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Effects of Mat-Based Pilates Versus Effects of Core Stability Exercises on Balance in Stroke Patients

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ABSTRACT

Background: According to WHO, stroke is defined as an accident to the brain with rapidly developing clinical signs of focal or global disturbance to cerebral function with symptoms lasting 24 hours or longer, or leading to death, with no apparent cause other than intracerebral hemorrhage and subarachnoid hemorrhage. It has been noted that diminished motor skills and balance following a stroke can restrict daily activities such as walking and increase the risk of secondary injuries like falls.

Pilates is a gentle exercise that helps strengthen the muscles and focuses heavily on building strong core muscles.

Core stability exercises are movements or activities designed to strengthen the muscles surrounding the spine, pelvis, and abdomen, helping to improve posture, balance, and overall stability.

METHODOLOGY:

Study design: Comparative study **Sampling Method**: Convenient sampling **Sample Size**: 30

Study setting:

1. Dr. B.R. Ambedkar Medical College, Department of Physiotherapy
2. Community-Dwelling.

Outcome measure: Berg Balance Scale

Criteria for sample selection:

Inclusion Criteria:

- Patients with hemorrhagic and ischemic stroke.
- Age between 35-70 years.
- Both males and females are included.
- Patients with first-time stroke.
- Definite diagnosis with CT scan and MRI.
- BBS score: Below 49

Exclusion criteria:

- Patients with second time stroke.
- Patients with acute stroke.
- Recovered patients.

RESULT: The individual effectiveness of both techniques is proven but there was no evidence of one being superior to another.

INTRODUCTION

According to WHO, Stroke is defined as an accident to the brain with rapidly developing clinical signs of focal or global disturbance to cerebral function with symptoms lasting 24 hours or longer, or leading to death, with no apparent cause other than of vascular origin and includes cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage.[1] Stroke is characterized by cerebrovascular bleeding and neural disease resulting from non-traumatic causes, often leading to brain damage or loss of function in the muscles on the affected side of the body. It has been noted that diminished motor skills and balance following a stroke can restrict daily activities such as walking and increase the risk of secondary injuries like falls.[2]

Pilates exercise, also known as Contrology, emphasizes muscle control and aims to achieve a neutral spine to prevent excessive spinal flexion and extension during upright movement. Research has shown that Pilates exercises not only enhance muscular strength, endurance, and flexibility but also serve as effective rehabilitation for the elderly. Unlike many other exercise programs, Pilates can be tailored to accommodate varying fitness levels and can be performed at home without requiring visits to a rehabilitation center. By targeting deep core muscles, Pilates improves spinal stability, reduces back pain, and enhances control of the pelvis and hip joints, thereby positively influencing gait ability. Pilates, a mind-body exercise dating back to the early 20th century, focuses on improving strength, core stability, flexibility, muscle control, posture, and breathing. It specifically aims to enhance coordination and control of the core trunk muscles, crucial for optimal lumbar-pelvic stabilization necessary for daily activities. Pilates exercises are typically divided into mat exercises, akin to yoga and tai chi, and equipment exercises that utilize springs for muscle strengthening. Many Pilates exercises are performed in a standing position with a narrow base of support, challenging trunk muscle stability to maintain upright posture.[2]

"Core stability" refers to the capacity to support the spine through local muscle engagement. The "core muscles" encompass various muscles that support the lumbo-pelvic-hip complex. Exercises targeting core stability involve activating specific motor patterns of the trunk muscles to challenge spinal stability and posture control. Engaging in core stability exercises has been shown to enhance body balance control after just one session. Evidence suggests that incorporating core stability exercises is a beneficial approach to enhancing trunk performance, dynamic sitting balance, standing balance, and gait in individuals recovering from a stroke.[3]

Need of the study:

There has been literary evidence proving the efficacy of mat-based pilates in subjects with stroke to improve balance similarly there has been literary evidence proving the efficacy of core stability exercises in subjects with stroke to improve balance, while the efficient rehab technique has not been determined to improve balance in subjects with stroke. Hence the need arises to compare these two techniques. The study aims to determine whether which of the above-mentioned technique is more effective in order to incorporate the more appropriate and more efficient technique during the rehab. Hence this study is conducted to compare the effect of Mat-based Pilates versus the effects of Core Stability exercises to improve balance in subjects with stroke.

OBJECTIVES

- To determine the effects of Mat-based Pilates on balance in stroke patients.
- To determine the effects of Core stability exercises on balance in stroke patients.
- To compare the effect of Mat-based Pilates and the effect of Core stability exercises on balance in stroke patients.

HYPOTHESIS

NULL HYPOTHESIS:

There will be no significant difference between the effects of Mat-based Pilates and the effect of Core Stability Exercises on balance in stroke patients.

ALTERNATIVE HYPOTHESIS:

There will be a significant difference between the effects of Mat-based Pilates and the effect of Core Stability Exercises on balance in stroke patients.

REVIEW OF LITERATURE

Review on stroke:

Roh S, Gil HJ, et al.[2016] conducted a study and stated that stroke is a cerebrovascular disease caused by nontraumatic reasons and is accompanied by brain damage or functional loss of lower body muscles on the paretic side. Despite advancements in modern medicine, economic growth, and increasing health awareness, the occurrence of stroke is rapidly increasing due to unhealthy lifestyles, environmental pollution, and stress in fast-paced societies. Loss of motor ability and balance due to stroke can limit daily living activities such as walking and may lead to secondary injuries like falls. Gait in stroke patients is characterized by reduced gait parameters. Decreased gait function following stroke is the primary reason why patients struggle to return to society. Yang et al. reported that hemiplegia patients with lesions support more than 60% of their body weight on the non-paretic limb during standing, resulting in an asymmetric gait pattern. They also found that stroke patients have lower gait velocity, stride time, stride length, and cadence compared to healthy elderly individuals. Gracies and Vattanasilp et al. observed that stroke patients tend to reduce the range of motion (ROM) of paretic lower limb joints during walking, while Fonseca et al.] reported that increased stiffness of the hip joint can reduce energy efficiency, limiting walking and running movement. Additionally, Turnbull et al. analyzed the gait cycles of eight elderly hemiplegia patients for ten years and found that they exhibited increased double support time and decreased single support time during walking, indicating a tendency to walk slowly and cautiously to maintain stability. As evident from previous studies, the predominant characteristic of hemiplegia patients with stroke is difficulty walking due to weakened lower limb muscles and imbalance. Therefore, many researchers have focused on gait recovery as the primary goal of stroke rehabilitation.[2]

Murphy SJ, Werring DJ, et al.[2020] conducted a study and stated that stroke is a clinically defined syndrome of acute, focal neurological deficit attributed to vascular injury (infarction, hemorrhage) of the central nervous system. They stated that stroke is the second leading cause of death and disability worldwide. Stroke is not a single disease but can be caused by a wide range of risk factors, disease processes, and mechanisms. Hypertension is the most important modifiable risk factor for stroke, although its contribution differs for different subtypes. Most (85%) strokes are ischaemic, predominantly caused by small vessel arteriolosclerosis, cardioembolism, and large artery athero-thromboembolism.

