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Effects Of Core Instability Trunk Training On Risk OfFall And Balance In Older Adults

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Abstract

This study explores the psychological theory of well-aging, which could shed light on various aspects of functioning such as motivation, emotion, and cognition.

Background: The substantial growth of India's population poses diverse challenges for social, economic, and healthcare policies, particularly amidst evolving family structures and anotable scarcity of support for the elderly.

Study Design: Randomize controlled trial study.

Aim: To assess the impact of a structured core instability strength training (CITT) program on the risk of falls and balance in older adults.

Objective: To Evaluate the impact of core instability strength training program on risk of fall and balance in older adults.

Participant: 52 Subjects who are cognitively healthy older adults.

Methods: This study conducted in two phases pre-assessment phase or post-assessment phase with experimental and control group in with total 52 participants in which 26 subject in experimental group ,26 subject in control group with age between 60 to 80 year, both male and female and who are cognitively healthy older adults. Administration of outcome measures was done through Tinetti Performance oriented mobility assessment (POMA) and Fall efficacy scale international (FES-I) for Pre and Post assessments.

Results: In core instability strength training impact of performance oriented mobility assessment (POMA), Pre and Post resulted that the pre mean value of POMA (21.069) accompanied by standard error (0.2327) and subsequently post mean value of POMA increased (25.7884) standard error (0.1175) and standard deviation (0.8479) which indicate progress of post mean value (25.7884) falls within low fall risk category. In fall efficacy scale assessment (FES-I), pre and post result that the pre mean of FES-I (25.538) accompanied by standard error (0.2963) and subsequently post mean value decrease (17.11) standard deviation (1.0783) which indicate progress of post mean value (17.1153) falls within reduction in fear of falling in older adults.

Conclusion: Core instability strength training indicates discriminable impact on fall risk and balance enhancement in POMA and also in FES-I on fall risk and ADL among older adults.

Keywords: Balance, POMA, FES-I, Assessment, Fall risk, ADL.

INTRODUCTION:

A psychological theory of well-aging that might be used to explain several aspects of functioning (e.g., motivation, emotion, and cognition).This approach is built on the premise that individuals face constraints and particular opportunities (such as schooling) throughout their lives, which may be effectively addressed via the coordinated use of three elements: optimization, compensation, and selection.[1]

In order to maintain their independence and prevent falls, older adults must be able to walk effectively and securely. The term "intra-individual gait variability" describes how a gait metric varies in value from one step to the next. It has been proposed to represent abnormalities in intrinsic motor control or postural control while walking brought on by a deterioration in the central and peripheral nerve systems associated with aging or illness. Compared to quantitative gait measures like gait speed, gait variability measurements have been shown to be superior predictors of falls and declines in mobility. It's crucial for determining the specific nature of the association between aging and gait variability, given the increased risk of falls and mobility issues in the elderly population. Such information might improve our understanding of motor function in the elderly and help identify those whoare particularly vulnerable to falls.[2]

Falling is the primary cause of morbidity and death. Everyone 65 years of age or older in the community will fall at least once a year, and the likelihood of this falling increases with age group. Falls significantly harm individuals, their families, the community health system, and the economy on a social and financial level. Internationally, the cost of falls rises with age group. Falls are the primary serious concern for public health. In order to prevent falls in the elderly population, it is imperative that we adhere to and execute well-designed intervention programs that are supported by global and national health organizations.[3]

The world's population has increased from 2.5 billion in 1950 to 7 billion today, growing at a rate of about 76 million people annually. By 2050, the world's population will be around 9.8 billion, growing at a rate of about 34 million people annually. However, 95% of all population growth is occurring in the least developed countries. The population of the more developed countries is predicted to remain at around 1.2 billion or decline. The EU27 countries in particular will see population shrinkage of around 0.2% per year between 2020 and 2045. Germany and Italy will be especially affected by the projected reductions. between 2010 and 2050, from 60 million to 57 million in Italy and 82 million to 79 million in Germany. But due to anticipated immigration during this time, the UK's population is expected to rise by 16% over the same period, from 62 million in 2010 to 72 million by 2050. The advancing age of the population is the second issue. In the more developed regions, where in 2010 there were 21.8% of people aged 60 or over and 16.5% of people under 15, projected to rise to 32.6% and 15.4% by 2050, respectively, there is already an unprecedented situation where there are more older people (here defined as those over 60) than children (under 15). This situation will be reached globally by the middle of the century. By this period, the proportion of individuals in the "working age" (15–59) will have dropped from 62% to 52%, and there will be twice as many elderly people as young. In the EU27, 22% of people are over 60. This number is expected to rise to 29.3% by 2030 and 34.2% by 2050. However, by 2050, those who are 60 or 65 years old may not.[4]

