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NUTRITIONAL ANTHROPOMETRY AND ITS ASSOCIATION WITH FUNCTIONAL ABILITY AND WELL-BEING AMONG THE ELDERLY KURICHIA TRIBE OF KERALA, INDIA

Anthropology

Kanala Kodanda Reddy* Faculty in Anthropology, Sri Venkateswara University, Tirupati-517 502, A.P, India. *Corresponding Author

Thavanati Parvathi Kumara Reddy Professor, Instituto de Genetica, Departamento de Biologia Molecular y Genomica, Universidad de Guadalajara, Jal 44340, Mexico.

Palla Venkatramana Faculty in Anthropology, School of Social Sciences, Indira Gandhi National Open University, New Delhi-110 068.

ABSTRACT

Aim: Elderly malnutrition is a chronic problem especially among the tribal elderly. The present study aimed at assessing the relationships between nutritional anthropometry with functional ability (activities of daily living [ADL] and mobility index [MI]) and well-being (WB) among the elderly Kurichia tribe of Kerala. **Material and Methods:** Information on demography, functional ability, well-being and anthropometric measuresments by assessed in 168 elderly (77 males and 91 females) aged >60 years administering inclusion and exclusion criteria with due approvals from Institutional ethical committee. **Results:** Height, weight, waist circumferences (WC), hip circumference (HC) and waist hip ratio (WHR) was greater in men while skinfold thickness (SFT) was greater in women ($p<0.05$). Anthropometry, functional ability and well-being tend to fall among the oldest old. All the correlation coefficients exerted a significant positive association between functional ability, well-being and anthropometry. Half of the sample population were suffering with undernutrition. Odds ratio for ADL dropped to 42% in undernutrition compared to normal weight. The odds for MI dropped to 65% (95%CI: 0.203-0.627) in men and 17% (95% CI: 0.589-1.192) in women. The odds of WB also dropped in undernutrition in both genders ($p<0.05$). Regression equation predicts that body mass index (BMI), mid upper arm circumference (MUAC) and sex were significant predictors in the variation of ADL, MI and WB. **Conclusion:** In conclusion, the present study highlight that undernutrition was a chronic problem associated with disability in functional ability and well-being.

KEYWORDS

Kurichia, undernutrition, activities of daily living, mobility index, well-being

INTRODUCTION

Population aging poses unprecedented challenges to society and individuals. Due to technological advancement, life expectancy at birth is increasing all over the world (WHO, 2018). WHO (2018) forecasts that in the future older people will outnumber than children and more people at extreme old age than ever before. By 2050, the world's population aged >60 years is expected to total 2 billion, up from 900 million in 2015. Today, 125 million people are aged >80 years. By 2050, 80% of all older people will live in low and middle-income countries. India's elderly population has increased from 71 million (7.5%) in 2001 to 103 million (8.6%) in 2011 according to the Census of India. Tribal communities in India are also experiencing similar trend in their elderly population little less than other caste communities (6.9%) (Nair and Thara, 2019). This is a great challenge to the health service systems (WHO, 2020). Chronic illness is endemic among many older people in the developing world, where technical advances in medicine have far outrun the social and economic development (Hajat and Stein, 2018).

Elderly malnutrition is a serious health problem for the developing countries like India (Battacharya et al., 2019). Published reports clearly emphasize a linear association between health and nutritional status including tribal populations (Arlappa et al., 2006). Anthropometric measurements are considered to be good indicators in assessing chronic energy deficiency in developing countries (Chakraborty et al., 2006). Further global self-ratings of health and functional ability are among the most commonly assessed and simplest measures for ascertaining an individual's health (WHO, 2020). Therefore, information on body composition and its association with functional ability and well being is essential in delineating the nutrition and health relationship. In the light of this background the present study aimed at assessing the relationships between nutritional anthropometry with functional ability and well-being among the elderly Kurichia tribe of Kerala.

