International Journal of Home Science 2019; 5(3): 35-40

International Journal of Home Science

ISSN: 2395-7476
IJHS 2019; 5(3): 35-40

www.homesciencejournal.com
Received: 25-07-2019
Accepted: 27-08-2019

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Association of diet and diseases with age related sarcopenia among elderly people

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Abstract
Background: Sarcopenia is an age-related progressive decline in muscle mass and function that contributes to increased physical disability, morbidity and mortality among the elderly people. Nutrition plays an important role in the sarcopenia. Exercise (both resistance and aerobic) is combination with adequate protein and energy intake is the key factor for the prevention and management of sarcopenia.
Objective: To study the association of diet and disease condition among sarcopenic subjects.
Methodology: A hospital based observational study was carried out on 100 patients who are admitted to Apollo BGS, Mysore. The required data was collected referring the case record of patients. A questionnaire with structural interviews was used during data collection.
Result: The findings shows that arthritis and chronic kidney disease patient having more sarcopenia. Less consumption of protein leads to sarcopenia condition.
Conclusion: This study shows that diet plays an important role in sarcopenia condition. Adequate protein helps to maintain muscle mass. As the body becomes vulnerable to the disease condition, sarcopenia may also increases in its progression.

Keywords: Sarcopenia, physical disability, muscle mass, arthritis

Introduction

The integrated function of skeletal muscle tissue is proportionally dependent to the physical strength, stamina and balance. Muscle and bone interact to impact on bone strength. Although they have common genetic, nutritional, lifestyle and hormonal determinants. A progressive decline in bone mineral density (BMD), muscle mass and muscle strength are key features of the ageing process. They predispose older individuals to disability, falls, fractures and frailty and so pose a major and increasing clinical and public health burden. In addition, (Verschueren *et al*., 2012).

In 1989, Rosenberg introduced the term 'sarcopenia' to describe the age-related loss of muscle mass. Sarcopenia is a syndrome characterized by age-related loss of skeletal muscle mass and physical function, which is responsible for frailty, disability, falls and poor prognosis. In addition, it results in impaired cardiopulmonary performance, unfavorable metabolic effects and mortality. Furthermore, sarcopenia is also associated with multi morbidity, cigarette smoking, low body mass index, underweight, and low serum levels of testosterone in men. In general, the association between sarcopenia and functional decline is more significant in men than in women.

Sarcopenia is a multi-factorial disorder and considered to be the underlying cause of death among people over 65years and will most likely to increase over 40 years due to the aging of the world's population, as its prevalence rate is known to increase with age. After 50 years of life, there is 1-2% decline in muscle mass per year, whereas muscle strength decreases faster, between ages of 50 and 60 subsequently at 3% per year (Liang kung chen *et al*. 2014) [2, 8].

Possible causal factors include age-related changes in the secretion of trophic hormones, malnutrition and inadequate dietary intake, changes in physical activity and a sedentary lifestyle and a decrease in muscle innervation and capillary density (Alison smith and Rezvan Hashemi *et al*., 2014) [3].

Nutrition and Ageing

In comparison with younger ages, older adults eat more slowly, they are less hungry and thirsty, consume smaller meals, and they snack less. The mechanisms for the "anorexia of ageing" are not fully understood but there may be a range of physiological, psychological, and social factors that influence appetite and food consumption, including loss of taste and olfaction, increased sensitivity to the satiating effects of meals, chewing difficulties, and impaired gut function. The negative consequences of these changes are compounded by the effects of functional impairments that impact on the ability to access and prepare food, psychological problems such as depression and dementia, as well as the social effects of living and eating alone. Low food intakes and monotonous diets put older people at risk of having inadequate nutrient intakes.

Dietary Management

Dietary Protein

Dietary protein provides amino acids that are needed for the synthesis of muscle protein as well as acting as an anabolic stimulus, with direct effect on protein synthesis (Groen BBI *et al*., 2015). Branched-chain amino acids have been shown to increase skeletal muscle protein synthesis and net balance, and supplementation with leucine, isoleucine and valine has been used to improve performance and attenuate muscle loss (Borak MS 2016). Overall evidence suggests that protein supplementation should have the potential to slow sarcopenic muscle loss particularly among older adults with low habitual intake (Hickson M 2015) [4].

