THE EVIDENCE

www.evidencejournals.com

Research Article | Non-communicable Diseases | Check for updates

Anemia, a risk factor for gastroenteritis among the elderly in India: evidence from the LASI cohort

AB Amaljith[1], Debankur Dey[2], Mirza Adil Beig[3], Mithun Mohan George[4], Dipanshu Aggarwal[5], Pavan Kumar[6], Sai Mahesh Vajjala[7], Aditi Pal[8], Tanya Gupta[9], S Suneeti Kanyari[10], Vineeth Rajagopal[11*]

[1] Center for Healthy Living, Global Center for Evidence Synthesis, Chandigarh, India.
[2] Medical College Kolkata, Kolkata, India.
[3] Dehradun Institute of Technology, Dehradun, India.
[4] Department of Infectious Diseases, Christian Medical College, Vellore, India.
[5] Department of Oral Pathology and Microbiology, Shree Bankey Bihari Dental College, Uttar Pradesh, India.
[6] Department of Public Health, Health Services Academy, Islamabad, Pakistan.
[7] Department of Community Medicine, Dr. D. Y. Patil Medical College Hospital and Research Centre, Dr. D. Y. Patil Vidyapeeth, Pune, India.
[8] ICMR-Regional Medical Research Centre, Bhubaneswar, India.
[9] TRIOS Development Support, New Delhi, India.
[10] Kalinga Institute of Medical Sciences, Bhubaneswar, India.
[11] Department of Community Medicine and School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh, India.

*Correspondence:drvineethrajagopal@gmail.com

evidence Journals

Cite this Article

Amaljith A, Dey D, Beig MA, George MM, Aggarwal D, Kumar P, Vajjala SM, Pal A, Gupta T, Kanyari SS, Rajagopal V, Anemia, a risk factor for gastroenteritis among the elderly in India: evidence from the LASI cohort. The Evi. 2024:2(3):1-.
DOI:10.61505/evidence.2024.2.3.54
Available From https://the.evidencejournals.com/index.php/j/article/view/54

Received:	2024-04-18
Accepted:	2024-07-06
Published:	2024-07-10

Evidence in Context

• Anemia prevalence at 3.89%, disproportionately affects women and rural elderly, increasing gastroenteritis risk fivefold. • High treatment-seeking behavior among anemic elderly indicates good healthcare engagement. • Study underscores need for targeted interventions for anemia and gastroenteritis, especially in vulnerable populations. • Data from Longitudinal Ageing Study in India (LASI) enhances understanding of health challenges in the aging population.

To view Article

Abstract

Background: Anemia and gastroenteritis are major public health concerns, particularly among the elderly population. This study aimed to investigate the prevalence of anemia and its association with gastroenteritis among older adults in India using data from the Longitudinal Ageing Study in India (LASI). The study was planned to comprehensively understand the epidemiology, risk factors, and potential interventions for anemia and gastroenteritis among the elderly Indian population.

Methods: A secondary analysis was performed on data from the first wave of Longitudinal Ageing Study in India (LASI) conducted in 2017-2018, involving 72,250 adults aged 45 and above. The prevalence of anemia was calculated, and logistic regression analyses were conducted to examine the association between anemia and self-reported gastroenteritis/diarrhea, adjusting for sociodemographic and health-related factors.

Results: The prevalence of anemia in the study population was 3.89% (2,586 cases). Women (69.1%), rural residents (74.0%), and those with lower educational attainment were disproportionately affected by anemia. Individuals with anemia had a five-fold increased likelihood of experiencing gastroenteritis (adjusted OR = 5.0, 95% CI: 3.44-7.42) compared to non-anemic individuals, even after adjusting for potential confounders.

Conclusion: The study highlights the substantial burden of anemia among the aging population in India and its strong association with the occurrence of gastroenteritis. Targeted interventions addressing anemia and its underlying determinants, particularly in vulnerable populations, and strategies for the prevention and management of gastroenteritis are warranted to improve the well-being and quality of life of India's elderly population.

Keywords: *anemia, gastroenteritis, elderly, LASI, public health, aging, India*

Introduction

The Longitudinal Ageing Study in India (LASI) is a comprehensive research project designed to explore the health, social, and economic dimensions of India's aging population. A collaborative effort led by prominent institutions, including the Harvard T.H. Chan School of Public Health, aims to provide vital data for policy-making and healthy aging initiatives. Tracking over 73,000 individuals aged 45 and older across India, LASI is set to offer insights into aging trends and challenges, aiding in the creation of informed policies and support systems for the elderly [1-3].

