EFFICACY OF PALL-OF PRESS VS RUSSIAN TWISTS ON CORE MUSCLES – A RANDOMIZED TRIAL

By,

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In partial fulfilment of the requirements for the degree of

MASTER OF PHYSIOTHERAPY (M.P.T)

In

SPORTS PHYSIOTHERAPY

Under the guidance of

DR. JOSEPH OLIVER RAJ

DEAN

ABHINAV BINDRA SPORTS MEDICINE & RESEARCH INSTITUTE

Bhubaneswar, Odisha

2022-2024

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"Efficacy of Pall-of Press vs Russian Twists on core muscles – A Randomized Trial"** is a bonafide and genuine research work carried out by me under the guidance of Dr. Joseph Oliver Raj, Dean, Abhinav Bindra Sports Medicine & Research Institute, Bhubaneswar, Odisha.

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LIST OF ABBREVIATIONS USED

ABSMARI – Abhinav Bindra Sports Medicine And Research Institute

IQ – Inter Quartile

IQR – Inter Quartile Range

KMBT test – Kneeling Medicine Ball Throw Test

PAR-Q - Physical Activity Readiness Questionnaire

SPSS – Statistical Package for Social Science

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ABSTRACT

EFFICACY OF PALL-OF PRESS VS RUSSIAN TWISTS ON CORE MUSCLES – A RANDOMIZED TRIAL

Background:

Over the last few years, Pallof Press is an exercise widely used by strength and conditioning coaches in improving the rotational core strength. Pallof Press is an isometric type exercise. Russian Twists is a dynamic type of exercise used widely over decades in any core muscles protocol. This study compares the difference between Pallof Press (isometric) and Russian twists (dynamic). Aim of this study is to compare the effect of Pallof Press and Russian Twists on stability of the rotational muscles of core. The objectives of this study were to observe if there is any difference produced in the endurance and strength of core muscles (rotational muscles) by Pallof Press and Russian Twists. According to the methodology, 50 recreational athletes were included into the study after screening them based on the selection criteria. McGill's Torso Endurance test was used to measure endurance and Kneeling Medicine Ball Throw Test (Rotational component) was used to measure the strength of rotational muscles of core.

Result: According to the statistical analysis, there was a difference observed within both the groups ($p < 0.05$). Both, Pallof Press and Russian Twists showed an impact on the endurance and strength. With the comparison done between groups, there was no significant difference ($p > 0.05$). This states that, both exercises show equal effect on the endurance and strength of core muscles, especially internal and external obliques.

Conclusion: Based on the results and statistical analysis we conclude that both Pallof Press and Russian twists can be used alternatively in an exercise protocol for the improvement of core muscle strength and endurance. Pallof Press showed more significant results for the left side rotational muscles, whereas Russian twists showed good results for the right-side rotational muscles.

Key words: Athletes, Muscles, Muscle strength, Pallof Press, Russian Twists, Torso

EFFICACY OF PALL-OF PRESS VS RUSSIAN TWISTS ON CORE MUSCLES – A RANDOMIZED TRIAL

INTRODUCTION

The term "core muscles" describes the collection of muscles found in the body's trunk, particularly in the area surrounding the lower back and abdomen. These muscles are essential for maintaining the stability of the body as a whole as well as the spine and pelvis. The primary muscles of the core consist of the muscles like diaphragm forming the roof, abdominals as the front, paraspinals as the back and pelvic and hip muscles as the floor. [1]

The muscles that form the core of human body are:

- Rectus abdominis
- Transverse abdominis
- Internal obliques
- External obliques
- Erector spinae
- Multifidus

Diaphragm and Pelvic Floor Muscles also play a significant role in core stability and function.

For daily tasks including lifting, bending, twisting, and keeping good posture, core muscles are necessary. The core, as a whole stabilizes the body and the

spine. Increasing the strength of these muscles can help decrease the chance of injury, increase general stability, and improve sports performance.

In recent years it is observed that; core stability, endurance, strength and flexibility are the most important aspects for sports medicine. The measurement of these aspects of core are done for various reasons, including:

1. Assessment for risk of injury
2. Prognosis of the rehabilitation program
3. Prognosis of the sports performance enhancement program [2]

Endurance of the core muscles is necessary for a better postural control during any sport. If this endurance is reduced due to deconditioning or any other reason, the transfer of forces (load) is passed to the spine which causes mechanical stress. [3]

McGill's Torso Endurance Test primarily evaluate the isometric endurance of core muscles. [1]

The McGill Torso Endurance test is safe, done using less technology as well as has very little monetary investment. It is an isometric technique that may be performed by any practitioner. The reliability is between high moderate to excellent. Also, each component has been identified as reliable, safe, sensitive to trunk muscle endurance, and of good predictive value for persons with LBP. [1]

The term core stability is a combination of muscular strength, flexibility, endurance, co-ordination, balance and movement efficiency. To achieve any functional movement, all these aspects should be present together. [4]

Hence, strength of the core musculature also becomes an important aspect for any functional movement or a sports activity.

The Kneeling Medicine Ball Throw test examines the explosive power and strength of the core muscles. In the rotational medicine ball throw, the arm strength is eliminated as both the elbows are in contact with the torso throughout the test. [4]

Because most of the athletic activities are performed in a closed chain, core becomes the primary path to transfer the load from lower limbs to upper limbs. [4] In this energy transfer, 4 major muscles that play role are:

1. Rhomboids
2. Serratus anterior
3. External obliques
4. Internal obliques

These 4 pairs of muscles form a scarf like garment and usually work simultaneously as a unit. This simultaneous work is termed as “serape effect”. [5] The orientations of these muscles will help understand the connection of this scarf like pattern.

Rhomboids: Connect scapula (medial border) to the spine (spinous processes of C7 to T5)

Serratus anterior: Makes a connection between the scapula (antero-medial border) to the antero-lateral aspect of the rib cage (ribs 1-8)

External obliques: Connect the rib cage (lower 8 ribs) to the pelvis (linea alba and iliac crest)

Internal obliques: This muscle overlaps the external obliques arising from the cartilage of the last 4 ribs, xiphoid process and linea alba. It goes obliquely downward towards the iliac crest, inguinal ligament and thoraco-lumbar fascia.

This makes us understand that the rhomboids and serratus anterior control the scapular and shoulder movements while the external and internal obliques make a connection between the pelvis and the scapula.

The universal law of human movement is “proximal stiffness enhances distal mobility and athleticism”. This requires core stiffness which is enhanced by “The Serape Effect”. [6]

NEED FOR STUDY

This study is to compare whether the isometric effect achieved with Pall-of Press and dynamic effect caused by Russian Twists is better to improve core stability.

To show how rotational stability training affects working of Serape effect.

To understand if training the rotational component is more effective on the isometric or dynamic component of the movements in the core muscle region.

There is a dearth of studies available on the importance of Pall-of Press exercise as an important aspect for core training.

AIM

- To compare the effect of Pall-of Press (isometric) and Russian Twists (dynamic) on stability of the rotational muscles of the core.

OBJECTIVES

- To check the effectiveness of the isometric component that Pall-of Press exercise works on the stability of core muscles.
- To know if Pall-of Press or Russian Twists have a greater effect on the stability component of rotational muscles of the core.

HYPOTHESIS

- **Null Hypothesis (H0):**

  There is no significant difference between Pall-of Press and Russian twists in improving rotational stability.

- **Alternate Hypothesis (H1):**

  There is a significant difference between Pall-of Press and Russian Twists in improving rotational stability.

REVIEW OF LITERATURE

1. The number of repetitions of the McGill tests to reliably determine core muscle endurance in subjects with and without chronic nonspecific low back pain: A cross-sectional study.