Ischaemic strokes in younger patients can result from a different spectrum of causes such as extracranial dissection. Approximately 15% of strokes worldwide are the result of intracerebral hemorrhage, which can be deep (basal ganglia, brainstem), cerebellar, or lobar. Deep hemorrhages usually result from deep perforator (hy- hypertensive) arteriopathy (arteriolosclerosis), while lobar hemorrhages are mainly caused by cerebral amyloid angiopathy or arteriolosclerosis- sis. A minority (about 20%) of intracerebral hemorrhages are caused by macrovascular lesions (vascular malformations, aneurysms, caverno- mas), venous sinus thrombosis, or rarer causes; these are particularly important in young patients (<50 years). Knowledge of vascular and cerebral anatomy is important in localizing strokes and understanding their mechanisms. This guides rational acute management, investigation, and secondary prevention.[4]

Tapas Kumar Bannerjee et.al, [2006] conducted a study and stated that a large number of population-based research studies on stroke were carried out in India. This article is an overview of the major epidemiological surveys of stroke reported in India. The age-adjusted prevalence rate of stroke for the previous ten years was 250–350/100,000. According to recent studies, Kolkata's urban population had an age-adjusted yearly incidence rate of 105/100,000, while Bengal's rural community had an age-adjusted annual incidence rate of 262/100,000. The brain infarction-to-hemorrhage ratio was 2.21. The most significant risk factor was hypertension. In India, strokes accounted for 1.2% of all fatalities. This ongoing study will also determine the prevalence, subtypes, case fatality rates, and risk factors and will provide valuable insight into stroke disorder in this country.[5]

Krishna A Dani. et al [2011] Conducted a study and stated that Computed tomography (CT) and magnetic resonance (MR) are two common methods for detecting cerebral perfusion. It was uncertain what the ideal perfusion values should be to identify tissue at risk of infarction during an acute stroke. In the case of an acute ischemic stroke, they thoroughly analyzed MR and CT perfusion imaging. As it was looked for studies that evaluated lesion volumes, perfusion lesion values, and imaging ion thresholds on MR or CT scans that were done within 24 hours of a stroke, Definitions were taken out, along with perfusion values, that compared terms and assessed perfusion thresholds for "nonviable or at-risk" and "at- risk or not-at-risk tissue" criteria.[6]

Review on Pilates:

de Oliveira LC, de Oliveira RG et al. [2015] Conducted a study on "Effects of Pilates exercise on muscle strength, postural balance, and quality of life in older adults" and investigated the efficacy of Pilates exercises in enhancing muscle strength, postural balance, and quality of life among elderly individuals. The study encompassed 24 older adults who were randomly divided into two groups: one undergoing Pilates exercises and the other serving as a control. Over a span of 12 weeks, the Pilates group engaged in sessions twice weekly, whereas the control group received no specific intervention. The outcomes revealed notable enhancements in knee extensor and flexor muscle strength among those in the Pilates group, assessed via an isokinetic dynamometer. Although not statistically significant, there were improvements in postural balance, measured through the Berg Balance Scale, observed within the Pilates group. Additionally, participants in the Pilates group reported an amelioration in their quality of life, as measured by the SF-36 questionnaire. These results underscore the potential of Pilates exercises as an effective means to enhance muscle strength, postural balance, and overall quality of life among older adults. Moreover, Pilates exercises are deemed safe and adaptable to various fitness levels, making them a valuable option for elderly individuals striving to enhance their physical well-being.[7]

Kloubec JA. Et al.[2010] Conducted a study on Pilates for Improvement of Muscle Endurance,

Flexibility, Balance, and Posture" and investigated the effectiveness of Pilates exercise in improving muscle endurance, flexibility, balance, and posture in a group of active middle-aged men and women. The study included 32 participants who were randomly assigned to either a Pilates exercise group or a control group. The Pilates group participated in Pilates classes twice a week for 12 weeks, while the control group received no intervention The results of the study showed that Pilates exercise was effective in improving abdominal endurance, hamstring flexibility, and upper-body muscular endurance. However, there were no significant improvements in posture or balance. These findings suggest that Pilates exercise can be an effective intervention for improving certain aspects of physical fitness, such as muscle endurance and flexibility. However, it may not be effective for improving posture or balance.[8]

Sathe P, Chitre P et al.[2018] conducted a study and investigated that in chronic stroke patients, mat-based pilates exercises demonstrated greater efficacy in enhancing balance and dynamic stability compared to conventional therapy. The research posits that this superiority may stem from the focus of Pilates exercises on core muscle engagement, crucial for maintaining balance. Another study conducted by the same author corroborated these findings, showing that Pilates mat exercises contributed to improved balance and functional mobility in chronic stroke patients, with participants exhibiting good tolerance to the exercises. These collective findings suggest that Pilates mat exercises could serve as a promising intervention for bolstering balance among chronic stroke patients. Nonetheless, further research is warranted to validate and expand upon these initial observations.[9]

Yun SM, Park SK, Et al. [2017] Conducted a study and investigated how Pilates exercise affects the quality of life of people who have had a stroke. The researchers divided 30 participants into two groups: one group did Pilates training, and the other group didn't (the control group). The Pilates group attended hour-long sessions three times a week for eight weeks. They used a survey called the Short Form Health Survey (SF-36) to measure the quality of life of both groups before and after the sessions. The results revealed that the Pilates group experienced significant improvements in all three areas of quality of life measured by the SF-36: physical, social, and psychological. On the other hand, the control group didn't show any significant changes in quality of life. These findings suggest that Pilates training could effectively enhance the quality of life for people who have had a stroke.[10]

Review on Core Stability Excercises:

Yu SH, Park SD, et al. [2013] Conducted a study on "The effects of core stability strength exercise on muscle activity and trunk impairment scale in stroke patients" and investigated whether Core stability exercises have the potential to enhance muscle activity and function among stroke patients. Additionally, they may contribute to improvements in balance and walking ability. Nonetheless, further research is necessary to ascertain the lasting impact of these exercises on individuals who have experienced a stroke.[11]

Review on Berg Blance Scale:

