

High prevalence of undernutrition and low dietary diversity in institutionalised elderly living in Sri Lanka

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1 **Title:** High prevalence of undernutrition and low dietary diversity in institutionalised elderly living
2 in Sri Lanka

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16

17

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26 interpretation and critical revision of the manuscript. The authors declare that there is no conflict of
27 interest of any kind involved in this study or this publication.

28 Ethical clearance for this study was obtained from the Ethical Review Committee of the Sri Lanka
29 Medical Association (ERC/13-037).

30

31

32 **Abstract**

33 **Objective:** The study aimed to assess nutrition status, dietary diversity and lifestyle risk factors
34 associated with undernutrition in an institutionalised Sri Lankan elderly population.

35 **Design:** The study was of cross-sectional design followed by a stratified sampling method.

36 **Setting:** Twelve homes for the elderly recruited from six provinces in Sri Lanka.

37 **Subjects:** A total of 311 institutionalised elderly age ≥ 60 years.

38 **Results:** The mean (SD) age of the study population was 74.4 (7.8) years. Prevalence of
39 undernutrition was 30%. Mean (SD) food variety score, dietary diversity score and dietary serving
40 score of the study population were 8.7 (1.5), 7.3 (1.2) and 10.9 (2.0), respectively. Mean daily
41 intakes of fruit, vegetables, meat, fish, eggs and pulses and dairy portions were below the national
42 recommendations, whereas the mean consumption of sugar exceeded the national recommendation.
43 Only the mean intake of starch was within the recommendation. Food allergies (OR=8.0; 95% CI
44 3.9, 16.2), skipping meals (OR=3.8; 95% CI 2.0, 7.5) and lack of leisure activities (OR=3.1; 95%
45 CI 1.5, 6.7) significantly increased the risk of undernutrition, whereas the use of dentures decreased
46 the risk (OR=0.20; 95% CI 0.06, 0.69).

47 **Conclusions:** High prevalence of undernutrition and low dietary diversity were observed in an
48 institutionalised elderly Sri Lankan population. Therefore, there is an urgent need to implement
49 nutrition interventions as part of geriatric care to reduce undernutrition and improve the diets of the
50 institutionalised elderly population in Sri Lanka.

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63 **Introduction**

64 Globally, prevalence of the elderly population (>60 years) has gradually increased over the past few
65 decades. In Sri Lanka it accounts for 12.3% of the total population⁽¹⁾, which is the fastest growing
66 elderly population in South East Asia^(2, 3). It is well-documented that worldwide there is a higher
67 prevalence of malnutrition in the institutionalised elderly compared with the free-living elderly⁽⁴⁻⁷⁾.
68 Existing literature suggests that nutritional status has a major impact on the health and functional
69 status of older individuals. Furthermore, biological, physiological, social and psychological changes
70 often accompanied with aging along with increased prevalence of morbidities enhance the
71 susceptibility of the elderly to be malnourished⁽⁸⁾. The aetiology of malnutrition is multifactorial in
72 older people. Evidence indicates that the elderly are at a risk of nutritional deficiencies due to
73 changes in body composition, the gastrointestinal tract, sensory function, and fluid and electrolyte
74 regulation, and from chronic illness, medication, hospitalisation and psychosocial factors, such as
75 financial restrictions, social isolation, widowhood and bereavement, food anxieties and decreasing
76 independence⁽⁹⁾. Nutritional status is a key determinant of quality of life, morbidity and mortality of
77 older people.

78 In Sri Lanka, pre and primary school children, adolescents and pregnant mothers are recognised as
79 nutritionally vulnerable populations. Sri Lanka and other counties are currently experiencing an
80 increasing aging population as a result of declining fertility and mortality rates. Siddhisena reported
81 that during the last two decades the number of institutionalised older people has risen considerably
82 suggesting a growing demand for care⁽¹⁰⁾. Furthermore, recent studies performed in India and
83 Malaysia showed a higher prevalence of malnutrition in the institutionalised elderly^(4, 11). It is
84 evident that the elderly, particularly those who are institutionalised, require specific attention and
85 should be a priority in public health nutrition intervention programmes. Thus, the prevalence and
86 risk factors associated with undernutrition in different elderly populations needs to be investigated
87 to determine suitable nutritional therapies to combat undernutrition in these population groups. The
88 study aim was to assess nutrition status, dietary diversity and lifestyle risk factors associated with
89 undernutrition in an institutionalised elderly population from Sri Lanka.

