

A Study of Assessment of Frailty and Functional Disability in Geriatric Population of Central India

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ABSTRACT

Introduction : Frailty is defined as “a clinically recognizable state of increased vulnerability, resulting from aging-associated decline in reserve and function across multiple physiologic systems, such that the ability to cope with every day or acute stressors is compromised”. A proposed phenotype definition is characterized by weight loss, fatigue, impaired grip strength, diminished physical activity, and slow gait. Frailty is a robust and powerful risk factor for disability. In this study our objectives were to find the prevalence of frailty and functional disability in elderly population and to compare the frailty using Indian standards and Fried Frailty Index and to study various clinical, biochemical and radiological factors associated with Frailty.

Methodology : An hospital-based descriptive Cross-sectional study was performed at tertiary care hospital between January 2018 and May 2019. A total of 130 participants were evaluated with structured questionnaire and assessed for frailty using Fried Frailty index and Indian Standards. Functional disability was assessed by Katz Index. Clinical examination, Blood investigations like Serum DHEAS, hs-CRP, Dexa scan for body mass composition and Bone mineral density were done. Binary logistic regression was used to determine the predictors of frailty.

Results : The prevalence of frailty was 36 (27.6%) and the prevalence of pre-frailty and non-frail or robust accounts for 64 (49.2%) and 30 (23.1%) respectively in the participants. About 17 (13.1%) of the study population were found to be functionally disabled. Almost all the patients who were functionally disabled were frail. By Indian Standards; the prevalence of frail individuals with decreased grip strength (44.6%) and slow walking speed (60%) were far less when compared with that using Fried Frailty Index which were 78.5% and 63.8% respectively. The predictors of frailty syndrome were being unmarried, living alone, arthritis, poor vision, cognitive impairment, elevated fat mass, low BMI and low lean mass are.

Conclusion : As the elderly population size in India is growing with the greater longevity, determining the predictors of frailty syndrome is important in identifying the modifiable risk factors as a guidance for intervention planning. Fried frailty Indices overestimates the burden of frailty as compared to the Indian Standards as it uses higher cut offs.

Key words : Frailty, Functional Disability.

Introduction :

The increasing numbers of older people in India poses a significant public health challenge to improving health and social care outcomes in older populations. A particular concern in older people is the development of frailty, defined as “a clinically recognizable state of increased vulnerability, resulting from aging-associated decline in reserve and function across multiple physiologic systems such that the ability to cope with every day or acute stressors is compromised.”¹ A proposed phenotype

definition characterized by weight loss, fatigue, impaired grip strength, diminished physical activity, and slow gait. Frailty is a robust and powerful risk factor for disability.² **Fig 1.** Shows development of frailty with advanced age as adapted from **Lang et al.**³

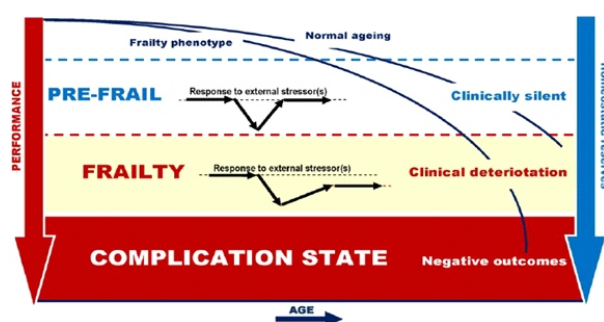


Fig 1. Development of frailty with advancing age (adapted from Lang et al).³

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Disability is usually defined in terms of restrictions in the ability to perform activities of daily living (ADL), or, the inability to function independently in terms of basic ADL or instrumental ADL (World Health Organization [WHO], 2003.⁴ Disability occurs late in the frailty process, after reserve and compensation are exhausted.⁵

There are nearly 104 million elderly persons (age more than or equal to 60 years) in India; 53 million females and 51 million males, according to population census 2011. It is interesting that up to 1991 Population Census, the number of elderly males exceeded elderly females. However, in the last two decades the trend has been reversed and the elderly females outnumbered the elderly males. Kerala has maximum proportion of elderly people in its population (12.6 per cent). In Maharashtra proportion of elderly people is 9.9 %. According to SRS (Sample Registration System) 2012-2016 life expectancy at birth is 68.7 years. For males and females it is 67.4 years and 70.2 years respectively. Kerala has got the highest life expectancy at birth which is about 75.1 years and for males & females it is 72.2 years and 77.9 years respectively. In Maharashtra it is 72.2 years and for males & females it is 70.8 and 73.7 years respectively. Locomotor and visual disability are the most prevalent disabilities among elderly persons. Almost half of the elderly disabled population was reported to be suffering from these two types of disabilities. Urinary problems were more common among elderly males while more elderly women reported to suffer from problem of joints.⁶

A study has been conducted by **Kashikar *et al*** using Fried Frailty index found prevalence of frailty in the community was 26%. Pre-frail and non-frail accounted to be 63.3% and 10.4% respectively.⁷ A study conducted by **Voznesensky M, *et al*** found the association between DHEAS (dehydroepian dosterone sulphate) and frailty in older men and women.⁸ A study conducted by **Gláucia Regina Falsarella *et al*** and **Anne M. Kenny** found the association of Frailty with Body Mass Composition and Bone Mineral Density respectively^{9,10}

This study has been done to find out the prevalence of frailty in elderly population and to compare the frailty using Indian standards and Fried Frailty Index. Functional Dependence was assessed using Katz Index. We also studied various clinical, biochemical and radiological factors associated with Frailty.

