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Sindhu N
R.V. College of Physiotherapy,
Bangalore, India

Bhatbolan SV
Assistant Professor R. V. College
of Physiotherapy, Bangalore,
India

Billore N
Assistant Professor, R.V. College
of Physiotherapy, Bangalore,
India.

Bashyal P
R.V College of Physiotherapy,
Bangalore, India

Correspondence
Sindhu N
R.V. College of Physiotherapy,
Bangalore, India

Effect of supervised Pilates mat exercises on parameters of health related physical fitness among young Indian women: An experimental study

Sindhu N, Bhatbolan SV, Billore N and Bashyal P

Abstract

Background and Objectives: In today's competitive world young women require adequate levels of physical fitness (e.g. core muscle strength, endurance and flexibility). One specific exercise method that received a lot of attention is Core Strength Training (CST) through Pilates. The aim of the study was to determine the efficacy of Pilates on core strength, flexibility and on BMI among young Indian women aged between 18-26 years.

Methods: The study included 50 subjects who consented to participate and were recruited as per the inclusion/exclusion criteria. Demographic data and BMI was recorded and subjects were assessed for pre intervention core strength and flexibility using DLLT and SR test respectively. The subjects were included in a supervised classical Pilates mat exercise protocol which comprised of 10 exercises performed 3 times a week for duration of 4 weeks. After 4 weeks subjects were re-assessed for post intervention core strength and flexibility and the data was analyzed.

Results and Conclusion: The results showed were: The core strength showed a significant statistical change with the pre intervention (63.85 ± 9.01) post intervention (52.29 ± 10.41) with t value (10.458) and p value ($<0.001^{**}$). This demonstrated an overall clinically and statistically significant improvement in the core strength post intervention. Flexibility parameter at pre intervention (19.41 ± 9.90) post intervention (21.20 ± 5.97) with t value (1.51) and p value (0.138). Though flexibility parameter on analysis did not show any significant statistical change, but there was a clinically observable improvement demonstrated by few subjects. BMI remained unchanged with no significant change.

Keywords: Classical pilates mat exercises, young Indian women, core strength, flexibility, BMI, double leg lowering test (DLLT), sit and reach test (SRT) body mass index (BMI)

Introduction

In today's fast paced, competitive world, young women require adequate levels of physical fitness to effectively multitask. It calls upon high levels of endurance, flexibility, as well as maximal and explosive muscle strength to outperform their daily work^[1, 2]. Being physically fit has been defined as "the ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies"^[3]. Physical fitness is a set of attributes that are either health- or skill-related pertaining to certain athletic ability. The degree to which people have these attributes can be measured with specific tests^[4]. The health-related components of physical fitness are (a) cardiorespiratory endurance, (b) muscular endurance, (c) muscular strength, (d) body composition, and (e) flexibility. The five health-related components of physical fitness are more important to public health than are the components related to athletic ability^[5]. It is well-known that improvements in physical performance can be achieved by means of strength training^[6, 7, 8]. One specific strengthening method that has recently received a lot of attention, particularly in the lay literature, is Core Strength Training (CST) through Pilates, because the core appears to play a crucial role during performance of everyday^[9, 10]. According to Akuthota *et al.*^[11] the core refers to a muscular box consisting of the abdominals in the front, Para spinals and gluteal in the back, the diaphragm as the roof, and the pelvic floor and hip girdle muscles as the bottom. The abdominal muscles, consisting of the transversus abdominis, rectus abdominis, and internal and external oblique's, are primarily involved in controlling the

position of the spine and pelvis [11]. Functionally, these muscles are centrally located in almost all kinetic chains and important for stabilizing the spine and pelvis, providing proximal stability and strength for distal mobility and function of the limbs during everyday activities [12]. CST programs are used in addition or as an alternative to traditional balance and strength training programs and are known to improve variables of muscle strength, balance, and functional performance in women [13]. Pilates exercises were designed by Joseph Pilates in Germany in 1883 and were intended to strengthen human mind and body [14, 15]. The Pilates methods seeks to develop movement control from a strong core apparatus to guide and train the body. Originally it was developed as mat exercises. But Pilates exercises were used in rehabilitation for the first time in New York in late 1960. In 1990s many rehabilitation practitioner started using this method in multiple fields of rehabilitation like general orthopedic, geriatric, chronic pain, neurological rehabilitation and more [14, 15, 16]. The advantages of Pilates exercises is that participants enjoy this exercises. The originality and variety of this method may have encouraged a more trusting attitude to the program. It works on 6 principles that are Concentration, Control, Center Flow, Precision and Breathing [17]. Pilates exercises helps to boost energy, relieve stress, build strength, increase flexibility, improve balance and co-ordination, develop proper posture, develop proprioception and decrease pain [18, 19]. The Pilates method incorporates both physical and mental elements. Pilates exercises involve stabilization and progressive multi-planar excursion of the trunk and limbs with additional focus on breathing. Exercises are performed both on the mat as well as on specialized equipment [20].