   Naeemeh Haddadi Esfahani, et. al.

   Discovery Journals

   2019

   Specifies how many repetitions of McGill's tests are appropriate to make an accurate observation of the core endurance. He observed 50 subjects between the age group of 25-50. All of them had a history of sitting for longer periods of time throughout the day as their work demand. According to the conclusion of the study, the sufficient number of repetitions are two. With two repetitions, a reliable score for core endurance can be obtained for a person with or without back pain.[1]

2. The Development and Assessment of Core Strength Clinical Measures: Validity and Reliability of Medicine Ball Toss Tests

   Mallory Anne Sell

   Isokinetic and Exercise Science Journal

   2013

   The study concluded that the considerable intraclass correlation coefficients that occurred between the medicine ball toss tests in sessions one and two confirmed that the medicine ball toss test might display good test-retest reliability. According to the author, the validity

of the kneeling medicine ball throw test cannot be validated in comparison with another test for strength of the core muscles specifically. A reason for this maybe that the arms are restricted while throwing the ball which shifts the attention of the subject to stabilizing the arms rather than contraction of the muscles of the core.[4]

3. The Serape Effect

   Gene A. Logan & Wayne C. McKinney

   Journal of Health, Physical Education and Recreation

   2013

   The study explained the clinical significance of “The Serape Effect”. The rhomboids and serratus anterior stabilize and give mobility to the scapula. In the trunk region, the external oblique of ipsilateral side and the internal oblique of contralateral side continue as a diagonal and attach to the pelvis. The author termed this pairing of muscles as “Muscular Serape”. The study also suggests that in order to maintain stability of the spine during any rotational motion, the ipsilateral rhomboids, serratus and external obliques concentrically contract to generate the required force while the contralateral rhomboids, serratus and external obliques concentrically contract to maintain stability of the spine.[5]

4. Anterior and posterior serape: The rotational core

   Juan C. Santana

   Strength and Conditioning Journal

   2015

   According to the author the APS system unifies an understanding of how the body organizes the many parts of the body linkage to create rotational activity. The author stated that there are 4 pairs of muscles which are oriented such that they look like a scarf or “serape” around the trunk. Rhomboids, serratus anterior, internal obliques and external obliques are the muscles involved. They work as a unit and help the shoulder to follow the movement of hips. This connection helps in sports activities like punching, throwing, batting, etc. [6]

5. The Pallof Press

   Michael Mullane, et. al.

   Strength and Conditioning Journal

   2020

   It was proved that using isometric-based core exercises can minimize spinal loading while yet giving the boot region the necessary rigidity. The Pall-of press exercise is recommended by practitioners as a way to improve core and spinal stability. By practicing Pall-of-Press exercise, a person or athlete learns to maintain, align and stabilize the spine. This stabilization helps in smooth transfer of load from lower body to the upper segments. According to the authors the easy transfer

of load is useful for activities such as pushing, pulling, throwing, jumping and many more athletic activities.[7]

6. Effect of long-term isometric training on core/torso stiffness

   Benjamin C. Y. Lee et al.

   Journal of Strength and Conditioning Research

   2015

   An experiment was conducted in order to observe which type of exercise is beneficial for improving passive stiffness of the core muscles while performing an activity. The author observed 24 subjects among which 12 were new to any strength exercise and 12 were athletes. He had given an isometric and a dynamic exercise protocol for a time of 6 weeks. The tests for measurement of muscle contractions were done both pre and post the intervention. The conclusion was such that, the isometric exercises showed an increase in the passive contraction of the muscles rather than dynamic type of exercises. There was no effect of both the types of exercises on the active contraction of the core. [8]

7. Normative Data of Trunk Muscle Endurance for Male Long-Distance Runners of Vadodara: An Observational Study

   Bhura Paras A., et. al.

   Indian Journal of Public Health and Research Development

   2020

   This study was done to establish a normative data of the trunk muscle endurance in the long-distance runners. According to the study, a normative data will help plan for a rehabilitation programme or any other research purpose. Endurance of the trunk muscles was tested using McGill's Torso Endurance Test. The results suggest the means of all the components of McGill: Flexors – 148 sec, Extensors – 108 sec, Right lateral plank – 83.2 sec and Left lateral plank – 81.5 sec. [9]

8. Trunk muscle endurance tests: Reliability, and gender differences in athletes

   Kerrie Evans, et. al.

   Journal of Science and Medicine in Sports

   2006

   This specific study was conducted to understand the inter and intra-rater reliability of the flexor and extensor component of McGill Endurance Test and side planks. The other part of this study was to observe the difference of trunk endurance between various athletes and non-athletes as well as between athletic men and women. This study stated that there is a high inter and intra-rater reliability of the side planks. Also, endurance of rotators show more difference in male

and female athletes, but the flexors and extensors do not show a significant difference. [10]

MATERIALS AND METHOD

METHODOLOGY:

- An ethical clearance was obtained from the Institutional ethical committee regarding the comparative study to be done. Samples collected for a randomized trial were 50 collegiate level recreational athletes between the age group of 18-35. The people who had recent injuries, any back condition or had a score of less than 7 on the PAR-Q scale were excluded. After collecting the pre-exercise data, the participant was asked to pick a chit and then given a group which was on the chit. This was the randomization method used to divide samples into 2 groups.

INCLUSION CRITERION

- Recreational athletes
- Athletes who participate in recreational sports at-least 4-5 hrs. a week
- Age: 18 – 35 years
- Both male and female

EXCLUSION CRITERION

- Recreational athletes having any recent injury in the past three months
- Athletes with a history of existing low back condition
- Already under any kind of training (gym)
- If unable to clear PAR-Q

MATERIALS REQUIRED

- Resistance band
- Stop watch
- Wooden board
- Couch
- Straps
- Medicine ball (2-3 kg)
- Measuring tape

OUTCOMES

- Primary Outcome:

  McGill's Torso Endurance Test

- Secondary Outcome:

