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Research Article

Anemia and Associated Factors among Adolescent Girls Attending High School in Mizan Aman Town, Bench Sheko Zone, Southwest Ethiopia, 2020

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Abstract

Background: Worldwide Anemia is a common health problem. In Ethiopia, the magnitude of anemia among adolescent girls is a mild to a moderate public health problem. Unfortunately, because initiatives to prevent anemia commonly target pregnant, lactating women, infants, and children, but adolescents may remain unmet and the effect of anemia in adolescents continued. Besides, there are a few studies done on anemia among high school adolescents in Ethiopia, and no documented study is found in the study area.

Objective: To assess the prevalence of anemia and its associated factors among high school adolescent girls in Mizan AmanTown, Bench Sheko Zone, Southwest Ethiopia.

Methods: Institutional based cross-sectional study design was employed among randomly selected 281 high school adolescent girls in Mizan-Aman Town from March 08 to April 19, 2020. Data were entered into Epi-Data version 3.1 then exported to SPSS version 24 for further analysis. On bivariate analysis p ≤0.25 were considered as candidates for multivariable logistic regression. Multivariable logistic regression was done to control for confounders, and to pinpoint factors independently associated with anemia. The level of statistical significance was declared at P < 0.05.

Results: A total of 281 adolescents were involved in this study with a response rate of 93.7%. The prevalence of anemia among adolescent girls was 23.5% with (95%CI: 18.9, 28.8). This study identified important Factors associated with anemia among adolescent girl in the study area were Father education (AOR = 1.27; 95%CI: 0.67, 5.70; P = 0.0014), family size (AOR = 3.23; 95%CI: 1.13,5.78; p = 0.012), wealth index (AOR = 6.00; 95%CI: 2.31,15.7; p = < 0.001), duration of menstruation (AOR = 2.63; 95%CI: 1.03, 6.67; p=0.043) and dietary diversity score (AOR = 2.13; 95% CI: 1.16, 8.43; p = 0.024).

Conclusion: The Prevalence of anemia among school adolescent girls was a moderate public health problem. Father education, family size, lower wealth index, duration of menstruation, and low dietary diversity score were independent significant predictors of anemia. Therefore, iron-rich food, nutritional education, and diversified food consumption should be given attention to reducing the burden of anemia.

***Keywords**: Anemia, Adolescent Girls, High School, Mizan Aman, Ethiopia*

Abbreviations

AOR - Adjusted Odds Ratio; CI- Confidence Interval; COR- Crude Odds Ratio; FANTA- Food and Nutrition Technical Assistance; IDA - Iron-deficiency Anemia; IDDS-Individual Dietary Diversity Score; Hb- Hemoglobin; SNNPR- Southern Nation Nationalities Peoples Region; SOP- Standard Operating Procedures; SPSS - Statistical Package for Social Sciences; STH-Soil Transmitted Helmets

Introduction

Anemia is a condition characterized by a reduction in the number of red blood cells (RBCs)and/or hemoglobin (Hb) concentration in the human body, which decreases the oxygen-carrying capacity of hemoglobin to tissue [1]. The existence of anemia is due to the numerous red cell defects such as defects in hemoglobin production (iron deficiency anemia), maturation defect, production defect (Aplastic anemia), genetic defects of hemoglobin maturation and physical loss of red cells [2].

The causes of anemia in developing countries are different factors from those the common cause is nutritional deficiencies (iron, folate, Vit A and vitamin B12), infections (like intestinal parasite infestation, malaria), and health problems (inflammation, heavy menstruation and chronic illness [3]. In addition to these factors affecting anemia also gender, age, socio-demographic status, dietary habits, repeated pregnancies, postpartum hemorrhage, gastric ulcers, hemorrhoids, and pure vegetarian diet [1].

Nutrition during adolescence plays an important role in the human life cycle and the feeding of adolescents and children must be adequate to support normal and sometimes in fast growth and development [4]. They require 15 to 25% of final adult height and 50% of adult weight are attained with a bone mass increase of 45% [1,5].

Worldwide anemia is a common health problem, as well as around two billion people, were suffering from anemia and it affects 24. Eight percent the population of world with burden varying with a person's sex, age, altitude, nutritional status, and physiological status (pregnancy states) [1].

WHO and the International Center for Research on Women (ICRW) described that around 27% of adolescent girls in developing countries are anemic compared to developed countries (6%) with this high rate of anemia among adolescent girls in India (55%), Nepal (42%), Cameroon (32 %), and Guatemala (48%) [6,7].

