



# BMJ Open Determinants of undernutrition among older adults in South Gondar Zone, Ethiopia: a community-based study

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## ABSTRACT

**Objectives** The objectives of this study were to assess the prevalence and determinants of undernutrition among older adults aged 65 years in the south Gondar Zone, Ethiopia, in 2020.

**Design** A community-based cross-sectional study.

**Setting** The study was conducted from 1 October to 15 December 2020, in the South Gondar Zone, Ethiopia. Study participants were selected by systematic random sampling. A pretested and structured questionnaire adapted from different literature was used to collect data. Anthropometric measurements were taken following the standard procedure.

**Participants** A total of 290 older adults aged greater than or equal to 65 years of age were included in the study.

**Data analysis** Descriptive and summary statistics were employed. Multiple logistic regression was fitted to identify determinants of undernutrition. ORs and their 95% CIs were computed to determine the level of significance.

**Outcome measures** Undernutrition was assessed by using Body Mass Index and Mini Nutritional Assessment (MNA) tool.

**Results** The prevalence of undernutrition was 27.6% (95% CI 22.4 to 32.8), and 2.1% (95% CI 0.7 to 3.8) of the study participants were overweight. Based on the MNA tool, 29.7% (95% CI 24.5 to 35.2) of the study participants were undernourished and 61.7% (95% CI 55.5 to 67.2) were at risk of undernourishment. Rural residence adjusted OR (aOR)=10.3 (95% CI 3.6 to 29.4), inability to read and write aOR=3.5 (95% CI 1.6 to 7.6), decrease in food intake aOR=13.5 (95% CI 6.1 to 29.5) and household monthly income of less than US\$35.6 aOR=4.3 (95% CI 1.9 to 9.4) were significantly and independently associated with undernutrition.

**Conclusion** The level of undernutrition among older adults in the study area was high, making it an important public health burden. The determinants of undernutrition were a place of residence, educational status, food intake and monthly income.

## INTRODUCTION

According to a factsheet released by the WHO, around 12% of the global population (900 million people) was aged 60 years or over in 2015, with forecasts that this number will nearly double to 22% (2 billion people) by 2050.<sup>1</sup> Furthermore, the older

## Strengths and limitations of this study

- The study was community-based, unlike hospital-based studies, so it can represent the population.
- Instead of height measurement, this study used arm span, as it can increase the precision of the result because the usual height measurement may underestimate the result.
- The study assessed nutrition by only anthropometric methods of nutritional assessment.
- The sample size was small and restricted to south Gondar, which means that it may not represent the whole country.
- The study was conducted during a fasting period, and it might have affected the dietary diversity score.

adult population in developing countries is expanding at a faster rate than in developed countries.<sup>2</sup> Around 3.2% of the Ethiopian population is categorised as an older adult population aged ≥65 years.<sup>3</sup> Chronic diseases and disability are becoming a public health challenge as the world's population ages, particularly in developing nations where the healthcare system is underdeveloped and resources are scarce.<sup>4</sup> This rapid demographic shift leaves these countries with insufficient time to construct their health, economic and social infrastructures to deal with the ageing population. Another issue is that in developing countries, population ageing is accompanied by persistent poverty.<sup>5</sup> Healthy diets and exercise are frequently emphasised in nutrition to reduce the chance of acquiring lifestyle diseases such as cancer, diabetes and cardiovascular disease. However, as people get older, their nutritional objectives shift to fulfilling greater nutrient needs while consuming less energy and preventing lean muscle loss.<sup>6,7</sup> To assess the nutritional status of older adults, the well-known, simple, easy and applied anthropometric assessment is the body mass index (BMI).<sup>8</sup>

Malnutrition contributes significantly to morbidity and mortality among older adults, without a doubt.<sup>9</sup> Undernutrition and accidental weight loss contribute to health decline, decreased physical and cognitive functional status, higher healthcare consumption, premature institutionalisation and increased mortality. The number of existing geriatric disorders had a positive association with the probability of malnutrition. Depression, dementia, functional dependency and other comorbidities have all been linked to poor nutritional status.<sup>10 11</sup> A recent study demonstrated that malnourished older adult patients with COVID-19 were at the greatest risk of severe illness.<sup>12</sup> Despite these, the health and nutrition of the older adults are usually ignored; many of the intervention activities are directed towards neonates, children, adolescents, expectant and nursing mothers.<sup>13</sup>

As far as the authors' best search, there are limited studies in Ethiopia and in South Gondar Zone to determine the nutritional status and its determinants among these segments of the population. Therefore, understanding the prevalence and causes of undernutrition among older people has the utmost importance for arresting the problem. Hence, this study was carried out to determine the magnitude and determinant factors of undernutrition among people aged  $\geq 65$  years in South Gondar Zone, Ethiopia.

