Nutritional Intake and Frailty among Older Adults in India

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Abstract

Lack of nutrition has been identified as one of the most important factors in developing of age-related diseases such as frailty, however the study of same is largely ignored within the health policy landscape for older people in India. Using data from Wave 2 of The Study on Global Ageing and Adult Health (SAGE), the proposed study estimates the prevalence of frailty among older adults and analyses if inadequate intake of nutrition has significant association with frailty among older people in India. Prevalence of frailty in the older adults was estimated to be approximately 35%. The study results highlight that the percentage of frail older adults is highest in the age group 80 and above (64%) and among the widowed (47.9%) and poorest (44%) groups. The older adults with adequate food access and the ones consuming adequate quantity of fruits had significantly lower odds of being frail. The study highlights the need for a multifaceted approach that includes nutritional interventions, policies aimed at reducing food insufficiency, and targeted interventions to improve the health of vulnerable populations such as the oldest old, widowed, and the poor.

Key words: Nutrition, Food Security, Frailty, Older people.

Introduction

Declining fertility and an increase in survival at older ages have resulted in the proportion of older people (60 years and above) in the population increased substantially within a relatively short period of time. India recorded a significant improvement in life expectancy at birth, and with ever-increasing life expectancy comes an increased risk of health problems and illnesses many of which can be prevented, delayed or improved by maintaining a healthy diet. Nutrition is a key contributor to maintaining good health and reducing the risk of disease. Eating a balanced diet and maintaining a healthy body weight are critical for maintaining good health in people of all ages, but they are significant for healthy ageing. (Leslie and Hankey, 2015).

Lack of nutrition has been identified as one of the most important factors in developing of age-related diseases such as frailty, sarcopenia, cognitive decline, diabetes, vascular diseases, cancer and osteoporosis. (Vandewoude, Alish, Sauer, & Hegazi, 2012; Shlisky et al., 2017; Ramya et al., 2017). Frailty is a multidimensional geriatric syndrome characterised by a decline of physical and cognitive reserves that leads to increased vulnerability. The consequences of frailty can have a profound impact on the health, well-being, and quality of life of older adults (Gill et al.,2006).

Malnutrition and frailty are closely related and have a complex interplay, leading to a vicious cycle of decreased function, increased vulnerability, and further deterioration (Bollwein et al., 2013a). Older

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adults are particularly susceptible to malnutrition and frailty due to age-related changes in body composition, metabolic rate, and nutrient requirements. Furthermore, various social, economic, and health factors may contribute to malnutrition and frailty in older adults.

Research has looked into identifying nutrition intake or dietary quality as a predictor of frailty and found consumption of poor-quality diets to be associated with a higher incidence of frailty. Studies such as Hengeveld et al. (2019), Bollwein et al. (2013a), and Bollwein et al. (2013b) have indicated prospective associations between better diet quality and lower incident frailty risk. These findings highlight how a balanced diet may be able to delay the onset of frailty. A systematic review found that low body weight, low muscle mass, and malnutrition were all associated with an increased risk of frailty (Khor, Vearing, & Charlton, 2022). Limited research in India has also found that frailty was prevalent among older adults in India, with more than half of the participants meeting criteria for frailty. (Shalini et al., 2020) The study also found that frailty was significantly associated with lower dietary energy and protein intake, as well as lower muscle mass and physical activity levels.

The existing literature thus suggests existence of a complex relationship between nutritional status and frailty in older adults. However, literature studying nutrition and frailty among older people in India is scarce. Studying and addressing the problem of frailty among older adults in India is crucial given its implications for the individuals as well as the healthcare systems. Frailty significantly increases the risk of falls, fractures, hospitalizations, disability and development of chronic conditions. This not only diminishes the well-being of elderly individuals but also imposes substantial strain on healthcare systems. Further research is needed to better understand the relationship between nutrition and frailty, to identify the socio-economic groups vulnerable to frailty and to develop effective interventions to address this relationship.