The number of older people in society is increasing, which has given rise to a desire for study into the risk factors and causes of impairment as well as age-related changes in functioning. The International Classification of Functioning, Disability and Health (ICF) of the World Health Organization uses the term "participation restriction" to refer to "problems an individual may experience in involvement in life situations," which include managing financial matters, social interaction, community mobility, and employment. Engagement holds significance as it pertains to day-to-day living and integrating into the community; it's associated with a healthy quality of life and graceful aging and survival, and is highly esteemed by people compared to the limitations or challenges of doing particular duties and activities. On the other hand, 52% of those over 50 report having minimal involvement[5]

Age-related hyperkyphosis can be defined by an increased anterior thoracic spine curvature. Hyperkyphosis in older people increases the risk of fractures, falls, and reduced physical function. While several studies have shown that hyperkyphosis has a detrimental impact on physical function, none have been able to determine whether the function impairment is due to spinal osteoporosis or another linked prognosis. Additional investigations into the association between kyphosis and assessed physical function may help develop alternative therapeutic approaches to delay or perhaps prevent functional decline, as reduced physical performance is linked to fall risk and fractures. Currently, doctors seldom refer patients with hyperkyphosis to physical therapy; instead, they are more likely to recommend them for treatment of balance and gait disorders. The significance of age-related postural shift may be minimized by the correlation between hyperkyphosis and advanced age, reduced grip strength, poor bone mineral density, and spinal compression fractures—all of which might have an influence on physical function.[6]

METHODS:

A total sample of 52 older adult with cognitively healthy older adults was determined. The participants recruited from Bhagirathi seva sansthan old age home. As per inclusion criteria, Age between 60-80 years, both male & female, Individual who are capable of walking independently without any assistive device, Individual who are not priory experienced with core instability training, Individual who are cognitively healthy older adults are included. As per exclusion criteria, who are not capable of walking independently without any assistive device, Individual who are not cognitively healthy older adult, Individual with having any history musculoskeletal, neurological or orthopedic disorders are excluded. This study conducted in two phases pre & post assessment with experimental and control group, administration of scale was done for pre & post assessment through outcome measures
,POMA & FESI before intervention and re administration of scale was done after 6 weeks, per week 5 sessions for 45 minutes. Inform consent form was given to the selective participant on the basis of convenient sampling and data was collecting from all the participant respectively and were also explain about the purpose of the study.

Outcome measure:

1. TINETTI PERFOMNCE ORIENTED MOBILITY ASSESSMENT (POMA)

The Tinetti Performance Oriented Mobility Assessment (POMA) is a well-established tool for assessing mobility and fall risk in elderly individuals. Developed by Mary Tinetti in 1986, it consists of two main components: balance assessment and gait assessment. The balance assessment evaluates sitting balance, arising from a chair, and standing balance, while the gait assessment examines gait initiation, step continuity, and path. Each component is scored separately, with a maximum total score of 28 points, indicating better mobility and lower fall risk. The Tinetti test is widely used in clinical settings to guide interventions and monitor changes in mobility over time [7]

2. FALL EFFICACY SCALE INTERNATIONAL (FES-I)

The Falls Efficacy Scale International (FES-I) is a widely used tool to assess an individual's concern about falling. It is designed to measure the level of confidence a person has in performing various activities of daily living without falling. The scale consists of 16 items related to different activities, such as walking on icy sidewalks, reaching for objects on high shelves, or taking a bath. Each item is rated on a 4-point scale ranging from 1 (not at all concerned) to 4 (very concerned). This scale has been widely validated and used in various clinical and research settings to assess fear of falling and its impact on daily activities, functional independence, and quality of life among older adults and individuals with balance impairments.[8]

Treatment Protocol: The Treatment Protocol which have been followed for Experimental and Control Group are given below:

1. EXPERIMENTAL GROUP :- Core instability strength training

SL.NO	TRAINING	ACTIVITY	DURATION / REPETATION
1.	Curl-UpExercise	Patient is supine position with knees 90ºflextion position.	15 to 20 repetition for 3 to 4sets. Rest duration between set 30 sec and rest duration between exercise 2 to 3 min .
2.	Side Bridging Exercise	Patient is side line position lift the hip and legs on the elbow.	15 to 20 repetition for 3 to 4sets. Rest duration between set 30 sec and rest duration between exercise 2 to 3 min
3.	Quadruped Exercise	Patient is quadruped position	15 to 20 repetition for 3 to 4sets. Rest duration between set 30 sec and rest duration

		alternative lift opposite arm and leg.	between exercise 2 to 3 min .
4.	Partial Curl	Cross your arms loosely. Tightenyour abdomen and curl halfway up, keeping your head in line with yourshoulders.	15 to 20 repetition for 3 to 4sets. Rest duration between set 30 sec and rest duration between exercise 2 to 3 min

