Anemia and Its Associated Factors among Haramaya and Dire Dawa University Students, Eastern Ethiopia

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Abstract

Background: Anemia is a global public health problem affecting about one-fourth of the world's population. It has adverse social, economic and health consequences, and affected people of different age groups. University students are among the classified under vulnerable groups that suffer from anemia. However, studies on anemia among university students are limited. Therefore, this study aimed to assess the magnitude of anemia and its associated factors among the students at Haramaya and Dire Dawa Universities in eastern Ethiopia.

Methods: A cross-sectional study was conducted from January to February, 2017 on 895 regular university students who were selected using multistage sampling techniques from the two universities. A pre-tested structured questionnaire was used to collect data using self administered techniques and interview**.** Blood and stool sample from each participant was collected and investigated following standard procedures. The data were coded and entered into Epi-Data Version 3.1 and exported to STAT Version 14.2 for analysis. Descriptive statistics and regression model were used to analyze the data.

Results: The magnitude of anemia among university students was 20.6% (95% CI: 18.0, 23.3%). Being female (AOR=2.3; 95% CI:1.6, 3.5), five or fewer serving of fruits and vegetables per week (AOR=1.9; 95% CI: 1.3, 2.9), once or less consumption of egg per week (AOR=1.6; 95% CI: 1.1, 2.3), three and less than three servings of meat per week (AOR=2.1; 95% CI: 1.1, 4.2), chewing *khat* four or more times per week (AOR=2.7; 95% CI: 1.1, 8.3), and consuming tea once a day (AOR=1.9; 95% CI: 1.2, 3.1) were significantly associated with the occurrences of anemia.

Conclusion: Anemia was moderate public health problem among Haramaya and Dire Dawa university students. Frequency of vegetable/fruit, egg, and meat consumption and being female were important factors associated with anemia. Thus, focused nutritional intervention such as promoting the use of meats, egg and fruit especially among female students and reduction of *Khat* chewing practices should be considered to reduce the problem.

Keywords: *Anemia; Dire Dawa; Eastern Ethiopia; Haramaya; Hemoglobin*

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Background

Anemia is a common blood disorder associated with an abnormal decrease in the number of red blood cell or less than the normal quantity of hemoglobin in the blood, which leads to hypoxia (Fauci and Longo, 2008). It remains a significant public health challenge, which affected 1.93 billion (27%) of the world's population in 2013 (WHO, 2015) and developing countries account for more than 89% of the burden (Kassebaum and Khader, 2016). It was mild to moderate public health significance problem among university students in developing countries (Al-alimi *et al*., 2017; Babita, 2014; Khan *et al*., 2010; Kumar *et al.*, 2014).

Although anemia is common among infants, preschool aged children, young women and older people, it can occur at all ages and in any region (Pandey, 2013). Adolescence and early adulthood are one of the most vul-

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nerable life stages due to growth spurt (OSU, 2012). Similarly, university students exposed to the risk of anemia due to their high nutrient demand related to their life stage, long schedule of studying, reduced nutrient intake frequency, and altered dietary habits owing to moving away from their parents and families (Al-alimi *et al*., 2017). In addition, socioeconomic status (Khan *et al*., 2010; Javed *et al*., 2017; Babita, 2014), parasitic infections (Manjula, 2014), dietary consumption (Pandey, 2013; Al-alimi *et al*., 2017), menstrual status among female students (Babita, 2014; Manjula, 2014) and *khat* chewing (Al-alimi *et al*., 2017) are some of the factors that contribute for the occurrence of anemia among university students. .

Many of the studies conducted on the magnitude of anemia have targeted infants, children, and pregnant women (Kenea, 2018; Kebede, 2018; Alemayehu, 2019; Tezera, 2018; Berhe, 2019).Very few studies have been conducted on the magnitude of anemia and its associated factors among university/college students (Al-alimi *et al*., 2017; Khan, 2010, Kumar *et al*., 2014), and none explicitly identified in Eastern Ethiopia. Therefore, this study assessed the magnitude of anemia and associated factors among the students in Haramaya and Dire Dawa universities.

