Prevalence of anemia and associated factors among age 15-64 ''apparently healthy'' urban and rural residents in Gilgel Gibe Field research center, Jimma Ethiopia: comparative cross sectional study

BY:

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Abstract

Background: Anemia affects the lives of more than 2 billion people globally, accounting for over 30% of the world's population which is the most common public health problem particularly in developing countries. Most studies indicate prevalence of anemia vary in all age group in rural and urban areas. The higher prevalence of anemia from rural areas is likely related to, inadequate diet; parasitic infestation, economic factors and inaccessibility of health care centers.

Objective: To determine prevalence rate of anemia and associated factors among apparently healthy urban and rural residents in Gilgel Gibe Field Research Center.

Methods and materials: This was a comparative cross-sectional study based on secondary data collected from late September 2008 to the end of January 2009 in Gilgel Gibe Field Research Center of Jimma University. Sample size was determined using recommendations in the WHO-STEP wise surveillance manual. Data were collected according to WHO-STEP wise approach in a community setting. .Data on a total of 1602 was included in the analysis. Information on hemoglobin level and independent variables were extracted accordingly. The participants' were stratified by urban and rural and frequency distribution, mean and standard deviation (SD) for continuous variables and proportions for categorical variables of each stratum was computed. The prevalence rate of anemia was calculated for both urban and rural. A logistic regression was used to identify independent determinants of anemia. A P-value < 0.05 at 95 % CI was considered statistically significant.

Result: The overall prevalence of anemia was 40.9%. 20.1 % among urban and 46.6 % for rural residents. In urban residents, sex (AOR=2.152, 95% CI=1.029-4.500) and educational status(AOR=5.745 95% CI=1.266-26.071) were determinants of anemia and in rural residents' sex (AOR=1.788 ,95 %CI=1.267-2.522) , educational level (AOR=3.615 95% CI=1.565-8.351) heart disease (AOR=2.628 ,95 % CI= 1.091-6.332) and presence of central obesity(AOR=1.832,95% CI=1.305-2.572) were significantly associated with presence of anemia.

Conclusion: This study showed difference of anemia prevalence in urban and rural and also found a high prevalence of anemia in both males and females, indicating that anemia was related to a wider population than the traditional groups of females and implicit the importance of including all apparently healthy individuals in addressing anemia.

Key words: Anemia, Apparently healthy, Community based, Gilgel Gibe Field Research Center

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Acronyms

BMI	Body mass index
CHF	Chronic heart failure
CNC	Chronic non communicable disease
DALYs	Disability Adjusted Life Years
DM	Diabetes Mellitus
EDHS	Ethiopia demographic and health survey
GGFRC	Gilgel Gibe Field Research Center
G/L	Gram per Liter
Hb	Hemoglobin
HTN	Hypertension
IDA	Iron deficiency anemia
SNNPR	Southern Nations and Nationalities Peoples Regional State
WHO	World health organization

1. Introduction

1.1. Background

Anemia is defined as a condition in which there is less than the normal hemoglobin (Hb) level in the body, which decreases oxygen-carrying capacity of red blood cells to tissues. Anemia is a global public health problem affecting both developed and developing countries with major consequences for human health as well as social and economic development(1).

Anemia affects the lives of more than 2 billion people globally, accounting for over 30% of the world's population which is the most common public health problem particularly in developing countries occurring at all stages of the life cycle. The prevalence of anemia in developing and developed countries is estimated to be 43% and 9%respectively. Pregnant and lactating females, growing children's and elderly people with some underlying disease causing blood lose are at more risk as compared to other groups of population. However ,nobody is immune to have anemia(1,2).

Hemoglobin concentration is the most reliable indicator of anemia at the population level. Measuring Hb concentration is relatively easy and inexpensive, and this measurement is frequently used as a proxy indicator of iron deficiency(2).Although many studies have described reference intervals for hemoglobin in healthy individuals, there is significant variability in the definition of anemia among clinical laboratories ,but the most commonly used definition of anemia is the World Health Organization's definition of a hemoglobin concentration below 130 g/L for men and 120 g/L for non-pregnant women or below 110 g/L in pregnant women(3). However, reference range for normal blood hemoglobin levels may vary in individuals depending on the age, gender, race, geographical location and food habits of the study population(4). Anemia is again classified according to its severity as mild degree in non-pregnant adult women (Hb110-119 g/L) and (Hb 110-129g/L) in adult male, moderate (Hb80-109g/L) and severe (Hb lower than 80 g/L) in both sex(5).

Anemia is said to be a severe public health problem when its prevalence is 40% or more in any group (all types of anemia) and no public health problem when the prevalence is less than 5%(2).Anemia may result from a number of causes, with the most significant contributor being iron deficiency. Approximately 50% of cases of anemia are considered to be due to iron deficiency(6).This is true in all developing countries including Africa, where consumption of iron is limited. This is because iron-rich or animal based foods are not affordable by most families(7).

There are various modifiable and non-modifiable factors affecting anemia in combination or alone. These may range from ethnicity, gender, age, socio demographic status, dietary habits, physical and mental health, gynecological/obstetric history, cancers, and anti-cancerous drugs to genetic makeup Specific risk factors include deficiency of iron, worm infestation, repeated pregnancies, menorrhagia, postpartum hemorrhage, gastric ulcers, hemorrhoids, intake of aspirin/no steroidal ,anti-inflammatory drugs, and pure vegetarian diet (8).

In most of the cases, anemia is largely preventable and easily treatable if detected in time. Effective management of anemia includes treatment of the underlying causes, restoration of the hemoglobin concentration to normal levels, and prevention and treatment of complications(9). Given the multi-factorial nature of this disease, correcting anemia often requires an integrated approach. In order to effectively combat anemia, the contributing factors must be identified and addressed (10).

1.2. **Statement of the problem**

In a world plagued by poverty, ignorance, malnutrition and disease, Anemia is a prominent and at times troublesome feature of today's health scene and about 2 billion people around the world suffer from this anemia(11). According to WHO criteria, every 9 out of 10 persons affected by anemia live in developing world. Anemia is a severe public health program in nearly all developing countries. For all age groups, the risk of developing anemia is two to seven times greater in developing countries than in industrialized countries and anemia prevalence is higher in rural areas compared with urban areas(12,13).

The greatest burden of anemia is borne by Asia and Africa where it is estimated that 60% and 52% of women respectively are anemic and between 1% and 5% are severely anemic. Surprisingly, it has been suggested that the unacceptably high prevalence of anemia in developing countries could be an underestimate because data from rural areas is still lacking, the actual prevalence rates for many individual countries are not known, and there are very few community based survey(14).

Studies conducted over the years witnessed the public health significance of anemia in Ethiopia(15). 17% of Ethiopian women age 15-49 are anemic, with 13% having mild anemia, 3 % having moderate anemia and 1% having severe anemia. Anemia prevalence also varies by urban and rural residence; a higher proportion of women in rural areas are anemic (18 %) than those in urban areas (11%). Also, women in the Somali, Afar, and Dire Dawa regions have a relatively high prevalence of anemia (44%, 35 %, and 29% respectively(16).

Women in Addis Ababa, SNNP and Tigray regions are at the other end of the range, with relatively low prevalence of anemia (9%, 11%, and 12 %, respectively) nationally, 11 % of men 15-49 are anemic. Rural men are more likely to be anemic than urban men (13 and 5 %, respectively). Men residing in Addis Ababa have the lowest anemia prevalence (3%) of any region, while men in Afar, Somali, and Dire Dawa (all 15%) have the highest(16).

Apparently healthy and mildly anemic subjects with borderline hemoglobin levels are reported to be quite common in the general population all over the world. While moderate and severe anemia gets immediate attention due to more obvious symptoms, mild anemia is often ignored by the people as well as by the general practitioners. Most of these mildly anemic individuals are not investigated sufficiently to establish the probable cause of their anemia.Failure to identify and investigate mild anemia in apparently healthy people could lead to delayed diagnosis of potentially treatable conditions (4).

Functional consequences of anemia are diverse. It follows the life cycle approach where each stage of life is affected. Inside the mother's womb it decreases fetus' physical growth and may cause mental growth retardation; during childhood it affects cognitive growth and development; during adult hood it decreases physical work capacity, and finally in elderly it affects the quality of life. In addition, in severe cases it may lead to maternal and infant mortality (8).

Vital aspects of human health are also adversely affected by anemia, including physical activity, temperature regulation, behavior and immune function .Previous studies have linked iron deficiency and anemia with cognitive impairment and altered brain function(17).

Anemia has fore most concerns not only on human health but on social and economic development as well. World Wide, Anemia is considered as second leading cause of disability which accounts for about 1 million deaths per year. In terms of lost years of healthy life, IDA causes 25 million cases of Disability Adjusted Life Years (DALYs) which is accountable for 2.4 per cent of the total DALYs worldwide. In the World Health Organization rankings, iron deficiency anemia is the third leading cause of Disability Adjusted Life Years lost for females' (15–44 years age group)(18).

Failure to reduce anemia worldwide consigns millions of women to impaired health and quality of life, generations of children to impaired development and learning, and communities and nations to impaired economic productivity and development. So, the international community, through the United Nations, has committed to reducing the global prevalence of anemia by one third by 2010 and in 2012 the World

Health Assembly Resolution specified six global nutrition targets for 2025 and 50% reduction of anemia in women of reproductive age is one of the targets. This presents an enormous challenge, as progress towards achievement (12)(6).

Despite the high prevalence of anemia and its serious consequences, very few examples of effective anemia control programs exist. This may be due to the multi-factorial etiology of anemia and the fact that there is not one easily administered solution available. In summary, the development of effective anemia control programming first requires analysis of the main determinants of anemia in the target population and then selection of interventions that are most likely to be effective given the socio-demographic characteristics of the intended beneficiaries(12).

Most studies indicate prevalence of anemia vary in all age group in rural and urban areas(12,16).The higher prevalence of anemia from rural areas is likely related to lack of information about adequate nutrition during pregnancy, economic factors and inaccessibility of health care centers(19).Inadequate diet, parasitic infestations, and malaria in the endemic regions, case of high loss of blood during delivery are additional factors increasing the risk of development of anemia, in rural areas(20).

Institution/hospital-based studies are available regarding prevalence and risk factors for anemia but are subjected to selection bias and may not be generalizable therefore; reassessing anemia through community-based approach is a crucial component of public health research(8).And Most of the anemia prevalence related studies have been performed on pregnant women, children and adolescents. Very few studies concentrated on apparently healthy general population. So, this study aimed to study the prevalence of anemia and associated factor among apparently healthy adults aged 15-64 Years in urban and rural communities of Gilgel Gibe Field Research Center, Southwest Ethiopia, 2016.