Suzuki M, Fujisawa H, et al. [2013] Conducted a study on the "Relationship between the Berg Balance Scale and Static Balance Test in Hemiplegic Patients with Stroke" and investigated the limitations of the widely used Berg Balance Scale (BBS) in detecting subtle differences in balance ability, especially among high-functioning patients. Researchers introduced the Simple Balance Test (SBT) as a potentially more sensitive and efficient alternative for evaluating static balance in hemiplegic stroke patients. The SBT consists of five straightforward posture-holding tasks, focusing on maintaining stability near the

limits of balance. This method allows for a more detailed assessment compared to the BBS, potentially uncovering subtle impairments overlooked by the latter. The study revealed a strong positive correlation between SBT and BBS scores, indicating that the SBT captures similar aspects of balance while offering greater sensitivity. Interestingly, even among patients with maximum BBS scores, the SBT could detect further variations in balance ability. This study suggests that the SBT shows promise as a tool for evaluating static balance in hemiplegic stroke patients. Its simplicity, sensitivity, and potential for better predicting overall balance make it a valuable addition to balance assessment tools. Further research is needed to validate its reliability and broader applicability, but the SBT holds significant potential for enhancing balance assessment in stroke patients.[13]

Szafraniec R, Barańska J, et al. [2018] Conducted a study on "Acute effects of core stability exercises on balance control" and investigated that after completing just one session of core stability exercises, there was an improvement in controlling body balance. This improvement was noticeable 30 minutes after the exercise and lasted for at least 24 hours. The enhancement in postural stability was particularly linked to movements in the frontal plane. This could be attributed to the involvement of hip girdle muscles in the exercises targeting this area. Furthermore, 24 hours post-exercise, there was an observed increase in the automaticity of maintaining a stable upright stance.[12]

Blum L, Korner-Bitensky N et al. [2008] conducted a study and investigated the reliability, validity, and responsiveness to change of the Berg Balance Scale (BBS). The findings indicate that the BBS is highly reliable, valid, and sensitive to changes over time. It is also practical and straightforward to administer, requiring no expensive equipment or prolonged assessment time. However, it has been noted that while the BBS is effective in predicting certain outcomes such as discharge disposition, it may not accurately predict falls. Concerns have been raised regarding the BBS showing floor and ceiling effects, particularly in patients with severe or mild balance impairments. For example, the least demanding item on the BBS is sitting independently, which may be challenging for patients with severe impairments, leading to low scores that do not accurately reflect their potential for improvement. Similarly, patients with mild impairments may reach the maximum score on the BBS, masking potential gains in balance critical for community reintegration. Alternative measures, such as the Postural Assessment Scale for Stroke Patients (PASS), have shown slightly better psychometric properties than the BBS and do not exhibit significant floor or ceiling effects. Similarly, the Activities-Specific Balance Confidence (ABC) Scale offers a wider range of items with minimal floor and ceiling effects, but its applicability has mainly been tested in community-based populations. Additionally, the Trunk Impairment Scale (TIS) may be a promising alternative for patients struggling with the easier items of the BBS, as it focuses on sitting balance and does not demonstrate ceiling effects. However, the TIS's ability to detect clinically meaningful improvements has not yet been fully explored.[14]

Kudlac M, Sabol J et al.[2019] conducted a study, encompassing a total of 33 articles. The Berg Balance Scale (BBS) was evaluated and found to exhibit excellent reliability and validity. The scores obtained from the BBS were predictive of various factors influencing patient function and performance. However, the ability to predict fall risk based on these scores was not found to be strong. In conclusion, the BBS proves to be a reliable and valid instrument for assessing balance and functional mobility in post-stroke individuals. Nevertheless, caution should be exercised when using it as a robust predictor of fall risk within the stroke population, as indicated by the scoring description.[15]

METHODOLOGY

STUDY DESIGN: Comparative study

STUDY SETTING: Dr. B.R Ambedkar College of Physiotherapy and Community-Dwelling

SAMPLE SIZE: 100

SAMPLING METHOD: Convenient Sampling

MATERIALS USED:

- Yoga Mat
- Bed
- Pillow



CRITERIA FOR SAMPLE SELECTION:

The participants are selected for the study based on the following criteria

INCLUSION CRITERIA:

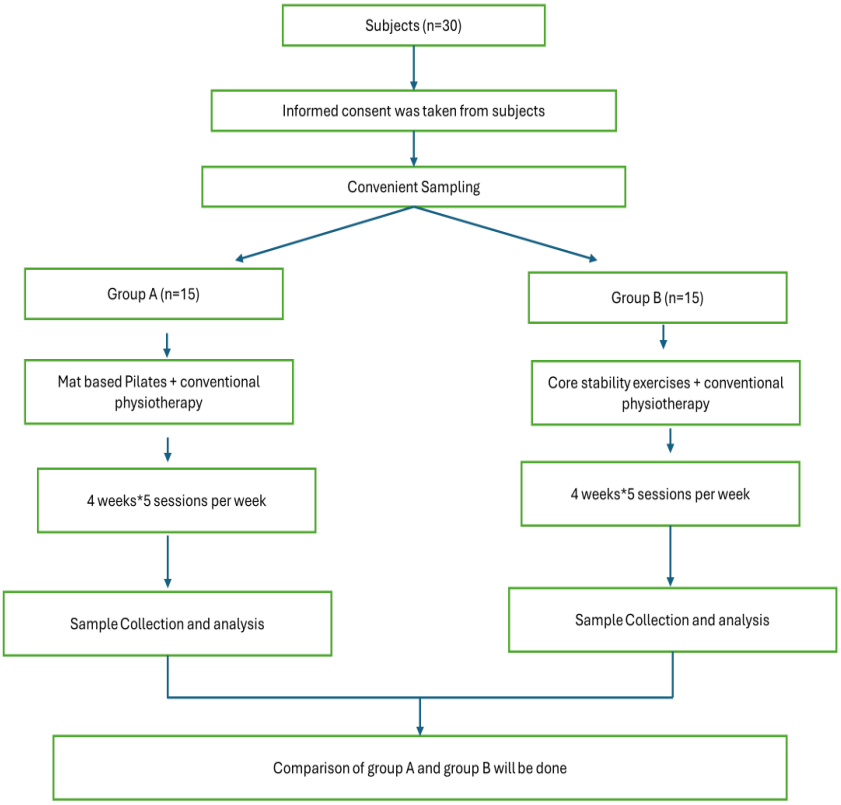
- Patients with hemorrhagic and ischemic stroke.
- Age between 35-70 years.
- Include both male and female.
- Patients with first-time stroke.
- Definite diagnosis with CT scan and MRI.
- Berg Balance Score: Below 49.

EXCLUSION CRITERIA:

- Patients with second time stroke.
- Patients with acute stroke.
- Recovered patients.

