

Original Research

Received 18 March 2026

Revised 25 April 2026

Accepted 15 May 2026

Natural Resources for Human Health 2026, Vol. 6 (3): 1072–1079

KEYWORDS:

Older adults, Balance and Strengthening Exercise, Fall, Injury

Investigating the Effectiveness of Balance and Strengthening Exercise and Modification of Home Environment on Risk for Fall among Older Adults in Rural Community

Sumathi Mani¹, Poongodi Ramalingam², Punitha Josephine Santhanasamy³, Vidhya Thirunavukkarasu⁴, Sindhu Ramalingam⁵, Vathana Pazhanivelu⁶, Aruna Subramaniam⁷

¹ Formal Faculty, Sri Ramachandra Faculty of Nursing, Department of Community Health Nursing, Sri Ramachandra Institute of Higher Education and Research (Deemed to be University), Chennai 600116, India. poongodimohan@sriramachandra.edu.in

² Sri Ramachandra Faculty of Nursing, Department of Community Health Nursing, Sri Ramachandra Institute of Higher Education and Research (Deemed to be University), Chennai 600116, India. poongodimohan@sriramachandra.edu.in

³ Sri Ramachandra Faculty of Nursing, Department of Community Health Nursing, Sri Ramachandra Institute of Higher Education and Research (Deemed to be University), Chennai 600116, India. aruna.s@sriramachandra.edu.in

⁴ Kasturba Gandhi Nursing College, Sri Balaji Vidyapeeth (Deemed to be University), Puducherry 607402, India. psysspj2011@gmail.com

⁵ College of Applied Medical Sciences, King Faisal University, Al Hasa, Saudi Arabia. drvidhyatr@gmail.com

⁶ Saveetha College of Nursing, Saveetha Institute of Medical and Technical Sciences (SIMATS), India. sindhuramalingam.scon@saveetha.com

⁷ College of Applied Medical Sciences, King Faisal University, Al Hasa, Saudi Arabia. drvidhyatr@gmail.com

ABSTRACT:

Background: India is an aging society, the prevalent problems experienced by the older adults include sleep disorder, problems with eating or feeding, incontinence, confusion, depression, evidence of fall and skin break down. Falls are a leading cause of death in older adults. Falls lead to 20% to 30% of mild to severe injuries and major cause of 10% to 15% of all emergency department visits. Fall related injuries typically occur in the home. The main purpose of this study is to determining the effect of family focused nursing interventions on level of risk for fall among older adults at selected rural community, Chennai (India).

Materials and Methods: A true experimental study, two group pre and post-test was conducted among 220 older adults with risk of fall. Systematic sampling method was used to select the samples and screening of an older adults using Fulmer SPICES tool, risk for fall was assessed using Screening Assessment for Fall Evaluation (SAFE) tool. The balance and strengthening exercise and modification of home environment was administered to the older adults living in the community setting.

Results And Discussion: After administration of intervention, the overall means score for risk for fall 3.37 with the SD 1.21, whereas in control group, it was 7.35 with the SD

1.93 with t value 18.26, proved that there was a high statistical significant reduction of risk for fall in the experimental group (29.7%) than the control group (1.6%).

Conclusion: Balance and strengthening exercise and modification of home environment help to reduce the risk for fall significantly among older adults and promote active aging in community settings.

1. INTRODUCTION:

Normal aging brings about inevitable and irreversible changes. These normal ageing changes are partially responsible for the increased risk of developing health related problems within the elderly population. Many of the health problems faced by older persons are the result of risk factors such as smoking, lack of physical activity and unhealthy diets. Maintaining an active lifestyle is one of the most cost-effective ways to stay healthy. An active lifestyle means older persons continue to participate in social, economic, cultural, spiritual and civic affairs. Longer life is a benefit to individual and community only if the quality of life is maintained¹.

Globally, the number of people aged 60 years and above is growing faster than any other age group. It is estimated that by 2050, for every one child there will be two elderly people². Older adults in the rural community face special challenges because of geographical isolation, high poverty level and declining of self care abilities and less access to health care providers. Majority of the older adults are less engaged in health promoting activities and often under served by health care personnel. The rural older adults face medical indifference, not only in hospital care, but elder nursing homes, recreation facilities and old age centres are over whelming us presently in the urban areas. With such a huge mismatch in the urban rural population and health care system, elderly in India faces an uphill task.