  Kneeling Medicine Ball Throw test

Figure 1.1: Flexion

Figure 1.2: Extension

Figure 1.3: Right side plank

Figure 1.4: Left side plank

Figure 1: McGill's Torso Endurance Test

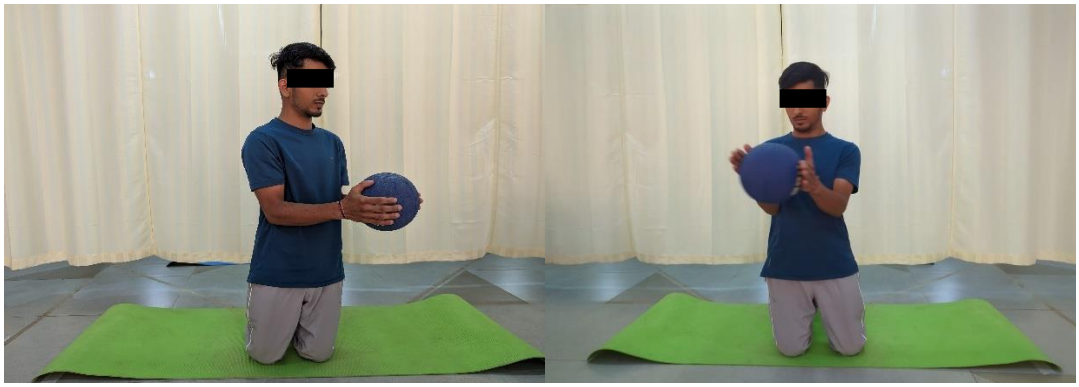


Figure 2.1: Right Rotational Kneeling Medicine Ball Throw

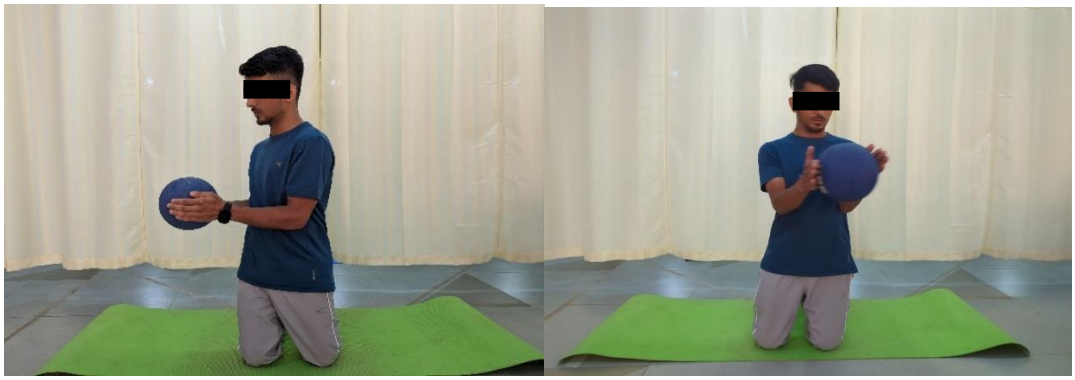


Figure 2.2: Left Rotational Kneeling Medicine Ball Throw

Figure 2: KMBT test

FLOW DIAGRAM

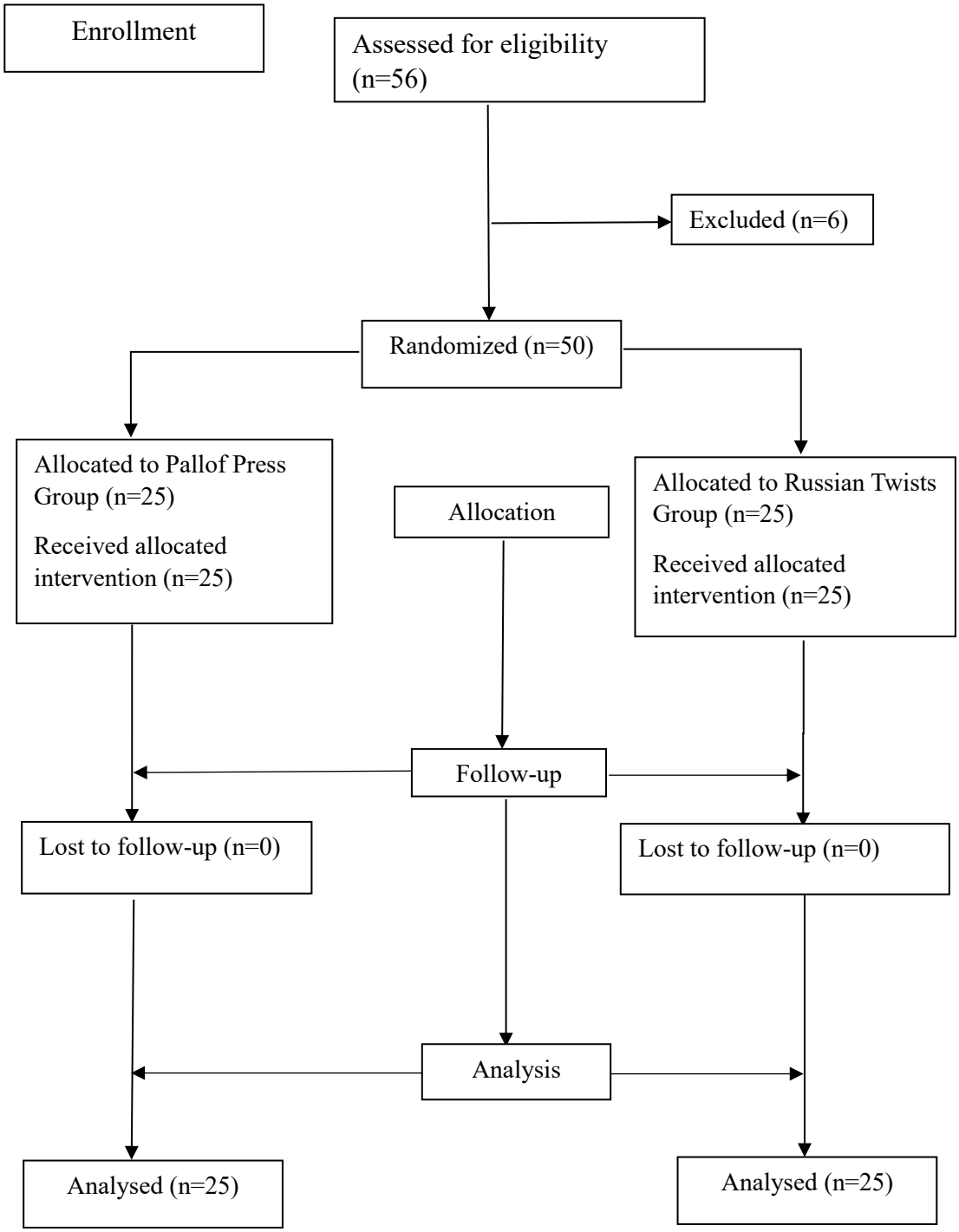


Figure 3: Flowchart of data collection

PROCEDURE

- An ethical clearance from the institutional committee of Abhinav Bindra Sports Medicine and Research Institute (ABSMARI), Pahal, Bhubaneswar prior to the commencement of the study was taken.
- A randomized trial was performed at Abhinav Bindra Sports Medicine and Research Institute (ABSMARI), Bhubaneshwar.
- For the same, 50 samples were randomly collected based upon the inclusion and exclusion criterion.
- All the participants were explained about the tests and exercises they would have to perform over a time period of 4 weeks.
- A general screening of age, height and weight was done for every participant.
- The pre-exercise tests were performed only after taking a consent from the participants.
- McGill Torso Endurance Test was performed first followed by the rotational component of Kneeling Medicine Ball Throw Test.
- After every component of the test (flexion, extension, right side plank, left side plank), 4-5 mins rest was given to the participant.
- In order to randomly divide the participants into groups, every participant was asked to pick a chit for either A or B group.
- Group A had to perform Pallof Press exercise 3 sets of 10 repetitions each side, with a hold time of 5 sec, twice a week for 4 weeks.

- Group B had to perform Russian Twists with 3 sets of 10 repetitions twice a week for 2 weeks.
- After 4 weeks, all the participants were retested for both McGill Torso Endurance Test and rotational component of Kneeling Medicine Ball Throw test. Again a 4-5 mins break was given to the participant between every component of the test.
- All the pre and post exercise values were recorded and an excel sheet was maintained.