In sub-Saharan Africa about half of high school girls are anemic [8]. Mostly anemia is a result of nutritional deficiency disorder and poor dietary intake of iron and it is the most dangerous public health problem among adolescents. There is a high prevalence of anemia in the African Region and those factors affecting anemia in this region are malnutrition (under nutrition), malaria, parasitic infection, and poor dietary habit [7-9].

In Ethiopia, the study showed that the prevalence of anemia among adolescent males was from 2.8% to 15%, and females 9.3% to 34.8% and in pregnant women is high (40% or more) [1,11].

Anemia is a common health problem specifically in adolescent girls. So, identifying the determinant factor is needed to develop appropriate intervention, control and prevention.

Aim of the Study

Therefore, this study aims to assess the magnitude of anemia and associated factors among high school adolescent girl students of Mizan Aman Town, southwest Ethiopia.

Materials and Methods

Study design, setting, and area

An Institutional-based cross-sectional study design was conducted. And was conducted from February 01 to March 19, 2020 in Mizan Aman town High Schools Bench-sheko Zone, South West Ethiopia. Mizan Aman Town is found 561 km from the capital city Addis Ababa, and it is the largest town and administrative center for Bench Sheko Zone. Mizan Aman town has latitude and longitude of 70 'N 3535' E/ 7.000N 35.583E and have 1451 meters elevation above sea level. According to the Mizan Aman Town education office in 2012 E.C, there are about six high schools in which four of them were governmental, and the rest two were private schools. And the total number of students in both government and private in high schools is 7724, from this 3590 were males and 4134 females from this 3792 were an adolescent girl aged 10 - 19 years [12].

The main sources of income for residents in the town are trade, government employee, and agriculture, mostly main food crops in Bench Sheko Zone includes godere (taro root), maize, and teff, Enset, sorghum, barley, wheat, and coffee are cultivated to a significant extent. Although, goats, cattle and poultry are produced in limited numbers, meat and milk are very common. Cash crops include fruits (like oranges and bananas) and spices (e.g. coriander and ginger) are grown in the zone. Honey is also crucial local source of income [12].

Inclusion criteria

Adolescent girls who are high school students in Mizan Aman Town were included in the study.

Exclusion criteria

Adolescents who are ill during data collection, blood donate within 16 weeks during data collection, adolescent girl students from another area join into the study, and area (high school) within less than four- month were excluded from the study.

Sample size determination

The sample size was calculated using Epi Info™7 by using the formula for estimation of a single population proportion for anemia and two [2] population proportion formulas for determinant factors with the following assumptions: the prevalence of anemia among adolescent girl of 25.5%, 95% confidence level, and 5% margin of error from a previously study [22] and adding a contingency for a non-response rate of 10%. Thus, a total of 300 adolescent girl students in the six high schools were included.

Sampling procedure

First, we toke list of all high schools with their list of students found in the town that were registered in the Mizan Aman Town educational office. By using the student registration document as the sampling frame, which included name, age, and sex of all list students (from 9 - 12) were written in the registration document in each school with their level of grade. Then the eligible adolescent students are selected from each school, and then sample size was allocated proportionally for each school after that, Study participants were selected using a simple random sampling technique specifically by the computer-generated method to allocate the participant students.

Data collection instruments and procedure

A structured pretested interviewer-administered questionnaire (tools) was developed in English and then deciphered into the Amharic language for ease then back-deciphered to the English language for its uniformity by two [2] different language professional individuals who speak fluently in both Amharic and English language. The questionnaire having socio-demographic characteristics, nutritional

related characteristics; health-related information, sanitation, and environmental health- related factors, and parasitic infection-related characteristics were collected.

Specimen collection and processing

Hemoglobin (Hb) measurement and malaria status were done by laboratory investigations. Hemoglobin measurement was measured from capillary blood by collecting one drop of blood from middle finger. The finger of the adolescent pricked after rubbing the fingertip with sterile cotton (immerse in 70% alcohol) with a sterile disposable lancet. To determine the hemoglobin concentration, Automated HEMOCUE Hb 301, HEMOCUE AB, ANGELHOLM SWEDEN machines was used and Adjusted Hb concentration was calculated as Hb = −0.32 × (altitude in meters × 0.0033) +0.22 × (altitude in meters × 0.0033) 2 (-0.48) to subtract the adjustment from measured Hemoglobin concentration at the altitude (1451 m above the sea level) to get the sea-level value then categorized based on criteria of WHO cut off point, the results were expressed in g/dl [13].