2. CONTROL GROUP: Occupational therapy program

SL.NO	TRAINING	ACTIVITY	DURATION /REPETATION
1.	Pelvic Bridging	The patient lies down with the back, knees in full flexion and feet flat on the floor and close to the buttock. Then the patient lifts hip off the floor towards the ceiling/sky as high as possible.	10 repetition / set , 3times /day and 5 days/week.
2.	Pelvic Tilt	Patient angle created by a line running from the sacral endplatemidpoint to the center of the bifemoralheads and the vertical axis.	10repetation / set , 3times /day and 5 days/week
3.	Back Extension	Patient Lie on your back on the floor with your knees bent. Flatten your back against the floorby tightening your abdominal muscles and bending your pelvis up slightly. Hold for up to 10 seconds.	10repetation / set , 3times /day and 5 days/week
4.	Lion Exercise	Patient kneel on the floor bring your feet together and open knee. Place your hands on the floor between the knees point your backextend your neck.	10repitation / set , 3times /day and 5 days/week
5.	Cat Camel Stretch	Step 1:Set up is in quadruped position, on all fours. Hands areunder shoulders and knees are under hips. Drop head down and contracting abdominal muscles, raise your belly button up towards the ceiling. Hold this position for 10seconds. Step 2: Slowly raise the head up while dropping belly button as low to the mat as you can, arching your back. Hold this position for 10 seconds.	10 repetition / set , 3times /day and 5 days/week.[9]

DATA COLLECTION

Participant selected through convenient sampling according to inclusion & exclusion criteria, data was

collected in two phases for pre & post assessment in which hard copy of outcomes measure distributed.
Also collected consent form from all subjects of experimental and control group who are agree to participate in the study and participants were also explain about the purpose of the study. Demographic details were also collected through data collection form.
For phase one, administration of outcome measure was done for pre assessment of experimental and control group. After duration of 6 weeks per week 5 session 45 minutes the Re-administration of outcome measure was done for post assessment of experimental and control group, and responses were recorded to calculate the pre and post data of experimentaland control group.

DATA ANALYSIS

After completion of all (pre treatment and post treatment) evaluation, results were collectedand data were put in the master chart and analyzed by using IBM SPSS.
The scoring of pre-treatment and post-treatment data of outcome measures TINETTI PERFOMNCE ORIENTED MOBILITY ASSESSMENT (POMA) and FALL EFFICACY
SCALE INTERNATIONAL (FES-I) were analyse using IBM SPSS for statisticalsignificance result.
The Pre-test and Post-test for scoring of experimental and control group were analyse throughparametric test, T-test was used to analyze the cognition and activities of daily living scores for analysis of outcome measure

RESULT:

The result presented in two phases: Pre test and Post test assessment and the significance of CORE INSTABILITY STRENGTH TRAINING was determined through POMA and FES-I Outcome measures. In phase one: the pre test assessment of the POMA and FES-I administered to the participants before providing intervention. And in second phase the posttest assessment of the POMA & FES-I was re-administered after duration of 6 weeks, per week 5 sessions for 45 minutes was provided for intervention interval of experimental and control group.

Table 1: Demographic characteristic of subjects

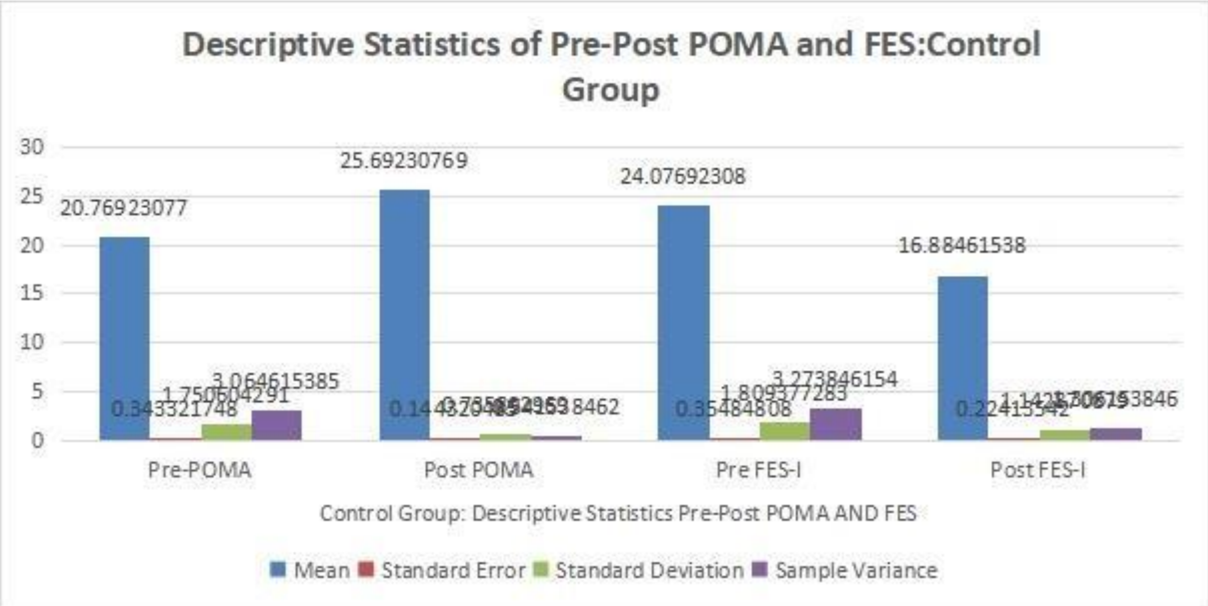
S.No.	Baselines characteristics	GROUP-1 EXPERIMENTAL GROUP	GOUP-2 CONTROL GROUP
1	No of subjects	26	26
2	Age range (Year)	60-80	60-80
3	Gender M/F	14/12	21/5
4	Intervention	Core instability strength training	Occupational therapy program