2. Literature review

2.1. Overview of prevalence of Anemia

Anemia is considered the most common nutritional deficiency worldwide and in 95% of cases it is associated with an iron-poor diet despite the fact that iron is the second most abundant metal in the earth's crust(21).

The 2011 WHO estimates suggest anemia affects around 800 million children and women.273.2 million Children, 496.3 million non-pregnant women, and 32.4 million pregnant women, Of these, 9.6 million children, 19.4 million non-pregnant women and 0.8 million pregnant women had severe anemia(1).

The global prevalence of anemia among non-pregnant women, pregnant women and children aged less than 5 years have fallen only slightly: from 33 to 29%, 43 to 38% and 47 to 43%, respectively. Although the corresponding prevalence of severe anemia have shown more substantial declines over the same period –from 1.8 to 1.1%, 2.0 to 0.9% and 3.7 to 1.5%, respectively .The global prevalence of anemia only fell by 0.2 to 0.3 percent- age points per year between 1993 and 2013.Anaemia in women especially among non-pregnant women in central, northern and western Africa, Central Asia and the Middle East and among pregnant women in southern Africa and Southern Asia is a particularly persistent problem(22).

There are almost no countries where anemia is not at least a mild public health problem in all three of the population groups for which country-level estimates were generated. In spite of the epidemic proportions of the problem, the prevalence of anemia significantly varies in different populations and among different groups within one population. Anemia estimates by UN regions state that Africa has the highest prevalence of anemia for all three population groups, but the greatest numbers of people affected are in Asia, where 58.0%, 56.1% and 68.0% of the anemia burden in preschool-aged children, pregnant women and non-pregnant women, respectively, exists. The majority of these people live in south-central Asia(2,23).

High-income regions, central and eastern Europe, and southern and tropical Latin America had the highest hemoglobin, and smallest prevalence of anemia, all less than 25%. Percentage of women in reproductive age (15–49 years)with anemia in regions of America, European region and western pacific regions is 16.5%,22.5% ,19.8% respectively(24,25)

Anemia prevalence was about 50% in non- pregnant women or above 50% in pregnant women in central and West Africa and south Asia. These regions also had the countries with the lowest hemoglobin concentrations and highest anemia prevalence, including Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Senegal, and Togo (24).

Anemia is a significant public health problem in Ethiopia .According to the 2012 Ethiopian Central Statistical Agency report, nationally, 44% of children aged 6-59 months were anemic, with 21%, 20% and 3% having mild, moderate and severe anemia. Moreover, 17% of women aged 15-49 were anemic; of which 13% had mild anemia, 3% were moderately anemic, and less than 1% were severely anemic. Iron deficiency anemia was ranked as one of the significant micronutrient deficiency problems in Ethiopia(19).

Reasonable number of national level surveys also determined the prevalence of anemia in women of reproductive age and came up with figures ranging from 16.6 to 30.4%. Concerning pregnant women, two large scale surveys reported 30.6% and 18.4% prevalence. Small scale studies in Awassa and Jimma towns also found 15.1% and 38.2% prevalence. All the studies consistently witnessed the public health significance of anemia in the country(26).

Anemia prevalence also varies by urban and rural residence; a higher proportion of women in rural areas are anemic (18 percent) than those in urban areas (11 percent). Also, women in the Somali, Afar, and Dire Dawa regions have a relatively high prevalence of anemia (44 percent, 35 percent, and 29 percent, respectively). Women in Addis Ababa and the SNNP and Tigray regions are at the other end of the range, with relatively low prevalence of anemia (9 percent, 11 percent, and 12 percent, respectively)Rural men are also more likely to be anemic than urban men (13 and 5 percent, respectively). Men residing in Addis Ababa have the lowest anemia prevalence (3 percent) of any region, while men in Afar Somali, and Dire Dawa (all 15 percent) have the highest(16)

2.2. Socio-demographic and economic factors

Socio-demographic and economic characteristics such as ethnicity, sex, age, occupation, educational status, marital status, family size and income play their role through depriving a person from acquiring and maintaining sufficient amount of micronutrients by different mechanisms. Anemia is one of the most common problem among population groups with low socioeconomic status(27).Low socioeconomic status affects healthcare seeking behavior, nutrition as well other infestations and infections that may lead to anemia(28).Study done in Rural Punjab, India indicate the prevalence of anemia decreases with an increase in the standard of living index among both males and females (15-49 years)(29).

Almost all studies indicate anemia prevalence is higher in women than in men (2,3,16,21,30) and Age has a big contribution to anemia occurrence. Studies done in Saudi Arabia indicate that females less than 35 years had the highest prevalence rate of anemia (31).

Educational status of has a big role in the anemia occurrence according to finding from different studies. In study conducted in Saudi Arabia, Bangladesh and Ethiopia state that anemia prevalence is higher in illiterate than literate (10,30,31).

Occupation of women also affects the anemia prevalence in pregnant women, and this fact was supported by study done in Azezo Health Center Gondar Town in which, the risk of anemia was 2.42 times higher among housewives as compared to governmental employee(10) and study done in Rural Punjab, India ,indicated the prevalence of anemia does not vary much by the work status, but women who do not work have a slightly less prevalence of anemia than the working women (29) and Study done in Wolayita Sodo town, indicates a higher prevalence of anemia in young pregnant mothers, large family size and large number of children ever borne(9).

Study done in East Harerge found a significantly higher prevalence of anemia was found among pregnant women who were from rural areas. Pregnant women from rural areas were more than three times more likely to be anemic than their urban counter- parts. The higher prevalence of anemia among pregnant women from rural areas is likely related to lack of information about adequate nutrition during pregnancy, economic factors and in accessibility of health care centers(19)and also study done in northern Tigray stated variation of prevalence of anemia in urban and rural areas(32).

2.3. Nutrition and dietary habit related factors

Healthy and correct diet prevents anemia, especially in child bearing age women. Dietary iron comprises of heam and non heam iron. heam iron is mainly available through meat intake and may be absorbed up to 50%, whereas non heam iron mainly available through fruits, vegetables, dairy products (milk, butter, and yogurt) is variable and depends upon enhancers and inhibitors for iron absorption. Absorption of non heam iron increases in presence of meat, poultry, sea food, and juices with vitamin C, whereas tea, coffee, and egg yolk act as inhibitors towards iron absorption(8).

A cross sectional study carried out based on the secondary data of the Ethiopia Demographic Health Survey (EDHS) 2005 indicated that ,mean hemoglobin level among those who consumed iron rich foods was significantly higher than those who didn't and The risk of anemia was 1.3 times higher among those who did not consume iron reach foods compared to their counterparts(15).Study done in Rural Adolescent Girls in District Karnal ,India indicate that Most of the anemic adolescent girls were vegetarian (53.18%)(18).and also other study in Adolescent Girls of Rural Ward, India state that vegetarian diet were important determinants of anemia(33).

Fruit consumption has shown an association with maternal anemia by playing a preventive role through enhancing absorption of non-heme iron. A facility based cross-sectional study carried-out in Egypt on 381 pregnant women revealed that anemia prevalence among those who consumed fruits less than four times a week was almost double (66.2%) than those who consumed it more than four times a week (33.8%).(28) Green leafy vegetables consumption did also established a significant association with anemia as reported from West Arsi, Ethiopia (34).

2.4. Physical Measurements related factors

The prevalence of overweight and obesity has increased significantly in children and adolescents and, in these individuals, iron deficiency may be related to a micronutrient-poor, calorie-rich diet, to a greater need for iron that is associated with body weight, to genetic factors and/or to sedentary life. Furthermore, overweight and obesity lead to a continuous inflammatory process, intensifying anemia and hampering treatment (21).

Study done in Rural Punjab, India implies that the prevalence of anemia in females was found to increase with a decrease in the BMI, that is, the prevalence was 91.4% in females with low BMI, 83.6% in those with normal BMI and 73.7% in females with high BMI. Similarly, in males, the prevalence of anemia was 91.8%, 78.2% and 90.9% in those with low, normal and high BMI respectively(29).Another study in

adult rural population of West Bengal, India state Mean values increased steadily from the underweight through the normal to the overweight/obese groups. Overweight/obese subjects had the highest mean value of hemoglobin and statistically and significant differences were found in the prevalence of anemia between groups based upon BMI of both sexes(35).

According of study based on EDHS 2005,the mean hemoglobin levels for low, normal and overweight categories of BMI were 12.6 g/dl ,12.9 g/dl and 13.3 g/dl), respectively. The difference was statistically significant (P=0.000). Compared to those with normal BMI, women with low BMI were 1.36 (95% CI: 1.19-1.56) times more likely to have anemia(15)

2.5. Medical condition related factors

The relationship between infection and anemia varies with the nature of the disease. Chronic diarrheal disease and bacterial or viral infections of the gastrointestinal tract cause iron deficiency and anemia secondary to mal absorption and intestinal blood loss. Chronic inflammation is also associated with anemia due to swelling of tissues, rather than nutritional iron deficiency. Some chronic diseases, s, greatly increase metabolism, thus increasing the body's requirement for iron, and other nutrients and for overall caloric intake. These higher needs are often difficult to meet which leads to malnutrition, including the nutritional deficiencies which cause anemia.

Anemia occurs commonly in patients with chronic heart failure (CHF) and has been proposed as a novel therapeutic target in this population. Estimates of the prevalence of anemia in patients with CHF and low ejection fraction range widely from 4% to 61% (median 18%).Variability in estimated prevalence is partly attributable to use of inconsistent definitions of anemia in individual reports(36).Several studies have demonstrated that anemia is a prevalent co morbidity in patients with HF, and a marker of a worse outcome, with increased left ventricular mass re hospitalizations and increased mortality(37).

In a recent meta-analysis of 34 CHF studies including a total of 153,180 patients, 37.2% were anemic (using the authors' own criteria) and the adjusted hazard ratio for death was 1.46 in these anemic CHF patient (37).

A population-based cohort study in Canada also indicate that from all the cardiac patient 17% had anemia and from them 21% had iron deficiency anemia(38).

Anemia is a common accompaniment to diabetes, particularly in patients with albuminuria or reduced renal function. According to study done in Australia indicates, nearly one in four patients with diabetes (23%) have anemia(39).It has been recently recognized that anemia is also a common complication of diabetes, particularly in patients with diabetic kidney disease. In a recent cross-sectional survey of patients with diabetes in a single clinic, nearly a quarter of all outpatients had anemia.

