Volume 1, Issue 2, July-September 2026

JOURNAL OF NOVEL PHARMACEUTICAL DISCOVERIES (JNPD)

e-ISSN: 3139-9606

OPEN ACCESS

Publisher: Inscierra Edge Press

Journal homepage: https://jnpdglobal.com/index.php/files/index

Anaemia Prevalence and Sociodemographic Determinants among Adolescents Aged 15–19 Years in Al-Kufra, Libya: A Cross-Sectional Study

Jebril Saad Elabidi[1*], Asmaa Faraj Salih[2], Muna H. Ali[3] and Soad Mohamed[4]

1.2. Paediatric Department, Faculty of Medicine, Benghazi University, Libya.
3. Department of Biostatistics, Faculty of Science, Ajdabiya, Libya
4. Chemistry Department, faculty of science, Kufra University, Libya.

Article Info

ARTICLE HISTORY
Received: 15-07-2026
Accepted: 15-08-2026
Published: 29-08-2026

CITATION
*Jebril Saad Elabidi. Anemia Prevalence and Sociodemographic Determinants among Adolescents Aged 15–19 Years in Al-Kufra, Libya: A Cross-Sectional Study, Journal of Novel Pharmaceutical Discoveries (JNPD). 1(2), 01-10.

ABSTRACT

Background: Adolescent anaemia remains an important public-health and nutritional problem, particularly in settings affected by socioeconomic inequality, dietary inadequacy, and barriers to preventive care. Local data from southeastern Libya are limited. **Objective:** To describe anaemia prevalence and examine sociodemographic patterns among adolescents aged 15–19 years in Al-Kufra, Libya. Methods: The supplied aggregate cross-sectional table originally reported 400 participants. For this manuscript, subgroup counts were proportionally harmonized to an analytic total of 200, and all percentages, Pearson chi-square tests, 95% Wilson confidence intervals, and unadjusted odds ratios (ORs) were recalculated from the n=200 counts. Source inconsistencies were resolved using arithmetic consistency rules before rescaling.
Results: Among 200 adolescents, 76 were classified as anaemic, giving a prevalence of 38.0% (95% CI 31.6–44.9%). Anaemia was more frequent among females than males (44.6% vs 29.5%, p=0.029), rural than urban adolescents (51.7% vs 32.4%, p=0.011), and students in governmental compared with private schools (48.5% vs 15.6%, p<0.001). Lower parental education and lower family income were also associated with anaemia. The strongest unadjusted association was observed for the lowest versus highest income category (OR 7.67, 95% CI 3.30–17.81).
Conclusion: The harmonized analysis indicates a substantial anaemia burden with clear social gradients. Female sex, rural residence, governmental schooling, lower parental education, and lower household income were the main risk markers. The n=200 results should be verified against participant-level records before journal submission.

Keywords: Anaemia; adolescents; Al-Kufra; Libya; socioeconomic determinants; school health; iron deficiency

1. Introduction

Anaemia is a condition in which the haemoglobin concentration or red-cell mass is insufficient to meet physiological needs. It remains a major global public-health problem and disproportionately affects children, menstruating adolescent girls, women of reproductive age, and populations experiencing nutritional or socioeconomic disadvantage [1,2]. Iron deficiency is the most common nutritional contributor, although folate and vitamin B12 deficiency, infections, chronic disease, hemoglobinopathies, and blood loss can also contribute [1,3]. Recent work has also examined blood indices and erythropoietin levels in cystic kidney disease, highlighting the relevance of renal and erythropoietic factors when evaluating anemia-related hematologic changes [14].

Adolescence is characterized by rapid somatic growth, expansion of blood volume, increased lean body mass, and major changes in diet and lifestyle. Iron requirements rise during this period; in girls they are further increased by menstrual blood loss. These biological demands may interact with low dietary diversity, limited access to iron-rich foods, food insecurity, and poor health literacy [4,5]. Because adolescence also encompasses intensive schooling and cognitive development, anemia and iron deficiency may have implications for fatigue, attention, physical performance, and academic functioning [6,7].

