



Estimation of Sarcopenia cases among Middle aged women using clinical screening tools: A cross section study.

DR.Aradhana Singh (MD), DR. Vani Aditya(MD),DR.Najma Malik(MS),DR. chanchala (JR).

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I. INTRODUCTION

Sarcopenia is a condition which is characterized by progressive and generalized loss of skeletal muscle mass and strength, leads to poor quality of life.¹ This condition is common in elder population above 40 years of age and this lead to mobility problems, increase risk of fall and fracture, impaired ability to perform activities of daily living, disability and loss of independency in the elderly population.

According to a working definition proposed by European working Group of Sarcopenia in Older People (EWGSOP), the criteria for diagnosis of sarcopenia is based on documentation of low muscle mass with the poor muscle strength or physical performance². Sarcopenia is primary due to aging or maybe secondary due to reduced activity like bedrest, chronic disease, malignancy, poor nutrition or endocrinal diseases^{3,4}

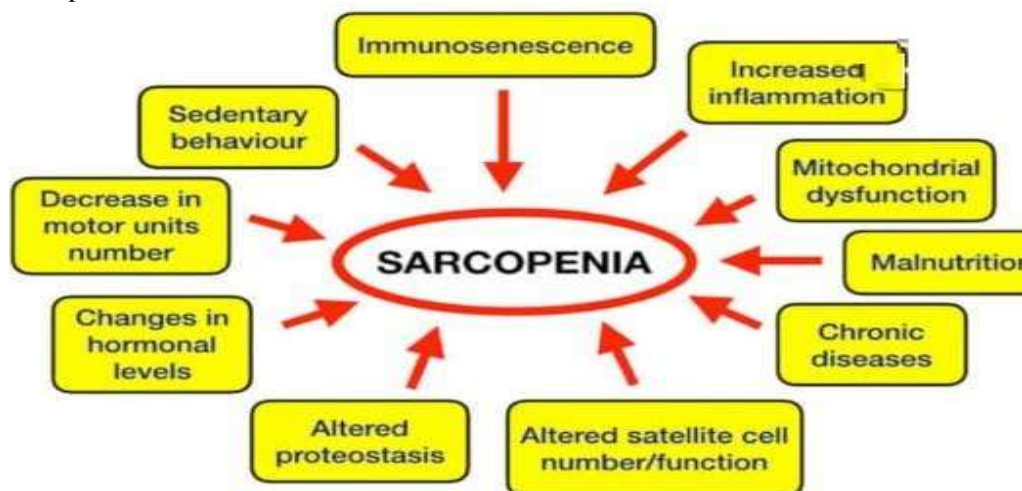
The physiological and morphological changes in skeletal muscle with advancing age are characterized by overall declines in size and number of skeletal muscle fibers in the type 2/fast twitch muscle fiber and marked infiltration of fibrous and adipose tissue in the skeletal muscles.⁵

There are satellite cells which are responsible for skeletal muscle repair and regeneration in response to stress of heavy muscles used such as weight bearing activity or through traumatic events such as injuries in skeletal muscles. In older adults, the satellite cell content is reduced and most specifically in the type 2 skeletal muscle fiber⁶. This is responsible for sarcopenia in old age.

The term sarcopenia was first coined by Rosenberg⁷ in identifying the ages associated loss of muscle mass and function.

Cause of sarcopenia

Risk factors of sarcopenia are change in hormones level, immobility, age related muscle changes, malnutrition and inadequate protein intake, co-morbidity, exercise level, low birth weight, chronic diseases, low physical activity. The degree of sarcopenia is determined by twofactors-firstly, the initial amount of muscle mass and secondary, rate at which muscle mass declines. These two factors are variable in different population so the degree of sarcopenia is variable in different population⁸