Classically Anaemia is defined as reduced oxygen carrying capacity of the blood either due to reduced haemoglobin or due to reduced normal red cell mass [4]. Anemia, affecting approximately one-third of the global population, is characterized by lower-than-normal hemoglobin (Hb) concentration and/or red blood corpuscles (RBC) numbers, leading to an insufficient supply to meet physiological requirements [5]. Iron deficiency anemia (IDA) remains a significant contributor to disability-adjusted life years in the global population, with a notable impact on women's health [6]. In 2020, global maternal mortality stood at 1520 deaths per million live births, potentially underestimated. The World Health Organization (WHO) approximates that each year, between 16,800 and 28,000 deaths occur in women of reproductive age as a result of anemia. IDA complicates 30% to 60% of pregnancies worldwide, with about 75% of individuals affected by the third trimester due to increased iron deficiency. Disparities in IDA prevalence exists, particularly among women of colour and those of low socioeconomic status. Despite its widespread impact, IDA remains underdiagnosed, under researched, and undertreated [7]. Diarrhea is characterized by loose stools and an increase in stool frequency, weight, or volume. It poses a significant health concern, contributing to 2.5 million deaths globally each year [8]. Aeromonas species are increasingly identified as a cause of acute gastroenteritis, but they are less frequently encountered in hospitals compared to other bacteria such as Clostridioides difficile, Salmonella spp., and Escherichia coli [9]. Annually, approximately 500,000 children under the age of five succumb to acute infectious gastroenteritis worldwide [10]. Zoonoses are illnesses that can be transmitted between animals and humans or from humans to animals. It is estimated that more than 60% of newly emerging infectious diseases in humans have animal origins. The global public health systems face significant challenges due to the impact of zoonotic diseases, leading to over 2 million human fatalities and 2.4 billion cases of illness worldwide each year [11]. In 2019, one-quarter of global deaths were due to infectious diseases, especially in low-income countries, the majority of deaths are caused by infectious diseases [12].

The rising trends of anaemia in India, especially among elderly, is concerning. The causes can vary from acute infections, nutritional causes and chronic diseases [13]. At a base level, surveys have been conducted to estimate the prevalence, a 20% prevalence of anaemia in urban elderly, with more than half of them related to nutritional causes has estimated [14]. In high-altitude regions like Uttarakhand more than 90% of the elderly were anaemic [15]. Pathania et al [16] estimated around 70% in old age homes were anaemic. Concurrently, the burden of gastroenteritis predominantly from waterborne diseases is very high in India. This is attributed to unsafe drinking water, non-availability in some cases, sanitation issues, and poor personal hygiene from the individuals themselves [17].

Anaemia is a major cause of morbidity in elderly individuals, presenting as weariness, sleep difficulties, restless legs syndrome, concentration deficiencies, and female infertility, all of which greatly reduce their quality of life. Blood loss, recurrent infections, nutritional deficiencies caused by insufficient diets, and malabsorption owing to poor absorption are all factors that contribute to anaemia in the elderly [18]. The majority of the strategies and interventions focus on children, adolescents, and pregnant women, and the elderly age group has not garnered enough attention [13]. In contrast, gastroenteritis causes diarrhoea and vomiting, and it is a significant source of morbidity in older persons [19,20]. Anaemia and gastroenteritis both worsen symptoms such as weariness, weakness, cognitive impairment, and dehydration, which have a significant influence on older individuals' health and well-being [21,22]. Diagnosing these illnesses in old age is difficult due to issues such as polypharmacy, medication interactions, medical tolerance, and additional concurrent medical conditions, which frequently result in delayed diagnosis and treatment, affecting care quality. The simultaneous impact of gastroenteritis and anaemia greatly increases healthcare expenditures, including hospitalisations, regular patient visits, and other expenses. The objective of

This study was to utilize LASI data to comprehensively understand the epidemiology, identify risk factors, and develop effective prevention and treatment strategies for anemia and gastroenteritis among the elderly population in India.

Methods

Study design, population and data

We performed a secondary analysis utilizing data gathered from the initial wave of LASI carried out in 2017-2018. The LASI focused on health, economic and social determinants of the ageing Indian population through a nationwide survey. The survey comprised 72,250 adults above 45 years of age and their spouses. Respondents were surveyed in all Indian states and union territories except Sikkim, employing a multistage, stratified area probability cluster sampling methodology. Information on the study design, instruments, data collection and results are summarised and published as the LASI India report and is accessible from a public domain [23]. Our study specifically focussed on the factors associated with gastroenteritis as reported in the LASI data and a probable association of anemia **(Figure 1).** Number of participants with reported gastroenteritis was 8,275(12.46%).

