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ORIGINAL RESEARCH

Prevalence of Anemia and Associated Factors Among "Apparently Healthy" Urban and Rural Residents in Ethiopia: A Comparative Cross-Sectional Study

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Background: Anemia is the most frequent micronutrient deficiency; globally it has an impact on more than 2 billion people. Different studies have indicated that the prevalence of anemia varies between rural areas and urban centers. This study focused on determining the prevalence and identifying the factors associated with anemia among "apparently healthy" urban and rural residents of Gilgel Gibe Field Research Center.

Methods and Participants: A comparative cross-sectional study was done using secondary data of Gilgel Gibe Field Research Center. Data of 1,602 (1,258 rural and 344 urban) apparently healthy adults whose hemoglobin level was available were included in the analysis. Data were analyzed by SPSS 20 and separate logistic regression models; urban and rural were fitted. Statistical significance was set at p-values < 0.05 with 95% CI.

Results: The overall prevalence of anemia was 40.9%. Anemia was higher among rural residents (46.6%) than urban residents (20.1%). In urban centers, being male (AOR = 2.15, 95% CI: [1.03, 4.50]) and illiterate (AOR = 5.76, 95% [CI: 1.27, 26.07]) were significantly associated with anemia. In rural areas, being female (AOR = 1.78, 95% CI: [1.27, 2.52]), presence of heart disease (AOR = 2.63, 95% CI: [1.09, 6.33]), central obesity (AOR = 1.83, 95% CI: [1.31, 2.57]), illiteracy (AOR = 3.62, 95% CI: [1.57, 8.35]), and primary school completion (AOR = 2.69, 95% CI: [1.08, 6.73]) were significantly associated with anemia.

Conclusion: According to the WHO classification, the overall prevalence of anemia was a severe public health problem. This study also marked urban–rural variation in anemia prevalence, indicating the need for targeting specific areas for intervention. Strengthening strategies aimed at educational empowerment and nutritional education will have a contribution to combating anemia, especially in the rural kebeles of the study area.

Keywords: anemia, risk factors, apparently healthy, Ethiopia

Introduction

Anemia, as defined by the World Health Organization is a low blood hemoglobin concentration (below 130 g/L for men, 120 g/L for non-pregnant women and below 110 g/L in pregnant women).[1] However, the reference range for normal blood hemoglobin levels may vary in individuals depending on gender, race, age, dietary habits, and geographical area. Children, elderly people, pregnant and lactating women, and people with disease causing blood loss are at higher risk as compared to other groups of the population.[2,3]

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The effect of anemia is diverse; it follows the life cycle approach where each stage of life is affected. During pregnancy, it decreases fetus' physical growth and leads to mental growth retardation; during childhood, it affects cognitive growth and development; during adulthood, it limits physical work capacity, and finally, in the elderly, it affects the quality of life. Moreover, in complicated cases, it is associated with an increased risk of maternal and infant deaths.[4]

Anemia is an important global public health problem, affecting the lives of more than 2 billion people globally, accounting for about 30% of the world's population, which is the most common public health problem in developing countries occurring at all stages of life. An estimated 43% population in developing, and 9% in developed countries, are anemic.[1] In Ethiopia, anemia affects 17% women and 11% men aged 15–49 years.[5]

The majority of researches regarding anemia has been focused on children, adolescents and pregnant women and almost all of them are Institution based studies.[6] However, assessing anemia among apparently healthy adults through a community-based approach is a critical component of public health research. Therefore, the aim of this study was to assess the prevalence of anemia and its associated factors among apparently healthy urban and rural adult residents of Gilgel Gibe Field Research Center (GGFRC), Jimma, Southwest Ethiopia.

Methodology

Study Design, Setting and Period

A community-based comparative cross-sectional study design was used from March–April 2016. The original study was conducted from late September 2008 to the end of January 2009 at GGFRC of Jimma University, which is located surrounding the Gilgel Gibe Hydroelectric dam, within the four districts of Jimma Zone, Oromia Region, Southwest Ethiopia. The center comprised of eleven kebeles (smallest administrative structure in Ethiopia) of which three are small towns. The study area was comprised of about 11,000 households with a total population of 50,0009.

