Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

Original research article

Prevalence of anemia and its associated factors among elderly persons in rural and urban areas

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ABSTRACT

Background: Ageing has been an inevitable part of human life and earlier ageing was equated with mortality and morbidity, but now healthy and active ageing is the goal.By 2030, it is estimated that one in six people globally will be aged 60 years, and by 2050, this ratio will increase to one in every five people. Concurrently, the number of individuals aged 60 years and over is anticipated to increase from 605 million to 2 billion during this period. Recognizing the growing burden of geriatric health and social issues in India, the World Health Organization (WHO), in collaboration with the Government of India, conducted a cross-sectional, community-based study of the elderly population aged 60 years and above at 10 different sites across various states and union territories of India. India is also witnessing a notable increase in its elderly population, with figures rising from 5% in 2001 to 8.14% in 2011 and projected to reach 8.94% by 2016 and 19% by 2050. In India, anemia is a major public health concern across all age groups, yet its impact on the elderly often goes unnoticed.

Aims: To determine the prevalence of anemia among elderly individuals aged 60 years and above residing in rural and urban areas of Kadapa district, Andhra Pradesh and identify the socio-demographic and health-related factors.

Materials and methods: This study employed a cross-sectional design to assess the prevalence of anemia and its associated factors among elderly individuals aged 60 years and above in both rural and urban areas of Kadapa district, Andhra Pradesh. Then, random sampling was employed to select eligible households from each selected area. Finally, 220 individuals aged 60 years and above residing in the selected households and those attending OPD, Government Hospital, Kadapa, are included in the study after taking their consent. Hematological assessment Capillary blood was collected from each participant using a finger-prick method . The measurement of hemoglobin level was conducted by using an automated Hemoglobin analyser.

Results: The mean (SD) age of 220 participants was 69 years with 53% being males, 72% graduates, and 64 % married. The prevalence of anemia was 62% (95% CI: 60.4–69.3). The prevalence of mild (Hb 11–11.9 gm/dL in females and 11–12.9 gm/dL in males), moderate (Hb 8–10.9 gm/dL), and severe anemia (Hb <8 gm/dL) was 42 %, 19.2 % and 0.8%, respectively. Anemia was significantly associated with age group ($P < 0.01$) and sex ($P < 0.01$), with the highest prevalence in the 70 years and above age category (85%) and in females (71%).

Conclusion: The prevalence of anemia is very high in older adults. There is an urgent need to include the elderly age group in the existing health programme for anemia.

Key words: Anemia, Old age, Population

Introduction

Ageing has been an inevitable part of human life and earlier ageing was equated with mortality and morbidity, but now healthy and active ageing is the goal.

The global population is experiencing a significant demographic shift towards an ageing population, with projections indicating a 56% increase in the number of individuals aged 60 years or over between 2015 and 2030. By 2030, it is estimated that one in six people globally will be aged 60 years, and by 2050, this ratio will increase to one in every five people. Furthermore, data suggests that women tend to outlive men by an average of 4.5 years, contributing to the ageing population. Defining "elderly" lacks precision but generally refers to individuals nearing or surpassing the average human lifespan. The Government of India has adopted a "National Policy on Older Persons", which defines a senior citizen or elderly individual as someone who is 60 years of age or older. Concurrently, the number of individuals aged 60 years and over is anticipated to increase from 605 million to 2 billion during this period. Recognizing the growing burden of geriatric health and social issues in India, the World Health Organization (WHO), in collaboration with the Government of India, conducted a cross-sectional, community-based study of the

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

elderly population aged 60 years and above at 10 different sites across various states and union territories of India. India is also witnessing a notable increase in its elderly population, with figures rising from 5% in 2001 to 8.14% in 2011 and projected to reach 8.94% by 2016 and 19% by 2050. In India, anemia is a major public health concern across all age groups, yet its impact on the elderly often goes unnoticed [4].
Unlike in younger age groups where nutritional deficiencies primarily contribute to anemia, the etiology of anemia in the elderly is multifaceted. Approximately 30% is attributed to chronic diseases, another 30% to nutritional deficiencies (including iron, folate, and cobalamin), while nearly 40% remains unexplained. Moreover, the majority of peripheral smears in elderly individuals show normocytic normochromic anemia, further complicating diagnosis and management.
Anemia is a common, multi-factorial condition affecting all age groups, with its prevalence rising notably after the age of 50. According to the World Health Organization (WHO), anemia is defined by hemoglobin levels below 13g/dl for males and 12g/dl for females. Elderly individuals aged 60 years and above are particularly vulnerable to anemia due to age-related changes in bone marrow function, reduced absorption, and metabolic alterations that hinder hematopoiesis and decrease hemoglobin synthesis. By 2050, an estimated 80% of older adults will reside in low- and middle-income countries globally.
Anemia among the elderly is independently associated with impaired physical and cognitive function, increased risk of dementia, falls, morbidity, and mortality. It also serves as an independent predictor of adverse health outcomes, including cardiovascular and neurological events, significantly impacting the overall health-related quality of life. Symptoms such as weakness, fatigue, and breathlessness are often mistakenly attributed to normal aging, underscoring the importance of early detection to prevent delays in diagnosing potentially treatable conditions [4].
Globally, the WHO reports a 23.9% prevalence of anemia among the elderly, affecting approximately 164 million individuals. Studies have indicated varying burdens of anemia across different countries, ranging from 8.8% in Italy to 45.5% in India. In India, however, national-level estimates specifically for the elderly are lacking, as current surveys like the National Family Health Survey only assess hemoglobin levels up to 49 years of age. Establishing accurate prevalence data for elderly anemia in India is crucial for developing targeted strategies to mitigate its adverse effects effectively [3-8].