It is unproven whether anemia directly contributes to the acceleration of complications in DM or to the progression of diabetic renal disease. However, patients with diabetes may be more vulnerable to the effects of anemia because many also have significant cardiovascular disease and hypoxia-induced organ damage. In addition, Hb levels may be linked to the risk of cardiovascular events, hospitalization, and mortality. Against this, there is no conclusive evidence that correcting anemia significantly improves outcomes in patients with failing renal function, apart from quality of life(39).
HIV infection is strongly linked with anemia through a variety of mechanisms. These include chronic disease and inflammation; increased metabolic and nutritional needs; poor intake of iron and other nutrients due to reduced appetite and anorexia; mal absorption of nutrients; and direct suppression of red blood cell production(12).

2.6. Behavioral related factors

In addition to age and sex, there are several environmental factors, particularly those affecting oxygen supply, which can influence the levels of hemoglobin in the blood. Among others, smoking is one of the factors. They need to be considered in setting hemoglobin cutoff points for individual hemoglobin testing as well as for population-based anemia studies(40).

Literature review done in USA state, Cigarette smoking during pregnancy may alter the micronutrient status of the pregnant woman and the fetus, leading to adverse pregnancy outcomes. Cigarette smoking decreases appetite and may decrease the amount of nutrients consumed by the pregnant woman. Cigarette smokers may be less likely to consume micronutrient supplements and more likely to consume alcohol and other substances that interact with nutrient metabolism. Cigarette smoking may decrease absorption of micronutrients in the intestine and increase the utilization of nutrients(41).

Similar to the effects of cigarette smoking, many of the effects of alcohol use during pregnancy may be mediated through micronutrients .Chronic alcohol intake can produce malnutrition as a result of inadequate dietary intake. Energy from alcohol may replace that from food, leading to an overall decline in nutrient intake. Alcohol intake can disturb gastrointestinal function, leading to reduced or enhanced absorption of vitamins and minerals(41).

A retrospective, epidemiological cohort study in Denmark result show that, in both genders smokers had significantly higher mean hemoglobin than non-smokers. There was also a weak but significant positive correlation in daily smokers between hemoglobin and the number of cigarettes/day in women. In all groups, heavy smokers had higher mean hemoglobin levels than “light” smokers (less than or equal to ten cigarettes/day) male non-smokers consuming >14 drinks/week have 1.3% higher mean hemoglobin than non-smokers consuming ≤14 drinks/ week and female non-smokers, where heavy drinkers had on the average 1.9% higher mean hemoglobin than light drinkers(42).

2.7. Conceptual frame work

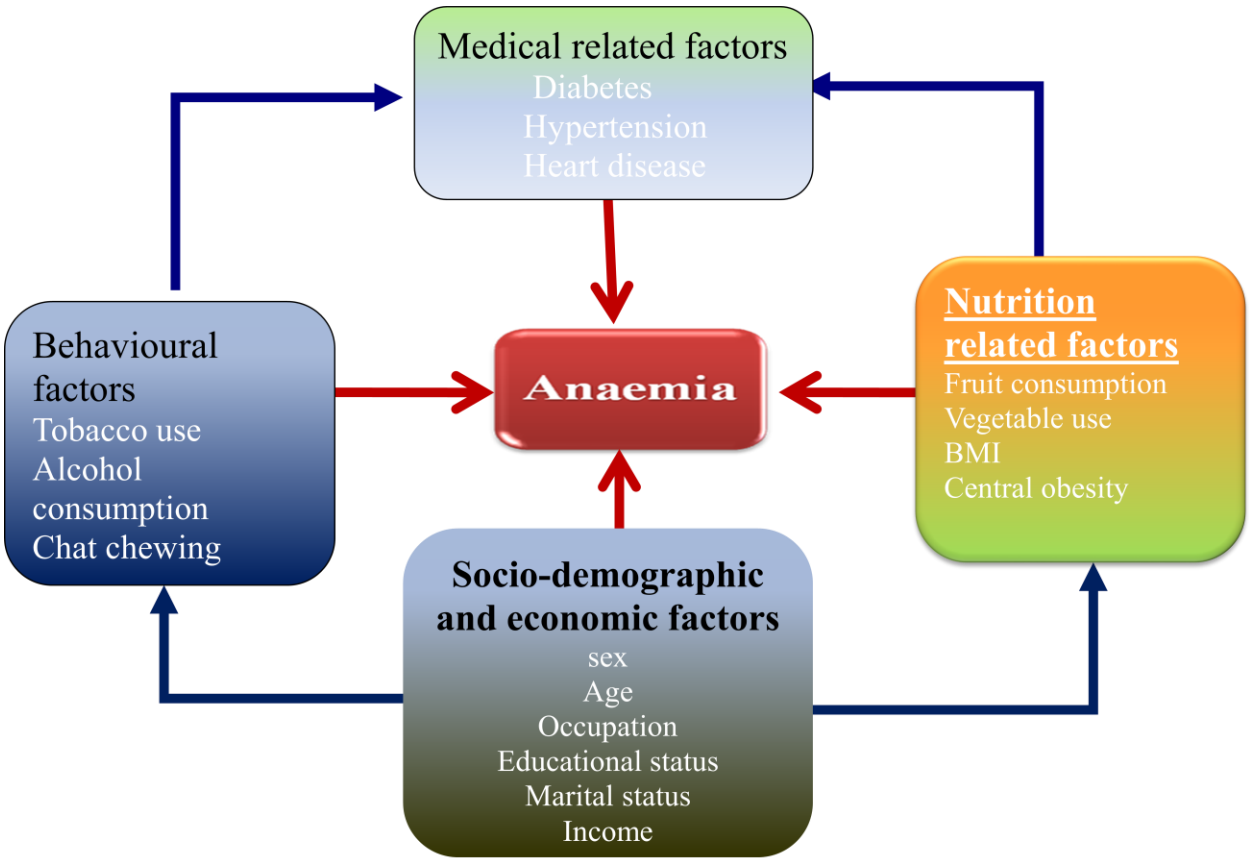

Figure 1 Conceptual framework on different risk factors of anemia (adapted from WHO stepwise guidelines)

2.8. Significance of the study

Due to high prevalence and the significant impact it has on the population's health, anemia has been recognized as a public health problem for several decades. However, despite all the efforts that have been made to reverse this, the global prevalence of anemia is still unacceptably high. Understanding the prevalence and associated risk factors is a critical component of any effort that aims to reduce the burden of anemia.

The management and control of anemia can be enhanced by the availability of local data, which is, however, not adequately provided in Ethiopia and specifically in this source population. So, this study determined the prevalence of anemia and its associated factor in urban and rural communities of Gilgel Gibe Field Research Center.

Since this research is done on apparently healthy 15-64 age individuals it provided the situation of anemia in the general community which is comprehensive of all age group both in rural and urban population and showed the discrepancy and the factors related to it.

The data obtained from this study used as a guide for health professionals working on anemia, and it can also be used as an input for different policy makers concerned in drawing strategic plan to halt anemia burden in this population. Findings from this study can be used as a reference for researchers who are interested to study similar issues in the area.

3. Objectives of the study

3.1. General objective

- To determine prevalence of anemia and associated factors among ‘’apparently healthy’’ urban and rural residents in Gilgel Gibe field research center, Jimma Ethiopia, 2016.

3.2. Specific objectives

- To determine prevalence of anemia among ‘’apparently healthy’’ urban residents in Gilgel Gibe field research center, Jimma Ethiopia, 2016.
- To determine prevalence of anemia among ‘’apparently healthy’’ rural residents in Gilgel Gibe field research center, Jimma Ethiopia, 2016.
- To Identify factors associated with anemia among ‘’apparently healthy” with comparison of urban and rural residents, 2016.

4. MATERIALS AND METHOD

4.1. Study area and period.

The community based cross-sectional survey was conducted in Gilgel Gibe Field Research Center (GGFRC) of Jimma University .Gilgel Gibe Field Research Center is located in Southwestern Ethiopia, Jimma zone, around Gilgel Gibe Hydroelectric dam, 260 km southwest of Addis Ababa and 55 km Northeast of Jimma town within four districts of Jimma Zone, Oromia Region, Southwest Ethiopia and found at altitude of 1672-1864 m above sea level.

The center comprised of 10 kebeles (smallest administrative structure in Ethiopia) of which 3 are small towns. The study area comprised of about 11,000 households with a total population of more than 50,000. By ethnicity and religion, the population comprises of mainly Oromo and Muslims. Out of the total population, 15 to 64 years comprised of about 49%. There were one health center and 4 health posts in the center during the study period. There were two trained health extension workers in each kebeles (43).

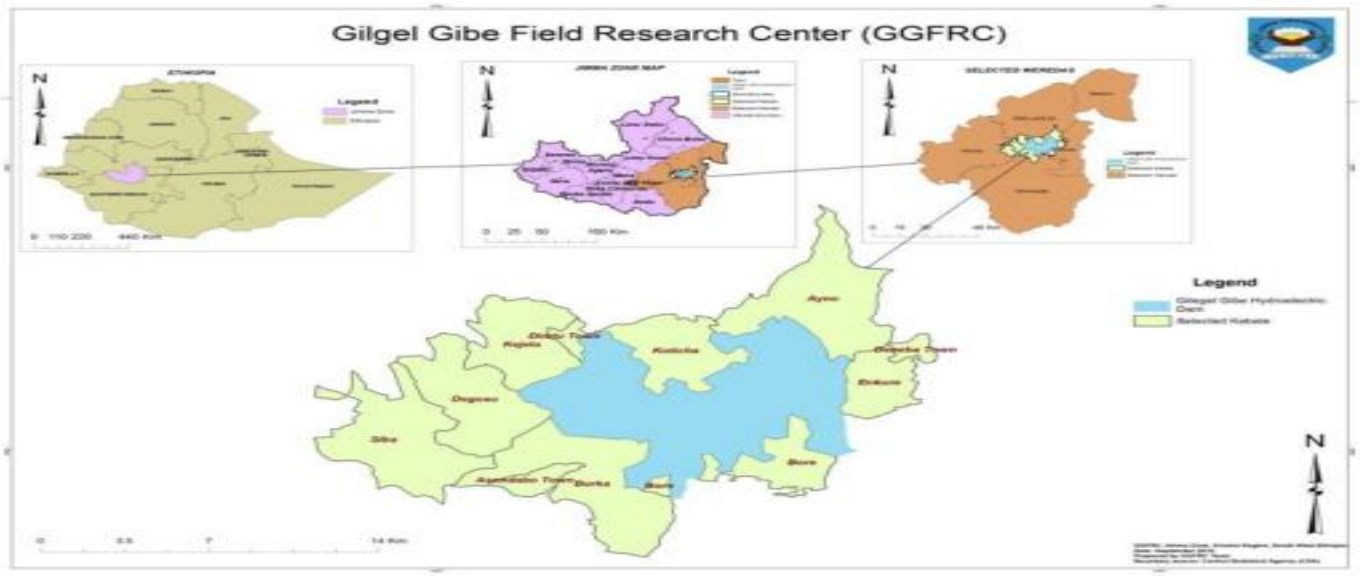

Figure 2: Location map of the study area: Gilgel Gibe Field Research Center(43)

4.2. Study design and period

- Community based Comparative cross-sectional study design was used from March 1 –April 30 2016.

