Comparison of Sarcopenia with Modified Frailty Index as a Predictor of Adverse Outcomes in Critically Ill Elderly Patients

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Authors' contributions

This work was carried out in collaboration among all authors. Authors SB, SA, SK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SK SA and SG managed the analyses of the study. Author SB managed the literature searches. All authors read and approved the final manuscript.

Study Protocol

ABSTRACT

Background: Ageing is a global fact affecting both developed and developing countries.It brings out various catabolic changes in body resulting in frailty(i.e. the person is not able to with stand minor stresses of the environment, due to reduced reserves in psychologicalreserve of several organ system).Thus causing a great burden of disease, dependence & health care cost. Sarcopenia is the leading component for frailty in the elderly population, but very few studies have been done in India for correlating frailty with sarcopenia.
Aim: To compare sarcopenia with modified frailty index (MFI) as a predictor of adverse outcomes in critically ill elderly patients.
Methodology: Cross-sectional study will be performed on all the critically ill geriatric subjects/patients coming to all the ICU's of AVBRH, Sawangi (M), Wardha who will satisfy various inclusion and exclusion criteria for selection and all standard parametric & non-parametric data will be assessed by using standard descriptive & inferential statistics.
Expected Results: In our study, we are anticipating that the Modified frailty index to be a better

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predictor of adverse outcomes in terms of mortality as compared to sarcopenia in the critically ill elderly patients. Also, we are anticipating that sarcopenia to be the most important contributor of frailty in critically ill elderly patients and the prevalence of frailty will be high in critically ill elderly patients.

Limitation: Due to limited time frame & resources we will not be able to follow up the patients.

Keywords: Sarcopenia; frailty; critically ill geriatric population; modified frailty index.

1. INTRODUCTION

Frailty phenotype represents weight loss, decrease functional & physical capacity & activity, falls, slow gait & memory impairment [1]. Sarcopenia which is a generalized and progressive loss of skeletal muscle mass, strength and function which occurs due to primary effects of aging and secondary effects of other causes including diseases, malnutrition and inactivity [2]. Aging leads to increase in Prevalence of sarcopenia and it is approximately about 5-13% in 6th and 7th decade of life [2]. Its prevalence for people aged >80 years may be as high as 50% [3]. Even in the critically ill patients also, its prevalence is 5-13% [3].

To define sarcopenia, the Asian Working Group for Sarcopenia (AWGS) made acriteria which states that a person is said to be sarcopenic if he/she has lower physical performance and/or lower muscle mass plus lower muscle strength.In 2010 the European Working Group On Sarcopenia in Older People (EWGSOP) gave a worldwide accepted definition of sarcopenia, which was later altered by them (EWGSOP2) in 2018.It was re-defined as 1. Lowermuscle strength; 2.Lowermuscle quantity or quality; 3.Lowerphysical performance. Butthis title is especially denoted for geriatric patients, previously it's not been very well defined in critically ill patients of ICU [4].

Like sarcopenia a condition termed as secondary sarcopenia is been defined in the ICU patients and also named as ICU Acquired Weakness (ICU-AW) [4]. As there is scarcity of studies in this area, the informative data for primary sarcopenia or sarcopenia related to age in patients of ICU is not enough [4].

Following Fig. 1 explains the process of how critically ill patients become frail:
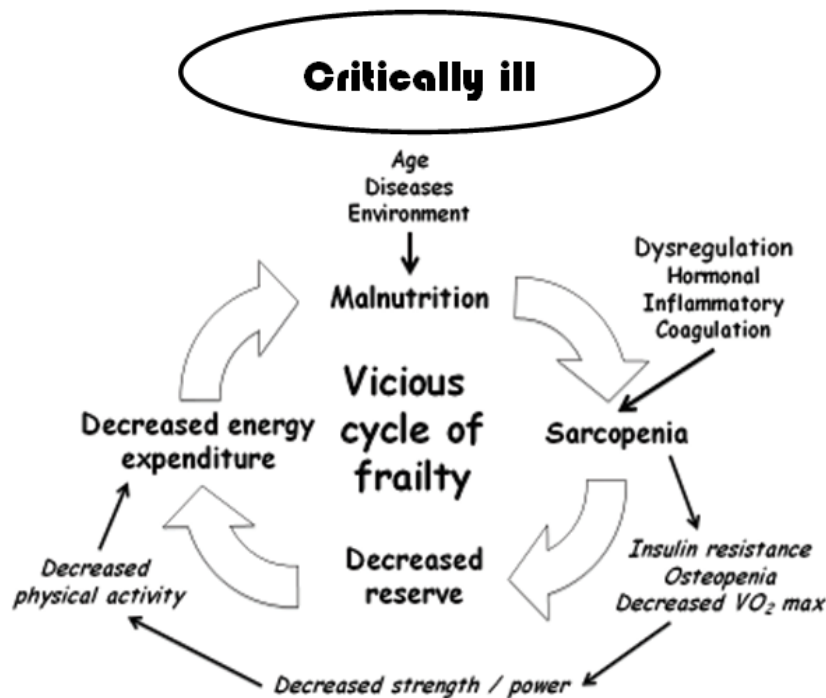
Fig. 1. Overview of the vicious cycle of frailty. VO2 max, maximal oxygen consumption