Materials and Methods :

A hospital-based Descriptive Cross-sectional study was performed at Government Medical College, Nagpur between January 2018 and May 2019. Ethical committee approval was obtained from the Institute Ethical Committee. Participants were more than 60 years attending the OPD of General Medicine. Those with psychiatric illness and who were not willing to give informed consent / cooperative were excluded. A total of 130 patients were included in the study. Sample size was calculated with the prevalence of frailty (n = 26) from the previous study, with 95% CI and absolute precision as 7. Sampling method was convenient sampling. All the subjects were interviewed with the predesigned Questionnaire and was followed by clinical examination, blood investigations and DEXA scan.

Structured questionnaires : It included Socio-demographic and socio-economic characteristics, with the following variables : age, gender, marital status, education status & literacy, living status, occupation and economical dependency. Health-related variables : self-report of addiction (smoking / tobacco and alcohol), practice regular exercise / yoga and age of menopause (in females); self-report of diseases (diabetes mellitus, heart disease, hypertension, respiratory problems, gastrointestinal problems, cancer, paralytic attack and arthritis); self-report of geriatric syndromes (poor hearing, poor vision, appetite loss, sleep-related problems, fracture of limbs, and urinary complaints); other self-report of symptoms like history of falls, breathlessness, backache, difficulty in stair climbing, hemorrhoids were also enquired.

Fried frailty phenotype : A five criteria scale were operationalized as follows : 2

1. Un-intentional weight loss : = 4.5 kg or 5% of weight loss in the previous year (Self-reported, Yes or No) or BMI = 18.5
2. Exhaustion : frequent experience of exhaustion / tiredness (Self-reported, Yes or No)
3. Low Physical activity : frequency, duration and intensity of usual activities were assessed. Frequency of exercise < 5 times a week were considered positive (Self-reported, Yes or No)
4. Hand-grip strength (Muscle strength measured by hand dynamometer). Frailty Cut point : For Men : [BMI = 24 and GS = 29 kg]; [BMI 24.1-28 and GS = 30 kg]; [BMI > 28 and GS = 32 kg]
For Women : [BMI = 23 and GS = 17]; [BMI 23.126 and GS = 17.3 Kg]; [BMI 26.1-29 and GS = 18 kg]; [BMI > 29 and GS = 21 kg] {GS Grip Strength}
5. Walking time (time required to walk 15 feet or 4.5 m) was used. Frailty Cut point :
In men : [height = 173 cm and time = 7 seconds]; [height > 173 cm and time = 6 seconds]. In women : [height = 159 cm and time = 7 seconds]; [height > 159 cm and time = 6 seconds]

Each criteria was given one point and based on the score an individual is considered Frail : if = 3 criteria present, Pre-Frail : if 1 or 2 criteria present and Robust : 0 criteria present.

Frailty by Indian Standards : 12

Comfortable Gait Speed : was assessed by asking the participants to walk on their own pace for a distance of four meters and the time taken was noted by a stopwatch. Assistive devices like walking stick / cane were allowed wherever required. Subjects were asked to walk through a 6 m lane : first 1 m for acceleration, a central 4 m zone that is times with a stopwatch and a last 1 m for deceleration. The central 4 m testing zone has a starting line and a finish line that are not visible to the subject; assessment of gait speed begins when the subject's lead leg crosses the starting line and ends when the subject's lead leg crosses the finish line. The cut off of Gait speed was 0.6 m/s for all age groups and for all height ranges irrespective of the gender.¹² **Fig. 2.** shows the measurement of Gait speed.

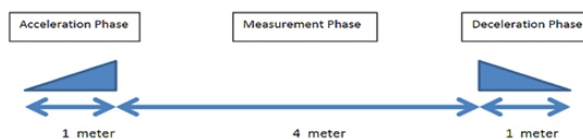


Fig 2 : Measuring Gait Speed

Grip Strength : was assessed by using hand held dynamometer with subject's arm held by their sides and elbow held in right angle. Subjects were instructed to sit in a chair with arm support to rule out gravitational force. The subjects were asked to press the dynamometer for 3 times in each hand and the maximum of six values chosen as the grip strength. Frailty cut point : 12 **Fig. 3** shows the hand dynamometer used for Grip strength measurement.

For men : [Age 60-65 and GS < 20]; [Age 66-70 and GS < 15]; [Age > 70 and GS < 15]

[BMI = 18.5 and GS < 14]; [BMI 18.5-24.9 and GS < 18]; [BMI 25-29.9 and GS < 20]; [BMI = 30 and GS < 15]

For women : [Age 60-65 and GS < 8]; [Age 66-70 and GS < 6]; [Age > 70 and GS < 6]

[BMI = 18.5 and GS < 7]; [BMI 18.5-24.9 & GS < 8]; [BMI 25-29.9 and GS < 7]; [BMI = 30 & GS < 7]



Fig 3 : Hand Dynamometer used for hand grip measurement.

