



Prevalence and Associated Factors of Anemia among People with Cancer in ACSH, Tigray, Ethiopia

Abraha-G Woldemariam^{1*}, Asgele Tsehaye², Wendyefraw Mokonen³, Kinfe Tsehaye⁴, Mebratom Zeru⁴, Abel Hagos⁴, Gebriela Tsegay⁴, Yemane Birhane⁴, Guesh Teklu⁵

¹Department of Health Science, Aksum University, Axum, Ethiopia; ²Department of Medical Physiology, Adigrat University Adigrat, Ethiopia; ³Department of Health Science, Addis Ababa University, Addis Ababa, Ethiopia; ⁴Department of Biomedical science, Adigrat University, Adigrat, Ethiopia; ⁵Department of Nursing, Adigrat University Adigrat, Ethiopia

ABSTRACT

Background: Anemia is becoming a tricky health problem among people suffering from different types of cancer.

Objective: The aim of this study was to assess the prevalence and associated factors of anemia among people with cancer.

Methods: An institution based cross-sectional study was conducted from January to June 2020 in ACSH, Tigray, Ethiopia. Medical records were systematically reviewed to get demographic and clinical characteristics of 72 study subjects. Data were entered to SPSSv25 and descriptive analysis, logistic regression, independent sample T test and ANOVA were used for analysis.

Results: About 45.8% of study subjects with different types of cancer were found to have anemia. Unemployment (OR=2.167; 95%CI: 1.093, 4.294; p=0.027), rural residence (OR=3.750; 95%CI: 1.245, 11.299; p=0.019), advanced stages of cancer (OR=10.771; 95%CI: 3.580, 32.405; p=0.000), duration of cancer (OR=3.542; 95%CI: 1.289, 9.728; p=0.014) and higher (5-8) cycles of chemotherapy (OR=3.000; 95%CI: 1.090, 8.254; p=0.033) were variables found to have statistically significant association with anemia.

Conclusion: Anemia is a common complication in patients with different types of cancer. Occupation, residence, duration of cancer, stage of cancer, chemotherapy, and cycles of chemotherapy significantly increased the prevalence of anemia in cancer patients.

Keywords: Anemia; Prevalence of anemia; Risk factors of anemia; Cancer; Chemotherapy

BACKGROUND

Cancer related anemia is a public health problem, and has multifactorial pathogenesis [1]. Different reports are showing that anemia is common among people with cancer. According to reviewed literatures, the prevalence of anemia among people with solid cancer ranges from 23% in Ethiopia to 68% in United States of America [2-7]. Gaspar et al reviewed that the prevalence of anemia among patients treated for malignancies ranges from 40% to 64% [8]. The European Cancer Anemia Survey (ECAS) reported that 39.3% of prospectively evaluated

cancer patients were found to be anemic, and around 63.2% of Chinese with solid cancer were presented with anemia [6]. Even a higher prevalence rate (68%) was reported from an Intensive Care Unit (ICU) in United State of America (USA) comprehensive cancer center [7]. In India, Sharma et al found that 46.7% of 116 women with breast cancer were detected to have mild to moderate anemia at baseline; whereas, all these women (n=116) had developed anemia during the course of chemotherapy [9]. Another study in Saudi had reported that 44.1% of 320 patients with solid cancer were anemic, and patients with colorectal (56.8%) and female genital cancer

Correspondence to: Abraha-G Woldemariam, Department of Health Science, Aksum University, Axum, Ethiopia, E-mail: tsadkangg@gmail.com

Received: 10-Jul-2023, Manuscript No. JCM-23-22535; **Editor assigned:** 12-Jul-2023, Pre QC No. JCM-23-22535(PQ); **Reviewed:** 25-Jul-2023, QC No. JCM-23-22535; **Revised:** 01-Aug-2023, Manuscript No. JCM-23-22535(R); **Published:** 08-Aug-2023, DOI: 10.35248/2157-2518.2.14.423.

Citation: Woldemariam GA, Tsehaye A, Mokonen W, Tsehaye K, Zeru M, Hagos A, et al (2023) Prevalence and Associated Factors of Anemia among People with Cancer in ACSH, Tigray, Ethiopia. *J Carcinog Mutagen.* 14:423.