Pilates method has been increasingly applied in achieving various fitness objectives. But limited evidence is available which explains its effect on specific parameters of health related fitness in young women in India. Thus, the objective of this study was to determine the efficacy of Classical Pilates mat exercise technique on core strength, flexibility and on BMI among Indian women aged between 18-26 years.

Materials and Methods

The study was conducted in exercise therapy outpatient unit/ biomechanics laboratory at R.V. College of Physiotherapy. The study used an experimental study design and evaluated the effect of Classical Pilates on strength, flexibility and BMI as outcome variables in pre-post experimental design. The study was conducted on a sample size of 50 young Indian women and subjects were recruited as per the inclusion/exclusion criteria. 2 subjects could not complete the study due to personal reasons and 48 subjects completed the study intervention.

Inclusion criteria: Age group between 18-26 years, apparently healthy women, willingness towards participation in the study, BMI 18 and above.

Exclusion criteria: History of any lumbar or abdominal surgeries, History of any musculoskeletal impairment of upper and lower limbs, Psychological problems, History of any neurological conditions etc, Un-cooperative subjects, History of alcohol or drug abuse, Pregnancy, Professional athletes.

Materials used: Sit and reach box, Digital weighing machine, Pen, Measuring tape, Notepad, Mat, Goniometer. Subjects

were explained in detail about the study and an informed consent was obtained. Demographic data was recorded. Subjects were assessed at baseline for pre-intervention core strength and flexibility using Double Leg Lowering Test (DLLT) and Sit and Reach test (SRT) respectively. The subjects were then included in supervised classical Pilates mat exercises protocol which comprised of 10 Classical Pilates exercises performed on mat 3 times a week for a duration of 4 weeks. Every exercise was demonstrated by trained qualified physiotherapist followed by practice and training under guided supervision through-out the entire session.

Classical Pilates mat exercises were performed as per the proper standardised instructions and method [22]. The following exercises were practiced by the subjects following a demonstration and guided supervision.

1. Saw
2. Swan
3. Single leg stretch
4. Planks
5. Side planks
6. Hundred
7. Criss-Cross
8. Scissors
9. Roll over
10. Rolling like a ball



Post intervention the outcome measures for core strength ie DLTT and flexibility ie SRT were assessed at the end of 4 weeks in the following manner.

Assessment of core strength: Double Leg Lowering test (DLLT)

The subjects in supine, on a firm surface. Forearm folded across the chest to ensure that the elbows are not resting on the table for support.

Test/ Scoring: The examiner assisted the subjects in raising the legs to vertical position, or the examiner instructed

subjects to raise the legs one at a time to that position, keeping the knees straight. Subject tilts the pelvis posteriorly to flatten the low back on the table by contracting the abdominal muscles and holds the low back flat while slowly lowering the legs. The subjects were instructed not raise the head and shoulders during the test. Strength is graded based on the ability to keep the low back flat on the table while slowly lowering both the legs from the vertical position. The angle between the extended legs and the table is noted at the moment that the pelvis tilts anteriorly and the low back arches from the table.

- Normal – 0 to 15 degrees
- Good - 15 to 45 degrees
- Fair – 45 – 90 degrees.

Assessment of flexibility: Sit and Reach test (SRT)

The most commonly used health related static flexibility test is sit and reach test. It is the most widely used flexibility measure of hamstrings and erector spinae.

Test/ Scoring: This test involves sitting on the floor with legs stretched out straight ahead. Shoes should be removed. The soles of the feet were placed flat against the box. Both knees were be locked and pressed flat to the floor. With the palms facing downwards, and the hands on top of each other or side by side, the subjects were told to reach forward along the measuring line as far as possible. The examiner ensured the hands remained at the same level, not one reaching further forward than the other. After some practice reaches, the subject reached out and held the position for one – two seconds while the distance is recorded. The score is recorded to the nearest centimeter or half inch as the distance reached by the hand.

Statistical Method

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean SD (Min-Max) and results on categorical measurements are presented in Number (%).

Student t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale with in each group.

Paired Proportion test has been used to find the significance of proportion in paired data.

+ Suggestive significance (P value: $0.05 < P < 0.10$)

* Moderately significant (P value: $0.01 < P < 0.05$)

** Strongly significant (P value: $P < 0.01$)

Statistical software: The Statistical software SAS 9.2, SPSS 15.0, were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Results

Table 1: Age distribution of subjects studied

Age in years	No. of patients	%
18-20	31	64.6
21-22	4	8.3
23-25	13	27.1
Total	48	100.0

Mean \pm SD: 20.25 \pm 2.42

The above table shows a total of 48 subjects among which 31 subjects (64.6%) were between 18-20 years, 4 subjects (8.3%) were between 21-22 years, 13 subjects (27.1%) were between 23-25 years of age.

