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Research Article

Pilates versus Conventional Balance Training on Functional Balance and Quality of Life in Elderly Individuals: A Randomized Controlled Study

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Abstract: The objective of the study was to compare the effectiveness of Pilates intervention (PI) and Conventional Balance Training (CBT) in improving functional balance and quality of life (QOL) in elderly individuals. In a prospective randomized controlled design, 51 ambulatory elderly individuals were recruited from four different old age homes and randomly allocated into three groups(Pilates intervention-PI; Conventional Balance training-CBT and Control; N=17 in each group). All the groups underwent 6 weeks of supervised intervention programs in their old age homes. Functional reach test (FRT), timed up and go test (TUG), dynamic gait index (DGI) for functional balance and RAND-36 for quality of life were recorded at baseline and after 6 weeks of intervention. The 6 weeks of PI & CBT program resulted in significant improvement of functional balance (FRT, TUG & DGI: p=0.000) and QOL (RAND-36: p=0.000) in ambulatory elderly individuals which was not evident in the control group. However PI was found to have greater improvements in functional balance and QOL scores compared to CBT and control. Both PI and CBT can improve functional balance and decrease propensity to fall in elderly individuals thereby improving QOL. However, PI was found to be superior to CBT in improving functional balance and QOL among ambulatory elderly individuals.
Keywords: Pilates training; Balance training; Geriatric; Physical activity.

INTRODUCTION

The increased number of older adults among the world population during the last few decades may be due to socio-economic developments and better medical services. Although this may be considered as a positive development, there are a number of serious health issues in elderly.[1]Falls and falls related injuries are one of the most common health issues in the elderly population [1, 2]. Declines in sensory function (vision, vestibular, proprioception), motor function (strength, coordination, endurance) and integration (response time, multi-task ability) have been identified as the major factors contributing to poor balance and falls [3]. Falls and fall-related injuries can cause restricted mobility and functional decline leading to disability and may have a negative effect on the socioeconomic status and quality of life (QOL) in elderly individuals. Physical activity is helpful in counteracting these age-related functional declines& aid in prolonging independence in elderly individuals. Thus balance assessment, training & fall prevention in elderly individuals are of critical importance and should be incorporated into treatment [4].

Several models of balance training programs varies from computerized feedback postural control training [5], sophisticated exercise machines [6], controlled conventional exercises in clinical settings [7] to simple community [8] and home based exercise protocols [9].Conventional balance exercise which includes training the strength and endurance, maximizing flexibility and postural control have been proven effective in improving functional ability in addition to reducing risk of falls in elderly individuals[10, 11]. Recently, Pilates have become a popular exercise program which can be used for all age groups and fitness levelsthat combines strength, flexibility and movement co-ordination along with rhythmic respiratory training which may provide an effective mode of improving postural stability in elderly individuals. Several studies have been conducted showing beneficial effects of Pilates interventionin improving balance and postural stability in elderly population [12-14]. However, till date no prospective studies are found making the comparison between the effectiveness of PI and CBT program in improving functional balance and QOL in the elderly population. Moreover, a standard protocol for either of the intervention has not been agreed upon. This

study aims in determining and comparing the effectiveness of PI and CBT specially designed for the elderly population inimproving functional balance and QOL. It was hypothesized that there would be a significant difference in the effectiveness of PI and CBT in improving functional balance and QOL in elderly population. The result of this study would implicate a better exercise program for the elderly population and can help the older adults to age gracefully and enjoy a fall free exceptional quality of life.