The burden of iron deficiency remains important in the Middle East and North Africa (MENA) region. Recent burden estimates indicate persistent high prevalence across several countries and particularly among children and women of reproductive age [8]. A 2024 study from Tobruk, Libya, reported a high burden of anemia and iron deficiency among adolescent girls, reinforcing the need for more geographically diverse Libyan evidence [9].

Socioeconomic and educational context can shape anemia risk. Rural residence, lower household income, lower parental education, and attendance at resource-limited schools may influence dietary quality, access to screening, treatment, supplementation, and health information. Recent African meta-analyses have also identified rural residence and limited anemia awareness as important correlates among adolescent girls [10,11].

The present manuscript aims to characterize the prevalence of anemia and its sociodemographic distribution among adolescents aged 15–19 years in Al-Kufra, southeastern Libya. The analysis is based on a harmonized n=200 version of the supplied aggregate cross-sectional table; participant-level verification is required before publication.

2. Materials and Methods

2.1 Study design and setting

This manuscript is based on a cross-sectional summary of adolescents aged 15–19 years from Al-Kufra, Libya. The supplied summary did not include the study period, participating schools, recruitment dates, or sampling frame. These items should be inserted from the original protocol before submission: [AUTHOR TO CONFIRM STUDY PERIOD AND SAMPLING FRAME].

2.2 Study population and harmonized analytic sample

The source summary reported 400 adolescents. To obtain the requested analytic total of 200, subgroup counts were reduced by approximately 50% using constrained integer rounding. Each analyzed variable was required to total 200 participants, and the overall anemia count was harmonized to 76. This preserves the source distribution as closely as possible but is not equivalent to selecting 200 individual records from the raw dataset.

2.3 Data harmonization and consistency rules

Before rescaling, internal inconsistencies in the supplied table were resolved using explicit arithmetic consistency rules. Cell counts were treated as authoritative when printed percentages or totals conflicted with those counts. Accordingly, the age-17 percentages were recalculated from the reported counts (78 non-anemic and 56 anemic out of 134), and the higher maternal-education category was treated as 70 participants because its component counts were 59 non-anemic plus 11 anemic, rather than the printed total of 49. The household-income currency label was omitted because it was inconsistent with the Libyan study setting, while the numerical income categories were retained as source-coded units. The separate intervention table (control n=50; intervention n=53) was excluded from this cross-sectional analysis because its linkage to the cohort was not documented. All n=200 percentages and inferential statistics were then recalculated from the harmonized counts.

2.4 Variables and anemia definition

Variables available in the supplied summary included age, sex, locality, school type, school grade, parental education, parental occupation, family income category, crowding index, and anemia status. The exact hemoglobin threshold used to classify participants as anemic was not included in the source table. The final manuscript should report the original laboratory method and age/sex-specific cutoff and confirm alignment with current WHO guidance on hemoglobin thresholds and measurement [2,3].

2.5 Statistical analysis

Descriptive results are presented as counts, percentages, and anemia prevalence. Overall and subgroup prevalence estimates were accompanied by 95% Wilson confidence intervals where relevant. Associations between categorical variables and anemia status were assessed using Pearson chi-square tests without continuity correction, matching the convention evident in the source table. Unadjusted odds ratios with 95% confidence intervals were calculated for selected binary contrasts. Because joint participant-level covariate data were unavailable, multivariable logistic regression was not performed. Statistical significance was defined as two-sided $p<0.05$. All inferential statistics were recalculated from the harmonized n=200 aggregate counts using Python/SciPy.

2.6 Ethics and data governance

Ethical approval, consent/assent procedures, and data-protection details were not present in the supplied summary. These details must be completed from the original study documentation before submission: [INSERT ETHICS COMMITTEE, APPROVAL NUMBER, PARENTAL CONSENT/ADOLESCENT ASSENT PROCEDURES].

3. Results

3.1 Overall anemia prevalence

Among the 200 participants in the harmonized analysis, 76 were anemic and 124 were not anemic. The overall anemia prevalence was 38.0% (95% CI 31.6–44.9%).