Against this backdrop, the objectives of this study are to estimate the prevalence of frailty among older people, across selected demographic and socio-economic characteristics and to study the association between inadequate nutrition intake and frailty among older people in India. Additionally, the research aims to identify and characterize the subset of older individuals who face challenges related to food insecurity.

Data and Methods

The present Study utilizes data from Wave 2 of the WHO-Study of Global Ageing and Adult Health (SAGE). It forms part of the WHO multi-country survey that coordinates the Study on global ageing and adult health to compile comprehensive longitudinal data on the health and well-being of adult populations in six countries.

The SAGE India sample is nationally representative and was implemented in six states – Assam, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal. This initiative focuses on collecting data from adults aged 50 years and older, while also including a smaller comparative sample of adults aged 18-49 years. The baseline of the SAGE India was conducted in 2003, Wave 1 was during 2007-08 and Wave 2 was conducted in 2015. The analytical sample size for this study was 7118 individuals (aged 50 or older).

The method of this study is a secondary analysis of the data obtained from the SAGE wave 2. The first part of the analysis is primarily descriptive, where information on the socio-economic and demographic characteristics of the study sample is provided. Next, bivariate analysis of frailty across the socio-economic variables has been done.

In the second part of the analysis, logistic regression models have been used to study the association between nutritional intake and frailty among older people. In particular, two models have been run, with the difference being in the stage-wise introduction of independent variables. The first model includes only the nutrition related independent variables while the second model is the complete model with socio-demographic and nutrition variables.

Dependent Variable

The dependent variable for the study is presence or absence of frailty in the older adults. An adapted version of the frailty phenotype published by Fried and colleagues was used to evaluate the physical frailty of older persons. The "Frailty Phenotype" was first published by Fried et al. in 2001 in the Journal of Gerontology: Medical Sciences. The authors developed a clinical definition and diagnostic criteria for frailty, which they defined as a "multisystem physiological and functional decline leading to vulnerability to adverse health outcomes." The phenotype consists of five criteria: exhaustion, weakness, slow gait speed, low physical activity, and weight loss. The presence of three or more of these criteria indicates frailty. A detailed account consisting of components used to create the variable of frailty is given in appendix (Supplementary table 1).

Independent Variables

Three variables signifying nutritional intake have been taken as independent variables for the study. These include intake of fruits, intake of vegetables and adequacy of food. The minimum servings of fruits and vegetables required for a healthy diet has been recommended by the World Health Organisation. The cut off points for constructing the variables have been taken based on the WHO recommendations. A detailed account of the construction of the independent variables is given in the appendix (Supplementary table 2).

Control Variables

Control variables included are age, sex, place of residence, marital status, education, work, religion, caste and wealth quintile.

Results

In this section, the results are presented. Table 1 provides background information on the sample of individuals, separated by gender. The sample includes information on age group, place of residence, marital status, education, employment status, religion, and wealth quintile. For the age group, the highest percentage of both male (38.7%) and female (45.8%) individuals were between 50-59 years old. The lowest percentage of individuals was in the 80 and above age group, 6 percent males and 4 percent females. Approximately eighty percent of the sample, both males and females belonged to the rural area.

For marital status, most individuals were currently married, at 88 percent for males and 62 percent for females. With respect to education, the largest percentage of individuals had less than primary education, at 23 percent for males and 32 percent for females. The smallest percentage of individuals had postgraduate education, at 4

percent for males and 2 percent for females. For employment status, 65 percent of males and 53 percent of females were currently working. The majority of individuals in the sample identified as Hindu (83.4% for males and 84 percent for females). In terms of wealth quintile, the largest percentage of individuals were in the "richest" category, at 24 percent for males and 23 percent for females. The smallest percentage of individuals were in the "poorest" category, at 19 percent for males and 20 percent for females.

