



CORRELATION BETWEEN GAIT ABNORMALITY RATING SCALE-MODIFIED AND FALL EFFICACY SCALE-INTERNATIONAL IN COMMUNITY DWELLING AMBULATORY ELDERS

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Abstract : **BACKGROUND:** Ageing causes greying and deterioration of various body system leading to number of health conditions and consequences relation to it, the most common consequence being risk of falling which ultimately make living for older adults difficult. Also, any threat to balance induces changes in the strategies for standing and walking - the stance and gait base is widened, bipedal floor contact is prolonged, step length becomes shorter, the feet are lifted less high during the swing phase, walking becomes slower and the posture becomes stooped. Thus, analysis of gait parameters has become very essential for the prevention of risk of fall. This study was conducted as the interconnection between fear of falling and gait disturbances as assessed via GARS-M and FESI have not been thoroughly investigated. **PURPOSE:** The purpose of this study was to investigate a possible correlation between GARS-M and FES-I in community-dwelling ambulatory elders, scales designed to predict risk of falling. **SUBJECTS:** Thirty-five community-dwelling elders walking without assistive device, with a mean age of 65.1 years participated in the study. **METHODS:** This study was a cross-sectional analytical and purposive study. It was conducted in Vikhe Patil Memorial hospital and Matoshri Geriatric center, vilad ghat. The sample consisted of 35 participants above 60 years of age. To collect data, questions related to fear of falling was determined using Fall Efficacy Scale-International. The GARS-M was scored from the videotapes of subjects walking at their self-selected paces. Gait characteristics was recorded during a timed walk on 6-m long runway. **RESULT:** A significant positive linear correlation between GARS-M and FES-I as statistically evaluated by Pearson correlation coefficient test was observed. A strong correlation amongst individual fall risk category was not obtained due to small sample size. **CONCLUSION:** The findings indicate that within this sample, gait disturbances were a key factor for fear of falling in community-dwelling older adults above 60 years of age.

KEY WORDS: Ageing, Fear of fall, Gait disturbances, GARS-M, FES-I, Correlation

INTRODUCTION

Ageing is the process of becoming older. It causes greying and deterioration of various systems, leading to a number of health problems and consequences related to it, the most common consequence being the risk of fall¹. According to statistic evaluated by Centers for Disease Control and Prevention (CDC), it is stated that about 1/3rd of the community dwelling adults older than 60 years of age in developed countries fall every year wherein women are more prone than men to falling. In India, according to WHO it has been recently reported that nearly 15,800 people above 65 years of age died from injuries related to unintentional falls^{2,3}.

Fall is an unintentional loss of balance or a sudden and unexpected changes in body position usually while landing on the floor that leads to failure of postural stability, and is a leading cause of injury-related death, and the third leading cause of poor health in individuals above 65 years of age^{1,2}.

Gait is the manner or style of walking. The individual gait pattern is influenced by age, personality, mood and sociocultural factors. The preferred walking speed in older adults is a sensitive marker of general health and survival. Gait disorders lead to a loss of personal freedom, falls and injuries and result in a marked reduction in the quality of life.⁵ An analysis of each component of the three phases of ambulation is therefore an essential part of the diagnosis of various risks and diseases.³

Balance refers to an individual's ability to maintain their line of gravity within their base of support. It can also be defined as the ability to maintain equilibrium, where equilibrium can be defined as any condition in which all the acting forces are cancelled by each other resulting in a stable balanced system. Physiologically, balance or postural control depends on integration and coordination of body's three systems i.e., sensory system, central nervous system and neuromuscular system. Therefore, any age related or pathological changes in these three systems of postural control will increase the risk of falling in elderly individuals^{6,7}. Due to all this reasons, early detection of risk of fall and its prevention is very necessary. One of the way preventions can be achieved is by analyzing the gait of the community dwelling ambulatory elders by using Dynamic Gait Index (DGI), Timed Up-and- Go (TUG), Berg Balance scale (BBS), 30 -Second Chair Stand Test, 4 -Stage Balance Test, Gait Abnormality Rating Scale (GARS-M), and many others.^{9,10}

The GARS-M is a reliable and valid measure for documenting gait features associated with an increased risk of falling among community-dwelling, frail older adults and may provide a clinically useful alternative to established quantitative gait-assessment methods.¹¹ FES-I is a measure of "fear of falling" or "concerns about falling", developed as a part of the Prevention of Falls Network Europe project from 2003 to 2006 by Todd et al. Test-retest reliability of the FES-I has ranged from 0.79 to 0.96 in older adult population.^{3,4} During assessment, it is checked that if the patient require assistance walking, is the gait continuous and fluid, or it is halting and unsteady. Also, both feet are evaluated for swing (step length) and clearance. Each foot should completely clear the floor and should step completely ahead of the other foot. Also Staggering, Guardedness, hip ROM, Arm=heel-strike synchrony is checked.