Thirty Second Chair Stand Test : was assessed by asking the participants to sit comfortably in a chair, of standardized height without arms, with their feet resting flat on ground. Then subjects will be asked to stand up from and sit down on the chair, without using their hands, for thirty seconds. The number of times they could perform the test was noted with the help of a stopwatch. Frailty cut point : 12 **Fig. 4.** shows demonstration of thirty.



Fig. 4 : Thirty Second Chair stand Test

For men : [Age 60-65 and C < 10]; [Age 66-70 and C < 9]; [Age > 70 and C < 8]

[BMI = 18.5 and C < 9]; [BMI 18.5-24.9 and C < 9]; [BMI 25-29.9 and C < 9]; [BMI = 30 and C < 8]

For women : [Age 60-65 and C < 8]; [Age 66-70 and C < 8]; [Age > 70 and C < 7]

[BMI = 18.5 and C < 8]; [BMI 18.5-24.9 and C < 8]; [BMI 25-29.9 and C < 7]; [BMI = 30 and C < 7]

C Count / no. of times performed

Katz Index of Independence in Activities of Daily Living : It is a 6-item index that gives an assessment of the performance in the six functions of bathing, dressing, toileting, transferring, continence, and feeding. Scoring of each item of this instrument includes independence (1) and dependence (0). Independence is defined as performing these tasks without supervision, guidance or personal assistance while dependence is defined as doing the tasks with supervision, guidance or personal assistance. Total score is in the range of 0 to 6. Score of 6 represents an independent patient and 0 indicated a very dependent one or total functional disability. Score of 1 to 5 were considered as some functional disability.

Mental Status Examination : The MMSE is widely used screening measure of cognitive impairment. It consists of 30 items included items on orientation, registration, attention and calculation, recall, language, visual constructions, and ability to follow simple commands. The MMSE has a maximum score of 30 and a minimum of 0. A score equal to or greater than 24 is taken to indicate no cognitive impairment, whereas a score 19-23 indicates mild, 10-18 moderate and below 10 severe cognitive

impairment.¹³ HMSE (Hindi Mental State Examination) : Hindi version of the Mini Mental State Examination was used for illiterate and Hindi speaking population based on the recommendation by **Ganguli et al. (1995)**.¹⁴ Cognitive impairment was correlated with Frailty.

Blood investigations : The following blood investigation were done for all the patients : Hemoglobin, Serum Calcium, hs-CRP (high sensitivity CRP), DHEAS and Serum Albumin.

DEXA scan : Body mass composition and Bone Mineral Density were done for all the patients using dual energy X-ray absorptiometry (DEXA) (GE / Lunar Prodigy Advance), GE Healthcare, Inc, Milwaukee, WI, USA. USA (Combined NHANES / Lunar) Enhanced Analysis was used to measure the following parameters of BMC : Total Lean Weight, Total Fat, % Fat, Total mass, Total tissue weight, Body Mineral Content, Fat Free, % Android fat and % Gynoid fat and A/G ratio. The percent (%) of body fat was also evaluated using cutoff point values = 27% of body fat for men and $\geq 38\%$ for women.¹⁵

Rothney et al considered DXA as a valid and reliable method for measuring BC in adults and the elderly.¹⁶ Bone Mineral Density (BMD) was calculated at AP Spine (L1-L4) and both Femur Neck. Osteoporosis was defined according to WHO criteria of T-score ≤ 2.5 SD, Low Bone Mass was defined as T-score between -1 & -2.5 SD. Normal is T-score > -1 SD. BMD and BMC were correlated with frailty.

The total participants were divided in three groups 60-65 years, 66-70 years and > 70 years and various parameter were compared among them and gender-wise.

Statistical Analysis :

The data obtained was entered into Microsoft Excel Worksheet. Continuous variables were presented as mean and SD (standard deviation). Categorical variables were expressed in frequency and percentages. Categorical variables were compared by performing Chi-square test. For small numbers Fischer-Exact test was used wherever required. Continuous variable were compared by performing Independent t test for normalized data and Mann-

Whitney test was used for non-normalized data. $P < 0.05$ was considered as statistical significance. Statistical software STATA Version 14.0 was used for data analysis.

Observations and Results :

Characteristics of the study participants :

A total of 130 [38 (29.2%) M / 92 (70.8%)] participants with a mean age of 68.2 ± 4.76 years. About 35 (26.9%) were in age group 60-65 years, 55 (42.3%) in 66-70 years, 40 (30.8%) above > 70 years. The majority of the respondents were married 82 (63.1%), stayed with families 113 (86.9%), and able to read & write one language - literate 91 (70%). About 17 (13.1%) of the participants were living alone and most of them were unemployed or already retired 98 (75.4%). About 31 (23.8%) of the study participants were totally dependent economically & 67 (51.5%) were partially dependent or pensioners and remaining 32 (24.7%) were independent economically it was found that the economical dependency increases with age. In the context of addictions tobacco chewing 62 (47.7%) was the most common followed by smoking 16 (12.3%). About 33 (25.4%) of the study participants had regular exercises or practice of yoga. The mean age of menopause (in female) was 44.04 ± 3.5 years. Hypertension 33 (25.4%) was the most common reported disease followed by diabetes (21.5%) followed by Diabetes Mellitus 28 (21.5%) and COPD / Asthma 22 (16.9%). Whereas for geriatric syndrome, poor appetite 87 (66.9%) was the most common reported symptom followed by difficulty in climbing stairs 75 (57.7%). Most of the geriatric syndromes and symptoms increased with age. Various Geriatric syndrome and symptoms are presented in **Fig 5**.