METHODOLOGY

An assessor blinded prospective randomized controlled design was used. The physiotherapist who performed the assessment at baseline and post intervention was blinded to the use of the intervention programs; however, neither the participants nor the therapist who provided the interventions were blinded. The ambulatory geriatric subjects were recruited from four different old age homes (OAH) in Surendranagar area. The OAH provides food, accommodation, recreational activities and basic primary health care (e.g. regular blood pressure monitoring, health screening etc.). Some general physical activities provided to the residents include laughter therapy, pranayama, and regular morning walk. But balance training program was not provided routinely. There were altogether 153 residents in the four OAH. Out of 74 subjects willing to participate in the physical therapy program, 51 subjects were recruited for the study that fulfills the selection criteria (Figure 1).Participants were then randomly assigned with concealed allocation method into one of the three groups (PI group N=17; CBT group N=17 and Control group N=17) using a computer generated randomization method after thorough initial physical therapy evaluation according to American/British Geriatrics Society Clinical Practice Guideline for Prevention of Falls in Older Persons [15].

The subjects were included if, 1) age between 65 - 74 years both males and females ; 2) able to walk at least 30 feet with or without an assistive device; 3) not participating in any sports or physical therapy sessions; 4) willingness to do physical exercise thrice a week with regular attendance; 5) have fallen at least once within previous year; 6) fear of fall scoring >23 in 16 item falls efficacy scale international questionnaire; 7) Mini-Mental Status Examination score of 24; and 8) no affirmative responses to the PAR-Q instrument for inactive older adults [16]. The subjects were excluded if they have acute medical problems, surgical treatment during the last year, history of fall related fracture, presence of artificial prosthesis or any other disease that contraindicated the exercise program. All the subjects provided their demographic details (Table 1) and written informed consent prior to collection of baseline data.