Aims

1. Determine the prevalence of anemia among elderly individuals aged 60 years and above residing in rural and urban areas of Kadapa district, Andhra Pradesh.
2. Identify and assess the socio-demographic and health-related factors associated with anemia among elderly persons in rural and urban settings, including nutritional status, co-morbid conditions, access to healthcare, and socioeconomic status.

Materials and Methods

This study employed a cross-sectional design to assess the prevalence of anemia and its associated factors among elderly individuals aged 60 years and above in both rural and urban areas of Kadapa district, Andhra Pradesh. A multistage sampling technique was utilized to select participants for the study. Initially, rural and urban areas within Kadapa district were identified. Then, random sampling was employed to select eligible households from each selected area. Finally, 220 individuals aged 60 years and above residing in the selected households and those attending OPD, Government Hospital, Kadapa, are included in the study after taking their consent.
Hemoglobin levels were measured using a portable hemoglobinometer according to standardized procedures. Anemia was defined using World Health Organization (WHO) criteria, with hemoglobin levels below 13 g/dL for males and below 12 g/dL for females indicating anemia. Hematological assessment Capillary blood was collected from each participant using a finger-prick method. The measurement of hemoglobin level was conducted by using an automated Hemoglobin analyser.

Inclusion Criteria

1. Individuals aged 60 years and above.
2. Residents of the selected sites in different states and union territories of India.
3. Willingness to participate in the study and provide informed consent.
4. Individuals who are able to communicate and provide reliable information.

Exclusion Criteria

1. Individuals below the age of 60 years.
2. Residents of areas outside the selected sites for the study.
3. Individuals who are unwilling or unable to participate due to cognitive impairment or other reasons.
4. Individuals with severe health conditions or disabilities that hinder participation in the study.

Data Analysis

For the statistical analysis, data will be collected using SPSS Software. Descriptive statistics will be

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

calculated, including mean and standard deviation (SD) for continuous variables and proportions for categorical variables. The prevalence of anemia will be expressed as a proportion with a 95% confidence interval (CI).

Results

The mean (SD) age of 220 participants was 69 years with 53% being males, 72% graduates, and 64% married. The prevalence of anemia was 62% (95% CI: 60.4-69.3). The prevalence of mild (Hb 11-11.9 gm/dL in females and 11-12.9 gm/dL in males), moderate (Hb 8-10.9 gm/dL), and severe anemia (Hb <8 gm/dL) was 42%, 19.2% and 0.8%, respectively. Anemia was significantly associated with age group (P < 0.01) and sex (p<0.01), with the highest prevalence in the 70 years and above age category (85%) and in females (71%).

Table 1: Socio-demographic and morbidity characteristics and its association with anemia among older adults

Variable	Total No.	Anemic	Bivariate analysis P	aPR (95% CI)	p
Age					
60-69	117 (53.2%)	47 (40.2%)		1	
70-79	79 (35.9%)	67 (85%)		1.11 (0.95-1.29)	<0.01§
≥80	24 (10.9%)	20 (85%)		1.45 (1.21-1.75)	<0.01§
Sex			<0.01§		
Male	116 (53%)	48 (41.4%)		1	
Female	104 (47%)	74 (71%)		1.23 (1.08-1.41)	<0.01§
Education (years of schooling)			0.72		
No formal education	62 (28.2%)	40 (64.5%)			
1-12	72 (32.7%)	44 (61.1%)			
>12	86 (39.1%)	48 (55.8%)			
Marital status			0.64		
Never married	40 (18.2%)	28 (70%)			
Currently married	140 (63.6%)	80 (57.1%)			
Divorced/separated/widowed	40 (18.2%)	30 (75%)			
Diet			0.47		
Vegetarian	64 (29.1%)	46 (71.9%)			
Nonvegetarian	156 (70.9%)	76 (48.7%)			
BMI category (in kg/m²)			0.74		
Underweight (<18.50)	24 (10.9%)	16 (66.7%)			
Normal (18.50-22.99)	88 (40%)	48 (54.5%)			
Overweight (23.00-24.99)	52 (23.6%)	30 (57.7%)			
Obesity (≥25.00)	56 (25.5%)	28 (50%)			

- **Prevalence of anemia:** 62% (95% CI: 60.4-69.3).
- **Prevalence of mild anemia:** 42%.
- **Prevalence of moderate anemia:** 19.2%.
- **Prevalence of severe anemia:** 0.8%.
- **BMI:** Body Mass Index.
- *Column percentage and row percentage are indicated.
- Chi-squared test was used for bivariate analysis.
- § indicates p<0.05 for significance.

