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Effect of group exercise programme on Fall risk, Lower limb strength, fear of fall and quality of life among older adults of India: A feasibility study

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Abstract

Background: The frequency of falls increases with age. Exercise plays an important role in minimizing the fall risk by improving balance and strength.

Methods: A pilot randomized controlled trial was conducted with the objectives to assess the feasibility of a group exercise programme to explore whether a group exercise programme minimizes the fall risk impacting modifiable risk factors of falls in older adults such as fear of fall, lower limb strength and Quality of Life (QoL).Participants included were older adults with age:>60 years, increased fall risk and having fear of fall along with significant concern about their balance also not involved in regular exercise program. 21 participants were randomly assigned to either group exercise programme (N=10) or individualized exercise programme (N=11) for 10 weeks by permuted block randomization method. Demographic data, Timed Up and Go test (TUG), 5-times sit to stand test(5TSTST), Fall Efficacy Scale–I (FES), SF12 were assessed before and after 10 – weeks of intervention.

Results: The experimental group was statistically significant in physical component summary (PCS) ($p<0.00$) and mental component summary (MCS) scores ($p<0.05$) than control group in terms of SF12V2 reflecting the quality of life. The FES, TUG and 5TSTST did not show any statistically significant difference ($p>0.001$).

Conclusion: The results of this feasibility study support future RCT in older adults of India and stated that group exercise programme reduced the risk of fall and fear of fall and improved the lower limb strength and Quality of Life.

Keywords: fall, exercise**,** strength, balance

Introduction

The United Nations has defined an older adult, as an individual over the age of 60 years. India is the second largest population of the older adults (60+) in the world. Among the age related health problems in elderly one of the commonest is falls [1]. Around 30% of generally healthy elderly people over 60 years of age experience a fall each year, and around half of them will have repeated falls [2]. In India, the reported prevalence ranged from 14% to 53% [3].

Risk factors for falls in older adults are multifactorial and complex, comprising of intrinsic factors, including the physiological changes of ageing, frailty and pathologies, as well as extrinsic including environmental and situational factors [4]. However reduced strength and poor balance both are considered the most readily modifiable risk factors for falls and can be improved by specific exercises. Impaired balance and strength are associated with the age related changes like impaired neuromuscular control, decrease in muscle mass decreasing the muscle function aggravating the fall risk [5].

There is strong evidence that physical inactivity is a major risk factor for non-communicable diseases and premature death. Even a small amount of regular physical activity can lead to significant health benefits in older adults. However exercising regularly is a major challenge in this population [6].

Falls in elderly is a major cause of injuries associated with old age leading to considerable morbidity and mortality [7]. Fall-related injuries increase the economic burden related to medical management, hospital stay, and rehabilitation. Impact of fall related injuries was also found significant on physical and mental health of older adults [8].

Consequences of falls include soft tissue injury, fracture, pain, impaired function, decreased confidence in carrying out activities of daily living, loss of independence and autonomy, and sometimes even death [9].

Physical and psychological consequences of falls subsequently reduce the quality of life. Elderly individuals, who fall, with or without sustained injury, may develop a fear of falling [10].

Physiological changes associated with aging leads to deterioration of sensory and neuromuscular control mechanisms as a result of which there is a detrimental effect on postural control. Impaired postural control can seriously affect the physical functioning and is considered as a predictor for falls in older adults [11].

In older adults depression is more common than the rest of the population. One prime characteristic of depression is lack of interest or pleasure, which affects one's ability to initiate activities, including physical activity. Also, older adults suffer disproportionately more personal loss than the rest of the population, including loss of spouse, friends, or family members which contributes to a tendency to stay sedentary. The loss of a spouse, close friends, or relatives has a direct psychological impact on person affecting one's social support structure [12].

Considering the magnitude of the ageing population and socio-economic changes in India, measures to keep older adults healthy and active are of utmost importance [13]. In an effort to address the alarming statistics of fall related injuries, a large number of trials have studied the efficacy of different intervention strategies. Regular physical activity is an integral part to the maintenance of good health and functional independence in older adulthood [14]. Among the most promising strategies studied are those that include physical activity or exercise as either a standalone strategy or core component of a multifactorial intervention approach. Intervention strategies incorporating physical activity have consisted of single exercise like resistance training, walking, tai chi or multimodal exercise programs including aerobic endurance, flexibility, strength, and balance training [15].