Copyright: ©2023 Woldemariam GA, et.al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

(43.8%) demonstrated higher prevalence of anemia [4]. It was also reported that around 42.4% of patients with gastric cancer had experienced anemia at least once in five year after gastrectomy [10]. Similarly, studies from Africa are showing high prevalence of anemia among cancer patients. In Kenya, about 38.6% of women with cervical cancer were reported to have severe anemia [11]. Likewise in Ethiopia, the prevalence of anemia ranges from 23% to 54.8% across different types of cancer, and from 21.7% in patients with breast cancer to 50.95% in patients with cervical cancer [3,12,13].

Different variables had been identified to be a risk factor of anemia in cancer patients. Reviewed studies show that “types of cancer”, “administration of chemotherapy” and “chemo-radiation”, “number of chemotherapy”, “types of chemotherapy”, “stage of cancer”, “use of substances” and “having comorbidities” were variables that had significantly associated to cancer related anemia [2,6,13,14].

Anemia in cancer patients has several etiologic factors [1]. It can occur as a result of cytokines imbalance, anemia of chronic diseases, nutritional deficiencies, due to the administration of chemotherapy and due the tumor (cancer) itself [14-19]. Chronic diseases accounts to 33.1% of cancer related anemia, while iron deficiency is reported to account 32% to 60% of cancer related anemia [20]. Anemia also occurs as a result of cancer treatments. For example, Aynalem et al reported that hemoglobin and hematocrit count had significantly reduced after the initiation of cancer treatments for patients with breast cancer in Ethiopia [21].

Although the prevalence of anemia among people with cancer is high, only less proportion of cancer patients get appropriate diagnosis and treatment of anemia [5,22,23]. If untreated, anemia could have additive consequences to cancer patients. For example, untreated anemia may compromise the Quality of Life (QoL) and causes fatigue in cancer patients [22,24,25]. For example, a cross-sectional study in Ethiopia confirmed that anemic cancer patients had increased risk of experiencing fatigue compared to patients without anemia [12]. Clarke and Pallister had reviewed that around 65% of cancer patients have an overall increased risk of death related to anemia. Likewise, a study conducted in Ethiopia had demonstrated an increased risk of anemia related deaths in patients with cervical cancer [14,26].

Administration of Erythropoiesis Stimulating Agents (ESA), transfusion of packed red blood-cells, and administration of Intravenous (IV) iron are mostly reported treatment options for cancer related anemia. Spivak et al on his review had concluded that ESAs have efficiently improved erythropoiesis and reduced the need for red blood transfusion in anemic cancer patients [20,27-30]. Similarly, Bryer and Henry reviewed that the use of intravenous iron and/or ESA had reduced the need for blood transfusion in the treatment of cancer-related anemia. Another review also recognized that anemic cancer patients demonstrated superior response to ESAs combined with intravenous iron [31,32]. Epoetin alfa was also reported as a choice of treatment. It was reported to increase hemoglobin level and improve quality of life of cancer patients with anemia [33-35].

Literature reviews indicated that anemia is highly prevalent among cancer patients and its distribution is similar across the world [2,3,5,10,11,26]. Although Ethiopia is multi-ethnic and multi-cultural country, most of the studies are conducted in Addis Ababa and Amahar regional states. These studies are also specific to breast and cervical cancers. This indicates that there is lack of preliminary evidences on the prevalence and associated factors of anemia among patients with solid cancer in the country, particularly in Tigray regional state. Lack of robust information on cancer related anemia may affect the quality of care provided to cancer patients with anemia. So, this study had tried to fill this knowledge gap by assessing the prevalence and associated risk factors of anemia among patients with solid cancer in Ayder Comprehensive Specialized Hospital, Tigray, Ethiopia.

MATERIALS AND METHODS

An institution based cross-sectional study was conducted at Ayder Comprehensive Specialized Hospital (ACSH) which is located in Mekelle, the capital city of Tigray. The study was conducted from January to June 2020. Sample size were calculated using Epi-info software to be N=72, with an assumptions of 95% level of confidence, 80% of power, and the ratio of exposure to chemotherapy among cancer patients to be 1:1. Study subjects who visit the oncology clinic during the study period were systematically selected based on the following eligibility criteria, then their medical records were reviewed to get demographic and clinical characteristics.

