

Diet and Nutritional Status of the Older Adults in Rural India

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Abstract

Objectives: World has witnessed a considerable increase in the proportion of elderly population. Aging is associated with decreased physical activity and metabolism and thereby the changes in the nutritional requirements of older adults. The objective of this communication was to assess the nutritional status of rural elderly population in India.

Methodology: A community based¹ cross-sectional study; adopting multistage stratified random sampling procedure was carried out by the National Nutrition Monitoring Bureau (NNMB), during 2005-06 among the rural population of nine major states of India. A total of 3871 older adults were covered for anthropometry and of them, a total of 2138 older adults were covered for dietary assessment.

Key Results: In general, the consumption of all the foods was below recommended daily intakes (RDI), and the in-adequacy (<70% of RDI) of intake was high with respect to leafy vegetables, milk & milk products, fats & oils and sugar & jaggery. Similarly, the in-adequacy of intakes of micronutrients such as vitamin A, iron, riboflavin and free folic acid was high among both genders. The poor intake of diet was reflected in high prevalence of chronic energy deficiency (CED) among the rural elderly in India.

Conclusions: In general, the rural elderly were subsisting on inadequate diets in terms of both quantity and quality. Similarly, the prevalence of CED among elderly is a "very high" public health nutrition problem in India. Therefore, the Government of India should initiate appropriate nutrition intervention measures to improve the overall nutritional status and special nutrition policies to address the health and nutritional problems of the aging population.

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Introduction

The world's population is ageing: virtually all countries are experiencing growth in the number and proportion of older persons in their populations. Globally, the number of older persons is growing faster than the numbers of people in other age groups¹. Elderly or old age consists of ages nearing or surpassing the average life span of human beings. Government of India adopted 'National Policy on Older Persons' in January, 1999, and defined elderly as a person who is of age 60-years and over and the United Nations also consider the same age for reference of older population. The number of elderly in the developing countries has been growing at a phenomenal rate; where 67% of older persons are living in developing countries¹ and the story of India is not an exception. According to census, 2011, elderly population (age 60-years and over) constitutes about 8% of total population². According to the United Nations Population Division report, India's older population will increase dramatically over the next four decades, constituting 19% of total population of India by 2050³.

The combination of high fertility and declining mortality during last few decades has resulted in large and rapid increases in elderly populations as successively larger cohorts step into old age. It is well recognized that with advancing age the incidence of chronic diseases increases, and evidence points to the importance of nutrition in the development, susceptibility and outcome of these diseases by affecting the immune system^{4,5}.

Older adults are a heterogeneous population with varied nutrition requirement⁶. Aging and nutrition has explicit intrinsic relationship. Old age has direct effect on required amounts of nutrients, their absorption

and subsequent metabolism. Physical, mental, social and environmental changes which take place with ageing may affect the nutritional status of elderly people. There is evidence that undernutrition is common in elderly people and may influence the clinical outcomes during disease⁴. Thus, the majority of the health problems are nutrition related and nutrition dependent. Therefore, it is very essential to assess the nutritional status of the older adults to initiate appropriate nutrition interventions to prevent or delay the adverse health effects of malnutrition among the older adults.

In India, national representative and systematically collected comprehensive data on diet and nutrition status of rural elderly was very old (1996-97)⁷. Considering the growing numbers of elderly and the role of nutrition in quality of life during the old age, it is imperative to develop a national data base on the diet and nutritional status of the elderly to facilitate national policies on elderly and to initiate targeted intervention programs for healthy aging. For this communication, we specially analysed the data keeping in view the objective to assess the nutritional status of older adults utilising the national representative large data base collected by the National Nutrition Monitoring Bureau (NNMB) during 2005-06.

Materials & Methods

Study Design and Sampling

A community based cross-sectional study; adopting multistage stratified random sampling procedure was carried out by the National Nutrition Monitoring Bureau (NNMB), during 2005-06 among rural population of nine major states of India, such as Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Gujarat, Tamil Nadu and West Bengal. A total of 3871 older adults were covered from

all the HHs (20 HHs per village) for anthropometric measurements such as weight and height. Of them, a total of 2138 older adults were covered (10 HHs per village) for a one day 24-hour re-call method of diet survey.