Table 2 provides the distribution of frailty status among older adults in different demographic groups separately for male and female individuals. The overall estimate for prevalence of frailty is found to be around 35 percent. The percentage of frail older adults is highest in the age group 80 and above (64%) and among the widowed (47.9%) and poorest (44%) groups. On the other hand, the percentage of non-frail older adults is highest in the age group 50-59 (77.2%) and among the currently married (69.5%) and richest (73.9%) groups.

Table 1 Socio-economic and Demographic profile of study sample by selected background characteristics, SAGE 2015

Background Characteristics	Male	%	Female	%
Age Group				
50-59	1,170	35	1,734	45.8
60-69	1,292	38.7	1,293	34.2
70-79	675	20.2	610	16
80 and above	200	5.9	144	4
Place of residence				
Rural	2658	79.5	2948	78.8
Urban	679	20.5	833	22.2
Marital Status				
Never Married	50	1.5	26	0.7
Currently Married	2,950	88.4	2,355	62.2
Separated/Divorced	12	0.4	29	0.8
Widowed	325	9.7	1,368	36.2
Education				
Less than primary	539	22.9	403	32.09
Primary	586	24.9	394	31.4
Secondary	466	19.8	209	16.7
High School	436	18.5	111	8.8
College/University	223	9.5	66	5.3
Post Graduate	86	3.7	25	2
Currently Working				
Yes	1636	65.1	579	52.6
No	877	34.9	522	47.4
Religion				
Hindu	2784	83.4	3182	84.2
Muslim	414	12.4	455	12
Others	137	4.2	142	3.8
Caste				
Schedule Tribe	237	8.2	285	8.6
Schedule Caste	533	18.5	635	19.2
OBC	1562	54.1	1751	53
None of the above	556	19.3	631	19.1
Wealth Quintile				
Poorest	619	18.5	752	19.9
Poorer	605	18.1	699	18.5
Middle	632	18.9	686	18.1
Richer	676	20.3	792	20.9
Richest	805	24.1	852	22.5

Source: Authors own computation from SAGE data on older adults in India

The table shows that there is a higher prevalence of frailty among female older individuals residing in rural areas (38.1%) compared to those residing in urban areas (31.3%). Across the marital status, the widowed older adults have the highest prevalence of frailty, with 48 percent of male older adults and 48 percent of female older adults being frail.

The education section shows that those with less than primary education has the highest prevalence of frailty, with 38 percent of male older adults and 33 percent of female older individuals being frail. The employment status section indicates that there is a higher prevalence of frailty among those who are not currently working, with 41 percent of male older adults and 41 percent of female older individuals being frail. There is not much difference in prevalence of frailty across different religious groups. The wealth quintile section shows that the poorest older adults individuals have the highest prevalence of frailty, with 41 percent of male older adults and 46 percent of female older adults being frail.

Table 3 shows the percentages of frail or non-frail older adults, based on their fruit and vegetable intake and overall food sufficiency. For male older adults, 23 percent of those with sufficient fruit intake are frail, while 77 percent are non-frail. In contrast, for those with insufficient fruit intake, 33 percent are frail and 67 percent are non-frail.

Table 2 Gendered distribution of frailty among older adults across background characteristics