Sampling

The GGFRC study was designed to provide a representative estimate of CNCDs and their risk factors in the GGFRC. Individuals aged 15–64 years of both sexes, who were residents of the 11 kebeles of the center were included. Using the WHO-STEP guideline, stratifying the population by sex, age, and residence the sample size was determined. Based on this, a total of 4,371 participants for step I, 2,653 individuals for step II, and 1,861 adults in the age group of 15–64 years were included for step III. The sample size was allocated to rural and urban strata proportional to their size in a ratio of 75% to 25% respectively. Moreover, an equal sample was assigned to each sex and age strata. Age was categorized into five groups, with a range of 10 years. Individual study participants were then selected using a simple random sampling technique.

Data Extraction

This study was based on secondary data of the GGFRC of Jimma University. Secondary data were extracted from 1,602 individuals who had complete data records. Data on a broad potential variable, including hemoglobin level, socio-demographic, socioeconomic, nutritional status, dietary intake, and health status were extracted from the database using a template prepared for this study.

Data Processing and Analysis

Data were entered, cleaned and analyzed using SPSS 20 for Windows version. Hemoglobin level was modified for altitude and individual smoking status using the recommendation by WHO. WHO hemoglobin levels were used as cut-off values to classify anemia.

Descriptive analysis was done to determine the prevalence of anemia and its distribution among the characteristics of the respondents. Both bivariable and multivariable binary logistic regression was computed to identify factors associated with anemia.

All variables with a p-value < 0.25 at bivariate logistic regression were considered as candidates for multivariable logistic regression models. Separate models were fitted; for urban, and rural participants. Variables were entered into the model using the "Enter logistic regression" method. During the analysis, the statistical assumptions of logistic regression and model fitness were checked. The Adjusted odds ratio (AOR) and its 95% confidence interval (CI) were used to measure the strength and significance of the association. Statistical significance was set at p-value < 0.05.

Results

Socio-Demographic Characteristics

Data of 1,602 study participants were included in the analysis. More than three-quarters (1258, 78.5%) of participants were from rural areas and less than a quarter (344,

21.5%) were from urban centers. More than half the urban (207, 60.2%) and slightly more than half (638, 50.7%) the rural participants were females. The mean age (SD) of the rural and urban residents was 40.36 (14.9) years and 43.3 (14.4) years, respectively. A larger proportion of study subjects, both in urban (94, 27.3%) and rural (290, 23%) areas were in the age group 55–64 years. More than one third (131, 38.5%) of urban residents were housewives and more than half (729, 58.1%) of rural residents were farmers. Regarding educational status, the majority of the participants were illiterate, both in urban centers (190, 56.7%) and rural areas (1044, 84.9%) (Table 1).

Prevalence of Anemia

After adjusting the hemoglobin value for altitude and smoking, the mean (SD) hemoglobin concentration of the study participants was 13 g/dL (2.3). Overall, 40.9% were anemic. The prevalence was 20.1% among urban residents and 46.6% among rural residents. Regarding the degree of anemia, the majority of participants (392, 59.8%), urban residents (55, 79.7%) and rural residents (337, 57.5%) had mild anemia (Figure 1).

Table 1 Socio-Demographic Characteristics of study participants by Residence, GGFRC, September 2008–January 2009

Variables	Urban n = 344	Rural n = 1258
	Number (%)	Number (%)
Sex		
Female	207 (60.2)	638 (50.7)
Male	137 (39.8)	620 (49.3)
Age Group		
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 (25.0)	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 Level		
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 (27.8)
≥ 1000	18 (23.4)	142 (15.8)

Factors Associated with Anemia

In urban centers, in the bivariate analyses, sex, age group, educational level, current smoking status, smoking history, and hypertension became candidate variables for multivariable analyses. In the final model of logistic regression, the prevalence of anemia was found to be two times higher in males than females (AOR = 2.15, 95% CI: [1.03, 4.50]) and almost six times higher among illiterates than those who had secondary and above educational level in urban centers (AOR = 5.76, 95% CI: [1.27, 26.07]) (Table 2).