Table 2: BMI (kg/m^2) distribution at pre and post assessment

BMI (kg/m^2)	Pre	Post	% change
<18.5	3(6.3%)	3(6.3%)	0.0%
18.5-25	33(68.8%)	34(70.8%)	2.0%
25-30	7(14.6%)	6(12.5%)	-2.1%
>30	5(10.4%)	5(10.4%)	0.0
Total	48(100%)	48(100%)	-

The above table shows the BMI distribution. 6.3% of subjects were maintained in pre and post intervention who categorize under the low/underweight category, 68.8% and 70.8% subjects were under the normal BMI category pre and post intervention respectively, whereas 14.6% pre and 12.5% were in overweight category, and 10.4% pre and 10.4% fall under the obese category.

Table 3: Comparison of Study variables at pre and post

Variables	Pre	Post	difference	t value	P value
BMI (kg/m^2)	23.17 \pm 3.92	23.26 \pm 3.92	-0.092	0.911	0.367
Core Strength	63.85 \pm 9.01	52.29 \pm 10.41	11.563	10.458	<0.001**
Flexibility	19.41 \pm 9.90	21.20 \pm 5.97	1.788	1.510	0.138

The above graphs and tablee show the comparison of study variables at pre post assessment.

1. The pre (23.17 \pm 3.92) post (23.26 \pm 3.92) t value (0.911) and p value (0.367) of BMI did not show any statistically significant difference and BMI of the subjects post intervention was maintained similar to pre intervention values.
2. The core strength showed a significant statistical change with the pre intervention (63.85 \pm 9.01) post intervention (52.29 \pm 10.41) with t value (10.458) and p value (<0.001**), so this demonstrated an overall clinically and statistically improvement in the core strength post intervention.
3. Flexibility parameter at pre intervention (19.41 \pm 9.90) post intervention (21.20 \pm 5.97) with t value (1.51) and p value (0.138). Though flexibility parameter on analysis did not show any significant statistical change, but there was a clinically observable improvement demonstrated by few subjects.

Discussion

Pilates method of exercises are intended to strengthen human body and mind. The method seeks to develop controlled movement from a strong core apparatus to guide and train the body. Originally it was developed as mat exercises. The technique focuses on the “power house” or what is known today as the core and by stabilizing the core musculature through a controlled range of motion.

Young women require to cope up with highly competitive world and such multitasking ability needs high levels of endurance, flexibility, as well as maximal and explosive muscle strength to outperform their daily tasks. Research by Finch C *et al.* [23] shows that young college women are more prone to have decreased flexibility for prolonged sitting during the day and they are more vulnerable for decreased flexibility and strength because most of the women are not into any sporting activities. So, in this study we wanted to find out the effect of Pilates on fundamental fitness parameters like core strength, flexibility and BMI among young Indian women Thus, the present study was conducted on young Indian women in the age group of 18-26 using classical Pilates mat exercises for 3 times a week for a duration of 4 weeks as a group exercise program supervised

by the same instructor who is a qualified physiotherapist.

The results showed a statistically significant improvement in core strength which was similar to the findings obtained by Emery K *et al.* [24] who conducted a study for 12 weeks with Pilates exercise protocol involving a control group and an experimental group and showed improvement of core strength. Unlike the study conducted by Emery *et al.* the present study did not employ any control group and it was only a single group experimental pre- post study design. In the present study it was also observed that a significant improvement in core strength may be achieved even with the intervention delivered for a duration of as less as 4 weeks. We attribute this to the fact that Pilates workouts are performed in a series of repetitive, low impact modules using specific abdominal muscles and was performed by the subjects under supervision of a qualified physiotherapist regularly.

Apart from the core strength the study conducted by Kloube *et al.* [25] also demonstrated a significant increase in muscle flexibility although in the present study it was noted that a 4 week training protocol involving Pilates did not significantly improve the flexibility component. Although there was a reported and clinically observable change in these parameters the difference in post assessment was not a significant one. Three substantial reasons we like to consider are

1. The study subjects by Kloube *et al.* included predominantly middle aged men and women whereas it was specifically conducted on younger women in the present study.
2. The duration of intervention was taken as 4 weeks whereas it was for a much longer time ie for 12 weeks by the previous researchers.
3. Pilates protocol of exercises in their basic nature are focused towards delivering abdominal and core muscle workout and are not essentially targeted at improving the muscle length and flexibility.

Flexibility component could be a derivative of an extended exercise protocol over a greater time periods or adding specific flexibility maneuvers may show a significant change and may be conducted in future.

The third outcome measure in the present study was BMI (Body Mass Index) which after 4 weeks of training period did not show any statistically significant change. Previous studies done by Seal *et al.* [26] also reported similar findings in their study which was conducted on middle aged men and women for a duration of 6 months using Pilates mat exercises. Body Mass Index is a ratio of body weight to height and does not precisely note the change in body compositions. Therefore in future studies it will be interesting to utilize analysis of specific and more sensitive body composition measures like muscle mass and fat mass than using BMI in isolation.

A study with a bigger sample and a control group may be considered for further research. Usage of better objective outcome tools may allow more accurate results.

Thus this study concluded that supervised Classical Pilates mat exercise protocol in young Indian women showed significant improvement in core strength but minimal clinically observable changes in flexibility components. The BMI parameter was maintained identical when compared to pre and post values and did not show any statistically significant change.

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