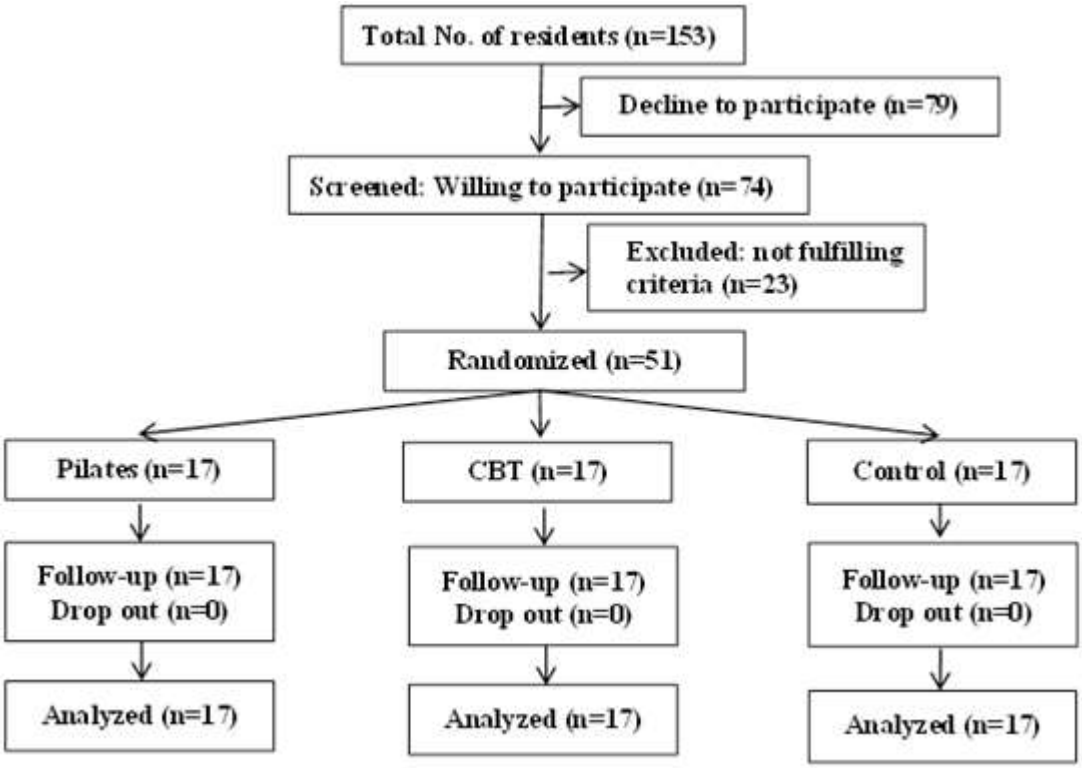

Fig. 1: Sampling flow chart

Table 1: Baseline Data

Variables	PI (N*=15)	CBT (N*=15)	Control (N*=15)	P-value
Age (Y)*	70.7±2.7	70.3±2.9	69.35±3.0	0.303
Height (cm) *	168.3±7.7	170.1±6.8	167.7±7.4	0.582
Weight (kg) *	71.8±4.8	71.7±4.7	71.2±3.9	0.868
BMI*	25.5±3.2	24.6±2.6	25.5±2.8	0.579
Male/Female	13/7	15/5	12/8	0.605
FRT (cm)	28.5±3.2	28.6±3.2	29.4±2.8	0.606
TUG (sec)	16.5±1.1	16.6±1.0	16.6±1.1	0.910
DGI	18.1±0.9	18.0±0.8	17.9±0.9	0.759
RAND-36	63.9±3.0	63.2±2.6	63.9±3.0	0.677
Y=year; cm=centimetre; kg=kilogram; BMI=body mass index; N=number				

All the subjects were evaluated for functional balance by functional reach test (FRT) [17], timed up and go test (TUG) [18] dynamic gait index (DGI) [19] and QOL was measured by using RAND-36 [20] at baseline and after 6 weeks of intervention by an assessor who was blinded to the intervention methods.

The PI group received Pilates exercises (Table 2) focusing on lower limb strength, flexibility and co-ordination. Exercises or movements were done on a mat, on an exercise ball or in standing position while emphasizing on spinal and pelvic alignment, maintaining core contraction and the rhythm of respiration. Exercises were held in small groups of two or three subjects only ensuring correct execution and were progressed at the earliest opportunity in terms of repetitions or advanced method. All exercises were done for 10 repetitions with a rest period of two minutes before commencing the next exercise, and lasted for about 45 minutes. The CBT group received flexibility exercises and strength training focusing on the trunk and lower limb muscles, postural control exercise in different positions and different surfaces and general endurance training (Table 3). Control group received intervention in the form of five minutes warm up followed by 12 minutes of walking at their comfortable pace and concluded with a five minutes cool down. All the groups received the above mentioned interventions thrice in a week for a period of 6 weeks.

Table 2: Description of Pilates Exercises

Hundred (with head down): Performed on mat in supine, both lower limb is raised together off the mat to about 30 degrees (initially with knee flexion and later progressed with knee extension)
Shoulder bridge: Performed on the mat in crook lying and lifting the pelvis off the mat; progressed with the use of exercise ball placing below lower leg and lifting the pelvis
Single leg circles: Performed in supine on mat & making circles with lower limb (one after another)
Alternate toe tap: performed on mat with both hips & knees in 90 degree flexion & alternately touching the toes on the mat
Leg pull front (beginner): Performed on the mat in quadruped position with the use of exercise ball placed under one lower leg by pulling it front and back
Spine twist: Performed in kneel standing on mat with Upper limb abducted to 90 degree & twisting the spine from side to side
Ball leg lift: Performed by sitting on the exercise ball and alternately lifting one leg off the floor
Standing side splits: Performed in standing on one leg with the other leg placed on exercise ball & performing side splits by rolling the ball away and close to the stance leg
Ball wall squat: Performed in standing against a wall with the exercise ball in the lumbar region & performing semi squats
Tandem walking: Heel to toe walking in a straight line

