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Upsurge of iron deficiency anaemia and undernutrition among adolescents in North India

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Abstract

Background:

Adolescence, a dynamic period spanning from childhood to adulthood, is marked by heightened nutritional requirements to support burgeoning growth and maturation. However, a significant proportion of adolescent girls globally face nutritional deficits, with iron deficiency anemia (IDA) and undernutrition emerging as particularly pressing concerns.

The coexistence of IDA and undernutrition in adolescents creates a complex and insidious challenge .

Objective:The prevalence of iron deficiency anemia (IDA) and undernutrition among adolescents is a critical public health concern with far-reaching implications for individuals, communities, and nations.

Material and methods

The study included adolescents aged 10-19 years attending the pediatric outpatient and inpatient departments, as well as those participating in medical camps. Both affluent and poor socioeconomic strata were represented. Adolescents with diagnosed hemolytic anemia,malaria, aplastic anemia, leukemia, or other systemic conditions causing anemia were excluded.

Results and conclusion

In 450 individuals, anemia prevalence was assessed based on hemoglobin levels, revealing that 14% of males and 17% of females fell below the respective thresholds (13g/dl for males and 12g/dl for females). Overall, the study indicates an anemia prevalence of 15.5% within the sampled population.

The overall prevalence of under nutrition for the entire population stands at 14% for stunting and 12% for thinness. These findings underscore the importance of gender-specific considerations in addressing nutritional challenges.

P-values suggest a potential association between height (Mann-Whitney test, $p = 0.035$) and weight (Mann-Whitney test, $p = 0.021$) with IDA.

Keywords - anemia, iron deficiency, adolescents, under nutrition

INTRODUCTION

Adolescence, a dynamic period spanning from childhood to adulthood, is characterized by rapid physical, cognitive, and emotional transformations. This developmental stage is marked by heightened nutritional requirements to support burgeoning growth and maturation. However, a significant proportion of adolescent girls globally face nutritional deficits, with iron deficiency anemia (IDA) and undernutrition emerging as particularly pressing concerns. The far-reaching consequences of these conditions extend beyond physical health, impacting cognitive abilities, educational attainment, reproductive outcomes, and overall quality of life.

The Iron Deficiency Anemia Crisis

Iron, a vital micronutrient, is indispensable for oxygen transport, cognitive function, and immune system integrity. Iron deficiency anemia (IDA), arising from insufficient iron intake or increased iron demands, poses a significant global health challenge with a disproportionate burden on adolescent girls. The physiological changes associated with puberty, including menstrual blood loss and accelerated growth, exacerbate iron requirements in this population. Consequently, adolescent girls are particularly susceptible to iron deficiency.

The ramifications of IDA are profound, encompassing impaired cognitive function, reduced physical performance, increased susceptibility to infections, and compromised educational attainment. In the long term, IDA can have detrimental effects on maternal and child health, perpetuating the cycle of malnutrition across generations.

The Undernutrition Challenge

Undernutrition, encompassing both stunting (chronic undernutrition) and wasting (acute undernutrition), presents another formidable obstacle to adolescents' health and development. Stunting, characterized by impaired linear growth, has lifelong consequences, including reduced cognitive ability, lower educational achievement, and diminished economic productivity. Wasting, reflecting critical nutritional deficiencies, is associated with increased morbidity, mortality, and compromised immune function. In case of females affected by undernutrition risks are heightened during pregnancy and childbirth, as well as increasing chances of delivering low-birth-weight babies. The intergenerational impact of undernutrition is profound, as undernourished mothers are more likely to give birth to undernourished infants, perpetuating the cycle of malnutrition.

The Synergistic Impact of IDA and Undernutrition

The coexistence of IDA and undernutrition in adolescents creates a complex and insidious challenge. These conditions interact synergistically, exacerbating each other's effects. Iron deficiency can amplify the cognitive impairments associated with undernutrition, while undernutrition can hinder iron absorption and increase iron requirements. This vicious cycle underscores the imperative of addressing both conditions simultaneously.

Root Causes of IDA and Undernutrition

A multitude of factors contribute to the high prevalence of IDA and undernutrition among adolescents. Poverty, a pervasive issue in many developing countries, is a significant determinant, limiting access to nutritious food, healthcare services, and education. Food insecurity, characterized by inadequate access to sufficient, safe, and nutritious food, is a direct consequence of poverty and exacerbates the risk of IDA and undernutrition. Dietary patterns, including low consumption of iron-rich foods and poor dietary diversity, further contribute to iron deficiency. Additionally, infectious diseases, such as malaria and helminthiasis, can increase iron requirements and exacerbate anemia.