To determine malarial infection, a rapid antigen whole blood test with the trade name (Care Start TM) malaria was used. Sample for the rapid diagnostic test (RDT) was collected immediately after determining the hemoglobin level, adolescents with hemoglobin < 12 g/dl was considered for conducting RDT and presence of fever in the last two weeks. Bio-safety measures were taken such as the use of sterile gloves; alcohol/clean water during the collection of the specimen as well as a safe disposal system was employed (Used gloves and other materials are collects using boxes and transported to the health center for proper disposal [14].

Stool samples

Fresh Stool was collected by using a clean and labeled container from the study participants and microscopic examination was done to identify eggs, intestinal protozoa, and larvae of helminths by the direct smear examination. This was done by the saline wet mount by mixing a small quantity (about 2 mg) of faces in a drop of saline placed on a clean glass slide [15].

Anthropometric measurements

Measurements of height were done using a wooden height measuring board with a sliding head bar. The participant was stand straight on the leveled surface with heels together and their heads positioned and eyes looking straight ahead (Frankfort plane) without shoes. Heels, buttocks, shoulder blades should touch the vertical surface of the Studio meter. The moving headpiece of the Studio meter was applied to lower to rest flat on the top of the head and read to the nearest 0.1cm, and the weight was measured using an electronic digital weight scale (Secca Germany) with light clothing and without shoes and then record to the nearest 0.1 kg. Calibration was done every morning and before every weight measurement, the data collectors check the scales reading exactly at zero. The weight scale was checked through known object weighing measured regularly. Same measures were conducted to give anthropometric measurements to avoid variability. Height and weight were measures twice and the average value was used for analysis [16].

Dietary diversity score (IDDS)

It was conducted consuming adolescent girls within 24 hours from the nine food groups such as starch (cereals, tuber, and wheat), vegetables, fruits, fish, tubers, meat, honey, milk, egg, and legumes. Each food group had been counted once resulting may be scores of zero to nine. Then, the food groups were categorized into low dietary diversity (less than 3 food groups), medium dietary diversity score who consumed 4 and 5 food groups, and high dietary diversity (greater than or equal to 6) [17].

Wealth index status

Nineteen items used to assess household assets. The tool were adapted from Ethiopian demographic and health survey (EDHS) and it was ranked as low, medium, and high [3].

Knowledge

Anemia related knowledge was assessed by using a pretested questionnaire. Adolescents girls have been questioned anemia related Knowledge questionnaire that had been adapted from assessing Knowledge, Attitude and Practices (KAP) Food and Agriculture Organization (FAO) guidelines. It has ten questions that asked about anemia, cause, symptom, iron-rich foods, and health consequences of anemia to children and pregnant. The answer to each question was analyzed as know and don't know. And finally from the total nine items for each correct answer were coded as 1 which is known and for each wrong answer 2 (don't know) score was given. The maximum response score will be ten and the minimum may score is zero. The answers changed to a percentage. An individual who scored 50% and above had been taken as good knowledge and adolescent girls who scored below 50% have been taken as poor knowledge [18,19].

Data processing and analysis

Collected data were entered into Epi data 3.1 after coding and checking for completeness and consistency and exported to Statistical Package for Social Sciences (SPSS) software version 24.0 appropriate analyses were done. Descriptive statistics like frequency, Mean, Median, standard deviation (SD), and the percentage was used to give a clear picture of background information and determine the prevalence of anemia. The normality of continuous variables (anthropometric, food groups, and hemoglobin) was checked using graphic methods (Histograms with normality curves and QQ-plots).

Height and weight were transferred into WHO Anthro plus considering age to convert nutritional data into Z-score of indices HAZ and BAZ using the standard of WHO 2009 growth reference. According to this reference if adolescent girls had BAZ less than -2SD considered as thinness, normal if BAZ between +1 and -2SD as well as overweight was considered as if the BAZ greater than or equal to +2SD and if the respondents HAZ ≤-2SD was stunting [20].

Household wealth: principal component analysis (PCA) to construct a wealth index. In order to construct a relative household's wealth status, different socio-economic indicators was collected. Finally, socio-economic status was constructed by dividing the resulting score into quintiles that indicate poor, medium, and rich households.