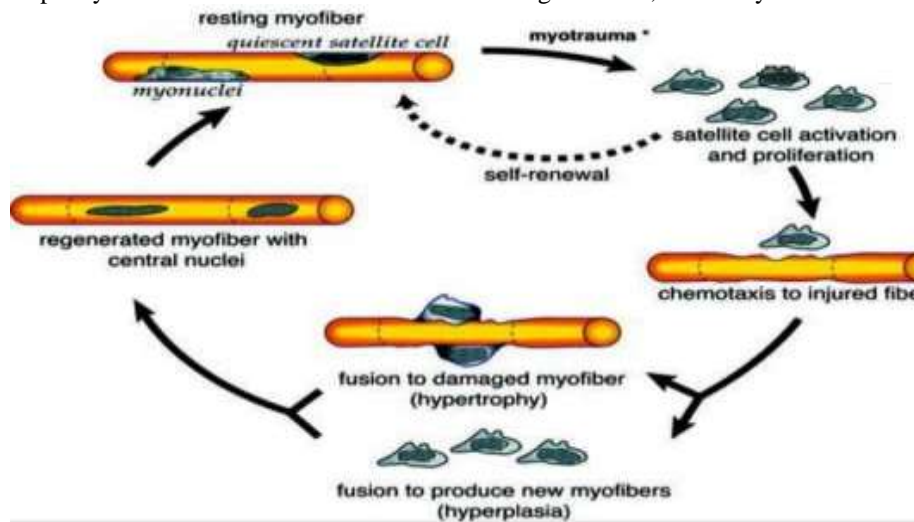
(Risk Factors of sarcopenia)



Pathophysiology of sarcopenia

With aging, there is atrophy of skeletal muscles and microfibers. Loss of skeletal muscles which leads to sarcopenia in old age. With aging, a lack of exercise, malnutrition, low physical activity and hormonal changes leads to neuromuscular junction insufficiency, decrease capillary blood flow of skeletal muscles, reduce repair and regeneration capacity of muscle cells due to

decrease in number of muscles satellite cells. Satellite cells are spindle shaped, mononuclear cells, located within the basal lamina but outside the sarcolemma of skeletal muscle⁹. Satellite cells are primary stem cells in adult skeletal muscles and are responsible for postnatal muscle growth, hypertrophy and regeneration. Inflammatory cells and oxidative stress result in muscle protein degeneration, exceed synthesis.

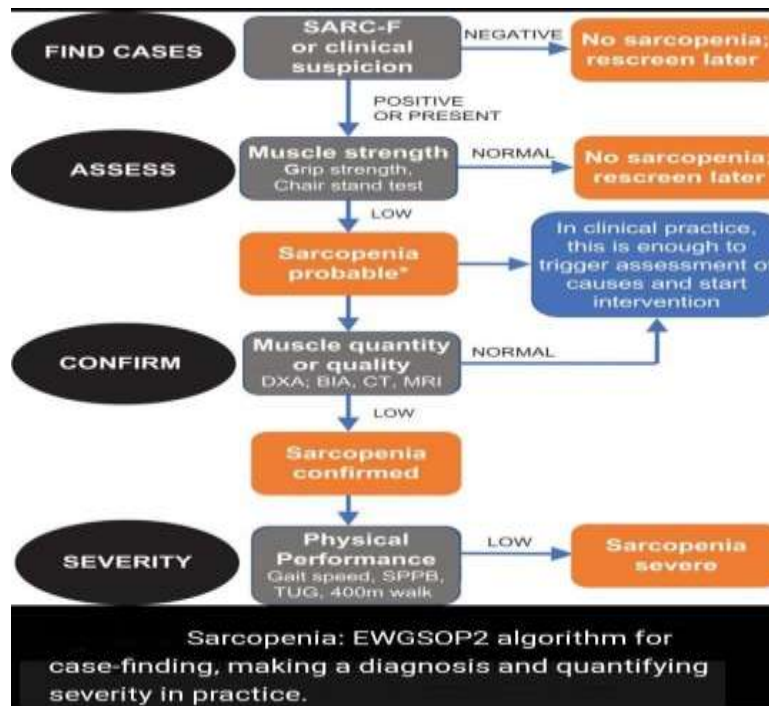


(Pathophysiology of sarcopenia)

Diagnosis of sarcopenia

In 2010, the European Working Group on Sarcopenia in Older People (EWGSOP), published a

sarcopenia definition that aimed to faster advances in identifying and caring for people with sarcopenia.





AIM AND OBJECTIVES

AIMS

Estimation of sarcopenia cases in middle aged female (equal to/ above 40 years) among Eastern UP with help of Clinical Screening Tools.

Comparison of clinical screening tools of sarcopenia – SARCF, hand grip test and SPPB test.

OBJECTIVES

To find cases of sarcopenia, which were undetected and unaddressed in our population, in middle aged women above or equal to 40 years of age. To find out relation of different risk factors like age, menopausal state, diet, physical activity, co-morbidity, protein intake, BMI, any addictions, HRT, exercise with sarcopenia. It helps to prevention and management of sarcopenia in our setting and improve life quality of older population.