Sampling Frame: We adopted the national sampling survey organization's (NSSO)⁸ 54th round of consumer expenditure survey-1998, as the sampling frame for this present study. The villages covered by NSSO are the sampling frame for this present NNMB rural study. The NSSO divided the States into several strata based on agro-climatic criteria; and the rural population of about 1.8 million is considered as one stratum. The districts with more than 1.8 million rural population are divided into two or more strata.

Selection of Villages and Households: The NSSO has adopted two-stage stratified random sampling procedure, where, the villages formed the First Stage Units (FSUs), while the households (HHs) formed the Second Stage Units (SSUs). However, considering the constraints of the manpower and available resources, the NNMB, covered 16 strata from each State. Five villages were randomly selected from each stratum, thus, 80 villages were covered per State and a total of 713 villages (short of seven villages) were covered from nine states.

The HHs in each village was selected adopting the cluster-sampling procedure, where the village was divided into five geographical areas based on natural groups of houses or streets. Households belonging to Scheduled Caste/Scheduled Tribe communities, who in general, live separately as a group, were considered as one of the five geographical areas. A total of 20 HHs (@ four HHs per each geographical area) were covered from one village.

About NNMB

Since 1972, the National Nutrition Monitoring Bureau (NNMB) under the aegis of Indian Council of Medical Research (ICMR) has been carrying out periodic population based diet and nutrition surveys in rural and tribal areas of 10 major states of India, comprising of two-thirds geographical region of the country. Each NNMB State unit constitutes regular medical officer, nutritionist and anthropologist/social worker well versed in native language.

Training

Staff of all the NNMB state units were underwent three weeks training at the National Institute of Nutrition (NIN), Hyderabad in nutrition survey methodology before initiation of the survey. However, they have been undergoing periodic re-orientation training in nutrition survey methodology at the NIN for every new study undertaken by the NNMB.

Ethics and Consent

The study was approved by the scientific advisory committee (SAC) of ICMR, New Delhi and ethical clearance was obtained from the Institutional Ethics Review Board (ERB) of NIN, Hyderabad. Informed oral consent was also obtained from all the participants in this study.

Statistical Analysis

Data analysis was done using Statistical Package for the Social Sciences (SPSS)⁹ version 19.0. The data was analysed by stratifying the elderly into three age groups of 60-69 ,70-79 and ≥ 80 years. The mean, median and standard deviations (SD) of various foods and nutrient intakes were calculated for each age group and gender and compared with the recommended daily

intakes (RDIs)¹⁰ and recommended dietary allowances (RDAs)¹¹ for Indian population. Means values of Food and nutrient intakes were compared across age groups by ANOVA with post hoc test of Least Significant Difference (LSD) method. The association between the nutritional status and different socio-demographic variables among older adults was assessed by the chi-square (χ^2) test. P value of <0.05 was considered as statistically significant.

The Definition of Some Variables Mentioned in the Text:

Community (Caste): The Indian community is categorized into four major castes based on their occupations. They include socially underprivileged and economically underdeveloped poorer sections of the society i.e. Scheduled Caste (SC) & Scheduled Tribes (ST), Backward Caste (Different artisans come under this category) and Forward Caste. Generally, the Forward Caste communities are socially highly privileged and economically well off. The Scheduled Caste and Scheduled Tribe communities are provided with certain social and economic guarantees by the government of India.

Type of House: The type of house is one of the generally accepted indices to determine socioeconomic status of the inhabiting household. The houses with mud walls and thatched/tiled roofs are referred to as *kutcha* and are usually inhabited by the poorest of the poor. The houses with brick walls and tiled/asbestos/tin roofs are considered *semi-pucca* and those with brick walls and reinforced cement concrete roofs as *pucca* and are inhabited by relatively better-off families.