90

91 **Methods**

92 **Study design and participants**

93 This study was conducted with a cross-sectional design followed by a stratified sampling method.
94 Ethical clearance was obtained from the Ethical Review Committee of the Sri Lanka Medical
95 Association (ERC/13-037). The study aimed to recruit 300 elderly men and women, with an
96 expected prevalence of 20%, with a power of 95% and a 5% significance level, which included a
97 drop-out rate of 10%⁽¹²⁾. A total of 311 older adults (age \geq 60 years) were recruited from 12 homes

98 for the elderly from six provinces, which were considered as primary units, in Sri Lanka. The six
99 provinces were Western, North Western, Sabaragamuwa, Central, Northern and Eastern province. A
100 list of all registered elders' homes in each province were obtained from the relevant provincial
101 social services departments and from this list two elderly homes were randomly selected as
102 secondary units. Subjects were purposively included who could communicate, did not have any
103 cognitive impairment and were able to carry out a face-to-face interview for approximately 40
104 minutes. The selected elderly homes were initially contacted via telephone by the study team who
105 explained the study and verbal consent was taken. Elderly homes were randomly visited (including
106 both week and weekend days) to minimize data bias. All subjects provided written informed
107 consent prior to data collection. An interviewer-administered questionnaire was used to collect
108 information regarding socio-demographic status (age, gender, level of education and financial
109 status), physiological factors (appetite loss, tooth loss, use of dentures and vision impairment),
110 psychological factors (presence of depression as defined by lack of interest or pleasure in life, lack
111 of engagement with friends, caregivers and day to day activities, low mood and frequent negative
112 thoughts), lifestyle factors (ability to move, leisure activities, usage of medication and betel
113 chewing) and dietary risk factors (skipping meals, ability to eat and food allergy). The presence of
114 food allergy was self-reported and not necessarily clinically diagnosed.

115

116 **Anthropometry**

117 Anthropometric measurements, including height, body weight, mid upper arm circumference
118 (MUAC) and calf circumference (CC), were obtained by trained investigators using standard
119 equipment according to standard guidelines⁽¹³⁾. Participants were asked to remove jackets, shoes,
120 and jewellery and empty their pockets, before body weight was measured using a calibrated
121 electronic scale (Seca 813, Hamburg, Germany), accurate to the nearest 0.1 kg, which was placed
122 on an even concrete floor. Height was measured to the nearest 0.1 cm with an upright plastic
123 portable stadiometer (Invicta Plastics-Model IP0955, Leicester, UK) while the subject was in a
124 standing position without footwear. BMI was calculated as weight divided by height² (kg/m²).
125 According to the WHO cut-off values for Asians, a BMI of ≤ 18.5 kg/m² is considered a marker of
126 undernutrition⁽¹⁴⁾. A non-stretchable measuring tape was used to assess the MUAC, which was
127 taken at the midpoint between the acromial process of the scapula and olecranal process of the
128 elbow of the non-dominant arm when the forearm was hanging relaxed at the side. The two
129 categories of MUAC were < 21 cm and ≥ 21 cm, with < 21 cm being an indicator of undernutrition⁽¹⁵⁾.
130 CC, considered the most sensitive measure of muscle mass in the elderly⁽¹⁶⁾, was measured with the
131 subject sitting in a chair with the knee and corresponding ankle kept bent to a 90° angle. The
132 researcher knelt beside the lateral side of the left calf and a loop of measuring tape was placed

133 around the calf. When the largest circumference was located, by moving the loop up and down the
134 calf, the tape was pulled snugly around the calf. This measurement was recorded to the nearest 0.1
135 cm and two consecutive measurements were taken and the mean circumference recorded⁽¹⁵⁾. As
136 categorised in the mini-nutritional assessment tool (MNA)⁽¹⁷⁾, the two categories of CC were set as:
137 1) <31 cm and 2) 31 or >31 cm.