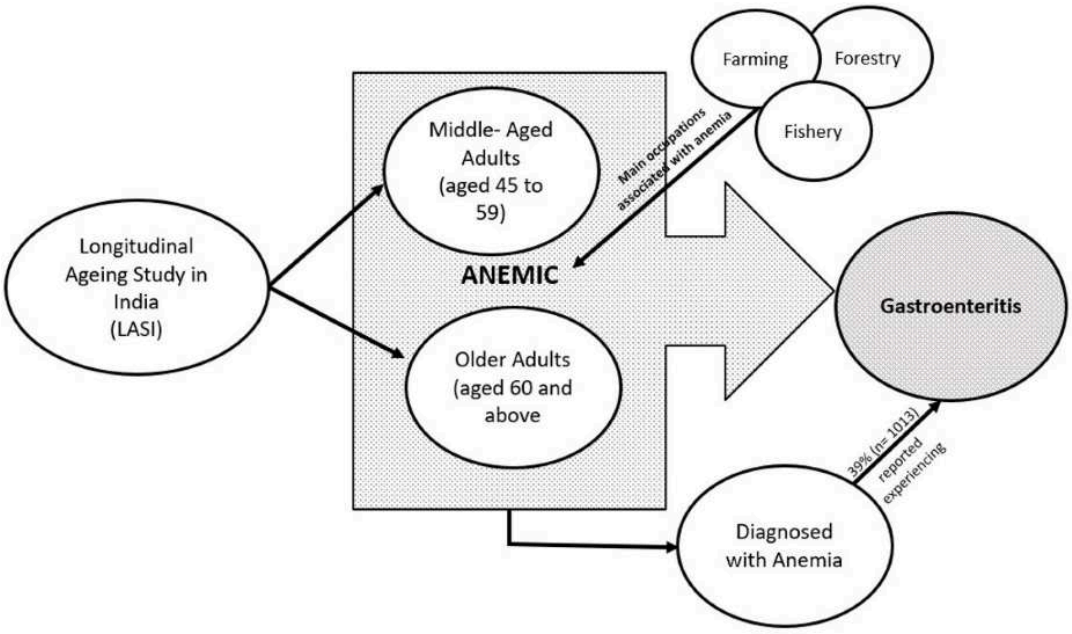

Figure 1: Association of anemia & gastroenteritis with cross-functional factors

Primary outcome

The primary outcome for our analysis was reported gastroenteritis/ diarrhoea. The primary outcome was assessed from the survey question "In the past 2 years, have you had gastroenteritis/ diarrhoea. The data was dichotomized as gastroenteritis/ diarrhoea "yes" or "no" in our analysis.

Statistical Analysis

The individuals' baseline sociodemographic variables were described using descriptive statistics. All categorical data was represented as frequency and percentages. To estimate the association of anaemia with gastroenteritis, we performed univariate then multivariate logistic regression. Statistical significance is interpreted as a p-valueof 0.05 or less. We used STATA 16 (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC) for statistical analysis and visualisations.

Results

Description of study population

The LASI initially involved 34,704 participants identified as middle-aged adults (ages 45 to 59)

And 31,915 individuals recognized as elderly population (60 years of age and older). A total of 66,397 participants were selected for this study.

Prevalence of anemia

In the study conducted across India, anemia was observed with a prevalence rate of **3.89%**, affecting a total of 2,586 individuals within the study population. The distribution of anemia prevalence across different states is detailed in **Figure 2**. The **Table 1** represents a thorough evaluation of the socio-demographic characteristics of the patients.