II. MATERIAL AND METHODS

Study setting- Study will be carried out in OPD cases, Department of Obs and Gynaecology, BRD medical College, Gorakhpur.

Study subject- Women with age equal to/ more than 40 years, attending to OPD of department of Gynaecology, BRD Medical College, with any complaints.

Inclusion criteria-

Women, above or equal to 40 years of age, attending to OPD of department of Gynaecology, BRD Medical College, with any complaints

Exclusion criteria-

Participants who are critically ill, pregnant, uncontrolled HTN or Diabetes, complicated vasculopathy, unable to walk, very frail, had cardio pulmonary problem, any malignancy.

Study unit - Women over or equal to 40 years of age.

Study design- This is a cross sectional study.

Sample size- 150 cases.

III. METHODOLOGY

PATIENT ENROLLMENT

Patients attending gynae OPD for any complaints, above or equal to age of 40 years was selected over the period of one year. They were counselled to take part in the study and procedure explained in detail to the patient in patient's own language. Those who gave consent to take part in a study, enrolled for the study and selected for SARC-F questionnaires, Hand grip strength test and for short physical performance battery test (SPPB).

INCLUSION CRITERIA-

- All patients who came to Gynae OPD for any cause, who were equal or more than 40 years of age.

EXCLUSION CRITERIA-

- Those patients who didn't give consent for study.
- critically ill patients.
- physically or mentally challenged patients.
- patients diagnosed with any malignancy or taking treatment for the same.

After applying inclusion and exclusion criteria, 150 patients were enrolled in study for sarcopenia. Firstly, all the patients asked for SARC-F questionnaires. Questions were explained to the patients in their local languages so they fully understood and gave appropriate answers. There are 5 components of SARCF questionnaires.

These components are

- Deficiencies of strength
- Rise from a chair
- Climb the stairs
- Falls
- Assistance in walking.

Each component having minimum score 0 and maximum score 2. So SARC-F QUESTIONNAIRES, minimum score is zero and maximum SARC-F score is 10. Answers of patients were recorded and scored. SARC-F QUESTIONNAIRES is a screening tool which is rapidly implemented to identify probable sarcopenia.

- **Score equal to or more than 4 is called high score.**
- **Score less than 4 is called low score.**

The patient having high score of SARC-F questionnaire have higher probability of sarcopenia. The patient having low score of SARC-F questionnaire have no or very less probability of having sarcopenia.

After SARC-F QUESTIONNAIRES scoring, all the patients went through different physical tests to determine strength of muscle in a stepwise manner.

HAND GRIP STRENGTH TEST-

Test was done by instrument called **hand dynamometer (unit kg, range -0 to 130)**. For this test, patient was instructed to sit on a chair with shoulder abducted, elbow flexed to 90 degrees, and forearms and wrist in neutral position. Hand dynamometer was placed in patient's hand while gently supporting the base of the dynamometer. Patient was instructed to squeeze the dynamometer as hard as possible. The patient was instructed that force should be applied smoothly without rapid jerking motion. The test was done three times with dominant hand of the patient.



Out of three squeezing, maximum reading was recorded and scored.

Handgrip strength test score cutoff: < 16 kg.(for female)

That means, hand grip strength test score less than 16kg, have probable sarcopenia and the patient having score equal or more than 16 kg have no probability of sarcopenia.

We decided to estimate sarcopenia by score of hand grip strength test in our clinical setting.

SHORT PHYSICAL PERFORMANCE BATTERY (SPPB) TEST-

SPPB test is combination of balance tests, gait speed test and repeated chair stand test. Before initiating the tests, it was secured that patient was able to stand without support and without use of cane or Walker.

1) BALANCE TEST

A. Side by Side Stand Test-

ACCORDING TO TIME OF HOLDING THE POSITION, POINT WAS GIVEN.