EXERCISE PROTOCOL

Pallof Press

10 repetitions each side

↓

3 sets

↓

Twice a weeks

↓

4 weeks

Russian Twists

10 repetitions each side

↓

3 sets

↓

Twice a week

↓

4 weeks

Figure 4: Pall-of Press

(a) Right side rotational muscles
(b) Left side rotational muscles

Figure 5: Russian Twists

a) Rotation towards left
(a) Rotation towards right

PROCEDURE FLOWCHART

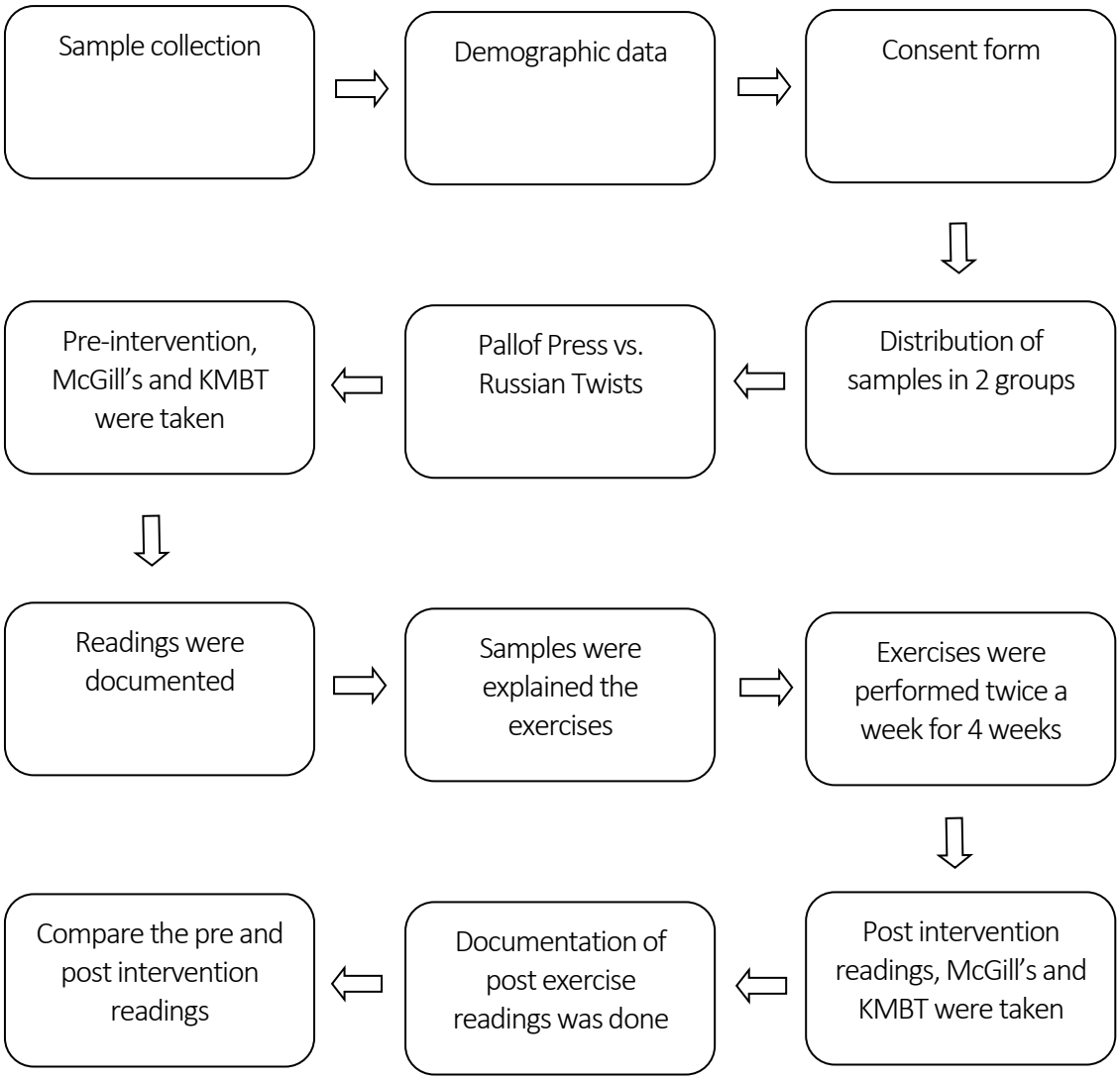


Figure 6: Flowchart of procedure

STATISTICAL ANALYSIS

- Statistical analysis was performed using SPSS statistical package of social sciences version 25.
- The normality of the data was found using Shapiro-Wilk test.
- Descriptive Statistics: Median & Interquartile Range (IQ)
- Interferential statistics:

  As the data was not normally distributed,

  Wilcoxen test was used to analyse the factors of within group.

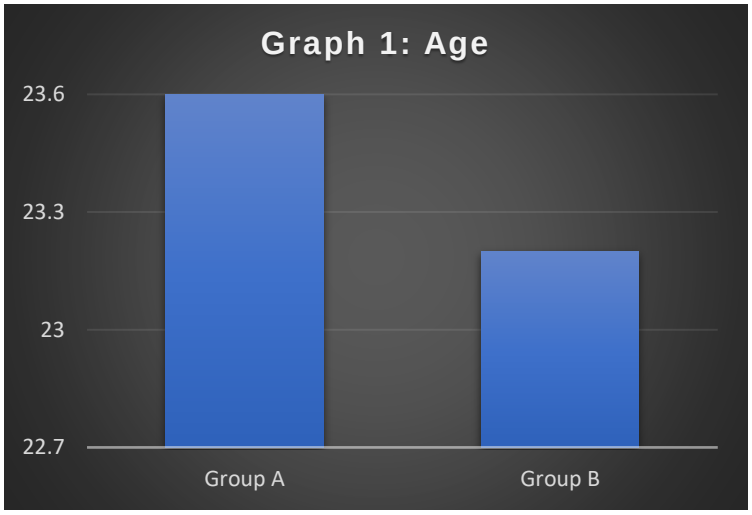
  Mann Whitney U test was used to analyse if any significant difference present or not between group.

RESULTS

- The study included 50 participants between the age group of 18-35 years. They were categorised as recreational athlete who was defined as a person who participates in any group sports activity like cricket or exercise (yoga) session 4-5 hours per week.
- Graph 1 illustrates age distribution between the two groups and table 1 gives the exact values of the mean age in both the respective groups:

  Group A - Pallof Press

  Group B – Russian Twists



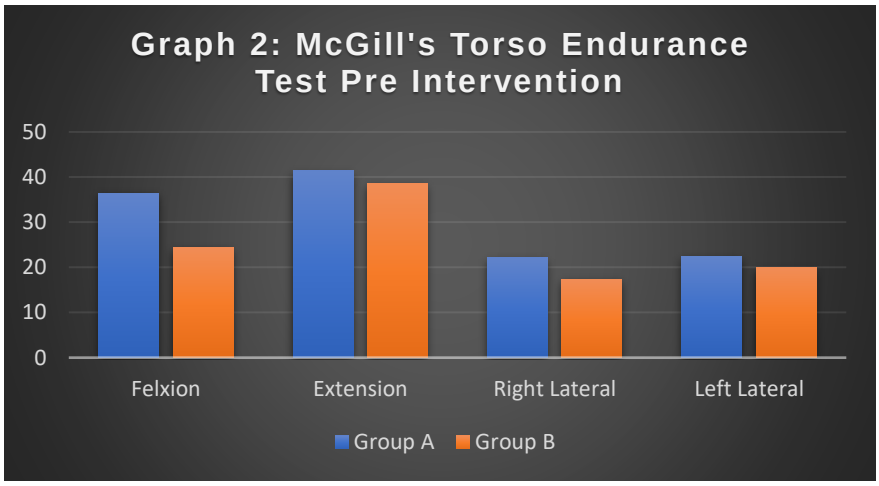
	Group A	Group B
Mean Age	23.6	23.2

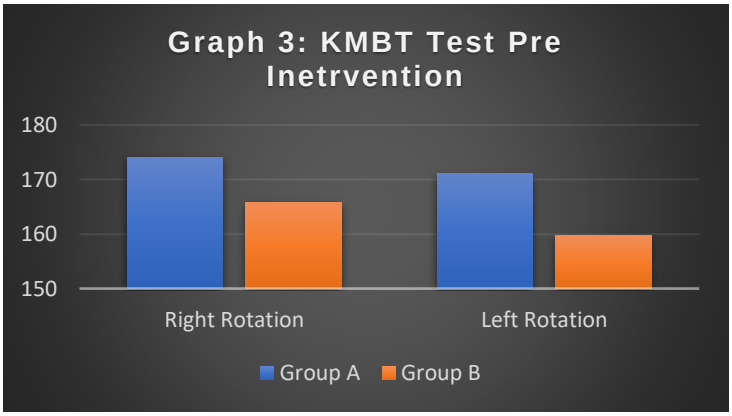
Table 1: Mean age of the samples in both groups

- The pre intervention data for both the groups did not reveal any significant difference between the endurance and strength of the core muscles. The following table 2 and graphs 2, 3 depict the same.