138

139 **Dietary diversity**

140 A single 24-h dietary recall was used to assess dietary intake. The recalls were taken on random
141 days (week or weekend day) by a trained researcher to minimise day-to-day variation. All foods and
142 drinks consumed on the previous day were obtained in direct chronological order by following the
143 standard protocol of multiple-pass recalling technique⁽¹⁸⁾. In addition, a detailed description of the
144 foods, cooking method and brand names of some foods, such as milk and processed foods, were
145 recorded. Food intake was obtained using standard household measures, such as coconut spoons,
146 tablespoons, teaspoons, bowls, glasses and teacups. To assist the subjects in accurately reporting the
147 intake of foods, a series of food portion size photographs and food models prepared by the
148 researcher were shown. For each subject, all food and drink items consumed were assigned to one
149 of the major food groups as described in Sri Lankan food-based dietary guidelines⁽¹⁹⁾. Those food
150 groups were: 1) cereal or equivalents (starchy foods), 2) vegetables, 3) fruits, 4) meat, fish, eggs and
151 pulses, 5) dairy and 6) added sugars. The quantity of household measures for one serving of food in
152 the selected food groups were obtained as defined by Jayawardena *et al*⁽²⁰⁾. For each food group, the
153 quantity of household measures of food consumed was divided by the quantity of household
154 measure for one serving and summed to derive the total number of servings consumed. Composite
155 food dishes were disaggregated into its ingredients and those ingredients were assigned to the
156 appropriate food groups for calculating the number of servings. The dietary diversity of the study
157 population was assessed by a food variety score (FVS; a simple count of food items consumed),
158 dietary diversity score (DDS; a simple count of food groups consumed out of 12 groups considered)
159 and dietary serving score (DSS; number of portions of different food groups in conformity with
160 dietary guidelines of Sri Lanka)⁽²¹⁾.

161

162 **Data analysis**

163 Data were analysed using SPSS version 21 (SPSS Inc. Chicago, IL, USA). In all analyses, a P-value
164 <0.05 was considered as statistically significant. Both univariable and multivariable logistic
165 regression analyses were performed to determine the risk factors associated with undernutrition.
166 Data presented represent mean (standard deviation; SD), unless otherwise specified.

167

168 **Results**

169 The study sample consisted of 45% men (n=140) and 55% women (n=171). The mean (SD) age of
170 the study population was 74.4 (7.8) years. The socio-demographic and anthropometric
171 characteristics of the study population are shown in Table 1. The mean (SD) BMI, MUAC and CC
172 of the subjects were 21.5 (4.8) kg/m², 23.4 (3.5) cm and 28.3 (3.7) cm, respectively. The prevalence
173 of BMI <18.5 kg/m² to determine undernutrition was 30%. Prevalence of MUAC < 21 cm and CC <
174 31 cm was 23% and 73%, respectively (Table 2).

175 Mean (SD) FVS, DDS and DSS of the study population were 8.7 (1.5), 7.3 (1.2) and 10.9 (2.0),
176 respectively, with similar mean values in men and women, respectively, for FVS (8.8 (1.5) and 8.5
177 (1.5)), DDS (7.4 (1.1) and 7.2 (1.2)) and DSS (10.8 (1.9) and 11.0 (2.1)). Undernourished subjects
178 had a lower median DSS compared with nourished counterparts. The nourished elderly had
179 maximum of 16 DSS, whereas in the undernourished elderly it was approximately 13.

180 Mean daily intakes of fruit, vegetable, meat, fish, eggs and pulses and dairy were below the national
181 recommendations for a Sri Lankan population (Table 3), whereas the mean consumption of sugar
182 appeared to exceed the national recommendation. Only the mean intake of starch was within the
183 recommendations (Table 3).