Materials and Methods

Study setting and design

An institution-based quantitative cross-sectional study was conducted among the students at Haramaya and Dire Dawa universities from January to February, 2017. Haramaya university is one of the oldest universities in Ethiopia, and has three campuses: Haramaya campus (main campus), which is in Haramaya district 2047m above sea level; Harar campus, found in Harar city 1885m above sea level and Chiro campus, found in Chiro Town 2816m above sea level (HU, 2019). The university consists of twelve colleges which include 106 departments. By the year 2017, the university was training a total of 15,986 students (4,210 females and 11,776 males) (Academia, 2019). Dire-Dawa university is located in Dire Dawa city which is found at elevation of 1,276 m above sea level. In 2017, the university had six colleges and thirty-one departments, and taught 11,268 students (3,564 female and 7,704 male) (Ezega, 2019; Academia, 2019).

Populations

All students at the two universities were source population, and all randomly selected undergraduate regular students were the study population.

Inclusion and exclusion criteria

The undergraduate regular students were included in the study whereas those in non-regular program (summer, weekend and distance), postgraduate study, on treatment for anemia, with recent surgical procedure or bleeding due to any reason, female on mensuration, pregnant, and unable to respond for the study were excluded from the study.

Sample size determination and sampling techniques

The sample size was calculated by single population proportion formula considering proportion (p) of 55.3% prevalence of anemia based on study conducted in Bangladesh (Kumar B. Shill, 2014), Za/2 of 1.96, 5% of absolute precision, 20% non-response rate and design effect of two. Hence, the total sample size was 907. A multi-stage sampling technique was used to select students participated in the study. Accordingly, students were first stratified by the university and sex. Then sample populations were selected using a proportion to population size. Finally, the study participants were selected using simple random sampling method (Figure 1).

Data collection Methods

Data were collected by interview using a self-administered questionnaire which was developed by a comprehensive review of relevant literature (Abdullah Ahmed Al-alimi, 2017; Abdul-Rahim, 2011; Chathuranga, 2014; Debjit, 2013; Healthline, 2016; Jain, 2011; Javed, 2017; Jemal, 2010; Kassebaum NJ, 2013; Khan, 2010; Mikki, 2011; Bhusal, 2016). The questioner contains socio-demographic characteristics like age, sex, religion, place of birth, pocket money, year of study, place of study (campus); Parasitic infections, meal frequency, consumption of fruit, vegetable, egg, meat alcohol, *Khat*, tobacco and frequency of tea and coffee.