METHODOLOGY

The material selected for the present study was *Kurichia* tribe of the Wayanad plateau, Kerala, the trijunction of Kerala, Karnataka and Tamil Nadu. They are a tribe of with total population size of 35,171 as per the 2011 census, who live in enormous joint families and follow a commune type of family organization. The elderly population (60+) of Kurichias higher compared to the elderly population of Kerala state (12.6%) and at national level of India (8.6%) by 2011. The proportion of elderly Kurichias is almost close to the western countries. The key 'emic' factor explaining the peculiarities of Kurichia life style is their exceptional honesty and truthfulness. They used to observe untouchability with other tribal and caste populations. The Kurichia are well known for their matrilineal tradition. The general longevity and overall health of Kurichias show some important cultural factors which include some healthy food habits like ragi and meat as staple foods coupled with regular intake of green leafy vegetables and tubers. They work daily in their paddy fields and walk for hours in the forest for rearing cattle and hunting, which provide an essential exercise. The excellent ecology and climate coupled with environmental sanitation and personal hygiene prevented the risk of several communicable diseases.

SAMPLING

For the present study 168 elderly (77 males and 91 females) aged >60 years was screened. Subjects were classified into three age groups: 60-69, 70-79 and ≥80 years. The objectives of the study were explained to the subjects before their consent is given. Study ethical permission was obtained from Research and Development Committee of Sri Venkateswara University, Tirupati. Written informed consent was obtained from each participant. The inclusion criteria were apparently healthy elderly willing to provide written informed consent. The exclusion criteria include subjects with any gross abnormalities, bedridden patients or patients suffering from any chronic diseases.

METHODS

A structured and standardized questionnaire was used to collect the data on the demography, socioeconomic status, physical activity, ADL, MI, WB and smoking & alcohol habits, lifestyles and anthropometry. Socioeconomic status (SES) was classified into five groups (i.e. I–V) based on scores of education, occupation, housing condition, ownership of durables and per capita income of the family. SES-I will be the highest and SES-V will be lowest class. Physical activity was assessed from occupational and spare time activities and subjects were graded as sedentary, mild, moderate or heavy. Information on individual health history also obtained. As a part of general structured interview conducted in the subject's own home, several questions were asked about self-rated health, ADL, MI and WB. Self rated health was evaluated using the response to the question, "How would you rate your health at the present time?" with possible responses being poor,

fair, good. ADL and MI was assessed administering 15-item questionnaire. WB was measured by a seven-item, binary-coded, closed-ended questionnaire. The details of the study instrument and scoring were available in our previous publication (Reddy et al., 2004). The physical assessment included height, weight, MUAC, WC, HC, SFT at triceps, subscapular and abdomen as per the standard procedures to the nearest 0.1 cm, 0.5 kg and 0.1 mm respectively. BMI was calculated as weight in kilograms divided by height in meter square. Nutritional status was evaluated as per WHO guidelines using BMI as mentioned below

Chronic energy Deficiency (CED)-3	: <16
Chronic energy Deficiency (CED)-2	: 16.1- 16.99
Chronic energy Deficiency (CED)-1	: 17-18.49
Normal weight	: 18.5 – 24.99
Over Weight	: 25- 29.99
Obesity	: >30

Waist to height ratio (WHtR) was calculated as waist circumference/height. WHR was calculated as WC/HC. Sum of the SFT was calculated as biceps+subscapular+ abdominal.

Statistical Treatment

Statistical analysis was carried out via SPSS 16.0 and the alpha levels were set at $p < 0.05$. The prevalence rates were reported as percent. Continuous variables were reported as mean±SD and the differences between genders was tested by students't' test and within the categories of age and BMI were tested by one way analysis of variance. Correlation coefficients were used to examine the linear associations. Multivariate logistic regression models were employed to investigate the effect of BMI categories on ADL, MI and WB. Further linear regression model with stepwise was fitted to study the impact of sex and anthropometric variables on ADL, MI and WB.

