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Research

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Prevalence and Factors Associated with Undernutrition on Cancer Patients at Tikur Anbessa Specialized Hospital, Ethiopia: A cross-sectional study

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Abstract

Background: Cancer is one of the leading causes of death in the world and it is considered that every fourth person dies of it. Under-nutrition is most commonly seen in cancer patients with some types of solid tumors, various chronic diseases, as well as in older persons and young children. This can result in longer hospital stay, reduced response to therapies, increased complications to therapy and surgery proceedings, poor survival and higher care costs. This study aimed to assess the prevalence and factors associated with under-nutrition on cancer patients.

Methods: Cross-sectional study was conducted from September to October 2018 among 347 cancer patients in Tikur Anbessa Specialized hospital Addis Ababa, Ethiopia. Quantitative data was collected using questionnaires and the Patient Generated-Subjective Global Assessment (PG-SGA) score. Data was entered into Epi-Info version 7 and exported and analyzed by SPSS version 20. Both bivariate and multivariate logistic regression analyses were employed to identify the associated factors. Variables with *P* value of less than 0.05 were considered as significant predictors.

Results: The prevalence of under-nutrition according to PG-SGA score result 202 (63.1%) and 88(27.5%) of the participants were moderately and severely undernourished, respectively. BMI of the participants also showed that 206 (64.4%) and 89 (27.8%) were normal and underweight, respectively. Two hundred seventy-six (86.3%) of the patients needed critical nutrition intervention. Performance status of ≥ 2 and cancer stage II, III & IV were significantly associated with malnutrition on cancer patients at a P-value <0.05 .

Conclusion: The prevalence of under-nutrition is prevalent in the study area. Performance status of ≥ 2 and cancer stages were important factors associated with malnutrition in cancer patients. Screening and evaluation of nutritional status of the patients and planning nutritional therapy such as dietary supplements or enteral nutrition to counteract malnutrition on cancer patients should be implemented.

Keywords: Cancer Patients, Under-nutrition, Ethiopia

Background

Cancer is one of the causes of death in high and lower-income countries of the world and it is considered that every fourth person dies of it. Malnutrition and cachexia are most commonly seen in cancer patients with some types of solid tumors, various chronic diseases, in older persons and young children [1]. However, the nutritional aspect of cancer management has not always been given priority. Cancer patients suffer from protein-energy malnutrition throughout the evolution of their disease, with elevated basal energy requirements, due to their inherent illness and decreased oral intake due to reduced gustatory senses [2].

Under-nutrition is a possible complication in patients with cancer and can be the first symptom to reveal the presence of the disease. It is a major cause of morbidity and mortality.

45 Even before starting anticancer treatment patients can experience profound metabolic and
46 physiological alterations with increased needs of macro and micronutrients. Malnutrition impairs
47 the immune status and reduces the body's defense against infectious diseases [3].

48 Malnutrition in cancer patients has been also associated with several clinical
49 consequences, including quality of life impairment, decreased treatment response, increases in
50 the risk of infections, high risk of chemotherapy-induced toxicity, length of hospital stay,
51 hospitalization costs, and increased morbidity and mortality[4]. The prevalence of under-
52 nutrition in people with cancer is estimated up to 40% to 80%, which is higher than in the
53 general patient population due not only to the illness but also to the treatment involved [5].
54 Malnutrition is thus a frequent manifestation of cancer and a significant contributor to morbidity
55 and mortality. National Cancer Institute reports 20-40% of cancer patients die from causes
56 related to malnutrition rather than the cancer itself [6].

57 A study in Libya shows that the global malnutrition rating (SAG A, SGA B and SGA C)
58 identified 25 % to be severely malnourished, 73.5% either moderately malnourished or suspected
59 to be malnourished while only 1.5% of subjects were well-nourished [7]. Many studies revealed
60 that socio-economic and demographic variables like age, economic status, smoking behavior,
61 location and type of tumor, stage of the disease, functional performance status, smoking status,
62 and previous weight are significantly associated with malnutrition among cancer patients. For
63 instance, the prevalence of malnutrition in the study conducted in India was high (84.21%) and it
64 was associated with the tumor type, tumor location, stage of the disease, and treatment received
65 and the type of nutritional assessment method used [8].

