscle strength (Tyagi & Kumar, 2019). Pilates is a low intensity exercises focused on core strengthening and posture correction (Albert, 2022). Furthermore Pilates exercises also reduces body weight, so can be helpful for overweight or obese people (Vancini *et al.*, 2017). Beside this Pilates training also develops the activity of core muscle with minimal efforts, so it can be recommended for the obese people to get ideal body weight as well as body composition (Cavina *et al.*, 2020).

So it is clear from various researches and investigation that various exercises programmes helps in the improvement of core muscle strength and performance of functional line by reducing body fat. By this understanding the present researcher intended to find out the effect of Pilates training programme on core muscle strength and BMI of obese children.

## 1.1. AIM AND OBJECTIVES

The aim of the study was to find out the effect of six weeks pilates training on core muscle strength and BMI of obese children.

## 2. MATERIALS AND METHODS

### 2.1. Participants

For the purpose of the study 10 obese children from Bolpur, Birbhum, West Bengal, India aged 11 to 18 years has been selected (see table 1 & 2; Figure 1) according to WHO (Rush, 2004) BMI criteria. They have been randomly divided into two equal groups namely Pilates Training Group (PTG, N-05) and Control Group (CG, N-05).

**Table-1: Inclusion and exclusion criteria of the participants**

Inclusion Criteria	
Children from Bolpur, Birbhum, West Bengal, India.	
Children Age 12 to 18 years male.	
Children who are eligible as per as BMI score comes $\geq 28$ (WHO norms).	
Exclusion Criteria	
Children not from Bolpur, Birbhum, West Bengal, India.	
Children aging $\leq 12$ years or $\geq 18$ years.	
Children who are not eligible as per as BMI score comes $\leq 28$ (WHO norms)	

**Table-2: BMI of Training and Control Group**

Criteria	Subject	Training Group	Control Group
BMI	1	31.48	30.02
	2	36.02	28.26
	3	33.52	28.16
	4	34.62	28.13
	5	35.10	28.04

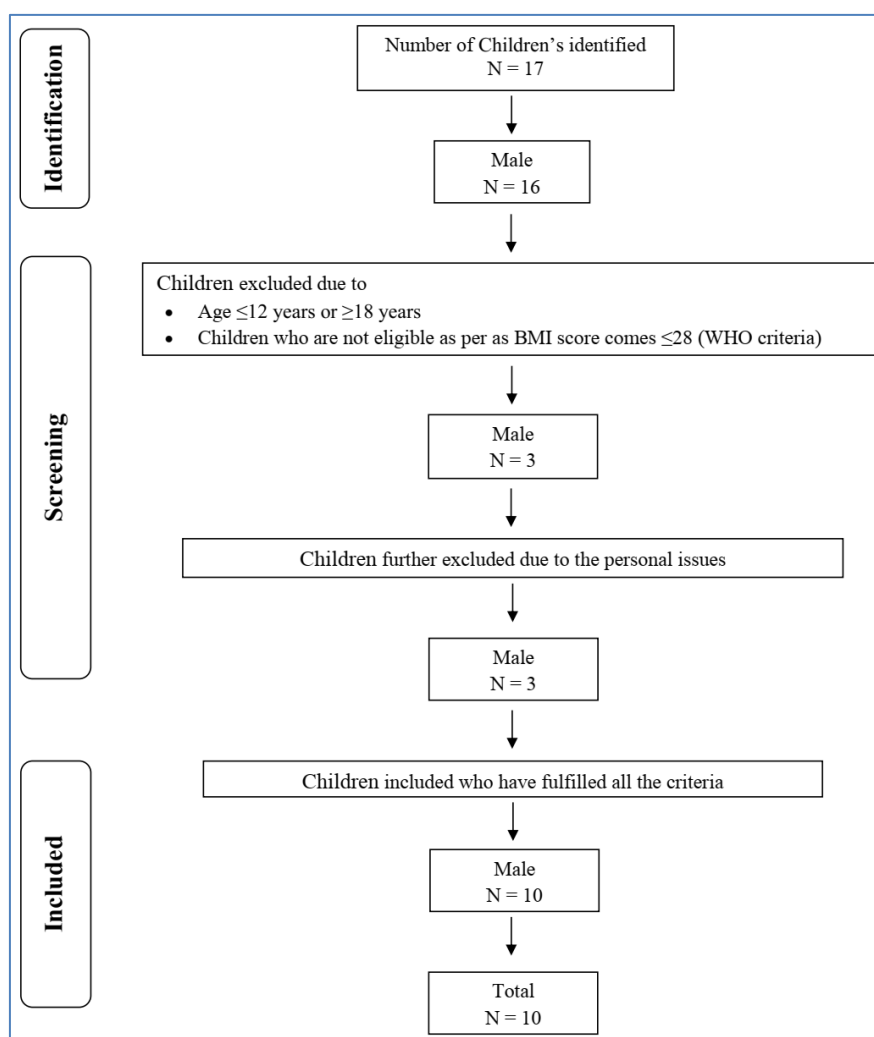
### 2.2. Criterion Measures

By glancing the available literatures following variables are selected as the criterion measures for

testing (see table 3) the effect of Pilates training on core muscles 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