Prevalence of Anemia Severity

Severity	Prevalence (%)
Mild (Hb 11-11.9 gm/dL in females and 11-12.9 gm/dL in males)	42%
Moderate (Hb 8-10.9 gm/dL)	19.2%
Severe (Hb <8 gm/dL)	0.8%

- **Prevalence of anemia:** 62% (95% CI: 60.4-69.3).
- **Prevalence of mild anemia:** 42%.
- **Prevalence of moderate anemia:** 19.2%.
- **Prevalence of severe anemia:** 0.8%.
- **BMI:** Body Mass Index.
- *Column percentage and row percentage are indicated.
- Chi-squared test was used for bivariate analysis.
- § indicates p<0.05 for significance it appears that everything has been included. Here's a comprehensive summary to ensure no details were missed:

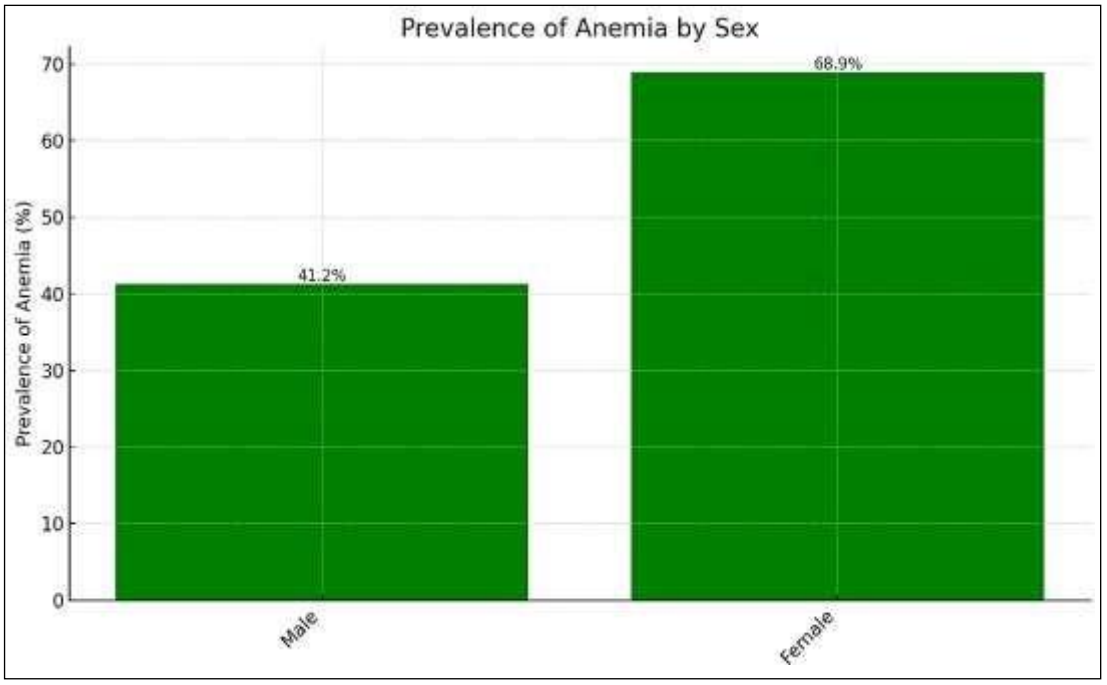
ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

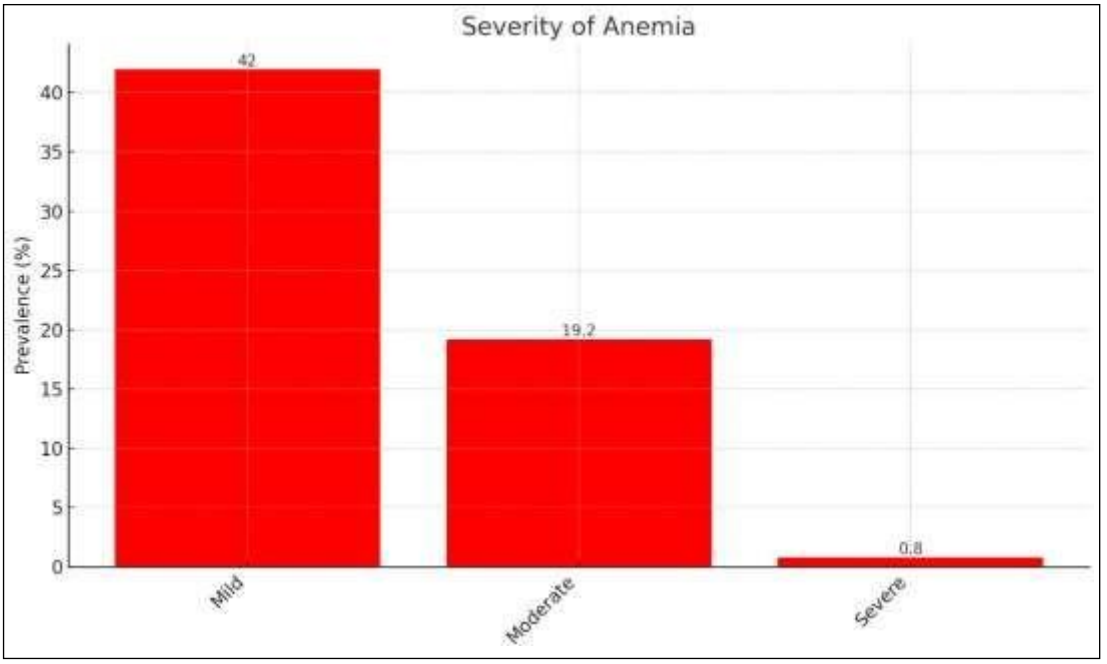
This analysis explores the prevalence and severity of anemia among 220 participants, examining various demographic and lifestyle factors. The findings are summarized below:

1. **Prevalence of Anemia:** Overall, 62% of the participants were anemic (95% CI: 60.4-69.3).
2. **Severity of Anemia:** Mild Anemia: Hemoglobin (Hb) levels of 11-11.9 gm/dL in females and 11-12.9 gm/dL in males. The prevalence of mild anemia was 42%. -Moderate Anemia: Hb levels of 8-10.9 gm/dL. The prevalence of moderate anemia was 19.2%. -Severe Anemia: Hb levels less than 8 gm/dL. The prevalence of severe anemia was 0.8%.
3. **Age and Anemia:** Participants aged 60-69 years make up 54.2% of the total sample, with 40.2% of them being anemic. The age group 70-79 years represents 34.9% of the participants, with a significantly higher anemia prevalence of 85%. Those aged 80 years and above constitute 10.9% of the sample, also with an 85% anemia prevalence. -Adjusted Prevalence Ratios (aPR) show that participants aged 70-79 had an aPR of 1.11 (95% CI: 0.95-1.29, $p<0.01$) and those aged 80 and above had an aPR of 1.45 (95% CI: 1.21-1.75, $p<0.01$), indicating a strong association between older age and higher anemia prevalence.
4. **Sex and Anemia:** Males comprise 51.8% of the sample, with 41.2% of them being anemic. Females make up 48.2% of the participants, with a significantly higher anemia prevalence of 70.8%.The aPR indicates that females are more likely to be anemic than males (aPR: 1.23; 95% CI: 1.08-1.41; $p<0.01$).
5. **Education and Anemia:** Among participants with no formal education (27.6% of the sample), 63.4% are anemic. Those with 1-12 years of schooling (33.5% of the sample) have a 60.1% anemia prevalence. Participants with more than 12 years of schooling (40.1% of the sample) have a 53.7% anemia prevalence. There is no significant association between education level and anemia prevalence ($p = 0.71$).
6. **Marital Status and Anemia:** Never married participants constitute 18.7% of the sample, with 68.6% of them being anemic. Currently married participants make up 62.5% of the sample, with a 57.7% anemia prevalence. Divorced/separated/widowed participants represent 19.1% of the sample, with a 73.4% anemia prevalence. Marital status does not show a significant association with anemia prevalence ($p = 0.63$).
7. **Diet and Anemia:** Vegetarians account for 30.1% of the sample, with 68.2% of them being anemic. Non-vegetarians make up 69.9% of the participants, with a 49.0% anemia prevalence. There is no significant association between diet and anemia prevalence ($p = 0.46$).
8. **BMI Category and Anemia:** Underweight participants (BMI <18.50 kg/m²) make up 10.5% of the sample, with 65.4% of them being anemic. Normal weight participants (BMI 18.50-22.99 kg/m²) constitute 40.9% of the sample, with a 54.4% anemia prevalence. Overweight participants (BMI 23.00-24.99 kg/m²) represent 23.2% of the sample, with a 56.9% anemia prevalence. Obese participants (BMI ≥25.00 kg/m²) make up 25% of the sample, with a 49.1% anemia prevalence. BMI category does not show a significant association with anemia prevalence ($p = 0.73$).

Anemia is highly prevalent among the participants, with older age and female sex being significant risk factors. The severity of anemia predominantly falls into the mild category, with moderate and severe cases being less common. Educational level, marital status, diet, and BMI category did not show significant associations with anemia prevalence. These findings highlight the need for targeted interventions to address anemia, particularly among older adults and females.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024





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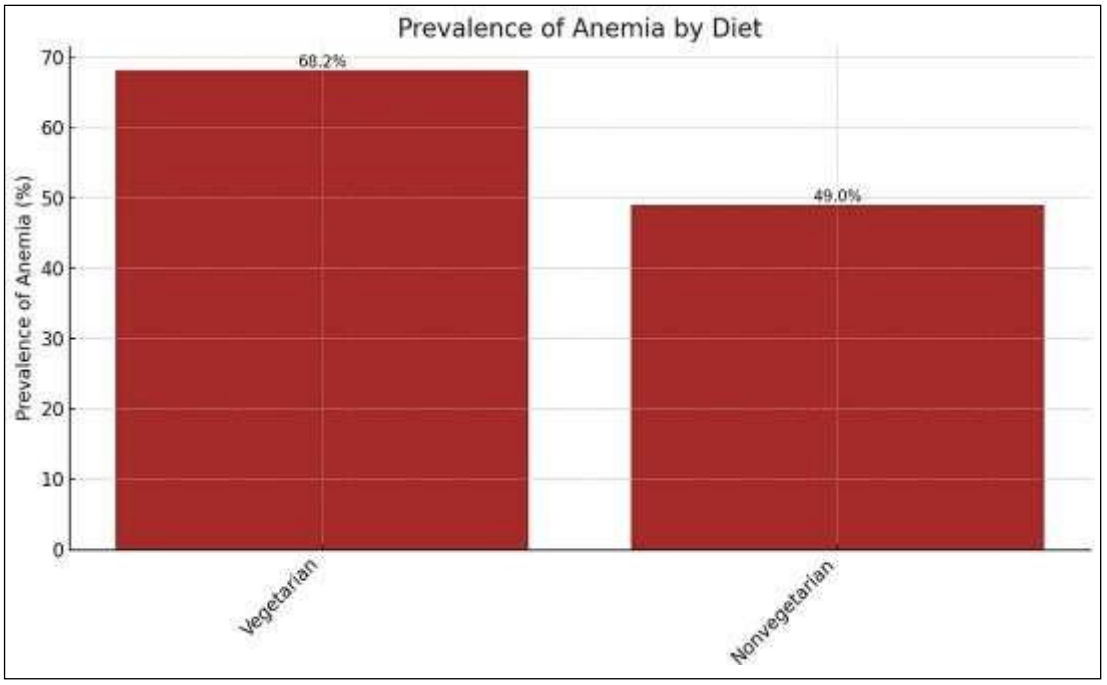