Prevalence of frailty and functional disability :

Out of 130 elderly, 36 (27.6%) individuals were categorized as Frail. Prevalence of pre-frailty accounts for 64 (49.2%) and non-frail or robust elderly constituted for 30 (23.1%). Major contributor to frailty were low grip strength 102 (78.5%) and slow walking speed 83 (63.8%). No gender-wise difference was observed. **Fig 6. &**

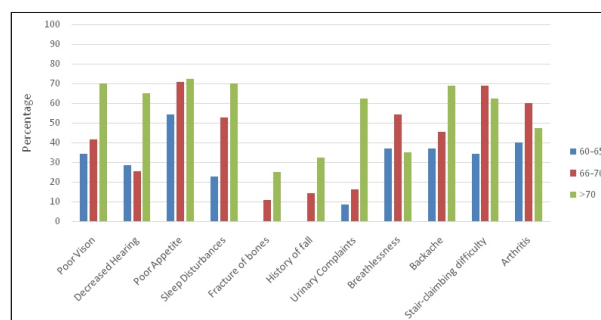


Fig. 5 : Various Geriatric syndrome and symptoms in age-wise distribution.

Table 1 represents age and gender-wise prevalence of frailty and its five components. Study participants with frailty using Indian Standards for low grip strength and slow walking speed were 58 (44.6%) and 78 (60%) respectively, which is less than in Fried frailty index. Mean grip strength and thirty second chair test were more in males. Age and Gender-wise distribution and frailty using Indian Standards : of Gait speed, Grip Strength & Thirty second chair test is presented in the **Table 2**.

About 17 (13.1%) of the study population using Katz Index were found to be functionally disabled. Major contributors of disability were involvement of Continence 16 (12.3%) and Transferring 5 (2.3%). Age and Gender wise distribution of Katz Index of Independence in Activities of Daily Living (Functionally disability) is shown in **Table 3**.

The prevalence of cognitive impairment in males was 22 (16.9%). 17 (13.1%) had mild cognitive impairment, 5 (3.8%) were with moderate impairment and none were found to have severe impairment. The females had higher value of cognitive impairment than in the males. Age and gender-wise distribution of cognitive impairment is shown in **Fig 7**.

Table 4 & Fig. 8 the results of blood investigations in age and gender-wise distribution are represented. 52 (40%) had elevated high-sensitivity CRP and 11 (8.5%) had low DHEAS. Body mass composition and Bone Mineral Density are represented in **Table 5 & 6**. It was found that Fat% increased with age and were more in female. BMD T-Score (WHO); females were found to be more osteoporotic than females and T-Score decreased with age.

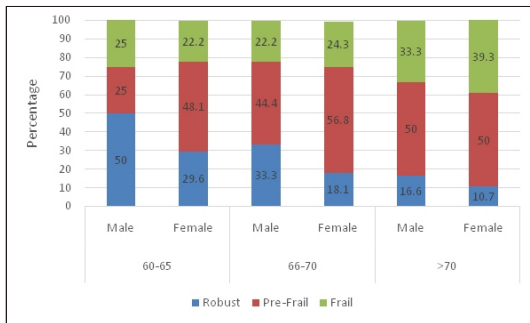


Fig. 6 : Prevalence of Frailty with age and gender-wise distribution.

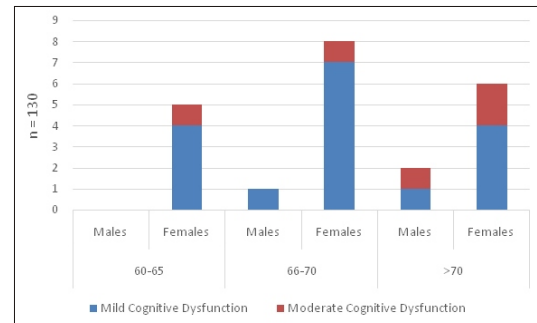


Fig. 7 : Age and Gender wise distribution of Cognitive Impairment.

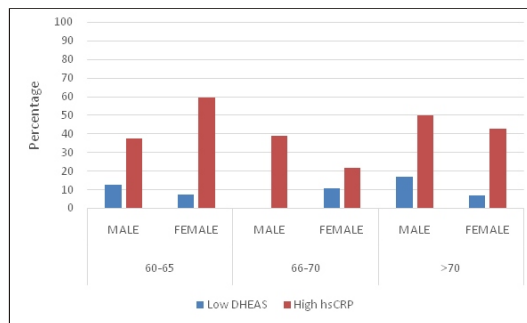


Fig. 8 : Age and Gender-wise distribution of Low DHEAS and High hs-CRP
DHEAS Dihydroepian derosterone sulphate, hs CRP- High sensitivity CRP

Table 1 : Distribution of Fried frailty variables with Age and Gender using Frailty et el criteria.