In rural areas, in the bivariate analyses, sex, age group, occupation, educational level, history of smoking, current chat chewing status, presence of heart disease, presence of diabetes, serving of fruit and vegetable, central obesity and BMI became candidate variables for multivariable analyses. In the multivariable logistic regression analysis, odds of anemia was 1.78 times higher in females than males (AOR = 1.78, 95% CI: [1.27,2.52]), 2.63 times higher in those with heart disease (AOR = 2.63, 95% CI: [1.09,6.33]), almost two times higher in participants with central obesity (AOR = 1.83, 95% CI: [1.31,2.57]), 3.6 times higher in illiterates (AOR = 3.62, 95% CI: [1.57,8.35]) and 2.69 times higher in those who had primary school (AOR = 2.69, 95% CI: [1.08,6.73]) as compared to those who had secondary and above educational level (Table 3).

Discussion

This study has determined the prevalence of anemia among rural and urban residents. The overall prevalence of anemia (40.9%) highlights anemia is a severe public health problem in the study area.[1] This prevalence (40.9%) was compared with a study done in Egypt (39%).[7] But the finding was much higher than the findings from The People's Republic of China (13.4%),[8] Serbia (7.7%),[9] and Korea (8.4%).[10] This variation could be because of the difference in socioeconomic and educational status, and dietary intake.

In this study, anemia prevalence was 20.1% among urban and 46.6% among rural residents. This observed high prevalence of anemia among rural residents was similar to the finding from the Ethiopian demographic and health survey 2011, 31% for rural and 16% for

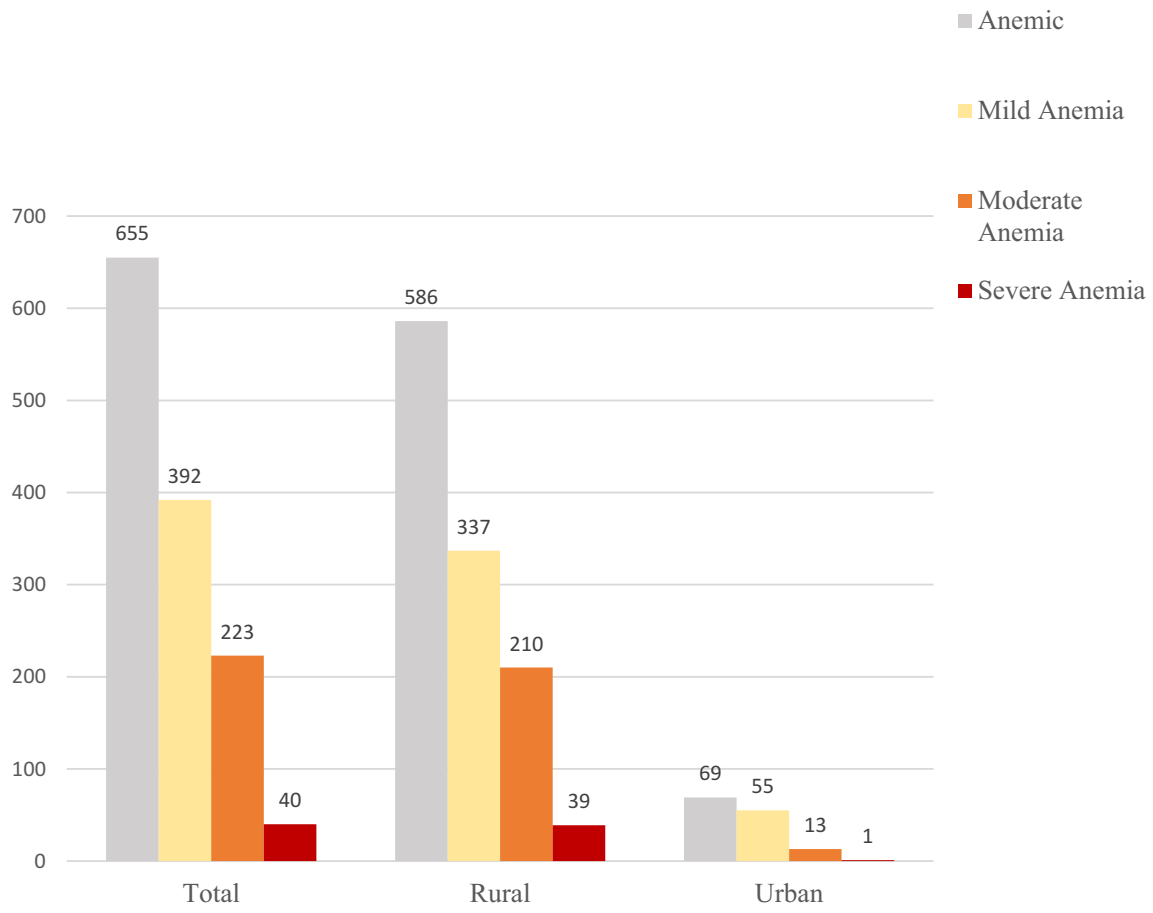

Figure 1 Anemia severity among urban and rural residents, GGFRC, September 2008–January 2009.