Bivariate and multivariate logistic regressions were used to assess the association of various determinant factors of anemia. Bivariate logistic regression was used to identify presence of an association between independent variables and anemia. Multivariable logistic regression analysis was used to control the possible confounding effects of variables. In Bivariate logistic regression analysis all variables are significant at a p-value of 0.25 and 95% CI were entered into a multivariate logistic regression analysis model. Variables that are significant at p-value < 0.05 level and 95% CI are considered to be the determinant factors of anemia. An adjusted odds ratio with 95% CI were used for those variables which are found to be determinant factors of the anemia. The fitness of the model was tested by Hosmer Lemeshow goodness of fit test and depend on the model was considered fit if it is found to be insignificant ($p > 0.05$) and multi-collinearity was checked using Variance Inflation Factor (VIF).

Data quality assurance

Questionnaires from English were translated to Amharic and again back-translated to English and for the assurance of data quality 5% pre-test was performed at semen bench high school adolescent girls (15 adolescent girls) to check consistency, validity, and completeness of the data collection tool before the actual data collection period. Training was given for data collectors and supervisors. Continuous and supportive supervision was given. Both the supervisor and principal investigator were checking the completeness of collected data on daily basis. For additional better data quality management data was entered into Epi data 3.1 by preparing double entry verification. Weight Calibration was done before every weight measurement, the data collectors assured that the scales reading exactly at zero.

The proper functioning of instruments, laboratory reagents, expiry date, and technical performance was checked by using quality control samples. For malaria test, the rapid diagnostic tests (RDTs) result with blood film result by microscope and for Hemocue result with the CBC machine was checked. Comparisons of Hemocue machines with CBC (Complete blood count) machine, Sysmex analyzer (Sysmex XS-500i, made in China) were done. This was just to be confident on the working instruments by themselves but not on technical issues behind the machines, that how they measure. Standard operating procedures (SOP) and manufacturer's instruction were strictly followed starting from sample collection up to result in reporting for laboratory activities. Before data analysis cleaning was done and also out layer was identified and managed.

Results and Discussion

A total of 281 was interviewed in this study yielded a 93.7 present response rate. The mean age of the respondents was 15.85 ± 1.74 years. Of these, 86 (30.5%) were found in the early adolescence age group and 66 (23.5%) of the respondents were found in the late adolescence age group. Almost all (95.4%) of respondents were from government schools. forty-two (14.9%) of the adolescent girls were married. One hundred fifty-two (54.16%) of the adolescent girls were living with their parents. Regarding the religion of respondents, 103 (36.7%) of them were Orthodox followed by protestant 83 (29.5%).

Regarding parental education level, three fourth (29.9%) of adolescent girl fathers were attained college and above followed by high school (25.1%). And three fourth (29.5%) of adolescent girl mothers were attained high school level, seventeen (25.5%) adolescent girls' mothers were college and above and 31 (11.3%) of adolescent girl's mothers were Illiterate.

Regarding the occupation of parents, 48% of fathers of adolescent girls were government employees, 34.2% of them were merchants and 7.4% of fathers were daily laborers. Around half (53.5%) of mothers were Housewife's, whereas 37.1% of mothers were government employees. Eighty-five (30.2%) of adolescent girls' parents were with higher wealth status and 118 (42%) were with low wealth status (Table 1).

Variables	Category	Frequency	Percentage (%)
Age category	Early adolescence	86	30.6
	Middle adolescence	129	45.9
	Late adolescence	66	23.5
Type of school	Governmental	268	95.4
	Private	13	4.6
Religion	Orthodox	103	36.7
	Muslim	64	22.8
	Protestant	83	29.5
	Catholic	31	11.0
Ethnicity	Bench	82	29.2
	Amhara	73	26.0
	Oromo	63	22.4
	Keffa	52	18.5
	Others* (Hadiya Gurage and Wolayta)	11	3.9
Living arrangement	Living with parents	151	54.1
	Living with relative	96	34.5
	Living with a friend	34	11.4