Inclusion criteria

- All adult cancer patients aged 18 years and above.

Exclusion criteria

- Critically ill
- Those who were treated for hematologic problems in the past 3 months
- Pregnant women
- Malaria in the last 2 weeks
- Bleeding history in the last 2 weeks
- Patients with Aplastic anemia
- Patients with other chronic co-morbidities
- Other therapies that suppress bone marrow

Data collection tools and procedures

Standardized semi-structured and pretested questionnaire was used during face-to-face interview and review of documented medical records. Study subjects were interviewed for eligibility and to get Socio-demographic data. Their medical records were reviewed to collect medical characteristics like duration of disease, type and stage of cancer, type of medication, duration of treatment and hematologic indices (level of Hb) were taken from patients' medical records.

Data quality control

To keep the quality and reproducibility of the data, the data collectors were trained on the objective of the study and every

procedure the data collection. Validity of the questionnaire was maintained by performing pretest in 5% of the sample size and necessary corrections were done on the questionnaire after pretest. Data from pretested subjects was not included in the actual study result. Each completed questionnaire was checked each day by the principal investigator to ascertain that all the questions were answered consistently and incomplete data was discarded and/or corrected. The data was entered into SPSS version 25 statistical software and rechecked carefully.

Data analysis

Data was manually checked for its clarity and completeness and then coded, cleaned and entered in to SPSS version 25 software. Descriptive statistics, logistic regression, independent-samples T test and one way ANOVA models were used to describe the data, to identify associations of anemia and categorical variables, to compare mean differences in hemoglobin level between variables at p-value less than 0.05.

RESULTS

Demographic descriptions

From the total study subjects participated in the study (N=72) majority (54.2%) were males and have an average age of 47 years old (Std.=15 Years). Half of the study subjects were secondary or

above in their educational level and about 26.4% were rural resident and around 47.2% have regular income (Table 1).

Description of hemoglobin (Hb=Hg/dL)

The mean hemoglobin count for the total study subjects (N=72) were 12.126 g/dL \pm 1.955 g/dL and statistically significant mean difference in hemoglobin count was observed on variables like occupation, residence, duration of cancer, stage of cancer, and chemotherapy use (Table 2). From the total chemotherapy users, study subjects those who have high cycles (5 to 8 cycles) of chemotherapy demonstrated statistically significant difference in mean in Hemoglobin (Hb) count when compared to study subjects who take low cycles (1 to 4 cycles) of chemotherapy or who did not take chemotherapy at all (Table 2).

Table 3 presents the description of anemia, Cancer and Chemotherapy. In this study, around 45.8% (n=33) of the total study subjects (N=72) were found to have mild to severe ranges of anemia. Anorectal/Colorectal cancer accounts for 27.8% and lung cancer for 23.9% of the total cancer among cancer patients. Majority of study subjects have either Stage-II or Stage-III cancer, 33.3% have stage-II and 30.6% have stage-III. Half of the study subjects were on chemotherapy and around 37.5% of study subjects took combined chemotherapy (Table 2).

No	Variables		Frequency	Per. (%)
1	Age	Mean=47 Std.=15 Skewness=-.326 Kurtosis=-1.073		
2	Sex	Female Male	33 39	45.8 54.2
3	Marriage	Married Single Widowed	57 13 2	179.2 18. 2.8
4	Religion	Orthodox Muslim	68 4	94.4 5.6
5	Education	Secondary or above Primary or below	36 36	50.0 50.0
6	Residence	Urban Rural	53 19	73.6 26.4
7	Occupation	Employed Unemployed	34 38	47.2 52.8
8	Regular income	Yes No	34 38	47.2 52.8

Table 1: Socio-demographic description of study subjects at ACSH, Tigray, Ethiopia (N=72).