Some studies believe thatfrailty in the patientswho are critically ill is requiredfor evaluation and its correlation with end points likeexistence, life quality, and its relation with the utilization of the resources, like duration of mechanical ventilation, the length of ICU stay &hospitalization [5]. Assessment of sarcopenia & their correlation with modified frailty index in critically ill elderly patients attending the ICU's will help in correlating its importance with frailty & various other systemic component of frailty. So that earlier evaluation of sarcopenia & its management can be planned to improve the frailty.

With this background, the present study will be undertaken with the following objectives:

1. To correlate adverse outcomes with sarcopenia
2. 2. To correlate adverse outcomes with modified frailty index.
3. To compare sarcopenia with the Modified Frailty Index (MFI) as the indicator of mortality.

2. MATERIALS AND METHODS

All the critically ill geriatric subjects who will come to all the ICU's of Acharya Vinoba Bhave Rural Hospital (AVBRH), a tertiary care hospital attached to Jawaharlal Nehru Medical College (JNMC), Sawangi (Meghe), Wardha.

A prospective cross sectional study will be performed on all the critically ill geriatric population (of age >60 years) coming to the ICU;'s of AVBRH, Sawangi (Meghe), Wardha for 6 months duration after getting ethical committee approval, who will satisfy the various inclusion and exclusion criteria for selection.

The history in the form of age, sex, occupation, reason for hospital visit/admission, diabetes mellitus (DM), hypertension (HTN), chronic obstructive airway disease (COAD), asthma, cardiovascular & cerebrovascular diseases & medications etc will be recorded in proforma.

We will assess frailty by modified frailty index i.e. theFrailty Index in the Rural Elderly – Mental Status, Activities of daily living, Depression and Events (FIRE-MADE)6).

We will assess sarcopenia in the same patients & compare and correlate it with modified frailty index (FIRE-MADE).

Parameters of FIRE-MADE with their scoring is given in the following Table 1 [6].

Table 1. Components of FIRE-MADE frailty index

Sr. No.	Parameter	Score (0 to 10)
1	Mental status by Mini Mental State Examination (MMSE)score 27-30 = Normal <27 = impaired cognitive function	Normal =0 Impaired =1
2	Activities of Daily Living (ADL) score (bathing, dressing, feeding,going to the toilet, transferring, urinary incontinence).	No help- 0, Need help – 1, on any of the following parameters
3	Geriatric depression scale (GDS) (short version) score (>5 = probable depression)	No= 0 Yes =1
4	Events like	
A	Polypharmacy,	No = 0, yes =1
B	DM	No = 0, yes =1
C	IHD	No = 0, yes =1
D	COPD/Asthma	No = 0, yes =1
E	Stroke	No = 0, yes =1
F	Cancer	No = 0, yes =1
G	Others	No = 0, yes =1

The index was calculated as sum of the presence of the deficits which isdivided by the totalnumber of all the potential deficits(10 in this model); Score < 0.25 correspond to fit; 0.25-0.49 represented mild frailty; 0.5-0.69 represented moderate frailty &>0.7 correspond to severe frailty

Sarcopenia will be assessed by EWGSOP2 criteria, which includes: 1.Lower strength of muscle; 2.lower quantity or quality of muscle; 3.Lower performance physically. Sarcopenia will be probably recognised by the criteria.1.Diagnosis will be validated by adding evidence of the criteria 2.When the criteria 1,2 & 3get fulfilled then the sarcopenia will be considered as severe [7].

Strength of the muscle will be assessed by hand grip strength, & upper limb & lower limb muscle strength or power [7].

Physical performance will be assessed by the short physical performance battery (SPPB) that measures in group in which the results of balance test, chair stand and gait speed are combined [7-10].