Results

A total of 2,138 older adults (Men: 1073; Women: 1065) were covered for the diet survey,

while the anthropometric measurements were obtained from 3,871 older adults (Men: 49.5%; Women: 50.5%). A majority of the elderly were in the age group of 60-69 years. About 69% of the elderly were literate and the rest were illiterate. Most of the elderly were living in *semi-pucca* houses (65%) followed by *Kutcha* houses (mud walls with thatched roof) (19%). In about 30% of HHs, the major occupation of the head of the household was labourer and 38% of HHs did not possess any agricultural land. In about 49% of HHs, the family size was 5-7 (Table 1).

Food Consumption

The mean (SD) daily intakes of various food groups among the older adults by age group and gender are presented in Table 2. In general, the consumption of all the foods was below Recommended Daily Intakes (RDI) in both genders and all age groups, except for roots & tubers among elderly men and non-leafy vegetables among elderly women. Cereals & millets formed the bulk of the diet of the rural population in India and the mean intakes were observed to be declined as age advances among both genders. Barring cereals & millets, no significant differences were observed between the intakes of various food groups among different age groups in both genders. The consumption of protective foods, such as leafy vegetables, pulses, milk & milk products, fats & oils and sugar & jaggery were grossly deficient, as against their RDIs in both genders.

The proportion of older adults with in-adequate (<70% of RDI) intake of various foods by gender is presented in Table 3. In general, the in-adequacy of intakes was high with respect to leafy vegetables, milk &

Table 1. Socio-demographic profile of older adults

Variable	Categories	n	Per cent
Gender	Men	1917	49.5
	Women	1954	50.5
Age Group (Yrs)	60-69	2598	67.1
	70-79	1036	26.8
	≥80	237	6.1
Community	SC+ST [¶]	1000	25.8
	OBC ^β	1473	38.1
	Others	1398	36.1
Type of House	Kutchra	734	19
	Semi Pucca	2513	65
	Pucca	624	16
Literacy status	Illiterate	1171	30.3
	Literate	2700	69.7
Occupation	Labourer	1166	30.1
	Agriculturist	1205	31.1
	Others	1500	38.8
Land holdings (Acres)	No land	1474	38
	< 5	1769	45.7
	5 - 10	366	9.5
	> 10	262	6.8
Family size	1 - 4	1383	35.7
	5-7	1884	48.7
	≥8	604	15.6

¶ Scheduled Caste/ Scheduled Tribe. β: Other Backward Communities.

Table 2. The mean (SD) intakes of various major food groups (g/day) among the older adults by age group and gender

Age (Years)	n		Cereals & Millets	Pulses	Leafy vegetables	Non-leafy vegetables	Roots & Tubers	Nuts & Oils	Fruits	Milk & Milk Prod.	Fats & Oils	Sugar & Jaggery
MEN												
60-69	699	Mean	412	33	17	53	60	12	27	92	15	16
		SD	158	37	44	72	68	32	42	129	13	16
70-79	297	Mean	374	28	18	54	62	12	28	73	13	17
		SD	150	31	42	75	75	25	43	105	13	20
≥80	77	Mean	329	22	11	41	60	4	21	103	12	18
		SD	168	22	35	46	68	11	36	154	14	21
Pooled	1073	Mean	395	31	17	53	61	12	27	87	14	16
		SD	158	35	43	71	70	29	42	125	13	17
RDI			460	40	40	60	50	-	-	150	40	30
<i>P-value</i>			0.000	0.034	0.486	0.765	0.980	0.065	0.513	0.149	0.041	0.386
WOMEN												
60-69	692	Mean	337	25	14	44	47	12	22	76	11	15
		SD	130	27	39	61	55	29	36	110	10	18
70-79	283	Mean	305	27	14	40	50	10	22	77	11	15
		SD	131	31	36	61	56	20	46	118	11	14
≥80	90	Mean	251	22	11	29	43	14	19	76	9	17
		SD	103	23	32	41	55	23	39	89	7	16
Pooled	1065	Mean	321	25	14	42	47	11	22	76	11	15
		SD	131	28	38	59	55	27	39	111	10	17
RDI			420	40	100	40	50	-	-	100	20	20
<i>P-value</i>			0.000	0.687	0.596	0.200	0.396	0.107	0.278	0.333	0.344	0.618