184 Food allergies, skipping meals and lack of leisure activities significantly increased the risk of
185 undernutrition, whereas the use of dentures decreased the risk in both univariable and multivariable
186 logistic regression analyses (Table 4).

187

188 **Discussion**

189 Numerous risk factors for undernutrition among the elderly have been identified, with many studies
190 performed in developed countries where the ageing population is escalating. However, there is an
191 urgent need for these risk factors to be pre-tested and modified if required for application in Asian
192 populations since there are apparent differences in anthropometric indicators, lifestyle and food
193 patterns among different ethnic groups. Both the risk factors and prevalence of undernutrition
194 among institutionalised elderly people in Sri Lanka remain poorly understood.

195 In the present study, the institutions studied were non-paying homes for the elderly. The majority
196 were managed by religious and non-government organisations, philanthropic families or trusts,
197 whilst others were financially assisted by the Ministry of Social Services of Sri Lanka. The food
198 offered to the residents was prepared by the institution, with the exception of food provided by
199 visitors on special occasions. The majority of the institutions had set menus for three daily meals,
200 which were not prepared with nutrition requirements or dietary diversity considerations. The variety
201 of foods offered on the menus was dependent on the financial resources of the institution. The
202 current study demonstrated that undernutrition is common among a representative sample of

203 institutionalised elderly residents across Sri Lanka. Using BMI as a useful approximate
204 anthropometric indicator to determine undernutrition in elderly⁽²²⁾, nearly one-third (30%) of the
205 studied residents were identified as being undernourished, with a similar prevalence among men
206 (28.6%) and women (31.6%). According to the WHO cut-offs⁽¹⁵⁾, 23% of the institutionalised
207 elderly in this study had a lower MUAC than recommended if sufficiently nourished, which
208 suggests declining muscle mass and fat stores. Sarcopenia, which is the decline in muscle mass, is a
209 major physiological condition that is predominantly found with increasing aging. Although the
210 aetiology of sarcopenia remains unclear, physical inactivity, inadequate dietary protein and/or
211 impaired protein utilisation have been identified as indirect factors that contribute to declining
212 muscle mass⁽²³⁾. In this study group, protein-rich food consumption was below the national
213 recommendations. Additionally, based on the cut-off defined from the MNA tool⁽¹⁷⁾, 74% had CC
214 of ≤ 31 cm. Previous studies identified CC as a potential marker of physical function, which provides
215 valuable information on muscle-related disability and physical function⁽¹⁶⁾. High prevalence of low
216 CC showed weakness in leg strength and physical function in this population.

217 Dietary diversity, used as a simple tool to identify those at risk of food and nutrition insecurity^(24, 25)
218 and as a marker of population micronutrient status⁽²¹⁾, was assessed using three measures: FVS,
219 DDS and DSS. A recent study conducted in Sri Lanka demonstrated that FVS, DDS and DSS were
220 useful proxy indicators of nutrient adequacy of elderly people⁽²⁶⁾. Macro- and micronutrient
221 deficiencies are public health concerns in Sri Lanka due to the monotonous, cereal-based diets that
222 lack diversity. Several studies have shown that the overall nutritional quality as well as nutrient
223 adequacy of the diet is improved with a diverse diet⁽²⁷⁻³⁰⁾. DDS is a major element of a high quality
224 diet as it represents the variety of the diet. In the current study, none of the dietary diversity
225 measures of the study sample met the optimum level (DDS was approximately 7 out of 12 food
226 groups considered) suggesting that both the quality and quantity of their diets were poor. Only
227 cereal consumption was within the recommendations. Noticeably, consumption of fruits, vegetables,
228 dairy and animal foods were substantially lower than the minimum national recommendations.
229 Since the quality and quantity of the diet is inadequate, there is a higher tendency of developing
230 both macro- and micronutrient deficiencies among the study sample. When comparing the dietary
231 diversity indicators (FVS, DDS and DSS) of undernourished and nourished elderly people, there
232 was no significant difference in terms of FVS and DDS. However, as expected, the DSS of the
233 undernourished elderly was less than that of nourished elderly. Although the number of different
234 food groups consumed by both the undernourished and nourished elders was similar, the diversity
235 of different food groups consumed by the undernourished elderly was less than that of the nourished
236 elderly. Moreover, consumption of fruits, both fruits and vegetables, meat, fish and egg portions per
237 day were relatively low among the undernourished elderly than the nourished elderly.