Hand grip strength (HGS) will be assessed as per neurological examination. Patients will be asked to grip the examiner's finger perfectly in a standing position with the forearms away from the body at the level of thigh.

Participants will be then asked to apply the maximum grip strength & hold it for 3-5 seconds, &the examiner will try to free his fingers from the grip. If low grip strength will be observed, maximum 3 attempts will be given to the participant, with at least 30 seconds of resting interval.

Upper limb and lower limb muscle strength or power of major muscles will be assessed by neurological examination methods by standard protocol for tone and power.

Muscle mass or quantity will be assessed by mid arm circumference & calf circumference measurements.

The use of SARC-F questionnaire is recommended by the EWGSOP2 which is used to demonstrate self documentation from subjects on sarcopenia characteristic signs (score≥4) [7].

SARC-Fquestionnaire with scoring is given in the following Table 2 [8].

Table 2. SARC-F Sarcopenia Questionnaire

Component	Question	Scoring (0-10 points)
Strength	How much difficulty do you have in lifting and carrying 10 pounds?	None=0 Score=1 A lot or unable=2
Assistance in walking	How much difficulty do you have walking across the room?	None=0 Score=1 A lot or uses aids, or unable=2
Rise from chair	How much difficulty do you have transferring from a chair or bed?	None=0 Score=1 A lot or unable without help =2
Climb stairs	How much difficulty do you have climbing a flight of 10 stairs?	None=0 Score=1 A lot or unable=2
Falls	How many times have you fallen in the last year?	None=0 1-3 falls = 1 4 or more falls = 2

2.1 Anthropometric Measurements

Mid Upper Arm Circumference Measurement (MUAC) – it will be taken with elbow relaxed & arm hanging freely to the side, at mid-point of halfway between the tip of the acromion process and the tip of the olecranon process, perpendicular to the long axis of the upper arm, and values will be recorded to the nearest 0.1 cm. MUAC of both the right and left sides will be taken twice, and an average will be recorded. MUAC of <23.0 cm (for males) &<22.0 cm (for females) will be considered as loss of muscle mass [11-13].

Calf circumference (CC) –With the help of elastic measuring tape,calf circumference will be measured at the calf's greatest girth, when the subject will stand upright and weight of the body will be evenly distributed on both the legs.Two measurements of both right and left sides will be taken and the average will be recorded. CC of <35.0 cm (for males) &<33.0 (for females) will be considered as a loss of muscle mass [14].

Physical performance will be assessed by SPPB, that is a group of measures which combines results of chair stand, balance test and gaitspeed [7,9].

To check the balance [7,9] - we will ask the subject/patient to stand with feet together for more than 10 seconds (will be measured by stopwatch). She/he can use her/his arms, bend knees or move body for her/his balance, and will not try to move feet.

1. Those who will stand for 10 sec, will be allotted 1 point & will be promoted for semi-tandem stand.
2. Those who will not be able to stand for 10 sec, will be allotted 0 point & will be forwarded for gait speed test.

Same procedure will be repeated for semi-tandem stand (heel of one foot placed by big toe of other foot) (either foot in front, whichever will be more comfortable for patient) & test will be stopped when the patient will move their feet, grasp the examiner for support, or complete the test.

Again, the test will be repeated for full tandem stand (feet directly in front of each other) (either foot in front) for 10 seconds (stand behind the subject/patient for protection)

1. Those who will stand for 10 sec, will be allotted 2 points
2. Those who will stand for 3 sec to 99.9 sec will be allotted 1 point
3. Those who will not be able to stand or will stand but for<3 sec, will be allotted 0 point.

All the patients will be then examined for gait speed.

To check the gait speed [7,9] - We will ask the patient to walk on the 4m pre-measured testing zone with normal pace. Patient may use an assistive device, if needed. Patients will also be instructed not to slow down before reaching the end point. Points will be awarded as follows:

<4.82 sec (4 points); 4.83-6.20 (3 points); 6.21-8.70 (2points); >8.71 (1point); unable to do (0 point).

All the patients will be taken for chair stand (rise) test.

To check the chair stand test [7,9]- We will ask the patient to stand from sitting position from a chair (with arm rest) with arms folded across the chest (i.e. without using arm rest of chair) for 5 times as rapid as possible without stopping. We will start the stopwatch as soon as they will say ready, and bend forward at their hips. We will count out the number of stands loudly, & will stop at the completion of 5th stand, or if the patient cannot complete 5 rises, and if the participant's safety will be concerned due to the presence of imbalance.