OUTCOME MEASURE: Berg Balance Scale.

FLOW CHART OF METHODOLOGY



PROCEDURE

In this study, 30 participants aged between 30 and 65 years will be included based on specific inclusion and exclusion criteria.

After completing the participant selection, the participants will randomly be assigned to two groups: Group A and Group B. Group A will perform Mat-based pilates along with conventional therapy while Group B will perform Core Stability exercise along with conventional therapy.

The outcome measure used will be the "Berg Balance Scale".

Therefore, the efficacy of Mat-based pilates and Core stability exercises will be determined.

Mat-based pilates: The pilates exercise program used in this study will be conducted 5 times a week for 4 weeks. The exercise was composed of a warm-up exercise, the main exercise, and the cool-down exercise. The details of the program are provided below:

Pilates exercise program

WARM-UP EXERCISES (10 min)

1. Breathing: 8 sets
2. Chin up & down: 8 sets
3. Spine stretch forward: 8 sets MAIN EXERCISES (40 min)
4. Spine stretch side: 8 sets
5. Draw a sword: 8 sets
6. Deltoid lift: 8 sets
7. Foot and ankle strengthener: 8 sets
8. Abdominals with head support: 8 sets
9. Top leg pulse-downs: 8 sets

10. Bottom leg pulse-ups: 8 sets
11. Deep abdominal cue: 8 sets - between the leg
12. around the leg
13. Prone Glute series-Charlie Chaplin: 8 sets
14. Prone glute series-swimming: 8 sets
15. Bridge: 8 sets
16. Prone glute series-heel squeeze

FINISHING EXERCISE (10min)

1. Breathing: 8 sets
2. Swan: 8 sets

Core stability exercises- The core stability training consisted of ADIM as a selective contraction of TrA, selective movements of the pelvis, and pelvic movements with ADIM (Abdominal drawing-in maneuver).

For ADIM, subjects were instructed to draw the abdomen up and in toward the spine, without movement of the trunk or pelvis while continuing to breathe normally. The core stability exercises program used in this study will be conducted 5 times a week for 4 weeks.

ADIM will be performed in a crook lying position and then in a sitting position.

Pelvic control exercises were composed of the following three planes of movement:

1. anterior-posterior tilt;
2. lateral lift; and
3. transverse rotation.

Along with mat-based pilates and core stability exercises conventional physiotherapy will also be given:

1. Gluteal Bridging
2. Pelvic

Figure: 01
MAT-BASED PILATES (Spine Stretch)

Figure:02
CORE STABILITY EXERCISES (Gluteal Bridging)

DATA ANALYSIS AND INTERPRETATION

Statistical analysis of the data was performed using SPSS 20.0. The Categorical variables were presented as frequency and percentage. The continuous variables were presented as mean ± SD. The pre-post comparison was done using a paired t-test and between-group comparisons were done using an unpaired t-test. A p-value <0.05 was considered statistically significant.

Table 1: Showing mean age in years in Group A and Group B

Age	Minimum	Maximum	Mean	Std. Deviation
Mat based pilates	37.00	70.00	53.000	9.449
Core stability exercise	35.00	64.00	52.533	8.871

Group A exhibits a broader age range with an average mean age of 53 ±9.449 years. Conversely, Group B demonstrates a slightly narrower age range with a mean age of 52.533±8.871 years.

Figure 1: Representing mean age in Group A and Group B

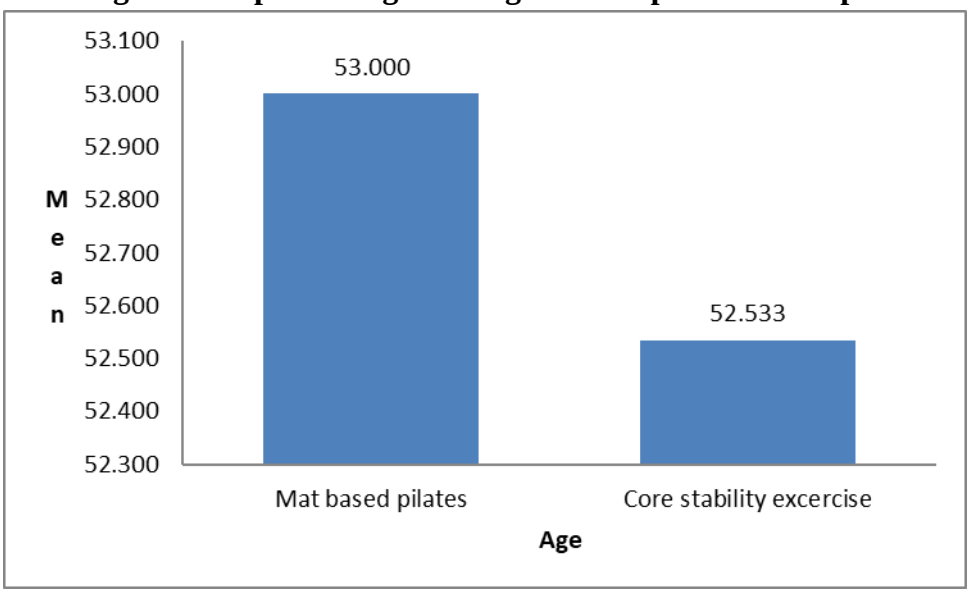


Table 2: Showing distribution of gender in Group A and Group B

		GROUP		Total
		Mat based pilates	Core stability exercise	
Gender	Female	4	6	10
		26.7%	40.0%	33.3%
	Male	11	9	20
		73.3%	60.0%	66.7%
Total		15	15	30
		100.0%	100.0%	100.0%

In Group A, there are 4(26.7%) females and 11(73.3%) males. In contrast, Group B has 6(40.0%) females and 9(60.0%) males.