4.3. Data type

- Secondary data was used from GGFRC database.

4.4. Population

4.4.1. Source population

- All individuals age 15-64 living in Gilgel Gibe Field Research Center of Jimma University

4.4.2. Study population

- Selected individual's age15-64 in Gilgel Gibe Field Research Center of Jimma University.

4.5. Inclusion Criteria and Exclusion Criteria

4.5.1. Inclusion Criteria

- Individuals in which hemoglobin measurement were taken

4.5.2. Exclusion Criteria

- Individuals with incomplete data records.

4.6. Sample size and sampling techniques

Sample size was determined using recommendations in the WHO-STEP wise surveillance manual to estimate prevalence of CNCDs and their risk factors in each stratum of age, sex and residential area. For both sexes, 250 individuals were taken from each age stratum (5age stratum) giving a sample size of 2500. However, due to further stratification of the study population into urban and rural within age and sex, the sample size was doubled to 5,000. Taking 10% non-response rate, the total sample size became 5,500.

To select the study participants, the 2008 updated census list of the population and households of the ten kebeles was used as sampling frame. Taking 25% urban and 75% rural population distribution in the center, the total sample was distributed proportionally. Then the sample was distributed to each Kebeles proportional to their population size. Using the age and sex stratified sampling frame obtained from the census list, individuals were selected randomly.(44)

For this analysis all sampled individuals whose hemoglobin level were determined (n=1,602) were included.

4.7. Data collection procedure and Data Extraction

Data for the analysis was extracted from the main study database using data extraction templates. The primary data, from which secondary data were extracted, collected according to the WHO- STEP wise approach which involves survey questionnaires for step I, physical body measurements for step II and bio chemical measurements for step III.

Hemoglobin level was determined for respondents selected for hemato immunological tests (Step III). From all the STEPS (STEPS I, II and III). The questionnaire for Step 1 comprised questions about socioeconomic and demographic variables (sex, residence, age, occupation, educational status and income) and questions for assessing behavioral risk factors including cigarette smoking, alcohol drinking, chat chewing and dietary habit. The recording formats were used to record physical measurement values of Step 2 such as blood pressure (BP), weight, height, waist and hip circumference.

The outcome variable, Anemia was extracted from Step III based on the hemoglobin measurements according to the (World Health Organization's Intervals of Hb for the diagnosis of Anemia in which hemoglobin concentration below 130 g/L for men and 120 g/L for women)(5)

4.8. Study variables

4.8.1. Dependent variable:

- Anemia

4.8.2. **Independent variables**:

Socio demographic characteristics

- Sex
- Age
- Occupation
- Educational status
- Marital status
- Family size
- Income

Medical history related factors

- Hypertension
- Heart disease
- Diabetes mellitus

Behavioral related factors

- Tobacco Use
- Alcohol Consumption
- chat chewing

Nutrition and dietary habit related factors

- Green vegetables consumption
- Fruit consumption
- Central obesity
- BMI

4.9. Operational definitions

Anemia; hemoglobin concentration below 130 g/L for men and 120 g/L for non-pregnant women

Mild anemia; hemoglobin concentration between 110-119 g/L in adult women and 110-129g/Lin adult male

Moderate anemia; hemoglobin concentration between 80-109g/L in both sex.

Severe anemia; hemoglobin concentration lower than 80 g/L in both sexes

Apparently healthy; an individual without any symptoms of illness and seems healthy in appearance.

Incomplete data records: Data records which doesn't include major variables .

One standard serving of fruits and vegetables = 80 grams (translated into different units of cups depending on type of vegetable and standard cup measures available in the country

Low serving of fruits and vegetables; less than five serving of fruits and vegetables per day or less than 400 gram per a day

Hypertension: as systolic blood pressure 140mmHg or above and/or diastolic blood pressure 90mmHg or above

Overweight: BMI 25Kg/m2 or higher

Central obesity: Waist to Hip Ratio (WHR) greater than one for men and greater than 0.85 for women

Reported presence of specific CNCDs (DM, HTN, Cardiac disease): defined as the presence of particular CNCDs among interviewed population diagnosed by health professionals while visiting health institutions

Observed/measured CNCDs: the presence of actual CNCDs on physical or biochemical measurement among measured population.

4.10. Data quality assurance

During the primary data collection, interviewer administered structured questionnaires in English language were adapted from WHO STEPS instruments to collect data. Training was given for data collectors and supervisors. Pre-test was conducted on the interview and measurement sections of the study instrument in urban and rural settings which are physically away from the study area. Standardized and calibrated measuring instruments were used for physical measurements. Data were double entered by trained data clerks using EpiDdata version 3.1Data were properly filed and stored both in electronic copies with back up and hard copies(45). The extracted data was cleaned prior to data analysis. This includes: checking ranges, completeness, consistency, missing data and outliers and after detecting appropriate handling for each was done accordingly.

Appropriate coding and recoding of variables was also done and different statistical analysis was done appropriately and all their assumptions were checked in order to make the analysis valid.

4.11. Data processing and analysis

Data was extracted from GGFRC database and was analyzed using SPSS version 20.Further Data cleaning and editing was done and incomplete and inconsistent data was excluded from the analysis. The participants were stratified by urban and rural and frequency distribution, mean and standard deviation (SD) for continuous variables and proportions for categorical variables of each stratum was computed for the descriptive analysis. Data was summarized and organized using Tables and Graphs.

The prevalence rate of Anemia was calculated for both urban and rural. Chi square test was used to determine the association between different factors and the outcome variable. Binary Logistic Regression model was fitted to assess factors associated with Anemia. All variables with a p-value of < 0.25 at bivariate logistic regression were candidates to multivariable logistic regression models. In multivariable logistic regression, backward likelihood ratio with 0.10 probability of removal were used both in urban and rural to identify independent predictors of anemia.

Those variables with *P*value <0.05 in the multivariable logistic regressions were considered as independent predictors of Anemia. Odds ratio and 95% confidence interval was calculated. During the analysis, Hosmer-Lemeshow statistic was used to assess the fitness of the model at P value > 0.05 and it was 0.54 for urban and 0.75 for rural residents. Multicollinerity was also checked using variance inflated factor (VIF<10) and tolerance (<0.1)

4.12. Ethical consideration

An official support letter was obtained from the ethical review board of Jimma University College of health Science to conduct this study. Additionally secondary data was accessed and extracted from GGFRC through legal and official means.

During the original data collection each respondent were informed about the benefits and objective of the study and signed informed consent was obtained from study participants before interview, physical measurements and blood sample collection Confidentiality was kept at each step of data collection and processing. The participants were assured that they have full right to participate or withdraw any time during the study.

4.13. Dissemination plan

The final result of this study will be presented to Jimma University, College of health science department of Epidemiology and will be presented to other concerned governmental and nongovernmental organization.

Finally an attempt will be made to publish in different local and international scientific peer reviewed medical journals.

5. Results

5.1. Socio-demographic characteristics

From the total of 1602 study subjects, 344 (21.47%) were from urban (Females=207) and 1258(78.5%) were from rural (females=638). The mean ages (±SD) for rural and urban residents were 40.36 ±14.9 and 43.3± 14.4 years respectively. Almost a quarter of the study subjects in urban 94(27.3%) and rural 290(23%) were within 55-64 age group. One hundred thirty one (38.5%) urban were housewives and more than half of rural residents were farmers 729(58.1%).Regarding educational status, in both urban and rural areas majorities were illiterate which accounts 56.7% and 84.9% respectively. Both in urban (53.2%) and rural (56.4%) more than half of the respondents monthly income was <500 respectively. (Table 1)

Table 1 Socio demographic result of urban and rural residents of GGFRC, Jimma, South West Ethiopia, Sept 2008-Jan 2009

Variables		Urban Number (%)	Rural Number (%)
Sex	Male	137(39.8)	620(49.3)
	Female	207(60.2)	638(50.7)
Age categories	15-24	39(11.3)	195(15.5)
	25-34	56(16.3)	265(21.1)
	35-44	69(20.1)	271(21.5)
	45-54	86(25)	237(18.8)
	55-64	94(27.3)	290(23.0)
Occupation	Farmer	39(11.5)	729(58.1)
	Housewife	131(38.5)	407(32.5)
	Student	12(3.5)	49(3.9)
	Employed	109(32.1)	41(3.3)
	Unemployed	49(14.4)	28(2.2)
Educational status	Illiterate	190(56.7)	1044(84.9)
	Primary	81(24.2)	137(11.1)
	Secondary and above	64(19.1)	48(3.9)
Income	≤500	41(53.2)	508(56.4)
	500-1000	18(23.4)	251(27.9)
	≥1000	18(23.4)	142(15.8)

5.2. Behavioral and medical characteristics of the respondents

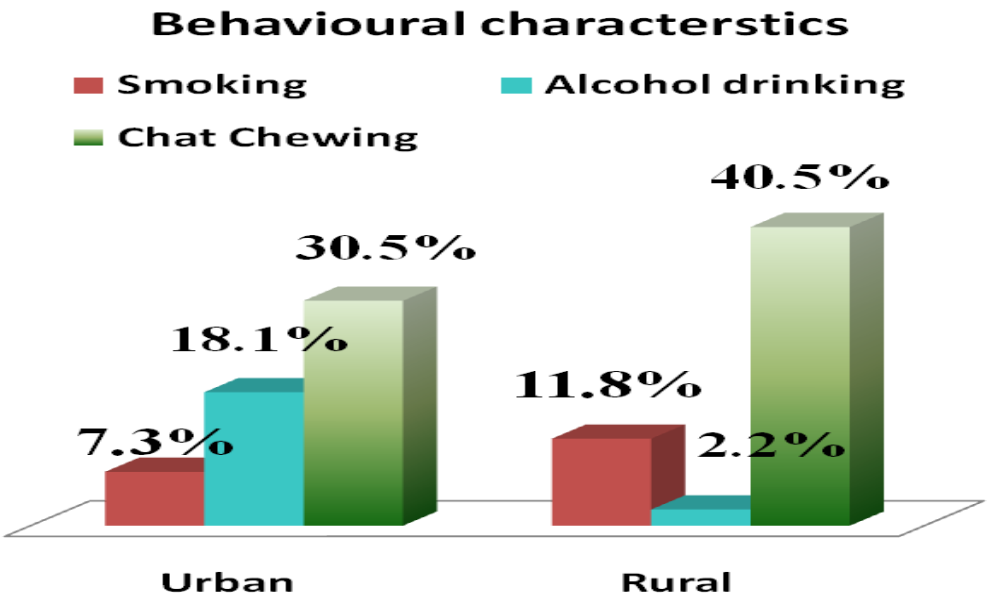

Figure 3 Behavioral characteristics of urban and rural residents of GGFRC, Jimma, South West Ethiopia Sept 2008-Jan 2009