Various trials in older populations have demonstrated positive effects of exercises on balance, strength, falling, fear of falling, and general health perception by in minimizing fall risk through balance and mobility improvement [16]. A study done by Mutrie N *et al*. (2007) stated that, the community-based group exercise programmes are easily accessible, affordable and suitable for older people. Also, group exercises have positive impact on psychological status of older adults [12]. In group exercises, working with other participants stimulates individual's efforts and confidence in the own abilities while the performance is guided and controlled by the physiotherapist [17].

However, there is inadequate evidence till date to determine whether group exercise targeted to at-risk older adults is effective in preventing falls. Therefore, to encourage successful aging, interventions that reduce fall risk in older adults need to be studied further. This trial was conducted with the objectives to study the feasibility of a group exercise programme to explore whether a group exercise programme minimizes the fall risk and to study the impact of group exercise programme on modifiable risk factors of falls in elderly individuals such as fear of fall, lower limb strength and Quality of Life (QoL).

Materials and Methods

The study obtained ethical clearance from the Institutional ethical committee of Pravara Institute of Medical Sciences-DU. This pilot study was a part of a parallel-group randomized controlled study (Trial registration: Clinical trial registry of India: CTRI/2016/06/007014) with an allocation ratio of 1:1 was conducted during the year 2018-2019.

Study setting and participants

Study setting

The study was conducted in Dwarkamai old age home at Shirdi, Maharashtra, India. The approval to conduct the study was obtained from the management of old age home. They made announcement about the research. Among them, 72 older adults were approached for pre eligibility screening. Individuals were briefed about the study through an informative lecture, the intervention with a detailed information sheet and a written informed consent was obtained. Out of them 48 potentially eligible older adults were assessed for eligibility out of which 16 did not meet the inclusion criteria.

Inclusion Criteria

Participants (males or females) with age:>60 years, increased fall risk assessed by timed up and go test [TUG score >12 seconds] and fear of fall [FES-I score > 19], significant concern about their balance, not involved in regular exercise program and willing to participate.

Exclusion criteria

Participants excluded were those with a history of traumatic fall within past year, uncontrolled cardiovascular disease, severe cognitive impairments, physical deterioration due to severity of associated co morbidity, neurological disorders, severe depression, undergoing palliative care, those with amputation and having prosthetic limb.

The reasons for the 16 participants out of 48 who responded but who were not satisfying the inclusion criteria were as follows: <60 years old (N=7), and were not having fall risk TUG score <12 seconds and fear of fall [FES score <19] and were already involved in regular physical activity (N=6). Recent history of fracture of lower limb (N=1), stroke with cognitive impairment (N=2). The 32 eligible participants were gathered and information of nature of study was given in the form of a lecture. The contact numbers and emails of the researchers were also

given during the gathering. Out of the eligible participants, 11 were excluded, as they were not willing to participate in the study (8 due to lack of interest and 3 due to time constraint).

Allocation

Twenty one participants were randomly assigned to either group exercise programme or individualized exercise programme for 10 weeks by permuted block randomization method with the help of sealed envelopes. Individuals were randomly allocated while maintaining a balance across intervention groups. Each "block" has a specified number of randomly ordered intervention assignments. Research coordinators and data analyst were blinded to the allocation and intervention. Demographic data, Timed Up and Go test (TUG), 5-times sit to stand test(5TSTST), FES –I Marathi, SF12 Marathi were assessed before and after 10 weeks of intervention by blinded assessors.

Baseline assessment

We used Falls Efficacy Scale –International (FES-I) Marathi language version to assess fear of fall, pre and post-intervention. This is a self-report questionnaire for assessing fear of falling while performing the activities of daily living [18].

Timed Up and Go test was used for assessing the fall risk and functional performance. The TUG is a timed performance of getting up from a chair, walking 3 m, turning around, and walking back to sit down again. A faster time indicates a better functional performance and a score of ≥12 seconds is used as a cut-point to identify those at increased fall risk in the community setting. Excellent inter-rater and intra-rater reliability has been established for use of the TUG in community dwelling elderly population. [19,20]

Lower limb strength was assessed by 5- times sit to stand test [Chair-stand test] for assessment of simple chair stand test, which may identify lower-extremity weakness, poor muscle power, and limitations in dynamic balance, may be sufficient for evaluating performance as part of a risk stratification strategy for injurious falls [21, 22].

Short Form 12 (SF 12) was used to examine the quality of life (QoL). The SF-12 is a shorter version of the SF-36 and uses only 12 questions to measure functional health and wellbeing from the patient's perspective. It consists of 12 items: 2 items on physical functioning, 2 items on role physical, 1 item on bodily pain, 1 item on general health, 1 item on vitality, 1 item on social functioning, 2 items on role emotional, and 2 items on mental health. SF-12 is a reliable and valid measure of health status [23].