Background Characteristic		Total Sample	Frail (%)	Male (%)	Female (%)
Age Group	50-59	2,672	22.7	21.7	23.4
	60-69	2,391	35.6	29.9	41.2
	70-79	1,145	53.3	48.7	58.4
	80 and above	278	64.0	57.6	74.5
Place of residence	Rural	5,164	36.3	34.3	38.1
	Urban	1,322	27.9	23.7	31.3
Marital Status	Never Married	66	34.9	37.21	30
	Currently Married	4,866	30.5	31	30.49
	Separated/Divorced	34	26.5	20	29.17
	Widowed	1,517	47.9	48.29	47.76
Education	Less than primary	854	36.1	38.21	33
	Primary	908	30.2	31.5	28.18
	Secondary	622	24.9	28.27	17.53
	High School	500	20.2	20.8	17.82
	College/University	262	23.7	24.26	21.67
	Post Graduate	94	17.0	16.44	19.05
Currently Working	Yes	2049	26.6	26.2	27.5
	No	1252	40.7	40.7	40.8
Religion	Hindu	5427	34.8	32.2	36.9
	Muslim	512	36.6	34.6	38.4
	Others	279	25.1	26.6	23.6
Wealth Quintile	Poorest	1,247	44.0	41.18	46.36
	Poorer	1,199	39.0	36.76	40.99
	Middle	1,189	35.0	31.64	38.09
	Richer	1,346	31.1	29.8	32.24
	Richest	1,505	26.1	24.93	27.25
Total		6486	34.61	32.34	36.62

Source: Authors own computation from SAGE data on older adults in India

For females, 9 percent of those with sufficient fruit intake are frail, while 92 percent are non-frail. For those with insufficient fruit intake, 37 percent are frail and 63 percent are non-frail.

Similar patterns are observed for vegetable intake and overall food sufficiency, where the percentages of frail individuals are higher for those with insufficient intake/insufficiency compared to those with sufficient intake/sufficiency. In general, the table suggests a positive correlation between sufficient fruit and vegetable intake and being non-frail. This information suggests that, compared to non-frail older adults, a larger proportion of frail older adults have inadequate nutritional intake. This highlights the importance of addressing the nutritional needs of frail older individuals to promote health and well-being.

Table 4 shows the percentage of older people in different states who experienced food insufficiency. The two columns show the percentage of older adults who ate less due to insufficient food, and the percentage of older adults who could not afford enough food. In Assam, 33 percent of the older population ate less due to insufficient food and 31 percent could not afford enough food. In Karnataka, For Karnataka, the figures are 20 percent and 17 percent respectively. For Maharashtra, the respective percentages are 22 percent and 21 percent. Rajasthan had 15 percent of older adults consuming less due to food scarcity, and 11 percent unable to afford enough food. Uttar Pradesh reported 16 percent and 15 percent for insufficient consumption and affordability respectively. Lastly, in West Bengal, 7 percent of older adults faced reduced food intake, with 5 percent being unable to afford adequate food.

Table 3 Prevalence of frailty based on the fruit and vegetable intake of older adults

Background Characteristics		Male (%)		Female (%)	
		Frail	Non-Frail	Frail	Non-Frail
Fruit Intake	Sufficient	23	77	9	92
	Insufficient	33	67	37	63
Vegetable Intake	Sufficient	32	68	35	65
	Insufficient	34	66	37	63
Food sufficiency	Sufficient	31	69	35	65
	Insufficient	37	63	45	55

Source: Authors own computation from SAGE data on older adults in India

Table 4 Percentage of older adults who experienced food insufficiency across States

State	Ate less due to insufficient food	Could not afford enough food
Assam	32.64	30.57
Karnataka	20.37	17.36
Maharashtra	22.05	20.51
Rajasthan	15.13	10.52
Uttar Pradesh	16.39	14.57
West Bengal	7.44	5.31

Source: Authors own computation from SAGE data on older adults in India

The table shows that the percentage of older adults experiencing food insufficiency varies across different states, with West Bengal having the lowest percentage (7.44% ate less due to insufficient food and 5.31% could not afford enough food) and Assam having the highest percentage (32.64% ate less due to insufficient food and 30.57% could not afford enough food). In general, the table highlights the issue of food insufficiency among the older adult's population and the need for proper support and resources to ensure their access to sufficient and nutritious food.

Table 5 provides the percentage of older adults who reported eating less due to insufficient food and who could not afford enough food, based on various background characteristics. With respect to age groups, the table shows that the percentage of older adults who ate less due to insufficient food ranged from 16 percent for those aged 80 and above to 18 percent for those aged 50-59, while the percentage who could not afford enough food ranged from 12 percent for those aged 80 and above to 17 percent for those aged 60-69.