urban.[5] However, this finding was inconsistent with a study done in central and eastern China, where the finding was almost the same, 13.6% in urban and 13.3% in rural areas.[8] The possible reasons might be due to low socioeconomic status, low serving of iron-rich foods, lack of adequate nutrition information and a high number of illiterates in rural areas as compared to urban in this study.

Regarding factors associated with anemia among urban residents, males were twice as likely to develop anemia (95% CI: [1.03, 4.50]) compared to females. This finding contradicts the finding from Serbia,[9] Korea[10] and, Central and Eastern Asia.[8] The possible discrepancy might be due to high substance use in males, which might have contributed to the observed higher prevalence.

Unlike urban inhabitants, in rural residents, females were almost two times as likely to develop anemia compared to males (95% CI: [1.27, 2.52]), which was similar to findings observed from West Bengal India.[11] The high level of anemia among rural women is likely related to inadequate dietary intake, absence of nutritional education during pregnancy, inaccessibility of health-care services and high blood loss during delivery.[12,13]

In this study, education remained one of the factors associated with anemia, illiterate urban residents were six times more likely to develop anemia as compared to those who had secondary and above educational level (95% CI: [1.27, 26.07]). A similar finding was observed in rural residents, illiterates were almost four times more likely to develop anemia as compared to respondents who had secondary and above educational level (95% CI: [1.57, 8.35]), and those who had primary education, were 2.69 times more likely to develop anemia than those who had secondary and above educational level (95% CI: [1.08, 6.73]). This finding was supported by reports of studies from Gondar[14] and a study based on secondary data of EDHS 2005.[15]

Table 2 Factors Associated with Anemia in Urban Residents, GGFRC, September 2008–January 2009

Variables	Normal	Anemic	COR (95%)	AOR (95%)
Sex				
Male	99	38	2.17 (1.22–3.72)	2.15 (1.03–4.50)***
Female	176	31	1	1
Age Group				
15–24	32	7	1.04 (0.37–2.90)	1.98 (0.12–2.20)
25–34	45	11	1.16 (0.47–2.87)	2.04 (0.15–1.57)
35–44	57	12	1	1
45–54	72	14	0.92 (0.39–2.15)	1.98 (0.17–1.48)
55–64	69	25	1.72 (0.79–3.73)	1.70 (0.21–1.62)
Educational Level				
Illiterate	151	39	1.58 (0.72–0.340)	5.74 (1.26–26.00)***
Primary	64	17	1.62 (0.67–3.93)	4.67 (0.95–22.99)
Secondary and above	55	9	1	1
Current Smoking Status				
No	259	60	1	1
Yes	16	9	2.43 (1.02–5.76)	0.58 (0.16–2.10)
History of Smoking				
No	257	61	1	1
Yes	17	8	1.98 (0.82–4.81)	1.21 (0.28–5.06)
Hypertension				
No	257	61	1	1
Yes	17	8	1.98 (0.82–4.81)	1.21 (0.29–5.06)

Note: ***Significant association at p-value < 0.05.
Abbreviations: AOR, Adjusted Odds Ratio; COR, Crude Odds Ratio.

Rural residents, who had heart disease, were 2.63 times more likely to develop anemia than their counterparts (95% CI: [1.09, 6.33]). This finding was in line with the findings from the meta-analysis of 34 CHF studies[16] and a study done in Canada.[17]

Rural residents who had central obesity were almost two times more likely to develop anemia (95% CI: [1.31–2.57]). This finding was similar to findings of cross-sectional studies done in the USA and Saudi Arabia[18,19] where waist-to-hip ratio had a statistically significant association, with anemia. However, a study done in The People's Republic of China indicated that women with central obesity were less likely to have anemia.[20] This discrepancy might be due to the increased iron requirement and reduced absorption in obese individuals which might lead to a higher prevalence of anemia in obese individuals.