Table 3. Proportion (%) of older adults by in-adequate (<70% of RDI) intake of various foods by gender

Gender	Cereals & millets	Pulses	Leafy vegetables	Non-leafy vegetables	Roots & tubers	Milk & milk products	Fats & Oils	Sugar & Jaggery
MEN	48.4	58.6	83	59.4	52.1	74.3	63.4	75.9
WOMEN	55	61.7	92.2	55.9	56.7	66.5	76.2	57.5
χ^2	9.35	2.15	41.48	2.76	4.68	15.88	40.97	78.13
<i>P-value</i>	<0.01	>0.05	<0.01	>0.05	<0.05	<0.01	<0.01	<0.01

milk products, fats & oils and sugar & jaggery in both genders. While, the intakes of cereals & millets, leafy vegetables, roots & tubers, fats& oils and sugar & jaggery were significantly different between genders (<0.05).

Nutrient Intake

The median, mean and SD intakes of nutrients among older adults by age group and gender are presented in Table 4. In general, the median intakes of all the nutrients among the older adults were below the suggested RDAs, except for thiamine among elderly women. Similarly, the median intakes of majority of nutrients tend to decrease with an increasing age among both genders. The median intake of micronutrients such as vitamin A, iron, riboflavin and free folic acid were grossly deficient as compared to their RDAs among both genders. The intakes majority of nutrients except for total fats, calcium, vitamin A and vitamin C were significantly ($p<0.01$) different between age groups in both genders.

The proportion of older adults consuming in-adequate ($<70\%$ of RDA) amounts of nutrients by gender is presented in Table 5. In general, the in-adequacy of intake of micro-nutrients such as vitamin A, iron, riboflavin and free folic acid was high among both genders. Similarly, the inadequacy of consumption of all the nutrients was significantly different between genders and the extent of in-adequacy of protein, calcium, iron, vitamin A, vitamin C and folic acid was higher among elderly women compared to elderly men.

Nutritional Status

The mean and SD of weights, heights and BMI of older adults by age group and gender are presented in Table 6. The weights, heights and BMIs of older adults were significantly ($p< 0.01$) different between

the age groups and decreased with increasing age among both genders. The mean values of weights and heights were higher among the elderly men; while the mean BMI is higher among the elderly women.

The distribution of older adults according to nutritional status by BMI classification, age group and gender are presented in Table 7. In general, the prevalence of underweight in terms chronic energy deficiency (CED) i.e BMI < 18.5 kgs/m² was reported to be higher among the elderly men (44.8%) as compared to their women counterparts (40.9%). Similarly, the prevalence of CED increased significantly ($p<0.01$) with increasing age. While, the prevalence of overweight/obesity (BMI >25.0 kgs/m²) was three folds higher among elderly women (21.8%) as compared to the elderly men (6.9%).

Chronic Energy deficiency versus Socio-demographic variables

The association between the nutritional status and different socio-demographic variables among the older adults is presented in Table 8. The prevalence of the CED among the older adults was significantly ($p<0.001$) associated with the community, type of house, occupation and possession of land holdings, where the prevalence of CED was significantly higher among the older adults belonged to households of marginalised scheduled caste/ Scheduled tribe communities, labourers, landless & marginal farmers and those residing in *Kutcha* type of houses (<0.001).

Discussion

The rural elderly are generally disadvantaged due to their physiological ageing and rural environment compared to their urban counterparts due to the issues related to availability, accessibility and quality of social and health care services¹². In general, the rural elderly

Table 4. The median, mean and SD intakes of nutrients among older adults by age group and gender