Variables		Mean in hg/dL	Mean difference	95% CI		P=value
				Lower	Upper	
Occupation	Employed	13.2971	2.21811	1.45649	2.97973	0.000
	Unemployed	11.0789				
Residence	Urban	12.7566	2.38818	1.47839	3.29797	0.000
	Rural	10.3684				
Duration of cancer	<6 month	12.8804	2.08813	1.21746	2.95879	0.000
	≥ 6 month	10.7923				
Stage of cancer	Stages I and II	13.0500	1.84722	1.03162	2.66283	0.000
	Stages III and IV	11.2028				
Chemotherapy use	No	12.9944	1.73611	0.90726	2.56496	0.000
	Yes	11.2583				
	No	12.9944				
Cycles of chemotherapy	1 to 4 cycles	12.2062	---	---	---	0.000
	5 to 8 cycles	10.5000				

Note: Description of anemia, cancer and chemotherapy.

Table 2: Comparison of hemoglobin count among study subjects at ACSH, Tigray, Ethiopia (N=72).

No	Variables		Frequency	Per. (%)
1	Presence of Anemia	No	39	54.2
		Yes	33	45.8
2	Scale of anemia	Normal	39	54.2
		Mild	14	19.4
		Moderate/Severe	19	26.4
3	Types of cancer	Anorectal/Colorectal cancer	20	27.8
		Lung cancer	10	13.9
		Oral/laryngeal/Nasopharyngeal cancer	7	9.7
		Sarcoma	9	12.5
		Breast cancer	7	9.7
		Bladder cancer	6	8.3
		Other types of cancer	13	18.1

Table 3: Description of Anemia, Cancer and use of chemotherapy among study subjects at ACSH, Tigray, Ethiopia (N=72).

4	Stages of cancer	Stage-I	12	16.7
		Stage-II	24	33.3
		Stage-III	22	30.6
		Stage-IV	14	19.4
5	Duration of cancer	<6 months	47	65.3
		≥ 6 months	25	34.7
6	Chemotherapy	No	36	50.0
		Yes	36	50.0
7	Types of chemotherapy	Antimetabolites	2	2.8
		Antimitotic agents	4	5.6
		Combined 1	11	15.3
		Double alkylators	3	4.2
		Combined 2	5	6.9
		Combined 3	8	11.1
		Combined 4	3	4.2
8	Cycles of chemotherapy	No	50	50.0
		1-4 Cycles	16	22.2
		5-8 Cycles	20	27.8

Note: 1) Alkylators+Antimetabolites; 2) Alkylators+Antitumor Antibiotics; 3) Alkylators and antimitotic agents; 4) Alkylators+Antimitotic agents+Antitumor Antibiotics.

Table 3: Description of Anemia, Cancer and use of chemotherapy among study subjects at ACSH, Tigray, Ethiopia (N=72).

Anemia and its determinant factors

Table 4 show what factors correlate to anemia. From the Table 4, we can understand that variables like employment, residence, duration of cancer, advanced stage of cancer, chemotherapy use,

and use of high cycles of chemotherapy are independent predictors of anemia among study subjects with cancer (Table 4). These variables have significantly increased anemia among study subjects.

Variables		Anemia				AOR	95%CI	P-Value
		No		Yes				
		No	%	No	%			
Sex	Male	23	59	16	41	1	1	1
	Female	16	48.5	17	51.5	1.527	0.600, 3.888	0.374
Age	18-31	9	47.4	10	52.6	1	1	1
	32-45	6	75.0	2	25.0	0.300	0.048, 1.882	0.199
	46-59	15	62.5	9	37.5	0.540	0.159, 1.833	0.323
	60-74	9	42.9	12	57.1	1.200	0.344, 4.181	0.775
Marriage	Married	31	54.4	26	45.6	1	1	1
	Single*	8	53.3	7	46.7	1.043	.334, 3.264	0.942
Religion	Orthodox	36	52.9	32	47.1	2.667	0.264, 26.938	0.406
	Muslim	3	75.0	1	25.0	1	1	1
Education	≥ 2nryschool	21	58.3	15	41.7	1	1	1
	≥ 1mry school	18	50	18	50	1.400	0.552, 3.550	0.478