As most of the studies for assessing risk of fall in elderly population is done by using Dynamic Gait Index but there are very less studies where Gait Abnormality Rating Scale are used for identification of the risk among elderly healthy population, this study focuses on analyzing gait through GARS-M and predicting risk of fall through it. Also, this study focuses on establishing correlation between GARS-M and FES-I.

NEED OF THE STUDY.

Mobility is a major factor contributing to loss of independence following a fall and injury associated with it among frail older elders. There is an increased risk of falling associated with decreased walking speed, decreased step and stride length, and increased step width and other increased variability. There are many studies conducted on correlation between Fall efficacy scale and Dynamic Gait Index Scale but no study has been done on correlation between Fall efficacy scale and Gait abnormality rating scale, so seeing to the needs of the elderly individual of rural population who are at risk of fall we will create an awareness about the consequences of the risk and the preventive strategies of risk of fall by correlating GARS-M and FES-I.

AIM: To determine the correlation between Gait Abnormality Rating Scale-Modified and Fall Efficacy scale- International in community dwelling ambulatory elders.

OBJECTIVES:

- 1.To assess gait pattern and its components in elderly individuals and predict the risk of fall through it.
2. To assess various aspect of Fall Efficacy scale and predict risk of fall through it.
3. To establish a correlation between GARS-M and FES-I.

REVIEW OF LITERATURE

1. **Guilherme Augusto Santos, Bueno, Flavia Martins, Gervasio, Ruth Losada de Menezes, 2019.** Title: Fear of falling contributing to cautious gait pattern in women exposed to a fictional disturbing factor: a non-randomized clinical trial. AIM: To investigate the gait pattern of elderly women with and without fall history, with high and low fear of falling, when exposed to a disturbing factor. Method: Study was conducted on 49 elderly women without cognitive impairment and were divided into four groups. Three- dimensional gait analysis was performed to assess gait kinematics before and after exposure to the fictional disturbing factor (psychological and nonmotor agent). Result: After being exposed to the perturbation, all showed shorter step length, stride length and slower walking speed. Those without fall history and with high fear of falling showed greater changes and lower Gait Profile score.
2. **Gilles Allali, Joe verghese, Roe Holtzer, 2017.** Title: The role of postural instability/gait difficulty and fear of falling in predicting falls in non-demented older adults. Method: Study was conducted on 449 community-dwelling elders. FoF was measured by a single-item question (Do you have a FoF?) and self-confidence by the Activities-specific Balance Confidence scale (ABC scale). Result: 169 participants (38%) had an incident fall over a mean follow-up. PIGD was present in 32% an FoF IN 23% of the participants.
3. **Scott D, McLaughlin P, Nicholson G.C, Ebeling P.R, Stuart A.L, Kay D, Sanders K.M 2015.** Title: Changes in gait performance over several years are associated with recurrent falls status in community-dwelling older women at high risk of fracture. Method: 135 female subjects participated in this study. Gait parameters (speed, cadence, step length, step width, swing time, and double support phase) were assessed using the GAITRite electronic walkway system at four annual clinics. Conclusion: Increasing gait speed (0.96,0.99) and step length (0.87; 0.77;0.98) from baseline to final follow-up was associated with reduced likelihood of being a recurrent faller over the study period. No significant associations were observed for baseline gait parameters

(all $\geq$ 0.05). At second follow-up (2.8 or above) an increase in swing time (0.65;0.43;0.98) was associated with reduced likelihood, while an increase in double support phase (1.31; 1.04; 1.66) was associated with increased likelihood for being a recurrent faller in subsequent 1.3 years following this time point.

4. **Moreira B.S, Sampaio R.F, Kirkwood R.N, 2015.**

Title: Spatiotemporal gait parameters and recurrent falls in community-dwelling elderly women: a prospective study. Method: Seven spatiotemporal gait parameters were collected with the GAITRite(r) system. Falls were recorded prospectively during 12 months through biweekly phone contacts. Elder women who reported two or more falls were considered as recurrent fallers. Conclusion: After 12 months 23 elder women fell twice or more comprised into recurrent faller group and 110 with one or no falls comprised the non-recurrent fallers group. PCA1 represented gait rhythm and showed that recurrent fallers tend to walk with lower velocity and cadence and increased stance time in relation to non-recurrent fallers. The analyzed spatiotemporal gait parameters failed to predict recurrent falls in this samples.