Vitamin D

There will be interrelationship between loss of muscle mass and vitamin D deficiency. Both are linked to common clinical outcomes that include weakness, falls and frailty in older age (Bischoff Ferrari HA 2012) [5]. Vitamin D Supplementation was shown to have beneficial effect on muscle function, with evidence of reduced postural sway, decreased time for the Timed Up and Go test, and gain in lower extremity strength (Muir SW, Montero-Odasso M 2011) [6]. There have been a number of trials of vitamin D supplementation to prevent falls in older adults. Apart from potential effects of vitamin D on muscle mass and strength, low status has also been linked to orthostatic hypertension, commonly considered to be a risk factor for falls (Gangavati A *et al*., 2011) [7].

Antioxidant Nutrients

Damage to biomolecules such as DNA, lipid and proteins may occur when reactive oxygen species (ROS) are present in cells in excess. As an accumulation of ROS may lead to oxidative damage, with the potential to contrite to losses of muscle mass and strength in older age (Kim J-S 2010). Studies shoes that low selenium status has been linked to muscle mass in older population (Chen Y-I *et al*., 2014) [2, 8]. The high dose vitamin C and E supplementation blunted some of the muscular adaptations to strength training in older men, raises significant concerns about the use of antioxidant supplements (Bjornsen T *et al*., 2016) [9].

Treatment of Sarcopenia

Progressive resistance training has been shown to be an effective intervention in older people with sarcopenia but there is also significant potential for whole diet interventions in the management of sarcopenia. Evidence suggests that protein and vitamin D may have a treatment and/or preventative role.

New evidence also suggests that the n-3 polyunsaturated fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) may help stimulate muscle protein synthesis (anabolism). In older age, the body's requirement for total protein may not change, but because of the decreased effectiveness of EAA, either more total protein, a greater nutrient density of EAA or higher quality protein may be required. On this basis, the optimal protein intake for older may be above current recommended level of 0.8–1g protein per kg body weight per day. EPA/DHA is thought to be useful in the treatment of conditions with an inflammatory component including sarcopenia. Research has suggested that resistance exercise combined with EPA/ DHA supplementation could double strength and functional ability (Alison smith 2014) [3].

Aims and Objective

- To study the prevalence of sarcopenia
- T study the association between disease and sarcopenia
- To study the nutrient intake on sarcopenia

Methodology

Research Design

It is a clinical observational study

Sampling Method

A sample size of 100 subjects was selected for study from Apollo BGS Hospital, located in Mysore. The basic information was collected from medical reports of sample and other details by direct interview.

Method of study, tools and technique

Demographic details

Demographic details like age, education, religion, gender, marital status, type of family, place of residence were collected using a standard questionnaire.

Anthropometric measurement

Height and weight of sample was noted and ideal body weight was calculated. The body mass index was also calculated and samples were categorized into underweight, normal, overweight or obese based on world health organization standards (2004).

Biochemical parameters

Hemoglobin level was recorded.

Sarcopenia screening tool

Sarcopenia was screened using SARC-F questionnaire **(**Theodore *et al*, 2013). It is used for rapid assessment of sarcopenia status, which does not require special measurements or equipment. The performance of this questionnaire in identifying elderly people with impaired physical function and sarcopenia was reported to be comparable to more rigorous tests, and it showed good predictive capabilities for physical limitations and mortality in the community-dwelling elderly population.

Table 1: SARC-F score (Malmstrom & Morley, 2014)

Component	Questions	Scoring
Strength	How much difficulty do you have in lifting and carrying 10lbs?	None=0
		Some=1
		A lot or unable=2
Assistance in walking	How much difficulty do you have walking across room?	None=0
		Some=1
		A lot, use aids, or unable =2
Rise from a chair	How much difficulty do you have transferring from a chair or bed?	None=0
		Some=1
		A lot or unable without help=2
Climb stairs	How much difficulty do you have climbing a flight of 10 stairs?	None=0
		Some=1
		A lot or unable=2
Falls	How many times have you fallen in the past years?	None=1
		1-3 falls=1
		≥4 falls=2

Diet Recall

Diet recall of 3 days was recorded, thereby calculating for total intake of calorie and proteins, Hemoglobin level was calculated using Microsoft excel. Diet type and food allergy were also noted. Lifestyle habits like smoking, alcohol consumption also noted down. A food frequency table was included in questionnaire which gives the idea about missing out the food groups in diet on daily and weekly basis.