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

**2.3. Design of the Study**

The researchers have randomly selected the children by seeing their fatness. Then by measuring the height and weight the BMI has been calculated. On the basis of BMI score those children have been selected purposively who's BMI score comes  $\geq 28$  (WHO criteria). 10 children were divided into two equal groups consisting of 05 each namely Pilates Training

Group (N - 05), and Control Group (N-05) (see table 2). The selected children have been oriented about the testing procedure of Bunkie test as well as the Pilates exercise for a week before the pre-test. The training was administered to the Pilates Training Group for three days of forty minutes per session in a week for 06 weeks. The pre-test measurement was taken on the selected variables at the base line i.e. before the training

starts and the post-test measurement was taken at the end of 06 weeks for both the groups. For detailed training schedule see table 4.

For the selection of Pilates exercises the researchers have gone through many journals, articles, research papers and also seen many videos from YouTube and then finalized and framed the Pilates training programme for obese children (see table 4).

**Table-4: Pilates Training Programme**

Day	Exercise Name	Repetition		Recovery	Set
		Right	Left	Each side	
DAY-1	1) Leg Circle (Abbate & Shiffer, 2021)	20	20	30	3
	2) Plank Leg Lift (Winderl, 2022)	20	20	30	
	3) Pelvic Curl (Kelly, 2019)	20	20	30	
	4) Slow Motion Mountain Climber (Winderl, 2022)	20	20	30	
	5) The Teaser (Winderl, 2022)	20		30	
Day-2	1) Single Leg Stretch (Ambandos & Bay 2013)	20	20	30	3
	2) Plank Rock (Winderl, 2022)	20		30	
	3) Toe Taps (Winderl, 2022)	20	20	30	
	4) Hip Dip (Winderl, 2022)	20	20	30	
	5) Rolling like a Ball (Abbate & Shiffer, 2021)	20		30	
Day-3	1) Double Leg Stretch (Winderl, 2022)	20	20	30	3
	2) Hip Dip (Winderl, 2022)	20	20	30	
	3) Pendulam (Winderl, 2022)	20	20	30	
	4) Tick Tock (Ambandos & Bay 2013)	20	20	30	
	5) Pelvic Curl (Kelly, 2019)	20	20	30	

**2.4. Statistical Tools Used**

Descriptive statistics in the form of mean and standard deviation has been applied to get the basic idea about pre-test and post-test performance score. To find out the effectiveness of Pilates training on core muscles strength and BMI of obese children Analysis of covariance (ANCOVA) has been applied. Level of significant has been kept at 0.05 level of confidence. Graphical representation has been given to show the

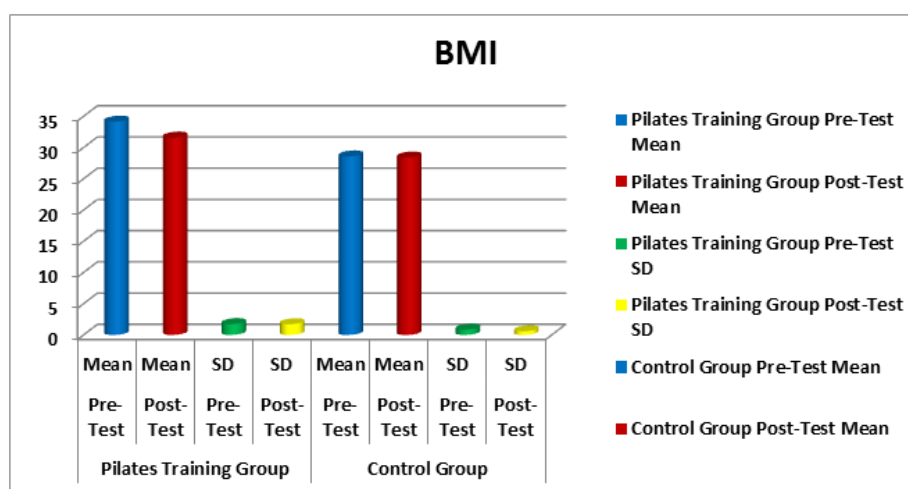
difference between the pre-test and post-test performance.

**3. RESULT**

The present research has been conducted to find out the effectiveness of six weeks Pilates training on core muscles strength and BMI of obese children. The pre-test and post-test data has been interpreted through descriptive analysis and ANCOVA.