Figure 2: Representing distribution of gender in Group A and Group B

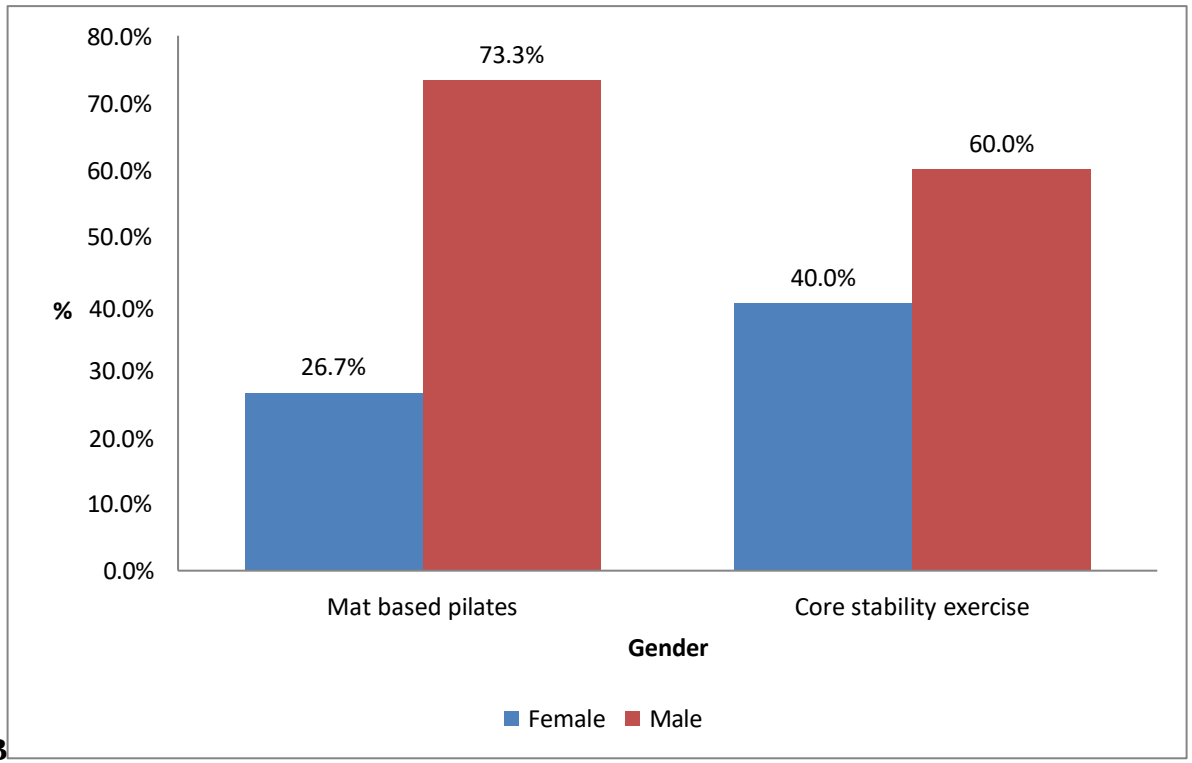


Table 3: Showing pre-post Treatment scores in Group A

Group A		Mean	Std. Deviation	Enhancement	t value	p-value
eatment scores	Pre	31.000	2.507	11.06	20.89	p<0.001
	Post	42.067	3.674			

The table provides the effectiveness of Mat-based Pilates within Group A. In the pre-intervention, participants had a mean score of 31.000±2.507. Following the intervention, the mean score increased to 42.067±3.674. The enhancement was 11.06 along with a p-value less than 0.001, indicating a significant improvement post-intervention.

Figure 3: Representing mean of Treatment scores in Group A

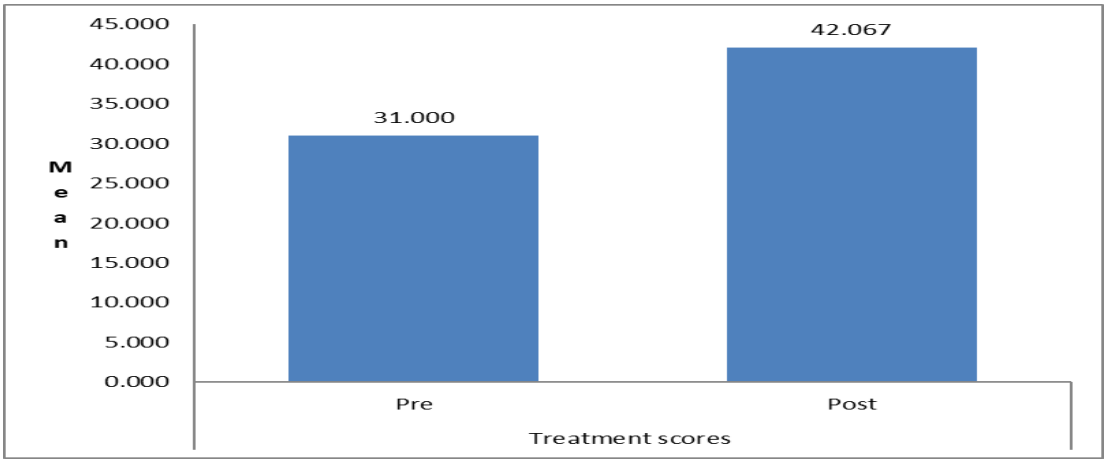


Table 4: Showing pre-post Treatment scores in Group B

Group B		Mean	Std. Deviation	Enhancement	t value	p-value
Treatment scores	Pre	30.333	1.877	9.86	15.81	p<0.001
	Post	40.200	4.057			

Before the treatment, Group B had a mean score of 30.333±1.877. Following the treatment, there was an improvement, with the mean score increasing to 40.200±4.057. The enhancement between pre and post-scores was 9.86 and a p-value less than 0.001, which suggests a significant improvement post-treatment.