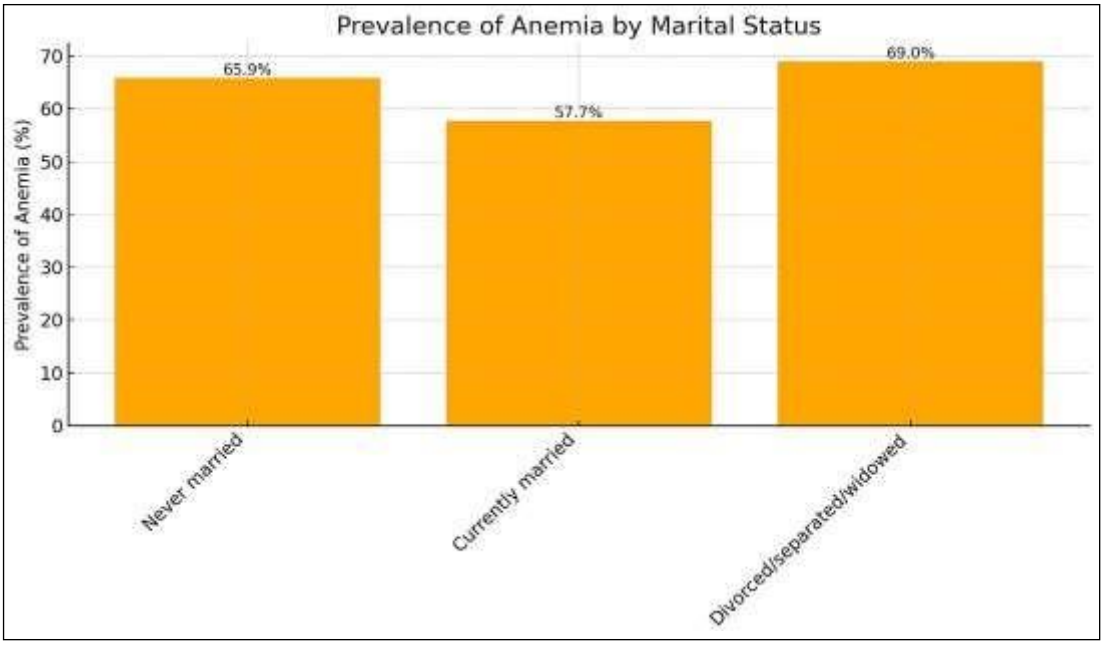

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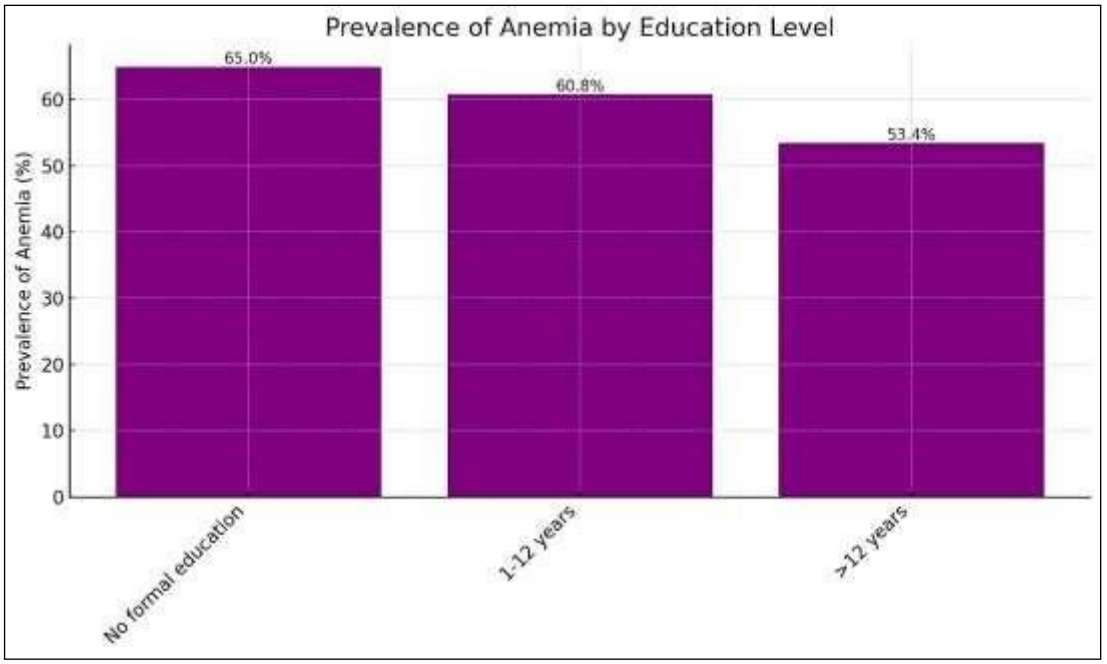