Age group (Yrs)	n		Protein (g)	Total Fat (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)	Vit.A (µg)	Thiamin (mg)	Ribo-flavin (mg)	Niacin (mg)	Vit.C (mg)	Free Folic acid (µg)
MEN													
60-69	699	Median	50	18	1883	368	13	117	1.2	0.6	14	29	51
		Mean	52	24	1935	493	16	259	1.3	0.7	15	47	55
		SD	18	21	596	396	10	470	0.6	0.3	6	59	27
70-79	297	Median	47	16	1720	338	12	100	1.1	0.6	14	30	47
		Mean	49	21	1776	460	15	236	1.2	0.6	15	45	51
		SD	19	18	574	406	11	387	0.6	0.3	6	47	22
≥80	77	Median	38	14	1468	287	11	97	0.9	0.6	11	22	39
		Mean	41	20	1571	414	12	221	1	0.6	12	34	45
		SD	18	18	632	364	7	469	0.5	0.3	7	36	25
Pooled	1073	Median	48	17	1818	358	13	109	1.1	0.6	14	29	49
		Mean	50	23	1865	479	15	250	1.2	0.7	15	46	53
		SD	19	20	601	397	10	448	0.6	0.3	6	54	26
RDA			60	-	2425	400	28	600	1.2	1.4	16	40	200
<i>P-value</i>			0.000	0.057	0.000	0.165	0.008	0.640	0.001	0.001	0.000	0.102	0.001
WOMEN													
60-69	692	Median	40	14	1533	290	11	96	1	0.5	12	22	43
		Mean	43	20	1583	399	13	235	1.1	0.6	12	38	45
		SD	17	19	513	331	11	477	0.5	0.3	5	50	22
70-79	283	Median	37	15	1466	280	10	89	0.9	0.5	11	22	39
		Mean	40	19	1478	374	12	189	1	0.5	11	35	41
		SD	16	15	499	323	8	413	0.5	0.3	5	44	18
≥80	90	Median	33	16	1241	254	8	83	0.7	0.4	10	19	35
		Mean	34	19	1280	345	10	151	0.8	0.4	10	31	34
		SD	12	14	385	271	5	249	0.3	0.2	4	39	14
Pooled	1065	Median	39	15	1493	286	10	92	0.9	0.5	11	22	40
		Mean	41	19	1529	387	13	216	1	0.6	12	37	43
		SD	16	17	507	325	9	446	0.5	0.3	5	48	20
RDA			50	-	1875	400	30	600	0.9	1.1	12	40	200
<i>P-value</i>			0.000	0.628	0.000	0.239	0.001	0.122	0.000	0.000	0.000	0.327	0.000

Table 5. In-adequate (<70% of RDI) intake of various nutrients by gender

Particulars	Protein	Energy	Calcium	Iron	Vit.A	Thia- mine	Ribofla- vin	Niacin	Vit.C	Folic Acid
MEN	35.1	51.4	36.8	78.1	87.8	31.5	87.6	35.7	48.5	78.5
WOMEN	38.5	37.5	49.0	87.2	90.6	24.9	83.0	26.3	59.5	90.7
χ^2	2.69	42.01	32.79	31.19	4.44	11.65	8.97	22.23	26.13	60.64
<i>P-value</i>	>0.05	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.001

Table 6. Mean anthropometrics Measurements of elderly by Age group and Gender

Age group (Yrs)	n	Parameter	Height (cms)	Weight (kgs)	BMI (kgs/m ²)
MEN					
60-69	1247	Mean (SD)	161.2 (6.6)	51.2(10.3)	19.7(3.4)
70-79	541	Mean(SD)	160.4(6.2)	49.6(10.1)	19.2(3.5)
≥80	128	Mean (SD)	159.3(6.5)	47.9(9.3)	18.8(3.2)
Pooled	1916	Mean (SD)	160.8(6.5)	50.5(10.2)	19.5(3.4)
<i>P-value</i>	-	-	<0.01	<0.001	<0.01
WOMEN					
60-69	1351	Mean (SD)	148.4(6.0)	44.7(10.1)	20.3(4.2)
70-79	493	Mean(SD)	146.9(6.5)	42.3(9.8)	19.7(4.0)
≥80	108	Mean(SD)	144.4(6.5)	38.0(7.5)	18.2(3.2)
Pooled	1952	Mean (SD)	147.8(6.3)	43.8(10.1)	20.0(4.1)
<i>P-value</i>	-	-	<0.001	<0.001	<0.001

Table 7. Distribution (%) of older adults according to nutritional status by BMI classification, age group and gender