RESULTS

The mean age of the elderly males and females were: 70.48±8.50 and 69.15±8.62 respectively. Joint family system with agricultural activity was predominant to an extent of 90%. Around 73% of the sample were illiterates and rest with primary education only. All were classified under SES-4. Smoking and alcoholism was absent among the elderly. Sedentary activity was noticed to an extent of 2% while the mild, moderate and heavy activity pattern was 21%, 49% and 27% respectively.

In the present study around 74% of the men and women perceived their health as good. Self reported fair and poor health status was noticed among one quarter of the subjects. 85% of the elderly claimed that they were free from any disease history. Rhematoid related health problems were noticed among 10% of the elderly. Only 6 subjects claimed that they are suffering with heart related problems, one each with diabetes and bronchitis.

Data on anthropometry and functional ability of the subjects were shown in table 1. Men were taller and heavier than women, while BMI failed to show difference between genders. WC, HC WHR was greater ($p<0.05$) in men than women. No significant differences were observed in MUAC and WHtR. Women folk noticed with higher SFT at triceps, subscapular and abdomen and sum of the SFT ($p<0.05$). No gender differences were noticed in ADL, MI, WB. In men BMI, MUAC, WC, HC and SFT tend to decrease with advancement of age, while in women only height, MUAC and triceps SFT decreased ($p<0.05$). In both genders the indicators of ADL, MI and WB decreased with advancement of age ($p<0.05$).

Data on prevalence of nutritional status based on BMI among the elderly was shown in table 2. Overall half of the Kurichia elderly were suffering with undernutrition. CED-1 and CED-2 were greater in women and CED-1 in men. 48% of the sample population were classified under normal weight category. Only one man and 2 women were recorded with overweight.

Distribution of mean ADL, MI and WB scores across BMI grading was shown in graphical presentation (Fig.1). Mean values of ADL, MI and WB significantly dropped in undernutrition from CED1 to CED-3. In order to understand bivariate relationship between anthropometry, functional ability and WB, we calculated partial correlation coefficients and presented in table 3. All the correlation coefficients exerted a significant positive association between functional ability, WB and anthropometry except with height.

In order to predict the risk of nutritional status in terms of BMI gradings towards functional ability and well-being, a multinominal logistic regression model was fitted controlling for age of the subjects. In the model overweight men and women were dropped as their number is only 3. In the model BMI grading was taken as dependent variable. ADL, MI, WB and age were loaded as covariates in the model. Normal weight subjects were taken as reference category and odds ratios (95% CI) for each covariates were shown in table 4 respectively. ADL was dropped 20% (95% CI: 0.686-0.914) in CED-1, further reduction of 15% noticed in CED-2 and 7% in CED-3. Overall odds ratio for ADL dropped to 42% in undernutrition than normal weight. Similar odds ratios were observed for ADL in women for undernutriton subjects. The odds for MI dropped to 65% (95%CI: 0.203-0.627) in men while the same was 17% (95% CI: 0.589-1.192) in women in CED-1 category. In both genders MI was dropped around 80% in CED-3. The odds of WB also significantly dropped from CED-1 to CED-3 when compared to normal weight ($p<0.05$) with overall reduction of 88% in men and 64% in women.

Further, a multiple linear regression with stepwise selection of variables has been run to study the impact of various factors like sex [Male is coded as 1 (comparison group) and females as '0' (reference group)], and anthropometry (continuous variable) on the ADL, MI and WB. The results were:

1. *ADL:* The model was a good fit with $R^2 = 0.389$, $F = 50.563$ and $p < 0.0001$. About 39% of the ADL changes can be explained with the help of BMI and MUAC, using the model given below.
   ADL =-2.864 + 1.885*BMI +0.564*MUAC
   BMI has the largest influence as evidenced by the beta coefficient (0.565; $p < 0.0001$) followed by MUAC (0.195, $p =0.002$).
2. MI: The model was a good fit with $R^2 = 0.208$, $F = 13.858$ and $p < 0.0001$. About 21% of the MI changes can be explained with the help of BMI, MUAC and sex using the model given below.
   MI = 0.089 + 0.445*BMI +0.179*MUAC+-0.760*Sex
   BMI has the largest influence as evidenced by the beta coefficient (0.377; $p < 0.0001$) followed by MUAC (0.175, $p =0.015$) and Sex (-0.150, $p=0.035$).
3. WB: The model was a good fit with $R^2 = 0.367$, $F = 46.023$ and $p < 0.0001$. About 37% of the WB changes can be explained with the help of Sex and BMI, using the model given below.
   WB =7.541 + -1.549*Sex +0.280*BMI
   Sex has the largest influence as evidenced by the beta coefficient (-0.487; $p < 0.0001$) followed by BMI (0.378, $p =0.0001$).

DISCUSSION

Epidemiological studies and whole body level measurements among the aged people reveal a decrease in anthropometric characteristics as observed in the present study (Arlappa et al., 2006; Almeida et al., 2013). Similarly studies from our laboratory and erstwhile while studies confirmed the loss of functional ability and reduced well-being with advancement of age (Reddy et al., 2004; Jahangir and Mahata, 2019). Together anthropometry and functional ability and well-being tend to fall with advancement of age and more prominent in oldest old (>80 yrs). Our results were in best agreement with the above studies. The values on anthropometry, functional ability and well-being of this study were comparatively higher than other contemporary tribal populations and lower than rural populations of India (Reddy et al., 2004; Arlappa et al., 2006; Jahangir and Mahata, 2019). The reduction in BMI accompanied with change in fat fold, android obesity, functional ability and well-being.

Overall the mean values for height, weight, WC, HC and WHR were greater in men while SFT in women. No gender differences were noticed in functional ability and well/being. The reduction in SFT among the Kurichia tribe oldest old was greater than that of WC, as observed in other longitudinal studies (Hughes et al., 2004). In the present study women have greater mean values of SFT, but the reduction of these variables was greater in men, and our results were in best agreement with study of Going et al., (1995).

Elderly malnutrition was widely prevalent among Kurichia community and this trend was more pronounced with advancement age. Half of the sample population were classified under normal weight category. CED-1 was greater than CED-3. The prevalence of undernutrition was comparatively lower than to the other tribal population groups of India (Bose and Chakraborty, 2005). Nutritional status of the tribal elderly by NNPB (Arlappa et al., 2006) from 9 provincial states highlight that overall prevalence of CED (BMI<18.5)

among elderly females were 65.4% and males 61.8% respectively. Progressive loss of weight which may result in chronic energy deficiency is a chronic problem especially among the oldest of old, which may lead to developing complications and diseases and likelihood of hospitalization and death (Bahat et al., 2012). Eventhough half of the sample population were suffering with undernutrition, the morbidity rate was very less when compared to contemporary populations (Arlappa et al., 2006). The survival of strong cultural attributes and life styles which are often seen peculiarly in this tribal population are the secret of their health and longevity (Sathyavathi et al., 2012).

The results highlight that mean values of functional ability and well-being depleted with undernutrition. The decrease in overall body mass occurs primarily as a result of biological changes and its consequences reduce muscular strength vis-a-vis mobility and an increased risk towards falls (Amarya et al., 2015). Research studies highlight that low body mass reserve linked to high rate of all cause mortality in women in US (Zhu et al., 2003). Hence reduction in muscle mass and fatmass may be relevant risk factor for predisposition of well-being, functional ability and diseases.