Data Analysis

The data obtained by demographic details, biochemical parameters and dietary recall were fed in SPSS software. Statistical analysis was done thereafter.

Results and Discussion

Sarcopenia a geriatric syndrome characterized by progressive loss of muscle mass and muscle strength functions(dynapenia) and linked to this, negative results like falling, reduced physical and cognitive capacity, low quality of life, increased dependence and death (Cruz- jentoft *et al*., 2010) [12]. BMI and inflammation have also been significantly associated with muscle mass loss. Table 2 presents the anthropometric measurements of the selected subjects. Comparing the mean height and weight 162±8.6 and 67±13.4 respectively, mean weight found to be more profound. Among the selected subjects only 5% was underweight, normal to overweight was within the range of 20-22%, and obese an exceedingly high percentage i.e. 53%. And mean values of hemoglobin 11.7 gms/dl against the standard range of ±2.18 range. Decrease in muscle mass could lead to a change in red blood cell mass through changes in erythropoietin production. As a result, the oxygen utilization system may be affected, resulting in anemia. Hematological factors including hemoglobin and low serum albumin are linked to grip strength decline in longitudinal studies (Hyunkyung Kim *et al*., 2016).

Table 2: Antropometric & Hb Assessment of the Selected Subjects

Variables	Characters	Frequency (%)
Height(cm)	140-150	12
	151-160	28
	161-170	41
	171-180	18
	181-190	01
Weight(kg)	30-50	09
	51-70	56
	71-90	29
	<91	06
IBW	30-50	17
	51-70	64
	71-90	19
BMI (Kg/m^2)	<18.5 (Underweight)	05
	18.5-22.9(Normal)	20
	23-24.9(Overweight)	22
	>25(Obese)	53
Biochemical parameter	Hemoglobin	Mean± SD
		11.7±2.18

Table 3 represents the component involved in SARC-F questionnaire. Total number of 66% were found to be non-sarcopenic and with an appreciable percentage of 34 being sarcopenic in selected subjects. SARC-F score 4 and more than 4 having risk of sarcopenia.

Table 4: Sarc-F Standard Score

Component	Scoring	Overall (n=100)	SARC-F <4 (n=66)	SARC-F≥ 4 (n=34)
Strength	None=0	53	51	02
	Some=1	28	15	13
	A lot or unable=2	19	00	19
Assistance in walking	None=0	50	45	05
	Some=1	39	19	20
	A lot, use aids, or unable =2	11	02	09
Rise from a chair	None=0	67	57	10
	Some=1	29	09	20
	A lot or unable without help=2	04	00	04
Climb stairs	None=0	41	39	02
	Some=1	37	25	12
	A lot or unable=2	22	02	20
Falls	None=1	75	58	17
	1-3 falls=1	22	08	14
	≥4 falls=2	03	00	03

Risk factors assessed for declines in muscle mass include chronic condition such as diabetes, heart disease and hyperlipidemia and have also been significantly associated with muscle mass loss (Hyunkyung Kim *et al*., 2016). Muscle strength loss has been associated with many chronic conditions and lifestyle factors, such as back pain, diabetes, cardiovascular disease, chronic kidney disease, hypertension, asthma, cognitive function, use of calcium channel blockers, caffeine intake, excess bodyweight, stress and smoking (Hyunkyung Kim *et al*., 2016)

The column graphic (Fig1) presents the patients disease condition tallied with SARC-F score. Based on the SARC-F score sarcopenia and non-sarcopenia were divided among the subjects with different disease condition. It shows that sarcopenia was more among arthritis and chronic kidney disease patient. Not surprisingly diabetes mellitus and hypertension were significantly associated with other disease conditions.