Table 1:Shows the demographic characteristic, the number of subjects ,the mean age of all the participants ,and the female participants .

Table 2 : Descriptive Statistics of Pre-Post POMA and FES: Control Group

Stats	Control Group: Descriptive Statistics Pre-Post POMA AND FES			
	Pre-POMA	*Post POMA*	*Pre FES-I*	*Post FES-I*
Mean	20.76923077	25.6923077	24.07692308	16.88461538
Standard Error	0.343321748	0.14432048	0.35484808	0.22413542
Standard Deviation	1.750604291	0.73589297	1.809377283	1.142870879
Sample Variance	3.064615385	0.54153846	3.273846154	1.306153846

TABLE 2. showing the descriptive statististics of Mean, standard deviation andstandard error in pre-post POMA & FES-I in control Group

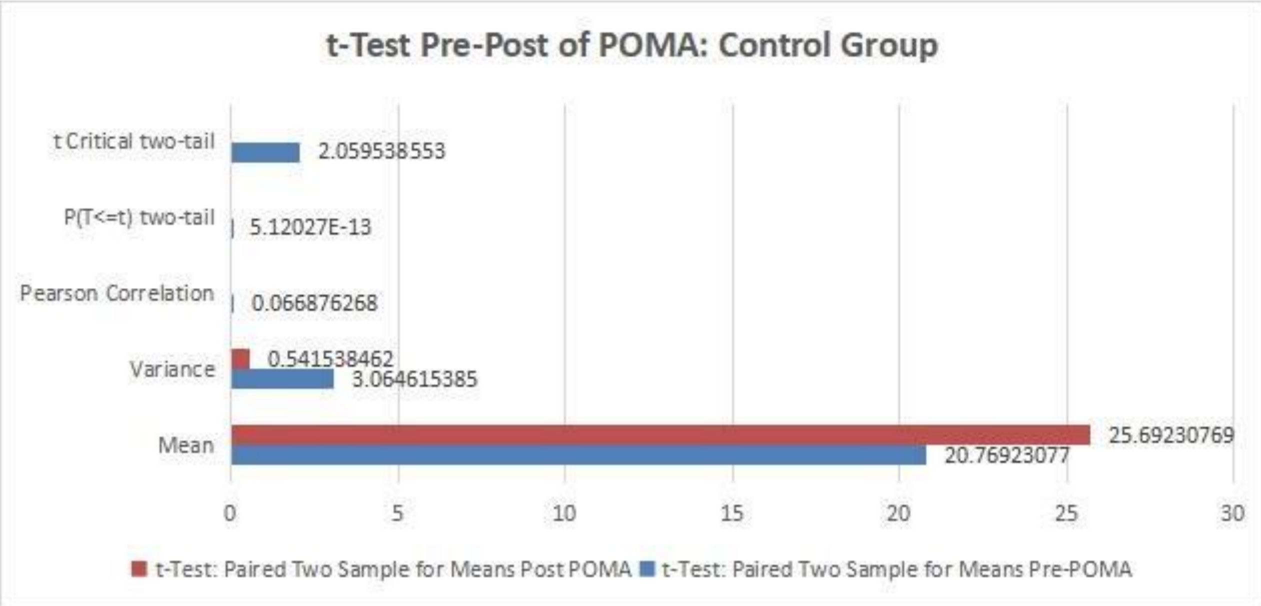


Graph 2. showing graphical presentation of Descriptive Statistics of Pre-Post POMA and FES in Control Group

The mean pre-intervention POMA and FES scores are 20.77 and 16.88, respectively, while the post-intervention means are 25.69 and 24.08. The increase in the post-POMA mean suggests improved balance among older adults, reducing their fall risk and categorizing them into a lower risk group compared to pre-intervention. Conversely, the decline in the post-FES mean indicates a reduced fall risk during daily activities. Pre-intervention standard deviation and sample variance values are 1.75 and 0.74, respectively, whereas post-intervention values are 1.81 and 1.14. These changes suggest a notable improvement in the fall risk among older adults.