5. **Alen M, Sipila M, 2014,** Conducted study on balance confidence was associated with mobility and balance performance in older people with fall -related hip fracture: a crosssectional study and concluded that in people who have had a fall -related hip fractures, an independent relationship exists between balance confidence, mobility, balance performance and on perceived mobility function. Lack of balance confidence may compromise rehabilitation and recovery, the Activities-specific Balance Confidence scale (ABC scale) may help to identify older hip fracture patients with mobility and balance limitation.

6. **Sebastiana Zimba Kalula, Monica Ferreria, and Motasim Badri, 2012.** Title: Risk factors for falls in older adults in a south African urban community. Method: A cross-sectional survey was conducted on 837 random individuals above 65 years of age by using logistic regression models for falls and recurrent falls. Result: Prevalence rates of 26.4% for falls and 11% for recurrent falls. In both prospective analyses, history of falls, dizziness/vertigo, ethnicity was significant predictor in falls analysis and marital status and increased time to perform the timed-up-and-go test in recurrent fall analysis.

7.**Renata Noce Kirkwood, Bruno de Souza Moreira, Marcia L.D.C. Vallone, 2011.**

Title: Step length appears to be a strong discriminant gait parameter for elderly females highly concerned about falls; a cross-sectional observational study. Aim: To determine if gait parameters and the Timed Up and Go test can discriminate between elderly females with high and low concern about falls. Method: 154 elderly females divided into two groups participated in this study. Eight gait parameters were recorded with the GAITRite system and the Timed Up and Go test score. Result: Step length proved to be the variable with the greatest discriminant coefficient (0.889) than the Timed Up and Go test (-0.369) and gait velocity (- 0.268).

8. **Buatois S, Perret-Guillaume C, Gueguen R, Miget P, Vancon G, Perrin P, Benetos A, 2010.** Title: A simple clinical scale to stratify risk of recurrent falls in community-dwelling adults aged 65 years and older. Aim: Correct identification of people at risk for recurrent falls facilitates the establishment of preventive and rehabilitative strategies in older adults. Method: 1618 subjects underwent a health checkup and 3 clinical balance tests i.e. The One-leg-balance test, the Timed Up and GO test and the Five-times-sit-to-d-stand test. Falls were recorded using self-administered questionnaire. Subjects were divided into two groups. Conclusion: Logistic regression analysis identified 4 variables that predicts recurrent falls in group A: history of falls, living alone, taking $\geq$ 4 medications per day and female sex. In group B: only the Fivetimes-sit-to-stand test provided added values in estimation of risk of falls, duration <15 secs doubled the risk.

9. **Talia Herman, No it Inbar- Borovsky, Marina Brozgol, Nir giladi and Jeffrey M. Hausdoff, 2009.** Title: The Dynamic Gait Index in healthy older adults. The role of stair climbing, fear of falling and gender. Aims: To evaluate DGI and its association with falls, fear of falling, depression, anxiety and other measures of balance and mobility in 278 healthy elders. Method: Healthy community dwelling older adults according to inclusion criteria participated in 3 years prospective study. Information about health status and medical history, medication usage and history of falls were taken. Conclusion: 278 subjects were studied. The BBT, TUAG and UPDRS mean scores were all near ideal values and indicative of good functional ability for the group. MMSE mean score were also close to 30-point perfect score. GDS were within normal range. State-Trait Anxiety Inventory reflected mild anxiety level.

10. **Jing shi, Yong-Kang Tao, Bai-Yu Zhou, Pu-Lin-Yu 2009;** Title: A prospective study on recurrent falls and related factors in elderly from the urban communities I Beijing. Aim: To investigate the incidence and risk factors for recurrent falls in community-dwelling elderly in Beijing. Method: A cross-sectional study was conducted on 1512 elderly in longtan community of Beijing where data on recurrent falls within the past 12 months were collected through face-to-face interview with questionnaire in their home. Result: The study suggested that incidence of fall in elderly increased with age and the episode of fall were more common in women (20.1%) than in men (14.9%).