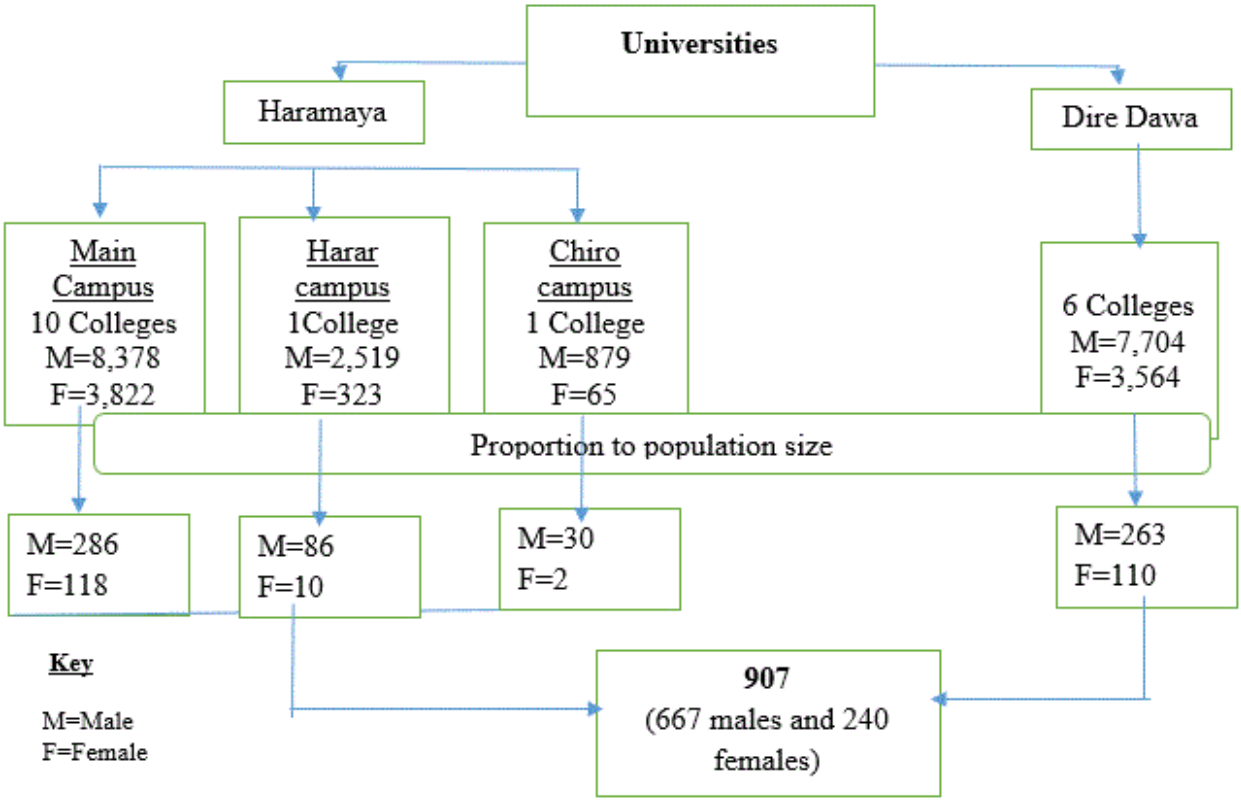

Figure 1: Diagrammatic presentation of sampling technique to select students at Haramaya and Dire Dawa university students, 2017.

Blood collection and hemoglobin measurement

After the study participants had been informed about the purpose and procedure of the study and given their consent, a capillary blood sample was collected from the participants by cleaning ring finger with 70% ethanol, air dried and puncturing using sterile lancet. The first drop of blood was wiped away with a dry piece of cotton wool and the next free flowing drop of blood was used for the test. Hard squeezing was avoided to prevent unreliable test result. Finally, after collecting sufficient blood, a piece of dry cotton wool was put over the puncture and held until the bleeding stopped (Cheesbrough, 2006; Cheesbrough, 2009).

The level of hemoglobin was measured using HemoCue® HB 301 by experienced medical laboratory professionals from the respective university clinics. Accordingly, the micro cuvette holder was first pulled out to its loading position. Then, the left button of the meter was pressed and held down until the display was activated. After the meter had showed three flashing dashes, mainly after 10 seconds, electronic calibration with red control micro cuvette was used. Then, micro cuvette was filled in from continuous capillary blood, and excess blood from the outside of the micro cuvette tip was wiped off. Then, the micro cuvette was placed in the micro cuvette holder for measuring hemoglobin within 10 minutes of filling the micro cuvette. After 15–60 seconds, the hemoglobin value was displayed in mg/dl (Cheesbrough *et al.*, 2009; Whitehead *et al.*, 2019; Hanudel *et al.*, 2017).

Stool sample collection and examination

Approximately 2 gram of fresh stool sample was collected using a small and labeled plastic container by experienced medical laboratory professionals at respective university clinics. The samples were then examined using a direct wet mount and formol-ether concentration techniques (Cheesbrough, 2009; WHO, 2011).

Data quality control

The data were collected by qualified and experienced

field staffs (data collectors and supervisors). Self-administered questionnaires were facilitated by experienced diploma Nurses. The hemoglobin measurement and the stool examination were done by medical laboratory professionals who were bachelor degree graduates. The overall data collection process was supervised by research assistant (Master of Public Health graduates). A three day intensive training was given to the data collectors and the supervisors.

The data collection instruments were pre-tested on 45 (5%) students at Jigjiga University and some adjustment was made to the approaches of data collection and study tool. The laboratory work was conducted according to the standard operating procedures. The supervisors and the research team have checked the data for completeness on ongoing basis. Double entry was made to validate the entry and correct errors, if any.

Data analysis

The data were entered into Epi-Data Version 3.1 and exported to STATA Version 14.2 for analysis. They were described using prevalence, mean and standard deviation (SD). The status of anemia was determined based on the WHO classification after the hemoglobin level had been adjusted for the altitudes of each campus, sex, and smoking status. The hemoglobin levels were adjusted for altitudes accordingly for Haramaya (-13 g/l), Harar (-8g/l), Chiro (-19g/l) and Dire Dawa (-5g/l). For smoker students, a further hemoglobin adjustment was made by -0.3g/l (WHO, 2011). The WHO cut-off levels were used for the interpretation of the measured haemoglobin. Accordingly, anemia was defined as hemoglobin <12.0 g/dl for female and <13.0 g/dl for male (WHO, 2011).