Among the Kuricha elderly, the function of ADL dropped around 40% in CED-3 compared to normal weight subjects. MI was dropped 77% in men and 74% in women in CED-3 category. 88% of the men and 64% of the women with CED-3 category were having lower WB scores compared to normal weight. Bivariate relationship of anthropometry with functional ability and well-being highlight that BMI was best predictor in assessing the functional ability and well-being. ADL increases by 1.9 times with unit increase in BMI and 0.6 times with unit increase in MUAC. MI score increases 0.5 times with unit increase in BMI, 0.2 times with increase in MUAC and reduces 0.8 times in male gender compared to females. The WB score of male gender was lower by 1.549 times compared female gender. Similarly WB score was increases by 0.38 times with unit increase in BMI. The study highlights that BMI and MUAC increases ADL, MI and WB. Female gender was advantageous in possessing higher score of WB and MI.

The prevalence of disability in ADL is higher among Indian elderly as compared to other ageing countries (WHO,2020). Jahangir and Mahata, (2019) observed that prevalence of disability among tribal elderly was significantly higher than general elderly population. Impairment in functional ability has a significant effect on the well-being of the elderly people (Reddy et al., 2004; Pallavi et al., 2015). Reddy et al (2004) study on rural elderly highlighted that aged people with low BMI equally associated with lowest scores on well-being and functional ability. The authors claim that functional ability can be used to predict the morbidity and mortality in the elderly subjects. Measures of disability in terms of ADL were the strongest predictors of WB. Therefore, individual evaluation of health is substantially influenced by his or her level of emotional well-being and physical function for the elderly people. In US and European countries, elderly reported increased concern with respect to posing a burden to their families and expressed to lead independent lives gaining life satisfaction. Indian culture is entirely different from other cultures, where elderly automatically depend on kith during old age which increases negative life events. But the culture of Kurichia community is different. Women and elderly were given utmost respect and protect their rights, which reflects interms of higher well-being scores and good self reported health when compared to other tribal counterparts (Sathyavathi et al., 2012). Evidences were in place regarding impaired functional ability exert a significant impact on psychological well-being and can lead to depressive symptoms, and psychological distress (Pallavi et al., 2015).

In conclusion, the present study highlight that undernutrition was a chronic problem associated with disability in functional ability and well-being. Nutritional interventional programmes are needed to improve the functional ability and well-being which may give life satisfaction. The findings contribute to the formulation of public health policies for disease prevention and health promotion among the elderly kurichia tribe.

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Table 1. Anthropometric and functional ability characteristics of the tribal elderly

	Males			Females			t-value
	Mean	SD	F-value	Mean	SD	F-value	
Height cm	158.87	7.1	3.99*	145.98	5.11	6.90*	13.64*
Weight kg	47.49	5.94	12.09*	40.44	5.95	1.49	7.66*
BMI kgm^{-2}	18.81	1.95	4.74*	18.98	2.64	0.10	0.48
MUAC cm	20.87	2.62	9.52*	21.05	2.33	3.91*	0.46
WC cm	72.88	5.16	6.84*	66.98	6.27	0.55	6.59*
HC cm	79.57	4.81	3.35*	76.36	7.1	0.66	3.37*
WHtR	0.46	0.03	1.90	0.46	0.04	0.11	0.04
WHR	0.92	0.04	2.36	0.88	0.05	0.29	5.21*
Triceps SFT mm	5.9	1.86	4.22*	8.15	3.28	4.53*	5.35*
Subscapular SFT mm	8.92	2.7	3.58*	10.7	3.79	1.05	3.45*
Abdominal SFT mm	11.48	4.76	3.12*	13.69	5.26	0.40	2.84*
Sum of the SFT mm	26.3	8.02	4.49*	32.55	10.8	1.57	4.19*
ADL	44.49	7.26	11.12*	44.61	7.24	8.35*	0.11
MI	11.35	2.32	42.81*	10.81	2.76	35.73*	1.36
WB	11	1.41	51.33*	10.55	1.68	17.20*	1.865

*p<0.05 F-value obtained from ANOVA carriedout across age groups
t-value between genders