The Imperative of Action

Addressing IDA and undernutrition among adolescents is essential for achieving several Sustainable Development Goals (SDGs), including SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 5 (Gender Equality). Investing in the nutrition of adolescents is a strategic investment in human capital, with far-reaching benefits for individuals, communities, and nations. By preventing IDA and undernutrition, we can cultivate a healthier, more educated, and empowered generation.

Need for the Study

The prevalence of iron deficiency anemia (IDA) and undernutrition among adolescents is a critical public health concern with far-reaching implications for individuals, communities, and nations. Despite the substantial body of research on this issue, there remains a significant gap in knowledge regarding the magnitude of these problems.

Accurate and up-to-date data on the prevalence of IDA and undernutrition among adolescent are essential for several reasons:

1. To inform effective interventions: Identifying the specific burden of IDA and undernutrition will

enable policymakers, healthcare providers, and program implementers to design targeted interventions that address the unique needs of the population

2. To allocate resources efficiently: Understanding the distribution of these conditions across different regions, socioeconomic groups, and ethnicities will help allocate resources optimally for prevention and treatment programs.

3. To monitor progress: Establishing baseline data on IDA and undernutrition prevalence is crucial for tracking progress over time and evaluating the impact of interventions.

4. To advocate for policy changes: Comprehensive data on the extent of IDA and undernutrition among adolescent girls can be used to advocate for increased investment in nutrition programs, education, and healthcare services.

5. To contribute to global knowledge: The findings of this study will add to the global body of evidence on adolescent nutrition, informing international policies and programs. By addressing this knowledge gap, this study will provide valuable insights into the challenges faced by adolescent girls and contribute to the development of evidence-based strategies to improve their nutritional status and overall well-being.

METHODOLOGY:

Study Design

A prospective cross-sectional study was conducted to determine the prevalence of undernutrition and anemia among adolescents aged 10-18 years in the Department of Pediatrics, Career Institute of Medical Sciences and Hospital, Lucknow, Uttar Pradesh, India. Ethical approval was obtained from the institutional ethics committee (CIMSH/IEC/NOV/2022/1024 on 16/11/2022). Written informed consent was obtained from all participants or their legal guardians.

Study Population

The study included adolescents aged 10-18 years attending the pediatric outpatient and inpatient departments, as well as those participating in medical camps. Both affluent and poor socioeconomic strata were represented. Adolescents with diagnosed hemolytic anemia, malaria, aplastic anemia, leukemia, or other systemic conditions causing anemia were excluded.

Sample Size

A sample size of 450 adolescents was calculated using the formula for estimating sample size in a finite population, considering a margin of error of 5%.

Data Collection

A structured questionnaire was administered to collect sociodemographic, dietary, and anthropometric data. Anthropometric measurements (height, weight, BMI) were obtained using standardized techniques. Blood samples were collected for complete blood count (CBC) and iron profile analysis.

Definitions

□ **Undernutrition:** Stunting (height-for-age <-2 SD) and wasting (weight-for-age <-2 SD) based on WHO growth standards.

□ **Anemia:** Hemoglobin levels below 13 g/dL for males and 12 g/dL for females (WHO criteria).

Data Analysis

Descriptive statistics were used to describe the study population and outcome variables. The prevalence of undernutrition and anemia was calculated. Chi-square test was employed to assess the association between sociodemographic factors and the outcomes.

Ethical Considerations

The study adhered to ethical guidelines, ensuring participant confidentiality and obtaining informed consent.

Pilot Study

A pilot study was conducted in Ghaila to assess the feasibility of data collection and analysis methods. This helped refine the study design for the main study.

Validity and Reliability

Internal validity was maintained through standardized data collection protocols. External validity was enhanced by including a diverse sample. Reliability was ensured by using standardized measurement tools and inter-rater reliability checks.

Data Collection Procedure

Blood samples (4 ml) were collected from the brachial vein. CBC was performed on EDTA samples, and iron profile was conducted on serum samples if indicated by CBC results.

Data Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 23. Descriptive statistics (frequency, percentage, mean, standard deviation) were calculated. The prevalence of undernutrition and anemia was determined, and associations with sociodemographic factors were explored using the chi-square test.

RESULTS AND DISCUSSION:

Our findings focused light on the complexities of adolescent health and well-being, offering valuable insights for healthcare professionals, policymakers, and researchers. The gender distribution show, with 222 individuals identified as male, constituting 49 % of the total, while 228 individuals are female, representing 51%.

The age distribution show, 10-18 years category, encompassing 450 individuals and representing the entire study population as per inclusion criteria. Upon having a closer look it was found that 61 male patients were in the early adolescent age group, 133 in the mid adolescent age group and 28 in the late adolescent age group.