238 The nutrition and behaviour risk factors associated with the prevalence of undernutrition in the
239 institutionalised elderly from this study were in line with those of previous studies⁽³¹⁻³³⁾. The elderly
240 who experienced a loss of appetite were 2.2 times more likely to be undernourished than those who
241 retained their appetite. There are many mechanisms by which appetite loss might confer an
242 increased risk of undernutrition among the elderly. Studies have reported that with increasing age,
243 the ability to visualise, smell and taste foods decreases^(34, 35) and there are distinct changes in
244 gastrointestinal function, which likely reduces motility rates and disrupts digestion or absorption^{(9,}
245 ^{36, 37)}. All of these age-related changes are associated with an increase in the satiety hormone
246 cholecystokinin and a reduced feeding drive, both of which result in a loss of appetite⁽³⁸⁾.
247 Supportive of previous literature⁽³³⁾, the present study observed that skipping meals was
248 significantly associated with a 3.8 times higher OR of being undernourished. Having food allergies
249 was also identified as a risk factor for undernutrition having an OR of 8.0. The association of
250 undernutrition in the elderly with psychological factors is of growing interest. **Although**
251 **multivariate analysis did not show a significant effect, the possibility that symptoms of depression**
252 **may exist.** Symptoms of depression (a lack of interest and pleasure in life) was associated with a 2.6
253 fold higher risk of undernutrition **in univariable analysis**, which supports previous work⁽³¹⁾.
254 Loneliness is associated with negative factors, including boredom, restlessness and unhappiness,
255 and ultimately leads to a decrease in food intake. Results of the present study indicate that a lack of
256 leisure activities was associated with 3.2 times higher risk for undernutrition, which is comparable
257 with previous findings⁽³⁹⁾. Indeed, we found that the use of dentures was associated with less
258 undernutrition in elderly. In line with our findings, a recent study reported a positive association
259 between both tooth loss and denture status and being underweight in the older elderly from Sri
260 Lanka⁽³²⁾.

261 The strength of this study was its diversity of homes for elders in Sri Lanka, representing six out of
262 the nine provinces in the country. Although a single day food record cannot be used to accurately
263 evaluate an individual's habitual dietary intake, 24-h dietary recalls provides an estimate of the
264 nutrition status of the elderly population studied. Indeed, there may be biases when taking 24-h
265 dietary recalls from the elders because of their memory lapses, however, in the current study, ,
266 visual recognition aids were used, as well as commonly used household measures to minimise the
267 recall biases⁽⁴⁰⁾. Oil and fats were not estimated in this study. Coconut fat is the major contributor of
268 dietary fat in Sri Lankan diets, and since coconut oil, coconut milk and/or scraped coconuts are
269 added into composite dishes, this would have led to methodological challenges in obtaining
270 accurate intakes of fats and oils⁽⁴¹⁾. The MNA is one of the most widely used tools for assessing
271 malnutrition in the elderly but has limitations in its application for non-Western and non-Caucasian
272 populations⁽⁴²⁾. Therefore, the modification of nutrition assessment tools according to different

273 populations is recommended to effectively assess the nutrition status of the elderly in both the
274 developed and developing countries.

275

276 **Conclusion**

277 The prevalence of undernutrition, as determined by BMI, in the institutionalised elderly in Sri
278 Lanka was high, and both the quantity and quality of diets failed to meet national recommendations.
279 Food allergies, skipping meals and lack of leisure activities all significantly contributed to
280 undernutrition. This high degree of undernutrition identified in the current study emphasises the
281 need for the development of a tool specific to the Sri Lankan elderly population to detect the
282 emerging nutrition problems and to allow a timely intervention to prevent the occurrence of severe
283 undernutrition in this vulnerable group.