We will score the test as follows:

1. If the subject will complete the test in ≤11.9 sec's (4points); 11.20-13.69 sec's (3points); 13.70-26.69 sec's (2points); 16.70-59.99 sec's (1 point).
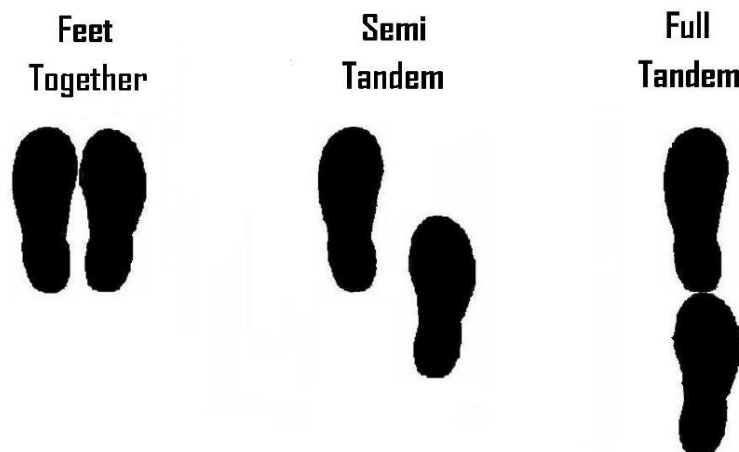

Fig. 2. Anthropometric measurements of foot

2. If the subject is will be unable to do test or unable to complete the test in 60 sec then he/she will be given 0 point.

Gait speed of <0.82 m/sec will be considered as an indicator of sarcopenia [7,9,10].

Total SPPB score of <7 will be considered as an indicator of sarcopenia [7,9,10].

Inclusion criteria:

All the critically ill geriatric subjects (age > 60 years) with co-morbidities who will come to all the ICU's(Medicine ICU, Surgery ICU, OBGY ICU, Neurosurgery ICU, Ortho ICU) of AVBRH of JNMC Sawangi (Meghe) Wardha.

Exclusion criteria:

Following cases will be excluded from the study:
1. Patient not willing to participate in the study.
2. Unconscious patients

Sample size:

$$N = \frac{Z\alpha/2\, 2 * p * (1-p)}{D2}$$

Where Zα/2 is the level of significance at 5% i.e. 95% confidence interval =1.96
P= Prevalence of sarcopenia in critically ill patients= 10%=0.100
D= Desired error of margin = 7% = 0.07

$$N = \frac{1.962 * 0.100 * (1-0.100)}{0.072}$$

= 70.56 = 71 subjects/patients are needed in the study.

3. EXPECTED/ANTICIPATED RESULTS

In our study we are anticipating that Modified frailty index to be a better predictor of adverse outcomes in terms of mortality as compared to sarcopenia in the critically ill elderly patients. Also we are anticipating that sarcopenia to be the most important contributor of frailty in critically ill elderly patients and the prevalence of frailty will be high in critically ill elderly patients.

4. DISCUSSION

In the study by Khalid et al, they concluded that the prevalence of frailty is high in Indian rural population. Sarcopenia is the most important contributor of frailty.MFI had the sensitivity of 91.07%, specificity of 73.08% & positive predictive value (i.e. ability to predict frailty) of 96.68%, which was higher than the ability to predict non-frailty or fit i.e. negative predictive value (48.72%). Thus a valid tool to predict frailty, and each component of MFI had a significant effect on frailty [15].

In the study by Kumar S et al, they concluded that the FIRE-MADE score has gone higher with the advancing age. As compared to ladies it was more in gents. The higher the FIRE-MADE score, there were higher the associations with mortality rates and an unplanned hospitalisation. In a multivariable analysis, predictors for mortality were Mini-Mental State Examination (MMSE), activities of daily living (ADL), ischaemic heart disease, history of stroke and polypharmacy [6].

5. CONCLUSION

With our study we can conclude that the prevalence of frailty will be higher in critically ill elderly population. Sarcopenia will be the most important contributor of frailty. Each component of MFI will have a significant effect on frailty. With the advancing age the FIRE-MADE score will be going on a higher side, it will be more in men than in women and there will be higher associations with mortality rates and unplanned hospitalisation.

CONSENT AND ETHICAL APPROVAL

Approval will be obtained from the Institutional Ethics Committee (IEC) and consent will be then taken from the patients participating in this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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