Frailty	Total n (%) n=130	Male (Age group in years)				Female (Age group in years)			
		60-65 n (%) n=8	66-70 n (%) n=18	≥ 70 n (%) n=12	Total n (%) n=38	60-65 n (%) n=27	66-70 n (%) n=37	> 70 n (%) n=28	Total n (%) n=92
Shrinking	24 (18.5)	0(0)	3 (16.7)	3 (25.0)	6 (15.8)	4 (14.8)	8 (21.6)	6 (21.4)	18 (19.6)
Exhaustion	36 (27.7)	1 (12.5)	1 (5.6)	5 (41.7)	7 (18.4)	7 (25.9)	12 (32.4)	10 (35.7)	29 (31.5)
Physical activity	34 (26.2)	2 (25.0)	3 (16.7)	4 (33.3)	9 (23.7)	4 (14.8)	9 (24.3)	12 (42.9)	25 (27.2)
Slow walking	83 (63.8)	3 (37.5)	10 (55.6)	11 (91.7)	24 (63.1)	13 (48.1)	27 (72.9)	19 (67.9)	59 (64.1)
Grip strength	102 (78.5)	4 (50.0)	11 (61.1)	11 (91.7)	26 (68.4)	20 (74.1)	32 (86.4)	24 (85.7)	76 (82.6)

Table 2 : Age & Gender-wise Distribution of frailty assessment using Indian Standards for : Comfortable Gait speed, Maximum Grip strength and Thirty second chair test.

Variables	Male (Mean ±SD)				Female (Mean ±SD)				Total Frailty n (%)
	60-65 years	66-70 years	≥ 70 years	Total years	60-65 years	66-70 years	> 70 years	Total years	
Gait speed	0.61 ± 0.12	0.52 ± 0.19	0.49 ± 0.11	0.53 ± 0.15	0.62 ± 0.13	0.54 ± 0.14	0.53 ± 0.12	0.56 ± 0.13	78 (60.0)
Max Grip Strength	23.62 ± 8.24	16.33 ± 8.30	10.66 ± 8.15	16.07 ± 6.35	12.70 ± 8.04	8.18 ± 5.25	7.17 ± 4.35	9.20 ± 6.35	58 (44.6)
Thirty Secchair Test	14.5 ± 4.84	10.83 ± 4.60	8.33 ± 3.39	10.81 ± 4.74	12.37 ± 4.12	9.51 ± 2.92	8.71 ± 4.18	8.10 ± 3.96	59 (45.4)

Table 3 : Age and Gender wise distribution of Katz Index of Independence in Activities of Daily Living.

Variables	Total n (%) n=130	Male (Age group in years)				Female (Age group in years)			
		60-65 n (%) n=8	66-70 n (%) n=18	≥70 n (%) n=12	Total n (%) n=38	60-65 n (%) n=27	66-70 n (%) n=37	>70 n (%) n=28	Total n (%) n=92
Bathing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Dressing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Toileting	1 (0.7)	0 (0)	0 (0)	1 (8.3)	1 (2.6)	0 (0)	0 (0)	0 (0)	0 (0)
Transferring	5 (3.8)	0 (0)	3 (16.7)	0 (0)	3 (7.9)	0 (0)	2 (5.4)	0 (0)	2 (2.2)
Continenence	16 (12.3)	0 (0)	4 (22.2)	2 (16.7)	6 (15.8)	3 (11.1)	5 (13.5)	2 (7.1)	10 (10.9)
Feeding	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Disability	17 (13.1)	0 (0)	4 (22.2)	2 (16.7)	6 (15.8)	3 (11.1)	6 (16.2)	2 (7.1)	11 (12.0)

Table 4 : Age and Gender wise distribution of Results of Blood investigations

Parameters	Total Mean ± SD	Male (Mean ± SD)				Female (Mean ± SD)			
		60-65 years	66-70 years	≥70 years	Total	60-65 years	66-70 years	>70 years	Total
Hb	11.50 ± 1.70	12.42 ± 1.50	11.41 ± 2.49	11.13 ± 1.12	11.53 ± 1.97	11.91 ± 1.22	11.44 ± 1.83	11.15 ± 1.52	11.19 ± 1.59
S. Ca	9.42 ± 0.48	9.59 ± 0.56	9.26 ± 0.27	9.30 ± 0.43	9.34 ± 0.41	9.60 ± 0.53	9.44 ± 0.48	9.32 ± 0.48	9.45 ± 0.50
S. Albumin	3.62 ± 0.37	3.77 ± 0.36	3.53 ± 0.32	3.55 ± 0.35	3.59 ± 0.34	3.74 ± 0.36	3.59 ± 0.43	3.61 ± 0.36	3.64 ± 0.39
DHEAS	49.68 ± 54.68	64.72 ± 42.37	70.34 ± 57.92	87.14 ± 119.54	74.46 ± 79.01	49.52 ± 53.31	34.07 ± 23.87	36.81 ± 29.37	39.44 ± 36.57
hs CRP	7.11 ± 15.80	13.13 ± 30.88	12.51 ± 23.73	11.89 ± 31.96	12.44 ± 27.26	5.89 ± 4.93	3.34 ± 4.80	6.02 ± 7.61	4.90 ± 5.91

Hb : Hemoglobin, S. Ca : Serum Calcium, S. Albumin : Serum Albumin,
DHEAS : Dihydroepian derosterone sulphate, hs CRP - High sensitivity CRP.