Gender	Age group (Yrs)	n	BMI(kgs/m ²)			χ^2	P-value
			<18.5	18.5-25.0	≥ 25.0		
MEN	60-69	1247	42.6	50	7.5	8.29	>0.05
	70-79	541	48	45.9	6.1		
	≥80	128	52.2	40.3	4.7		
	Pooled	1916	44.8	48.4	6.9		
WOMEN	60-69	1351	38.3	38.3	23.5	21.11	<0.001
	70-79	493	44.3	36.2	19.4		
	≥80	108	57.8	30.3	11.9		
	Pooled	1952	40.9	37.3	21.8		

Table 8. Distribution (%) of Elderly According To BMI by Socioeconomic Variables

Socio-Economic Particulars	N	BMI			χ^2	P-value
		< 18.5	18.5–25.0	≥25.0		
Community						
SC+ST	1000	50.8	43.5	5.7	51.21	<0.001
OBD	1473	41.8	47.5	10.7		
Others	1398	38.1	50.3	11.6		
Family Size						
< 4	1383	42	47.7	10.3	0.99	>0.05
5 –6	1884	43.3	47.3	9.4		
≥ 7	604	43.2	47.2	9.6		
Type of House						
Kutcha	734	53.1	41.3	5.6	91.94	<0.001
Semi-Pucca	2513	42.9	47.8	9.4		
Pucca	624	30.3	53.5	16.2		
Literacy status						
Illiterate	1171	51.9	42	6.1	66.36	<0.001
Literate	2700	38.9	49.8	11.3		
Occupation						
Labourers	1166	52.2	43	4.8	102.59	<0.001
Agriculture	1205	40.8	50	9.1		
Others	1500	37.1	48.9	14.1		
Land holdings (acres)						
No land	1474	44.4	46.1	9.4	44.16	<0.001
1-5	1769	45.1	46.4	8.5		
5 – 10	366	35.2	53	11.7		
≥10	262	28.6	54.6	16.8		

are subsisting on in-adequate diets in terms of both quantity and quality. The results suggest that the consumption of a majority of foods except for cereals & millets and roots & tubers among the older adults of both genders, and non- leafy vegetables among women, was below the RDIs for Indians. Similarly, the poor intake of diet was reflected in the consumption of nutrients, where the median intakes of all the nutrients, except for thiamine among elderly women were below the suggested levels. Likewise, the in-adequacy of various foods and nutrients is reflected in poor nutritional status of rural older adults, where the prevalence of CED is well above the World Health Organization suggested cut-off levels (CED $\geq 40\%$), indicating a "very high" public health nutrition problem¹³.

The prevalence of chronic energy deficiency was higher among the elderly men compared to their women counterparts. However, the prevalence of the CED observed among the rural elderly in this present study is lower as compared to the figures (Men: 53.5%; Women: 49.4%) reported by Arlappa et al⁷. While, the prevalence of obesity was reported to be higher (21.8%) among elderly women in this present study as compared to the figures (7.7%) reported by the earlier study among rural elderly women. Similarly, other studies carried out among older adults residing in tribal¹⁴ and desert¹⁵ areas in India are also reported higher prevalence of CED and lower prevalence of obesity as compared to the figures reported for this present study.

However, it should also be noted that ageing may be accompanied by changes which may impair the search for food and its subsequent intake resulting in undernutrition, but such changes are complex and difficult to document⁴. Ageing affects almost all the systems of the body, and is associated with several

physiological, metabolic and psychological changes, and older adults are at greater risk of developing nutritional deficiencies than younger adults due to age-related physiological changes, restrictive financial and social status, and functional decline. Thus, all these changes will result in multiple micro-nutrient deficiencies¹⁶. Vedantam et al¹⁹ reported the decreased food consumption and low Mini Nutrition Assessment (MNA) scores (< 23.5) among the elderly and attributed the same to protein-energy deficiency among the rural elderly of south India¹⁷. The high prevalence of the CED among the landless and marginalised SC/ST communities of elderly in rural areas may be attributed to the disproportionate chronic poverty¹⁸.