Falls are a common public health problem among the older adults in many communities. Falls are a significant threat to the safety, health and independence of older citizens. Around 30% of community dwelling elderly fall each year and some fall repeatedly. Every 17 seconds an adult over 65 years of age will fall and subsequently seek medical help in emergency department³. The Center for Disease Control and Prevention reported that 1 in 3 adults aged 65 years and older will experience a fall in a year. 20% to 30% of those who fall will sustain a moderate to severe injury⁴.

The global burden of Years Lived with Disability (YLD's) due to fall in adults aged 50 and 69 years was 66% in developing countries compared with 34% in developed countries. In 2010, falls accounted for over 77% and 85% of YLD's resulting from unintentional injuries than traffic accidents in adults aged 50 to 69 years and 70 and over. People aged 65 and older have the highest risk for falling with 30% and 50% of people older than 80 falling at least once in a year⁵.

Among older adults, falls are the number one cause of fractures (hip, pelvis, spine arm hand or ankle), most common reason for hospital admissions for trauma, loss of independence, need long term care and deaths. 20% to 30% of traumatic brain injuries occur due to fall⁶. The economic impact of falls is critical to family, community, and society. Fall incurred costs are categorized as direct and indirect cost. Direct costs include health care costs such as medications and other services such as consultation and rehabilitation services. Indirect costs include loss of income due to inability of individuals or family caregivers to undertake productive activities due to the older adults fall related injuries⁷.

Regular participation in moderate physical activity is integral to good health and maintaining independence. Exercise reduces the risk for falling by 10% and balance training programs reduces the risk by nearly 20%. Exercise can improve the balance, mobility and control the weight thereby contributing to healthy bone, muscles and joints by stimulating the proprio receptors. It can increase bone mineral density of postmenopausal women and individuals aged 70 years and over⁸.

Strength and balance training is recommended for older adults and is most likely to be beneficial to older people living in the community with a history of recurrent falls and/or balance and gait deficit. A muscle-strengthening and balance programme should be offered. This should be individually prescribed and monitored by an appropriately trained professionals⁹. Regular participation in moderate physical activity is integral to good health and maintaining independence. Exercise reduces the risk for falling by 10% and balance training programs reduces the risk by nearly 20%. Exercise can improve the balance, mobility and control the weight thereby contributing to healthy bone, muscles and joints by stimulating the proprio receptors. It can increase bone mineral density of postmenopausal women and individuals aged 70 years and over⁸.

Protective factors for fall in old age are behavioral change and environmental modification. Behavioral change to healthy life style to prevent falls includes taking adequate amount of nutritious diet, regular physical check up, screening and follow up, doing regular exercise, maintaining sound sleep and optimum body weight and staying mentally active⁷.

2. MATERIALS AND METHODS:

The present study is a true experimental two group pre-test and post test design. Totally 220 older adults were selected based on inclusion criteria like older adults aged 60 years and above, willing to participate, permanent residents of community (village) area, had risk for fall (mild, moderate, severe risk) older adults. Moreover, the older adults who are paralyzed, physically immovable, advised for immobilization after surgery were excluded from the study. Random systematic sampling method was used to select the samples After obtaining the informed consent, all older adults residing in villages were screened for older adult problems using Fulmer SPICES tool. By cluster randomization the experimental and control group were selected and level of risk for fall was assessed using Screening Assessment for Fall Evaluation (SAFE) tool and body balance by “get up and go test” for both the groups.

After assessment of personal and environmental factors related to risk for fall, the researcher demonstrated balance and strengthening exercise to the older adults which included knee flexion, plantar flex, side leg rise, leg extension, and hip extension for experimental group. Each exercise was to be done 5 times in both right and left side of the limbs. The older adults were instructed to continue to practice the exercises daily for 15 minutes once a day for 6 months. The balance and strengthening exercise adherence were assessed by maintaining diary and non-participatory observation technique. Same time modification of home environment was carried out based on their need. Community routine care followed for the control group. After the intervention at the end of first, sixth- and nine-month interval, the same tool was utilized to assess the risk for fall and body balance. Reinforcement of intervention was given using video show. At the end of the study period the intervention administered to the control group also.

The data were collected using demographic variables including age, gender, religion, diet pattern, marital status, educational status, occupational status, type of family, family income, family size and family support system and history of chronic illness, activities of daily living, type of recreational activity and previous history of fall.