11. **Stalenhoef P.A, Diederiks J.P.M, Knottnerus J.A, Kester A.D.M, Crebolder H.F.J.M, 2002.** Title: A risk model for the prediction of recurrent falls in community-dwelling elderly: a prospective cohort study. Aim: To determine the predictive value of risk factors for recurrent falls and the construction of fall risk model as a contribution to a mobility assessment for the identification of community-dwelling Elderly at risk for recurrent falling in a general practice. Method: 3311 subjects were

studied from four primary health care centers. A sample stratified on previous falls, age and gender was taken from the respondents to a mail questionnaire. They were visited at home to assess physical and mental health, balance and gait, mobility and strength. A 36-week follow up with telephone calls every 6 weeks was conducted. Fall and fall injuries were measured. Conclusion: During follow-up 197 falls were reported by 33% of the participants: one fall by 17% and two or more falls by 16%. Injury to a fall was reported by 45% of the fallers: 2% hip fractures, 4% other fractures and 39% minor injuries. A fall risk model converted to “Desk model” consisting of the predictors postural sway, fall history, hand dynamometry, and depression provides added value in the identification of communitydwelling elderly at risk for recurrent falling and facilitates the prediction of recurrent falls.

12. **Koller (1998):** Described old age gait as broad base with small steps, diminished arm swing, stooped posture, flexion at hips and knees with uncertainty and stiffness while walking.

13. **Jessie Vanswearingen, et, al, 1996,** Title: The modified gait abnormality rating scale for recognizing the risk of recurrent falls in community-dwelling elderly adults. Aims: To Determine the reliability and validity of measurements obtained using GARS-M. Method: Fifty-two frail old elders with mean age 78 participated, fall history and videotape of the gait was taken and evaluated. Relationship between stride length, step length and walking speed was obtained using spearman correlation. Conclusion: The GARS-M for rating qualitative aspects of ambulation appears to provide reliable measurements that may be valid predicting risk of falling community dwelling elders.

14. **Michelle M. Lusardi et al,** Title: Determining the risk of falls in community dwelling older adults. Aim: Firstly, to evaluate the predictive ability of history questions, self-report measures, and performance-based measures for assessing fall risk of community dwelling elders by calculating PoTP values for individual test. Secondly, to evaluate usefulness of cumulative PoTP for measures in combination. Conclusion: No single test/measure demonstrated strong PoTP values and was useful in assessing risk of falling.

15. **Susan B. O. Sullivan:** Measurements of variables such as degree of foot angle, width of BOS, step length, and stride length can be assessed simply and inexpensively in clinic by recording the patients foot prints during gait by painting, inking, or chalking of feet and felt tip markers attached to shoes.

Population and Sample

STUDY DESIGN: Cross-sectional analytical study

SAMPLE SIZE: 35

SAMPLING TECHNIQUE: Purposive sampling

STUDY SETTING: Vikhe Patil Medical hospital and Geriatric home center (Matoshri), Vilad Ghat.

INCLUSION CRITERIA:

1. Age: 60 and above
2. Elders walking without assistive devices
3. Both Male and Female

EXCLUSION CRITERIA:

1. Neuromuscular condition
2. Cardiovascular conditions
3. Cognitive impairments
4. Uncorrected auditory defects

MATERIAL USED:

1. Corridor (6m long)
2. Measuring tape
3. Video recorder (Phone) and a screen to display it.
4. Scales: 1) GARS-M 2) FES-I

Measuring tape**Corridor**

PROCEDURE: Prior to the commencement of the study, the ethical committee approval was obtained from the institution (DVVPF's College of Physiotherapy, Ahmednagar); the consent form was filled by all the participants in his/her language and complete procedure was explained to each of them. The present study was a cross-sectional analytical study and was carried out on 35 individuals above 60 years of age. The individuals were selected as per the inclusion and exclusion criteria. The demographic data was collected as per the data collection sheet. The subjects were asked to walk at their self-selected speed at a 6m long runway. A video of the walking was taken and displaced at a bigger screen to evaluate various gait components using GARS-M scale. The purpose of this scale was to determine risk of fall (low, moderate, high) by combining the scores of seven components of this scale. The subject was then asked questions related to fear of fall using FES-I scale. This scale had sixteen questions related to fall, each questions having 1-4 rating range. The total score was evaluated for low, moderate and high fall risk. The two outcome measures were then correlated using Pearson correlation coefficient test and the result was obtained.

Descriptive Statistics The data was entered in MS Excel 2019 and analyzed using Graph pad instat software. Pearson correlation coefficient test was used for data analysis.