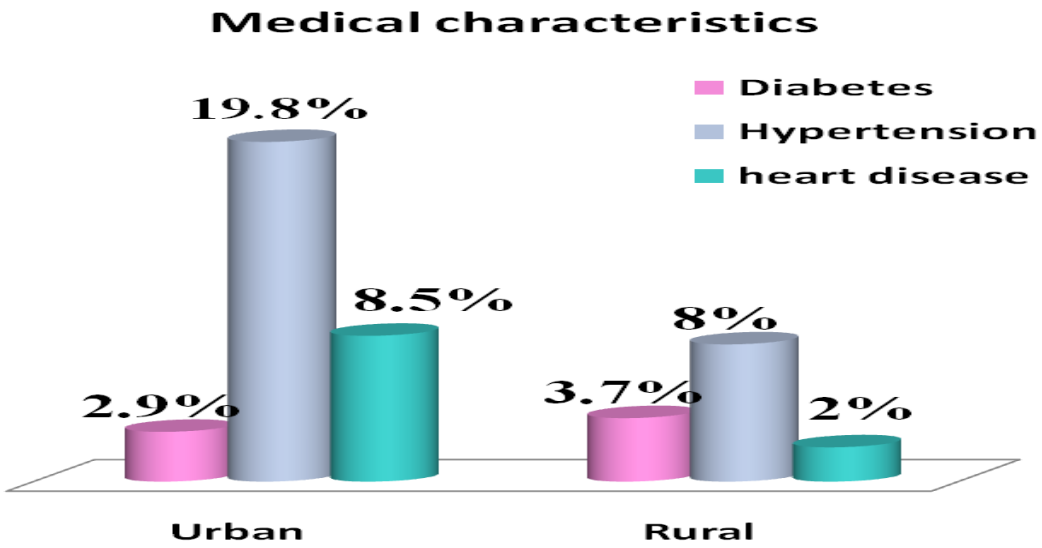

Figure 4 Medical characteristics of urban and rural residents of GGFRC, Jimma, Southwest Ethiopia, Sept 2008-Jan 2009

5.3. Prevalence of anemia

After adjusting of hemoglobin for altitude (Hgb-0.5) and smoke (Hgb-0.3), mean hemoglobin concentration of the study participants was 13 g/dl ± 2.3 with the minimum and maximum value of 3.4 and 57.8 respectively. About 655(40.9 %) (42.9% men and 39% women) had hemoglobin value below the cut-off point and classified as anemic. (95% CI=38.3 – 43.2)

The prevalence was 69 (20.1 %) (95% CI=15.7 - 24.4) among urban (31(15%) for women and 38 (27.7%) for men) and 586(46.6 %) (95% CI=43.7- 49.3) for rural (299(46.9%) for women and 287(46.3%) for men) residents.

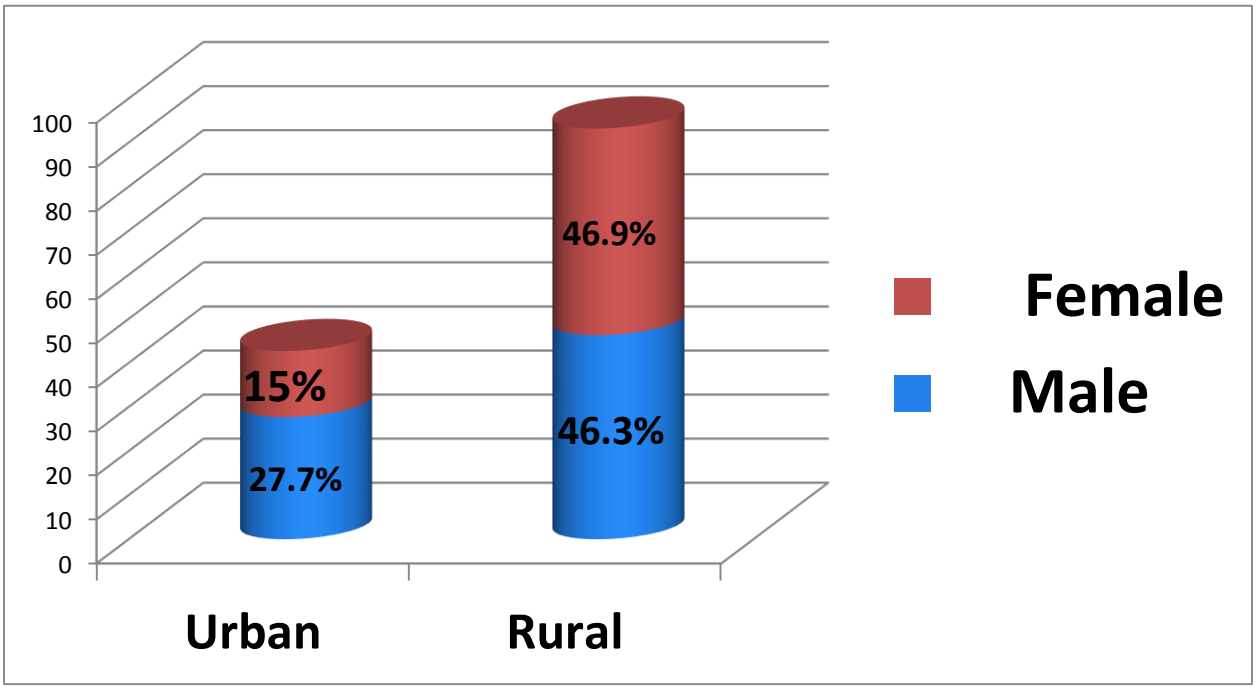

Figure 5: Prevalence of Anemia by resident and sex in GGFRC, South West, Ethiopia, Sept 2008-Jan 2009

Among anemic individuals; 392(59.8%) were mild, 223(34.1%) moderate and 40(6.1%) severe levels. With respect to anemia severity by residence 55(79.7%) mild, 13(18.8%) moderate and 1(1.4%) severe anemia are in urban and in rural 337(57.5%), 210(35.8%) and 39(6.7%) were mild, moderate and severe levels respectively.

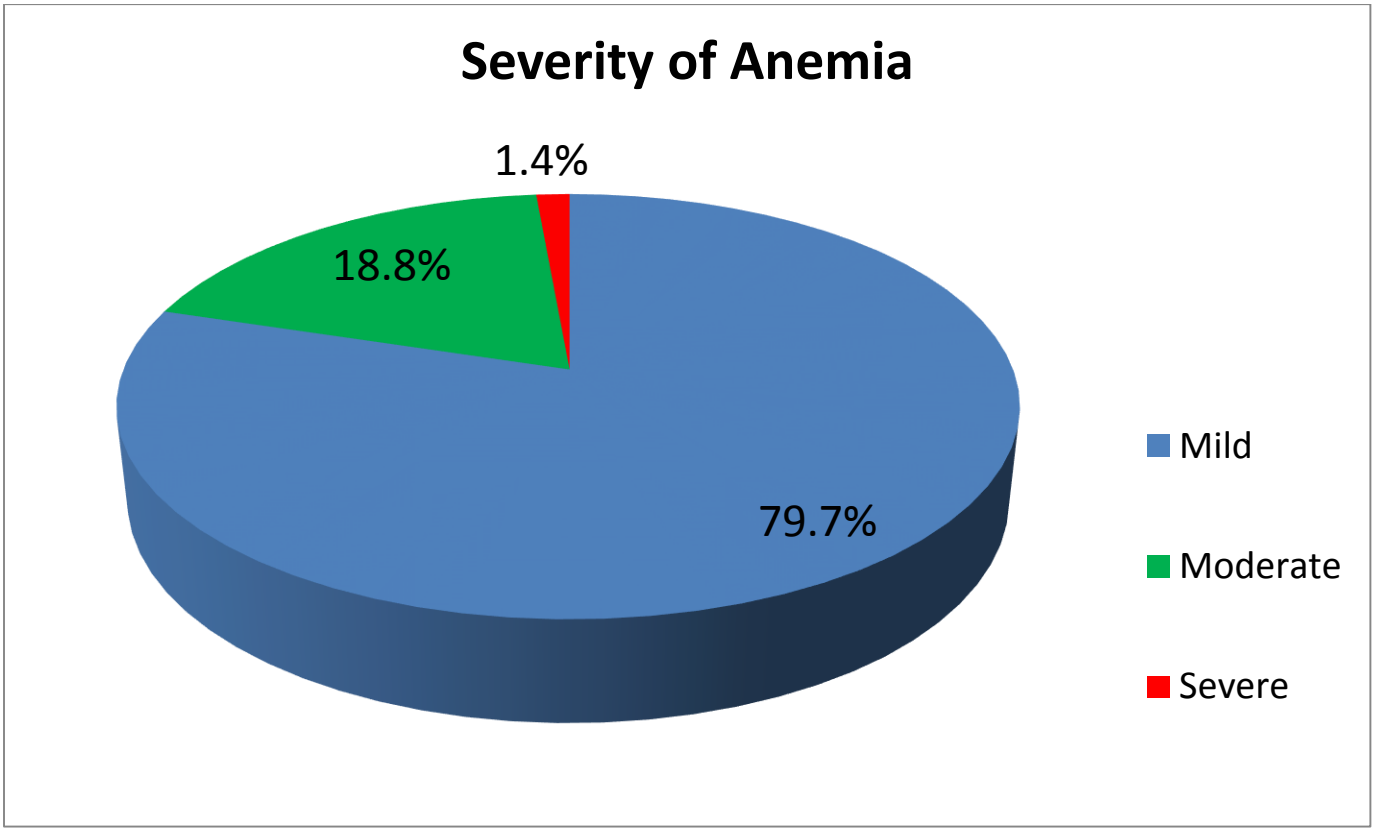

Figure 6: Severity of Anemia in GGFRC, South West Ethiopia, Sept 2008-Jan 2009

5.4. Factors associated with anemia

5.4.1. Association between socio-demographic characteristics and anemia

About 38(27.7%) men and 31(15%) of women in urban residents where anemic whereas, among rural residents around half of men 287(46.3%) and women 299(46.9%) were anemic. In urban around quarter 25(26.6%) of respondents in 55-64 age group had anemia and among rural residents of 55-64 age group about half had anemia 159(54.8%). Higher prevalence of anemia was observed among farmers 12(30.8%) which live in urban and the prevalence was higher in housewife's who live in rural 210(51.6%).Regarding education, around 20% of the illiterates had anemia in urban residents whereas, in rural almost half of the illiterates had Anemia (511(48.9%).In urban, among respondents who had monthly income ≤500 birr almost quarter of them 10(24.4%) had anemia. And in rural among respondents who had monthly income ≤500 almost half of them 241(47.4%) had Anaemia.