Table 5 : Age and Gender wise distribution of Body mass composition

Parameters	Total Mean ± SD	Male (Mean ± SD)				Female (Mean ± SD)			
		60-65 years	66-70 years	≥70 years	Total	60-65 years	66-70 years	>70 years	Total
Muscle mass	32.36 ± 6.69	38.11 ± 5.80	37.14 ± 7.37	34.76 ± 6.13	36.59 ± 6.65	32.85 ± 6.26	30.18 ± 6.04	29.03 ± 4.83	3.62 ± 5.91
BMC	1.80 ± 0.12	2.26 ± 0.35	1.99 ± 0.36	1.90 ± 0.03	2.02 ± 0.36	1.92 ± 0.23	1.66 ± 0.36	1.47 ± 0.02	1.71 ± 1.5
Fat mass	20.53 ± 7.54	16.8 ± 4.64	17.48 ± 5.69	17.53 ± 7.26	17.36 ± 5.89	19.96 ± 7.40	24.28 ± 7.98	21.98 ± 7.68	21.84 ± 7.78
Fat%	38.30 ± 8.65	30.26 ± 3.66	31.54 ± 6.58	32.35 ± 9.71	31.52 ± 7.14	38.45 ± 6.59	43.13 ± 7.35	42.64 ± 8.36	41.10 ± 7.63
BMI	22.10 ± 4.40	21.46 ± 3.21	20.13 ± 2.66	20.33 ± 3.80	20.82 ± 3.28	23.69 ± 5.69	22.08 ± 4.57	22.35 ± 3.70	22.63 ± 4.70

BMC : Bone mineral content

Table 6 : Age and Gender wise distribution of Bone Mineral Density (WHO: T-score)

Parameters	Total Mean ± SD	Male (Mean ±SD)				Female (Mean ±SD)			
		60-65 years	66-70 years	≥70 years	Total	60-65 years	66-70 years	>70 years	Total
AP Spine	-2.52 ± 1.50	-1.07 ± 1.37	-1.46 ± 1.27	-1.60 ± 1.37	-1.42 ± 1.30	-2.85 ± 1.64	-2.98 ± 1.22	-3.09 ± 1.18	-2.97 ± 1.33
L Femur	-2.19 ± 2.93	-0.97 ± 0.81	-2.02 ± 0.88	-2.25 ± 0.74	-1.87 ± 0.93	-1.93 ± 0.75	-2.49 ± 0.94	-2.49 ± 0.89	-2.33 ± 0.90
R Femur	-2.11 ± 0.95	-1.01 ± 0.92	-1.65 ± 0.97	-2.08 ± 0.62	-1.65 ± 0.92	-1.91 ± 0.76	-2.44 ± 0.91	-2.50 ± 0.92	-2.30 ± 0.90

Table 7 : Association of the variables with frailty syndrome (n=130)

Variables n (%) N=130	Non-frail n (%) n=94 or Mean ±SD	Frailty n (%) n=36 or Mean ±SD	p-value	
Age = 75 years	9 (6.9)	3 (3.2)	6 (16.7)	0.055, NS
Females	92 (70.8)	62 (65.9)	30 (83.3)	0.383, NS
Singles/Widow/Divorced	48 (36.9)	22 (23.4)	26 (72.2)	<0.001, HS
Alone	17 (13.1)	6 (6.4)	11 (30.6)	0.005, HS
Illiterate	39 (30.0)	9 (9.6)	30 (83.3)	0.045, S
Unemployed	98 (75.4)	64 (68.1)	34 (94.4)	0.030, S
Economical Dependency	31 (23.8)	17 (18.1)	14 (38.9)	0.157, NS
Smoking	16 (12.3)	9 (9.6)	7 (19.4)	0.412, NS
Tobacco	62 (47.7)	39 (41.5)	23 (63.9)	0.570, NS
Alcohol	14 (10.7)	6 (6.8)	8 (22.2)	0.094, NS
Regular exercise/yoga	33 (25.4)	25 (26.6)	8 (22.2)	0.147, NS
Diabetes mellitus	28 (21.5)	15 (15.9)	13 (36.1)	0.138, NS
Hypertension	33 (25.4)	19 (20.2)	14 (38.9)	0.275, NS
IHD	12 (9.2)	8 (8.5)	4 (11.1)	0.922, NS
Stroke	6 (4.2)	5 (5.3)	1 (2.8)	0.344, NS
COPD /Asthma	22 (16.9)	17 (18.1)	5 (13.9)	0.326, NS
Cancer	2 (1.5)	2 (2.1)	0 (0)	0.544, NS
Altered Bowel Habits	23 (17.6)	16 (17.0)	7 (19.4)	0.642, NS
Menopause	-	43.26 ± 8.71	41.80 ± 7.86	0.412, NS
Poor vision	63 (48.5)	27 (28.7)	28 (77.8)	0.001, HS
Decreased Hearing	50 (38.5)	23 (24.4)	15 (41.6)	0.824, NS
Poor Appetite	87 (66.9)	51 (54.3)	33 (91.7)	0.130, NS
Sleep disturbances	65 (50.0)	31 (32.9)	25 (69.4)	0.037, S
Fracture of bone(s)	16 (12.3)	4 (4.2)	7 (19.4)	0.047, S
History of falls	21 (16.2)	8 (8.5)	2 (5.6)	0.492, NS
Urinary complaints	37 (28.4)	10 (10.6)	8 (22.2)	0.345, NS
Breathlessness	57 (43.8)	30 (31.9)	27 (75.0)	0.007, HS
Backache	54 (41.5)	29 (30.8)	25 (69.4)	0.018, S
Stair-climbing difficulty	75 (57.7)	41 (43.6)	34 (94.4)	0.003, HS