### Specific objectives

To assess the prevalence of undernutrition among older adults in South Gondar Zone, Ethiopia.

To assess the factors related to undernutrition among older adults in South Gondar Zone, Ethiopia.

## METHODS

### Study area, design and period

The study was conducted in South Gondar Zone. South Gondar is a Zone in the Ethiopian Amhara Region. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone has a total population of 2 051 738. With an area of 14 095.19 square kilometres, South Gondar has a population density of 145.56; 195 619 or 9.53% are urban inhabitants. A total of 468 238 households were counted in this Zone, which results in an average of 4.38 persons to a household. According to the 2011 CSA, the South Gondar Zone has a total population of 2 239 077 (1 103 490 women and 1 135 587 men). Of 2.8% of the total population is expected to be over the age of 65 years and 60.2% of them are women. A community-based cross-sectional study was conducted from 1 October to 15 December 2020.

### Inclusion and exclusion criteria

All old people aged  $\geq 65$  years old who were living in three randomly selected Districts of South Gondar Zone at the time of data collection were the study population. Those who were critically ill and those cognitively impaired, which were assessed by eye-balling, were excluded from

the study. Eye-balling is the rapid judgement of how sick a patient is based on only visual cues with no specific knowledge of the patient's illness

### Sample size and sampling techniques

The sample size was calculated using the single population proportion formula for a cross-sectional study by using the formula  $((Z^2 p (1-p))/d^2)$ , taking the prevalence of undernutrition from a previous study from North West Ethiopia, 21.9%<sup>14</sup> a margin of error of 5%, the Z value of 1.96, and taking 15% non-response rate, the final sample size was 300. First, three districts from a total of 18 districts were selected by simple random sampling technique method; then census was conducted to enumerate the total number of older adults in each district. Then the calculated sample was allocated to each district proportionally based on the number of older adults. Finally, a systematic random sampling technique was used for the selection of individual respondents.

### Patient and public involvement

No patients and public were involved in the development of the research question, study design or data interpretation of this study.

### Measurements

#### Assessment of undernutrition

Undernutrition (underweight) was defined as BMI of less than 18.5 kg/m<sup>2</sup>, overweight was defined as 25.0 kg/m<sup>2</sup>  $\leq$  BMI  $<$  29.9 kg/m<sup>2</sup>, and obesity was defined as  $\geq 30.0$  kg/m<sup>2</sup>. Thus, in this study, BMI was estimated by weight in kilogram divided by arm span in metres squared (kg/m<sup>2</sup>).<sup>15 16</sup> In this study, arm span was used instead of height measurement.

The BMI–height model overestimated the nutritional status of older people compared with the BMI–arm span model, indicating that conventional height is not a trustworthy anthropometric marker for assessing the nutritional status of older adults.<sup>17</sup> As a result, for calculating BMI in older people, arm span is the best alternative to height.<sup>17</sup> In addition, the Mini Nutritional Assessment (MNA)<sup>18</sup> tool developed by Nestle Nutrition Institute<sup>18</sup> was used to assess nutritional status. MNA tool is a screening tool to help identify older adult patients who are malnourished (undernourished) or at risk of malnutrition (at risk of undernutrition). It identifies the risk of malnutrition before severe changes in weight or serum protein levels occur. The MNA tool was validated in developing settings including Ethiopia.<sup>16</sup> Based on MNA scores, an older adult is categorised into a non-undernourished group (MNA 12–14), the group with risk of undernutrition (MNA of 8–11) and the undernourished group (MNA score  $\leq 7$ ). The MNA has six components. The respondent was asked to answer questions A–F. When the respondent was unable to answer the question, the respondent's caregiver was asked to answer or check the medical record.

A. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties? (0=severe decrease in food intake, 1=moderate decrease in food intake, 2=no decrease in food intake), B. weight loss during the last 3 months

(0=weight loss greater than 3 kg, 1=does not know, 2=weight loss between 1 and 3 kg, 3=no wt loss), C. mobility (0=bed or chair bound, 1=able to get out of bed/chair but does not go out, 2=goes out), D. has suffered psychological stress or acute disease in the past 3 months? (0=yes and 2=no), E. neuropsychological problems (0=severe dementia or depression, 1=mild dementia, 2=no psychological problems), F.BMI (0=BMI less than 19, 1=BMI 19 to less than 21, 2=BMI 21 to less than 23, 3=BMI 23 or greater).<sup>17</sup>

### Anthropometric measurements

A digital weighing scale (Seca, Germany) was used to measure weight while wearing light clothing and walking barefoot. Arm span was measured between the tips of the middle figure of one hand to the tip of the middle figure of the other hand using a measuring tape to the nearest 0.1 cm. The anthropometric measurements were measured following a standard procedure.<sup>19</sup> All measurements were taken two times, and the average value was used for analysis.

### Assessment of predictors

In addition to anthropometric measurements, face-to-face interview with participants of the study was conducted to assess the place of residence, gender, age, monthly income, marital status, occupational status, educational status, illness in the past 3 months (a state of poor health or sickness reported by the respondent during data collection), decreased food intake in the past 3 months, presence of known chronic disease, current medication intake, physical activity, dietary habits (sugary and fatty foods), 24-hour dietary diversity score (DDS) (which was calculated by summing the number of food groups consumed during last 24 hour), smoking habit and alcohol consumption. The age of the older adult was defined as the age greater or equal to 65 years.

A DDS was detected using the 24-dietary recall method; participants were categorised into poor (those who consumed less than five food groups out of nine food groups) and good (those who consumed five or more food groups out of nine food groups) dietary diversity.<sup>20</sup> Physical activity was defined as doing 150 min of moderate-intensity aerobic physical activity per week.<sup>21</sup> Pretested and structured questionnaire which was developed after a review of different literature and by adapting it from the Food and Agriculture Organisation of the United Nations<sup>22</sup> was used. The data were collected by three diploma nurses and supervised by two public health officers. A 2-day comprehensive training was given to data collectors and supervisors. The questionnaire was first prepared in English and then translated into Amharic (the local language) and back into English to ensure

consistency. To ensure the quality of the data, every day the questionnaire was reviewed for completeness, accuracy and clarity by the principal investigator.

### Data processing and analysis

The questionnaires were coded and entered into Epi-data V.3.1 statistical software and then exported to SPSS windows V.25 for further analysis. Data were summarised and presented using descriptive statistics. Bi-variable logistic regression was done between the dependent and predictor variables. Variables having a p value of less than 0.2 during the bi-variable regression were entered into the final multivariable logistic regression.<sup>23 24</sup> ORs with 95% CI were computed and variables having p values less than 0.05 in the multivariable logistic regression were considered statistically and significantly associated with the outcome variable.

## RESULTS

### Sociodemographic and economic related characteristics of participants

A total of 290 older adults participated in the study, giving a response rate of 96.7%. The reason for non-responses was not willing to participate. The mean ( $\pm$ SD) age of participants was 68.5 (4.2) years. Most of them were aged 65–69 years, 169 (52.2%). Among the study participants, more than half of them were women 162 (55.9%).

Concerning the place of residence, 186 (64.1%) of the participants were from rural areas, and 170 (58.6%) of the participants were married according to their marital status. When we look at their educational status, 132 (45.5%) were unable to read and write. Concerning economic dependency, 153 (52.8%) of the respondents were partially dependent economically, and 138 (47.6%) were farmers before retirement. In terms of monthly income, 152 (52.4% of participants) had a low monthly income (US\$35.6) (table 1).

### Health and lifestyle characteristics

About 214 (73.8%) of the respondents had a history of known chronic illnesses during the interview. Of those having a chronic illness, 70 (32.7%) had hypertension and 51 (23.8%) had heart failure. Regarding alcohol intake and cigarette smoking, 174 (60.0%) took alcohol, and among them, 130 (74.7%) took alcohol daily but there was no cigarette smoker. Nearly half, 141 (48.6%), of the participants had a complaint of illness in the past 3 months before the interview. Among the study participants, 69 (23.8%) of them took soft drinks and other sugary foods once or two times per week, and the rest, 221 (76.2%), took them occasionally. About 76 (26.2%) of participants consumed meat and other fatty foods (butter and milk products) 1–3 times per week, 20 (6.9%) consumed daily, and the rest 194 (66.9%) consumed occasionally.