Marital status	Single	239	85.1
	Married	42	14.9
Educational status of Father	Illiterate	27	9.6
	Read and write	45	16
	Primary school	57	20.3
	Secondary school	68	24.2
	College and University	84	29.9
Educational status of Mother	Illiterate	34	12.1
	Read and write	41	14.6
	Primary school	55	19.6
	Secondary school	81	28.8
	College and University	70	24.9
Occupation of Father	Daily labor	21	7.5
	Merchant	101	35.9
	Government Employed	139	49.5
	Farmer	20	7.1
Occupation of Mother	Housewife	151	53.7
	Merchant	28	10
	Government Employed	102	36.3
Family size	>5	115	40.9
	≤ 5	166	59.1
Wealth index	Poor	117	42.0
	Medium	78	27.8
	Rich	86	30.2

Table 1: *Distribution of socio-demographic and economic characteristics among family of adolescent girls in Mizan Aman town, southwest Ethiopia, 2020. N = 281.*

Prevalence of anemia among adolescent girls

The magnitude of anemia among adolescent girls in Mizan Aman high school was 23.5% (95%CI: 18.9, 28.8). From this 13.2% as mild and 10.3% were moderate anemia. The Hb level of the high school adolescent girls ranged from 8.2 g/dl to 17.4 g/dl with a mean ± SD) value of 14.17 ± 2.61 g/dl. About seventy-three percent of adolescent girls heard or having information about anemia and twenty-seven of them had no information about anemia.

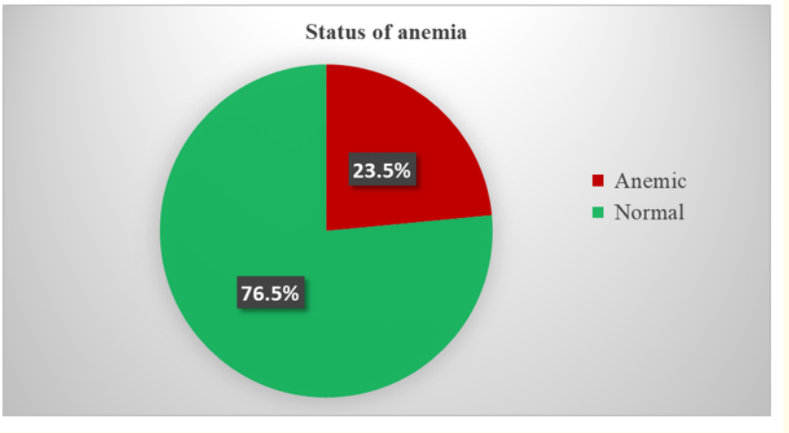

Figure 1: *Prevalence of anemia among adolescent girls attending high school in Mizan Aman Town, Southwest Ethiopia, 2020.*

Health, intestinal parasite and anthropometric characteristics of adolescent girls

Out of two hundred eighty-one girls, 48 (17.1%) were on menstruation during data collection period. Regarding the duration of menses in each cycle, two hundred twelve (82.2%) adolescent girls five or fewer days during their menstruation cycle, and 46 (17.8%) were greater than five days. From the total participants, seventy- five (26.7%) respondents reported as they have fever within two weeks, and similarly forty -six girls reported as they had a history of malaria illness within one month before the data collection period. Regarding diarrhea 32 (11.4%) of the respondent had a history of Diarrhea within two weeks, from those forty -four percent of them were diarrhea without blood and fifty-six percent of them had Diarrhea with blood. Adolescent girls 7 (2.5%) had a history of Aborted and facing problem of abdominal pain and heavy bleeding.

Eighty (28.5 %) of the adolescent girls were positive for intestinal parasites. From this, four species of intestinal parasites were identified. *Entamoeba histolytica* 33 (11.7%) was predominant followed by *Giardia lamblia* 24 (8.5%), *Ascaris lumbricoides* 17 (6%), and hookworm 6 (2.1%). From the total were tested for malaria using a rapid diagnostic test (RDT) 29 (10.3%) of adolescent girls had malaria. Among the identified specious Plasmodium vivax was the dominant 24 (23.5%) and plasmodium falciparum-infected adolescent girls were 6 (4.9%) and for those positive for malaria and intestinal parasite were linked to the hospital (MTUTH) to take the medication (Table 2).