**Table-5: Descriptive Analysis of BMI**

Variable	Pilates Training Group				Control Group			
	Pre-Test		Post-Test		Pre-Test		Post-Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
BMI	34.14	1.74	31.59	1.72	28.58	0.84	28.4	0.58



**Fig-2: Descriptive Analysis of BMI**

The descriptive analysis of pre-test and post-test BMI score simply showing noticeable amount of decrease in mean BMI score of post-test data (see table 5 & Figure 2) in PTG, but not much reduction could be noticed in CG.

To find out whether the Pilates training has significantly affected in reduction of BMI score

ANCOVA has been calculated and the level of significance has been kept at 0.05 level of confidence. The result of Analysis of covariance (ANCOVA) is showing that six weeks Pilates training have significantly reduced the BMI score 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 (ANCOVA) of BMI**

Variables	Sources of Variance	df	Sum of Squares	Mean Square	F-ratio
BMI	Between Groups	1	5.60	5.60	9.66*
	within Groups	7	4.06	0.58	

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

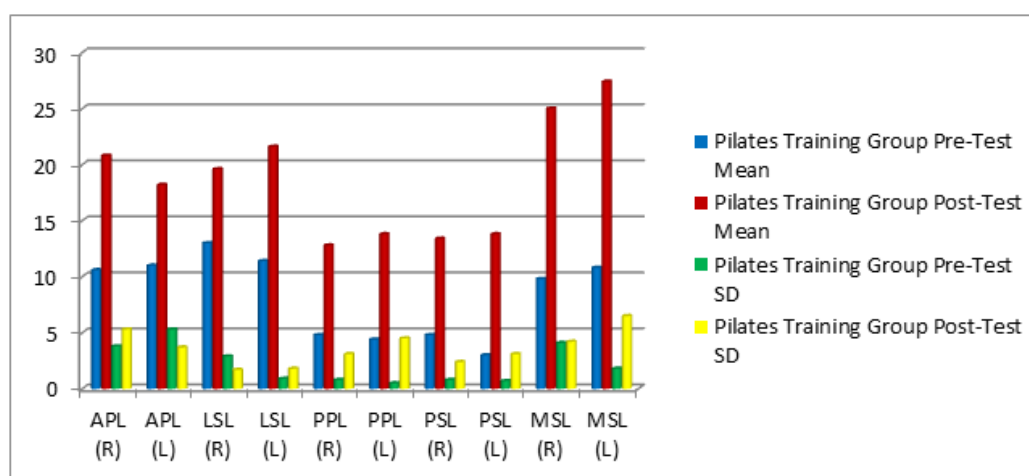
According to the pre-test performance score the descriptive analysis (mean score) has been done of all the functional lines. It has been found that the obese children of PTG have performed best in LSL (R) and the least in PSL (L); in CG the best performance found in MSL (R) and the least in APL (L) (see table 7A & Figure 3).

The descriptive analysis (mean score) of post-test performance noticeable improvement has been seen

in all the functional lines of obese children belonging to PTG. The best performance given by them is in MSL (L) and the least in PPL (R); but much improvement could not be seen in CG (see table 7B & Figure 4). So it is clear from the descriptive analysis of all the functional lines performance that six weeks Pilates training have improved the core muscles strength in PTG.

**Table-7: Descriptive Analysis of Bunkie Test**

Functional Line	Pilates Training Group (A)				Control Group (B)			
	Pre-Test		Post-Test		Pre-Test		Post-Test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
APL (R)	10.6	3.8	20.8	5.3	10	1.6	10.4	0.9
APL (L)	11	5.3	18.2	3.7	8.4	1.7	10.2	1.9
LSL (R)	13	2.9	19.6	1.7	14.8	4.8	16.4	6
LSL (L)	11.4	0.9	21.6	1.8	10.8	1.3	11	1.2
PPL (R)	4.8	0.8	12.8	3.1	10.2	0.8	11.6	1.3
PPL (L)	4.4	0.5	13.8	4.5	11.8	1.3	12	1.6
PSL (R)	4.8	0.8	13.4	2.4	16.2	1.3	16.6	1.5
PSL (L)	3	0.7	13.8	3.1	12.2	0.8	13	1.6
MSL (R)	9.8	4.1	25	4.2	23	1.6	23.6	3.2
MSL (L)	10.8	1.8	27.4	6.5	18.8	3.3	19.4	2.5



**Fig-3: Descriptive Statistics of Pilates Training Group (Bunkie Test Performance)**

The descriptive analysis between pre-test and post-test score of Bunkie test performance has established the fact that the six weeks pilates training have improved the core muscles strength of obese children. To find out whether the improvement is significant or not ANCOVA has been applied and the level of significance has been kept at 0.05 level of

confidence. The result of Analysis of covariance (ANCOVA) is showing that six weeks Pilates training have significantly improved the performance of core muscles as the cal. 'F' value of all the functional lines are greater than the tab. 'F' value at 0.05 level of significance (see table 8).