About 237 (81.7%) of the participants do physical activity, and among this majority, 179 (75.5%) of them do

**Table 1** Socio-demographic and economic characteristics of older adults in South Gondar Zone, Amhara, Ethiopia, 2020

Variables (n=290)		Undernourished	Not undernourished	Total	Percentage
Residence	Urban	6	99	105	36.2
	Rural	74	111	185	63.8
Sex	Male	21	107	128	44.14
	Female	59	103	162	55.86
Age	65–69	42	127	169	58.28
	70–74	28	67	95	32.76
	75–79	4	9	13	4.48
	≥80	6	7	13	4.48
Marital status	Currently married	35	135	170	58.62
	Single	0	2	2	0.69
	Separated	3	14	17	5.86
	Widowed	42	59	101	34.83
Economic dependence	Partially dependent	45	108	153	52.76
	Fully dependent	35	92	127	43.79
	Independent	0	10	10	3.45
Occupation before retirement	Housewife	32	52	84	28.97
	Self employed	2	44	46	15.86
	Farmer	42	96	138	47.57
	Nongovernment employee	2	2	4	1.38
	Government employee	2	16	18	6.21
	Total			290	100.00
Current occupational status	Retired	43	129	172	59.31
	Housewife	21	21	42	14.48
	Self employed	1	12	13	4.48
	Farmer	14	48	62	21.38
	Nongovernment	1	0	1	0.34
Educational status	Cannot write and read	63	69	132	45.52
	Read and write with no formal education	14	100	114	39.31
	Primary education	3	21	24	8.28
	College and above	0	20	20	6.90
	Total			290	100.00
Monthly household income	Low (<35.6 US\$)	76	76	152	52.41
	Middle (35.6US\$ –106.8US\$)	4	84	88	30.35
	High (>106.8 US\$)	0	50	50	17.24

AOR, Adjusted Odd Ratio; BMI, Body Mass Index; CDC, Centre for Disease Control; CI, Confidence Interval; CSA, Central Statistical Agency; DDS, Dietary Diversity Score; ETB, Ethiopian Birr; FAO, Food and Agriculture Organization of the United Nations.

walking, followed by walking and harvesting 26 (23.6%) and fetching water 2 (0.8%). Of the total participants, 111 (38.3%) were suffering from a decline in food intake in the last 3 months, and most (108 (97.3%)) mentioned the loss of appetite as a reason. Among the study participants, 140 (48.3%) took medication; among them, 93 (66.4%) took one or two medications (table 2).

### Dietary diversity characteristics

The most commonly consumed food groups in the last 24 hours were legumes and nuts with 220 (75.9%), followed

by cereals and roots with 150 (51.7%) and dark green vegetables with 135 (46.6%). Regarding the minimum DDS, 31 (10.7%) scored well and 259 (89.3%) scored poor (table 3).

### Nutritional status of older adults

According to this study, the overall prevalence of undernutrition among the participants was 80 (27.6%), 95% CI (22.4 to 32.8) and 6 (2.1%), 95% CI (0.7 to 3.8) of them were overweight. Sexwise, the prevalence of undernutrition was 20.3% among women and 7.2% among men.