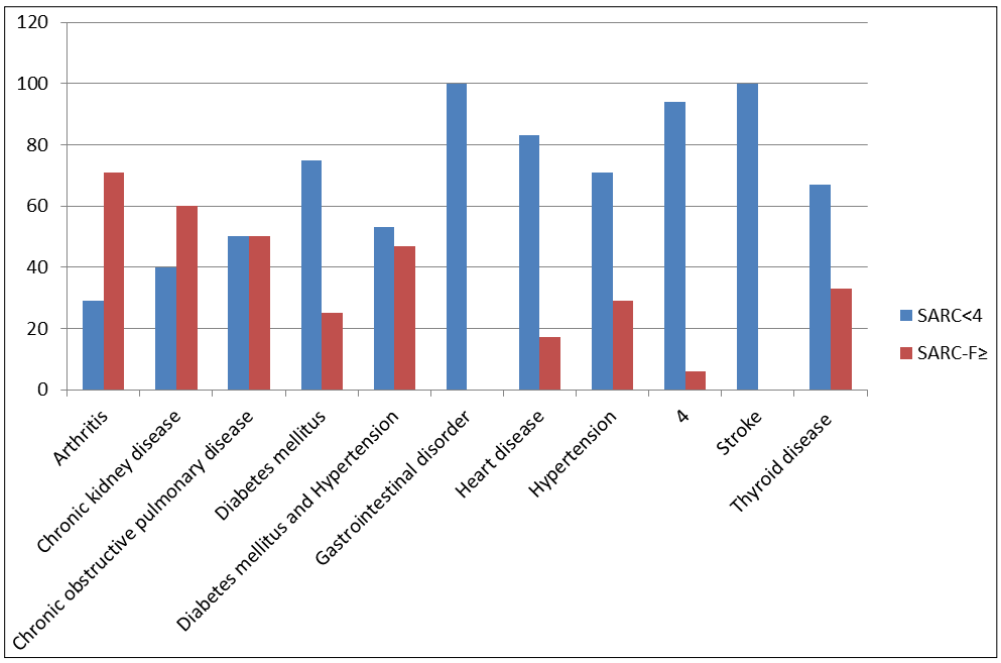

Fig 1: Percentage of sarcopenia and disease condition

A perusal of table 6, shows that frequency of food consumption. Consumption of cereals was obvious with a higher amount. In contrast, the pulses were consumed to a very low quantity, thereby protein content was comparatively lower than the standard requirements. And this was clear when the animal protentious food stuffs like poultry, fish, egg were consumed at a lower rate except for milk. Thus, declining muscle strength and physical capability in older age may increase the risk of poor nutrition, lacuna of protein foods may contribute to further declines in physical capability Sian (Robinson *et al*., 2012). Its alarming to understand that less than 50% of the subjects includes fruits in their daily regime and none of the subjects found to have regular fish in their daily diets. Healthier diets, characterized by greater fruits consumption, and oily fish have been shown to be associated with greater muscle strength and with better measures of physical function in older adults and lower risk of frailty (Bollwein J *et al*., 2013) [15]. Additionally, the content of potassium salts in the fruits can buffer sulphuric acid and phosphoric acid derived from the catabolism of the Sulphur-containing amino acids and phytases, and provide protection from known catabolic effects of acidosis on muscle tissue (Millward D J 2012) [16]

Table 5: Frequency of Food Consumption

Food groups	Daily Servings	Weekly once	Weekly twice	Alternate	None
Cereals	100	0	0	0	0
Pulses	47	0	0	53	0
Milk	97	0	01	0	02
milk products	47	03	18	24	08
Vegetable	95	04	01	0	0
Fruits	49	8	0	15	7
Fats and oil	100	0	0	0	0
Sugar	47	0	0	01	52
Red meat	0	16	11	38	35
Poultry	22	28	15	0	35
Fish	0	12	08	38	42
Egg	10	19	27	16	28

Sarcopenia can be prevented or delayed by modifiable behavioral factor such as physical activity level and smoking level although quality and quantity of dietary intake which plays an important role (Rezvan Hashemi *et al*., 2014). Overall, a minimum of 20-30 minutes of resistance and an substantial amount of exercise thrice a week is recommended to slow muscle loss and prevent sarcopenia (John E. Morley *et al*. 2010) [17]. Table 6 shows that mean demographic data of sarcopenic and non-sarcopenic subjects. There is no difference in the male and female subjects. Unhealthy lifestyle habits like smoking, alcohol and physical activity also doesn't shows any difference among the subjects. Bed rest results in rapid loss of muscle mass and strength especially in older persons. Muscle strength loss has been associated with alcohol intake, stress and smoking (Resistance exercise improved strength and decreased frailty in every old person Hyunkyung Kim *et al*., 2016).