66 Studies conducted in different countries revealed the prevalence of under-nutrition was
67 high. Reversing the nutritional status was a profound effect in addition to the therapeutic

regimens. There were a few studies regarding the prevalence of malnutrition and associated factors on cancer patients in Ethiopia. However, there were no study reports on the prevalence of malnutrition and associated factors on cancer patients in the study area. This study will serve as a baseline for further study, important for designing an intervention, guide policymakers and development planners. Therefore, this paper has an attempt to assess factors associated with malnutrition and fills the gaps regarding the problem in cancer patient's nutritional status attending Tikur Anbessa Specialized Hospital, Ethiopia.

Methods

Study design and area:

A facility-based cross-sectional study was conducted from September to October 2018 at Tikur Anbessa Specialized hospital Addis Ababa, Ethiopia. Tikur Anbessa Specialized hospital is one of the oldest Hospitals in Addis Ababa as well as in Ethiopia. It is a center of excellence in the diagnosis, treatment and care of patients with cancer.

Source and Study Population

The source of the population was all cancer patients at Tikur Anbessa Specialized Hospital. The study population was cancer patients at Tikur Anbessa Specialized hospital at the time of data collection.

Inclusion and Exclusion Criteria

Inclusion Criteria: All cancer patients 18-65 years of age who were on 2nd and above cycle of treatment as outpatients during the study period.

Exclusion Criteria: Patients who were seriously ill and unable to talk

89 **Sample size determination and sampling techniques**

90 The sample size of the study was determined by considering the expected prevalence rates of
91 undernutrition among cancer as 71.1% [9]. The sample size was calculated with 5% marginal error
92 and 95% CI and none response rate of 10%. Based on the above assumption, the sample size for the
93 study was determined using the formula for a single population proportion as follows.

94
$$n = \frac{(Z_{\alpha/2})^2 * p (1-q)}{d^2}$$

95
$$d^2$$

96
$$n = \frac{(1.96)^2 * 0.71 (1-0.71)}{(0.05)^2} = 316$$

97
$$(0.05)^2$$

98 When 10% of none response rate added = 316+31=347

99 So the final sample size was 347

100 Simple random sampling method was used to select samples from the sample frame.

101 **Data collection**

102 Data was collected by using a pre-tested questionnaire. The parameters were the Patient-
103 Generated Subjective Global Assessment (PG-SGA), current weight and height, percentage of
104 weight loss (%WL) and body mass index (BMI). Health-related and behavioral variables were
105 collected according to the report of the patient; socioeconomic class and educational status were
106 obtained from medical records.

107 **Height measurement:** Height was measured by using a stadiometer. The subjects were asked to
108 remove their shoes, stand erect and look straight in the horizontal plane. The shoulder blades,
109 buttocks and the heel touch the standing measuring board. Height was recorded to the nearest
110 0.1cm.

Weight measurement: Weight was measured by using beam balance. The scale was checked at zero before and after each measurement. The subjects were asked to remove heavy clothes and weight measurement was recorded to the nearest 0.1kg.

Patient Generated Subjective Global Assessment (PG- SGA) score: contained questions regarding the presence of nutritional symptoms including those affecting eating habits gives weightage to disease category and co-morbidities and takes into account metabolic stress. Its four components were scored depending upon the impact of the listed symptoms on the nutritional status with the total score forming the basis of Nutrition Triage Recommendations to determine the type of intended intervention. The total score from all the components was summated and depending upon the score obtained the level of intervention needed for the patient based upon his nutritional status could be attained. This questionnaire allowed to classify the nutritional assessment into three categories (A=well nourished, B = suspected or moderate malnutrition and (C = severe malnutrition)

Data Quality control and management

Data collectors and supervisor were trained for 1 day on basic data collection skills. The questionnaires were tested on 5% of the sample, who have similar characteristics to the study participants. All data collectors and supervisor were participating in pre-testing of the questionnaires. Problems highlighted during pre-testing were corrected before the start of the actual survey. Each question was properly coded; continuous supervision was done during the pre-test and data collection period by the investigators. Completeness and consistency of recording on the questionnaire sheets were evaluated by investigators at the end of each working day so that corrective measures were taken for the next time.