The major strength of this study was its large sample size. However, this study also had some limitations. First, the time of data collection to secondary analysis and the presence of missing data was potential limitations. Second, anemia was determined by hemoglobin value, biochemical tests like serum ferritin were not employed. Helminthic infections and malaria burden was not determined.

Conclusions

The overall prevalence of anemia in the area of study was a severe public health problem according to WHO. There is marked urban-rural variation in anemia prevalence, indicating the need for targeting specific areas for intervention. Strengthening strategies aimed at educational empowerment, nutrition education and nutrition service for non-communicable/lifestyle diseases have a positive contribution in combating anemia in the study area, especially in rural areas. The study also found a high prevalence of anemia in males, indicating that anemia was of wider population groups than the traditional ones, and it is implicit to consider the importance of addressing all population groups.

Table 3 Factors Associated with Anemia in Rural Residents, GGFRC, September 2008–January 2009

Variables	Normal	Anemic	COR (95%)	AOR (95%)
Sex				
Male	333	287	1	1
Female	339	299	1.02 (0.82–1.28)	1.79 (1.27–2.52)***
Age Group				
15–24	122	73	0.82 (0.56–1.19)	0.65 (0.40–1.04)
25–34	153	112	1.15 (0.82–1.62)	0.68 (0.46–1.01)
35–44	147	124	1	1
45–54	119	118	1.36 (0.95–1.93)	0.67 (0.45–0.98)
55–64	131	159	1.66 (1.19–2.32)	0.78 (0.52–1.17)
Occupation				
Farmer	395	334	2.62 (1.27–5.43)	0.72 (0.24–2.18)
Housewife	197	210	3.31 (1.58–6.92)	0.97 (0.31–2.99)
Student	32	17	1.65 (0.65–4.15)	1.62 (0.41–6.35)
Employed	31	10	1	1
Unemployed	15	13	2.69 (0.96–7.52)	2.35 (0.10–1.74)
Educational Level				
Illiterate	533	511	4.79 (2.22–10.34)	3.62 (1.57–8.35)***
Primary	86	51	2.97 (1.29–6.83)	2.69 (1.08–6.73)***
Secondary and above	40	8	1	1
Ever Smoke Daily				
No	628	536	1.48 (0.95–2.30)	0.83 (0.49–1.39)
Yes	38	48	1	1
Current Chat Chewing Status				
No	13	23	2.20 (1.09–4.44)	1.15 (0.59–3.39)
Yes	299	240	1	1
Heart Disease				
No	659	564	1	1
Yes	9	18	2.34 (1.04–5.24)	2.63 (1.09–6.33)***
Diabetes				
Normal	652	559	1	1
Diabetes	20	27	1.56 (0.87–2.84)	1.24 (0.39–1.66)
Serving of Fruit and Vegetable				
High	84	61	1	1
Low	556	495	1.23 (0.86–1.74)	0.85 (0.57–1.27)
Central Obesity				
No	426	319	1	1
Yes	169	198	1.57 (1.22–2.01)	1.83 (1.31–2.57)***
BMI				
Underweight	280	266	3.48 (0.96–12.62)	1.65 (0.29–9.10)
Normal	304	247	2.98 (0.82–10.79)	1.95 (0.37–10.21)
Overweight	11	3	1	1

Note: ***Significant association at P-value < 0.05.
Abbreviations: AOR, Adjusted Odds Ratio; COR, Crude Odds Ratio.

Abbreviations

EDHS, Ethiopian demographic and health survey; IDA, Iodine deficiency anemia; DALYs, Disability Adjusted Life Years; GGFRC, Gilgel Gibe Field Research Center; Hb, Hemoglobin; WHO, World Health Organization.

Ethics Approval

Ethical approval was obtained from the Ethical Review Board of the Institute of Health, Jimma University. Additionally, secondary data were extracted from the Gilgel Gibe Field Research Center through legal and official means. The original data were collected from participants in line with national ethical guidelines.

Data Sharing Statement

The data that support the findings of this study are available from GGFRC of Jimma but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the GGFRC of Jimma University.

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Author Contributions

The authors' contributions were as follows: TS designed and supervised the study. TS, the principal investigator, drafted the manuscripts. TS, FT, and HJ were involved in the data extraction and analysis, and provided continuous feedback and support during this research work. All authors contributed to data analysis, drafting or revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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