Changing family patterns, social norms and values made the elderly more vulnerable to abuse, neglect, isolation and abandonment. The joint family system and the benefits came along with it like financial and social security for elderly are swiftly disappearing with increasing number of nuclear families which has a negative effect on nutritional status of the elderly^{6,19}. An absence of reliable system of social services and lack of options for co-residential facilities also an indirect contributing factor for worsening nutritional status among elderly²⁰. Migration of breadwinners from rural areas to urban areas leaving the elderly parents in the villages also adding to the problem of undernutrition among older adults²¹. Similarly, chronic drought conditions and other natural calamities have adverse and negative impact on the food availability and supply and thereby the nutritional status of the elderly²². About 65 % of the aged had to depend on others for their day-to-day maintenance. Less than 20% of the elderly women but majority of elderly men were economically independent²³. Forty per cent of the elderly live below the poverty line and 73% are illiterate. Ninety per cent

of the elderly have no social security and the dependency ratio is 12.26²⁴. According to a report²³, one half of the rural elderly had a monthly per capita expenditure of Rs.420/- to Rs.775/ which indicates that rural elderly lack adequate financial resources at their disposal to spend on food which have a direct impact on quality and quantity of food consumed. Although per capita income was not assessed in this study, other factors such as social class, literacy status, living conditions (house), occupation and ownership of land significantly associated with the CED among the rural elderly. Because of low food intake compounded by increased incidence of physical diseases may interfere with intake, absorption, metabolism and utilization, the occurrences of multiple micro-nutrient deficiencies are more likely in the elderly than in the young.

The practical implications of the population aging for India are far reaching which needs be mitigated. The first step is advocacy to raise policy maker's awareness to multiple issues related to aging in the country²⁵. Since 75% of the elderly reside in rural areas, it is mandatory that geriatric health care services be made a part of the primary health care services. This calls for specialized training of Medical Officers in geriatric medicine. Also, factors such as a lack of transport facilities and dependency on somebody to accompany an elderly person to the health care facility impede them from accessing the available health services²⁶ which needs to be addressed by policy makers.

In order to promote healthier eating habits and consequently improve health status, it is first vital to understand what makes elderly people follow particular dietary patterns and, equally, which factors constrain their choice. There could be a wide array of factors which influence their choices of food intake including

social, economic, psychological, physiological, educational and personal factors²⁷. Other studies reported that the nutritional deficiencies often sub-clinical in the elderly thus, escaping the desired interventions⁶. Periodic nutrition screening initiatives can identify non institutionalized older adults at risk for low nutrient intake and health problems which may be explored in Indian context²⁸. As nutrition is an important determinant of the quality of aging population, because of its potential to modulate the transitions from vulnerability to frailty and dependence of the elderly appropriate/right nutrition may contribute to the healthy well-being of the elderly and to their ability to recover from illness²⁹. Therefore, it is very essential to assess the periodic nutritional status of the older adults, in terms of both dietary pattern as well as the anthropometric indices³⁰. This would facilitate for the early detection of undernutrition among the older adults and to formulate policies or programs to address the health and nutritional problems of the aging population.

Limitations of the Study:

The NNMB data utilised for the preparation of this communication is relatively old. Similarly, biochemical investigations were not carried out to assess the sub-clinical status of micronutrient.