		Pall-of Press	Russian Twists	IQR (Pall-of Press)	IQR (Russian Twists)	p Value
McGill's Torso Endurance Test	Flexion	35	22	19	15	$p < 0.05$
	Extension	32	35	29	28	$p < 0.05$
	Right Lateral	21	14	12.7	11	$p < 0.05$
	Left Lateral	22	17	18	8	$p < 0.05$
Kneeling Medicine Ball Throw	Right Rotation	162	162	72	48	$p < 0.05$
	Left Rotation	166	160	58	52	$p < 0.05$

Table 2: Pre intervention data





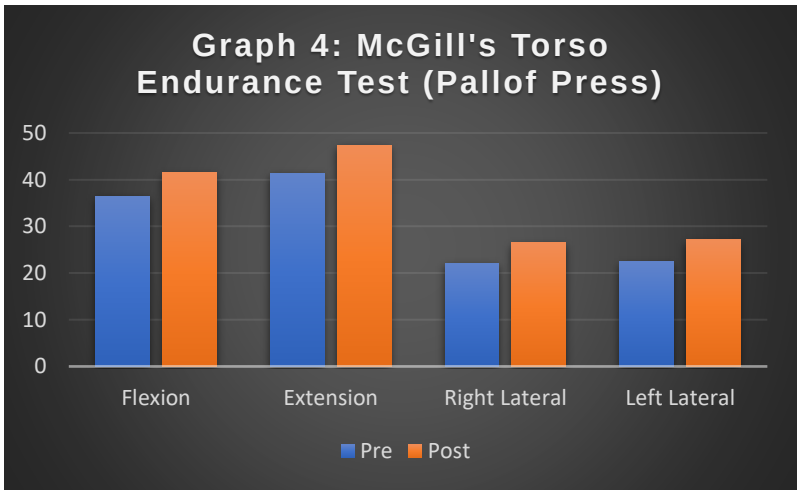
- The results for within group analysis are as follows:

    1. McGill's Torso Endurance Test for the Pall-of Press group shows statistical difference before and after the exercise prescription of 4 weeks. This suggests that there is an improvement in the endurance of core muscles after undergoing this training.

       Table 3 and graph 4 both give us an overview of the same.

Group A	Pre	Post	Mean Difference	Median	IQR	p Value
Flexion	36.44	41.544	5.104	4.7	5.8	$p < 0.05$
Extension	41.4	47.352	5.952	6	4.8	$p < 0.05$
Right Lateral	22.112	26.5	4.388	6	5.5	$p < 0.05$
Left Lateral	22.44	27.164	4.724	5	6.2	$p < 0.05$

Table 3: McGill's torso Endurance Test Within Group Comparison (Pall-of Press)

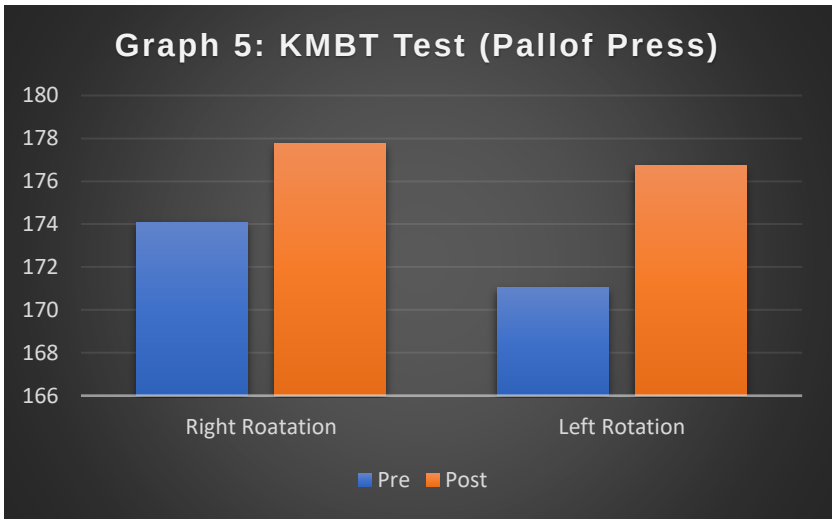


2. Kneeling Medicine Ball Throw Test shows that by performing Pallof press exercise, the is a significant difference observed in the strength of the rotational muscles of the core.

   Table 4 and graph 5 show the mean values of the within group tests for kneeling medicine ball throw and represent their difference in a bar chart.

Group A	Pre	Post	Mean Difference	Median	IQR	p Value
Right rotation	174.08	177.76	3.68	4	4	$p < 0.05$
Left rotation	171.04	176.72	5.68	4	3	$p < 0.05$

Table 4: KMBT Test Within Group Analysis (Pall-of Press)

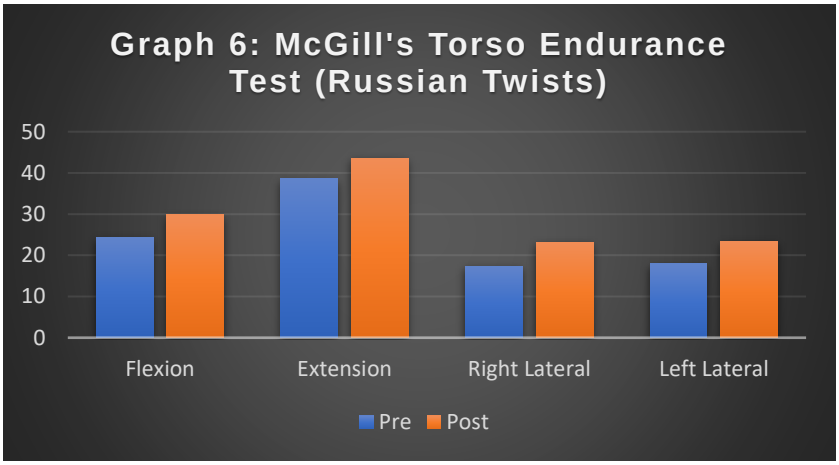


3. With the statistical analysis for within group of the group performing Russian Twists, it suggests that there is a significant difference observed in the endurance of core muscles which tested using McGill's Torso Endurance Test.

   Table 5 and graph 6 depict the average of both the readings before and after the performance of exercise and show difference between them which helps us understand the significant changes post the exercise.