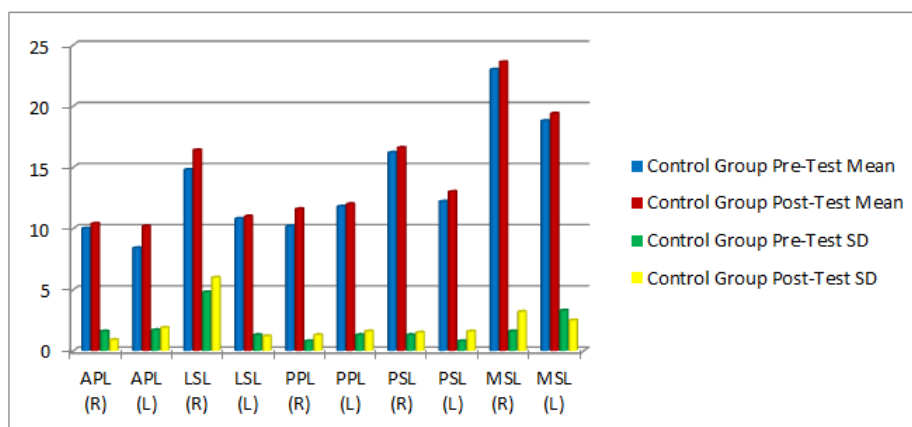


Fig-4: Descriptive Statistics of Control Group (Bunkie Test Performance)

Table-8: Analysis of Covariance (ANCOVA) of Bunkie Test Performance

Functional Line	Sources of Variance	df	Sum of Squares	Mean Square	F-ratio
APL (R)	Between Groups	1	87.29	87.29	21.52*
	within Groups	7	28.4	4.06	
APL (L)	Between Groups	1	260.79	260.79	108.04*
	within Groups	7	16.90	2.41	
LSL (R)	Between Groups	1	28.70	28.70	7.71*
	within Groups	7	26.06	3.72	
LSL (L)	Between Groups	1	49.90	49.90	9.85*
	within Groups	7	35.47	5.07	
PPL (R)	Between Groups	1	288.01	288.01	40.40*
	within Groups	7	49.90	7.13	
PPL (L)	Between Groups	1	90.48	90.48	91.79*
	within Groups	7	6.90	0.99	
PSL (R)	Between Groups	1	47.10	47.10	7.31*
	within Groups	7	45.14	6.45	
PSL (L)	Between Groups	1	98.69	98.69	10.94*
	within Groups	7	63.16	9.02	
MSL (R)	Between Groups	1	113.11	113.11	7.16*
	within Groups	7	110.58	15.80	
MSL (L)	Between Groups	1	242.83	242.83	8.66*
	within Groups	7	196.26	28.04	

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

#### 4. DISCUSSION

The researcher investigated the effect of Pilate’s exercises training programme on the core muscle strength measured by Bunkie test and BMI by height and weight. The main finding of the study shows that the Pilates exercises lead to significant improvement of core muscle strength as well as reduction of BMI after the training programme on PTG. The researcher would like to attribute few reasons behind such kind of findings.

The exercises like front bridge, Side bridge (both sides) and Supine bridges used in this study proved to be very much effective in decreasing the body fatness and improving the core strength (Esteban Garcia *et al.*, 2021) so may have improved the performance of APL, LSL, MSL. Furthermore the bridge exercises for abdominal and core muscles improve the back muscle strength (Mayo Clinic Staff, 2020) which may be the reason behind the better performance of PSL and PPL in this study. Core strengthening exercise like prone



plunk, bridging, one leg bridging, side plunk, knee to chest exercise used for this side may have improved the Bunkie test performance of APL, LSL, MSL etc. as these exercises enhances the body flexibility as well as core muscle strength (Datta *et al.*, 2014).

So it is clear from the above mentioned facts that the Pilates training programme comprised of bridging exercises, plank exercises, stretching exercises, curling exercises, rolling exercises etc. used in the present research have developed the core muscle strength and also reduced the fatness as well as increased the flexibility of the obese children participated in the Pilates training programme. So the performance of the Bunkie test has also improved significantly.

The result of this present study is in line with various other investigations where it has been found that the regular physical training programme have improved the core muscle strength (Tyagi & Kumar, 2019), reduced the body fatness (Aladro-Gonzalvo *et al.*, 2012), reduced the body weight (Wang *et al.*, 2021) and also effectiveness on reducing the fat percentage as well as in improving body mass index (Cakmakci, 2011).

## 5. CONCLUSION

On the basis of the result found in this study it can be concluded that six weeks of Pilates training programme is effective in the improvement of core muscles strength as well as in reduction of fatness and BMI among obese children, in turn have improved the Bunkie test performance.

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