Data analysis

After ensuring the completeness of the questionnaires the raw data were coded and entered in EPI INFO version 7, cleaned and exported to Statistical Package for Social Sciences (SPSS version 20) and analyzed. Descriptive and summary statistics were used to describe and present the data. The association between a single explanatory variable and a dependent variable was examined through bivariate analysis. Multivariable logistic regression was done to identify factors associated with malnutrition and to control confounding variables and to measure the strength of association of independent variables with dependent variables. This was done by entering all variables which showed association in bivariate binary logistic regression (p-value < 0.2) into multivariable logistic regression model. Crude and adjusted odds ratio with 95% Confidence interval was calculated. For all statistical significance tests between each independent and dependent variable, the significance level was fixed at $P < 0.05$.

Results

Socio-demographic and economic characteristics of the Respondents

From the total of 347 cancer patients, 320 were voluntarily participated, making the response rate 92.2%. The mean ($\pm$ SD) age of the study participant was 45.2 ($\pm$ 12.4). The majority (56.3%) of patients were in the age range of 36-55 years. Regarding the educational status of cancer patients, 209 (65.4%) attended elementary school and above. About half of the patients (53.4 %) were married and 69.7% live in urban areas. More than half (57.8%) of individuals had a monthly income of greater than 1500 Ethiopian birr. (Table 1)

Table 1: Socio-demographic and economic characteristics of study participants (n=320) at Tikur Anbessa Specialized Hospital, Sep to Oct 2018

Socio-demographic variables	Numbers	Percent (%)
-----------------------------	---------	-------------

Age	18-35	75	23.4
	36-55	180	56.3
	56-65	65	20.3
	Mean ($\pm$ SD) age in years	45.2 ($\pm$ 12.4)	
Residence	Urban	223	69.7
	Rural	76	23.8
	Semi urban	21	6.6
Current Marital Status	Married	171	53.4
	Single	96	30
	Divorced	19	5.9
	Widowed	34	10.6
Educational Status	Illiterate	62	19.4
	Read and write only	49	15.3
	Elementary education	68	21.3
	Secondary education	62	19.4
	Diploma and higher	79	24.7
Occupational Status	No work/housewife	69	21.6
	Daily laborer	13	4.1
	Merchant	55	17.2
	Private worker	73	22.8
	Government employee	55	17.2
	Others*	55	17.2
Monthly income (ETB)	< 500	23	9.6
	501-1000	54	22.6
	1001-1500	24	10
	1501-2000	31	13
	>2000	107	33.4
Source of drinking water	Piped water	276	86.3

	Borehole	14	4.4
	Wells	29	9.1
Drinking water treatment	Yes	98	30.6
	No	222	69.4

Health and Cancer-related characteristics of the Respondents

The most common types of cancer identified in this study classified by the organic system were reproductive system 87(27.2 %) and lower gastrointestinal tract (LGIT) 78 (24.4 %). The majorities were on stage II 123 (38.4%). The common types of treatments were 181(56.6 %) chemotherapy and radiation therapy 69 (21.6%) as a curative treatment. Most patients had a Performance status ≥ 2 (64.1%). Two hundred fifty-eight (80.6%) of patients had decreased food intake within the past month. Regarding weight loss 223(69.8%) of cancer patients loss >5% of their weight within the last 6 months. Two hundred seventy-six (86.3%) of the patients needed critical nutrition intervention. According to PG-SGA score result, 202(63.1%) and 88(27.5%) of the participants were moderately and severely malnourished respectively. BMI of the participants also showed that 206(64.4%) and 89(27.8%) were normal and underweight respectively. (Table 2)

Table 2: Health and Cancer- related characteristics of cancer patients (n=320) at Tikur Anbessa Specialized Hospital, Sep to Oct 2018

Characteristics		Number	Percent (%)
Alcohol	Yes	75	23.4
	No	245	76.6
Smoking status /Ex-smokers	Yes	83	25.9
	No	237	74.1