Occupation	Employed	27	79.4	7	20.6	1	1	1
	Unemployed	12	31.6	26	68.4	8.357	2.848, 24.524	0.000
Residence	Urban	35	66	18	34	1	1	1
	Rural	4	21.1	15	78.9	7.292	2.108, 25.218	0.002
Duration of cancer	<6 months	30	63.8	17	36.2	1	1	1
	≥ 6 months	9	36.0	16	64.0	3.542	1.289, 9.728	0.014
Stages of cancer	Stage-I and II	29	80.6	7	19.4	1	1	1
	Stage-III and IV	10	27.8	26	72.2	10.771	3.580, 32.405	0.000
Chemotherapy	No	24	66.7	12	33.3	1	1	1
	Yes	15	41.7	21	58.3	2.800	1.073, 7.304	0.035
Chemotherapy Chemotherapy	No	24	66.7	12	33.3	1	1	1
	Cycles 1-4	10	62.5	6	37.5	1.200	0.352, 4.092	0.771
	Cycles 5-8	5	25.0	15	75.5	6.000	1.760, 20.458	0.004

Table 4: Factors associated with Anemia among study subjects with cancer at ACSH, Tigray, Ethiopia.

DISCUSSION

An overall mean hemoglobin count of the total study subjects were 12.13 g/dL (\pm 1.96 g/dL). According to the findings of the present study, study subjects those who were unemployed, with rural residence, have cancer duration of \geq 6 months, having advanced stages of cancer (stages III and IV), those who were on chemotherapy, and those who have high cycles of chemotherapy demonstrated significantly lower hemoglobin count than their counter parts. Majority of study subjects were diagnosed as having stage-II or stage-III cancer.

Based on the results of this study the prevalence of anemia among patients with different types of cancer was 45.8%, which is similar to the prevalence rates in Malaysia (41.1%) and in Saudi (44.1%), but higher than the rates in Ethiopia (23%) [2-4]. However; result of this study is lower than the prevalence rates in European countries (53.7%), in china (63.2%) and in United States (68.0%) [5-7].

According to the present study; unemployment has significantly increased the occurrence of anemia. Unemployed cancer patients were 8.36 times more likely to develop anemia than employed. This could be explained by the fact that unemployed cancer patients could have anemia due to malnutrition, since they did not have income to get balanced diet [29,36]. Our study also indicated that cancer patients with rural residence were 7.29 times at increased risk to develop anemia than urban residents, and patients with duration of cancer \geq 6 months were 3.54 times more likely to develop anemia than those with duration of cancer <6 months. However, studies that assess the correlation of anemia with patient's residence and duration of cancer are in scarcity, which makes comparison of the present study to external evidences is difficult.

Similarly, results of the present study confirmed that advanced stages of cancer (Stage-III and IV) and higher cycles (5 to 8 cycles) of chemotherapy had significantly increased the prevalence of anemia among patients with different types of cancer. Patients with advanced stages of cancer and patients with

higher cycles of chemotherapy were 10.77 and 6.00 times more likely to develop anemia than their counter parts respectively. Possible explanations for this could be that advanced stages of cancer may have severe infiltrations and destruction of the bone marrow and use of higher cycles of chemotherapy may also induce severe bone marrow suppression [22,24,36].

CONCLUSION

Results of the present study allowed the identification of prevalence of anemia and discriminatory predictors contributing to the risk of having anemia among cancer patients. According to findings of the present study, anemia is a common complication in patients with different types of cancer in ACSH, Tigray, Ethiopia. Occupation, residence, duration and stage of cancer, use and cycles of chemotherapy were demographic and clinical factors that significantly increased the prevalence of anemia in cancer patients. Farther studies with large sample size are recommended by researchers to duplicate findings of the present study.

ACKNOWLEDGMENT

We wish to express our sincere gratitude to all who buttress us in any way at all to complete this study:-

Addis Ababa University, College of Health Science, department of medical physiology for the financial aid, reviewing and providing ethical clearance

Mekelle University Comprehensive Specialized Hospital for allowing the study to be carried at.

All friends and colleagues who encouraged and supported procedures of this study.

DECLARATION

We declare that "Prevalence and associated factors of anemia among people with cancer in ACSH, Tigray, Ethiopia" is our

own work and all sources that have been used or quoted in this work are well indicated and acknowledged by means of complete references and this work was not submitted for any reasons in any institutions.