Bivariate logistic regression analysis in urban residents was done to assess association of socio demographic factors and anemia the result showed sex (P=0.007, COR=2.174 ,95% CI=1.227-3.719) age (P=0.457) and educational status (P=0.24) were the candidates to multivariable regression ($p<0.25$) In rural residents, Sex (P= 0.838), age group (P=0.091), occupation (P=0.021) and educational level (P<0.000) were the candidates to multivariable regression.($p<0.05$)

Table 2 Bivariate regression result of Anemia and Socio demographic result in urban and rural residents of GGFRC, South West Ethiopia, Sept 2008-Jan 2009

variables		Urban				Rural			
		Anemia (%)	Normal (%)	COR (95% CI)	P-Value	Anemia (%)	Normal (%)	COR(95% CI)	P-Value
Sex	Male	38(27.7)	99(72.3)	1	1	287(46.3)	333(53.7)	1	1
	Female	31(15)	176(85)	2.179(1.277-3.7)	0.007*	299(46.9)	339(53.1)	0.977(0.783-1.220)	0.838
Age group	15-24	7(17.9)	32(82.1)	1.039(0.372-2.904)	0.942	73(37.4)	122(62.6)	0.709(0.487-1.033)	0.297
	25-34	11(19.6)	45(80.4)	1.161(0.469-2.875)	0.747	112(42.3)	153(57.7)	0.868(0.617-1.221)	0.416
	35-44	12(17.4)	57(82.6)	1	1	124(45.8))	147(54.2	1	1
	45- 54	14(16.3)	72(83.7)	0.924(0.396-2.152)	0.854	118(49.8)	119(50.2)	1.176(0.829-1.667)	0.091
	55-64	25(26.6)	69(73.4)	1.721(0.795-3.727)	0.168	159(54.8)	131(45.2)	1.439(1.032-2.007)	0.003**
Occupation	Farmer	12(30.8)	27(69.2)	1.862(0.812-4.271)	0.142	334(45.8)	395(54.2)	2.621(1.266-5.426)	0.009**
	Housewife	21(16.0)	110(84.0)	0.800(0.411-1.558)	0.512	210(51.6)	197(48.4)	3.305(1.579-6.918)	0.002**
	Student	2(16.7)	10(83.3)	0.838(0.171-4.114)	0.828	17(34.7)	32(65.3)	1.647(0.654-4.150)	0.29
	Employed	21(19.3)	88(80.7)	1	1	10(24.4)	31(75.6)	1	1
	Unemployed	11(22.4)	38(77.6)	1.213(0.533-2.762)	0.645.	13(46.4)	15(53.6)	2.687(0.960-7.521)	0.06**
Education level	Illiterate	39(20.5)	151(79.5)	1.578(0.718-3.470)	0.246	511(48.9)	533(51.1)	4.794(2.222-10.340)	<0.000**
	Primary	17(21.0)	64(79.0)	1.623(0.670-3.932)	0.283	51(37.2)	86(62.8)	2.965(1.287-6.830)	0.011**
	Secondary and above	9(14.1)	85.9(55)	1	1	8(16.7)	40(83.3)	1	1

***: candidate for multiple regressions at P value < 0.25, 1: Reference group,

5.4.2. **Association between behavioral related factors and anemia**

Thirty six percent of smokers 9(36.0%) in urban and forty three percent of smokers 65(43.9%) in rural were anemic. In urban 13(19.4%) who drink alcohol, had anemia whereas in rural, from those residents who drink alcohol, almost half of them 20(46.5%) had anemia. Regarding chat chewing, from respondents who chew chat 18(17.1%) had anemia and in rural from those who chew chat almost half of them had anemia 265(46.2%).

In Bivariate regression of urban smoking (P=0.044), ever smoke daily (P=0.130) are the candidates to multivariable logistic regression whereas, in rural residents ever smoke daily (P=0.081) and currently chat chewing (P=0.027) were the candidates.

Table 3 Bivariate regression of Anemia and behavioral factors in urban and rural residents of GGFRC, South West, Ethiopia, Sept 2008-Jan 2009

		Urban				Rural			
Variables		**Anemia**	**Normal**	**COR(95% CI)**	**P-Value**	**Anemia**	**Normal**	**COR(95% CI)**	**P-Value**
Smoke now	Yes	9(36.0)	16(64.0)	0.412(0.174-0.977)	0.044***	65(43.9)	83(56.1)	1.130(0.800-1.595)	0.490
	No	259(81.2)	60(18.8)	1	1	521(46.9)	589(53.1)	1	1
Ever Smoke daily	Yes	8(32.0)	17(68.0)	0.504(0.208-1.223)	0.130***	48(55.8)	38(44.2)	0.676(0.435-1.050)	0.081***
	No	257(80.8)	61(19.2)	1	1	536(46.0)	628(54.0)	1	1
Drink Alcohol	Yes	13(19.4)	54(80.6)	1.05790.540-2.072)	0.871	20(46.5)	23(53.5)	1.001(0.544-1.842)	0.998
	No	56(20.3)	220(79.8)	1	1	564(46.5)	648(53.5)	1	1
Currently chew chat	Yes	15(16.9)	74(83.1)	1	1	240(44.5)	299(55.5) 2.20	1	1
	No	4(21.1)	15 (78.9)	1.316(0.383-4.552)	0.663	23(63.9)	13(36.1)	2.204(1.093-4.443)	0.027***

***: candidate for multiple regression at P value < 0.25, 1: Reference group, COR: Crude Odds Ratio, CI: Confidence Interval

5.4.3. Association between medical related factors with anemia

From respondents who live in urban and had hypertension 5 (11.4) had anemia whereas in rural from respondents with a hypertension 39(43.8) had anemia. In urban 20.7% of residents who had heart disease had anemia whereas in rural, 18(66.7) of residents, who have heart disease had anemia. .Bivariate logistic regression analysis was done to assess association between medical related factors with anemia in urban residents and the result shows only raised blood pressure(Hypertension)(P=0.16) was the candidate to multiple logistic regression.

In rural residents, the result shows heart disease (P=0.039) and raised blood sugar level (Diabetes) (0.131) were the candidates.

Table 4 Bivariate regression of anemia and medical related factors among urban and rural residents in Gilge Gibe Field Research Center, Southwest Ethiopia, Sept 2008-Jan 2009

		Urban				Rural			
Variables		**Anemia**	**Normal**	**COR(95 % CI)**	**P-Value**	**Anemia**	**Normal**	**COR(95% CI)**	**P-Value**
Hypertension	yes	37(20.8)	141(79.2)	1	1	476(46.8)	542(53.2)	1.126(0.728-1.742)	0.594
	No	5(11.4)	39(88.6)	2.047(0.754-5.558)	0.16**	39(43.8)	50(56.2)	1	1
Heart disease	Yes	6(20.1)	23(79.3)	1	1	18(66.7)	9(33.3)	0.428 (0.191-0.960)	0.039**
	No	63(20.1)	251(79.9)	0.962(0.376-2.463)	0.936	564(46.1)	659(53.9)	1	1
Diabetes	Yes	3(30.0)	7(70.0)	0.575(0.145-2.282)	0.431	27(57.4)	20(42.6)	1	1
	No	66(19.8)	268(80.2)	1	1	559(46.2)	652(53.8)	0.635(0.352-1.145)	0.131**

***: candidate for multiple regression at P value < 0.25, 1: Reference group, COR: Crud Odds Ratio, CI: Confidence Interval.

5.4.4. Association between dietary related factors, and anemia

Higher prevalence of anemia was observed among respondents who eat low serving of fruits and vegetables and respondents who are underweight but, none of the dietary related factors were not candidate to multivariable regression.

Higher prevalence of anemia was observed among rural residents who are central obese, under weight and who take low serving of fruits and vegetables. Presence of central obesity (P= 0.000), normal BMI (P=0.097) and underweight (P= 0.057) has statically significant association (p<0.05) with anemia.

Table 5 Binary regression result between Anemia and dietary related factors in urban and rural residents of Gilgel Gibe Field Research Center,SouthWest,Ethiopia,Sept 2008-Jan 2009.

		Urban				Rural			
Variables		**Anemia**	**Normal**	**COR(95 %CI)**	**P-Value**	**Anemia**	**Normal**	**COR(95 % CI)**	**P - value**
Presence of central obesity	Yes	15(20.5)	58(79.5)	0.842(0.416-1.702)	0.632	198(54.0)	169(46.0)	0.639(0.497-0.822)	<0.000*
	No	27(17.9)	124(82.1	1	1	319(42.8)	426(57.2)	1	1
BMI categorize	Underweight	18(21.2)	67(78.8)	2.015(0.422-9.632)	0.645	266(48.7))	280(51.3)	3.483(0.961-12.624)	0.057*
	Normal	22(18.2)	99(81.8)	1.667(0.355-7.821)	0.517	247(44.8)	304(55.2)	2.979(0.822-10.797)	0.097*
	Overweight	2(11.8)	15(88.2)	1	1	3(21.4)	11(78.6)	1	1
Serving of fruit and vegetables	Low	57(20.1))	226(79.9)	1	1	495(47.1)	556(52.9)	0.816(0.574-1.159)	0.256
	High	8(20.5)	31(79.5)	1.023(0.446-2.346)	0.957	61(42.1)	84(57.9)		1

*: candidate for multiple regression at P value < 0.25, 1: Reference group, COR: Crud Odds Ratio, CI: Confidence Interval

5.4.5. Independent predictors of anemia

In Bivariate analysis of urban residents; Sex, smoking, ever smoke daily, hypertension and raised blood sugar (Diabetes) were found to be candidate for multivariable analysis (P<0.025) .So the multivariable analysis was done for these variables. Male (AOR=2.152, 95% CI= (1.029-4.500) and illiterates (AOR= 5.745 95% CI, =1.266-26.071) were the determinants of anemia in urban residents. So, being male increase the probability of anemia by two times than females and illiterates were almost six times more likely to had anemia than those who had secondary and above educational status.