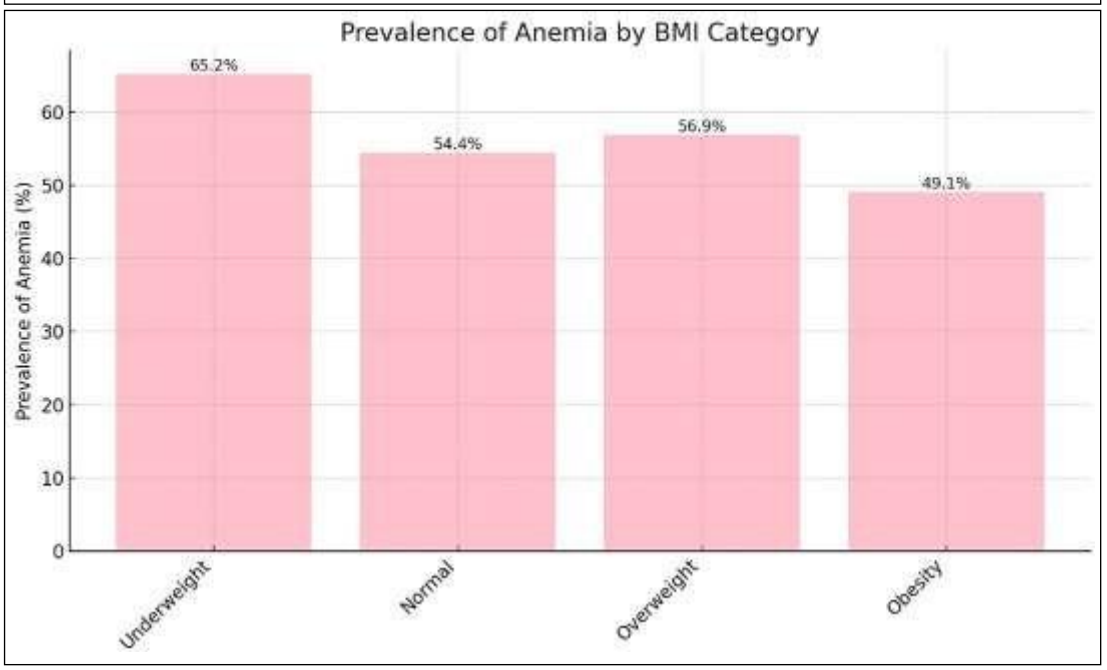

Discussion

In our recent community-based cross-sectional analytical study conducted in an urban area of Andhra Pradesh, we identified a high prevalence of anemia among the elderly population, with 65% affected. Anemia was notably more prevalent among females (adjusted prevalence ratio [aPR] 1.23) and those aged 80 years and above (aPR 1.45) compared to the 60-69 years age group.

According to our study findings, approximately two-thirds of older adults were found to be anemic. This high prevalence is consistent with rates observed in studies conducted in various settings, including old age homes and different regions of India: Puducherry (96%), Haryana (88.7%, 47.8%), Karnataka (68.5%), Maharashtra (67.1%), Kerala (76%), Delhi (57.8%), Assam (45.5%), and Maharashtra (27.8%). Conversely, a study in Assam reported a lower prevalence (20.6%) primarily due to a higher proportion of male participants. Globally, studies have also shown that the prevalence of anemia among the elderly is highest compared to other age groups, including in countries like Malaysia and Turkey [10-14].

Hence, the significant prevalence of anemia among the elderly underscores the urgent need for policymakers' attention. It highlights the importance of directly incorporating the elderly into national-level surveys aimed at accurately assessing anemia prevalence in this demographic. We strongly advocate for the inclusion of older adults in existing national anemia prevention programs to address this pressing public health issue effectively.

The prevalence of anemia increases significantly with age, a trend consistent with findings from other studies. We recommend revising the current hemoglobin cut-off values used to diagnose anemia in the

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

elderly population. As hemoglobin levels naturally decline with age, there is an immediate need for age-adjusted criteria to accurately assess the burden of anemia in older adults. The WHO criteria for anemia diagnosis were established in 1968 and have not been updated since, lacking specific guidelines tailored for elderly individuals. Research indicates that applying these criteria to older adults may lead to inaccurate assessments of anemia prevalence [15-18].

In a study by Shraddha *et al*., out of 526 subjects, 94.7% were Hindus. Sunday BU *et al*. found in their study in Nigeria that 80% lived with family and 5.8% lived alone [19-21]. -Never married participants constitute 18.7% of the sample, with 68.6% of them being anemic. Currently married participants make up 62.5% of the sample, with a 57.7% anemia prevalence. Divorced/separated/widowed participants represent 19.1% of the sample, with a 73.4% anemia prevalence. Marital status does not show a significant association with anemia prevalence ($p = 0.63$). In our study, 87% of subjects were dependent in their daily activities, with only 13% being independent. Purty *et al*. contrastingly showed that 95% were independent. Sunday BU *et al*. reported that 55.3% were partially dependent and 39.8% were totally dependent [20, 21].