Figure 4: Representing mean of Treatment scores in Group B

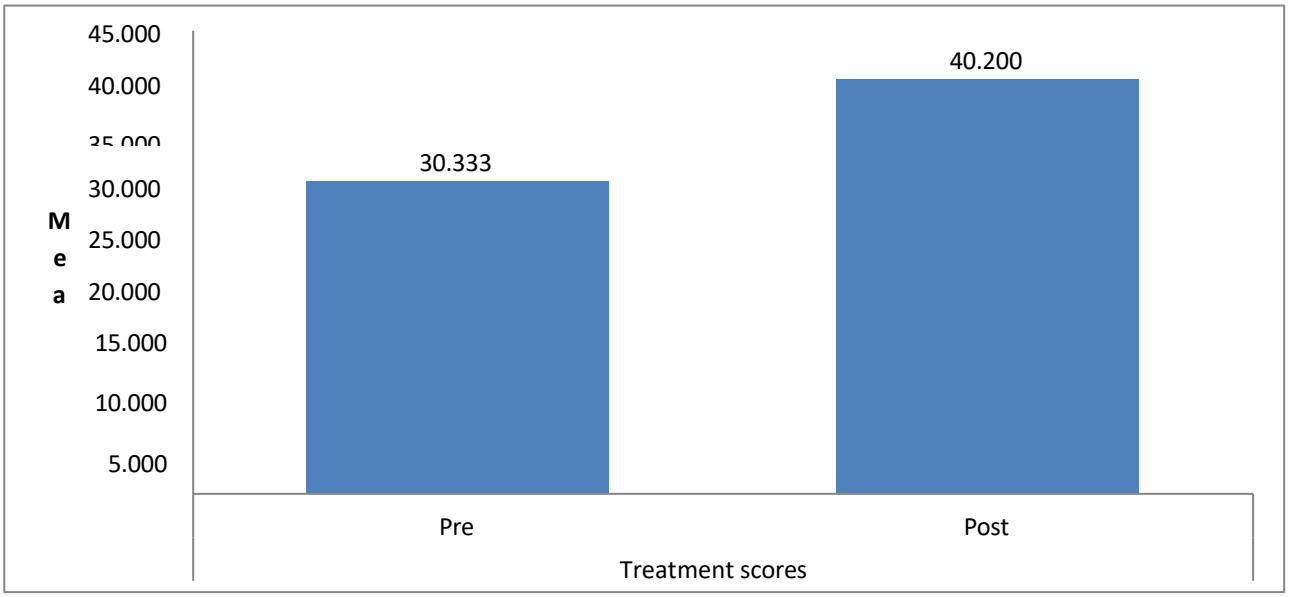
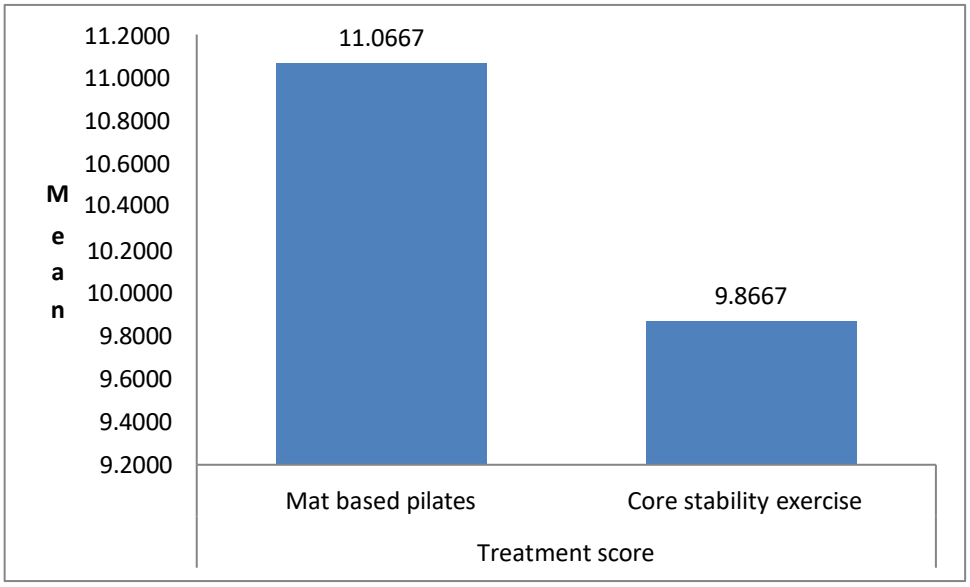


Table 5: Showing between-group comparison of treatment score

GROUP		Mean	Std. Deviation	t value	p-value
eatment score	Mat based pilates	11.0667	2.05171	1.46	0.154
	ore stability exercise	9.8667	2.41622		

There is no significant difference between Mat-based pilates as compared to Core stability exercise in Treatment score with p>0.05.

Figure 5: Representing mean of between-group comparison of treatment score



DISCUSSION

The main finding of this study was the subjects with stroke were treated either with mat-based pilates for improving balance or with core stability exercises for improving balance. However, the statistical analysis shows that there is no significant difference between the effects of mat-based pilates and the effects of core stability exercises in treatment.

In the present study, the result shows the outcomes of age in years of the subjects with stroke in both groups. In group A the ages of the subjects were with mean and SD of 53 ±9.449. In group B the subjects had with mean and SD of 52.533±8.871. A study done by Carlos M.Meclon. et al. yields similar results. [16] Yet another study done by Black Schaffer RM et al. yields similar results.[17]

In this present study, the overall gender outcome for females is 10(33.3%), and for males is 20(66.7%). A study done by Turtzo LC et al. also yields similar results stating that the prevalence of stroke is predominantly in males as per the result.[18] Yet another study done by Pandian JD et al. also yields the same results as the present study stating that the prevalence of stroke is predominantly in males as per the results.[19] Yet another study done by Bharati B et al. also yields the same results stating that shows that stroke is more prevalent in males than females.[20]

In the present study, the pre-treatment Berg Balance Score of Group A had a mean and standard deviation

of 31.000±2.507. Post-treatment Berg Balance Score of Group A had the mean and standard deviation which increased to 42.067±3.674. A study done by Roh S et al. Also yields similar results stating that mat-based pilates improves balance[2]. Yet another study done by Barker et al. Also yields similar results that pilates improves balance in the elderly.[21]

In this present study, pre-treatment Berg Balance Score of Group B had a mean and standard deviation of 30.333±1.877. Post-treatment, there was an improvement in Berg Balance Score with a mean and standard deviation of 40.200±4. A study done by Haruyama K also yields similar results that core stability exercises improve balance.[3] Yet another study done by Szafraniec R also yields similar results that core stability exercises improve balance.[12]

As discussed earlier both the techniques i.e. Mat based pilates and Core stability exercises are individually effective in improving balance in stroke patients. However, there was no evidence found in this present study of one technique being superior to another in improving balance in stroke patients.

Therefore, here in this study, the null hypothesis is accepted and the alternate hypothesis is rejected based on the outcome of the statistical analysis.

LIMITATIONS

- The study sample size was small and included only 30 patients.
- This study does not include acute stroke patients.
- The age criteria can be limited.

RECOMMENDATIONS:

- Population can be limited age specific in the future study.
- The population can be specific in the future study.
- Studies with a larger sample size can be undertaken in the future to achieve better results as this was conducted with a small sample size.

CONCLUSION

- Individually both techniques were effective in improving balance in stroke patients, there was no evidence found in this present study of one technique more efficient compate to another in improving balance in stroke patients.
- Statistically, there was no significant difference between the effects of mat-based pilates as compared to the effects of core stability exercises in improving balance in stroke patients.
- Therefore, here in this study, the null hypothesis is accepted and the alternate hypothesis is rejected based on the outcome of the statistical analysis.

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ANEXURE-01

Berg Balance Scale:

The Berg Balance Scale (BBS) serves as a tool to assess a patient's capacity to maintain balance securely through a set of predetermined tasks. It comprises 14 tasks, each rated on a five-point scale from 0 to 4. A score of 0 represents the lowest function level, while 4 signifies the highest level of function.