Table 6: Other Daily Habits of Nonsarcopenic and Sarcopenic Subjects

Variables	Characters	Non-sarcopenic (n=66)	Sarcopenic (n=34)
Sex	Male	45(68)	17(50)
	Female	21(32)	17(50)
Activity	Sedentary	44(67)	23(67)
	Moderate	09(14)	03(09)
	Heavy worker	13(20)	08(24)
Smoking	Non smoker	55(83)	31(91)
	Smoker	11(17)	03(09)
Alcoholic drinker	No	51(77)	26(76)
	Yes	15(23)	08(24)
Physical activity	Yes	42(64)	15(44)
	No	24(36)	19(56)

Difference (Mean ±SD) value of actual energy intake and their expected energy intake is presented in the table 7. And it clearly shows that actual energy intake is only 5% higher than RDA and has contributed chiefly from the carbohydrates, which is only of 2% excess. Protein adequacy indicates insufficient protein consumption (65%) which leads to muscle mass loss. This has effect in absence of muscle strength and low physical performance. Adequacy of fat consumption is only 3/4th of their bodily requirement. The observational evidence that links individual nutrients to differences in muscle mass and function in older age is that many dietary components are highly correlated with each other.

Table 7: Mean Adequacy of Nutrient Intake

Nutrients	RDA	Actual Intake	Adequacy (%)
Energy (Kcal)	2056±335	2165±458	105
Carbohydrate(g)	347±56	356±85	102
Protein(g)	65±15	44±14	65
Fat(g)	72±19	51±14	72

Conclusion

Sarcopenia is a risk-factor for all-cause mortality among older adults, but it remains unknown factor if it predisposes older adults to specific cause of death. The disparity is found between genders, among obese and non-obese individuals. Sarcopenia represents a major factor responsible for falls, fractures and functional decline in older persons. A substantial amount of exercise is a fundamental tool for maintenance of muscle mass and functioning with aging process, nutritional interventions involving protein intake patterns and its supplementation have emerged as most important approaches to managing sarcopenia.

Ageing induces sarcopenia is a result of decreased synthesis and increased degradation rate of myofibril proteins, which leads to the slower turnover rate of contractile proteins. Daily total intake of quality protein consumed is important, but as of recent research studies, indicates that the distribution of dietary protein throughout the day's meals is just as important. The Recommended Dietary Allowance (RDA) for protein (0.8g protein/kg/day) describes the quality of protein required daily to prevent deficiency for all adults, irrespective of age. National Health and Nutrition Examination Survey (NHANES), suggests that many adult population consume a moderate–to-high protein diet (1.3g protein/kg/day). Unfortunately, older adults generally consume less protein. Approximately one third of adults over 50 years of age faisl to meet the standard allowances of protein, while approximately 10% of older women unable to meet even the Estimated Average Requirement (EAR) for protein (0.66g protein/kg/day). Protein is important for older population is to experience catabolic stressors such as illness, physical inactivity or injury. The most common age-related causes of protein shortfall are inadequate intake of dietary protein (loss of appetite, gastrointestinal issues, reduced energy need, changes in food preference), a reduction in the utilization of available protein (anabolic resistance, insulin resistance, higher splanchnic extraction), and a higher basal requirement (acute and chronic diseases, inflammatory disease, increased oxidation of protein).

Age related condition such as osteoporosis and sarcopenia do not develop acutely. Rather they are insidious conditions whose onset may be accelerated by less than optimal lifestyle practices in early middle age. Muscle mass loss occurs in the course of time because of decreased physical activity, increased energy expenditure during rest, and hormonal and immunological alterations seen in patients with arthritis. In chronic kidney disease sarcopenia is due to malnutrition. Muscle wasting is more prone among dialysis patient. It is influenced by individual characteristics as the person's genotype, phenotype, medical history, duration and severity of renal failure, psychosocial condition, and lifestyle.

In conclusion sarcopenia is a common clinical problem among older adults. Diet and disease condition has a positive impact on sarcopenia. Protein plays an important role in managing sarcopenia. Sarcopenia is more prevalent among rural areas due to lack of dietary protein, which invariably predisposes to disease condition and eventually leading to sarcopenia. Poor nutrition is associated with malnutrition and increases risk of sarcopenia and mortality rates among older adults.

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