Table 3: Conventional Balance Training

Flexibility	Calf, hamstring, quadriceps, hip flexors & hip adductors (15 sec hold and 5 repetition)
Strength	Abdominal (curl ups), spinal extensors (prone extension), hip abductors (side lying with a weight around the ankle), hip extensors (in prone), hamstring (prone knee flexion) and quadriceps (knee extension in high sitting): all movements are given for 10 repetitions
Postural control	Stepping in all direction, reaching to limits of stability in different position (kneeling, half kneeling, standing: on hard surface and foam surface), step up and down, tandem standing and walking, single limb standing (eyes open and closed)
Endurance	Walking for 12 minutes at self-selected comfortable pace on a level surface

Statistical analysis

Analyses were done using SPSS-16. Descriptive analysis was used to calculate mean and standard deviation. Normality of distribution was verified using Kolmogorov-Smirnov test and found to have normal distribution in all data. Repeated measure ANOVA was used to determine intervention effect between the groups for the data. Analysis of FRT, TUG, DGI and RAND-36 scores were done using student's t-test to show change due to PI or CBT program. The level of significance was set at 95%.Clinically meaningful change was assessed by calculating Cohen d for effect size in relation to changes that occurred during the Pilates intervention, conventional balance training and control period. Data were analyzed using an intention-to-treat model.

RESULTS

The groups were homogenous at baseline (Table 3) in their demographic details and outcome scores with p-value >0.05;FRT (p=0.606), TUG (p=0.910), DGI (p=0.759) and RAND-36 (p=0.677). Comparison between groups for baseline scores was done using post hoc Tukey test. Pre and post intervention intra group comparison (Table 4)was done using paired t-test which shows highly significant difference in PI group as well as in CBT group in all the outcome scores (FRT, TUG, DGI& RAND-36 with p=0.000) but no significant difference in the control group for FRT(p=0.085) and RAND-36 scores (p=0.096), while shows some significant difference in the TUG (p=0.022) and DGI scores (p=0.042).The post intervention scores shows highly significant difference (p=0.000) between the intervention groups and the control group(Figure 2). Effect sizes of significant changes are listed in table 4 showing large effect size in both PI as well as CBT group. The largest effect size was evident for the variable RAND-36 for the Pilates intervention. A small effect size for the variable TUG was also noted in the control intervention.

Table 4: Intra group comparison

Variable	Pilates (Mean±SD)			Conventional (Mean±SD)			Control (Mean±SD)		
	Pre	Post	Effect size	Pre	Post	Effect size	Pre	Post	Effect size
FRT	28.5±3.2	38.2±3.4*	2.9	28.6±3.2	34.7±2.7*	2	29.4±2.8	29.6±4.7	NS
TUG	16.5±1.1	12.9±0.8*	3.7	16.6±1.0	15.2±1.0*	1.4	16.6±1.1	16.1±1.0*	0.4
DGI	18.1±0.9	21.0±0.8*	3.4	18.0±0.8	19.1±0.8*	1.3	17.9±0.9	17.7±0.7*	NS
RAND-36	63.9±3.0	82.6±2.1*	7.2	63.2±2.6	73.8±2.8*	3.9	63.9±3.0	63.4±3.1	NS
*p-value <0.05; NS- not significant									