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References

1. World Population Ageing 2015: Highlights (2015) Department of Economic and Social Affairs, United Nations, New York
2. Census. Population Composition (2011) Vol. 2014 Government of India, New Delhi.
3. United Nations Population Division, World Population Prospects: (2011) The 2010 Revision. New York: United Nations, accessed at <http://esa.un.org/unpd/wpp/index.htm>, on March 13, 2012
4. Gariballa, S. & Sinclair, A. (1998) Nutrition, ageing and ill health. *Brit J Nutr* 80, 7-23.
5. Lesourd, B. (2004) Nutrition: a major factor influencing immunity in the elderly. *J Nutr Health Aging* 8, 28-37.
6. The Role of Nutrition in Healthy Aging Research. Healthspan Campaign Newsletter, July 2015. <http://healthspancampaign.org/2015/08/06/the-role-of-nutrition-in-healthy-aging-research/> Accessed on 7 Aug 2016.
7. Arlappa, N., Balakrishna, N., Kumar, S., Brahman, G. & Vijayaraghavan, K. (2003) Diet and nutritional status of the elderly in rural India. *J Nutr Elderly* 22, 35-52.
8. NSSO: National Sample Survey Organization (1998) 54th round of consumer expenditure survey. Ministry of Statistics and Programme Implementation. New Delhi: Government of India
9. IBM. *SPSS Statistics for Windows*, Version 19.0. (2010) IBM Corporation Armonk, NY.
10. Expert Group of ICMR (1981) *Recommended Dietary Intakes for Indians*. New Delhi: Indian Council of Medical Research
11. Report of the Expert Group of the ICMR (1990) *Nutrient Requirements and Recommended Dietary Allowances for Indians*. New Delhi: Indian Council of Medical Research
12. Sharma, J. & Narang, R. (2011) Quality of healthcare services in rural India: the user perspective. *Vikalpa* 36, 51-60
13. WHO. (1995) Physical status: The use and interpretation of anthropometry; Technical Report no.854. Geneva, Switzerland: World Health Organization
14. Arlappa, N., Balakrishna, N., Brahman, G.N.V & Vijayaraghavan, K. (2005) Nutritional status of the tribal elderly in India. *J Nutr Elderly* 25, 23-39.
15. Arlappa, N., Mallikarjuna Rao, K., Venkaiah, K. & Brahman, G.N.V. (2009) Nutritional parameters and chronic energy deficiency in Older Adults of Desert Areas of Western Rajasthan, India. *J Nutr Elderly* 28 (1), 61-71.
16. Wadhwa, A., Sabharwal, M. & Sharma, S. (1997) Nutritional status of the elderly. *Indian J Med Res* 106, 340-348
17. Vedantam, A., Subramanian, V., Vijay Rao, N. & John, K. (2010) Malnutrition in free-living elderly in rural south India: prevalence and risk factors. *Public health nutr* 13, 1328-1332
18. Kapur Mehta, A. & Shah, A. (2003) Chronic poverty in India: Incidence, causes and policies. *World Development* 31, 491-511
19. Kumar, V. & Acanfora, M. (2001) Health status of the rural elderly. *J Rural Health* 17, 328-331
20. Rajan, S.I. & Kumar, S. (2003) Living arrangements among Indian elderly: new evidence from national family health survey. *Economic and Political Weekly*, 75-80
21. Srivastava, S. (2003) Elder Neglect in changing Indian scenario. *Delhi Psychiatry J* 16
22. Arlappa, N. & Kokku, S.B. (2015) Drought, food security and micronutrient malnutrition. R.R. Watson,

- J.A Tabor, J.E. Ehiri and V.R. Preedy (eds). Handbook of Public Health in natural disasters. Human Health Handbooks; Wgeningen Academic Publishers, pp 337.
23. MoSPI. Situation analysis of the Elderly in India (2011) Central Statistics Office, Ministry of Statistics & Programme Implementation, Government of India, New Delhi
24. Shah, N. (2001) Geriatric oral health issues in India. *Int Dent J* 51, 212-218
25. Dhar, H. (2005) Emerging geriatric challenge. *J Assoc Physicians India* 53
26. Ingle, G.K. & Nath, A. (2008) Geriatric health in India: Concerns and solutions. *Indian J Comm Med* 33, 214
27. Herne, S. (1995) Research on food choice and nutritional status in elderly people: a review. *Brit Food J* 97, 12-29
28. Posner, B.M., Jette, A.M., Smith, K.W. & Miller, D.R. (1993) Nutrition and health risks in the elderly: the nutrition screening initiative. *Am J Public Health* 83, 972-978
29. Payette, H. (2005) Nutrition as a determinant of functional autonomy and quality of life in aging: a research program. *Canadian journal of physiology and pharmacology* 83, 1061-1070
30. Arlappa, N., Qureshi, I.A., Ravikumar, .P., Balakrishna, N. & Qureshi, M.A. (2016) Arm span is an alternative to standing height for calculation of body mass index (BMI) amongst older adults. *Int J Nutr* 2, 12-24