Table 2 Prevalence of malnutrition based on body mass index in tribal elderly

BMI grading	Males	Females	Total	Chi-square
	n(%)	n(%)	n(%)	0.661
CED-3	4 (5.2)	9 (9.9)	13 (7.7)	
CED-2	8 (10.4)	13 (14.3)	21 (12.5)	
CED-1	25 (32.5)	25 (27.5)	50 (29.8)	
Normal Weight	39 (50.6)	42 (46.2)	81 (48.2)	
Overweight	1 (1.3)	2 (2.2)	3 (1.8)	

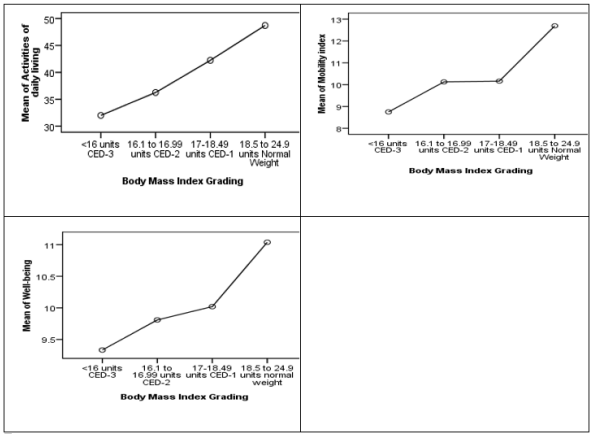

Fig. 1. Distribution of mean functional ability and well-being across body mass index grading

Table 3. Bivariate relationship of functional ability, well-being with anthropometric characteristics in the tribal elderly

	Males			Females		
	ADL	MI	WB	ADL	MI	WB
Height cm	0.035	0.120	0.186	-0.035	0.117	0.161
Weight kg	0.554*	0.634*	0.599*	0.566*	0.362*	0.522*
BMI kgm^{-2}	0.634*	0.661*	0.571*	0.600*	0.314*	0.458*
MUAC cm	0.492*	0.379*	0.402*	0.081	0.137	0.069
WC cm	0.477*	0.535*	0.415*	0.440*	0.203*	0.332*
HC in cm	0.363*	0.370*	0.273*	0.346*	0.134	0.274*
WHtR	0.419*	0.424*	0.273*	0.436*	0.147	0.256*
WHR	0.281*	0.362*	0.305*	0.156	0.116	0.092
Triceps SFT mm	0.230*	0.400*	0.362*	0.485*	0.370*	0.399*
Subscapular SFT mm	0.349*	0.455*	0.343*	0.449*	0.259*	0.335*
Abdominal SFT mm	0.214	0.446*	0.323*	0.407*	0.207*	0.294*
Sum of the SFT mm	0.298*	0.510*	0.391*	0.505*	0.305*	0.383*

Table 4. Age adjusted odds ratios (95% CI) for each dependent variable by BMI grading

Sex	BMI grading	ADL	MI	WB
		OR (95%CI)	OR (95%CI)	OR (95%CI)
Males	CED-3	0.581 (0.420-0.804)*	0.227 (0.068-0.756)*	0.122 (0.023-0.644)*
	CED-2	0.651 (0.530-0.801)*	0.242 (0.102-0.577)*	0.206 (0.065-0.649)*
	CED-1	0.792 (0.686-0.914)*	0.357 (0.203-0.627)*	0.304 (0.133-0.694)*
	Normal Weight	Ref.	Ref.	Ref.
Females	CED-3	0.602 (0.480-0.755)*	0.258 (0.127-0.521)*	0.361 (0.175-0.743)*
	CED-2	0.653 (0.536-0.796)*	0.433 ().255-0.735)*	0.382 (0.207-0.707)*
	CED-1	0.870 (0.766-0.988)*	0.838 (0.589-1.192)	0.483 (0.292-0.800)*
	Normal Weight	Ref.	Ref.	Ref.

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