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Table 1 Socio-demographic characteristics of the institutionalised elderly Sri Lankan population

Characteristic	All % (n)	Men % (n)	Women % (n)
Gender	100 (311)	45 (140)	55 (171)
Age			
60-69 years	28 (87)	14 (44)	14 (43)
70-79 years	44 (137)	17 (53)	27 (84)
>80 years	28 (87)	14 (43)	14 (44)
Level of education			
No schooling	32 (99)	9 (29)	23 (70)
Up to Grade 5	31 (96)	16 (50)	15 (46)
Up to Grade 10	31 (97)	17 (52)	14 (45)
G.C.E. O/L and above	6 (19)	3 (9)	3 (10)
Financial assistance			
Yes	20 (63)	9 (30)	11 (33)
No	80 (248)	35(110)	45 (138)
Number of years a resident			
1- 5 years	66 (204)	31 (96)	35 (108)
6-10 years	24 (74)	10 (32)	14 (42)
> 10 years	10 (33)	4 (12)	6 (21)
Mobility			
Active (walk actively)	52 (159)	25 (75)	27 (84)
Less active (walk using aids)	41 (129)	17 (53)	24 (76)
Inactive (walk with assistance)	7 (23)	4 (12)	3 (11)
Presence of chronic diseases			
Yes	59 (182)	22 (68)	37 (114)
No	41 (129)	23 (72)	18 (57)
Presence of acute illness			
Yes	19 (59)	11 (33)	8 (26)
No	81 (252)	34 (107)	47 (145)
Use of medication			
Yes	66 (206)	26 (82)	40 (124)
No	34 (105)	19 (58)	15 (47)
Betel chewing			
Yes	37 (115)	21 (64)	16 (51)
No	63 (196)	24 (76)	39 (120)

Table 2 Anthropometric characteristics of the study population

Factor	Mean	SD	% (n)
BMI (kg/m²)	21.5	4.8	-
<18.5	16.6	1.4	30 (94)
≥18.5	23.6	4.1	70 (217)
MUAC (cm)	23.4	3.5	-
<21	19.4	1.3	23 (72)
≥21	24.6	3.0	77 (239)
CC (cm)	28.3	3.7	-
<31	26.7	2.7	74 (229)
≥31	32.8	2.1	26 (82)

CC, calf circumference; MUAC, mid-upper arm circumference

Table 3 Comparison of mean food intake by food groups of the study population with national Sri Lankan dietary recommendations

Food Groups	Mean intake (portions/d)	National recommendation (portions/d)*
Cereal or equivalents (starchy foods)	8.24	6-11
Fruits	0.46	2-3
Vegetables	1.49	3-5
Fruits & vegetables	1.95	≥ 5
Meat, fish, eggs and pulses	1.56	3-4
Dairy (milk and/or milk products)	0.55	1-2
Added sugar	3.71	Sparingly

*Food-based dietary guidelines for Sri Lankans⁽¹⁹⁾

Table 4 Factors associated with undernutrition in elderly

Factors	Univariable analysis		Multivariable analysis		
	OR	P value	OR	P value	95% CI ^a
Skipping meals	6.08	<0.0001	3.84	<0.0001	1.971, 7.500
Food allergies	10.16	<0.001	8.01	<0.0001	3.948, 16.236
Loss of appetite	2.19	0.002	1.55	0.167	0.833, 2.876
Lack of leisure activities	3.78	<0.0001	3.19	0.002	1.517, 6.703
Lack of pleasure or interest (Symptoms of depression)	2.61	<0.0001	1.19	0.592	0.634, 2.222
Wearing dentures	0.28	0.019	0.20	0.011	0.057, 0.694

* CI, P values and OR were obtained from corresponding multivariable binary logistic regression analysis. Significant values in multivariable binary logistic regression analysis are given in bold type.