IV. RESULTS AND DISCUSSION

The scales were taken on thirty-five community-dwelling older adults walking without assistive devices, with a mean age of 65.1 years and standard deviation (SD) of 6.15; between December 2021 to June 2022. Among 35 participants, 26 were male and 9 were females. The mean GARS-M score was 3.17 and mean FES-I score was 22.08 (Table 1). According to GARS-M scoring, 22 participants showed low fall risk, 10 showed medium fall risk and 3 showed high fall risk; whereas on FES-I scoring 17 participants showed low fall risk, 11 showed medium fall risk and 7 showed high fall risk (Table no.2). When the data was calculated statistically using Pearson correlation coefficient test, the result showed that 16 out of 35 participants (62%) showed low fall risk, 07 out of 35 participants (27%) showed moderate fall risk and 3 out of 35 participants (12%) showed high fall risk both on GARS-M and FES-I scales (Table no.3). The result found a significant positive correlation between GARS-M and FES-I with correlation coefficient (r) being 0.4572 and P value being 0.0058 (Table no.5). When individual correlation for each fall risk category was calculated it was found to be nonsignificant with correlation coefficient (r) = 0.06383 for low fall risk and r = 0.1325 for medium fall risk (Table no.6&7). It was found that low and moderate risk of fall was very common in both male and female.

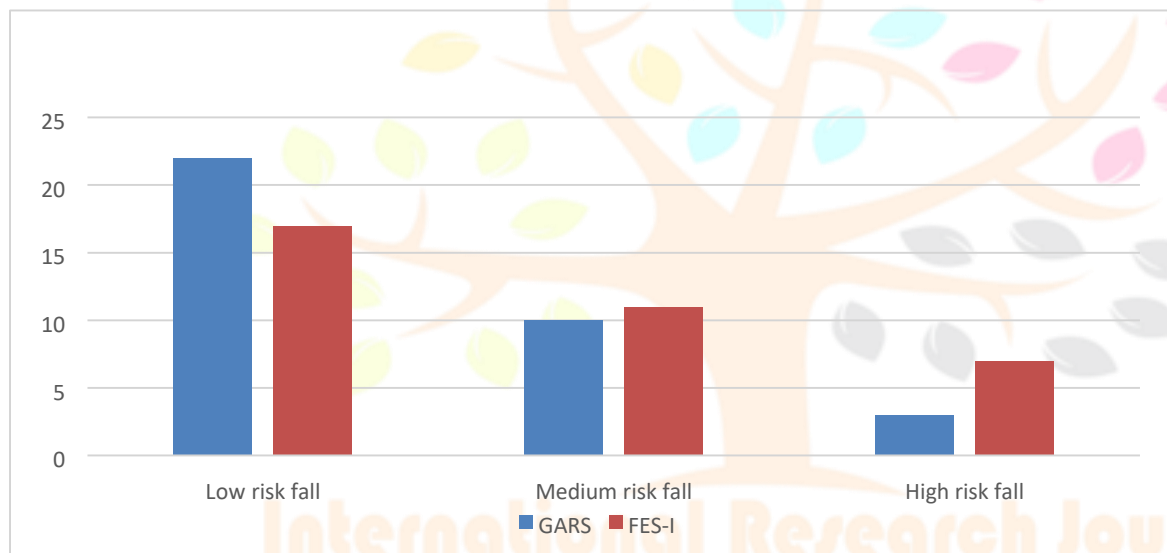
Research Through Innovation

4.1 Results of Descriptive Statics of Study Variables

Table no.1- Shows mean of the demographic data: -

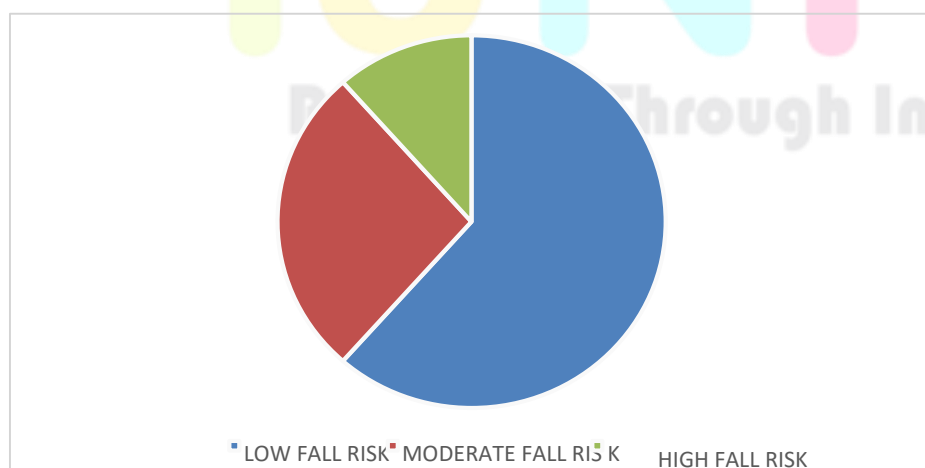
DEMOGRAPHICS	MEAN
AGE	65.1
WOMEN	9
MEN	26
GARS-M SCORE	3.17
FES-I SCORE	22.08

Table no. 2- Shows total number of participants with various fall risk according to GARS-M AND FES-I scoring



On GARS-M scoring: 22 had low fall risk, 10 had moderate fall risk and 3 had high fall risk, whereas on FES-I scoring 17 had low fall risk, 11 had moderate fall risk and 7 had high risk.