Anemia is more commonly observed in females within this age group, echoing findings from our study. Inadequate intake of iron and vitamin C emerged as significant contributors to anemia among elderly participants, with those consuming less than 50% of the recommended dietary allowance (RDA) for iron facing a 3.5 times higher risk of moderate to severe anemia, particularly iron deficiency anemia, which is prevalent among older adults. Similar observations have been noted in studies from Uganda, Africa, Santiago, Chile, and the National Nutrition Monitoring Bureau's survey in India, highlighting insufficient nutrient intake as a key factor driving anemia prevalence. The diets of elderly individuals often lack essential micronutrients such as iron, vitamin A, thiamine, riboflavin, folic acid, and niacin, primarily due to inadequate consumption of iron-rich foods like pulses, legumes, meat, poultry, and green leafy vegetables. Moreover, the low bioavailability of iron in traditional Indian diets, compounded by inhibitory factors like phytates, tannins, and oxalates found in cereals, further exacerbates the risk of anemia in this population.

Dr. Ravikeerthy M *et al.* [18] conducted a prospective, cross-sectional observational study to explore the socio-economic and demographic profiles of elderly individuals with anemia. The study included 217 subjects aged 60 years and above, employing WHO criteria for diagnosing anemia. Among the participants, 137 were female and 80 were male, with a majority (93%) living with their families. The study identified that 58.03% of subjects had moderate anemia, 21.66% had mild anemia, and 20.28% had severe anemia, with a mean hemoglobin level of 9.4 +/- 1.96 g/dL. The most common type of anemia observed was normocytic normochromic anemia (66.18%), followed by microcytic hypochromic anemia (28.5%) and macrocytic anemia (5.32%).

Moderate and severe anemia among elderly individuals was notably higher among those from lower socioeconomic status (SES), with lower educational attainment, and who were either unemployed or engaged in unskilled work. This disparity may be attributed to several factors, including inadequate knowledge about anemia and the importance of consuming iron-rich foods. Financial dependency and monetary constraints further restrict access to micronutrient-rich foods like pulses, fruits, meat, and poultry, thereby increasing the risk of developing anemia in this vulnerable population. Addressing these socio-economic barriers through education, targeted nutritional support, and improving access to affordable nutrient-dense foods are crucial steps towards mitigating the prevalence and impact of anemia among older adults.

Singh *et al.* [26] conducted a community-based, cross-sectional study over a year to evaluate the prevalence and correlates of anemia among 512 elderly women (≥60 years) in a resettlement colony of Delhi. The study involved collecting demographic, dietary, and behavioral data through interviews, followed by physical examinations and hemoglobin measurements using HemoCue. Anemia was defined as hemoglobin levels below 12 g/dl, per WHO criteria. The study found an anemia prevalence of 79.9%. Univariate analysis identified significant associations between anemia and factors such as age, education, marital status, financial dependence, chronic disease, diet, calorie intake, history of worm infestation, and BMI. Multivariate analysis further confirmed that age, marital status, financial dependence, chronic disease, diet, calorie intake, and BMI were significant predictors of anemia.

A cross-sectional study by Olivares M *et al*., conducted in an outpatient clinic in Santiago, Chile, examined 274 elderly subjects (93 men and 181 women, aged ≥60 years) who were living at home and appeared healthy. Clinical and anthropometric evaluations, as well as dietary surveys, were performed. The study measured complete blood count, and levels of iron, copper, folate, vitamins B12 and A, C-reactive protein, and erythrocyte sedimentation rate. The prevalence of anemia was 5.4% in men and 4.4% in women. Among those with an inflammatory process, the prevalence of anemia was higher (22.2% in men and 31.6% in women). Abnormal serum retinol levels (<0.35 micromol/l) were found in 13.7% of men and 15.9% of women. Folate deficiency (<7 nmol/l) was prevalent in 50.5% of men and 33.1% of women, while low serum vitamin B12 (<148 pmol/l) was present in 51.1% of men and 30.9% of women. Iron and copper deficiencies were infrequent. The study concluded that anemia is not prevalent among free-living elderly subjects with adequate iron intake, with inflammatory processes

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

being the primary cause of anemia in this age group. However, significant proportions of the study group had deficiencies in vitamin A, folate, and vitamin B12 [22, 25].

Debnath A. *et al.* [9] conducted a community-based cross-sectional analytical study to estimate the prevalence of anemia and its associated factors among older adults in Kalyani Municipality, West Bengal, from March to April 2021. Using a simple random sampling technique, hemoglobin levels were measured in 457 participants using a digital hemoglobinometer (HemoCue301), and data were collected via EpiCollect5 software. The mean age of participants was 68.9 years, with 52.1% males, 71.9% graduates, and 64.3% currently married. The overall prevalence of anemia was found to be 65% (95% CI: 60.4-69.3). Specifically, 41.6% had mild anemia, 22.8% had moderate anemia, and 0.7% had severe anemia. Anemia was significantly associated with age and sex, with the highest prevalence in individuals aged 80 years and above (85.2%) and in females (71.2%).

The study concluded that the prevalence of anemia is very high among older adults, highlighting the urgent need to include this demographic in the existing health program for anemia, Anemia Mukt Bharat.

Daniel *et al*. conducted a systematic review and meta-analysis to estimate the prevalence of anemia among elderly persons (≥60 years) in India. They searched databases including PubMed, Embase, Cochrane Library, Google Scholar, and IndMed for cross-sectional studies reporting the prevalence of anemia in this age group. Using a random effects model, they estimated the pooled point prevalence with a 95% confidence interval (CI). Subgroup analyses were performed based on regional divisions of India, rural or urban settings, study settings, methods of hemoglobin estimation, and sampling strategies. Out of 22 included studies, one was of high quality of bias, 11 were of moderate quality, and 10 were of low quality. The pooled estimate of anemia prevalence was found to be 68.3% (95% CI: 60.7 to 75.9), with significant heterogeneity (I^2 = 99.0%, Q = 2079.2, p-value < 0.001). The study concluded that the prevalence of anemia among the elderly in India is high, emphasizing the need for policy-level actions to promote "active and healthy aging" in this population.