Type of cancer	UGIT cancer	54	16.9
	LGIT cancer	78	24.4
	RS cancer	87	27.2
	Lung cancer	22	6.9
	Breast cancer	25	7.8
	Others***	54	16.9
Cancer stage	Stage I	38	11.9
	Stage II	125	39.1
	Stage II	89	27.8
	Stage IV	68	21.3
Type of treatment	Chemotherapy and Radiation	32	10.0
	Chemotherapy and Surgery	11	3.4
	Chemotherapy and Hormonal	7	2.2
	Chemotherapy	181	56.6
	Radiation and Surgery	10	3.1
	Radiation and Hormonal	6	1.9
	Radiation	69	21.6
	Anti-pain	4	1.3
Other co-morbidities	Yes	38	11.9
	No	282	88.1
Performance status	<2	115	35.9
	≥2	205	64.1
Food intake	Unchanged	49	15.3
	Increased than usual	13	4.1
	Decreased than usual	258	80.6
Weight loss percentage	0-1.9%	50	15.6
	2-5.0%	47	14.7

	5.1-9.9%	55	17.2
	10-19.9%	116	36.3
	>20%	52	16.3
BMI	Under weight	89	27.8
	Normal weight	206	64.4
	Over weight	25	7.8
	Mean ($\pm$ SD) BMI	20.26($\pm$ 3.13)	
PG-SGA score	Well nourished	30	9.4
	Moderately malnourished	202	63.1
	Severely malnourished	88	27.5
Total numeric score	>9	276	86.3
	4-8	2	.6
	2-3	9	2.8
	0-1	33	10.3
Total		320	100

*** Head and neck, hematological, sarcomas, melanomas, etc.

169 Symptoms with eating with cancer patients

170 The common symptoms that appeared among cancer patients were fatigue 137(42.8%), appetite
171 loss 123(38.4%), vomiting 98(30.6%), nausea 58(18.1%) and constipation 58(18.1%) (figure 1).

Figure 1. Symptoms with eating with cancer patients

Factors associated with malnutrition (underweight) of cancer patients

In the bivariate analysis sex, educational status, alcohol consumption, performance status, cancer type and stage of cancer were associated with nutritional status (underweight) of cancer patients. The variables mentioned above were entered into a multivariate binary logistic regression model to control the effect of confounders. In the multivariable logistic regression analysis; performance status ≥ 2 and cancer stage II, III & IV were associated with the nutritional status of cancer patients. Patients who had a performance status of ≥ 2 were 7.9 times malnourished than PS < 2 [AOR = 7.9, 95 % CI (3.05, 20.48)]. Patients with cancer stage II, III & IV were 3.47, 3.81 and 6.11 times more likely to be malnourished than stage I cancer patients [AOR = 3.47, 95 % CI (1.17,12.31)], [AOR = 3.81, 95 % CI (1.17,12.31)] and [AOR = 6.11, 95 % CI (1.48,25.14)] respectively. But the association of educational status was lost its significance with the nutritional status of cancer patients (underweight) after an adjustment was done for the other variables (table 3).

187 Table 3. Bivariate and multivariate regression analysis results of factors associated with undernutrition (as
 188 determined by PG-SGA score) of cancer patients (n=320) at Tikur Anbessa Specialized Hospital, Addis Ababa,
 189 Ethiopia, Sep to Oct 2018

Variable	Nutritional status (PG-SGA)		COR, 95% CI	AOR, 95% CI
	Undernourished N (%)	Normal N (%)		
Sex				
Female	155(53.4%)	12 (40%)	1.83(0.85,3.91)*	
Male	135 (46.6%)	18 (60%)	1	
Educational Status				
Illiterate	59(95.2%)	3(4.8%)	3.18(0.84,11.94)*	
Read and write only	44(89.8%)	5(10.2%)	1.15(0.39,3.36)	
Primary education	64(94.1%)	4(5.9%)	2.59(0.78,8.54)*	
Secondary education	55(88.7%)	7(11.3%)	1.28(0.46,3.49)	
College and higher	68(86.1%)	30(9.4%)	1	
Alcohol				
Yes	71(94.7%)	4(5.3%)	2.19(0.74, 6.49)*	
No	219(89.4%)	26(10.6%)	1	
Performance status				
<2	90(78.3%)	25(21.7%)	1	1
≥2	199(97.1%)	5(2.9%)	9.21(3.65,23.23)**	7.9(3.05,20.48)**