Balance Scoring		
Side-by-Side Stand		
Held for 10 sec	■	1 point
Not held for 10 sec	■	0 points
Not attempted	■	0 points

B. Semi- Tandem Stand Test-

I explained and demonstrated semi-tandem test to patient by doing it by myself. I described each step of semi-tandem stand test to the patient in patient's language. I explained to the patient that patient try to do this test and if feel unsafe during doing it, stop doing it, and inform. we move to the next step, skipping that particular test. I asked the patient to try to stand with side of the heel of one foot touching the big toe of other foot for about 10 second. Instructed that patient may move her

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I asked the patient to try to stand with their feet together, side by side for about 10 seconds, instructed that the patient may move her knee, arm, body to maintain balance but try not to move their feet. I stood beside the patient for safety of the patient. Once patient made particular position and confirmed that she was ready to begin test.

I started the stopwatch for the period of 10 seconds. Asked the patient to step out of this position and recorded the score. For the patients who were unable to hold the position for 10 second, recorded the time of holding the position and move to the other test.

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ACCORDING TO TIME OF HOLDING THE POSITION, POINT WAS given

Balance Scoring		
Semi-Tandem Stand		
Held for 10 sec	1 point	
Not held for 10 sec	0 points	
Not attempted	0 points	

C. tandemst and test:

I explained and demonstrated tandem test to the patient by doing it by myself. I described each step of tandem stand test to the patient in patient's language. I explained to the patient that the patient try to do this test and if feel unsafe during doing it, stop doing it, and inform. We move for the nextstep, skipping that particular test. I asked the patient to try to stand with the heel of one foot in front and touching the toes of other foot for

about 10 second. Instructed that patient may move her knee, arm, body to maintain balance but try not to move feet. I stood beside patient for safety of the patient. Once the patient made particular position and confirmed that she was ready to begin test. I started the stopwatch for a period of 10 seconds. Askedthe patient to step out of this position and i recorded the score. For patients who was unable to hold the position for 10 second, recorded the time of holding the position and move to other test.

ACCORDING TO TIME OF HOLDING THE POSITION, POINT WAS GIVEN.

Balance Scoring		
Tandem Stand		
Held for 10 sec	2 points	
Held for 3 to 9.99 sec	1 point	
Held for less than 3 sec	0 points	
Not attempted	0 points	

Final balance score was calculated by adding scores of side by side stand test, semi- Tandem stand test and Tandem stand test.

GAIT SPEED TEST-

For Gait speed test, a platform of 4 meters was made with 1-meter extra length on each side of the platform. Point A and B were marked on each side of the platform. The distance between point A and point B was 4 meters. I explained and demonstrated the test to the patient by doing it by myself. I described each step of test to patient in patient's language. I explained to the patient that

patient try to do this test and if feel unsafe during doing it, stop doing it, and inform. We moved for the next step, skipping that particular test. I asked the patient to walk along the platform with normal pace. I started the time counting, when patient crossed Point A and stopped the timer when patient crossed Point B of the platform. Time was recorded and gait speed test score was calculated.



POINTS WAS GIVEN TO PATIENT ACCORDING TO TIME TAKEN BY THE PATIENT.

For 4-Meter Walk:	
If time is more than 8.70 sec:	1 point
If time is 6.21 to 8.70 sec:	2 points
If time is 4.82 to 6.20 sec:	3 points
If time is less than 4.82 sec:	4 points

REPEATED CHAIR STAND TEST

For the test, patient must stand without help, or without using arms. If patient was not able to stand without arm, the test was ended and scored. Zero point given to patient for this test. If patient was able to stand without help of arm, they were sent further for the repeated chair stand test.

asked the patient to sit in the middle of chair and placed his hand on opposite shoulder crossed at wrist and placed the feet flat on floor and keep back straight. I asked the patient for rise to a full stand and then sit back down again. Repeated this for 5 times in continuous manner. How much time taken by patient in 5 rotations was recorded.

REPEATED CHAIR STAND TEST SCORE POINT WAS GIVEN TO PATIENT ACCORDING TO TIME TAKEN BY PATIENT TO COMPLETE 5 ROTATIONS.

Participant unable to complete 5 chair stands or completes in > 60 seconds:	0 points
If chair stand time is 16.70 sec or more:	1 point
If chair stand time is 13.70 to 16.69 sec or more:	2 points
If chair stand time is 11.20 to 13.69 sec:	3 points
If chair stand time is 11.19 sec or less:	4 points

SPPB final score was calculated by adding the scores of balance tests, gait Speed test and repeated chair stand test. SPPB final score gives an idea of disability in older population and

monitoring physical ability in older people. SPPB score ranges from 0- 12. Minimum value is 0(worst performance) and maximum value is 12 (best performance).