The severity of anemia was categorized as hemoglobin level between 11-12.9 g/dl was considered as mild anemia, 8-10.9 g/dl moderate anemia, <8 mg/dl severe anemia for male and hemoglobin level between 11-11.9 g/dl was considered as mild anemia, 8-10.9 g/dl moderate anemia, and <8 mg/dl severe anemia for female (WHO, 2011).

Public health significance was categorized based on the magnitude of anemia, which was classified as no public health problem (<5%); mild public health problem (5–19.9%); moderate public health problem (20–39.9%); and severe public health problem (≥40%) (WHO, 2015).

Bivariate and multivariable analyses were done to identify the factors associated with anemia. The variables with a p-value of less than 0.20 in the bivariate analysis were included in the multivariate analysis. The variables with the p-values of less than 0.05 at a 95% confidence interval (CI) in the multivariate analysis were declared significant factors associated with anemia.

Ethical consideration

The ethical clearance was obtained from Institutional Health Research Ethics Review Committee (IHRERC) of Haramaya University College of Health and Medical Sciences. Letter of the permission to conduct the study was written to the respective universities and colleges. The study participants gave their written and signed consent after they had been informed about the objective, the confidentiality, and the right to withdraw from the study at any stage. Anemic students and students with positive stool result were linked to the health facilities of the respective universities and the cost was covered by the investigators.

Results

Socioeconomic characteristics of the students

From the 907 students selected for the study, 12 were omitted due to incomplete response, and the response rate was 98.7%. The mean (± SD) age of students were 21.3 (± 1.6) years. Majority of students, 73.4% were male, and 58.4% were from Haramaya University. More than half, 54.2% of students were from an urban area, and 27.0% were freshman (first year) students. The mean (± SD) pocket money received by the students was 346.8 (± 205.6) ETB or 13.9 (± 8.2) USD per month (Table 1).

Table 1: Socio-demographic profile of Haramaya and Dire Dawa university students, eastern Ethiopia, 2017 (n=895).

Variables		Frequency	%
Sex	Male	657	73.4
	Female	238	26.6
Age$	18-21 years	543	60.7
	22-30 years	352	39.3
University	Haramaya	523	58.4
	Dire Dawa	372	41.6
Campuses	Haramaya	398	44.5
	Dire Dawa	371	41.4
	Harar	94	10.5
	Chiro	32	3.6
Place of birth	Urban	485	54.2
	Rural	410	45.8
Religion	Orthodox	423	47.3
	Muslim	223	24.9
	Protestant	213	23.8
	Others*	36	4.0
Year of study	1st year	241	27.0
	2nd year	263	29.4
	3rd year	276	30.9
	4th year	57	6.4
	5th year	56	6.3
Pocket money$ received per month	≤13.9USD	512	57.2
	>13.9USD	383	42.8

**=Catholic (19), Jehovah witness (9) and Wakefeta (traditional religion) (8) $=mean value was used as the base for classification after checking for normality, USD=United States Dollar*

Feeding habit and behavioral characteristics

About 87.0% of the students fed three and more times per day, and only 21.2% consume four or more serving of fruits and vegetables per week. Less than half, 44.5% of students consume less than three servings of egg per week and 12.6% of students consume more than three servings of meat per week. Many consumed coffee (65.7%) and tea (74.1%) at least once a day. About 9.4% of the study participants were currently smoking some types of tobacco products and 21.1% of students consumed alcohol at least once a month. Four out of ten of the students were Khat (*Catha edulis Forsk*) chewer (Table 2).

Parasitic infections

Sixty seven (7.5%) of the participants were positive for intestinal parasitic infections. *Giardia Lamblia* was the dominant parasitic infection identified among them (Table 2).

Magnitude of anemia

The overall magnitude of anemia among the university students was 20.6% (95% CI: 18.0, 23.3). The mean (± SD) of hemoglobin level was 14.9 (±1.9) mg/dl. Concerning the severity status, 143 (77.7%) were mildly anemic, 35(19.0%) were moderately anemic, and 6 (3.3%) were severely anemic. The magnitude of anemia was significantly higher among the female than the male; 32.4% (95% CI: 26.7, 38.6) among the female and 16.3% (95% CI: 13.6, 19.3) among the male, (chi-square (df) =27.6144(1), P<0.0001).