**Table 2** Health and lifestyle characteristics of older adults in South Gondar Zone, Amhara, Ethiopia 2020

Variable		Undernourished	Not undernourished	Total	Percentage
Illness in the past 3 months (n=290)	Yes	59 (41.8%)	82 (58.2%)	141	48.62
	No	21 (14.1%)	128 (85.9%)	149	51.38
Known chronic illness (n=214)	Hypertension	15 (21.4%)	55 (78.6%)	70	32.71
	DDiabetes Mellites	1 (5%)	19 (95%)	20	9.35
	Joint pain	10 (35.7%)	18 (64.3%)	28	13.08
	Heart failure	24 (47.1%)	27 (52.9%)	51	23.81
	Asthma	6 (35.3%)	11 (64.7%)	17	7.94
	HIV	0 (0%)	5 (100%)	5	2.24
	Liver disease	3 (100%)	0 (0%)	3	1.40
	Other	11 (55%)	9 (45%)	20	9.35
	None	10 (13.2)	66 (86.4%)	76	26.21
Family history of obesity	Yes	1 (100%)	0 (0%)	1	0.34
	No	79 (27.3%)	210 (72.7%)	289	99.66
Alcohol consumption (n=290)	Yes	46 (26.4%)	128 (73.6%)	174	60.0
	No	34 (29.3%)	82 (70.7%)	116	40.0
Frequency of alcohol consumption (n=174)	Daily	39 (30%)	91 (70%)	130	74.71
	5–6 days per week	2 (20%)	8 (80%)	10	5.75
	1–4 days per week	2 (10%)	18 (90%)	20	11.49
	1–3 days per month	3 (21.4%)	11 (78.6%)	14	8.04
	Once per month	0 (0%)	1 (100%)	1	0.57
Physical activity (n=290)	Yes	52 (22%)	185 (78%)	237	81.72
	No	28 (52.8%)	25 (47.2%)	53	18.28
Type of physical activity (n=237)	Walking	39 (21.8%)	140 (78.2%)	179	75.53
	Fetching	0 (0%)	2 (100%)	2	0.84
	Walking and harvesting	13 (23.2%)	43 (76.8%)	56	23.63
Decline in food intake (n=290)	Yes	68 (61.3%)	43 (38.7%)	111	38.28
	No	12 (6.7%)	167 (93.3%)	179	61.72
Reason for decline in food intake (n=111)	Loss of appetite	65 (60.2%)	43 (39.2%)	108	97.30
	Chewing problem	3 (100%)	0 (0%)	3	2.70
Current medication usage (n=290)	Yes	38 (27.1%)	102 (72.9%)	140	48.28
	No	42 (28%)	108 (72%)	150	51.72
Number of drugs (n=140)	≤2	43 (46.2%)	50 (53.8%)	93	66.43
	≥3	25 (53.2%)	22 (46.8%)	47	33.57
	Total			140	100.0

According to the MNA tool, 25 (8.6%) of study participants had normal nutritional status, 179 (61.7%) were at risk of malnutrition and 86 (29.7%) were malnourished.

### Factors associated with undernutrition

In bivariate logistic regression, residence (living in a rural area), sex (being female), not being married, being unable to read and write, illness in the last 3 months, poor DDS, a decline in food intake and household monthly income <US\$35.6 were positively associated with undernutrition, whereas, residence (living in a rural area), being unable to read and write, a decline in food intake and household monthly income of <US\$35.6 were remained

significantly associated with undernutrition on the multi-variable logistic regression. The odds of undernutrition were more than 13 times higher among older adults who had a history of decline in food intake in the last 3 months than their counterparts (adjusted OR (aOR)=13.5, 95% CI 6.1 to 29.5). This study also showed that older adults whose monthly income was less than US\$35.6 were 4.3 times (aOR=4.3, 95% CI 1.9 to 9.5) more likely to be undernourished than those with a monthly income of greater than or equal to US\$35.6. Being unable to read and write increased the odds of undernutrition among the study participants as compared with those with an

**Table 3** Consumption of the nine food groups by the study subjects in the last 24 hours in South Gondar Zone, Amhara, Ethiopia 2020

Variables (n=290)		Undernourished	Not undernourished	Total	Percentage
Cereal and root	Yes	37 (26.7%)	103 (75.3%)	150	51.72
	No	43 (30.7%)	107 (69.3%)	140	48.27
Dark green vegetable	Yes	49 (36.3%)	86 (63.7%)	135	46.55
	No	31 (20%)	124 (80%)	155	53.45
Fruits and vegetable	Yes	23 (21.5%)	84 (78.5%)	107	36.90
	No	57 (31.1%)	126 (68.9%)	183	63.10
Another vitamin A rich fruits and vegetables	Yes	10 (20.4%)	39 (79.6%)	49	16.90
	No	70 (29.0%)	171 (71.0%)	241	83.10
Meat and fish	Yes	1 (3.8%)	25 (96.2%)	26	8.97
	No	79 (30.0%)	185 (70.0%)	264	91.03
Organ meat	Yes	0 (0%)	4 (100%)	4	1.38
	No	80 (28%)	206 (72%)	286	98.62
Legumes and nut	Yes	63 (28.6%)	157 (71.4%)	220	75.86
	No	17 (24.3%)	53 (75.7%)	70	24.14
Milk	Yes	11 (17.5%)	52 (82.5%)	63	21.72
	No	69 (30.4%)	158 (69.6%)	227	78.28
Egg	Yes	0 (0%)	25 (100%)	25	8.62
	No	80 (30.2%)	185 (69.8%)	265	91.38
Dietary diversity score	Good	4 (12.9%)	27 (87.1%)	31	10.69
	Poor	76 (75.6%)	183 (24.4%)	259	89.31

GC, Gregorian Calander; MCH, Mother and Child Health; OPD t, Outpatient Departmen; OR, Odds Ratio; SD, Standard Deviation; SPSS, Statistical Package for Social Science; WC, Waist Circumference; WFP, World Food Program; WHO, World Health Organization.