Table no.3- Shows participants with same fall risk on both GARS-M and FES-I scoring



62% showed low fall risk, 27% showed moderate fall risk and 12% showed high fall risk

Table no. 4- Shows total no. of participants with same fall risk on GARS-M and FES-I according to gender.

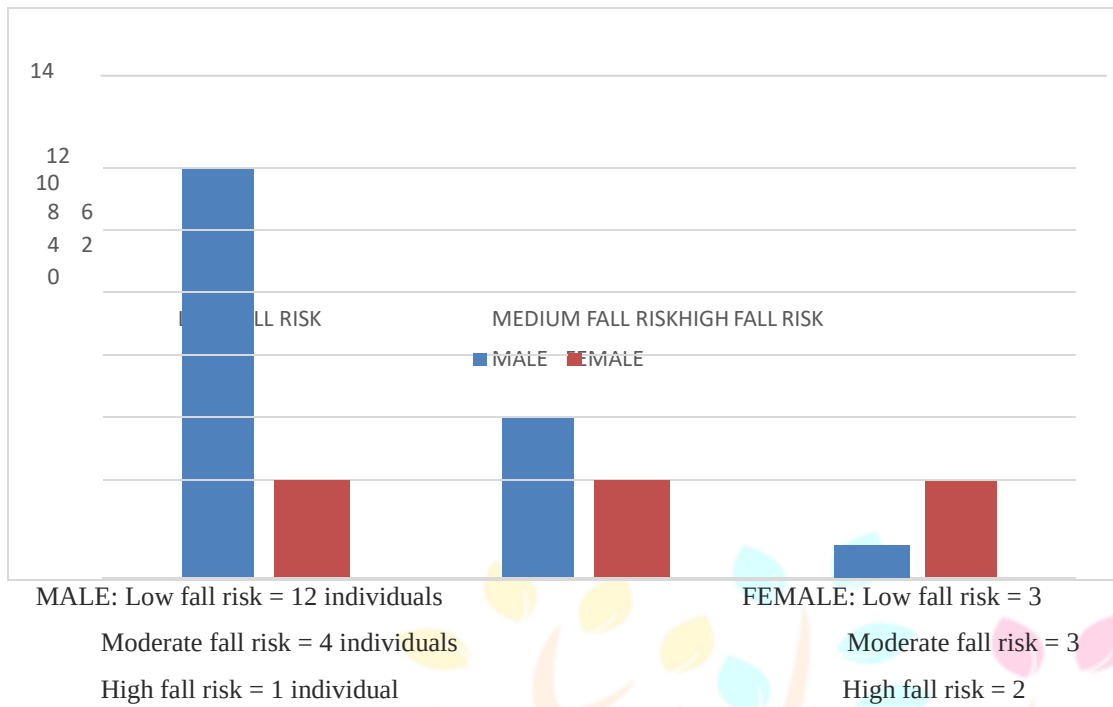


Table no.5- Shows correlation between GARS-M and FES-I of all 35 subjects.