Table 2: Feeding habit, behavioral characteristics and parasitic infections among Haramaya and Dire Dawa university students, 2017 (n=895).

Variables		Frequency	%
Currently smoke tobacco products	Yes	84	9.4
	No	811	90.6
Current alcohol consumption	Yes	188	21.0
	No	707	79.0
Frequency of chat chewing per week	Not at all	539	60.2
	Once	47	5.3
	Two-three times	240	26.8
	Four or more times	69	7.7
Frequency of coffee consumption after meal per day	Not at all	396	44.3
	Once	319	35.6
	Twice or more	145	16.2
	Three times or more	35	3.9
Frequency of tea consumption after meal per day	Not at all	232	25.9
	Once	360	40.2
	Twice	257	28.7
	Three times or more	46	5.2
Frequency of meal per day	Twice or less	116	13.0
	Three or more times	779	87.0
No of servings of fruits and vegetables per week£	≤ five servings	584	65.3
	.> five servings	311	34.7
No of servings of meat per week	Twice or fewer servings	179	20.0
	Three servings	603	67.4
	Four or more servings	113	12.6
Frequency of egg consumption per week	Once servings	201	22.5
	Two-three servings	197	22.0
	Four or more servings	497	55.5
Parasitic infections	No ova/ parasites	828	92.5
	G. lamblia	21	2.4
	E. histolytica	14	1.6
	A. lumbricoids	13	1.4
	Hook worms	10	1.1
	Others *	9	1.0

**= T.Saginata (6 and H.Nana (3); £= classification based on WHO recommendations (WHO, 2016).*

Factors associated with anemia

A total of 18 Variables were considered for the bivariate logistic regression , seven variables (University, campuses, place of birth, religion, alcohol use, frequency of meal consumption per day, and coffee consumption after meal) was removed from the model and 11 variables with p-value less 0.2 were included for the multivariable logistic regression model. Accordingly, being

female (AOR=2.3; 95% CI: 1.6, 3.5), five or less serving of fruits and vegetables (AOR=1.9; 95% CI:1.3, 2.9), consuming eggs once per week (AOR=1.6; 95% CI: 1.1, 2.3), consuming three servings of meat per week (AOR=2.1; 95% CI: 1.1, 4.2), tea consumption (AOR=1.9; 95% CI: 1.2, 3.1), and Chewing *Khat* (AOR=2.7; 95% CI: 1.1, 8.3) were significantly associated with the occurrence of anemia **(Table 3).**

Table 3: Factors associated with anemia among Haramaya and Dire Dawa university students, 2017 (n=895).