To evaluate the risk for fall, the SAFE tool with the components of personal factors including “get up and go test” and Environmental factors consisted of 15 items. SAFE tool had dichotomous options for personal and environmental factors like Yes or No. For get up and go test score ‘2’ was for multiple attempts to rise from the chair, ‘1’ for pushed up and successful in one attempt and ‘0’ for able to rise in single movement. The total score was 15. The results were interpreted as high SAFE score indicates high risk for fall and low SAFE score indicated low risk for fall. The score 0 represent no risk, 1-5 score indicate low risk, 6-10 is moderate risk and 11-15 indicate high risk for fall. The reliability was established by using Cronbach’s alpha and Inter Rater method. The r' value was obtained as 0.90 and the tool tended to be reliable to conduct the study.

This research study was reviewed and approved by the Screening Committee of the The Tamil Nadu Dr.M.G.R.Medical University and Ethics committee of Omayal Achi college of Nursing. The conceptual frame work for the present study was based on the Integrated theory of Robert R. Carkhuff helping and human relations theory and Stuffle Beam CIPP evaluation model¹⁰ which guided the investigator through a systematic approach in reduction of risk for fall among older adults.

The reliability for the background variables i.e general demographic variables, clinical variables, structured knowledge questionnaire, modified SAFE tool, and Pittsburg sleep quality Index tool (PSQI) were assessed using Inter - rater method. The ‘ r ’ value was 0.9 for all the tools and so the tools were found to be reliable.

The collected data were analyzed using the statistical software package of SPSS version 17 (statistical pakage for the social sciences) and descriptive statistics, frequency distribution tables, and statistical tests (t -test, ANOVA, and Pearson's correlation coefficient at significance level of 0.05).

Results: The data revealed that in the experimental group, 50.9% were in 60 to 65 years, 50% were males and females, 67.6% were Hindu religion, 71.31% were married, 50.9% were non literates and 42.6% were unemployed, 41(38.0%) had diabetes mellitus, 92(85.2%) lived independently and 73(67.6%) had no history of previous history of fall. Whereas in control group, 48.2% were in 60 to 65 years, 52.7% were females, 65(58%) were Hindu religion, 71.4% were married, 44.6% were non literates

and 47.3% were unemployed, 33.9% had diabetes mellitus, 85.7% lived independently, and 67.9% had no history of previous history of fall.

The study results showed that in one month and third month after the initiation of intervention there was a marked reduction in risk for fall but at the end of sixth month (post-test 3), 83.3% older adults had moved to the mild risk for fall and 16.7% older adults had moderate risk for fall and no one had high risk for fall in experimental group, whereas in control group 82.1% were still in the moderate risk for fall.

The mean score of risk for fall related to physical and environmental factors is significantly very high among older adults in both experimental and control group before and immediately after initiation of intervention. But after the intervention like balance and strengthening exercises and modification of room environment significantly reduced the risk for fall among older adults ($t=12.93$) in experimental group than the control group at the third- and sixth-month interval. Table 2 and 3 shows the comparison of mean and standard deviation and student independent “t” test value older adults risk for fall regarding physical factors and environmental factors. The study concluded that there was a significant reduction of risk for fall rate by 29.7% in experimental group and 1.67% reduction of fall in control group older adults at the end of the sixth month after administration of intervention like balance and strengthening exercise and modification of home environment. There was a significant association of age, and type of family at $P<0.05$ level and educational status at $P<0.01$ level.

3. DISCUSSION:

The study findings related to overall pre-test and post-test level of risk for fall among older adults in experimental and control group, revealed that in the pre-test the majority of older in experimental group 84(77.8%) had moderate risk for fall. Similarly, 92(82.1%) had moderate risk for fall, 4(3.6%) had high risk for fall in control group. In post-test 1 (at the end of one month) i.e. home safety education and balance and strength exercise, 23(21.3%) older adults had mild risk for fall and no one had high risk for fall. Whereas in control group majority 92(82.1%) older adults still had moderate risk for fall.

In the post-test 2 (at the end of the 3rd month) i.e. after the reinforcement of daily practice of balance and strengthening exercise including modifying their home environment, the analysis revealed that, 66(61.1%) had mild risk for fall, 42(38.9%) had moderate risk for fall in experimental group. Whereas in control group majority, 92(82.1%) older adults still remained at moderate risk for fall.

After the 3rd level of reinforcement (end of the 6th month) i.e. after the reinforcement of daily practice of balance and strengthening exercise including modifying their home environment, the analysis revealed that, majority 90(83.3%) older adults had mild risk for fall, 16(16.7%) had moderate risk for fall and no one had high risk for fall in experimental group. In contrast, in control group majority, 92(82.1%) older adults still had moderate risk for fall.