Cont.

Cont.

Arthritis	66 (50.7)	34 (36.2)	32 (88.9)	0.001, HS
Cognitive Impairment	22 (16.9)	1 (1.0)	11 (30.6)	<0.001, HS
Hemoglobin	-	11.72±1.83	11.09±1.35	0.046, S
Low DHEAS	11 (8.5)	7 (7.4)	4 (11.1)	0.899, NS
S. Calcium	-	9.49±0.46	9.29±0.49	0.0214, S
High hs-CRP	52 (40.0)	30 (31.9)	22 (61.1)	0.132, NS
Low S. Albumin	-	3.60±0.39	3.57±0.34	0.328, NS
Body Mass Composition				
BMI		23.37±3.93	19.71±4.27	<0.0001, HS
More Fat %	89 (68.5)	62 (65.9)	27 (75.0)	0.004, HS
Fat Mass		21.54 ±6.73	18.52±8.64	0.0350, S
Lean Mass		34.30±6.68	28.71±5.02	<0.0001, HS
BMC		1.78±0.39	1.84 ±2.13	0.7828, NS
Body Mineral Density				
AP spine		-2.18±1.53	-3.16±1.22	0.0003, HS
Left Femur Neck		-1.96±0.96	-2.64±0.69	0.0001, HS
Right Femur Neck		-1.86±0.94	-2.58 ±0.78	<0.0001, HS

NS : not significant statistically, S : Significant statistically, HS : Highly Significant statistically.

Table 8 : Multivariate Binary logistic regression analysis for frailty syndrome and significant variables.

Variables	Prevalence of Frailty n (%)	Adjusted Odds Ratio (95% CI)	p-value
Marital status			
Married	82 (63.1)	1.00	0.028, S
Others (Single/widow/divorced)	48 (36.9)	3.17 (1.12 8.92)	
Living Alone			
No	113 (86.9)	1.00	0.042, S
Yes	17 (13.1)	7.61 (1.07 54.02)	
Arthritis			
No	64 (49.3)	1.00	0.023, S
Yes	66 (50.7)	3.73 (1.19 11.64)	
Poor Vision			
No	67 (51.5)	1.00	0.035, S
Yes	63 (48.5)	3.15 (1.08 9.16)	
Cognitive Impairment			
No	108 (83.1)	1.00	0.012, S
Yes	22 (16.9)	17.48 (1.85 164.58)	
Fat mass	-	1.00 (1.00 1.03)	0.018, S
BMI	-	0.71 (0.55 0.91)	0.007, HS
Lean Mass	-	0.99 (0.99 0.99)	0.019, S

S - significant statistically, HS - highly significant statistically.

Table 9 : Association of frailty syndrome and functional disability.

Variable	No Disability n (%) N=113	Functionally Disability n (%) n=17	p-value
Non-Frail	93 (82.3)	1 (94.2)	<0.0001, HS
Frailty	20 (17.7)	16 (5.8)	

HS - Highly significant statistically

Discussion :

Frailty Syndrome :

The prevalence of frailty obtained in this study using Fried Frailty Index was 27.6%. Our prevalence rate for frailty was almost similar compared to the Indian study conducted in the community dwelling individuals of the elderly in Pune which was 26% by **Kashikar et al.**⁷ Similar results were obtained by the studies conducted across other developing nations like Brazil (17%-31%), Russia (21%-44%) and Asian countries like China (5%-31%) (**Nguyen et al, 2015**).¹⁷ Multi-centric study provided the prevalence for India as 55.5%, highest among the rest of five countries selected for the study (**Biritwum et al, 2015**).¹⁸ Another study conducted in Sri Lanka found the prevalence of frailty and pre-frailty among rural community-dwelling elderly aged were 15.2% and 48.5%, respectively.¹⁹ This difference may be due to different geographical set up, study design, heterogeneity in population in various aspects like culture, life expectancy, education etc. The major contributors of frailty in our study using Fried Frailty Index were gait speed and grip strength and each of the components were increasing proportionately with older age groups. When using the Indian Standards as the cut off for these two components the proportion of population with frailty is less than using the western cut off (Fried Frailty Index).