Variables	Category	Frequency	Percent
History of fever in the last two week	Yes	75	26.7
	No	206	73.3
History of malaria in the last one month	Yes	46	16.4
	No	235	83.6
Diarrhea in last two week	Yes	32	11.4
	No	249	88.6
Type of Diarrhea	Diarrhea without blood	14	43.8
	Diarrhea with blood	18	56.3
Status of menarche	Yes	258	91.8
	No	23	8.2
First attained menstruation	≤ 14	189	73.3
	>14	69	26.7
Duration of menses in each cycle	≤ 5	212	82.2
	> 5	46	17.8
Intestinal parasitic	Yes	80	28.5
	No	201	71.5
Malaria	Yes	29	10.3
	No	252	89.7

Table 2: *Health and intestinal parasite related characteristics of the study participants among adolescent high school girls in Mizan Aman Town, Southwest Ethiopia, 2020.*

Knowledge about anemia among adolescent girls

Around three- fourth of adolescent girls heard about iron deficiency anemia. Sixty-two percent of them responded to weakness or less energy to know someone has anemia. Forty-five percent of adolescent girls responded that heavy bleeding and thirty- eight percent of adolescent girls reported that lack of iron in the diet/ eating too small were causes of iron deficiency anemia. Sixty -nine (33.7%) of adolescent girls responded that feeding iron-rich foods could be taken as the prevention methods of anemia. Regarding iron absorption and high school adolescent girls reported that coffee 54 (26.3%) and tea 38 (18.5%) decreased Iron absorption but red meat 76 (36.7%) adolescent girls reported which was easily absorbable. Regarding knowledge of the adolescent girls 185 (65.8%) study subjects had poor knowledge related to anemia (Figure 2).

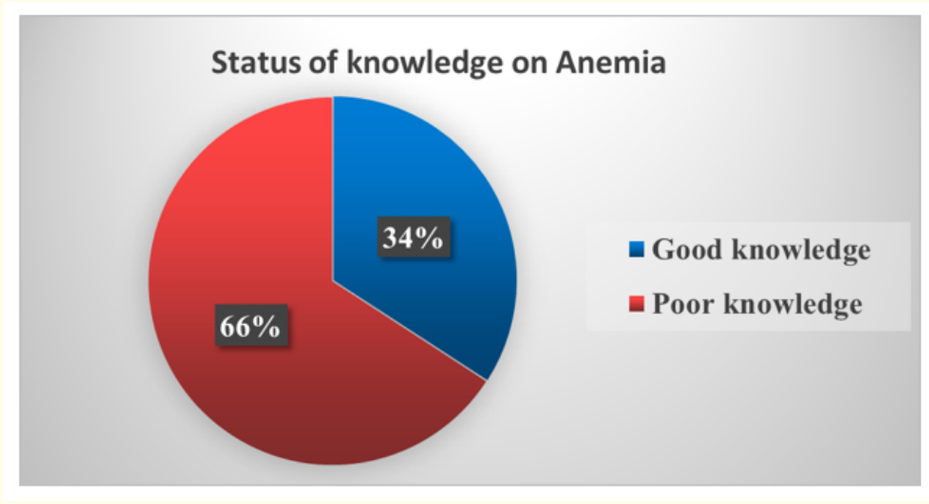

Figure 2: *Knowledge related to anemia of study participants among adolescent high school girls in Mizan Aman, Southwest Ethiopia, 2020.*

Characteristics of dietary practice

Two hundred twenty- two (79%) respondent girls drank coffee/tea from those they drink at the time of right after consumed meals 118 (53.2%) followed by 104 (46.8%) drank during a meal. Regarding food 226 (80.4%) adolescent girls consumed starchy foods. More than half of the respondents consumed fruits, vegetables, eggs, and meat, and Thirty-five (23.1%) of individuals consumed sweets. Regarding IDDS, One hundred seventeen (41.6%) girls had a high dietary diversity score of greater than and/or equal six food groups scores followed by ninety- six (34.2%) of the high school adolescent girls who had medium dietary diversity score who consumed 4 and 5 different food groups and sixty- eight (24.2%) had on the low dietary diversity score three and bellow food groups score (Table 3).

Variables	Category	Frequency	Percent
Meal frequency	Less than two times	72	27.7
	Three times	127	45.2
	More than three	82	29.1
Drinking coffee/tea	Yes	222	79
	No	59	21
Average cup of coffee/tea drink	Two and less cups	107	48.2
	Three and more cups	115	51.8
Time of drink coffee/tea	During meal	104	46.8
	Right after meal	118	53.2
Category of IDDS	Low	68	24.2
	Medium	96	34.2
	High	117	41.6

Table 3: *Individual dietary diversity and dietary pattern of the study participants among high school adolescent girls in Mizan Aman Town, Southwest Ethiopia, 2020. N = 281.*

Factors Associated To Anemia

In bivariate analysis with P-value < 0.25, Father education, Living arrangement, Father Occupation, Family size, use of ITN, Wealth index, Duration of menstruation, IDDS are significantly associated with anemia among adolescent girls attending high school. Multivariable logistic regression analysis with P-value < 0.05 indicated that father education, family size, wealth index, duration of ministration, and IDDS were significant predictors of anemia among adolescent girls attending high school.