PROCEDURE:-

- Explain the purpose of the assessment to the individual being tested and ensure they understand the tasks involved.
- Ask the individual to perform each task sequentially. Provide any necessary assistance or instructions, but try to minimize interference to get an accurate assessment of their balance abilities.
- ITEM DESCRIPTION SCORE (0-4)

Complete Detailed Scale:

Sitting Balance

Task 1: Sitting Unsupported

___ 4 able to sit safely and securely for 2 minutes
___ 3 able to sit for 2 minutes under supervision
___ 2 able to able to sit for 30 seconds
___ 1 able to sit for 10 seconds
___ 0 unable to sit without support 10 seconds

Standing Balance

Task 2: Standing Unsupported

___ 4 able to sit safely and securely for 2 minutes
___ 3 able to sit for 2 minutes under supervision
___ 2 able to sit for 30 seconds
___ 1 able to sit for 10 seconds
___ 0 unable to sit without support for 10 seconds

Task 3: Standing with eyes closed

___ 4 able to stand for 10 seconds safely
___ 3 able to stand for 10 seconds with supervision
___ 2 able to stand for 3 seconds
___ 1 unable to keep eyes closed for 3 seconds but stands safely
___ 0 needs help to keep from falling

Task 4: Standing with feet together

___ 4 able to place feet together independently and stand 1 minute safely
___ 3 able to place feet together independently and stand 1 minute with supervision
___ 2 able to place feet together independently but unable to hold for 30 seconds
___ 1 needs help to attain position but can stand 15 seconds feet together
___ 0 needs help to attain position and is unable to hold for 15 seconds

Task 5: Standing on one foot

___ 4 able to lift leg independently and hold > 10 seconds
___ 3 able to lift leg independently and hold 5-10 seconds
___ 2 able to lift leg independently and hold ≥ 3 seconds
___ 1 tries to lift a leg, unable to hold 3 seconds but remains standing independently.

___ 0 unable to try or needs assistance to prevent fall

Task 6: Turning to look behind

___ 4 looks behind from both sides and weight shifts well
___ 3 looks behind one side only other side shows less weight shift
___ 2 turns sideways only but maintains balance
___ 1 needs supervision when turning
___ 0 needs assistance to keep from losing balance or falling

Task 7: Grab an object from the floor

___ 4 able to pick up slipper safely and easily
___ 3 able to pick up slipper but needs supervision
___ 2 unable to pick up but reaches 1-2 inches from slipper and keeps balance independently
___ 1 unable to pick up and needs supervision while trying
___ 0 unable to try/needs assistance to keep from losing balance or falling

Task 8: Reaching forward with outstretched arms while standing

___ 4 can reach forward confidently 10 inches
___ 3 can reach forward 5 inches
___ 2 can reach forward 2 inches
___ 1 reaches forward but needs supervision
___ 0 loses balance while trying/requires external support

Task 9: Placing one foot in front of the other

___ 4 able to place foot tandem independently and hold for 30 seconds
___ 3 able to place foot ahead independently and hold for 30 seconds
___ 2 able to take a small step independently and hold for 30 seconds
___ 1 needs help to step but can hold for 15 seconds
___ 0 loses balance while stepping or standing

Dynamic Balance

Task 10: Going from sitting to standing

___ 4 able to stand without using hands and stabilize independently
___ 3 able to stand independently using hands
___ 2 able to stand using hands after several tries
___ 1 needs minimal aid to stand or stabilize
___ 0 needs moderate or maximal assistance to stand

Task 11: Going from standing to sitting

___ 4 sits safely with minimal use of hands
___ 3 controls descent by using hands
___ 2 uses the back of their legs against the chair to control their descent
___ 1 sits independently but has uncontrolled descent
___ 0 needs assistance to sit

Task 12: Transfer from a seat with an armrest to a seat without an armrest

___ 4 able to transfer safely with minor use of hands
___ 3 able to transfer safely definite need of hands
___ 2 able to transfer with verbal cueing and/or supervision
___ 1 needs one person to assist

___ 0 needs two people to assist or supervise to be safe

Task 13: Turn 360 degrees

___ 4 able to turn 360 degrees safely in 4 seconds or less
___ 3 able to turn 360 degrees safely on one side in only 4 seconds or less
___ 2 able to turn 360 degrees safely but slowly
___ 1 needs close supervision or verbal cueing
___ 0 needs assistance while turning

Task 14: Place alternating feet on a step or stool while standing unsupported

___ 4 able to stand independently and safely and complete 8 steps in 20 seconds
___ 3 able to stand independently and complete 8 steps in > 20 seconds
___ 2 able to complete 4 steps without aid with supervision
___ 1 able to complete > 2 steps needs minimal assist
___ 0 needs assistance to keep from falling/unable to try

Total : 56

- Assign a score to each task based on the individual's performance. The scoring criteria for each task are predetermined, with 0 indicating inability to perform the task and 4 indicating normal performance.
- Sum up the scores for all tasks to obtain the individual's total score on the Berg Balance Scale
- Interpret the total score in the context of the individual's balance abilities. Higher scores indicate better balance, while lower scores suggest greater impairment.

Interpretation: Berg balance scale scoring ranges from 0 to 56. The lower the score, the more at risk is an individual for losing the balance. In general, Berg balance scale scores are interpreted as such:

- 0 to 20- High fall risk
  A person with a score in this range will likely need the assistance of a wheelchair to move around safely.
- 21 to 40- Moderate fall risk
  A person with a score in this range will need some type of walking assistance, such as a cane or a walker.
- 41 to 56- Low fall risk
  A person with a score in this range is considered independent and should be able to move around safely without assistance.
- A score of ≤49 indicates a risk of falls in individuals with stroke.

ANNEXURE -02

CONSENT FORM

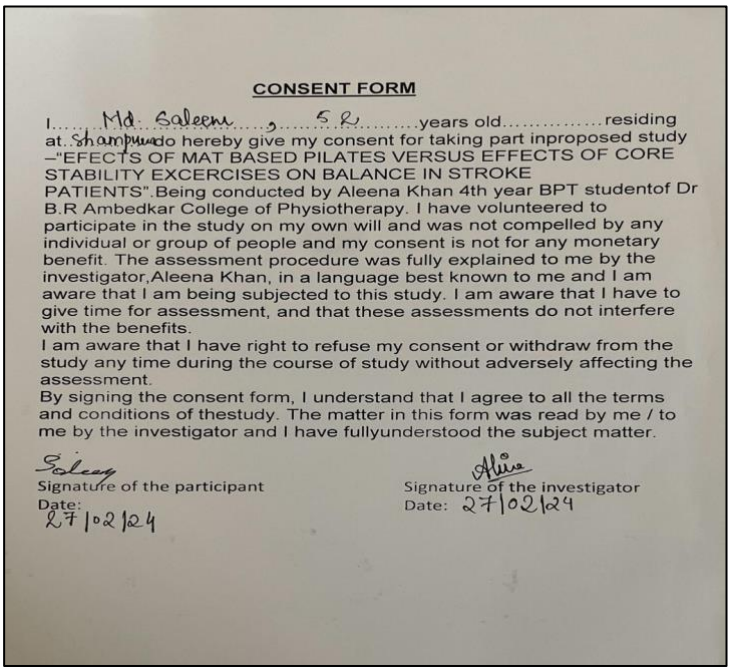
I.....years old residing.....“EFFECTS OF MAT BASED PILATES VERSUS EFFECTS OF CORE STABILITY EXERCISES 0N BALANCE IN STROKE PATIENTS”. Being conducted by Aleena Khan 4th year BPT student of DR.B.R Ambedkar College of Physiotherapy. I have volunteered to participate in the study of my own will and was not compelled by any individual or group of people and my consent is not for any monetary benefit. The assessment procedure was fully explained to me by the investigator, Aleena Khan, in a language best known and l am aware that I am being subjected to this study. I am aware that I have to give time for assessment, and that these assessments do not interfere with the benefits. I am aware that I