PATIENTS WERE DIVIDED INTO DIFFERENT CATEGORIES ACCORDING TO SCORE OF SPPB TEST.



By SPPB tests, we divided the patient into different categories according to their limitation of physical activity.

IV. OBSERVATION

The mean Age (Years) was 48.60 ± 9.69 .
The mean (SD) of SARC-F Score was 0.97 (1.52).
The median (IQR) of SARC-F Score was 0.00 (0-1). The SARC-F Score ranged from 0 - 7
The mean (SD) of Hand Grip Strength (Kg) was 14.34 (4.24). The median (IQR) of Hand Grip Strength (Kg) was 15.00 (12-17). The Hand Grip Strength (Kg) ranged from 4 - 28.

The mean (SD) of Balance Test Score was 3.67 (0.66). The median (IQR) of Balance Test Score was 4.00 (4-4). The Balance Test Score ranged from 1 - 4.

The mean (SD) of Gait Speed Score was 2.60 (0.83). The median (IQR) of Gait Speed Score was 3.00 (2-3). The Gait Speed Score ranged from 1 - 4. The mean (SD) of Repeated Chair Stand Score was 2.49 (0.93). The median (IQR) of Repeated Chair Stand Score was 3.00 (2-3). The Repeated Chair Stand Score ranged from 0 - 4.

Distribution of the Participants in Terms of SPPB Impression (n = 150)

SPPB Impression	Frequency	Percentage	95% CI
Minimal	61	40.7%	32.8% - 49.0%
Mild	68	45.3%	37.3% - 53.6%
Moderate	18	12.0%	7.5% - 18.6%
Severe	3	2.0%	0.5% - 6.2%

40.7% of the participants had SPPB Impression: Minimal. 45.3% of the participants had SPPB Impression: Mild. 12.0% of the participants had

SPPB Impression: Moderate. 2.0% of the participants had SPPB Impression: Severe.

Association between Hand Grip Strength (Kg) and Parameters

Parameters	Hand Grip Strength (Kg)	p value
Age (Years)***	Correlation Coefficient (rho) = -0.47	<0.001 ¹
Age***		<0.001 ²
40-49 Years	15.88 ± 3.38	
50-59 Years	12.90 ± 4.19	
60-69 Years	10.56 ± 3.97	
70-79 Years	10.33 ± 4.93	



Parameters	Hand Grip Strength (Kg)	p value
80-89 Years	7.00 ± 1.87	
Parity		0.613 ²
Nullipara	14.00 ± 1.00	
P1	14.75 ± 3.28	
P2	15.61 ± 4.65	
P3	14.56 ± 3.85	
≥P4	13.67 ± 4.42	
Socio-Economic Status		0.417 ²
Upper	11.33 ± 1.15	
Upper Middle	15.54 ± 2.60	
Lower Middle	14.00 ± 3.91	
Upper Lower	14.29 ± 4.22	
Lower	14.41 ± 4.81	
Education		0.137 ²
Illiterate	13.83 ± 4.47	
Primary	14.11 ± 4.40	
Middle	14.53 ± 3.72	
High School	15.36 ± 3.56	
Intermediate	17.12 ± 2.85	
Graduate	22.00 ± 0	
Height (cm)***	Correlation Coefficient (rho) = 0.2	0.014 ¹
Weight (Kg)***	Correlation Coefficient (rho) = 0.18	0.024 ¹
BMI (Kg/m²)	Correlation Coefficient (rho) = 0.13	0.101 ¹
BMI		0.148 ²
<18.5 Kg/m ²	14.00 ± 3.00	
18.5-22.9 Kg/m ²	12.88 ± 4.81	
23.0-24.9 Kg/m ²	14.52 ± 4.36	
25.0-29.9 Kg/m ²	15.27 ± 3.85	
30.0-34.9 Kg/m ²	12.83 ± 4.12	
35.0-39.9 Kg/m ²	12.00 ± 0	
MAC (cm)***	Correlation Coefficient (rho) = 0.25	0.002 ¹
MTC (cm)***	Correlation Coefficient (rho) = 0.21	0.009 ¹
MCC (cm)***	Correlation Coefficient (rho) = 0.19	0.017 ¹
AC (cm)***	Correlation Coefficient (rho) = 0.19	0.019 ¹