ETHICAL CONSIDERATION

Ethical clearance and approval later were obtained from Research and Ethical Review Committee of College of Health Sciences, Addis Ababa University. The proposal was further evaluated in light of the ethical standards and permission letter was obtained from Ayder Comprehensive Specialized Hospital (ACSH). The study participants were briefed on the objective and procedures of the study. Thereafter, informed consent was obtained from study subjects. No personal identifiers were attached or recorded to the interview or review of medical records. The data provided was kept strictly confidential by using only code numbers.

COMPUTING INTEREST

We researchers declare that we did not have any computing interest.

AUTHOR'S CONTRIBUTION

Woldemariam AG contributes on the preparation of the manuscript. Tsehay A carried out the overall study, Wendyefraw M participated as advisor and all other authors have participated in the study equally.

REFERENCES

- Gilreath JA, Stenehjem DD, Rodgers GM. Diagnosis and treatment of cancer-related anemia. *Am J Hematol*. 2014;89(2):203-212.
- Muthanna FMS, Karuppannan M. Prevalence and associated factors of anemia among breast cancer patients undergoing chemotherapy: A prospective study. *Adv Pharmacol Pharm Sci*. 2022;2022:7611733.
- Kifle E, Hussein M, Alemu J, Tigeneh W. Prevalence of anemia and associated factors among newly diagnosed patients with solid malignancy at tikur anbesa specialized hospital, radiotherapy center, addis ababa, ethiopia. 2019;2019:8279789.
- Almehmadi M, Salih M, Elmissbah TE, Alsharif A, Alsiwiehri N, Alzahrani K, et al. Prevalence of anemia among saudi patients with solid cancers at diagnosis in king faisal hospital, taif province, kingdom of saudi arabia. *PLOS ONE*. 2021;16(1):e0246202.
- Ludwig H, Van Belle S, Barrett-Lee P, Birgegård G, Bokemeyer C, Gascón P, et al. The European Cancer Anaemia Survey (ECAS): A large, multinational, prospective survey defining the prevalence, incidence, and treatment of anaemia in cancer patients. *Eur J Cancer*. 2004;40(15):2293-2306.
- Cheng K, Zhao F, Gao F, Dong H, Men HT, Chen Y, et al. Factors potentially associated with chemotherapy-induced anemia in patients with solid cancers. *Asian Pac J Cancer Prev*. 2012;13(10):5057-5061.
- Cardenas-Turan M, Cesta MA, Wakefield C, Wallace SK, Puana R, Price KJ, et al. Factors associated with anemia in patients with cancer admitted to an intensive care unit. *J Crit Care*. 2010;25(1):112-119.
- Gaspar BL, Sharma P, Das R. Anemia in malignancies: pathogenetic and diagnostic considerations. *Hematology*. 2015;20(1):18-25.
- Sharma P, Georgy JT. Anemia requiring transfusion in breast cancer patients on dose-dense chemotherapy: Prevalence, risk factors, cost and effect on disease outcome. 2022;30(6):5519-5526.
- Kim JH, Bae YJ, Jun KH, Chin HM. The prevalence and clinical significance of postgastrectomy anemia in patients with early-stage gastric cancer: A retrospective cohort study. *Int J Surg*. 2018;52:61-66.
- Mlange R, Matovelo D, Rambau P, Kidenya B. Patient and disease characteristics associated with late tumour stage at presentation of cervical cancer in northwestern Tanzania. *BMC Women's Health*. 2016;16(1):5.
- Animaw L, Woldegiorgis Abate T, Endeshaw D, Tsegaye D. Fatigue and associated factors among adult cancer patients receiving cancer treatment at oncology unit in Amhara region, Ethiopia. *PLOS ONE*. 2023;18(1):e0279628.
- Wassie M, Aemro A, Fentie B. Prevalence and associated factors of baseline anemia among cervical cancer patients in Tikur Anbesa Specialized Hospital, Ethiopia. *BMC Women's Health*. 2021;21(1):36.
- Clarke H, Pallister C. The impact of anaemia on outcome in cancer. *Clin Lab Haematol*. 2005;27(1):1-13.
- Dicato M. Anemia in cancer: some pathophysiological aspects. *Oncologist*. 2003;8(S1):19-21.
- Yasmeen T, Ali J, Khan K, Siddiqui N. Frequency and causes of anemia in lymphoma patients. *Pak J Med Sci*. 2019;35(1):61.
- Nowrousian M. Pathophysiology of cancer-related anemia. Springer. 2002.
- Balducci L. Anemia, cancer, and aging. *Cancer Control*. 2003;10(6):478-486.
- Kurtin S. Myeloid toxicity of cancer treatment. *J Adv Pract Oncol*. 2012;3(4):209.
- Aapro M, Österborg A, Gascón P, Ludwig H, Beguin Y. Prevalence and management of cancer-related anaemia, iron deficiency and the specific role of iv iron. *Ann Onco*. 2012;23(8):1954-1962.
- Aynalem M, Adem N, Wendesson F, Misganaw B, Mintesnot S, Godo N, et al. Hematological abnormalities before and after initiation of cancer treatment among breast cancer patients attending at the University of Gondar comprehensive specialized hospital cancer treatment center. *PLOS ONE*. 2022;17(8):e0271895.
- Abdel-Razeq HN. Cancer-related anemia. *Saudi Med J*. 2004;25(1):15-20.
- Gordon MS. Managing anemia in the cancer patient: old problems, future solutions. *Oncologist*. 2002;7(4):331-341.
- Groopman JE, Itri LM. Chemotherapy-induced anemia in adults: incidence and treatment. *J Natl Cancer Inst*. 1999;91(19):1616-1634.
- Smith RE. The clinical and economic burden of anemia. *Am J Manag Care*. 2010;16:S59-S66.
- Wassie M, Argaw Z, Tsige Y, Abebe M, Kisa S. Survival status and associated factors of death among cervical cancer patients attending at tikur anbesa specialized hospital, addis ababa, ethiopia: a retrospective cohort study. *BMC Cancer*. 2019;19(1):1221.
- Mercadante S, Ferrera P, Villari P, David F, Giarratano A, Riina S. Effects of red blood cell transfusion on anemia-related symptoms in patients with cancer. *J Palliat Med*. 2009;12(1):60-63.
- Rodgers GM, Becker PS, Blinder M, Cella D, Chanan-Khan A, Cleeland C, et al. Cancer-and chemotherapy-induced anemia. *J Natl Compr Canc Netw*. 2012;10(5):628-653.
- Busti F, Marchi G, Ugolini S, Castagna A, Girelli D. Anemia and iron deficiency in cancer patients: role of iron replacement therapy. *Pharmaceuticals*. 2018;11(4):94.
- Spivak JL, Gascón P, Ludwig H. Anemia management in oncology and hematology. *Oncologist*. 2009;14(S1):43-56.