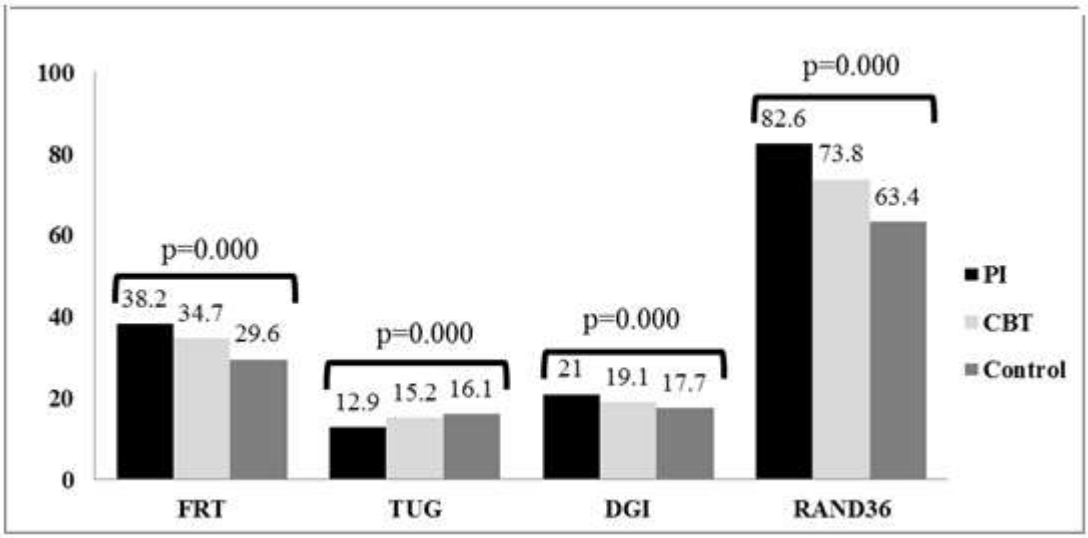

Figure 2: Post intervention inter-group comparison

DISCUSSION

This study provides the controlled evaluation of the effects of 6 weeks of PI and CBT on the variables, functional balance and QOL in ambulatory geriatric population. The overall finding shows that Pilates intervention as well as CBT program leads to significant improvement in functional balance and QOL, however participation in PI lead to statistically significant and clinically greater improvements compared to CBT &control condition of usual activity. This study further adds to the existing literature regarding the importance and benefits of exercise intervention in improving balance in geriatric population. The improvement in functional balance with the experimental intervention (PI as well as CBT) was consistent with the results of previous studies [10-14]. It was also found that participants with poor balance scores at baseline are likely to respond more positively after the intervention which is also in accordance to previous study [11].

Pilates intervention lead to significant and greater improvement in some key balance variables when

compared with CBT. One factor that might have contributed to more improvement in the PI group was the pattern of exercise. The exercises include maintaining a stable posture while concentrating in the rhythm of respiration thereby providing a multi task intervention with increased awareness of kinaesthesia, proprioception and movement co-ordination. Pilates impact on the serotonin hormone reduces depression [21] and also heightens concentration, relieves tension and improves mood, as it actively engages the body and mind [22] which may have a positive influence in the QOL. These findings are in accordance with previous studies [23, 24] as well as in adults[25]. This study not only proves the effectiveness of Pilates and CBT but also provides evidence to the importance of physical activity in the elderly population. One of the findings in the study is that, a regular 12 minutes of walking intervention in the control group also lead to significant improvements in some gait parameters as seen the TUG ($p=0.022$) as well as the DGI scores ($p=0.042$).

The study has certain limitations too. As it was done only in institutionalised elderly individuals, the results could not be generalized to community dwelling elderly individuals who has increased risk of falls. More over it was not possible to blind participants to the intervention, so the belief that Pilates training is of benefit may have been contributed due to the social interaction during group therapy that resulted in positive impact on outcomes. There was also practical difficulty while delivering the interventions at different old age homes which may not be feasible in a non-research set-up. Future research with cross over designs may also be conducted to determine the participants' preference of exercise program between PI and CBT. Further controlled comparative studies with larger sample size are recommended in community dwelling old elderly (75+ years) individuals and those with pathological conditions (e.g. Stroke, Parkinsonism etc.) who are at higher risk of falls and falls related injuries.

CONCLUSION

The results of this study shows that both Pilates as well as Conventional balance training program leads to significant improvement in functional balance and quality of life in elderly individuals who are bound to old age home. However Pilates intervention is found to have greater benefits compared to the conventional balance intervention. Thus Pilates can be incorporated with other physical exercises aimed to improve functional outcome and QOL in the elderly individuals who can help them to age gracefully and enjoy a healthy quality of life.

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