Parameters	Hand Grip Strength (Kg)	p value
Daily Work Out***		0.003 ³
Yes	18.00 ± 2.83	
No	14.08 ± 4.21	
Diet***		0.002 ⁴
Vegetarian	13.18 ± 4.26	
Mixed	15.30 ± 4.00	
Daily Caloric Intake	Correlation Coefficient (rho) = 0.11	0.185 ¹
Daily Protein Intake***		0.001 ³
Adequate	15.41 ± 3.90	
Inadequate	12.97 ± 4.32	
HRT		0.353 ³
Yes	13.33 ± 3.20	
No	14.40 ± 4.30	
Level Of Physical Activity***		<0.001 ³
Active	18.38 ± 2.87	
Sedentary	13.96 ± 4.15	
Any Chronic Illness***		<0.001 ³
Yes	10.70 ± 3.92	
No	14.90 ± 4.02	
Chronic Illness***		<0.001 ²
None	14.90 ± 4.02	
DM	10.64 ± 2.98	
HTN	7.33 ± 2.52	
Asthma	11.50 ± 0.71	
DM+HTN	7.50 ± 0.71	
Hypothyroidism	18.50 ± 3.54	
Menopausal Status***		<0.001 ³
Premenopausal	15.99 ± 3.38	
Postmenopausal	12.24 ± 4.31	
Any Addiction /Drug Abuse		0.054 ³
Yes	12.19 ± 4.89	
No	14.60 ± 4.10	



Parameters	Hand Grip Strength (Kg)	p value
Food Supplement Taken During/ After Pregnancy***		0.004 ³
Yes	17.50 ± 2.17	
No	14.11 ± 4.27	
Food Supplement Taken Currently		0.128 ³
Yes	13.24 ± 4.35	
No	14.56 ± 4.20	
SARC-F Score***	Correlation Coefficient (rho) = -0.57	<0.001 ¹
SARC-F Category***		<0.001 ³
<4	15.04 ± 3.74	
≥4	7.50 ± 2.35	
Hand Grip Strength***		<0.001 ³
<16 Kg	11.71 ± 2.90	
≥16 Kg	18.39 ± 2.37	
Balance Test Score***	Correlation Coefficient (rho) = 0.35	<0.001 ¹
Gait Speed Score***	Correlation Coefficient (rho) = 0.49	<0.001 ¹
Repeated Chair Stand Score***	Correlation Coefficient (rho) = 0.57	<0.001 ¹
SPPB Final Score***	Correlation Coefficient (rho) = 0.56	<0.001 ¹
SPPB Impression***		<0.001 ²
Minimal	16.30 ± 3.49	
Mild	14.35 ± 3.65	
Moderate	8.89 ± 2.70	
Severe	7.00 ± 1.00	

***Significant at p<0.05, 1: Spearman Correlation, 2: Kruskal Wallis Test, 3: Wilcoxon-Mann-Whitney U Test, 4: t-test

The following variables were significantly associated (p<0.05) with the variable 'Hand Grip Strength (Kg)': , Age (Years), Age, Height (cm), Weight (Kg), MAC (cm), MTC (cm), MCC (cm), AC (cm), Daily Work Out, Diet, Daily Protein Intake, Level Of Physical Activity, Any Chronic Illness, Chronic Illness, Menopausal Status, Food Supplement Taken During/ After Pregnancy, SARC-F Score, SARC-F Category, Hand Grip Strength, Balance Test Score, Gait Speed Score, Repeated Chair Stand Score, SPPB Final Score, SPPB Impression

V. CONCLUSION

In our study, sarcopenia was estimated by handgrip strength test score. If test score was more than or equal to 16 kg, patient was categorized as non-sarcopenic and if score was less than 16 kg, we categorized the patient as sarcopenic.

* In our study, out of 150, total 91 patients (60.70%) had hand grip score less than 16. So 60.7% participants was sarcopenic as per handgrip strength test score and 39.3 % was non- sarcopenic as per handgrip strength test score.

* Out of 91 participants, who were sarcopenic, 49.5% had age group 40-49 years, 34.1



% had age group 50-59 years, 8.8% had age group 60-69 years, 2.2% had age group 70-79 years and 5.5 % had age group 80-89 years. Out of 59 non-sarcopenic cases, 79.7 % had age group 40-49 years, 16.9% had age group 50-59 years, 1.7 % had age group 60-69 years, 1.7% case had age group 70-79 years and 0% had age group 80-89 years.