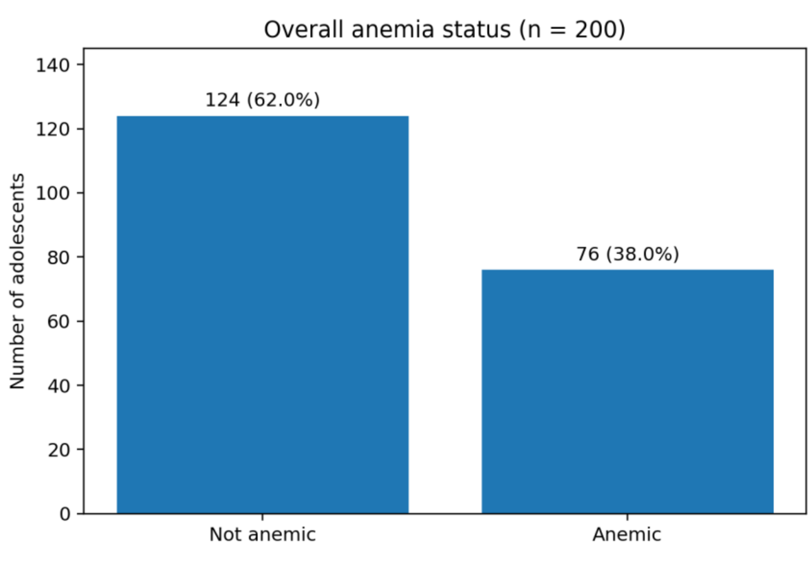

Figure 1. Overall anemia status in the harmonized analytic sample (n = 200).

3.2 Age and sex distribution

Table 1. Age and sex characteristics by anemia status.

Variable	Total n (%)	Not anemic n (%)	Anemic n (%)	p-value
15	11 (5.5)	7 (63.6)	4 (36.4)	0.954
16	65 (32.5)	42 (64.6)	23 (35.4)	
17	67 (33.5)	39 (58.2)	28 (41.8)	
18	51 (25.5)	32 (62.7)	19 (37.3)	
19	6 (3.0)	4 (66.7)	2 (33.3)	
Male	88 (44.0)	62 (70.5)	26 (29.5)	0.029
Female	112 (56.0)	62 (55.4)	50 (44.6)	

Age was not significantly associated with anemia (p=0.954). Females had a higher anemia prevalence than males (44.6% vs 29.5%; p=0.029).

3.3 Residence, school type, and grade

Table 2. Residence and school-related characteristics by anemia status.

Variable	Total n (%)	Not anemic n (%)	Anemic n (%)	p-value
Locality				
Urban	142 (71.0)	96 (67.6)	46 (32.4)	0.011
Rural	58 (29.0)	28 (48.3)	30 (51.7)	
School type				
Governmental	136 (68.0)	70 (51.5)	66 (48.5)	<0.001
Private	64 (32.0)	54 (84.4)	10 (15.6)	
Grade				
10	76 (38.0)	50 (65.8)	26 (34.2)	0.313
11	66 (33.0)	36 (54.5)	30 (45.5)	
12	58 (29.0)	38 (65.5)	20 (34.5)	

Anemia prevalence was substantially higher among rural adolescents (51.7%) than urban adolescents (32.4%; p=0.011). Governmental-school students had a markedly higher prevalence than private-school students (48.5% vs 15.6%; p<0.001). Grade level was not significantly associated with anemia (p=0.313).