Variables		Anemia		COR (95% CI)	AOR (95% CI)
		Yes (n=184)	No (n=711)		
Sex	Male	107 (16.3)	550 (83.7)	1	1
	Female	77 (32.4)	161 (67.6)	2.5 (1.7, 3.5) *	2.3 (1.6, 3.5) *
Age of students in year	18-21	115 (21.2)	428 (78.8)	1.1 (0.8, 1.5)	0.9 (0.6, 1.3)
	22-30	69 (19.6)	283 (80.4)	1	1
Pocket money received per month	≤ 13.9 USD	113 (22.1)	399 (77.9)	1.2 (0.9, 1.7)	1.2 (0.9, 1.8)
	>13.9 USD	71 (18.5)	312 (81.5)	1	1
Year of study	1st year	35 (14.5)	207 (85.5)	0.6 (0.4, 0.9) *	0.7 (0.4, 1.1)
	2nd year and above	149 (22.8)	504 (77.2)	1	1
Currently smoke tobacco products	Yes	14 (16.7)	70 (83.3)	0.8 (0.4, 1.4)	0.8 (0.4, 1.6)
	No	170 (21.0)	641 (79.0)	1	1
No of servings of fruits and vegetables per week	≤ five servings	146 (25.0)	438 (75.0)	2.4 (1.6, 3.5) *	1.9 (1.3, 2.9) *
	> five servings	38 (12.2)	273 (87.8)	1	1
Frequency of egg consumption per week	Once servings	46 (22.9)	155 (77.1)	1.4 (0.9, 2.1)	1.5 (1.1, 2.4) *
	Two-three servings	50 (25.4)	147 (74.6)	1.6 (1.1, 2.3) *	1.3 (0.8, 2.0)
	Four or more servings	88 (17.7)	409 (82.3)	1	1
No of servings of meat per week	Twice or less servings	29 (16.2)	150 (83.8)	2.0 (.9, 4.2)	1.1 (0.5, 2.5)
	Three servings	145 (24.1)	458 (75.9)	3.3 (1.6, 6.4) *	2.1 (1.1, 4.2) *
	Four or more servings	10 (8.9)	103 (91.1)	1	1
Frequency of chat chewing per week	Not at all	118 (21.9)	421 (78.1)	2.4 (0.9, 6.1)	1.9 (0.7, 5.4)
	Once	5 (10.6)	42 (89.4)	1	1
	Two-three times	45 (18.5)	195 (81.3)	1.9 (0.7, 5.2)	1.5 (0.5, 4.2)
	Four or more times	16 (23.2)	53 (76.8)	2.5 (0.9, 7.5)	2.7 (1.1, 8.3) *
Frequency of tea consumption after meal per day	Not at all	32 (13.8)	200 (83.2)	1	1
	Once	97 (26.9)	263 (73.1)	2.3 (1.5, 3.5) *	1.9 (1.2, 3.1) *
	Twice	51 (19.8)	206 (80.2)	1.5 (0.9,2.5)	1.4 (0.8, 2.3)
	Three or more times	4 (837)	42 (91.3)	0.6 (0.2,1.8)	0.6 (0.2, 1.8)
Intestinal Parasitic infections	Yes	8 (11.9)	59 (88.1)	0.5 (0.2, 1.1)	0.6 (0.3, 1.3)
	No	176 (21.3)	652 (78.7)	1	1

**Significant association (p< 0.05) COR-Crude Odds Ratio AOR – Adjusted Odds Ratio*

Discussion

In this study, the overall magnitude of anemia was 20.6%. This was moderate public health significance problem according to the WHO public health classification of anemia (WHO, 2015). However, it was lower compared to the finding from similar studies conducted in the University of Hodeida Yemen (30.4%) (Al-alimi *et al*., 2017), South India University (43.0%) (Subramanian *et al*., 2016), Central India Medical college (45%) (Javed *et al*., 2017), and Noakhali University, Bangladesh, (55.3%) (Kumar *et al.*, 2014).The relative lower magnitude in the current study could be the difference in hemoglobin measurement tool used in the previous studies. For example, the study conducted in Noakhali University (Kumar *et al.*, 2014) used Sahli's haemoglobinometer which is less accurate and overestimate anemia compared to HemoCue® HB 301 used in the current study. Besides, the other reason might be due to the difference in sample size, dietary habit, altitude or geographical location. Therefore, the moderate level of public health significance of anemia in the current study area and the higher magnitude on the study conducted among university students elsewhere (Al-alimi *et al*.,2017; Subramanian *et al*., 2016; Kumar *et al*., 2014) implies, anemia prevention and control strategies should target university students.

In the current study, the magnitude of anemia was higher among females than males. This finding was consistent with the one reported from several studies conducted among university students (Pandey and Singh, 2013; Khan *et al.*, 2010; Al-alimi *et al.*, 2017; Javed *et al*., 2017; Subramanian *et al*., 2016; Kumar *et al*., 2014). That might relate to females' menstruation and other obstetrics conditions (WHO, 2015; Sultan, 2007; Chathuranga *et al.*, 2014).There have been reports of a high magnitude of the menstrual disorder among female university students as a result of academic stress (Shiferaw *et al*., 2014; Ekpenyong *et al*.,2011; Cakir *et al.*, 2007; Nooh, 2015) and increase in physiologic body demand of iron during this age of life (Beard, 2000).

In our study the frequency of egg consumption was associated with the occurrence of anemia. This finding was in line with other study finding (Little *et al*., 2018) where, egg consumption plays an essential role in protecting the health of the body (Miranda *et al*., 2015) and good source of iron (Healthline, 2016). Besides, frequent consumption of egg results in improvements in plasma iron and transferrin saturation (Makrides *et al*., 2002). Egg also has a protective effect against diseases that perhaps cause anemia as it's often a side effect of other major diseases (Fernandez, 2016; Miranda *et al*., 2015; AOI, 2017). There is also a report egg white protein was useful for recovery from Iron deficiency anemia (IDA), while egg yolk protein delayed recovery of IDA (Kobayashi *et al*., 2015).