Detailed intervention protocol

The exercise program included the therapeutic elements which have been identified as most beneficial for older adults. The intervention consisted of warm up, balance retraining exercises and lower limb strengthening exercises derived from Otago Exercise Programme (OEP) forming the core program, which focus on balance and strength [24]. The duration of intervention was for 2 times in a week for the period of 10 weeks. Duration of each session was from 30 minutes initially then gradually progressing to 60 minutes. The intervention protocol was implemented to the experimental group consisting of 5 participants in each group and the same protocol was implemented to the control group individually i.e. one participant at a time. Emphasis was put on a correct and safe performance.

Intervention received by both the groups is as follows

Warm up: This consisted spot marching, mild stretching of large muscles groups for 10 seconds each.

Lower limb strengthening exercises: Target muscle groups were hip extensors and abductors, knee flexors and extensors, inner range quadriceps and ankle plantar and dorsiflexors which are considered to be important for gait [12].

Exercises derived from OEP were given using elastic resistance bands varying from low resistance to high resistance. Intensity of exercises was defined by level of difficulty, fatigue and number of repetitions starting from 12 – 13 RPE (somewhat hard) and progressing to 14 – 16 RPE (hard) with 10 – 15 repetitions (moderate resistance until muscle fatigue) and then 8 – 12 (high resistance until muscle fatigue). Initially 1 set progressing to 2, 3 sets of exercises with 2 minutes rest between sets.

Balance retraining exercises: These exercises were derived from OEP. Exercises comprised of sit to stand and knee squats starting from 10 repetitions with support then progressing to 3 sets of 10 repetitions without support, tandem stance, single limb standing with support and eyes open and progressing to eyes closed for 10 seconds without support, tandem standing to tandem walking; walking backwards, sideways walking, walking and turning around 10 steps 4 times with support then 10 steps 4 times without support [24].

Observations and Results

The data were analyzed by SPSS V20.Independent sample student t test was used for between group analyses. The mean age of the participants in the current study was 67.5 ± 5.1 years. Among all the participants 12

(57.1%) were women. The baseline comparison of the participants in both the groups revealed non-significant difference between both the groups. (Table 1).

Table 1: Baseline comparison of demographics and parametric variables

Variables	Experimental group	Control group	*p*
Age	69.5 ± 5	69.4 ± 5.4	>0.05
BMI	26.2 ± 1.2	26.1 ± 1.3	>0.05
TUG	13.4± 1.4	13.8 ± 1	>0.05
FES	33.4 ± 11.8	30.7 ± 9.3	>0.05

p – Value: * < 0.05, *** < 0.00

All the participants completed the intervention in allocated groups. No drop out or adverse event reported. Thus the percentage of retention in the groups was 100%. The between group analysis showed that experimental group was statistically significant in physical and mental parameters i.e. physical component summary (PCS) and mental component summary (MCS) scores than control group in terms of SF12V2 reflecting the quality of life. The FES, TUG and 5TSTST did not show any statistically significant difference in between group comparison. (Table 2)

Table 2: Independent Sample t–test: Difference in Means: Pretest vs Posttest by Groups

Variable	Difference in Means: Pre vs Post by Groups		t-value (df)	Confidence Interval
	Experiment (N = 10) Mean ±SD	Control (N = 11) Mean ±SD		
FES	5.20 ±3.49	6.45 ±3.36	-0.84 (19)	-4.38, 1.87
TUG	2.35 ±0.80	2.44 ±0.65	-0.27 (19)	-0.75, 0.57
5TSSTS	2.53 ±0.99	2.58 ±0.51	-0.15 (19)	-0.80, 0.71
PCS	6.67 ±3.17	0.93 ±1.09	5.68 [19] *** **********	3.43, 8.07
MCS	4.45 ±3.55	1.07 ±1.00	3.04 (19) *	0.81, 5.96

p–value: * < 0.05, *** < 0.00

Discussion

This study investigated the effects of group versus individualized exercise program, both derived from Otago Exercise Programme on fall risk, fear of fall, balance and lower limb strength of elderly individuals with evidence for effectiveness in preventing falls. Key components in the exercise programme were strength and balance as these are most readily modifiable factors in fall prevention of older adults [5]. Furthermore, it was taken into consideration that group-based training is recommended for elderly individuals to increase motivation for participation.