Cancer type

UGIT cancer	53(98.1%)	1(1.9%)	9.211(1.11,76.48)**
LGIT cancer	74(94.9%)	4(5.1%)	3.21(0.91,11.29)*
RS cancer	76(87.4%)	11(12.6%)	1.2(0.45,3.2)
Lung cancer	20(90.9%)	2(9.1%)	1.73(0.33,8.93)
Breast cancer	21(84%)	4(16%)	0.91(0.24,3.37)
Others*	46(85.2%)	8(14.8%)	1

Cancer stage

Stage I	22(66.7%)	11(33.3%)	1	1
Stage II	116(90.6%)	12(9.4%)	4.83(1.89,12.3)**	3.47(1.25,9.58)**
Stage III	82(92.1%)	7(7.9%)	5.85(2.03, 87)**	3.81(1.17,12.31)**
Stage IV	69(98.6%)	1(1.4%)	34.5(4.21,282)**	6.11(1.48,25.14)**

Total	320	100
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* Head and neck, hematological, sarcomas, melanomas, etc.

AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval; ** significant p-value <0.01; 1= reference

Factors associated with the malnutrition (underweight) of cancer patients (as determined by BMI)

In the bivariate analysis sex, age, marital status, educational status, occupation, monthly income, drinking water treatment, alcohol consumption, performance status, cancer type and stage of cancer were associated with nutritional status (underweight) of cancer patients. The variables mentioned above were entered into a multivariate logistic regression model to control the effect of confounders. In the multivariable logistic regression analysis; only performance statues ≥ 2 , was associated with the nutritional status of cancer patients. But the association of variable such as; sex, age, marital status, educational status, occupation, drinking water treatment, alcohol consumption, UGIT cancer and cancer stage IV was lost their significance with the nutritional status of cancer patients (underweight) after an adjustment was done for the other variables.

203 Patients who had Performance Status ≥ 2 were 2.01 times likely to be at risk of malnutrition than
 204 PS <2 and [AOR = 4.01, 95 % CI (1.16, 3.49)] (table 4).

205 Table 4. Bivariate and multivariate regression analysis results of factors associated with malnutrition (as determined
 206 by BMI) of cancer patients (n=320) at Tikur Anbessa Specialized Hospital, Addis Ababa Ethiopia, Sep to Oct 2018

Variable	Nutritional status (BMI)		COR 95% CI	AOR 95% CI
	Undernourished	Normal		
	n (%)	n (%)		
Sex				
Female	57(34.1%)	110(65.9%)	1.95(1.18,3.2)**	
Male	32(20.9%)	121(79.1%)	1	
Age				
18-35	34(45.3%)	41(54.7%)	1	
36-55	44(24.4%)	36(75.6%)	0.39(0.22,0.68)*	
56-65	11(16.9%)	54(83.1%)	0.24(0.11,0.5)**	
Marital status				
Married	37(21.6%)	134(78.4%)	1	
Single	37(38.5%)	59(61.5%)	2.27(1.31,3.9)**	
Divorced	5(26.3%)	14(73.7%)	1.29(0.43,3.82)*	
Widowed	10(29.4%)	24(70.6%)	1.5(0.66,3.43)*	
Educational Status				
Illiterate	19(30.6%)	43(69.4%)	0.64(0.32,1.31)*	
Read and write	15(30.6%)	34(69.4%)	0.64(0.3,1.37)*	
Only				
Primary	8(11.8%)	60(88.2%)	0.19(0.08,0.4)**	
education				
Secondary	15(24.2%)	47(75.8%)	0.46(0.22,0.9)**	
education				