Frailty syndrome Associated Factors :

The multivariate binary logistic regression analyses identified eight predictors of frailty among elderly which were : unmarried, living alone, arthritis, poor vision, cognitive impairment, elevated fat mass, low BMI and low lean mass. **Table 8** shows the multivariate binary logistic regression analysis for the significant variables.

Among the socio-demographic and socio-economic characteristics; frailty though increased with ageing, this association was not established statistically; in contradictory to other studies.^{2,20} Ageing itself increases the susceptibility to being frail; however, those who were getting old were not necessary getting frail. Moreover, the proportion of more elderly population was less in our study so the statistical association could not be ascertained. We also found no gender difference in frailty. A recent systematic review of longitudinal studies found both association and no association between gender and frailty.²¹ Few studies reported female sex as a risk factor for frailty.^{20,22} While other two studies reported no association.^{23,24} An interesting finding in our study was the association between frailty and marital status. Being married or living with a partner lowers the risk of getting frail; this association has an agreement with previous studies^{22,25,26} but in contrast, study by **Eyigor et al**²³ found that married individuals were at risk to be frail. Marital status and living arrangements may be considered as a main component of social supports particularly in elderly, and being married or staying with the family have been associated with positive social support and health outcomes. In our study, unemployment (current) and illiteracy were associated with frailty; this association have an agreement with previous study.²⁷ Associations of frailty with all the variables is shown in **Table 7**.

Among health-related status variables, those with history of poor vision was associated significantly with frailty, similar to previous study.²⁸ Poor appetite and sleep disturbances were positively associated with frailty similar to previous study.²⁷ Arthritis and backache were also positively associated.²⁹ Cognitive Impairment was found highly associated with frailty as seen in previous study.³⁰ Substantial literatures have demonstrated that most of the

diseases including diabetes, hypertension and heart diseases increase the risk of frailty.^{2,31} However, our results showed that most of the diseases including diabetes, hypertension, heart disease, stroke, COPD / Asthma, Cancer were insignificantly associated with frailty.

In terms of Biochemical measures, low hemoglobin and low calcium were significantly associated with frailty as shown in previous studies^{32,33} whereas low DHEAS, elevated hs-CRP and low albumin were not statistically associated unlike the other studies which showed association with frailty.^{32,33,34}

In terms of Body mass composition, elderly females had lower muscle mass and lower bone mass, although they had shown higher fat mass and fat% compared with elderly males. According to **Fragala et al**,³⁵ males and females differ significantly in their Body composition; males have higher lean mass and lesser adipose tissue similar to our study. Our findings demonstrated that the lower BMI contributed to the risk of frailty and supports the theory of frailty syndrome as a wasting disorder.^{2,36,37,38} In addition, our results showed the frail respondents had lower body composition (lean body mass, body fat) and higher fat% compared to non-frail respondents, which could delineate a characteristic of frail respondents that mostly were thinner and sarcopenic. The U-shaped curve of BMI was found on the risk of frail⁴⁰ and on the risk of mortality³⁹ which suggests that both wasting and obesity were correlated with frailty. However, our findings only association between lower BMI and frailty but not for higher BMI. Obesity seems to be not related to frailty in this population sample.

With respect to Bone Mineral density, increased age and female gender were more osteoporotic when compared with males. Low bone mineral density was significantly associated with frailty similar to previous studies.^{9,41}

Frailty is strongly associated with functional disability consistent with earlier findings.^{10,42} Frailty is not synonymous with disability and that the assessment of frailty status may be helpful in identifying those older adult most at risk for future disability and who may be the best candidates for

prevention programs. Association between frailty and functional disability is shown in **Table 9**.

Conclusion :

In conclusion, of the 130 participants in this study the prevalence of frailty syndrome was 27.6%. Prevalence of pre-frailty accounts for 49.2% and non-frail or robust elderly constituted for 23.1% by Fried frailty index. By Indian Standards, using normative data as recommended by **Gunasekaran V et al** from AIIMS, New Delhi¹²; the prevalence of frail individuals with decreased grip strength (44.6%) and slow walking speed (60%) were far less when compared with that using Fried Frailty Index which were 78.5% and 63.8% respectively.

Given eight factors : unmarried, living alone, arthritis, poor vision, cognitive impairment, elevated fat mass, low BMI and low lean mass are the predictors of frailty syndrome. Other factors such as illiteracy, unemployment, history of fracture, sleep disturbances, stair climbing difficulty, low hemoglobin, low calcium and low bone mineral density were found to be associated with frailty. As the elderly population size in India is growing with the greater longevity, the impact of frailty syndrome could not be ignored and neglected. Determining the predictors of frailty syndrome is important in identifying the modifiable risk factors as a guidance for intervention planning and should be brought in action well in advance to prevent patients landing up with functional disabilities.

Limitations of the study :

This being a hospital-based study with convenient sampling it may not represent the general population. Despite these limitations, this study findings, however, provide baseline data and deepen the knowledge of frailty and its assessments.

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