The second set of characteristics is place of residence, with categories of rural and urban. The table shows that the percentage of older adults who ate less due to insufficient food was higher in rural areas (19.71%) compared to urban areas (9.28%), and the same pattern was observed for the percentage who could not afford enough food (16.8% in rural areas and 8 percent in urban areas). The third set of characteristics is marital status, with categories of never married, currently married, separated/divorced, and widowed. The table shows that the percentage of older adults who ate less due to insufficient food was highest among the widowed (19.7%) and the percentage who could not afford enough food was highest among the never married (18.6%).

With respect to education and work status, the table shows that the percentage of older adults who ate less due to insufficient food availability and who could not afford enough food was highest among those with less than primary education and those who were not currently working. The table shows that the percentage of older adults who ate less due to insufficient food and who could not afford enough food was highest among those in the Schedule Tribe category. The final set of characteristics is wealth quintile, with categories of Poorest, Poorer, Middle, Richer, and Richest. The table shows that the percentage of older adults who ate less due to insufficient food availability and who could not afford enough food was highest among the Poorest category and lowest among the Richest category.

Table 6 presents the logistic regression estimates of physical frailty among older adults by their background characteristics. This logistic regression model examines the association between frailty (dependent variable) and various independent variables. Model-1 provides the unadjusted estimates whereas model-2 provides the adjusted estimates (adjusted for age, gender, marital status, working status, education, religion, caste, place of residence and wealth quintile). The odds ratio (OR) represents the odds of being frail associated with the corresponding independent variable, holding all other variables constant.

Table 5 Percentage of older adults who experienced food insufficiency across background characteristics

Background Characteristics		% who ate less due to insufficient food	% who Could not afford enough food
Age Group	50-59	18.03	15.28
	60-69	16.9	14.5
	70-79	17.84	15.65
	80 and above	16.08	12.28
Place of residence	Rural	19.71	16.8
	Urban	9.28	7.9
Marital Status	Never Married	18.6	18.6
	Currently Married	16.7	14.5
	Separated/Divorced	17.5	15
	Widowed	19.7	15.8
Education	Less than primary	17.13	13.6
	Primary	14.6	13.7
	Secondary	10.67	10.07
	High School	11.01	6.24
	College/University	11.4	9
	Post Graduate	10	10
Currently Working	Yes	20.62	16.6
	No	13.8	11.6
Religion	Hindu	17.02	14.28
	Muslim	19.05	17.9
	Others	22.94	19.35
Caste	Schedule Tribe	27.6	21.69
	Schedule Caste	18.7	17.2
	OBC	16.09	13.94
	None of the above	16.6	13.91
Wealth Quintile	Poorest	26.5	22.5
	Poorer	23.3	20.31
	Middle	16.7	13.76
	Richer	13.6	11.95
	Richest	9.4	7.93

Source: Authors own computation from SAGE data on older adults in India

Model-1 revealed that the older adults consuming adequate quantity of fruits had 35% significantly lower odds of being frail in comparison to those consuming less fruits. Moreover, the same model revealed that older adults with access to food had 71 percent significantly lower odds of being frail. The intake of vegetable was not statistically significant. Results of model-2 suggest that the following variables are significantly associated with frailty: vegetable intake, fruit intake, access to food, age, gender, area of residence, education, and working status. Religion and caste were found not to be significantly associated with being frail.

The intercept, represented by "cons", is also statistically significant (OR=0.10, $p<0.001$), indicating that there are other unmeasured factors influencing frailty in the population. It is important to note that statistical significance does not necessarily imply causal inference. Further research and analysis may be needed to fully understand the relationships between these variables and frailty.