Table 3. t-Test of Pre-Post POMA in Control Group

t-Test: Paired Two Sample for Means		
Stats	***Pre-POMA***	***Post POMA***
Mean	20.76923077	25.6923077
Variance	3.064615385	0.54153846
Pearson Correlation	0.066876268	
P(T<=t) two-tail	5.12027E-13	
t Critical two-tail	2.059538553	

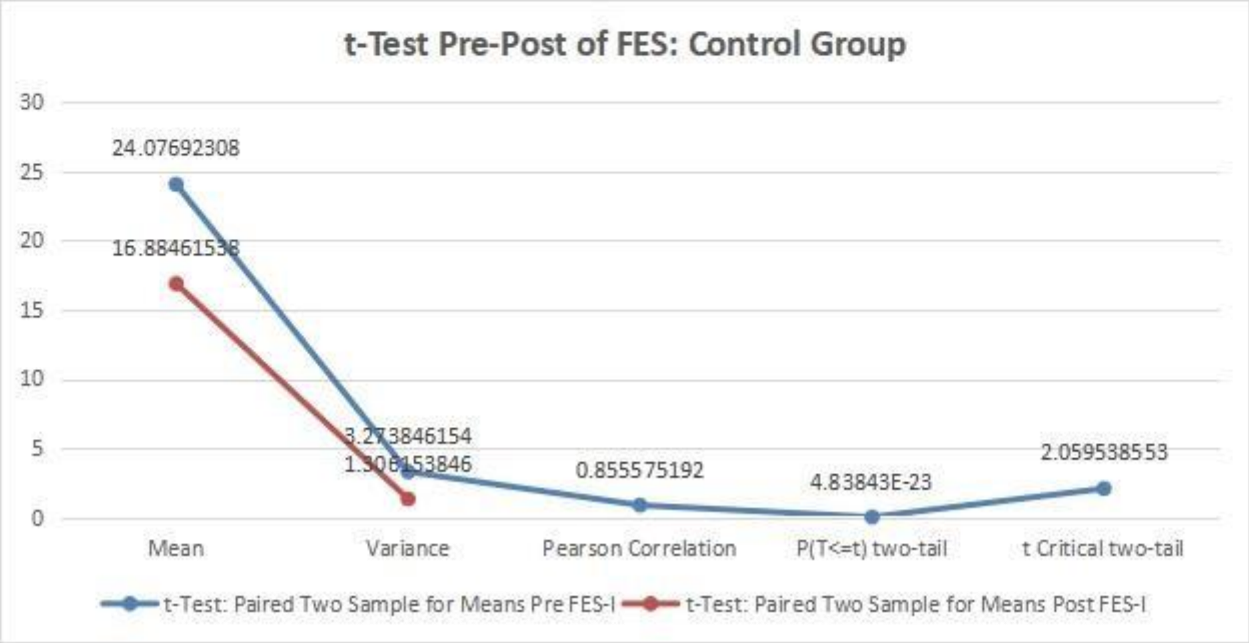


Graph 3. showing graphical presentation of Test of Pre-Post POMA in Control Group

The t-test results for the pre-post POMA (Performance-Oriented Mobility Assessment). The Pearson correlation coefficient is 0.06687, indicating a positive relationship between POMA scores and reduced fall risk in older adults, along with improved balance. The p-value is 5.12027E-13, which is significantly less than the 0.05 threshold ($p<0.05$), leading to the rejection of the null hypothesis (that core instability training has no effect on fall risk and balance in older adults). Consequently, the alternative hypothesis is accepted, affirming that core instability training positively affects fall risk and balance in older adults. Thus, the post-POMA results demonstrate a significant improvement in stability, as older adults exhibit better balance and a reduced risk of falling.

Table 4. t-Test for Pre-Post FES in Control Group

t-Test: Paired Two Sample for Means		
Stats	***Pre FES-I***	***Post FES-I***
Mean	24.07692308	16.8846154
Variance	3.273846154	1.30615385
Pearson Correlation	0.855575192	
P(T<=t) two-tail	4.83843E-23	
t Critical two-tail	2.059538553	