Timed up-and-go test was conducted to assess the fall risk and functional status of elderly individuals. The mean TUG score of both the experimental and control group and the intervention group decreased after10-weeks intervention period, but while the observed increments were different between the groups, they did not achieve statistical significance

(p =0.78). These results suggest that the supervised group exercise program and the individualized exercise program, which both consist of strength and balance training exercises, had a positive impact on reducing fall risk. These is in accordance with the study by Zhuang J. *et al*., (2014) which evaluated the effectiveness of a 12-week, combined exercise intervention, which consisted of balance exercises, strength training, Tai-Chi, and flexibility/stretching exercises, for older Chinese community-dwellers. Results of the TUG test suggested that there was significant improvement in the mobility and balance [25]. Similar results were obtained by Maritz *et al*., (2013), in a study which evaluated the impact of a 10-week, moderate intensity, group-based exercise program and suggested that the exercise intervention had a positive effect on lower extremity strength and functional mobility, and the exercise intervention reduced the fall risk among community-dwelling adults [26].

Fear of falling (FOF) has been identified as a risk factor for falls [7]. In current study both the groups significantly reduced FOF after intervention but between group comparison showed no significant difference in outcome scores (p=0 .41). This result stated that both the groups significantly reduced FOF and none of the group was superior. This is in line with a study involved balance training in a geriatric setting and achieved a 3% decrease in fear of falling measured using the Falls Efficacy Scale International questionnaire [27]. Similar conclusions were drawn from previous studies that therapeutic exercises helps to successfully manage the FOF and unnecessary avoidance of activity in community dwelling elderly individuals. Also, promotes independence, function, wellness, and safety of older adults [28].

In the present study, improvements in lower extremity strength were shown by both groups after the intervention. No between-group differences were found. Moreover, the results suggest that older adults who engage in exercise programmes at least 10 weeks are likely to experience a modest achievement in strength. There are several possible explanations for this finding. An increase in muscle strength can be the result of neural adaptations and an increase in muscle fiber size. In accordance with the specificity principle of exercise training; the adaptive effects of training are highly specific to the training method employed [29]. Previous

investigations have found large and promising evidence that older muscles respond vigorously to resistance training with increased motor activation, while myofiber hypertrophy can increase muscle mass, strength, and power. Myofiber hypertrophy can also reduce the difficulty of daily tasks, enhance energy expenditure and body composition, and promote participation in spontaneous physical activity [30]. Another study reported that improvements in lower extremity strength enhance the balance of the elderly [31]. Similar study stated that elastic-resistance exercises improve muscle strength and stability by improving proprioception of the neuromuscular system through muscle contraction and the stimulation of the proprioceptive senses [5].

The present study assessed the participants' quality of life with Short Form 12. Within group analysis of both the groups showed improved physical (PCS) and mental composite scores (MCS) after intervention. This is in accordance with the study of Acree et al. who concluded that healthy older adults who regularly participated in physical activity of at least moderate intensity for more than1 hour per week had higher HRQOL measures in both physical and mental domains than those who were less physically active [32]. It was noticeable in between group comparison that there was statistically significant difference in both the groups (PCS: $p<0.000$ and MCS: $p< 0.007$). This finding suggests that group exercises with peers promote socialization through potential interaction. Also the encouragement, improved mood and confidence might have contributed to make group exercise program more successful than individualized exercise programme. In control group, training one participant at a time might have led to monotony and boredom. Group created a joyous social atmosphere among the participants. This motivational outcome is important for adherence to any exercise programme and for general wellbeing [8].

Limitations

This study comes with several limitations. First of participants were not blinded to the intervention. Similarly, specific sophisticated tools such as Biodex Balance System^{SD} could have been used to evaluate the balance and fall risk.

Conclusion

It was concluded that group exercise programme can benefit the elderly individuals by minimizing the risk of fall and fear of fall and improving the lower limb strength and Quality of Life. The results of this feasibility study support future RCT in older adults of India. The group programme can be a viable option that can be easily implemented in any facility that provides care for the older adults. It has cost effectiveness, feasibility for application and can be performed by many individuals at the same time. Finally, the study demonstrated that participation in a group exercise programme twice a week was an adequate dose to minimize the fall risk and improving overall functional fitness levels older population.

Recommendations

- This pilot study shows participation in group exercises leads to motivation and increases adherence to the intervention.
- Group exercise programmes are most likely to be successful in enhancing Quality of Life of older adults by improving their physical and mental health.
- Future large-scale RCTs should include sufficient participants to clarify the effects of group exercise programme and whether the intervention provides a clinically significant effect on the fall risk, balance and strength in older adults.
- Furthermore, future studies should use specific instruments to investigate the effects on balance.

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Conflicts of interest

None declared

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