**Table 4** Factors associated with undernutrition among older adults in South Gondar Zone, Amhara, Ethiopia 2020

		Bivariate (COR), 95% CI	Multivariable, <sup>33</sup> 95%CI	P value
Educational status	Read and write and above	1	1	
	Cannot read and write	6.56 (3.64 to 11.84)	3.54 (1.64 to 7.64)	0.01*
Sex	Male	0.34 (0.19 to 0.60)	0.69 (0.29 to 1.65)	0.38
	Female	1	1	
Marital status	Married	0.43 (0.26 to 0.73)	0.85 (0.39 to 1.85)	1
	unmarried	1	1	
Residence	Urban	1	1	
	Rural	11.00 (4.58 to 26.39)	10.32 (3.62 to 29.39)	0.001*
Monthly income	<35.6US\$	3.25 (1.86 to 5.70)	4.32 (1.98 to 14.68)	0.001*
	≥35.6US\$	1	1	
Illness in the past 3 months	Yes	4.37 (2.48 to 7.76)	9.03 (0.37 to 22.3)	0.1
	no	1	1	
Decline in food intake	Yes	22.01 (10.94 to 44.29)	13.471 (6.15 to 9.53)	0.001*
	No	1	1	
Minimum dietary diversity	Good	0.36 (0.12 to 1.05)	0.389 (0.1 to 1.58)	0.18
	Poor	1	1	

\*P value <0.05.

BMI, Body Mass Index.

educational status of being able to read and write and above (aOR=3.5, 95% CI 1.6 to 7.6). Study participants who lived in rural areas were more than 10 times more likely to be undernourished than those from urban areas (aOR=10.3, 95% CI 3.6 to 29.4) (table 4).

## DISCUSSION

The current study assessed the prevalence and determinants of undernutrition among older adults in South Gondar Zone Ethiopia and found that the overall prevalence of undernutrition was 27.6% (95% CI 22.4 to 32.8). This finding is comparable with the study done in Nepal, where 24.8% (95% CI 20.2 to 29.3) of study participants were undernourished.<sup>25</sup> However, it was higher than that of the studies done in Wolaita Zone, Ethiopia (17.1%),<sup>26</sup> Northwest Ethiopia (21.9%),<sup>14</sup> Ethiopia (17.6% (95% CI 15.0 to 20.2)),<sup>27</sup> Cameroon (6%),<sup>28</sup> Delhi India (20.8%).<sup>29</sup> This difference could be due to geographical differences or variations in the socioeconomic status of the study population. In addition, in the current study, most of the study participants were from rural areas, which might be associated with the lower food buying power of participants who diversified their food items. On the other hand, the prevalence of undernutrition was lower as compared with the study done in Ghana (48.0%).<sup>28</sup>

In this study, the prevalence of undernutrition was high among women (20.3%) compared with men (7.2%). In agreement with this, a study from Gondar found that being women (aOR=3.0 95% CI (1.6 to 5.4)) was associated with undernutrition.<sup>14</sup> Similarly, a study that assessed chronic energy deficiency and associated factors among the older population in Aykhel town, Ethiopia in 2018 showed that undernutrition was significantly associated with the female sex (aOR=1.6, 95% CI (1.0 to 2.4)).<sup>27</sup> This might be because most female older adults were economically dependent. There might be gender discrimination and less health-seeking behaviour among women, which may negatively influence women's health and nutritional status.

This study pointed out that 89.3% of the older adults had poor DDSs. This might be due to the study being conducted during a fasting period. The fasting period was less than a week at the time of data collection, and it may not have affected the results of anthropometric measurements. Additionally, most of the participants were economically dependent and may not have the economic freedom to purchase diversified food items.