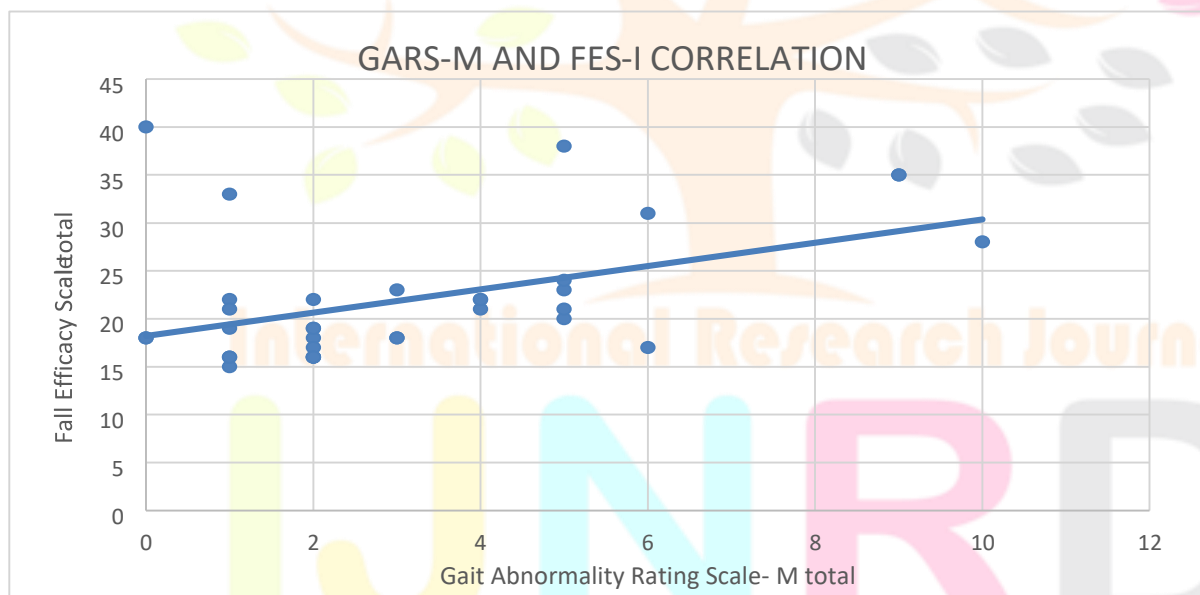
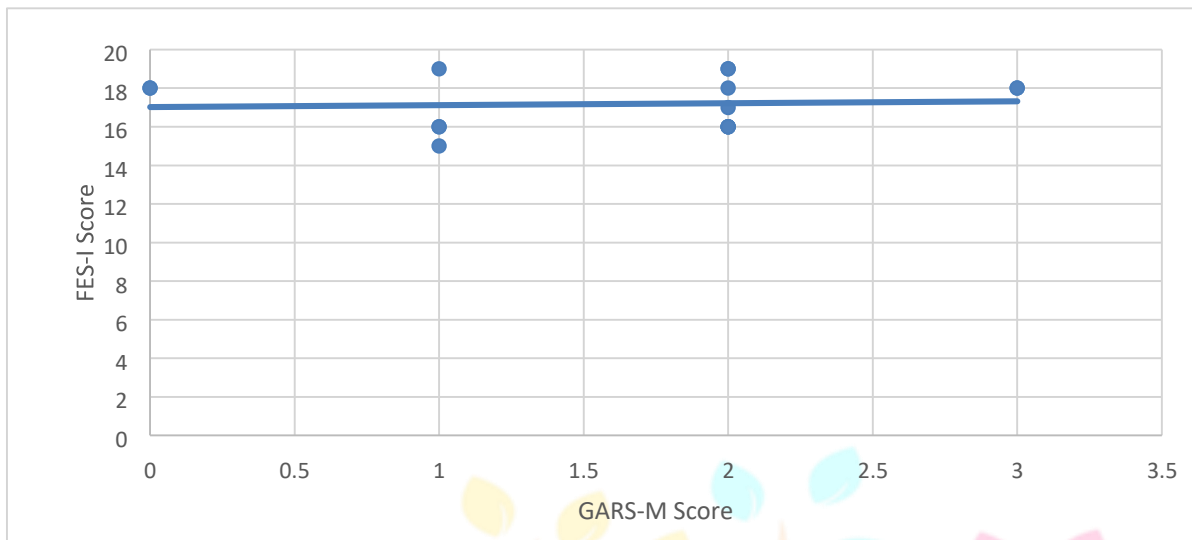
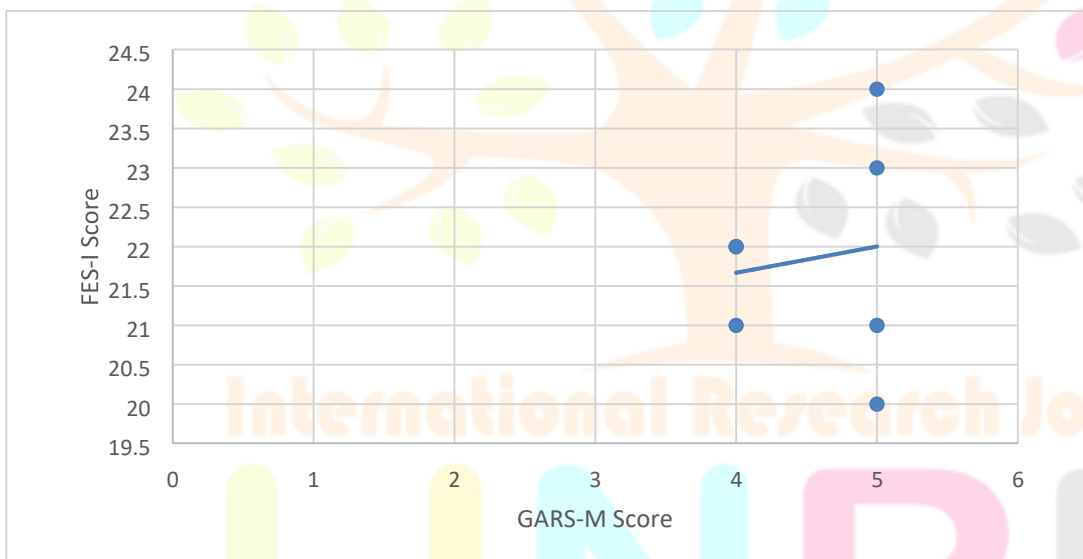