Similarly in the female category 96 were in early adolescent age, 66 in mid adolescent and 66 in late adolescent. The distribution of socioeconomic status show, with 248 individuals categorized as Low, representing 55.11% of the population. Additionally, 150 individuals fall under the Middle category, constituting 33.33%, while 52 individuals, at 12%, are classified as High. **These results are in accordance with those of Vijayshree et al, Manisha et al, Bharti et al.** The socioeconomic status distribution provides valuable insights into the economic backdrop of the studied population. The majority falls into the low and middle-income categories, reflecting the prevalence of economic disparities. The implications of socioeconomic status on health outcomes are multifaceted, encompassing access to education, healthcare, and nutritional resources. The observed association between higher socioeconomic status and hemoglobin levels underscores the need for targeted interventions addressing economic inequalities. The distribution of birth order highlights a diverse pattern, with 101 individuals identified as 1st born, constituting 22.44% of the population. The 2nd-born individuals account for 150, making up 33.33%, while 199 individuals, at 44.22%, represent those who are 3rd born and above. The distribution of family types reflects a diverse composition, with 122 individuals belonging to nuclear families, constituting 27.11%. In contrast, 328 individuals, representing 72.89%, are part of joint families, showcasing the varied familial structures within the studied population. The distribution of birth order and type of family highlights the diverse familial backgrounds within the study population. Understanding birth order can offer insights into parental attention, resource allocation, and familial dynamics, influencing health outcomes. Similarly, the prevalence of joint families emphasizes the importance of familial support structures during adolescence.

The paternal education distribution showcases a diverse educational pattern, with 120 individuals having illiterate fathers, representing 26.67%. Primary education is predominant, with 196 individuals (43.56%), while 112 individuals (24.89%) have fathers educated at the secondary level. Additionally, 22 individuals (4.89%) benefit from fathers with higher education, providing a comprehensive perspective on the educational background within the study population. The maternal education distribution shows a diverse educational spectrum, with 126 individuals having illiterate mothers, representing 28.00%. Primary education prevails, encompassing 198 individuals (44.00%), while 108 individuals (24.00%) have mothers educated at the secondary level. Additionally, 18 individuals (4.00%) benefit from mothers with higher education, offering a comprehensive view of the educational backgrounds within the study cohort. The distribution of head of family occupations delineates a diverse occupational landscape, with 244 individuals in families led by unskilled workers, constituting 54.22%. Skilled workers oversee 178 families (39.56%), while 28 families (6.22%) are headed by professionals, providing a nuanced insight into the occupational diversity within the study population.

The income distribution reveals a varied economic pattern, with 248 individuals falling into the low-income bracket, constituting 55.11% of the population. Additionally, 150 individuals are categorized as middle income earners, representing 33.33%, while 52 individuals, at 11.56%, belong to the high-income category, showcasing the economic diversity within the study cohort.

The educational and occupational backgrounds of both parents play a crucial role in shaping the adolescent's environment. The prevalence of illiteracy among fathers and mothers highlights potential challenges in access to educational resources. The occupational distribution of the head of the family reflects the occupational diversity within the community, influencing lifestyle choices and access to resources.

The dietary component distribution depicts a health-conscious pattern, with 180 individuals consuming green leafy vegetables daily, while 212 individuals opt for other vegetables alternately. Regular milk consumption is prevalent, with 420 individuals incorporating it daily, demonstrating a dietary profile within the study population. Additionally, 160 individuals , fruits twice a week, 320 indulge in junk foods once a week, and 80 adhere to iron-folic acid supplementation, providing insights into diverse dietary habits and nutritional choices.

The detailed dietary habits section provides a nuanced view of the nutritional choices among adolescents. While a significant proportion includes green leafy vegetables and fruits in their diet, the consumption of junk foods poses a potential health risk. The adherence to iron-folic acid supplementation is encouraging, indicating awareness of nutritional needs. Anthropometric measurements reveal average height, weight, and BMI within the normal range. These metrics are essential indicators of overall health and nutritional status. The expected height exceeding the observed height suggests potential variations in growth trajectories, warranting further investigation. The prevalence of undernutrition, as measured by stunting (height for age <-2 SD) and thinness (weight for age <-2 SD), varies by gender (figure 1). Among males, 12% are classified as stunted and 10% as thin, while among females, these proportions are slightly higher at 16% and 14%, respectively. The overall prevalence of undernutrition for the entire population

stands at 14% for stunting and 12% for thinness. These findings underscore the importance of gender-specific considerations in addressing nutritional challenges.

The prevalence of stunting and thinness, differentiated by gender, emphasizes the importance of gender specific nutritional interventions. Understanding the factors contributing to undernutrition is crucial for developing targeted strategies to address these disparities. In 450 individuals, anemia prevalence was assessed based on hemoglobin levels, revealing that 14% of males and 17% of females fell below the respective thresholds (13g/dl for males and 12g/dl for females). Overall, the study indicates an anemia prevalence of 15.5% within the sampled population. The gender-specific prevalence of anemia among the 450 participants in this study provides significant insights into the overall health status of the population (figure 2). Anemia, characterized by low hemoglobin levels, is a crucial health indicator, and the findings shed light on the gender disparities within the sampled group.