The conceptual frame work for the present study was based on the Integrated theory of Robert R. Carkhuff helping and human relations theory and Stuffle Beam CIPP evaluation model which guided the investigator through a systematic approach to approach the older adults with risk for fall.

The above description clearly highlights that the risk for fall of older adults in experimental group had reduced to a great extent. In post-test 1 there was not much significant changes noticed in experimental group because initiation of new practice of exercise was very difficult at the older adult age. But after reinforcement of older adults by direct visit, flashcard older adults were motivated to adhere the exercise programme and investigator was able to modify the home environment as much as possible.

The above findings are more consistent with the study conducted by Gusi N, Carmelo Adusar J, et al., (2012)¹¹, Jennifer R. Day, Lourdes C. Ramos et al., (2012)¹², Gillespie LD., et al., (2012)¹¹, Choi M, Hector M (2012)¹³. These findings suggest that balance and strengthening exercise, modification of home environment helps to reduce the risk of fall significantly.

Similarly the means score of risk for fall in the pre test experimental group was 7.69 with the SD 1.43, similarly in control group, it was 7.56 with SD 1.73. The unpaired ‘t’ test value of $t=0.57$ shows that there was no significant difference in the pretest level of risk for fall among older adults between the experimental and control group.

With respect to post test 1, the experimental group overall mean score was 7.10 with the SD 1.59, whereas in control group, it was 7.53 with the SD of 1.75. the unpaired ‘t’ test value of $t=1.88$ showed that there was no statistical significant difference in

the post test 1 risk for fall between experimental and control group. This infers that adherence to strength and balance exercise and initiation of new practice of exercise was difficult at initial stage of intervention phase among older adults.

With regard to post test 2, in experimental group, overall mean score was 5.22 with the SD 1.31, whereas in control group, it was 7.43 with the SD 1.81. The unpaired 't' test value of $t=10.33$ was greater than the table value and proved that there was a high statistical significant difference in the post test 2 risk for fall between experimental and control group at $p<0.001$ level. The adherence of balance and strengthening exercise with reinforcement were effective in reducing the risk for fall among the older adults in experimental group.

With regard to post test 3, in experimental group overall mean score was 3.37 with the SD 1.21, whereas in control group, it was 7.35 with the SD 1.93. The unpaired 't' test value of $t=18.26$ was greater than the table value and proved that there was a high statistical significant difference in the post test 3 risk for fall between experimental and control group at $p<0.001$ level. In post-test 3 levels, there was a significant reduction of risk for fall in experimental group than in control group. It was proved that balance and strengthening exercise, and change in the external environment were important to reduce the risk for fall. This results are highly consistent with the study conducted by Takshashila et al., (2012)¹⁴, Rula LA, Varasfabra, et al., (2012)¹⁵, Nyman SR, Victor CR (2012)¹⁶, Beling J, Roller M (2009)¹⁷, Reid KJ Baron KG, Lu B, et al., (2010)¹⁷, Chase, Carla A et al (2012)¹⁹, Jayestri, et al., (2014)², Zisberg A, (2010). The study concluded that there was a significant reduction of risk for fall rate by 29.7% among older adults after implementing the balance and strengthening exercise and modification of home environment.

The ultimate result of this study showed that balance and strengthening exercise and modification of home environment can be used as an effective intervention tool by community health nurses, nurse educators, nurse administrators and nurse researchers and other health care professional in improving the health of the older adults.

4. CONCLUSION

The research phenomena focused on effectiveness of balance and strengthening exercise and modification of home environment on risk for fall among older adults were assessed. The research investigator utilized the included balance and strengthening exercise, possible modification at home environment, sleep hygiene and breathing exercise. The study concluded that there was a significant reduction of risk for fall rate by 29.7% among older adults. The study result proposes and the research investigator also recommends that the utilization of these interventions any setting will help to prevent fall and promote active aging.