College and higher	32(40.5%)	47(59.5%)	1
Occupation			
No work/ Housewife	24(34.8%)	45(65.2%)	1
Daily laborer	5(38.5%)	8(61.5%)	1.09(0.52,2.32)
Merchant	10(18.2%)	45(81.8%)	1.28(0.36,4.49)
Private workers	19(26%)	54(74.4%)	0.45(0.18,1.1)*
Government Employee	13(23.6%)	42(76.4%)	0.72(0.33,1.56)
Others	18(32.7%)	37(67.3%)	0.63(0.27,1.47)*
Monthly income (ETB)			
<500	9(39.1%)	14(60.9%)	2(0.77,5.16)*
501-1000	14(25.9%)	40(24.1%)	1.09(0.51,2.31)
1001-1500	5(20.8%)	19(79.2%)	0.8(0.27,2.41)
1501-2000	4(12.9%)	27(87.1%)	0.46(0.46,1.44)*
>2000	26(24.3%)	81(75.7%)	1
Do you treat drinking water?			
Yes	22(22.4%)	76(77.6%)	0.67(0.38,1.16)*
No	67(30.2%)	155(69.8%)	1
Cancer type			
UGIT cancer	18(37.5%)	30(62.5%)	2.58(1.07,6.2)**
LGIT cancer	23(29.5%)	59(72.5%)	1.84(0.79,4.26)*
RS cancer	22(23.9%)	70(76.1%)	1.31(0.56,3.07)
Lung cancer	5(22.5%)	17(77.3%)	1.29(0.38,4.34)
Breast cancer	10(45.5%)	12(54.5%)	3.45(1.21,9.8)**

Others*	10(18.5%)	44(81.5%)	1	
Cancer stage				
Stage I	6(8.2%)	27(81.8%)	1	
Stage II	26(20.3%)	102(79.7)	0.26(0.09,0.5)**	
Stage III	25(28.1%)	64(71.9%)	0.3(0.16,0.5)**	
Stage IV	32(45%)	38(54.3%)	0.46(0.2,0.8)**	
PS				
<2	23(20%)	92(80.0%)	1	1
≥2	66(32.2%)	139(67.8%)	1.89(1.1,3.26)	2.01(1.16,3.49) **

* Head and neck, hematological, sarcomas, melanomas, etc.

AOR: adjusted odds ratio; COR: crude odds ratio; CI: confidence interval; ** significant p-value <0.01; 1= reference

Discussion

In this study, the prevalence of under-nutrition among cancer patients was determined using standard assessment tools. This study showed that the prevalence of malnutrition among cancer patients was 90.6% and 27.5% by PG-SGA score and BMI respectively. This prevalence is generally very high when compared to the prevalence of malnutrition reported among cancer patients worldwide (50% to 80%) [10]. Similarly, the prevalence of under-nutrition recorded in this study was higher than the prevalence reported from different countries; Spain, 64[11], Korea, 61 % [12], Croatia 52 % [13]; and Philippines (47.7%) [14] and France 30.9% and 76.1% [9, 15]. The difference may be explained by differences in the assessment method used, socioeconomic status, study area, sample size of the study and geographical area of the study setting.

The prevalence of under-nutrition among cancer patients in this study was also found high when compared with the finding of India study that had got 84.2% of under-nutrition. This might be because of the study setting and methods used [8]. On the other hand, the prevalence of

malnutrition in this study was slightly lower than the result reported from Libya in which as 98.5% (73.5% moderate and 25% severe) of the patients were malnourished[7].

In this study, 17.2% of patients had a weight loss of 5-10%, 36.3% of patients had a weight loss of more than 10-20% and 16.3% had a weight loss of more than 20%. Analysis of the percentage of weight loss shows that 68.9% of the participants had a weight loss of more than 5% over 6 months which is an early sign of malnutrition. A study in France showed 17.4%, 12.6% and 10.9% weight loss of 5-10%, 10-15% and greater than 15% respectively which is somehow lower than our result[15]. A study in Iran also revealed that 44% of patients lost 10% and above in the previous 6 months which is lower than our study (52%) [16].