This study has revealed that 25.5% of the rural study population was malnourished, in that participants who lived in rural areas were more than 10 times more likely to be undernourished than those from urban areas. Thus, it appears that undernutrition is much higher among those residing in rural areas. This finding is consistent with the results of studies conducted in the Wolaita Zone Ethiopia,<sup>26</sup> Northwest Ethiopia<sup>14</sup> and Ethiopia.<sup>27</sup>

In the current study, a monthly income of less than US\$35.6 had a significant association with undernutrition.

Similarly, studies that were done in Wolaita Zone Ethiopia,<sup>26</sup> Northwest Ethiopia<sup>14</sup> and Ethiopia<sup>27</sup> showed that low income had a negative effect on the nutritional status of older adults. This might be due to food purchasing ability, which depends on income level. A low income may make them prefer not to eat. In addition, poverty and malnutrition are deeply interrelated as poverty is a basic cause of malnutrition.<sup>30</sup>

In the current study, decreased food intake was associated with undernutrition, which is similar to a study conducted in Wolaita Zone, Ethiopia,<sup>26</sup> in which decreased food intake was positively associated with undernutrition. This could be due to the effects of increased age, which reduces the natural drive to eat and drink and results in anorexia of ageing; to their comorbid illnesses which most of them had chronic illnesses and, to the medications, they took since most of them took medications.<sup>10</sup> In general, decreased food intake is an immediate cause of malnutrition.<sup>31</sup>

This study pointed out that being unable to read and write was 3.5 times (aOR=3.5, 95% CI 1.6 to 7.6) riskier for being undernourished than those who could read and write. This finding is consistent with the results of earlier studies conducted in Wolaita Zone, Ethiopia<sup>26</sup> and in Northwest Ethiopia.<sup>14</sup> This might be related to the fact that educated people are more likely to consume diversified foods and follow healthy eating styles. In addition, education is categorised under the basic causes of undernutrition.<sup>32</sup>

## Strength and limitation of the study

The study was community-based, unlike hospital-based studies, so it can represent the population.

Instead of height measurement, this study used arm span and it can increase the precision of the result because the usual height measurement may underestimate the result. Even though it has these strengths, there are limitations like; the study assessed undernutrition by only anthropometric methods of nutritional assessment; the study was cross-sectional and the association cannot be causal; the questionnaire was self-reported and there might be bias even we have conducted quality control to the best of our ability; the sample size was small (300) and restricted to south Gondar, not the whole country. The study was conducted during a fasting period, and it might have affected DDS.

## Conclusion

The overall prevalence of undernutrition among older adults in the study area was high, making it an important public health burden. It was significantly associated with residence, being unable to read and write, a decline in food intake and household monthly income. Therefore, there is a need to design and implement programmes and strategies to improve nutritional status, particularly focusing on those living in rural areas and improving household economic status. Further studies are needed to generate a database for effective policymaking and

formulate a national policy on the nutrition of older adults to ensure healthy ageing.

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**Patient consent for publication** Not applicable.

**Ethics approval** This study has been performed per the Declaration of Helsinki. Ethical clearance was obtained from Debre Tabor University College of health sciences Institutional Research Ethics Review Committee (IRERC) with a reference number of DTU/re/89/27/2020. At all levels, officials were contacted with a formal letter obtained from the IRERC to secure permission. A permission letter has been submitted to South Gondar Zonal Health Bureau. The participants of the study were informed about the purpose of the study, the importance of their participation, and their right to withdraw at any time. All methods were carried out following the ethical guidelines and regulations. Informed consent was obtained before data collection. To keep the confidentiality of clients' data, their names were not documented. People aged  $\geq 65$  who were malnourished during the data collection were advised regarding their nutrition.

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**Data availability statement** Data are available upon reasonable request. The datasets used during the current study are available from the corresponding author on a reasonable request.