Group A	Pre	Post	Mean Difference	Median	IQR	p Value
Flexion	24.4	29.804	5.404	6	5	$p < 0.05$
Extension	38.53	43.54	5	5	4	$p < 0.05$
Right Lateral	17.372	23.196	5.824	6.1	6.4	$p < 0.05$
Left Lateral	17.912	23.392	5.48	6	6.5	$p < 0.05$

Table 5: McGill's torso Endurance Test Within Group Comparison (Russian Twists)

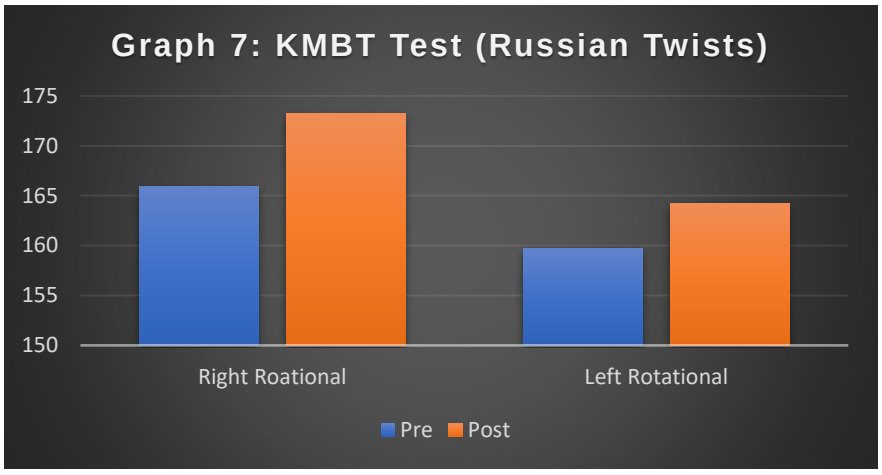


4. The group performing Russian twist for a time period of 4 weeks suggests that there is a significant difference in the strength of the rotational core muscles, especially external and internal obliques. This is tested using the rotational component of Kneeling Medicine Ball Throw Test.

   Table 6 and graph 7 specify the observed significant difference.

Group A	Pre	Post	Mean Difference	Median	IQR	p Value
Right rotation	165.88	173.2	7.32	6	3	$p < 0.05$
Left rotation	159.72	164.2	4.48	5	3	$p < 0.05$

Table 6: KMBT Test Within Group Analysis (Russian Twists)



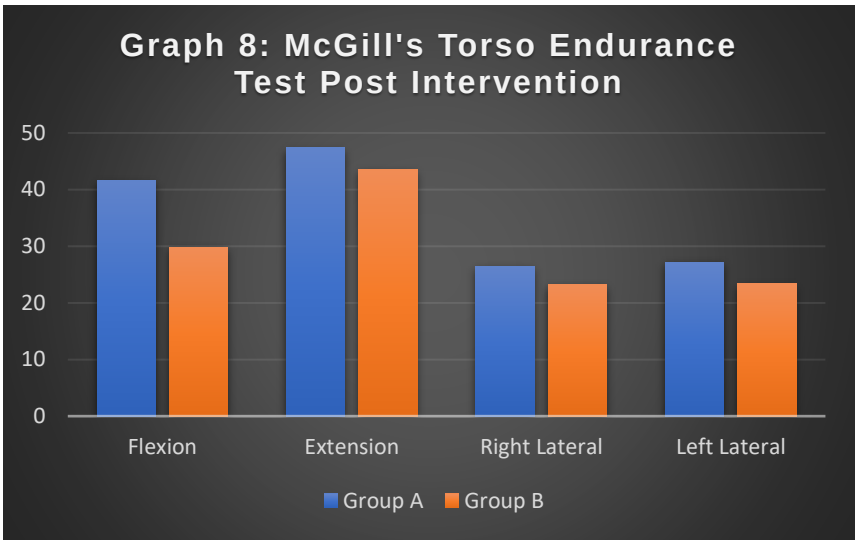
5. When the between group analysis was performed in SPSS software using unpaired T-test, there was no significant difference observed. Both, table 6 and graph 6 depict that there is almost equal effect on the endurance of core muscles after performing Pallof Press as well as Russian Twists.

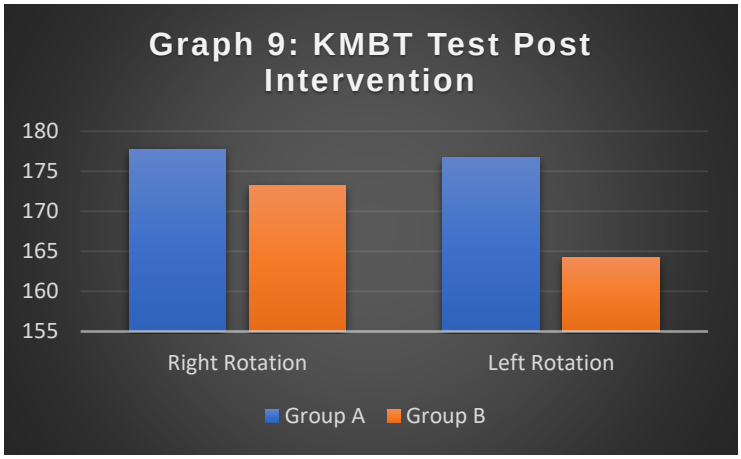
   Table 7 and graph 7 suggest that the strength is equally increased in both the groups performing Pallof Press and Russian Twists.

   Table 7, graphs 8 and 9 give a graphical representation for the same.

		Pall-of Press	Russian Twists	IQR (Pall-of Press)	IQR (Russian Twists)	p Value
McGill's Torso Endurance Test	Flexion	40.3	25	17	17	p > 0.05
	Extension	30	42	30	32	p > 0.05
	Right Lateral	26.8	20	15	10	p > 0.05
	Left Lateral	27	22	14	9	p > 0.05
Kneeling Medicine Ball Throw	Right Rotation	170	173	73	47	p > 0.05
	Left Rotation	168	165	66	51	p > 0.05

Table 7: Post intervention data





DISCUSSION

In this study titled, “Efficacy of Pallof Press vs Russian Twists on core muscles: a randomized trial”: a recreational athlete was defined as a person between the age group of 18-35 years, who participates in team sports like cricket or exercise activities like yoga at least 4-5 hours a week [11].

This study was done to identify whether an isometric or a dynamic type of exercise is beneficial for improving the endurance and strength of the core muscles. The isometric exercise that was advised, was Pallof Press and dynamic exercise was Russian Twists.

Pallof press is an exercise which challenges the core by making the person maintain a braced position. This exercise minimizes the repetitive loads on the spine as what happens during crunches (repeated flexion movement). Another advantage of Pallof Press is that it enhances the muscle stiffness thereby aiding the load transfer from lower limb to upper limb. This helps in activities like throwing, pushing, pulling where contralateral forces from the core to the shoulder are required. [7]

Russian Twists is a dynamic type of exercise which helps in strengthening the abdominal muscles especially the transverse abdominis, internal obliques and external obliques. This exercise primarily helps in improving the strength of core muscles thereby maintaining a proper alignment of the spine especially while performing any twisting/rotatory movements. An additional point regarding Russian twists is that it enhances balance, coordination and flexibility. [12]

According to the study “The Serape Effect” by Gene E. Logan & Wayne C. McKinney, while performing right side shoulder rotation simultaneously with left side pelvic rotation, the right serratus anterior, right external oblique and left internal oblique are eccentrically contracted and their respective pairs concentrically contract. For the opposite rotation to occur, the eccentrically contracted muscles should concentrically contract. This will summate the internal forces and aid perform opposite rotation. During this concentric contraction the contralateral pairs (left serratus anterior, left external oblique and right interna oblique) of the respective muscles eccentrically contract to provide dynamic stability. [5]

In this study, it has been proven that both the exercises Pallof Press and Russian Twists enhance the strength of internal and external obliques along with some other muscles of the core. This proves that both the exercises help improve the mechanics of the serape effect. According to serape effect, the stiffing of muscles while performing a movement is essential. [6] As discussed earlier, Pallof Press and Russian Twists improve this bracing capacity of the muscles of the core thereby aiding the action of serape.

With regard to the results of this study, we understand that Pallof Press and Russian twists are two such exercises which improve the endurance and strength of core muscles, especially internal obliques and external obliques. The McGill’s Torso Endurance Test (McGill’s Test) was used to measure the endurance of the core muscles through all 4 aspects: flexion, extension and side bridges. To measure the strength of the core muscles, especially the rotational muscles; Kneeling Medicine Ball Throw Test was used (KMBT).