About 80.6% of our study participants had a decreased intake of food within the past two weeks. The most common causes of food-intake reduction during the past two weeks were fatigue (42.8%), appetite loss (38.4%), vomiting (30.6%), nausea (18.1%) and constipation (8.1%). Similar problems were also reported from Libya[7], India[8] and France

It was identified that 89.7% and 86.3% of cancer patients need some sort of nutritional interventions and critical intervention respectively similarly a study in Libya also found 99.5% and 86.3%. Since dietary interventions should be continued according to the patients' needs and ability to eat even the 10.3% of patients currently not in need of any nutrition intervention, are still required to undergo routine and regular reassessment during the treatment[7].

In this study, a significant association was found between $PS \geq 2$, and cancer stage with the nutritional status of participants. Functional autonomy is a factor that deserves attention from health professionals when the point is nutritional risk indicators, considering that individuals with limited functional capacity have difficulties in the preparation and food intake[9]. The results of this study support this statement because it was observed that patients with $PS \geq 2$ were

7.9 times more likely to be malnourished than mobile patients. Other similar studies also find that $PS \geq 2$ (being immobile) was statistically associated with malnutrition [7-9, 15]. Immobility, a well-known factor unfavorably affecting physical health as a risk factor for many chronic diseases also adversely affects the quality of life, threatens independent living and personal autonomy and increases both formal and informal care needs[7]

Advanced cancer stage (III and IV) was found to be a predictor of malnutrition in Philippine and Korean studies[17, 18] in similar this study shows that patients who were at stage II, III and IV were at risk of malnutrition. In this study, a statistically significant association was found between patients with $PS \geq 2$ and BMI of the patients. Non-ambulatory patients ($PS \geq 2$) were 4 times more likely to be underweight than ambulatory ($PS < 2$).

In general, the prevalence of moderate to severe malnutrition among patients was 90.5 % when determined by PG-SGA and the prevalence of malnutrition was 27.5 % when BMI was used as an assessment. Our result shows how BMI underestimates the prevalence of malnutrition among cancer patients. Previous studies on cancers also highlighted the limitations of using BMI as a sole assessment tool to determine of nutritional status [8, 19].

Limitations of the study

Dietary pattern and nutrient adequacy of the patients were not determined which could be considered as a limitation.

Conclusion

The prevalence of under-nutrition among cancer patients was very high and the majority of the patients were in critical need of nutritional intervention. The nutritional status of cancer patients was significantly associated with $PS \geq 2$ and cancer stage. BMI should not be used as the sole anthropometric criteria to screen out malnourished cancer patients. Furthermore, the PG-SGA

can identify areas where tailor-made strategies to counteract specific malnutrition or its risk can be planned, implemented and monitored for each patient. Further studies should be conducted on cancer patients of dietary pattern and nutrient adequacy.

Abbreviations

AOR: Adjusted Odds Ratio; **BMI:** Body Mass Index; **CI:** Confidence Interval; **COR:** Crude Odds Ratio; **CRC:** Colorectal Cancer; **ETB:** Ethiopian Birr; **LGIT:** Lower Gastrointestinal Tract; **PG-SGA:** Patient-Generated Subjective Global Assessment; **PS:** Performance status; **SGA:** Subjective Global Assessment; **SPSS:** Statistical Package for Social Science; **UGIT:** Upper Gastrointestinal Tract; **%WL:** Weight Loss Percentage

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Availability of data and materials

Data will be available upon request from the corresponding authors.

Authors' contributions

Eyerusalem Worku has involved in study design, data collection, supervision and analysis, and interpretation of data and wrote the first draft of the manuscript. Hayat Aragaw and Damte Kebede were

involved in study design, reviewing data analysis findings, and revised the draft and final manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Ethical Review Board of Faculty of Chemical and Food Engineering, Bahir Dar University. Supportive letters were obtained from Amhara public Health institute wrote a letter to the Tikur Anbessa Specialized Hospital. Respondents were given assurances about the privacy and confidentiality of their responses. Informed oral consent was obtained from each participant to ensure their willingness to participate, and all were informed that they had the right to not participate or could withdraw from the study at any time. Confidentiality of the data was assured and kept in secret; code number was assigned to the study participants without mentioning the name, the information that was collected by the study was kept in a file and locked with a key.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1

Symptoms with eating with cancer patients