Bivariate analysis was also done to rural residents and sex, age group, occupation, educational level, ever smoke daily, current chat chewing, hypertension, heart disease, raised blood sugar, fruit and vegetables use, presence of central obesity and body mass index were found to be candidate for multivariate analysis(P<0.025).

From the candidate variables being female(AOR=1.788 95%CI=1.267-2.522 P≤ 0.001),illiterates (AOR=3.615 95% CI=1.565-8.351 P≤ 0.003) and primary school (AOR=2.694 95% CI=1.080-6.726 P=0.034) having Heart disease(AOR=2.628 ,95% CI=1.091-6.332 P=0.031)and Presence of central obesity (AOR=1.832 95% CI= 1.305-2.572,P<0.000) were the determinants of anemia in rural residents.(p<0.005)

So, being female increase the probability of anemia by two times , residents who are illiterates and had primary school educational status were four and three times more likely to develop anemia than those who had secondary and above educational status respectively. Respondents who had heart disease where three times more likely to develop anemia and also residents with central obesity increase the probability of anemia by 2 times compare to their respective counterpart.

Table 6 multiple logistic regression analysis of independent predictors of anemia in urban residents of Gilgel Gibe Field Research Center, Southwest Ethiopia, Sept 2008-Jan 2009

Variables		Anemic	Normal	COR (95% CI)	AOR(95%CI)
SEX	Female	176(85)	31(15)	2.174(1.227-3.719)	2.152(1.029-4.50)***
	Male	99(72.3	38(27.7)	1	1
Age group	15-24	32(82.1)	7(17.9)	1.039(0.372-2.904)	1.98(0.116-2.201)
	25-34	45(80.4)	11(19.6)	1.161(0.469-2.875)	2.044(0.152-1.572)
	35-44	57(82.6)	12(17.4)	1	1
	45- 54	72(83.7)	14(16.3)	0.924(0.396-2.152)	1.98(0.171-1.479)
	55-64	69(73.4)	25(26.6)	1.721(0.795-3.727	1.700(0.214-1.619))
Educational level	Illiterate	151(79.5)	39(20.5)	1.578(0.718-0.340)	5.745(1.266-26.0)***
	Primary	64(79.0)	17(21.0)	1.623(0.670-3.932)	4.671(0.949-22.999)
	Secondary and above	85.9(55)	9(14.1)	1	1
Smoking	No	259(81.2)`	60(18.8)	2.428(1.024-5.759)	0.578(0.159-2.102)
	Yes	16(64.0)	9(36.0)	1	1
Ever smoke daily	No	257(0.8)	61(19.2)	1.983(0.818-4.806)	1.207(0.288-5.062)
	Yes	17(68.0)	8(32.0)	1	1
Hypertension	No	257(0.8)	61(19.2)	1.983(0.818-4.806)	1.207(0.288-5.062)
	Yes	17(68.0)	8(32.0)	1	1

***: Significant association at P value < 0.05, 1: Reference group, AOR: Adjusted Odds Ratio,

COR: Crude Odds Ratio, CI: Confidence Interval

Table 7 multiple logistic regression analysis of independent predictors of anemia in rural residents of Gilgel Gibe Field Research Center, South West, Ethiopia, Sept 2008-Jan 2009

Variables		Normal	Anemia	COR (95% CI)	AOR(95%CI)
Sex	Male	333(53.7)	287(46.3)	1	1
	Female	339(53.1)	299(46.9)	1.023(0.820-1.277)	1.788(1.267-2.522)**
Age Group	15-24	122(62.6)	73(37.4)	0.817(0.560-1.194)	0.645(0.402-1.036)
	25-34	153(57.7)	112(42.3)	1.152(0.819-1.621)	0.677(0.456-1.006)
	35-44	147(54.2)	124(45.8)	1	1
	45- 54	119(50.2)	118(49.8)	1.355(0.952-1.927)	0.666(0.451-0.984)
	55-64	131(45.2)	159(54.8)	1.658(1.185-2.320)	0.778(0.519-1.166)
Occupation	Farmer	395(54.2)	334(45.8)	2.621(1.266-5.426)	0.715(0.235-2.176)
	Housewife	197(48.4)	210(51.6)	3.305(1.579-6.918)	0.968(0.313-2.994)
	Student	32(65.3)	17(34.7)	1.647(0.654-4.150)	1.618(0.412-6.349)
	Employed	31(75.6)	10(24.4)	1	1
	Unemployed	15(53.6)	13(46.4)	2.687(0.960-7.521)	2.347(0.104-1.737)
Education level	Illiterate	533(51.1)	511(48.9)	4.794(2.222-10.34)	3.615(1.565-8.351**
	Primary	86(62.8)	51(37.2)	2.965(1.287-6.830)	2.694(1.080-6.726)**
	Secondary and above	40(83.3)	8(16.7)	1	1
Ever smoke daily	Yes	38(44.2)	48(55.8)	1	1
	No	628(54.0)	536(46.0)	1.480(0.952-2.300)	0.825(0.489-1.391)
Currently chew chat	Yes	299(55.5)	240(44.5)	1	1
	No	13(36.1)	23(63.9)	2.204(1.093-4.443)	1.146(0.590-3.396)
Heart disease	No	659(53.9	564(46.1)	2.337(1.042-5.243)	2.628(1.091-6.332)***
	Yes	9(33.3)	18(66.7)	1	1
Diabetes	Yes	20(42.6)	27(57.4)	1.575(0.874-2.838)	1.24(0.389-1.658)
	No	652(53.8)	559(46.2)	1	1
serving of fruit and vegetable	High	84(57.9)	61(42.1)	1.226(0.863-1.742)	0.846(0.565-1.266)
	Low	556(52.9)	495(47.1)	1	1
Presence of central obesity	No	426(57.2)	319(42.8)	1.565(1.217-2.012)	1.832(1.305-2.572)***
	Yes	169(46.0)	198(54.0)	1	1
BMI categorize	Underweight	280(51.3)	266(48.7)	3.483(0.961-12.62)	1.647(0.298-9.102)
	Normal	304(55.2)	247(44.8)	2.979(0.822-10.79)	1.946(0.371-10.212)
	Overweight	11(78.6)	3(21.4)	1	1

***: Significant association at P value < 0.05, 1: Reference group, AOR: Adjusted Odds Ratio , COR: Crud Odds Ratio, CI: Confidence Interval.

6. Discussion

The current study attempted to asses anemia prevalence and associated risk factors in apparently healthy urban and rural residents. The overall prevalence of anemia was 40.9% (95% CI= 38.3-43.2) Based on WHO criteria, anemia is severe public health problem in this study area (≥ 40%).The observed 40.9 % anemia prevalence is consistent with study done in Egypt (39%) (46)

But this study revealed higher anemia prevalence than the finding of cross sectional studies conducted in china, Serbia and Korea 3.4%, 7.7% and 8.4% respectively(17)(47)(48).This difference may possibly be due to low socio-economic status, high number of illiterates and laboratory methods used for Hgb determination in this study. The observed result is lower compared to the study in done in West Bengal, India (57%)(35). A possible reason for this difference may be due to the socio demographic difference and also most of respondents in our study area are between (25-44) age group and this age group is less risky to anemia compared to other age groups.

In this study anemia prevalence was 69(20.1 %) (95%CI=15.7-24.4) among urban and 586(46.6 %)(95% CI= 43.7-49.3) for rural residents The observed higher prevalence in rural residents is consistent with Ethiopia demographic health survey report of 2011 in which, anemia prevalence is higher in rural than urban one (31% and 16%) respectively(16). But this finding is inconsistent with study done in eastern and western china in which prevalence of anemia in urban (13.6%) and rural (13.3%) areas are almost the same(17). This difference may possibly be due to the low socio economic status that leads to, not to afford high iron contents meals like meat and fish, low serving of green vegetables, lack of information about adequate nutrition and high number of illiterates of rural area compared to urban area in this study area.

In urban residents' of this study, Men's were 2 times more likely to develop anemia (AOR= 2.152 95% CI=1.029-4.500) than females. This finding is inconsistent with study done in Serbia, in which high anemia prevalence in female (20%) than males (3.86%), study done in Korea revealed prevalence of anemia 2.4% for males and 12.6% for females (48) cross sectional study done in eastern and western Asia also revealed the female rate of anemia (17.8 percent) is almost twice that of the male rate (8.5 percent)(17).

The possible discrepancy of this finding is in urban residents, low number of women is in reproductive age that decrease the risk of blood loss during menstruation, delivery, high amount of iron need in females and also the prevalence of substance use in males is high this might have contributed for the observed higher anemia prevalence in males than females in this study.

In rural residents females were almost 2 times more likely to develop anemia than men's. (AOR=1.788, 95% CI=1.267-2.522). This result is consistent with the study done among adult rural population of West Bengal, India in which prevalence of anemia was 46.62% in male and 66.87% in female (35).

Even though it is not significantly associated with anemia, higher prevalence of anemia was observed among elderly (Age group 55-64) in both urban and rural residents. This finding goes in line with the study done in rural India in which, the anemia was found to increase steadily to a maximum of 33% for men who were aged 50-54 years (29). study done in Korea also indicate prevalence of Anemia in males increased steadily after age 50 year, to ~2% between 50-74 year, and 4% (95% CI, 0.0%-9.7%) ≥ 75 year (48).

Regarding occupation, higher prevalence of anemia is observed among farmers (51.6%) in urban residents. In rural area of this study, higher prevalence of anemia is observed among housewives (51.6%) than employed ones. This finding go in line with study done in Azezo Health Center Gondar Town in which, The risk of anemia was 2.42 times higher among housewives as compared to governmental employee(10)

In our study of urban residents, illiterates were 6 times more likely to develop anemia than women who had secondary and above educational status (AOR=5.745 95% CI=1.266-26.07). In rural area of this study, illiterates were also 4 times more likely to develop anemia compare to respondents who had secondary and above educational status.(AOR=3.615 95%CI=1.565-8.351) and primary education level were also 3 times more likely to develop anemia than secondary and above educational status.(AOR=2.694 95% CI=1.080-6.726)

This finding is supported by previous studies in Gondar in which illiterate wre 8.8 more likely to have anemia as compared to those women with > 12 educational level (10). And study based on secondary data of Ethiopia DHS 2005 implies compared to women beyond secondary level of education, illiterates and those who had primary level education experienced significantly higher risk of anemia (AOR = 2.59, 95% CI: 1.62-4.14) and (AOR= 1.83, 95% CI: 1.13-2.96), respectively (15)

Even though it is not statically associated with anemia, in both study areas of this study high prevalence of anemia is observed with respondents with income of ≤500 birr than residents with income of > 1000 birr. But study done based on secondary data of Ethiopia DHS 2005 implies economic status had statically significant association with anemia.(AOR=2.45 95% CI=2.08-2.88)(15) Study done in Rural Punjab India also indicates the prevalence of anemia has significant association with standard of living index among both males and females (15-49 years)(29) The possible difference would be sample size, study subjects and setting difference.