The odds of having anemia were twenty-seven percent times higher among illiterate fathers of adolescent girls compared to adolescent girls their father's educational level were Collage and Above (AOR = 1.27; 95% CI: 0.67, 5.70; P = 0.014). the odds of having anemia was 3.23 times higher among adolescent girls having a family size greater than five compared to adolescent girls who had family size less than or equal to five (AOR = 3.23; 95% CI: 1.13, 5.78; p = 0.012). Adolescent girls from low wealth status families were six times more likely to be anemic compared to those girls who had high wealth status families (AOR = 6; 95% CI: 2.31, 15.7; p = < 0.001). Additionally, the odds of having anemia were 2.63 times higher among adolescent girls having a duration of menses > 5 days compared to girls who had a duration of menses ≤ 5 days (AOR = 2.63; 95% CI: 1.03, 6.67; p = 0.043). Additionally, the odds of having anemia was 3.27 times higher among adolescent girls Who had low IDDS compared to girls who had high IDDS (AOR = 2.13; 95%CI: 1.16, 8.43; p = 0.024) (Table 4).

Predictor	Category	Anemia status		COR 95%CI	AOR 95%CI	P-value
		Anemic (%)	Normal (%)			
Father education	Illiterate	9 (33.3)	18 (67.7)	0.625 (0.30, 0.83) *	1.27 (1.06,5.70)**	0.014
	Reade and write	17 (38)	28 (62)	0.52 (0.22,1.62)	1.670 (0.20,3.77)	0.801
	Primary school	13 (23)	44 (77)	1.05 (0.45 ,3.30)	1.37 (0.38,4.35)	0.628
	Secondary school	7 (11)	61 (89)	2,72 (0.24,1.61)	0.83 (0.23,3.04)	0.829
	Collage and Above	20 (24)	64 (76)	1	1	
Family size	>5	45 (39.1)	70 (60.9)	4.43 (2.46,8.02)*	3.23 (1.13,5.78)**	0.012
	≤ 5	21 (12.7)	145 (87.3)	1	1	
Wealth Index	Poor	40 (34.2)	77 (65.8)	5.1 (2.17,5.11.2)*	6 (2.31,15.7) **	<0.001
	Medium	18 (23.1)	60 (76.9)	2.9 (0.90,3.28)	2.40 (0.15, 5.49)	0.380
	Rich	8 (9.3)	78 (90.7)	1	1	
Duration menses	>5 days	17 (36.9)	29 (63.1)	2.05 (1.04,4.00)*	2.63 (1.03, 6.67)**	0.043
	≤ 5 days	47 (22.2)	165 (77.8)	1	1	
IDDS	Low	26 (38.2)	42 (61.8)	2.28 (1.60,6.98)*	2.13 (1.16, 8.43)**	0.024
	Medium	15 (15.6)	81 (84.4)	0.68 (0.15,4.38)*	1.26 (0.22, 3.51)	0.290
	High	25 (21.4)	92 (78.6)	1	1	

Table 4: *Bivariable and multivariable logistic regression model predicting of anemia among adolescent high school girls in Mizan Aman, Southwest Ethiopia, 2020.*

Key ** = candidate variables at p ≤ 0.25 in Bivariate logistic regression ** predictor variables in Multivariate logistic regression at p < 0.05.*

Discussion

The result of this study indicated that the overall prevalence of anemia among high school adolescent girls was 23.5%. Based on WHO criteria when, the magnitude of anemia within 20% to 39.9% is moderate public health problem. So that the magnitude of anemia in high

school adolescent girls in Mizan Aman Town is a moderate public health problem. Among high school adolescent girls who had anemia, the prevalence of mild and moderate anemia is 13.2%, and 10.3%. The finding of this study showed that father education, family size, lower wealth index, duration of menstruation, and low dietary diversity score were independent significant predictors of anemia.