Conflicts of interest

There are no conflict of interest

Funding: Nil

Acknowledgement: We extend out sincere thanks to all older adults who were participated from the selected villages for the study

REFERENCES:

- [1] World Health Organization (WHO). WHO global report on falls prevention in Older age. Available at: http://www.who.int/ageing/publication/Falls_Prevention7Marchpdf. Accessed at 5 March 2012.
- [2] United Nations. Department of Economic and social affairs population Division, World population Ageing 2013 ST/ESA/SER.A/348.
- [3] Lachman ME, Howland J, Tennstedt S, Jelte A, Assmann S, Petersen EW. Fear of falling and activity restriction. The survey of activities and fear of falling in the elderly (SAFE). J. Gerontol Psychol Sci Soc Sci. 1998; 53: 43 – 50. Cross Ref.
- [4] Renfro Mo, Fehrer S. Multifactorial screening for fall risk in community dwelling older adults in the primary care office; development of the fall risk assessment and screening tool. J. Geriatric Phys Ther. 2011 Oct – Dec, 34(4): 174 – 83.

- [5] Heather Hestekin, Tristan O'Driscoll et al. Measuring Prevalence and risk factors for fall related injury in older adults in low- and middle-income countries results from the WHO Study on Global AGEing and Adult health (SAGE) working paper No.6 July 2013.
- [6] Gururaj.G. The First Indian Injury Report – Problems to solutions Report submitted to the Natural Commission on Macro Economics and Health, Ministry of Health and Family Welfare, New Delhi, 2005.
- [7] World Health Organization (WHO). WHO global report on falls prevention in Older age. Available at:http://www.who.int/ageing/publication/Falls_Prevention7Marchpdf. Accessed at 5 March 2012.
- [8] Bloom G, Harrison et al. Evidence based Recommendation for the Assessment and management of sleep disorder in older persons JAGS 57:761-789, 2009.
- [9] NICE (National Institute for Health care excellence) Clinical Guidelines 161. Falls: Assessment and prevention of falls in older people available at guidance.nice.org.uk/CG161.2009
- [10] Carkhuff R. The art of helping. 4th ed. Amherst: Human Resource Development press; 1983. Available at http://currentnursing.com/nursing_theory/helping_human_relationships_theory.html
- [11] Gillespie LD, Robertons MC, Gillespie WJ, Lamp SE et al. Intervention for preventing falls in older people in the community available at Cochrane data base syst.Rev,2012;9
- [12] Jennifer et al., Falls in community dwelling older adults are often preventable. The Nurse Practitioner, The American Journal of primary health care. Wolters Kluwer/Lippincott Williams and Wilkins. July 2012 Vol.37.
- [13] Choi M, Hector M, Effectiveness of intervention programme in preventing falls: a systematic review of recent 10 years & metaanalysis J. Am. Med. Dir. Assoc. 2012 Feb; 13(2): 188.
- [14] Takshashila et al. Effectiveness of ten weeks of balance and strength training on dynamic balance of older adults among 52 older adults aged between 60 to 75 years at India. Cochrane data base syst.Rev 2012(59).
- [15] Rula LA, VarasFabra., et al., Effectiveness of a multifactorial intervention program to prevent falls among older adults in Spain. American Journal of Occupational Therapy. 66(3):284-291, May/June 2012.
- [16] Nyman SR, Victor CR, Older people's participation in and engagement with falls prevention interventions in community settings; an augment to the Cochrane systematic review. Age Ageing. 2012 Jan ;41(1): 16-23. Epub 2011 Aug 28.
- [17] Beling J, Roller M. Multifactorial intervention with balance training as a core component among fall prone older adults. Journal of Geriatric Physical Therapy. 2009; 32(3): 125-33
- [18] Reid KJ, Baron KG. Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia 2010 Oct; 11(9) 934 – 40.
- [19] Chase Carla, Mary Kathryn et al., Systematic Review of the effect of Home modification and fall prevention programmes on Falls and the performance of community Dwelling older adults. American Journal of Occupational therapy. 66(3):284-294 May/June 2012.
- [20] Jayestri, et al., Effectiveness of progressive muscle relaxation therapy with deep breathing exercise on sleep among the elderly. TNNMC JCHN Vol II/Issue 1/ Jan-Jun 2014 pp:4-7
- [21] Arjun Adlaka. US Department of Commerce. International trends in India. Available at <http://www.census.gov/population/International/files/ib-9701.pdf>.