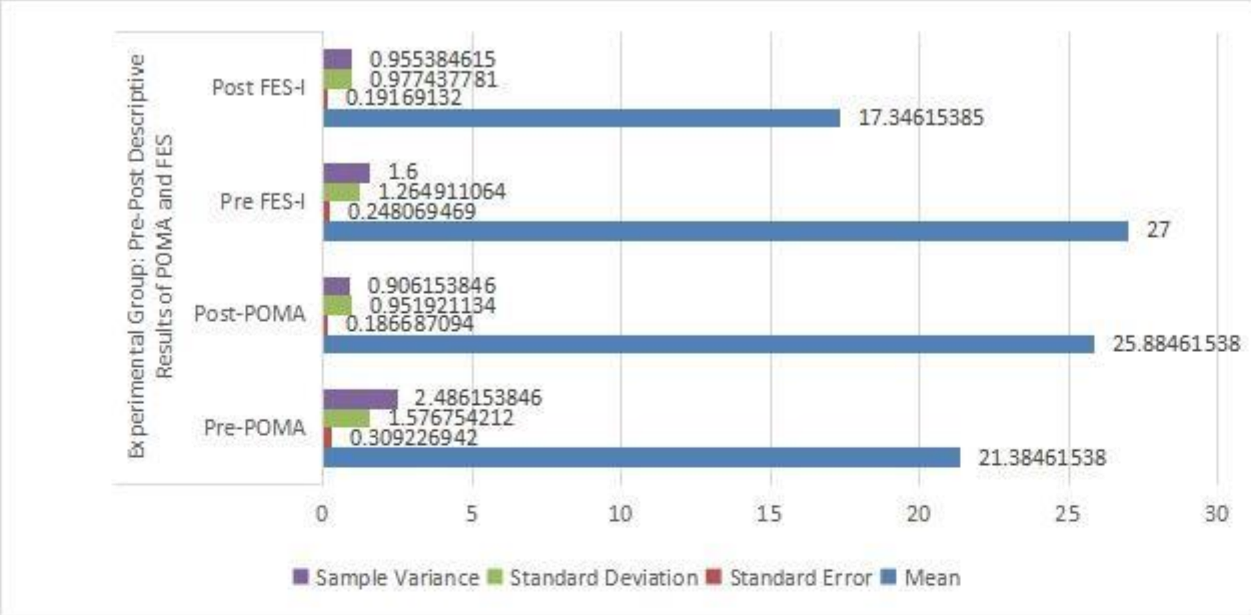
Graph 4. showing graphical presentation of t-Test for Pre-Post FES-I in Control Group

The t-test results for the pre- and post-intervention (FES). The Pearson correlation coefficient of 0.8555 indicates a significant positive impact of FES on reducing the risk of falls among older adults. This positive correlation suggests that FES training effectively helps older adults perform daily activities with a reduced risk of falling. The p-value of 4.83843E-23 is significantly less than 0.05 ($p < 0.05$), leading to the rejection of the null hypothesis and the acceptance of the alternative hypothesis. Therefore, the data supports the conclusion that FEShas a positive impact on the control group.

Table 5. Descriptive Statistics of Pre-Post POMA and FES in Experimental Group

Stats	**Experimental Group: Pre-Post Descriptive Results of POMA andFES**			
	Pre-POMA	***Post-POMA***	***Pre FES-I***	***Post FES-I***
Mean	21.38461538	25.88461538	27	17.34615385
Standard Error	0.309226942	0.186687094	0.248069469	0.19169132
Standard Deviation	1.576754212	0.951921134	1.264911064	0.977437781
Sample Variance	2.486153846	0.906153846	1.6	0.955384615

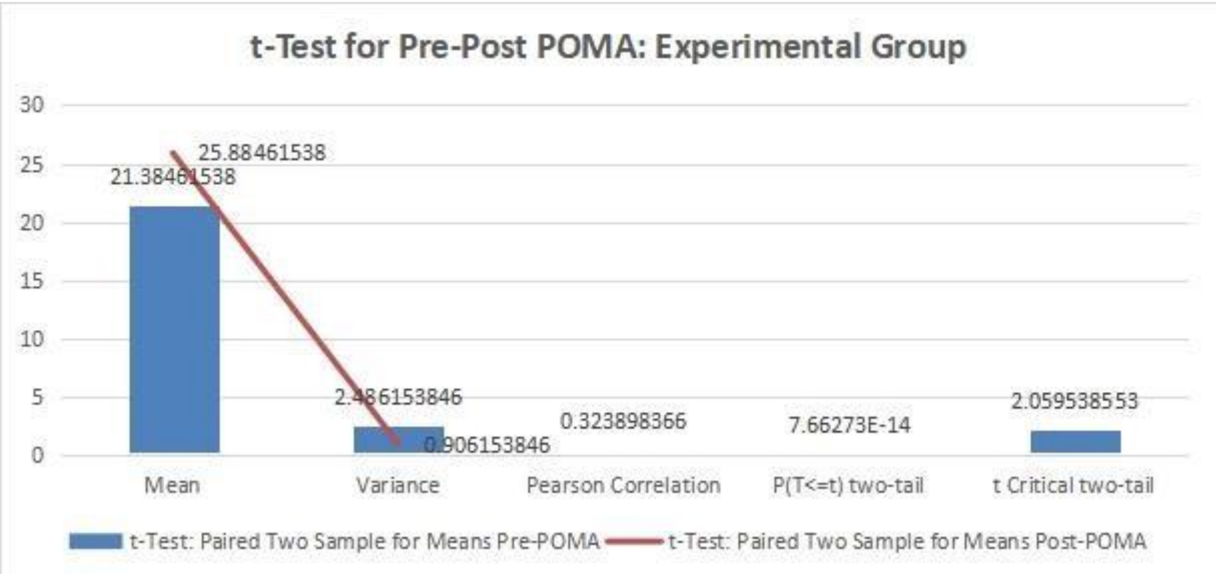
TABLE 5. showing the descriptive statistics of Mean, standard deviation andstandard error in pre-post POMA & FES-I in experiment Group