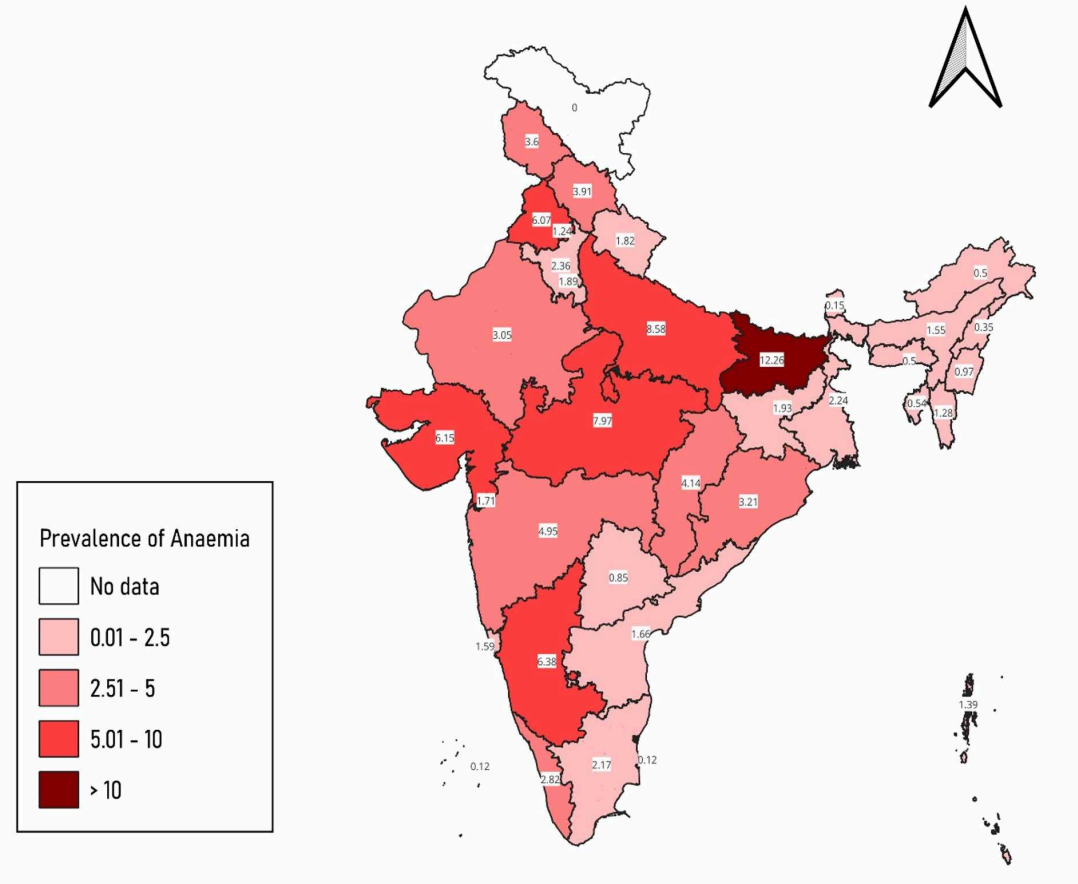

Figure 2: Statewise prevalence of anaemia

Table 1: Socio-demographic characteristics

Characteristics	Anemia =N (%)	Total number of cases (N)
Place of residence		2586
Urban	672 (25.9)	
Rural	1914 (74.0)	
Sex		2586
Male	800 (30.9)	
Female	1786 (69.1)	
Age		2586
45-59	1336 (51.7)	
60-69	754 (29.2)	
70-79	364 (14.1)	
80 & above	132 (5.1)	
Attended school		2586
Yes	1133 (43.8)	
No	1453 (56.2)	

Highest level of education		1133
Less than Primary (Standard 1-4)	280 (24.7)	
Primary Completed (Standard 5-7)	340 (30.0)	
Middle Completed (Standard 8- 9)	201 (17.7)	
Secondary School/Matriculation complete	171 (15.1)	
Higher Secondary/Intermediate/Senior	66 (5.8)	
Diploma and certificate holders	5 (0.4)	
Graduate degree (B.A., B.Sc., B. Com. etc.)	47 (4.1)	
Post-graduate degree or (M.A., M.Sc., etc.)	14 (1.2)	
Professional course/degree (B. Ed, BE, etc.)	9 (0.8)	
Current marital status		2586
Currently married	1186 (72.9)	
Widowed	626 (24.2)	
Divorced	13 (0.5)	
Separated	19 (1.0)	
Deserted	11 (0.4)	
Live in relationships	4 (0.1)	
Never married	27 (1.0)	
Currently working		1733
Yes	989 (57.1)	
No	744 (43.0)	
Main job		279
Farm/fishery/forestry (own/family)	103 (37.0)	
Agricultural laborer	85 (30.4)	
Non-agricultural business owner	10 (3.6)	
Own account worker	47 (17.0)	
Wage-salaried worker	28 (10.0)	
Paid family worker	6 (2.1)	
Self-rated health		2547
Excellent	72 (2.8)	
Very good	227 (9.0)	
Good	686 (27.0)	
Fair	994 (39.0)	
Poor	567 (22.3)	

Of the reported anemia cases, 25.9% (n=672) were from urban areas, while a significant majority of 74.0% (n=1914) were identified in rural locales. Demographically, women were disproportionately affected by anemia, constituting 69.1% (n=1786) of the cases. The age distribution reveals that 51.7% (n=1336) of anemic individuals were between 45 to 59 years old. Education levels among the anemic population showed that 56.2% (n=1453) had not received any formal education. Of those who had some level of schooling, 30.0% (n=340) had completed elementary education, reaching up to standards 5 to 7. Marital status and employment also emerged as notable factors; 72.9% (n=1186) of the anemia cases were among married individuals, and 57.1% (n=989) were among those who were employed. The predominant occupation among the anemic was in the sectors of farming, fishery, and forestry (either owned or family-run), accounting for 37.0% (n=103) of the cases. Self-report of health status revealed that 39.0% (n=994) of the anemic individuals considered their health to be fair. Among those diagnosed with anemia, 39.17% (n=1013) reported experiencing gastroenteritis or diarrhea. Notably, a significant portion of the anemic population, 83.44% (n=2157), had sought treatment for anemia, indicating a high level of healthcare engagement among the affected individuals.

Risk factors associated with gastroenteritis/diarrhea

The Logistic Regression Analysis was conducted on 66,397 participants to investigate the correlation with gastroenteritis. This analysis aimed to discern the relationships between various demographic and socioeconomic variables and the likelihood of gastroenteritis among

The study population. The analysis reveals significant associations across various demographic and socioeconomic variables **(Table 2).**