The results of both exercises show a significant difference when performed individually. With this we state that both of these exercises can be used in the exercise protocol for enhancing the strength and endurance of rotational muscles of core.

The between group analysis done using SPSS software, shows no difference in the effect produced by both exercises. Considering these results, it can be stated that both: Pallof Press or Russian Twists can be used in an alternating manner in an exercise protocol. According to a study which explains the Pallof Press exercise, states that with this exercise one learns to brace the core muscles while performing any movement. As it is an isometric type of workout, does not load the spine as much as Russian Twists.

Based on all the outcomes and their statistical analysis, the null hypothesis is getting accepted which says that there is no significant difference observed in the strength and endurance of the core muscles after performing either Pallof Press or Russian Twists.

This suggests that both the exercises, isometric and dynamic type of exercises are equally effective. According to the study “The Pallof Press” this exercise helps learning the bracing of core muscles during any activity. So, Pallof Press can be used even by any back pain population.

From the results and combination of all the literatures acquired, this study states that “use of both, Pallof Press and Russian Twists can be done alternatively for improving endurance and strength of the rotational muscles of the core including internal and external obliques”.

This study also states that both the exercises have an effect on Serape Effect (which includes internal and external obliques, serratus anterior and rhomboids). These exercises enhance the working of the rotational movements which are controlled by “The Serape Effect”.

Considering all the results, this study states the similarity in the effect of two exercises which work on the same muscles but their mechanism of action is different on every muscle. Though there are positives in the study observed, knowing the limitations of this study are also equally important.

CONCLUSION

From the results we conclude that, though there is no statistical difference observed in the improvement of strength by Pallof Press or Russian Twists, there is still some clinically significant difference observed in the strength. With Pallof Press, there was a clinically significant difference observed more on the left side and with Russian Twists, a clinically significant difference was observed on the strength of right-side muscles.

LIMITATIONS

1. Short duration of intervention:

   A short intervention period may not capture the long-term effects and adaptations resulting from the exercises.

2. Measurement and evaluation:

   The effectiveness of the exercises might depend on the accuracy and reliability of the tools used to measure core endurance and strength.

3. Control group:

   Without a control group performing no exercise or engaging in a different form of exercise, it's difficult to determine whether improvements were specifically due to the Pallof Press or Russian Twists.

SCOPE OF FURTHER STUDY

1. Long term effect:

   Explore how these exercises contribute to sustained improvements in core strength and endurance over extended periods.

2. Diverse population:

   Include a more diverse sample population to generalize findings across different ages, genders, fitness levels, and health conditions.

3. Different training program:

   Examine how these exercises perform as part of a broader training program versus in isolation.

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APPENDIX 1

Consent Form

I ……., confirm that I have understood about Pall-of Press or techniques of Russian Twists and their effects on my core muscles as explained by Nidhi Gangal and is as mentioned in her study which is taking place under the guidance of Prof. Joseph Oliver Raj, Dean of Abhinav Bindra sports medicine and research institute (ABSMARI) and co-guidance of Dr. Arpita Panda, HOD Cardiology, ABSMARI.

I understand that my participation is voluntary and I'm free to withdraw at any time, without giving any reason.

I understand that confidentiality will be maintained.

I voluntarily agree to and give my consent to be a part of the above mentioned study.

Signature:

Date:

APPENDIX 2

Assessment form

Name:

Age:

Gender:

Occupation:

Pre-Intervention

McGill's Torso Endurance Test

	Flexion (sec)	Extension (sec)	Right Lateral (sec)	Left Lateral (sec)
Test 1				
Test 2				
Average				

Kneeling medicine Ball Throw Test

	Right Rotation Throw (cm)	Left Rotation Throw (cm)
Test 1		
Test 2		
Average		

Post-Intervention

McGill's torso Endurance Test

	Flexion (sec)	Extension (sec)	Right Lateral (sec)	Left Lateral (sec)
Test 1				
Test 2				
Average				

Kneeling Medicine Ball Throw Test

	Right Rotation Throw (cm)	Left Rotation Throw (cm)
Test 1		
Test 2		
Average		

APPENDIX 3

Physical Activity Readiness Questionnaire (PAR-Q)

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or **NO**.	**YES**	**NO**
1) Has your doctor ever said that you have a heart condition ☐ **OR** high blood pressure ☐?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, **OR** when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness **OR** have you lost consciousness in the last 12 months? Please answer **NO** if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? **PLEASE LIST CONDITION(S) AND MEDICATIONS HERE:** _____	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer **NO** if you had a problem in the past, but it **does not limit your current ability** to be physically active. **PLEASE LIST CONDITION(S) HERE:** _____	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