have the right to refuse my consent or withdraw from the study at any time during the course of the study without adversely affecting the assessment. By signing the consent form, I understand that I agree to all the terms and conditions of the study. The matter in this form was read by me / to me by the investigator and I have fully understood the subject matter.

Signature of the participant
Date:

Signature of the investigator
Date

ANNEXURE-02

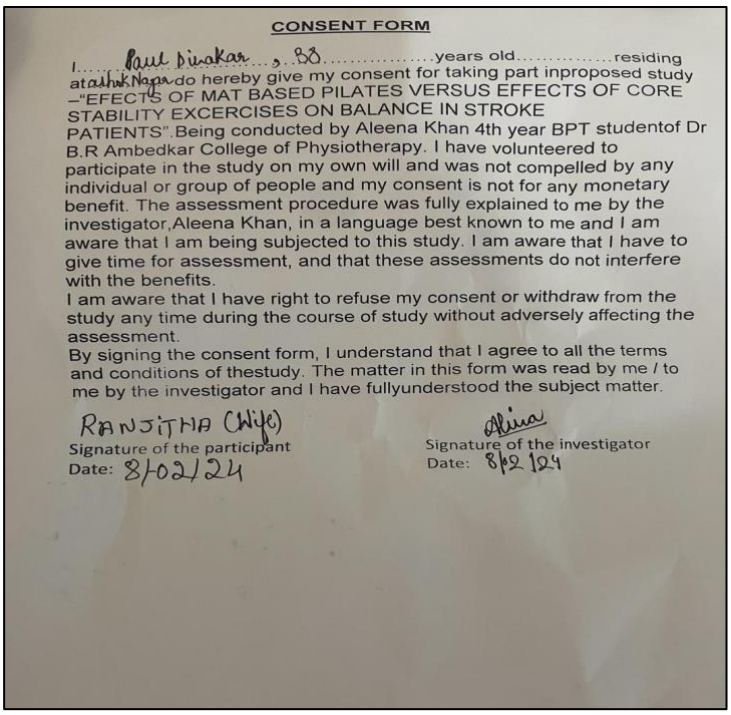


CONSENT FORM

I.....Md. Saleem.....s/o.....years old.....residing at. Shampur do hereby give my consent for taking part inproposed study –"EFECTS OF MAT BASED PILATES VERSUS EFFECTS OF CORE STABILITY EXCERCISES ON BALANCE IN STROKE PATIENTS".Being conducted by Aleena Khan 4th year BPT studentof Dr B.R Ambedkar College of Physiotherapy. I have volunteered to participate in the study on my own will and was not compelled by any individual or group of people and my consent is not for any monetary benefit. The assessment procedure was fully explained to me by the investigator,Aleena Khan, in a language best known to me and I am aware that I am being subjected to this study. I am aware that I have to give time for assessment, and that these assessments do not interfere with the benefits.
I am aware that I have right to refuse my consent or withdraw from the study any time during the course of study without adversely affecting the assessment.
By signing the consent form, I understand that I agree to all the terms and conditions of thestudy. The matter in this form was read by me / to me by the investigator and I have fullyunderstood the subject matter.

Signature of the participant
Date: 27/02/24

Signature of the investigator
Date: 27/02/24



CONSENT FORM

I.....Paul Sivakar.....s/o.....years old.....residing at Ashok Nagar do hereby give my consent for taking part inproposed study –"EFECTS OF MAT BASED PILATES VERSUS EFFECTS OF CORE STABILITY EXCERCISES ON BALANCE IN STROKE PATIENTS".Being conducted by Aleena Khan 4th year BPT studentof Dr B.R Ambedkar College of Physiotherapy. I have volunteered to participate in the study on my own will and was not compelled by any individual or group of people and my consent is not for any monetary benefit. The assessment procedure was fully explained to me by the investigator,Aleena Khan, in a language best known to me and I am aware that I am being subjected to this study. I am aware that I have to give time for assessment, and that these assessments do not interfere with the benefits.
I am aware that I have right to refuse my consent or withdraw from the study any time during the course of study without adversely affecting the assessment.
By signing the consent form, I understand that I agree to all the terms and conditions of thestudy. The matter in this form was read by me / to me by the investigator and I have fullyunderstood the subject matter.

RANJITHA (Wife)
Signature of the participant
Date: 8/02/24

Signature of the investigator
Date: 8/2/24

ANEXURE-03

MASTER SHEET

Table 1. Mat based pilates

Group A

S.no.	Age	Gender	Pre Treatment score	Post Treatment Score
1	57	M	33/54	48/54
2	48	M	33/54	47/54
3	40	M	30/54	43/54
4	49	F	29/54	41/54
5	70	M	26/54	37/54
6	58	F	32/54	42/54
7	50	M	33/54	41/54
8	62	M	30/54	39/54
9	37	M	34/54	46/54
10	56	M	28/54	37/54
11	63	F	30/54	42/54
12	64	M	29/54	38/54
13	44	F	33/54	45/54
14	51	M	30/54	39/54
15	46	M	35/54	46/54

Table 2 Core stability exercise

Group B

S.no.	Age	Gender	Pre Treatment score	Post Treatment Score
16	58	F	30/54	42/54
17	55	M	32/54	45/54
18	35	M	34/54	46/54
19	60	M	29/54	38/54
20	37	M	32/54	43/54
21	58	F	30/54	39/54
22	63	M	29/54	37/54
23	48	M	31/54	44/54
24	42	F	33/54	46/54
25	52	M	30/54	37/54
26	55	F	29/54	35/54
27	57	F	30/54	39/54
28	48	M	28/54	36/54
29	56	M	31/54	42/54
30	64	F	27/54	34/54