Table 2: Logistic Regression Analysis

Variables	Association with gastroenteritis			
	OR [95% CI]	p-value	aOR [95% CI]	p-value
Age				
45-59	Ref			
60-69	1.15 (1.1-1.2)	0.0	1.24 (0.99-1.55)	0.051
70-79	1.2 (1.1-1.3)	0.0	1.0 (0.65-1.55)	0.964
80 & above	1.4 (1.3-1.5)	0.0	1.2 (0.42-3.4)	0.705
Sex				
Male	Ref			
Female	1.1 (1.0-1.1)	0.005	1.0 (0.80-1.34)	0.751
Self-rated health				
Excellent	Ref			
Very Good	1.2 (1.0-1.3)	0.015	0.7 (0.46-1.08)	0.118
Good	1.2 (1.1-14)	0.002	0.7 (0.51-1.16)	0.224
Fair	1.7 (1.5-2.0)	0.0	0.9 (0.64-1.49)	0.939
Poor	2.2 (1.9-2.5)	0.0	0.81 (0.47-1.39)	0.46
Place of residence				
Urban	Ref			
Rural	1.8 (1.7-1.9)	0.0	1.0 (0.81-1.27)	0.870
Highest level of education				
Less than Primary (Standard 1-4)	Ref			
Primary Completed (Standard 5-7)	0.94 (0.85-1.0)	0.220	1.1 (0.89-1.47)	0.289
Middle Completed (Standard 8- 9)	0.92 (0.83-1.0)	0.171	1.1 (0.87-1.51)	0.309
Secondary School/Matriculation complete	0.71 (0.63-0.79)	0.000	1.1 (0.88-1.60)	0.256
Higher Secondary/Intermediate/Senior	0.77 (0.67-0.89)	0.000	0.8 (0.56-1.27)	0.428
Diploma and certificate holders	0.56 (0.36-0.86)	0.008	0.1 (0.02-1.44)	0.109
Graduate degree (B.A., B.Sc., B. Com. etc.)	0.62 (0.52-0.74)	0.000	0.9 (0.58-1.45)	0.731
Post-graduate degree or (M.A., M.Sc., etc.)	0.78 (0.60-1.0)	0.068	0.4 (0.13-1.43)	0.171
Professional course/degree (B. Ed, BE, etc.)	0.52 (0.36-0.74)	0.0	0.6 (0.18-2.19)	0.483
Current marital status				
Currently married	Ref			
Widowed	1.1 (1.06-1.18)	0.0	1.0 (0.75-1.55)	0.659
Divorced	1.2 (0.86-1.73)	0.246	1.0 (0.56-1.17)	0.583
Separated	0.8 (0.59-1.09)	0.167	0.5 (0.11-2.26)	0.382
Deserted	0.9 (0.67-1.3)	0.821	1.6(0.41-6.13)	0.493
Live in relationships	0.2 (0.11-0.37)	0.0	1.0 (0.57-1.56)	0.583
Never married	0.9 (0.75-1.15)	0.535	1.0 (0.44-2.38)	0.945
Currently working				
Yes	Ref			
No	1.0 (0.97-1.09)	0.220	0.6 (0.31-1.32)	0.23
Main job				
Farm/fishery/forestry (own/family)	Ref			
Agricultural laborer	0.7 (0.66-0.92)	0.004	0.7 (0.55-0.97)	0.031
Non-agricultural business owner	0.4 (0.30-0.57)	0.0	0.5 (0.35-0.75)	0.001
Own account worker	0.6 (0.54-0.79)	0.0	0.7 (0.61-1.03)	0.084
Wage-salaried worker	0.6 (0.50-0.75)	0.0	0.7 (0.59-1.00)	0.058
Paid family worker	1.5 (0.74-3.2)	0.244	1.3 (0.51-3.61)	0.524

Anemia				
Yes	Ref			
No	5.0 (4.61-5.44)	0.0	5.0 (3.44-7.42)	0.0

Age showed a progressively increasing association with gastroenteritis as participants aged, with those 80 years and above having the highest adjusted odds ratio (aOR) of 1.4 (95% CI: 1.3-1.5), although this became statistically non-significant when adjusted for other factors. Gender indicated a marginal association in the crude analysis, with females having an odds ratio (OR) of 1.1 (95% CI: 1.0-1.1) in contrast to men. However, this association disappeared in the adjusted analysis. Self-rated health status emerged as a strong predictor of gastroenteritis, with those rating their health as poor having an OR of 2.2 (95% CI: 1.9-2.5) in the crude analysis. Nevertheless, the significance of this association diminished upon adjustment. Residence type showed a strong crude association, while those living in rural regions had a substantially higher OR of 1.8 (95% CI: 1.7-1.9) than those living in urban areas, but this association was not significant after adjustment. Educational level displayed a gradient effect in the crude analysis, with decreasing odds of gastroenteritis as education level increased. However, adjustments for other variables largely nullified these associations. Marital status highlighted that being widowed, divorced, or separated slightly increased the odds of gastroenteritis in the crude analysis, but these associations were not significant after adjustments. Employment status and main job categories also showed varying degrees of association with gastroenteritis in the crude analysis, but these associations were generally weakened after adjustment. The most notable result showed that the incidence of gastroenteritis and anaemia had a strong connection. The likelihood of developing gastroenteritis was five times higher in those with anaemia (OR = 5.0, 95% CI: 4.61-5.44), which remained significant even after adjustments (aOR = 5.0, 95% CI: 3.44-7.42).

These findings underscore the intricate relationships between socio-demographic factors, health status, and the risk of gastroenteritis, with a particularly strong link between anemia and the likelihood of experiencing gastroenteritis.

Discussion

The current study offers valuable gain in understanding the burden of anemia and its link with gastroenteritis among the elderly population in India, utilizing data from the LASI. The findings highlight the substantial prevalence of anemia at 3.89% within the study population, aligning with previous reports indicating a significant burden of anemia among older adults, particularly in low- and middle-income nations [24]. Notably, the study revealed a striking five-fold increase in the likelihood of experiencing gastroenteritis among individuals with anemia, even after accounting for potential confounding factors. This finding corroborates prior research demonstrating a link between anemia and heightened susceptibility to gastrointestinal infections [25,26], as anemia can impair immune function and compromise the body's ability to mount an effective defense against infectious pathogens [27], also malnutrition and iron deficiency have been shown to raise the chance of getting gastroenteritis. The integrity of the mucosa and the absorptive capacities of the stomach epithelium, which has a rapid turnover rate, depend on sufficient nutrition. Defective epithelial development is the outcome of a persistent lack of tissue iron. Additionally, anemia's overall weakening of the immune system would raise the danger of gastroenteritis [28]. The study also shed light on the disproportionate impact of anemia on specific demographic groups. Women were significantly more affected, constituting 69.1% of anemia cases, consistent with the well-documented global gender disparity in anemia prevalence [29,30]. This disparity can be attributed to factors such as menstrual blood loss, increased iron requirements during pregnancy and lactation, and nutritional deficiencies [31].