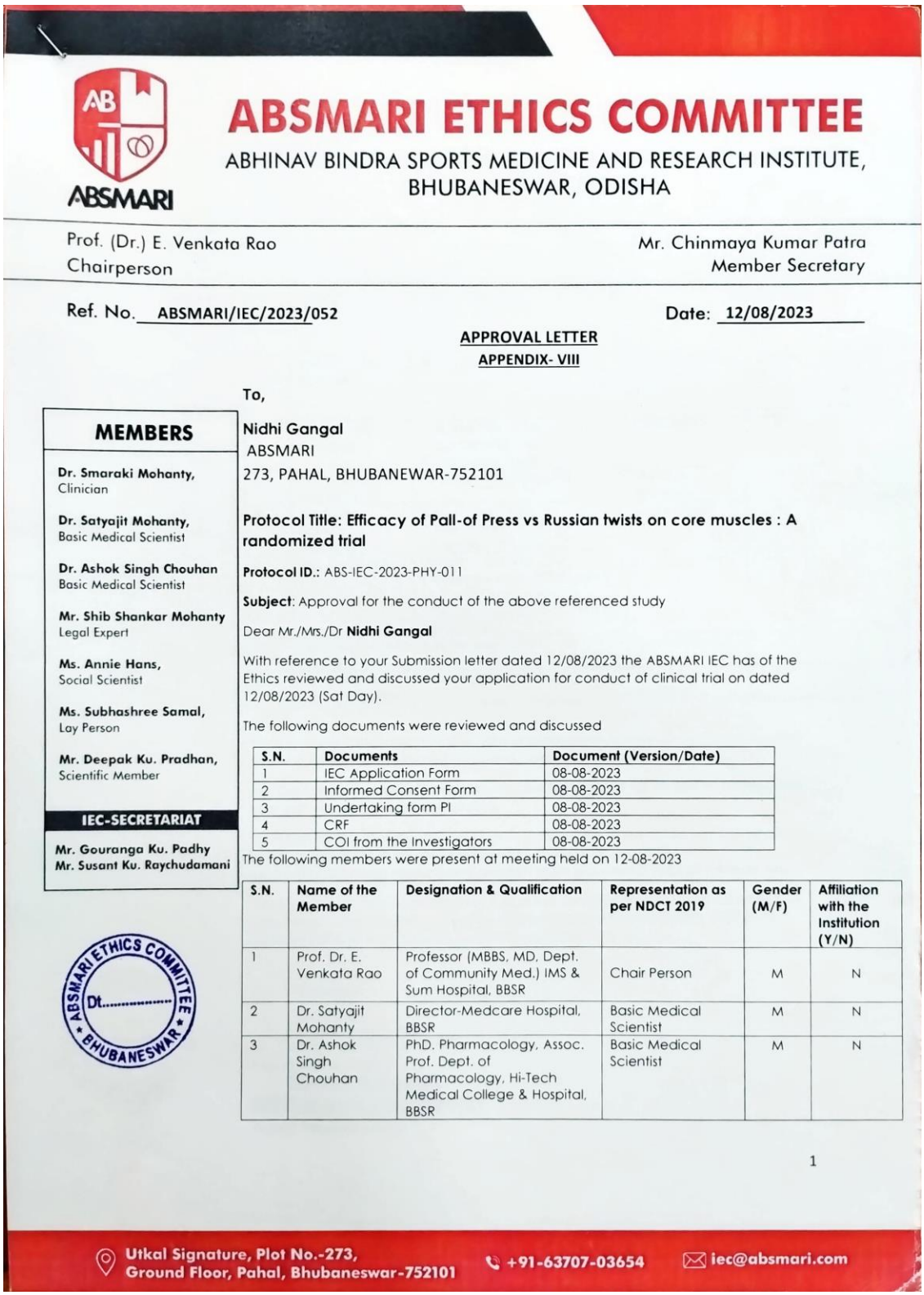
ANNEXURE 4

Master Chart

SR. NO.	MCGILL'S TORSO ENDURANCE TEST								GROUP	KNEELING MBT			
	F (pre)	F (post)	Ext (Pre)	Ext (Post)	RL (Pre)	RL (Post)	LL (Pre)	LL (Post)		Rrot (Pre)	Rrot (Post	Lrot (Pre)	Lrot (post)
BOYS													
1	37	45	54	60	7.8	10	8	12.5	A	227	233	193	201
2	9	13	35	42	12	19	10	17	A	180	188	152	161
3	35	39.7	28	35	20	26.8	23	32	A	325	330	259	263
4	45	52	22	30	18	25	9	16	A	172	170	169	175
5	34	40.3	120	123.8	21	30.1	21	30	A	223	227	244	257
6	25	29	70	76	17	15	27	30.1	A	276	280	284	287
7	34	42	86	94	39	45	53	58	A	162	171	183	190
8	49	77	25	55	35	42	38	45.6	A	190	183	190	226
9	43	44.2	25	27	30	30.5	32.1	33	A	163	165	176	179
10	72	73	50	53	28.7	30	30	30.8	A	173	177	166	168
11	39	40	20	23	18	19.8	15	18	A	238	240	229	231
12	23	29.5	69	77	32	39	19	26	A	251	255	287	290
13	20	28	18	25	9	15	10	16	B	200	204	177	183
14	15	21.2	43	48	13	21.4	15	22	B	205	206	198	201
15	10	16	99	104.6	24	31	18	25	B	131	139	156	160
16	9	15	35	42	10	18	15	23.3	B	370	373	322	323
17	15	17	17	18	15.3	16	14	15	B	143	146	139	145
18	13	17	20	25	14	16	17	18.5	B	179	183	181	192
19	22	22.8	30	31	21	23	19.8	21	B	186	192	126	128
20	17	18	21	24	13.6	15	13	15	B	142	145	150	154
21	27	35	30	36	17	25.4	23	31	B	185	187	152	160
22	24	25	40	43	25	26	21	24	B	115	121	100	103
23	32	35	45	46	35	35.7	32	33	B	197	203	203	202
24	34	59	72	80	38	60	40	59.1	B	137	198	182	180
25	35	36	30	32	28	29	27	30	B	174	179	178	180
26	21	24	18	20	12.4	14	12	13	B	108	114	105	111
GIRLS													
1	44	51	16	23.8	5	11.4	6.4	15	A	127	130	94	99
2	37	43	55	60.2	26	35	22	30	A	111	117	139	143
3	10	15.9	30	38	22	30	35	42.1	A	162	170	177	182
4	25	32	12	20	16	24.6	12	20	A	116	120	124	130
5	34	41	75	82	28	34	29	35	A	119	126	116	120
6	90	95	38	45	16	25	12	20	A	124	126	116	119
7	14	18	20	23	16.5	17	18.2	20	A	142	148	132	135
8	46	47	32	34	33.5	35	31	32	A	125	126	136	138
9	30	32	42	42	34	35	35.7	36	A	154	157	148	151
10	23	22	31	34	14	15.5	15.6	17	A	142	144	129	130
11	37	39	35	36	24	25	22	24	A	122	125	119	124
12	47	48	30	33	27	28.8	26	27	A	199	203	180	183
13	29	30	15	17	12.3	14	11	12	A	129	133	134	136
14	30	37	45	53	11	19	14	23	B	157	161	166	171
15	15	18	0.5	4.2	10	17	8	15	B	175	182	182	186
16	22	26	60	65	25	33	21	30	B	142	147	109	116
17	16	23	25	31	12	20	10	16	B	124	131	129	135
18	23	30.3	49	57	9	15.1	13	17.7	B	149	156	129	134
19	22	29	80	88.7	12	20	18	25	B	165	173	203	207
20	39	45	54	60	17	25	24	33	B	162	169	160	165
21	72	80	40	43	14	20	19	24.2	B	99	106	81	89
22	45	52.8	50	65	16	29	12	21	B	182	190	165	170
23	8	10	12	13	10	11.3	11	12	B	121	125	119	125
24	24	25	30	34	23	25	21	22	B	199	200	181	185

ANNEXURE 5

IEC Certificate



ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE, BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/052

Date: 12/08/2023

APPROVAL LETTER

APPENDIX- VIII

To,

Nidhi Gangal
ABSMARI
273, PAHAL, BHUBANEWAR-752101

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

Protocol Title: Efficacy of Pall-of Press vs Russian twists on core muscles : A randomized trial

Protocol ID.: ABS-IEC-2023-PHY-011

Subject: Approval for the conduct of the above referenced study

Dear Mr./Mrs./Dr **Nidhi Gangal**

With reference to your Submission letter dated 12/08/2023 the ABSMARI IEC has of the Ethics reviewed and discussed your application for conduct of clinical trial on dated 12/08/2023 (Sat Day).

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	08-08-2023
2	Informed Consent Form	08-08-2023
3	Undertaking form PI	08-08-2023
4	CRF	08-08-2023
5	COI from the Investigators	08-08-2023

The following members were present at meeting held on 12-08-2023

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
1	Prof. Dr. E. Venkata Rao	Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR	Chair Person	M	N
2	Dr. Satyajit Mohanty	Director-Medcare Hospital, BBSR	Basic Medical Scientist	M	N
3	Dr. Ashok Singh Chouhan	PhD. Pharmacology, Assoc. Prof. Dept. of Pharmacology, Hi-Tech Medical College & Hospital, BBSR	Basic Medical Scientist	M	N

ABSMARI ETHICS COMMITTEE * BHUBANESWAR * Dt.....

1

Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/052

Date: 12/08/2023

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
4	Dr. Smaraki Mohanty	Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med)	Clinician	F	N
5	Mr. Chinmaya Kumar Patra	Principal-ABSMARI, MPT	Member Secretary	M	Y
6	Mr. Shiba Sankar Mohanty	Junior Counsel-Lt. Ramachandra Sarangi's Chamber / BA LLB	Legal Expert	M	N
7	Ms. Annie Hans	Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Srilanka). /MA in Social Work	Social Scientist	F	N
8	Ms. Subhashree Samal	Ret. Reader-Pol Sc.	Lay Person	F	N
9	Mr. Deepak Kumar Pradhan	Asst. Prof-ABSMARI, MPT	Scientific Member	M	Y

This is to confirm that only members who are independent of the Investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

This Committee approves the documents and the conduct for the trial in the presented form with necessary recommendation.

The ABSMARI IEC must be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent and requests to be provided a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

ABSMARI ETHICS COMMITTEE * BHUBANESWAR * Dt.....

Yours sincerely

Mr. Chinmaya Kumar Patra
Member Secretary
Member Secretary
ABSMARI ETHICS COMMITTEE
Pahal, Bhubaneswar

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