Table no. 6- Shows correlation between low fall risks of both GARS-M and FES-I scales. : Found non-significant correlation.**Table no. 7- Shows correlation between moderate fall risks of both GARS-M and FES-I scales: Found non-significant correlation.**

DISCUSSION

This study aimed to determine the correlation between GARS-M and FES-I in communitydwelling ambulatory older adults by evaluating the risk of fall on an individual scale. The result pointed to 26 subjects showing positive significant correlation between GARS-M and FES-I. In GARS-M, lesser the score better is the gait and balance and in FES-I, lesser the score better is the balance and lesser is the fear of fall; thus, a positive correlation was obtained.

It was also observed that few subjects with highest score on FES-I showed lowest score on GARS-M indicating that the fear of fall was psychological in them. However, individual paired comparison was found to be insignificant. It was concluded that this was because of small sample size. According to Stephane Rochat, Bula CJ, Martin E, 2010, who conducted a study with a aim to evaluate the cross-sectional relationship between self-reported fear of falling, with or without activity restriction, and specific gait parameters assessed at baseline in a cohort of young (65– 70y) and well-functioning community-dwelling older people, had a result showing 70.3% (605/860) of the participants reported no fear of falling, 24.4% (210/860) reported fear of falling without activity restriction, and 5.2% (45/860) reported fear of falling with activity restriction which was also found in our study i.e. 62% reported low fall risk, 27% moderate and 12% high. In both of our studies a positive linear correlation was found between gait variability and fear of fall. In a study conducted by Guilherme Augusto Santos Bueno, Flavia Martins Gervasio in 2019 on “Fear of falling contributing to cautious gait pattern in women exposed to a fictional disturbing factor” showed that non-fallers with high FOF change their gait patterns to a cautious gait which was also seen in our study that individual with high risk of fall showed higher score on Gait abnormality rating scale indicating disturbances in gait parameters.

In another study conducted by Jean-Baptiste Mignardot, Thibault Deschamps and other in 2014 on title “Gait disturbances as specific predictive markers of the first fall onset in elderly people” concluded that gait analysis is probably one of best tools to predict the first fall onset which is also the conclusion of our study that gait variability is strongly associated with fear of fall and risk of falling. Many studies have been conducted on spatio-temporal gait parameters (walking velocity, swing time, stride length, stride time variability and double support time variability) and risk of fall but none have been conducted on parameter included in GARS-M (Variability, Guardedness, Staggering, Foot contact, Hip ROM, Shoulder extension and Arm-heel-strike synchrony) and FES-I, therefore this study focuses on determining risk of fall through basic walking style and associating it with FOF. Thus, our study stresses on the idea of accurately assessing gait behavior in geriatric ambulatory population and therefore, performing a walking test at least once a year for fall prevention is necessary. Our study provides a key information that might be useful for recommending a specific falls prevention program.

CONCLUSION:

According to research findings, there was a significant positive correlation between GARS-M and FES-I scales. It suggests that if a participant's FES-I score indicates fall risk, it could be due to disturbances in his/her gait parameters and GARS-M scoring should be obtained. Given the importance of correlating fear of fall with gait disturbances in older adults to prevent fall and recurrent falls, it seems essential to spread an awareness regarding the same by incorporating these scales in nursing homes, conducting camps or by informing the elders while their regular check-ups.

LIMITATIONS:

- 1.The sample size was very small.
- 2.Male and female participants were not equal.
- 3.The rating of gait parameter through video tape was very subjective, thus different investigator may rate differently.
- 4.Many patients were walking consciously even after proper instructions given to them.

FUTURE SCOPE OF THE STUDY:

- 1.This study should be done on a larger population.
2. It can be done in a population with a particular disorder.
- 3.Correlation between each component of GARS-M and FES-I can be found out, so as to determine which component of FES-I correlates with which one in the GARS-M

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