Graph 5. showing Graphical presentation of Descriptive Statistics of Pre-Post POMA and FES-I in Experimental Group

Table 6. t-Test of Pre-Post POMA in Experimental Group

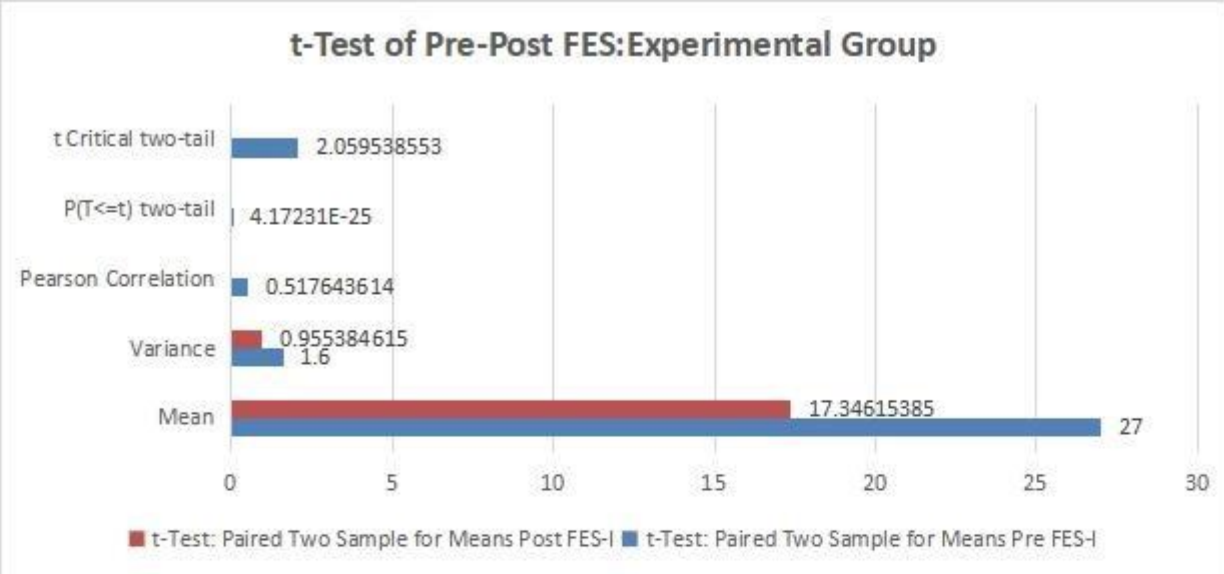
t-Test: Paired Two Sample for Means		
	Pre-POMA	*Post-POMA*
Mean	21.3846154	25.88461538
Variance	2.48615385	0.906153846
Pearson Correlation	0.32389837	
P(T<=t) two-tail	7.6627E-14	
t Critical two-tail	2.05953855	



Graph 6. showing graphical presentation of t-Test of Pre-Post POMA in experimentgroup.

Table 7. t-Test for Pre-Post FES-I in Experimental Group

t-Test: Paired Two Sample for Means		
Stats	***Pre FES-I***	***Post FES-I***
Mean	27	17.34615385
Variance	1.6	0.955384615
Pearson Correlation	0.517643614	
P(T<=t) two-tail	4.17231E-25	
t Critical two-tail	2.059538553	



Graph 7. showing graphical presentation of t-Test for Pre-Post FES-I in ExperimentalGroup

The p-value obtained is 4.17231E-25, which is significantly lower than the threshold of 0.05 ($p < 0.05$). This result leads to the rejection of the null hypothesis in favor of the alternative hypothesis, confirming the positive impact of FES. Furthermore, the experimental group post-FES demonstrates significantly better outcomes compared to the control group's post- FES results.

Table 8. Comparison of Control and Experimental Group Pre-Post POMA and FES inDescriptive and P-value

Stats	**Comparison of Control and Experimental Gorup Pre-Post POMA and FES**							
	Control Group				**Experimental Group**			
	Pre- POMA	***Post POMA***	***Pre FES-I***	***Post FES-I***	***Pre-POMA***	***Post-POMA***	***Pre FES***	***PostFES***
Mean	20.77	25.69	24.08	16.88	21.38	25.88	27	17.34615
Standard Error	0.34	0.14	0.35	0.22	0.31	0.19	0.2481	0.191691
Standard Deviation	1.75	0.74	1.81	1.14	1.58	0.95	1.2649	0.977438