The magnitude of this finding is Similar finding with that of reported in Aw-Barre refugee camp, Southeast Ethiopia, [21], Berhale, afar region [22], Dembia northwest Ethiopia [10], research done in three districts of Ethiopia namely, Debrelibanose, Laygayint and Damotegale [23] and in Kenya [7]. The prevalence of the current study result also higher than studies done in central Kerala, India [24], in rural western China [25], Bahir Dar, Northern Ethiopia [26]. In Hadero, Southwest Ethiopia, and Kebena garage zone [27,28]. In contrast, the current study result is lower than studies conducted in Kashmir Pakistan [29], the eastern part of Nepal [30], And the Baglung municipality in Nepal [31]. The difference might be due to the area difference, socio-economic difference, sample size difference, and cultural behaviors like dietary habit differences.

Fathers' educational status is significantly associated with the magnitude of anemia among high school adolescent's girls. High School adolescent's girls who had illiterate fathers were twenty-seven percent times more likely to be anemic as compared to high school adolescents who had fathers were collage and above level. similar studies were reported in Pakistan, Kenya, and Mekelle adolescent girls whose fathers were either illiterate were developed anemia than their counterparts [5,7,29]. In contrast to this finding, the study finding in Rwanda [32], China [25] showed that father educational status did not show significantly associated with anemia among adolescent girls. This might be due to the reason that an educated father is make informed decisions about his own family, and for his child as compared to his illiterate father. This is because, in Ethiopia, most of family decisions are made by the father, and if they are educated and they might have the power to make decisions related to child health and the expected expenses, which affected the anemia magnitude. Additionally. The reason might be that educated fathers are more likely to have well-paid jobs, and more likely to adopt healthier dietary behavior.

Adolescent girls who had a household family size five and more were significantly associated with anemia among high school adolescent girls. High school adolescent girls who had a family size five and more were 3.23 times more likely to be anemic as compared with high school adolescent girls from less than five family size. Similar studies were reported in Haldwani India, Gedeo, and Bahir Dar [26,33,34]. But this finding is a contrast in Bhilwara [35]. The reason might be due to the large size of the family that can be related to low care per family member and income constraint to obtain diet with diversified foods richest in micronutrients.

The reverse association was seen between wealth status and anemia; it is evident that girls from the poorest wealth status family were more affected by anemia compared to those from richest wealth status of the family. The odds of anemia were six times higher among high school adolescent girls whose families are under low wealth status than those who had high wealth status family. This finding also similar to a study conducted in Berhale afar region [22] Pakistan and Bhilwara [29,35]. The reason might be Adolescent girls of poor wealth status condition tend to consume poor iron-rich food sources, with lesser micronutrient content which might have resulted from a higher prevalence of anemia.

Adolescent girls who had menstrual flow for greater than five days were 2.63 times more likely to be anemic as compared to those high school adolescent girls with menstrual flow ≤ 5 days per each cycle. This finding is in line with Tamil Nadu India, Bahir Dar, Hadero and Pakistan [4,26,27,29]. This reason may be due to blood loss during menstruation time.

Another interesting finding of this study is a dietary diversification intake score were also found to be an independent predictor of anemia among adolescent girl students, low dietary diversification intake score was two times more likely to be anemic compared to those with a high dietary diversification intake score. This is agreement with the study done in. Hadero and Bhilwara, Southern Ethiopia as consumption of low diversified foods were associated with anemia among adolescent girls [27,35]. This might be Poor dietary diversity leads to a deficiency of minerals, nutrients, and vitamins that may affect iron status then it can lead to anemia. dietary diversity is strongly associated with adequacy of nutrient including iron adequacy this was consistent with a study conducted in Tigray north Ethiopia and

Dembia northwest Ethiopia [5,10]. This might be due to adolescents girls consumed less quality diet are more likely to be anemic when the nutrient adequacy increases as diet diversity. Because the adolescent time is a special period with increased energy and nutrient requirements, so they need to receive an adequate variety of food groups on dietary diversification and are simple, cost-effective, and sustainable methods to alleviate the problem.

Conclusion

The result of this study indicated that the overall prevalence of anemia among high school adolescent girls in Mizan Aman Town is a moderate public health problem. This study identified Factors associated with anemia among adolescent girls in the study area were father education, family size, low wealth index, duration of menstruation, and low dietary diversity score. Therefore School-based intervention among school adolescents girls based on identified determinant factors will be very important for the prevention and control of anemia among the group. As well as they need health education, Nutrition and an iron-rich source of food.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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