Furthermore, the study revealed a higher prevalence of anemia in rural areas (74.0% of cases) compared to urban regions, aligning with previous research documenting higher rates of anemia in rural populations, potentially driven by factors like limited access to healthcare, poor nutrition, and lower socioeconomic status [32]. Interestingly, the study also highlighted the association between anemia and certain socioeconomic factors, with a substantial proportion of anemic individuals lacking formal education (56.2%) and being employed, predominantly in the farming, fishery, and forestry sectors. These findings underscore the complex interplay between socioeconomic determinants, occupational factors, and the risk of anemia, warranting further investigation [33].

The high proportion of anemic individuals (83.44%) seeking treatment for their condition is an encouraging finding, suggesting a relatively high level of healthcare engagement among the affected population. However, it also highlights the need for continued efforts to improve access to effective anemia management strategies, particularly in vulnerable populations [34].

While the study provides valuable insights, certain limitations should be acknowledged. The cross-sectional nature of the data precludes the establishment of a causal relationship between anemia and gastroenteritis, and this research relied on participants' self-reported information, which may be influenced by recall bias and potential under- or over-reporting of symptoms and conditions. Future research should consider longitudinal study designs to elucidate the temporal relationship between anemia, gastroenteritis, and other potential risk factors. Additionally, incorporating objective measures of anemia and gastroenteritis, as well as detailed information on dietary patterns, nutritional status, and comorbidities, could provide a more comprehensive understanding of the complex interplay of factors contributing to these conditions.

Future directions

The exploration of socio-demographic factors influencing the prevalence of gastroenteritis has predominantly focused on pediatric populations in developing countries, leaving a gap in understanding the impact on other demographics [35-37]. Our study, utilizing data from LASI Wave 1, presents an additional perspective by examining this issue within the aging population of India, offering comprehensive insights into health, social, and other demographic aspects. Notably, we uncovered a significant association between anemia and gastroenteritis, even after adjusting for confounding factors. This finding underscores the need for further investigation into the underlying mechanisms linking anemia and gastrointestinal infections. Moreover, understanding the etiology of anemia is crucial for gaining a comprehensive understanding of the pathophysiology. Future research should prioritize clinical validation of self-reported diagnoses, conduct multifactorial analyses to comprehensively assess various influences, and employ randomized study designs to strengthen the available evidence. Additionally, investigations into healthcare access, quality, nutritional interventions, and psychosocial factors are imperative for developing holistic approaches to disease prevention and management, thus warranting evaluation in future studies.

Strengths and Limitations

To the best of our knowledge, this study represents the largest investigation providing valuable insights into the prevalence and association of socio-demographic risk factors of age-related gastroenteritis in India, utilizing a nationally representative, comprehensive longitudinal dataset that enhances the study’s validity and reliability. A notable observation has been the increased odds of gastroenteritis observed among anemic individuals provided, given that most studies aiming to explore this association have been performed on pediatric populations [38,39]. However, certain limitations must be considered while interpreting the results. Firstly, the reliance on self-reported data is susceptible to recall bias, potentially influenced by factors such as stigma and the misclassification of health conditions. Systematic underreporting of gastroenteritis has been acknowledged in similar studies. Without clinical confirmation of these disease conditions, there is a risk of misclassification bias. Secondly, the observational nature of the study precludes the establishment of causal relationships, necessitating caution in interpreting the findings. Randomized study designs are required to validate the significant associations found in this study. Additionally, long-term follow-up data were not available since we utilized one-year longitudinally collected data. Lastly, despite the comprehensive collection of socio-demographic variables, factors such as income, sanitation practices, and dietary habits, which can act as potential confounders, could not be accounted for. Additionally, we could not determine whether any access to and use of medications could have impacted the outcomes. Despite these limitations, this study offers valuable insights into the epidemiology of gastroenteritis and its association with anemia in India's elderly population, laying groundwork for future research and informing public health interventions, given the scarcity of population-based studies on gastroenteritis in India.

Conclusion

In conclusion, the study underscores the significant burden of anemia among the aging population in India and its strong association with the occurrence of gastroenteritis. The findings

Highlight the need for targeted interventions aimed at addressing anemia and its underlying determinants, particularly in vulnerable populations such as women and rural residents. Additionally, the study emphasizes the importance of integrating strategies for the prevention and management of gastroenteritis, given its heightened risk in individuals with anemia. By implementing evidence-based strategies and addressing the complex interplay of socioeconomic, demographic, and health-related factors, the burden of anemia and gastroenteritis can be mitigated, ultimately improving the the wellbeing of India's ageing population and their quality of life.