Sample Variance	3.06	0.54	3.27	1.31	2.49	0.91	1.6	0.955385
Pearson Correlation	0.07		0.86		0.32		0.5176	
P(T<=t) two-tail	7.66273E-14		4.17231E-25		5.12E-13		4E-25	
t Critical two-tail	2.06		2.06		2.06		2.0595	

Table 7. shows a comparison of pre- and post-intervention scores for the Performance- Oriented Mobility Assessment (POMA) and the Falls Efficacy Scale (FES). This comparison utilizes descriptive statistics and t-tests to evaluate the pre- and post-intervention results for POMA and FES. The experimental group demonstrates greater effectiveness compared to the control group. The overall p-value is less than the 0.05 level of significance ($p < 0.05$), leading to the rejection of the null hypothesis (indicating no effect of core instability training on fall risk and balance in older adults) and the acceptance of the alternative hypothesis (indicating an effect of core instability training on fall risk and balance in older adults). Post- intervention results for the experimental group show significant improvements in reducing fall risk and enhancing balance among older adults, compared to the control group.

DISCUSSION:

The present study explore the impact of core instability strength training program on risk of falland balance in older adults.
A total of 52 participants are selected through randomization on basis of convenient samplingas per inclusion and exclusion criteria. In experiment group, 12 female and 14 male are participated and in control group 5 female and 21 male are participated.
The mean values for pre-intervention POMA and FES-I are 20.77 and 16.88, respectively, while the mean values for post-intervention POMA and FES-I are 25.69 and 24.08.
For the pre-intervention phase, the standard deviation and sample variance are 1.75 and 0.74, respectively. For the post-intervention phase, these values are 1.81 and 1.14. This decrease in variance indicates an improvement in the risk of falling among older adults.

The p-value is 5.12E-13, which is less than the 0.05 significance level ($p < 0.05$). This result leads to the rejection of the null hypothesis, which posited no effect of core instability training on the risk of falls and balance in older adults. Consequently, the alternative hypothesis is accepted, suggesting a significant effect of core instability training on reducing fall risk and improving balance in this population.
The post-POMA mean values have increased, indicating that older adults are less likely to fall due to improved balance. These mean values now lie within the low-risk category, showing a reduction in fall risk compared to pre-POMA levels. Additionally, the post-FES-I mean values have declined, suggesting a decrease in the risk of falling during daily activities. This overall improvement in balance and fall risk among older adults is reflected in both post-POMA and post-FES-I values.
The p-value of 5.12027E-13, which is less than the 0.05 significance level ($p<0.05$), leads to the rejection of the null hypothesis (that core instability training has no effect on fall risk and balance in older adults). Consequently, the alternative hypothesis is accepted, confirming the positive impact of core instability training on fall risk and balance. Therefore, post-POMA results indicate a significant improvement in stability and a reduction in fall risk among older adults.
Post-FES-I results also demonstrate a positive correlation with reduced fall risk in older adults, suggesting that core training has helped them perform daily activities more safely. With a p-value of 4.83843E-23, which is less than 0.05 ($p<0.05$), the null hypothesis is rejected, and the alternative hypothesis is accepted, highlighting the positive impact of FES inthe control group.
Descriptive statistics show that pre-POMA and FES-I standard deviation and sample variancevalues (1.5767 and 1.2649, respectively) decreased post-intervention (0.9519 and 0.9061, respectively), indicating improvement. The experimental group exhibited greater improvements compared to the control group, with more effective post-POMA and FES results.
The p-value of 7.6627E-14, which is below the 0.05 significance level ($p<0.05$), further supports rejecting

the null hypothesis and accepting the alternative hypothesis that core instability training positively affects fall risk and balance. The experimental group demonstrated more significant improvement than the control group, as evidenced by post- POMA and post-FES results.

CONCLUSION:

This study indicates significant improvements in balance and a reduction in the risk of falls among older adults following core instability training. The post-POMA mean values increased, signifying enhanced balance and a lower fall risk. These values now fall within the low-risk category compared to pre-POMA values. Conversely, the post-FES-I mean values decreased, demonstrating a reduced risk of falls in daily activities. Both metrics indicate substantial improvements in balance and fall risk post-intervention.

The statistical analysis supports these findings, with p-values significantly lower than the 0.05 significance level leading to the rejection of the null hypothesis and acceptance of the alternative hypothesis. This confirms that core instability training has a positive effect on the risk of falls and balance in older adults.

LIMITATION OF THE STUDY:

The study established with smaller sample size and was completed from a single place. Thisstudy limited to those Individual who are capable of walking independently without any assistive device, and also who are not priory experienced with core instability training.

RECOMMENDATION

larger and more diverse populations to enhance the generalizability of the findings. Including participants from different demographic backgrounds and health statuses will provide a more comprehensive understanding.long-term studies will help determine the sustained effects of core instability trunk training on fall risk and balance. Follow-up assessments over months or years can provide insights into the durability of the training benefits. Developing a consensus on the best assessment methods can improve the quality of research in this area.

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