In the current study, consuming less than four servings of meat in meal per week and five or less serving of fruits and vegetables per day increased the risk of anemia. This finding goes in line with the findings of most of the similar studies done elsewhere (Ghose and Yaya, 2018; Moshe *et al*., 2013; Pasricha *et al*., 2008). This is because iron is present in foods in two forms ; as heme iron, which is derived from flesh foods like meats and as non-heme iron which is present in plants food like vegetables (Amoroso and Thompson, 2011). In addition to meats and vegetables, fruits can also reduce substances that keep iron in the form of ferrous to be absorbed (Amoroso and Thompson , 2011). It has also reported that frequent consumption of meats , fruits and vegetables increases the red blood cell production and reduces the occurrences of anemia (Billett, 1990).

In this study, the students who consume tea once a day had higher risks of anemia compared to those who did not consume tea. This finding is supported by the case reports, review works and clinical trials (Fan, 2016; Nelson and Poulter, 2004; Temme and Hoydonck, 2002; Kaltwasser *et al*., 1998). This is due to the fact that tea interferes with iron absorption which can lead to iron deficiency anemia. Even in healthy sub-jects tea interferes with iron absorption due to the inhibitory effects facilitated by the marked iron-binding properties of the phenolic compounds bearing catechol groups in tea (Kaltwasser *et al*., 1998; Fan, 2016; Zijp *et al*., 2000). However, sufficient amounts of iron ab-sorption enhancers (ascorbic acid, meat, fish, poultry) in meals overcomes inhibition of iron absorption by

even large amounts of tea consumption (Zijp *et al*., 2000).

Like the study findings report of (Kedir *et al*., 2013; Ketema *et al*., 2015 ; Al-alimi *et al*, 2017); in our study the frequency of Khat consumption (chewing) was significantly associated with the occurrence of anemia. Khat (*Catha edulis*) is a plant chewed by people in East Africa and the Arabian countries to elevate mood (euphoria) and contains the alkaloids cathine and cathinone which have amphetamine-like properties (Omar *et al*., 2015; Wabe, 2011). Chewing Khat frequently is becomes a common practice in Ethiopia and it is more so among university students (Haile and Lakew, 2015; Gebrehanna *et al*., 2014; Teni *et al*., 2015 ; Alemu *et al.*, 2018). Frequent Khat use was associated with various health effects, including esophagitis, gastritis, duodenal ulcer, loss of appetite (restrictive dietary behavior), constipation, myocardial infarction, sleeping disturbance , depression , anxiety , mood instability , and mania which might have direct or indirect effect on the occurrence of anemia (Omar *et al*., 2015 ; Wabe, 2011; Kedir *et al*., 2013; Alemu *et al*., 2018; Teni *et al*., 2015).

Limitations

In this study, the effects of family history, menstrual disorder, nutritional status, cereal-based monotonous diet and diet consumption habit other than fruits, vegetables, egg, and meats were not assessed due to the cross-sectional nature of the study. The study also did not identify the type of fruits or vegetables consumed. Furthermore, the current study did not consider acute and chronic illnesses, hereditary disorders, infections which may cause anemia.

Conclusion

Anemia is a moderate public health problem among Haramaya and Dire Dawa university students. Being female, chewing *khat*, consuming five or less serving of fruits and vegetables, eggs once per week, three servings of meat per week and tea were significantly associated with the occurrence of anemia. Therefore this study recommends nutritional intervention which promote the use of meats, egg, fruit, and vegetable particularly among female students. It is also recommended that the students should take tea with meals that contain iron absorption enhancers to reduce the effect of tea on iron absorption. This study also recommends further study to validate the current findings and addressing the limitations of the current study using a larger sample of university students which might help development of finding based programs to prevent the occurrences of anemia.

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Competing of interests

The authors declare that they have no competing interests.

Author's contributions

BH, AG, AA and DA: Conceived and designed the study; BH, AG, AA, DA and TT: adopted data collection instrument and acquisition of data; BH, AG, AA, DA and TT: Cleaned the data, analyzed the data and interpreted findings; BH, AA and TT: drafted the manuscript; BH, AG, AA, DA and TT: Critical revision and approval of the final manuscript.

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