* Out of 91 cases having handgrip strength less than 16 kg, most of the cases(50.5%) had parity ≥ 4 . Out of 59 non-sarcopenic cases, most of the cases(40.7 %) had parity ≥ 4 .

* Out of 91 sarcopenic cases, most of the cases (41.8%) belonged to upper lower class. Out of 59 non-sarcopenic cases, most of the cases (40.7%) belonged to upper lower class.

* Out of 91 sarcopenic cases, 62.6% were illiterate, 7.7% were Primary School pass, 18.7% were passed Middle school, 7.7% had education up-to Highschool, 3.3 % had education up-to Intermediate and 0% was Graduate. out of 59 non – sarcopenic cases, 54.2 % was illiterate, 3.4 % was educated up-to Primary School, 25.4% was middle class passed, 6.8% was High School passed ,8.5 % had education up-to intermediate and 1.7 % was Graduate.

* Out of 91 participants, maximum proportions(34.1 %) had BMI 25 to 29.9 KG per metre square . Out of 59 non-sarcopenic cases, maximum proportion (47.5%) had BMI 25 to 29.9 KG per metre square.

* Out of 91 cases who were sarcopenic according to handgrip score, 54.9% were vegetarian and 45.1% were mixed and out of 59 non-sarcopenic cases, 30.5% were vegetarian and 69.5% were mixed.

* Out of 91 sarcopenic cases, 47.3 % had taken adequate protein/ day, 52.7 % had taken inadequate protein in their diet, out of 59 non - sarcopenic cases, 69% were taken adequate protein/day and 31% population taken inadequate protein in their diet.

* Out of 91 sarcopenic cases, 6.6% had history of HRT and out of 59 non- sarcopenic cases, 5.1 % had history of HRT.

* Out of 91 sarcopenic cases, 2.2 % had active life style and 97.8 % had sedentary life style. Out of 59 non sarcopenic cases, 18.6% had active lifestyle and 81.4 % had sedentary lifestyle.

* Out of 91 sarcopenic cases as per score of handgrip test, 18.7% had co-morbid illness and out of 59 non sarcopenic cases as per score of handgrip test, 5.1% had co-morbid illness.

* Out of 91 sarcopenic cases, 2.2% did daily workout and out of 59 non-sarcopenic cases, 13.6% did daily workout.

* 44.0% cases of sarcopenia were premenopausal and 56.0% cases were postmenopausal. 74.6% cases of non sarcopenia were premenopausal and 25.4% non sarcopenic cases were postmenopausal.

* 12.1% of total sarcopenia cases had any addiction ,8.5% of non sarcopenia cases had any type of substance abuse history.

* 19.8% of sarcopenic population were on food supplement currently, and 11.9% of non sarcopenic population were on food supplement currently.

* Out of 91 participants, had handgrip score < 16 kg, 77[84.6%] had SARCF score < 4 , and 14[15.4%] participants had SARCF score ≥ 4 . Out of 59 participants, had hand grip test score ≥ 16 , all had SARCF score < 4 .

* Out of 91 sarcopenic cases, 30.8% were in minimal SPPB impression, 46.2% lied in mild limitation category, 19.8% lied in moderate limitation category and 3.3% were lie in severe limitation category. Out of 59 non sarcopenic cases ,55.9% lied in minimal limitation category ,44.1% lied in mild limitation category, no participants were lie in moderate or severe limitation category.

* In our study, it was found that the following variables were significantly associated [$p < 0.05$] with the variable Handgrip strength–age, MAC(cm), MTC(cm), AC(cm), daily workout, diet, BMI, daily protein intake, level of physical activity, any co-morbidity, menopausal status, food supplements intake, SARCF score, SPPB score, SPPB impression.

Correlation between handgrip strength test and SARC-F score-

in our study, it was found that there was a moderate negative correlation between handgrip strength test(kg) and SARCF score and this correlation was statistically significant ($\rho = -0.57, p < 0.001$).

For every 1 unit increase in handgrip strength(kg), the SARCF score decreases by 0.22 units. conversely, for every 1 unit increase in SARCF score, the handgrip strength(kg) decreases by 1.75 units.

84.6% of the participants in the group (Handgrip strength < 16 kg) had SARCF category < 4 (low score).

15.4% of the participants in the group (handgrip strength < 16 kg) had SARCF score ≥ 4 (high score).