Table 1: The comparison of risk for fall score of subjects before and after balance and strengthening exercise and modification of home environment

N=220

Level of risk for fall		Group				Chi square test
		Experiment n=108		Control n=112		
		No	%	No	%	
Pretest	No risk	0	0.0	0	0.0	$\chi^2=1.11$ d.f=2 P=0.57 NS
	Mild risk	21	19.4	16	14.3	
	Moderate risk	84	77.8	92	82.1	
	High risk	3	2.8	4	3.6	
Posttest1	No risk	0	0.0	0	0.0	$\chi^2=5.46$ d.f=2 P=0.07 NS
	Mild risk	25	21.3	16	14.3	
	Moderate risk	82	78.7	92	82.1	
	High risk	0	0.0	4	3.6	
Posttest2	No risk	0	0.0	0	0.0	$\chi^2=53.08$ d.f=3 P=0.001*** S
	Mild risk	66	61.1	16	14.3	
	Moderate risk	42	38.9	92	82.1	
	High risk	0	0.0	4	3.6	
Posttest3	No risk	0	0.0	0	0.0	$\chi^2=102.65$ d.f=2 P=0.001*** S
	Mild risk	90	83.3	16	14.3	
	Moderate risk	16	16.7	92	82.1	
	High risk	0	0.0	4	3.6	

*significant at $p<0.05$, **significant at $p<0.01$, *** significant at $p<0.001$

Table 2 shows the comparison of mean and standard deviation of older adults personal factors in relation to risk for fall before and after intervention in experimental and control group

Level of risk for fall related to personal factors	Group				Student independent t-test
	Experiment n=108		Control n=112		
	Mean	SD	Mean	SD	
Pretest	4.86	1.20	4.61	1.42	t=1.43 p=0.15
Posttest1	4.28	1.49	4.61	1.42	t=1.67p=0.10
Posttest2	3.44	1.43	4.59	1.45	t=5.89 p=0.001***
Posttest3	1.98	1.18	4.54	1.47	t=14.25 p=0.001***

*significant at $p<0.05$, **significant at $p<0.01$, *** significant at $p<0.001$

Table 3 shows the comparison of mean and standard deviation of older adults environmental factors in relation to risk for fall before and after intervention in experimental and control group

Level of risk for fall related to Environmental factors	Group				Student independent t-test
	Experiment n=108		Control n=112		
	Mean	SD	Mean	SD	
Pre test	2.82	0.77	2.96	0.74	t=1.28 p=0.19
Post test 1	2.82	0.77	2.92	0.76	t=0.92 p=0.35
Post test 2	1.84	0.67	2.91	0.77	t=10.98 p=0.001***
Post test 3	1.39	0.73	2.80	.88	t=12.93p=0.001***

*significant at p<0.05, **significant at p<0.01, *** significant at p<0.001

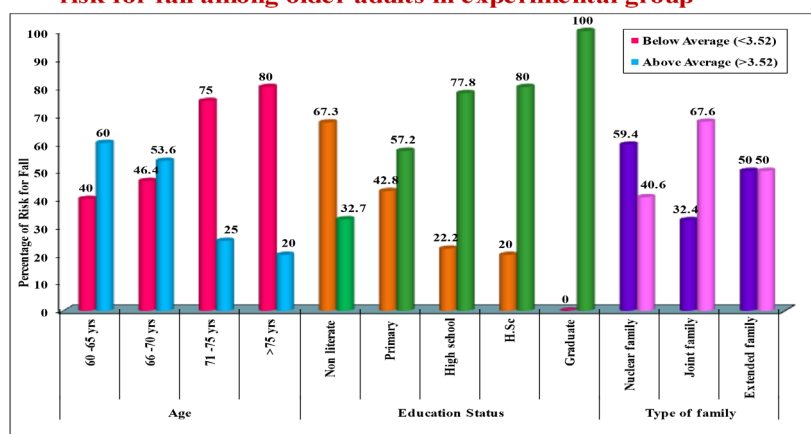
Table 4 shows the overall comparison of pre-test and post-test level of risk for fall cumulative mean score among older adults in experimental and control group

N = 220

Group	Pretest		Posttest1		% reduction of risk for fall 95% CI	Posttest2		% reduction of risk for fall 95% CI	Posttest3		% reduction of risk for fall 95% CI
	Mean score	%	Mean score	%		Mean score	%		Mean score	%	
Experiment n=108	7.69	52.2	7.10	47.3	4.9	5.22	34.8	17.4	3.37	22.5	29.7
Control n=112	7.56	50.4	7.53	50.2	0.2	7.43	49.5	0.9	7.35	49.0	1.6

Association of age, education, type of family with the level of risk for fall among older adults in experimental group

N=220



*significant at P<0.05, ** significant at P<0.01, ***Significant at P<0.001

Fig 1 shows the association of selected demographic variables like age, educational status and type of family of older adults with the level of risk for fall reduction score in experimental group