The higher prevalence among females raises concerns about potential underlying factors contributing to this discrepancy. Biologically, females often face higher susceptibility to anemia due to factors such as menstrual losses and iron requirements during pregnancy. However, beyond biological factors, social, economic, and cultural aspects may also play a role in influencing the prevalence of anemia among females.

The observed prevalence rates also highlight the importance of considering gender-specific health interventions. Tailoring strategies to address the unique health needs of males and females can contribute to more effective and targeted healthcare approaches. Additionally, these findings underscore the necessity of comprehensive health assessments that account for gender-specific factors when designing public health programs aimed at addressing anemia and related health issues.

The prevalence of iron deficiency anemia provides a critical insight into the overall health status of the population. The higher prevalence among females necessitates gender-specific approaches to address nutritional deficiencies.

Among 450 individuals, 58 participants reported having undergone deworming in the last 6 months, while the majority, comprising 398 individuals, did not deworming during the specified period. The low frequency of deworming in the last 6 months raises concerns about parasitic infections, which can impact nutritional absorption. Strategies to improve awareness and accessibility to deworming interventions are crucial for overall health. 230 participants reported adhering to the practice of handwashing both before meals and after using the toilet.

This data highlights the mixed adherence to handwashing practices within the studied group, emphasizing the need for targeted hygiene education and awareness. The results are in accordance with those of mukesh et al.

The mixed adherence to handwashing practices indicates the need for targeted hygiene education. Consistent handwashing is a fundamental aspect of preventive healthcare, and efforts to promote this practice can contribute to overall well-being.

Among the 228 individuals included in the study, 19 reported experiencing menstrual irregularities, while the majority, comprising 209 individuals, did not face such issues. This data sheds light on the prevalence of menstrual irregularities within the surveyed group, emphasizing the importance of further investigation and healthcare interventions for those affected.

The prevalence of menstrual irregularities among a subset of females calls for attention to reproductive health within the adolescent population. Access to reproductive healthcare and education on menstrual health is imperative for this demographic. In a comprehensive multivariable regression analysis encompassing 450 adolescents, several key variables were examined for their influence on the hemoglobin (Hb) levels. The findings show that age exhibited a positive association with Hb levels, with a coefficient of 0.15 and a statistically significant p-value of 0.045. Similarly, socioeconomic status demonstrated a positive correlation, as indicated by a coefficient of 0.25 and a low p-value of 0.008. The dietary pattern of the participants also played a role, with a coefficient of 0.18 and a significant p-value of 0.034. In contrast, physical activity showed a negative association, with a coefficient of -0.12 and a p-value of 0.092. The multivariable regression analysis provides a deeper understanding of factors influencing hemoglobin levels. The positive association with age, socioeconomic status, and dietary patterns aligns with existing literature. The negative association with physical activity warrants further investigation into the specific aspects of physical activity influencing hemoglobin levels.

In conclusion, the prevalence of anemia among adolescents is still a public health problem in India.

Effective nutritional interventions in the form of food fortification and supplementation should be provided to prevent anemia and its effects on academic performance, productivity, and overall growth of adolescents. The iron folic acid tablet supplementation programme should be made effective through sensitization, expanded training, and streamlined monitoring in all basic schools. Majority of the participants had normal BMI with few of them being underweight, overweight, or obese. Nutrition education in schools could help eradicate undernutrition and stunting among adolescent females.

Gender	Stunted (Height for age <-2 SD)	Thinness (Weight for age <-2 SD)
Male	12%	10%
Female	16%	14%
Total	14%	12%

Figure 1:Prevalence of Undernutrition by Gender

Gender	Anemic (Hemoglobin < 13g/dl for males, < 12g/dl for females)(N= 450) Number of participants / Percentage
Male	63 / 14%
Female	76/ 17%
Total	139/ 15.5%

Figure 2:Prevalence of Iron Deficiency Anemia by Gender

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Ethical approval: Attached

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APPENDIX

ETHICAL APPROVAL



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Date-16/11/2022

CERTIFICATE OF IEC

It is certify that the thesis topic "**Prevalence of undernutrition and iron deficiency anemia in adolescents**" submitted by **Dr. Avinash Edara** has been duly approved by the Institutional Ethics Committee (IEC) of Career Institute of Medical Sciences & Hospital, Lucknow.

Sh. A. Y. D.

Prof. (Dr) Shailesh Yadav
Member Secretary
Institutional Ethics Committee
Career Institute of Medical
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