In rural residents of this study respondents who had heart disease were 3 times more likely to develop anemia than their counterparts.(AOR=2.628 ,95% CI=1.091-6.332) this finding is in line with In a recent meta-analysis of 34 CHF studies including a total of 153,180 patients, in which 37.2% were anemic(37). And also study done in Canada also indicate that 17% of cardiac patient had anemia (38).

In rural residents respondents who had central obesity were 2 times more likely to develop anemia (AOR=1.832 95% CI=1.305-2.572) .This finding is consistent with cross sectional study done in USA and Saudi Arabia in which Weight for height ratio had statically significant association, indicating independent effect of WHR on anemia(p=0.001)(P=0.035) respectively (49)(50).In contrast study done in china's women indicate that women with central obesity were less likely to have anemia (51). The difference may be due to increase iron requirement and reduced iron absorption which lead to high prevalence of anaemia in obese individuals of this study.

Higher prevalence of anemia was also observed among respondents which have low serving of fruit and vegetables both in urban (20.1%) and rural (47.1 %) than those having high vegetables and fruit serving but this association was not statically significant in multivariate regression. A facility based cross-sectional study carried-out in Egypt on 381 pregnant women also revealed that anemia prevalence among those who consumed fruits less than four times a week was almost double (66.2%) than those who consumed it more than four times a week (33.8%)(28). Green leafy vegetables consumption did also established a significant association with anemia as reported from West Arsi, Ethiopia (34)But in contrary Study done in Rural Adolescent Girls in District Karnal ,India indicate that Most of the anemic adolescent girls were vegetarian (53.18%)(18).This difference may be due to the type of vegetables in this area may contain non heam iron (Iron which found from plants) that can prevent the occurrence of anemia.

Lower prevalence of anemia was observed among urban residents having high BMI (11.8%) when compared to respondents with low BMI (21.2%) and also in rural residents. Lower prevalence (21.4%) of anemia was observed among residents having high BMI) compared to low BMI (48.7%).

Study based on secondary data of Ethiopia DHS 2005 supports this finding in which, The mean hemoglobin levels for low, normal and overweight categories of BMI were 12.6 g/dl ,12.9 g/dl and 13.3 g/dl), respectively. The difference was statistically significant ($P \leq 0.0010$). Compared to those with normal BMI, women with low BMI were 1.36 (95% CI: 1.19-1.56) times more likely to have anemia (15) .

Study done in Rural Punjab India also implies that the prevalence of anemia in females was found to increase with a decrease in the BMI, that is, the prevalence was 91.4% in females with low BMI Similarly, in males, the prevalence of anemia was 91.8%(29).

Another study in adult rural population of West Bengal, India state Mean values of Hgb increased steadily from the underweight through the normal to the overweight/obese groups. Overweight/obese subjects had the highest mean value of hemoglobin and statistically and significant differences were found in the prevalence of anemia between groups based upon BMI of both sexes(35).

7. Limitation of the study

- Since it is secondary data some important variables such as intestinal parasitic infection and malaria weren't assessed.
- Serum ferritin, folate and cobalamine concentrations, measurement were not including in the data which would be important in specifically suggesting the micronutrient responsible for the observed anemia.

8. Conclusion

The present study highlights anemia is a severe public health problem among apparently healthy residents of Gilge Gibe Field Research Center and there is difference in prevalence rate of anemia in urban and rural areas.

In urban residents being male and illiterate increase the probability of anemia and in rural area sex, educational level, having heart disease and central obesity increases the probability of anemia.

The present study also found a high prevalence of anemia in both males and females, thus indicating that the problem of anemia was related to a wider population than the traditional groups of females and implicit the importance of including all apparently healthy individuals in process of controlling anemia.

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9. Recommendation

- **Oromia Regional Health Bureau**: should strengthen on-going anemia control programme in the area including men's and elderly group in addition to the previously targeted group.
- **Oromia Regional Health Bureau**: should work together with other concerned bodies toward improving overall nutritional status of the individuals with focus of rural residents.
- **Ministry of education**: in collaboration with responsible stakeholders should strengthen adult learning program for those illiterate which is already set as national adult learning program.
- **Health extension workers**: should encourage the residents to increase consumption of low cost iron rich foods like green vegetables and fruits.
- **Health professionals**: in the area should also encourage the residents, to have normal weight and also check blood sugar and heart condition of individuals routinely..
- **Researchers**: should do further large scale investigations in the area to identify specific causes of anemia among apparently healthy individuals particularly by assessing micronutrients (serum iron, folate and vitamine-B12 levels) ,stool examination for helmintiasis and blood film for malaria.

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11. ANNEX

11.1. Questionnaire

Step 1 Demographic Information

Number	Question	Response	Code
201	Sex (*Record Male / Female as observed)*	0.Male 1. Female	
202	How old are you? [in years) if you don't know your age or if you don't want to answer just tell in some interval.	Years------ 777. don't know	
204	Can you read and write?	0.Yes 1.No	
205	Do you attend formal school?	0.Yes 1.No	
206	What is the highest level of education you have completed?	_____ 999.Refused	
207	Which of the following best describes your main work status over the past 12 months?	1.Farmer 2.Govermnet employee 3.Nongovernmental employee 4.Merchant 5 Self employe 6. Non-paid 7.Student 8.House Wife 10.Retired 11.Un employed 12 other(mention…	

208	How many people older than 15 years, including yourself, live in your household?	Number of people---	
209	Taking the past year, can you tell me what the average earnings of the household have been?	per month------- per year-------- Teff----- Kuntal Maize-----Kuntal Berbere----- Kuntal Others[Mention…..Kuntal] 999….Refused	

CORE 2: Tobacco Use			
Number	Question	Response	Code
301	Do you currently smoke any tobacco products, such as cigarettes, cigars or pipes? *(USE SHOWCARD*	0.No 1.Yes	
302	Do you currently smoke tobacco products daily?	0.No 1.Yes	
303	How old were you when you first started smoking daily?	Age (years) 777. Don't know..If known go to 305	
304	Do you remember how long ago it was? *(RECORD ONLY 1, NOT ALL 3)*	In years-------- In months--- In weeks---- 777.Don't know	
305	On average, how many of the following do you smoke each day?	Manufactured cigarettes--- Hand-rolled cigarettes--- Pipes full of tobacco---- ---Cigars, cheroots,	

		cigarillos— Other (please specify):--- 777.Don't remember	
306	In the past, did you ever smoke daily?	0.No *If No, go to 309* 1.Yes	
307	How old were you when you stopped smoking daily?	Age (years)--- 777.don't know	
308	How long ago did you stop smoking daily? *(RECORD ONLY 1, NOT ALL 3)*	Years ago-------- or Months ago---- or Weeks ago-----	

CORE 3: Alcohol Consumption; The next questions ask about the consumption of alcohol.			
Number	Question	Response	Code
309	Have you ever consumed an alcoholic drink such as beer, wine, , Tela,Tej	0.No 1.Yes	
310	Have you consumed an alcoholic drink within the past 12 months?	1. Daily 2. 5-6 days per week 3. 1-4 days per week 4. 1-3 days per month 5. Less than once a month	
311	During the past 30 days, when you drank alcohol, on average, how many standard alcoholic drinks did you have during one drinking occasion?	Types of alcohol No ---------- ------- ---------- ------- 777.I don't know	
312	Have you consumed an alcoholic drink within the past 30 days?	0.No 1.Yes	

313	During each of the past 7 days, how many standard alcoholic drinks did you have each day? *(USE SHOWCARD*	Monday ---------- Tuesday ---------- Wednesday ---------- Thursday---------- Friday---------- Saturday---------- Sunday----------	
314	During the past 30 days, what was the largest number of standard alcoholic drinks you had on a single occasion, counting all types of alcoholic drinks together?	Type of Alcohol Largest No ---------- -------- ---------- ---------- --------- ---------- ---------- ---------- ---------- ---------- ---------- ----	

CORE 4: Diet; The next questions ask about the fruits and vegetables that you usually eat.. As you answer these questions please think of a typical week in the last year			
Number	Question	Response	Code
315	In a typical week, on how many days do you eat fruit? *(USE SHOWCARD)*	Types of fruits No of days ---------- ---------- ---------- - -- ---------- *If Zero days, go to 317* *777 I don't know*	
316	How many servings of fruit do you eat on one of those days? (*USE SHOWCARD)*	Type of fruits NO of servings ---------- ---------- ------ ---------- ---------- ------- 777.I don't know	
317	In a typical week, on how many days do you eat vegetables? *(USE SHOWCARD)*	Types of vegetables No of days ---------- ---------- ---------- --- ---------- *If Zero days, go to 319* *777 I don't know*	
318	How many servings of vegetables do you eat on one of those days? *(USE SHOWCARD)*	Type of vegetables NO of servings ---------- ---------- ---------- ----------	

CORE 3:Chat chewing; The next questions ask about the consumption of chat			
Number	Question	Response	Code
336	Have you ever chewed chat?	0.No *If No, go to 345* 1.Yes	
337	How long do you chew chat?	In years In months In weeks 777..don't know	
338	Do you currently chew Chat?	0.No *If No, go to 344* 1.Yes	
339	In a typical week, on how many days do you chew Chat?	Number of days----------	
340	How much time do you spend while chewing chat on a typical day?	Hours : minutes ---- ----	
341	On average, how much of Chat g do you Chew each day?		
342	How old were you when you first started chewing Chat?	Age [years] 777.don't remember	
343	Do you remember how long ago it was? *(RECORD ONLY 1, NOT ALL 3)*	In years-------- In months--- In weeks---- 777.Don't know	
344	If you stop chewing Chat, How long ago did you stop *(RECORD ONLY 1, NOT ALL 3*	In years-------- In months--- In weeks---- 777.Don't know	

Chronic non communicable disease			
CORE; History of Diabetes			
Number	Question	Response	Code
345	Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	0.No *If No, go to 350* 1.Yes	
346	Have you been told in the past 12 months?	0.No *If No, go to 350* 1.Yes	

CORE; History of Raised Blood Pressure			
Number	Question	Response	Code
352	Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension	0.No go to 356 1.Yes	

Core; Heart failure			
361	Have you ever been told by a doctor or other health worker that you have heart disease?	0.No go to 367 1.Yes	
362	Have you been told in the past 12 months that you have a heart disease?	0.No go to 367 1.Yes	