Table 6 Logistic Regression of Frailty and Nutrition Intake among older adults

Background Characteristic		Model 1		Model 2	
		OR	(95% CI)	OR	(95% CI)
Fruit Intake	Insufficient®				
	Sufficient	0.35	(0.19-0.66)	0.31*	(0.10-0.93)
Vegetable Intake	Insufficient®				
	Sufficient	1.15*	(0.85-1.5)	1.7*	(0.98-2.94)
Access to Food	Insufficient®				
	Sufficient	0.71*	(0.63-0.82)	0.68*	(0.50-0.91)

Note: Model 1 includes only the nutrition related independent variables while Model 2 is the complete model with socio-demographic and nutrition variables.
Odds ratios are adjusted for socio-economic co-variates. Level of significance *=P<0.05

Discussion

Nutrition plays a critical role in the health and well-being of older adults, especially in the context of frailty. The relationship between nutrition intake and frailty is especially relevant in India, where the older adult population is growing rapidly and their nutritional status is not very favourable. This study aimed to determine the prevalence of frailty among the older adult population, considering specific demographic and socio-economic attributes and to investigate the potential link between insufficient nutritional intake and frailty.

Prevalence of frailty was found to be 35 percent which is slightly higher compared to other studies estimating community based prevalence of frailty in India, found to be 26 percent in (Kashikar & Nagarkar, 2016), 20 percent in (Shalini et al., 2020). However, it was similar to the estimates of a recent study based on population data (LASI), which found prevalence to be 27 percent in males and 32 percent in females, Srivastava & Muhammad (2022). Our study results highlight that the percentage of frail older adults is highest in the age group 80 and above (64%) and among the widowed (47.9%) and poorest (44%) groups. The findings of the study highlight that the percentage of frail older adults is highest in the age group 80 and above, among the widowed and poorest groups. The observation that the percentage of frail older adults is most pronounced in the higher age group aligns with other studies. For instance, research by Xue Q.L. (2011), Buttery et al. (2015) Shalini et al., (2020), showed a similar trend of increasing frailty with advancing age among older populations. Similarly, other research has reported a higher prevalence of frailty among older adults who are socially isolated, have limited access to healthcare, and have lower socioeconomic status (Kojima, Iliffe, & Walters, 2018). This underscores the need for targeted interventions to improve the health and well-being of these vulnerable groups.

The study findings suggest a positive correlation between sufficient fruit and vegetable intake and being non-frail. It finds that, compared to non-frail older adults, a larger proportion of frail older adults have inadequate nutritional intake. Global study supports the relationship between fruit and vegetable intake and frailty. The findings of the international research by Ghoreishy et al.

(2021) and Garcia-Esquinas et al. (2016) support the beneficial link between appropriate fruit and vegetable diet and decreased frailty. This highlights the importance of addressing the nutritional needs of frail older individuals to promote health and well-being.

The study also shows that the percentage of older adults experiencing food insufficiency varies across different states, with Assam having the highest percentage of food insecure older adults (32.64% ate less due to insufficient food and 31 percent could not afford enough food). This finding is similar to that of Kandpan et al. (2022) which found the central and eastern regions of India to have remarkably higher prevalence of food insecurity among elderly. In a broader context, this finding is also consistent with studies that have shown that food insecurity is a major issue in low-income countries, particularly in regions affected by poverty, conflict, and natural disasters (World Health Organization, 2018).

The logistic regression analysis demonstrates that adequate fruit consumption is linked to reduced odds of frailty, while access to sufficient food is associated with even lower odds of frailty. Additionally, it highlights that older adults, particularly those in the oldest and youngest age groups, rural areas, widowed, lower education and work statuses, marginalized social categories, and the economically poorest quintile, are more susceptible to food insufficiency challenges. The logistic regression model's outcomes resonate with broader findings. The association of vegetable and fruit intake with frailty is supported by research conducted by Ghoreishy et al. (2021) and Kojima et al. (2018). Moreover, the model's emphasis on variables such as age, gender, area of residence, education, and working status aligns with the multidimensional nature of frailty outlined by several studies including Buttery et al. (2015); Boulos et al. (2014) and Kashikar & Nagarkar (2016).