31. Bryer E, Henry D. Chemotherapy-induced anemia: etiology, pathophysiology, and implications for contemporary practice. *International J Clin Trans Med*. 2018;21-31.
32. Steinmetz HT. The role of intravenous iron in the treatment of anemia in cancer patients. *Therapeutic Advances in Hematology*. 2012;3(3):177-1791.
33. Jones M, Schenkel B, Just J, Fallowfield L. Epoetin alfa improves quality of life in patients with cancer: results of a metaanalysis. *Cancer*. 2004;101(8):1720-1732.
34. Cella D, Zagari MJ, Vondoros C, Gagnon DD, Hertz H-Jr, Nortier JW. Epoetin alfa treatment results in clinically significant improvements in quality of life in anemic cancer patients when referenced to the general population. *J Clin Oncol*. 2003;21(2):366-373.
35. Crawford J, Cella D, Cleeland CS, Cremieux PY, Demetri GD, Sarokhan BJ, et al. Relationship between changes in hemoglobin level and quality of life during chemotherapy in anemic cancer patients receiving epoetin alfa therapy. *Cancer*. 2002;95(4):888-895.
36. Haddad L, Alderman H, Appleton S, Song L, Yohannes Y. Reducing child malnutrition: How far does income growth take us? *World Bank Econ Rev*. 2003;17(1):107-131.