Supporting information

None

Ethical Considerations

None

Acknowledgments

None

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author contribution statement

All authors contributed equally and attest they meet the ICMJE criteria for authorship and gave final approval for submission.

Data availability statement

Data included in article/supp. material/referenced in article.

Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

1. Longitudinal Aging Study in India (LASI). Available from: https://lasi-india. org/. *Accessed 10 April, 2024. [Crossref][PubMed][Google Scholar]*

2. International Institute for Population Sciences. Longitudinal Ageing Study in India (LASI). Available from https://www. *iipsindia.ac.in/lasi. Accessed 10 April, 2024. [Crossref][PubMed] [Google Scholar]*

3. Harvard T. H. Chan School of Public Health. *Longitudinal Aging Study in India (LASI). Available from: Accessed 10 April, 2024. [Article][Crossref][PubMed][Google Scholar]*

4. Daniel RA, Ahamed F, Mandal S, Lognathan V, Ghosh T, Gomathi et al. Prevalence of Anemia Among the Elderly in India: Evidence From a Systematic Review and Meta-Analysis of Cross-Sectional Studies. Cureus. *2023;15(7):e42333. [Crossref][PubMed][Google Scholar]*

5. Chaparro CM, Suchdev PS. Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. Ann N Y Acad Sci. *2019;1450(1):15-31. [Crossref][PubMed][Google Scholar]*

6. Cappellini MD, Musallam KM, Taher AT. Iron deficiency anaemia revisited. J Intern Med. *2020;287(2):153-70. [Crossref][PubMed][Google Scholar]*

7. Benson AE, Shatzel JJ, Ryan KS, Hedges MA, Martens K, Aslan JE, et al. The incidence, complications, and treatment of iron deficiency in pregnancy. Eur J Haematol. *2022;109(6):633-642. [Crossref][PubMed][Google Scholar]*

8. Sokic-Milutinovic A, Pavlovic-Markovic A, Tomasevic RS, Lukic S. Diarrhea as a Clinical Challenge: General Practitioner Approach. Dig Dis. *2022;40(3):282-289. [Crossref][PubMed][Google Scholar]*

9. Dharanendra S, Gillet AS, Geer B, Hall MA, Hwang PR. Watery Diarrhea Is Not Always Clostridioides difficile: A Case Report of Aeromonas hydrophila Gastroenteritis. Cureus. *2024;16(1):e51940. [Crossref][PubMed][Google Scholar]*

10. Posovszky C, Buderus S, Classen M, Lawrenz B, Keller KM, Koletzko S. Acute Infectious Gastroenteritis in Infancy and Childhood. Dtsch Arztebl Int. *2020;117(37):615-24. [Crossref][PubMed][Google Scholar]*

11. Mubemba B, Mburu MM, Changula K, Muleya W, Moonga LC, Chambaro HM, et al. Current knowledge of vector-borne zoonotic pathogens in Zambia: A clarion call to scaling-up "One Health" research in the wake of emerging and re-emerging infectious diseases. PLoS Negl Trop Dis. *2022;16(2): e0010193. [Crossref][PubMed][Google Scholar]*

12. DeWeerdt S. Uneven-attention-hampers-drive-to-control-infectious-diseases. Springer Nature; 2021. *[Crossref][PubMed][Google Scholar]*

13. Shivale SJ, Madamanchi D, Akhila BS, Vajjala SM. Comprehensive Approach to Address Anaemia: Beyond Conventional Methods. Natl J Community Med. *2023;14(11):781-2. [Crossref][PubMed][Google Scholar]*

14. Vadakattu SS, Ponday LR, Nimmathota A, Nagalla B, Kondru DS, Undrajavarapu P, et al. Prevalence of nutritional anemia and hyperhomocysteinemia in urban elderly. Indian J Clin Biochem. *2019;34:330-5. [Crossref][PubMed][Google Scholar]*

15. Gupta A, Ramakrishnan L, Pandey RM, Sati HC, Khandelwal R, Khenduja P, et al. Risk factors of anemia amongst elderly population living at high-altitude region of India. J Family Med Prim Care. *2020;9(2):673-82. [Crossref][PubMed][Google Scholar]*

16. Pathania A, Haldar P, Kant S, Gupta SK, Pandav CS, Bachani D. Prevalence of anemia among elderly persons residing in old age homes in national capital territory, Delhi, India. Indian J Public Health. *2019;63(4):288-92. [Crossref][PubMed][Google Scholar]*

17. Kumar P, Srivastava S, Banerjee A, Banerjee S. Prevalence and predictors of water-borne diseases among elderly people in India: evidence from Longitudinal Ageing Study in India, 2017–18. BMC public health. *2022;22(1):993. [Crossref][PubMed][Google Scholar]*

18. Chaubal A, Pandey V, Choksi D, Poddar P, Ingle M, Phadke A, et al. Anemia in patients with ulcerative colitis in remission: A study from western India. Indian J Gastroenterol. *2017;36:361-5. [Crossref][PubMed][Google Scholar]*