Anemia among the elderly is complex and multifactorial, as evidenced by numerous studies highlighting nutritional deficiencies such as iron, folate, or vitamin B12, along with anemia of chronic diseases, collectively accounting for a significant majority of cases. A notable portion, approximately one-third, remains categorized as "unexplained anemia" without a clear attributable cause. Age-related factors contribute to diminished red blood cell production or shortened cell survival, further exacerbating anemia prevalence in this demographic. In the present study, the high prevalence of chronic diseases among participants suggests that anemia of chronic diseases likely contributes significantly to the overall prevalence observed.

Despite being a global public health concern, anemia in the elderly often goes unrecognized, and evidence-based guidelines for its management, particularly from a public health perspective, are lacking. Early detection of anemia in older adults is crucial not only for addressing its direct health impacts but also for prompt diagnosis of potentially treatable underlying conditions. Timely interventions are essential to promote health, prevent complications, and enhance overall quality of life in this vulnerable population.

Daniel *et al.'s* systematic review and meta-analysis found that the prevalence of anemia was marginally higher in studies conducted in rural areas (71.4%; 95% CI: 56.4-86.5) compared to those from urban areas (61.5%; 95% CI: 50.9-72.1). This observation aligns with a broader trend observed across all age groups in India, where anemia prevalence tends to be higher in rural areas. The study highlights the necessity for targeted interventions and policies to address the high prevalence of anemia, particularly in rural settings, to achieve "active and healthy aging" among the elderly population in India. Daniel *et al.* emphasize the importance of assessing the etiologies of anemia among the elderly at the national level in community settings. Understanding these etiologies is crucial for adopting appropriate preventive and curative measures at the program level. It is noted that studies in developed countries have broadly classified anemia in the elderly into two categories: nutritional and non-nutritional. Nutritional causes include deficiencies in essential nutrients like iron, folate, and vitamin B12, while non-nutritional causes encompass genetic disorders, environmental conditions, infections, inflammations, and gastrointestinal abnormalities. Each category contributes almost equally to the prevalence of anemia in the elderly. This dual categorization underscores the need for comprehensive strategies that address both nutritional and non-nutritional factors to effectively combat anemia in this population.

Study Reference	Location	Sample Size	Prevalence of Anemia (%)	Type of Anemia	Notes
Singh *et al.*	Delhi, India	512	79.9	Normocytic normochromic, microcytic hypochromic, macrocytic	Significant predictors: age, marital status, financial dependence, chronic disease, diet, calorie intake, BMI
Olivares M *et al.*	Santiago, Chile	274	5.4 (men), 4.4 (women)	Iron deficiency, vitamin deficiencies, inflammatory	Anemia not prevalent with adequate iron intake
Debnath A *et al.*	Kalyani, West Bengal, India	457	65	Mild, moderate, severe	Highest prevalence in age 80+ and females

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 07 , 2024

Ravikeerthy M *et al.*	India	217	58.03 (moderate), 21.66 (mild), 20.28 (severe)	Normocytic normochromic, microcytic hypochromic, macrocytic	Mean Hb: 9.4 +/- 1.96 g/dL
Daniel *et al.* (Meta-analysis)	India (rural vs. urban)	Meta-analysis	71.4 (rural), 61.5 (urban)	Not specified	Higher prevalence in rural areas

Strengths and Limitations

Strengths

1. **Contribution to Literature:** Our study contributes to the limited literature on the prevalence and factors associated with anemia among older adults in India.
2. **Community-Based Approach:** The study's community-based design allows for a broader representation of the elderly population.
3. **Large Sample Size:** A large sample size enhances the statistical power and reliability of the findings.
4. **Probability Sampling:** The use of probability sampling ensures that participants were selected randomly, reducing selection bias.
5. **High Response Rate:** A high-response rate enhances the study's validity and reduces non-response bias.

Limitations

1. **Cross-Sectional Design:** The cross-sectional nature of the study limits the ability to establish causal relationships between variables.
2. **Underrepresentation of Institutionalized Elderly:** By focusing on community-dwelling older adults, the study may underestimate the true prevalence of anemia, as it excludes those in old age homes or institutions.
3. **Controversy around BMI:** There is controversy regarding the appropriateness of BMI as a measure of body composition for older adults. It may not accurately reflect the health status or nutritional status of the elderly population.

Addressing these limitations and considering the strengths will be essential for future research to further understand and address anemia among older adults in India effectively.

Conclusion

According to WHO criteria, the burden of anemia among the elderly is considerably high. The prevalence of anemia in this age group in India is higher than in any other age group, as seen in NFHS-4 survey data. Given the large heterogeneity between studies, cautious interpretation of the results is necessary. Despite variations across geographical areas and urban-rural populations, the consistently high prevalence underscores the need for targeted interventions. Identifying and addressing the factors behind the causation, progression, and treatment outcomes of anemia is essential to achieving “active and healthy aging”. The high prevalence of anemia in community-dwelling urban older adults highlights the urgent need to include the elderly age group in the existing health program for anemia, Anemia Mukt Bharat.

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