Overall, the findings of this study bring to fore the problem of frailty in Indian older adults and identifies the specific cohorts that are more vulnerable to the condition. The findings have important implications for the development of targeted interventions and policies aimed at reducing the risk of frailty among older adults. International studies with similar findings have called for the need for a multifaceted approach with nutritional interventions at its core for mitigating the risk of frailty among individuals. Similar policies aimed at improving nutrition and reducing food insufficiency with targeted interventions to improve the health of vulnerable populations such as the older adults, widowed, and poor must be prioritised.

Conclusion

In conclusion, this study sheds light on the pressing issue of frailty among older adults in India and underscores its implications for specific vulnerable groups. The findings emphasize on the role of nutrition in influencing frailty and the need for targeted interventions to improve the health and well-being of older adults. The study's identification of regional variations in food insufficiency further emphasizes the need for policies to tackle this challenge. Altogether, the study's outcomes offer valuable insights for the development of interventions and policies aimed at reducing frailty risk and enhancing the overall health of older adults, particularly those who are most vulnerable.

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APPENDIX

Supplementary Table 1: SAGE Wave 2 Data Items used for Constructing Frailty Variable

Outcome	Component	Question/Measurement	Construct
Frailty	Exhaustion	Overall in the last 30 days, how much of a problem did you have due to not feeling rested and refreshed during the day (for example, feeling tired, not having energy)?	Dichotomised into Exhausted (1)/Not exhausted (0)
	Grip strength	In SAGE, handgrip strength was measured in kilograms using a handheld Dynamometer. The cut-off limits for frailty were decided based on mean weight lifted after adjusting for gender and BMI.	Below cut-off (1)/ Above cut-off (0)
	Physical Activity	Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate [such as brisk walking, cycling or swimming] for at least 10 minutes at a time?	Dichotomised Yes (0)/No (1)
	Walking Time	In SAGE, respondents were asked to walk 4-m twice, and slowness was assessed by averaging the time (in seconds) taken in completing the 4 m. The cut-off limits for frailty were decided based on mean time after adjusting for gender and height.	Below cut-off (1)/ Above cut-off (0)
	Low Weight	Measured using BMI.	Older adults having BMI<18.4 (1)/ Others (0)
Scores for all the five components were added and those with a score of 0 -2 were classified as "not frail," and those with a score of 3-5 as "frail."			

Supplementary Table 2: SAGE Items used for constructing Nutritional Intake

Component	Question/Measurement	Construct
Fruit intake	How many servings of fruit do you eat on a typical day?	WHO considers fewer than five (WHO, 2003) servings of vegetables per day to be insufficient to reduce the risk of diet contributing to cardiovascular disease and other health conditions. Same was taken here to construct sufficient (1) and insufficient (0).
Vegetable Intake	How many servings of vegetables do you eat on a typical day?	WHO considers fewer than five (WHO, 2003) servings of vegetables per day to be insufficient to reduce the risk of diet contributing to cardiovascular disease and other health conditions. Same was taken here to construct sufficient (1) and insufficient (0).
Food Sufficiency 1	In the last 12 months, how often did you ever eat less than you felt you should because there wasn't enough food?	Reponses including "Every month, almost every month, some months, but not every month, only in 1 or 2 months" were grouped together as Insufficient and coded as "0" while the response "Never "was coded as sufficient "1".
Food Sufficiency 2	In the last 12 months, were you ever hungry, but didn't eat because you couldn't afford enough food?	Reponses including "Every month, almost every month, some months, but not every month, only in 1 or 2 months" were grouped together as Insufficient and coded as "0" while the response "Never "was coded as sufficient "1".