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#### REFERENCES

- 1 Capistrant BD, Glymour MM, Berkman LF. Assessing mobility difficulties for cross-national comparisons: results from the world Health organization study on global ageing and adult health. *J Am Geriatr Soc* 2014;62:329–35.
- 2 Zohoori N. Nutrition and healthy functioning in the developing world. *J Nutr* 2001;131:2429S–32.
- 3 Charles TAH, Tesfayi G, Hassan A. *Population dynamics, food/nutrition security and health in ethiopia. Delicate balance of vulnerability & resilience IUSSP marrakech*, 2009.
- 4 Rynning E. The ageing populations of Europe—implications for health systems and patients' rights. *Eur J Health Law* 2008;15:297–306.
- 5 Fuster V. Changing demographics: a new approach to global health care due to the aging population 2017;69:3002–5.
- 6 Milne AC, Potter J, Vivanti A, et al. Protein and energy supplementation in elderly people at risk from malnutrition. *Cochrane Database Syst Rev* 2009;2:CD003288.
- 7 Agarwal E, Miller M, Yaxley A, et al. Malnutrition in the elderly: a narrative review. *Maturitas* 2013;76:296–302.
- 8 MAaKB-R A. Obesity increases blood pressure in North-African elderly subjects. *Pak J Nutr* 2018;17:152–5.
- 9 Chen CC, Schilling LS, Lyder CH. A concept analysis of malnutrition in the elderly. *J Adv Nurs* 2001;36:131–42.
- 10 Saka B, Kaya O, Ozturk GB, et al. Malnutrition in the elderly and its relationship with other geriatric syndromes. *Clin Nutr* 2010;29:745–8.
- 11 Evans C. Malnutrition in the elderly: a multifactorial failure to thrive. *Perm J* 2005;9:38.
- 12 Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497–506.
- 13 Agarwalla R, Saikia AM, Baruah R. Assessment of the nutritional status of the elderly and its correlates. *J Family Community Med* 2015;22:39.
- 14 Tessfamichael DGA, Wassie MM. High prevalence of undernutrition among elderly people in north-west, a cross sectional study. *J Nutrition Health Food Sci* 2014;2:1–5.
- 15 Organization) WWH. nutrition disorders.
- 16 Malnutrition in the Older Adult [Internet], 2010. Available: <http://www.nestle.com/asset-library/documents/>
- 17 Arlappa N, Aatif Qureshi I, Philip Ravikumar B, et al. Arm span is an alternative to standing height for calculation of body mass index (BMI) amongst older adults. *Int J Nutr* 2016;2:12–24.
- 18 Bekondi C, Mobima T, Ouavènè JO, et al. [Etiopathological factors of hepatocellular carcinoma in Bangui, Central African Republic: clinical, biological characteristics and virological aspects of patients]. *Pathol Biol* 2010;58:152–5.
- 19 Harris D, Haboubi N. Malnutrition screening in the elderly population. *J R Soc Med* 2005;98:411–4.
- 20 Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. In: *Nutrition and consumer protection division, food and agriculture organization of the United Nations*, 2011.
- 21 Muchiri WA, Olutende OM, Kweyu IW. Meaning of physical activities for the elderly: a review. *Am J Sports Sci Med* 2018;6:79–83.
- 22 Food and Agriculture Organization of the United Nations. *Dietary assessment a resource guide to method selection and application in low resource settings*, 2018.
- 23 Bendel RB, Afifi AA. Comparison of stopping rules in forward “stepwise” regression. *J Am Stat Assoc* 1977;72:46–53.
- 24 Mickey RM, Greenland S. The impact of confounder selection criteria on effect estimation. *Am J Epidemiol* 1989;129:125–37.
- 25 Tamang MK, Osseinzadeh H, Kafé B. Nutritional assessment and factors associated with malnutrition among the elderly population of Nepal: a cross-sectional study. *BMC* 2016.
- 26 Wondiye K, Asseffa NA, Gemebo TD, et al. Predictors of undernutrition among the elderly in Sodo zuriya district Wolaita zone, Ethiopia. *BMC Nutr* 2019;5:50.
- 27 Legesse M, Abebe Z, Woldie H. Chronic energy deficiency and associated factors among older population in Ethiopia: a community based study. *PLoS One* 2019;14:e0214861.
- 28 organization. WH. *Health Situation and trend assessment- elderly population*, 2019.
- 29 Goswami AK NB, Kalaivani M, Gupta SK. Double burden of malnutrition among elderly population of Delhi. *Indian J Comm Health* 2016;28:324–30.
- 30 Siddiqui F, Salam RA, Lassi ZS, et al. The intertwined relationship between malnutrition and poverty. *Front Public Health* 2020;8:453.
- 31 Reinhardt K, Fanzo J. Addressing chronic malnutrition through multi-sectoral, sustainable approaches: a review of the causes and consequences. *Front Nutr* 2014;1:13.
- 32 UNICEF. *UNICEF conceptual framework of malnutrition*, 2008.
- 33 Traoret CJ, Lokko P, Cruz ACRF, et al. Peanut digestion and energy balance. *Int J Obes* 2008;32:322–8.