19. Ecollan M, Guerrisi C, Souty C, Rossignol L, Turbelin C, Hanslik T, et al. Determinants and risk factors of gastroenteritis in the general population, a web-based cohort between 2014 and 2017 in France. BMC Public Health. *2020;20:1-1. [Crossref][PubMed][Google Scholar]*

20. Cardemil CV, Balachandran N, Kambhampati A, Grytdal S, Dahl RM, Rodriguez-Barradas MC, et al. Incidence, Etiology, and Severity of Acute Gastroenteritis Among Prospectively Enrolled Patients in 4 Veterans Affairs Hospitals and Outpatient Centers, 2016-2018. Clin Infect Dis. *2021;73(9):e2729-e2738. [Crossref][PubMed][Google Scholar]*

21. Kadla SA, Shah NA, Bindroo MA, Khan BA, Farooq A, Yousf W, et al. Evaluation of iron deficiency anaemia for gastrointestinal causes in patients without GI symptoms in high prevalent GI malignancy zones. Arab J Gastroenterol. *2016;17(2):67-72. [Crossref][PubMed][Google Scholar]*

22. Antunes CV, Hallack Neto AE, Nascimento CR, Chebli LA, Moutinho IL, Pinheiro BD, et al. Anemia in inflammatory bowel disease outpatients: prevalence, risk factors, and etiology. Biomed Res Int. *2015;2015:728925. [Crossref][PubMed][Google Scholar]*

23. LASI India report; 2020. Available from: https://lasi-india. org/. *Accessed 10 April, 2024. [Crossref][PubMed][Google Scholar]*

24. World Health Organization (WHO). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. 2011. *[Crossref][PubMed][Google Scholar]*

25. Khan JR, Awan N, Misu F. Determinants of anemia among 6–59 months aged children in Bangladesh: evidence from nationally representative data. BMC Pediatrics. *2016;16(1):3. [Crossref][PubMed][Google Scholar]*

26. Oppenheimer SJ. Iron and its relation to immunity and infectious disease. J Nutr. *2001;131(2s-2):616S-633S. [Crossref][PubMed][Google Scholar]*

27. World Health Organization (WHO). Worldwide prevalence of anaemia 1993–2005 WHO Global Database on Anaemia; 2008. *[Crossref][PubMed][Google Scholar]*

28. Jayamanna U, Jayaweera JAA. Childhood Anemia and Risk for Acute Respiratory Infection, Gastroenteritis, and Urinary Tract Infection: A Systematic Review. J Pediatr Infect Dis. *2022;18. [Crossref][PubMed][Google Scholar]*

29. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: a systematic analysis of population-representative data. Lancet Glob Health. *2013;1(1):e16-25. [Crossref][PubMed][Google Scholar]*

30. Abbaspour N, Hurrell R, Kelishadi R. Review on iron and its importance for human health. J Res Med Sci. *2014;19(2):164-74. [Crossref][PubMed][Google Scholar]*

31. Ghose B, Tang S, Yaya S, Feng Z. Association between food insecurity and anemia among women of reproductive age. PeerJ. *2016;4:e1945. [Crossref][PubMed][Google Scholar]*

32. Bentley ME, Griffiths PL. The burden of anemia among women in India. Eur J Clin Nutr. *2003;57(1):52-60. [Crossref][PubMed][Google Scholar]*

33. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R, et al. A systematic analysis of global anemia burden from 1990 to 2010. Blood. *2014;123(5):615-24. [Crossref][PubMed][Google Scholar]*

34. Kumar SB, Arnipalli SR, Mehta P, Carrau S, Ziouzenkova O. Iron Deficiency Anemia: Efficacy and Limitations of Nutritional and Comprehensive Mitigation Strategies. Nutrients. *2022;14(14). [Crossref][PubMed][Google Scholar]*

35. Gopalkrishna V, Joshi MS, Chavan NA, Shinde MS, Walimbe AM, Sawant PM, et al. Prevalence and genetic diversity of gastroenteritis viruses in hospitalized children < 5 years of age in Maharashtra state, Western India, 2017-2019. J Med Virol. *2021;93(8):4805-4816. [Crossref][PubMed][Google Scholar]*

36. Paul P. Socio-demographic and environmental factors associated with diarrhoeal disease among children under five in India. BMC Public Health. *2020;20(1):1886. [Crossref][PubMed][Google Scholar]*

37. Azemi M, Berisha M, Ismaili-Jaha V, Kolgeci S, Avdiu M, Jakupi X, et al. Socio-demographic, Clinical and Laboratory Features of Rotavirus Gastroenteritis in Children Treated in Pediatric Clinic. Mater Sociomed. *2013;25(1):9-13. [Crossref][PubMed][Google Scholar]*

38. Deshmukh PR, Dongre AR, Sinha N, Garg BS. Acute childhood morbidities in rural Wardha: Some epidemiological correlates and health care seeking. Indian J Med Sci. *2009;63:345-54. [Crossref][PubMed][Google Scholar]*

39. Levy A, Fraser D, Rosen SD, Dagan R, Deckelbaum RJ, Coles C, et al. Anemia as a risk factor for infectious diseases in infants and toddlers: Results from a prospective study. Eur J Epidemiol. *2005;20:277-84. [Crossref][PubMed][Google Scholar]*

Disclaimer / Publisher's Note