100.0% of the participants in the group (handgrip strength ≥ 16 kg) had SARCF score < 4 .

So this study shown that participants in the group handgrip strength ≥ 16 kg had the larger proportion of SARCF category < 4 . Participants in



the group handgrip strength <16kg had the larger proportion of SARCF category ≥ 4 .

Correlation between SPPB final score and hand grip strength (kg)

There was a moderate positive correlation between SPPB final score and hand grip strength (kg) and this correlation was statistically significant ($\rho = 0.56, p < 0.001$).

For every one unit increase in SPPB final score, the hand grip strength (kg) increases by 1.38 units.

Conversely, for every one unit increase in hand grip strength (kg) the SPPB final score increased by 0.29 units.

30.80% of participants in the group [hand grip strength less than 16 kg] had [SPPB impression: minimal]. 46.20 % of participants in the group [handgrip strength <16 kg] had SPPB impression mild. 19.8% of the participants in the group [handgrip strength <16 kg] had [SPPB impression: moderate]. 3.3 % of participants in the group had [hand grip strength <16kg] had [SPPB impression:severe] .55.9 % of the participants in the group [hand grip strength ≥ 16 kg] had [SPPB impression minimal]. 44.1 % of participants in the group [handgrip strength ≥ 16 kg] had [SPPB impression mild]. 0.0 % of the participants in the group [handgrip strength ≥ 16 kg] had [SPPB impression moderate]. 0.0 % of the participants in the group [hand grip strength ≥ 16 kg] had [SPPB impression severe].

Participants in the group hand grip strength ≥ 16 kg had the large proportion of SPPB impression: minimal. Participate in the group handgrip strength <16 kg had a larger proportion of SPPB impression: mild. Participants in the group handgrip strength : < 16 kg had the larger proportion of SPPB impression: moderate & participants in the group hand grip strength <16 kg had larger proportion of SPPB impression: severe.

In our study, it was shown that there was strong correlation between SARCF score, handgrip strength, and SPPB score & impression.

In our study, out of total 150 cases, 136 cases had SARCF score <4. and out of these 136 cases, 59 cases had hand grip strength ≥ 16 kg. 77 cases had handgrip strength <16kg. In the study, out of 150 cases, 14 cases had SARCF score ≥ 4 . All these cases belonged to handgrip score <16kg.

So if we only took SARCF score ≥ 4 cases for handgrip strength test, a large portion of cases which handgrip strength <16kg (SARCF score <4) were left out. So we have to do handgrip strength

test for all the cases either SARCF score <4 or ≥ 4 to estimate sarcopenia cases.

In our study, participants which had Handgrip strength test score <16 kg, belonged to all category of SPPB impression (minimal 30.8%, mild 46.2%, moderate 19.8%, severe 3.3%). Participants which had handgrip strength test ≥ 16 kg, belonged to minimal and mild category of SPPB impression. No participants belonged to moderate and severe categories.

So the participants had handgrip strength <16 kg, should go further for SPPB test for categories into minimal, mild, moderate, severe.

Participants had handgrip strength ≥ 16 kg, should not go further categorization of SPPB impression. They should be counselled for risk factors and follow up yearly.

So, if we try to estimate sarcopenia cases in low setting area with the help of SARCF questionnaires and handgrip strength test, SPPB score, it gives satisfactory results. The confirmatory tests of sarcopenia like DXA, CT scan, MRI scan, BIA which are expensive and not available in low setting areas. In this situation, we can estimate sarcopenia cases only with help of SARCF Questionnaires, handgrip strength test and SPPB final score.

The cases had handgrip strength score <16kg, were decided to be sarcopenic, and then by SPPB score we further divided it into minimal/mild/moderate/severe categories. As we seen in our study that risk factors for sarcopenia were age, parity, socioeconomic status, education, diet, daily protein intake, exercise, lifestyle, food supplements, any addiction, comorbidity, hormonal status. We counselled the patients for change lifestyle (more active), do daily exercise, take healthy diet with more protein: carbohydrate ratio, cessation of smoking, cessation of any other addiction, control co-morbid conditions along with giving treatments.

The cases had handgrip strength score ≥ 16 kg were categorized as non sarcopenic in our study. We give a brief information about risk factors of sarcopenia to these patients also and counselled these patients to adopt healthy diet, daily exercise, active lifestyle, cessation of addiction. We should follow these cases yearly.

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