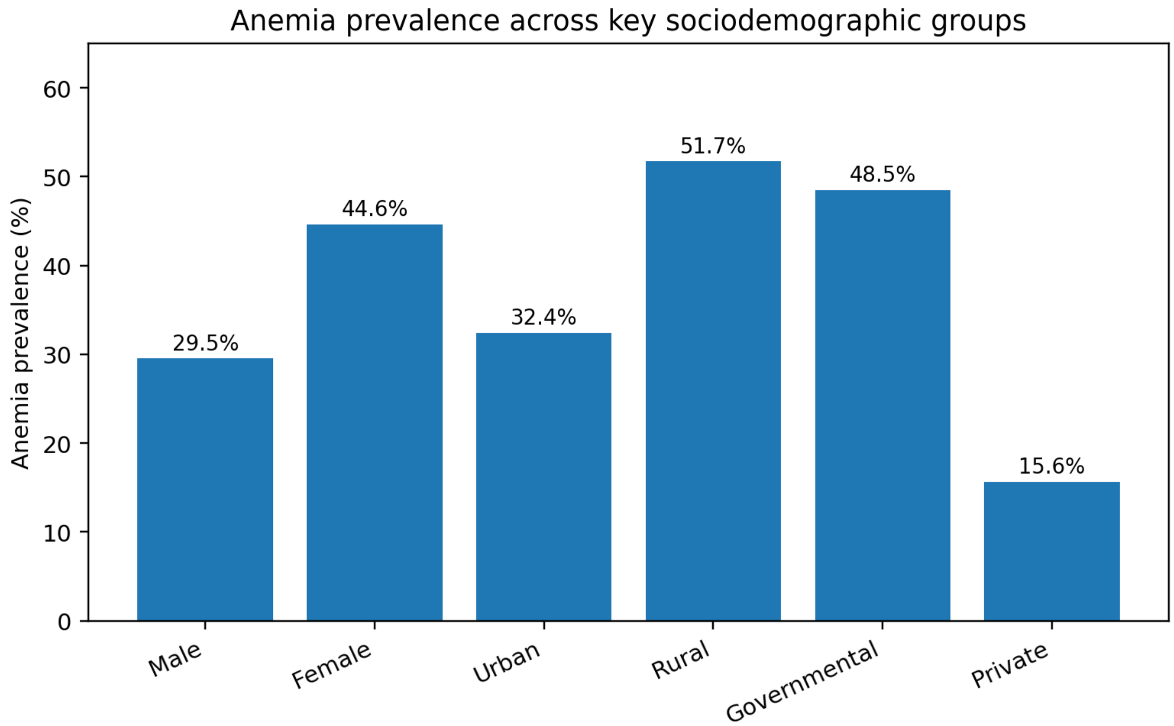

Figure 2. Anemia prevalence across selected sociodemographic subgroups.

3.4 Parental education and occupation

Table 3. Parental education and occupation by anemia status.

Variable	Total n (%)	Not anemic n (%)	Anemic n (%)	p-value
Father education				
Primary/preparatory or lower	134 (67.0)	74 (55.2)	60 (44.8)	0.005
Secondary school or university	66 (33.0)	50 (75.8)	16 (24.2)	
Mother education				
Primary/preparatory or lower	165 (82.5)	95 (57.6)	70 (42.4)	0.005
Secondary school or university	35 (17.5)	29 (82.9)	6 (17.1)	
Father occupation				
Not employed	51 (25.5)	30 (58.8)	21 (41.2)	0.588
Employed	149 (74.5)	94 (63.1)	55 (36.9)	
Mother occupation				
Not employed	171 (85.5)	104 (60.8)	67 (39.2)	0.403
Employed	29 (14.5)	20 (69.0)	9 (31.0)	

Lower paternal and maternal education were both significantly associated with anemia (p=0.005 for each comparison). Parental employment status was not significantly associated with anemia (father: p=0.588; mother: p=0.403).

3.5 Household income and crowding

Table 4. Household economic indicators by anemia status.

Variable	Total n (%)	Not anemic n (%)	Anemic n (%)	p-value
Monthly family income (source-coded units)				
Low (<30,000)	78 (39.0)	32 (41.0)	46 (59.0)	<0.001
Middle (30,000–70,000)	65 (32.5)	44 (67.7)	21 (32.3)	
High (>70,000)	57 (28.5)	48 (84.2)	9 (15.8)	
Crowding index				
≤2	42 (21.0)	26 (61.9)	16 (38.1)	0.494
2 to 4	78 (39.0)	52 (66.7)	26 (33.3)	
>4	80 (40.0)	46 (57.5)	34 (42.5)	

*Income thresholds are retained exactly as source-coded numerical categories. The currency label is intentionally omitted because the supplied table used a currency inconsistent with the Libyan study setting; the correct unit should be confirmed from the original questionnaire or data dictionary before submission.

A strong inverse income gradient was evident: anemia prevalence was 59.0% in the lowest income category, 32.3% in the middle category, and 15.8% in the highest category (p<0.001). Crowding index was not significantly associated with anemia (p=0.494).

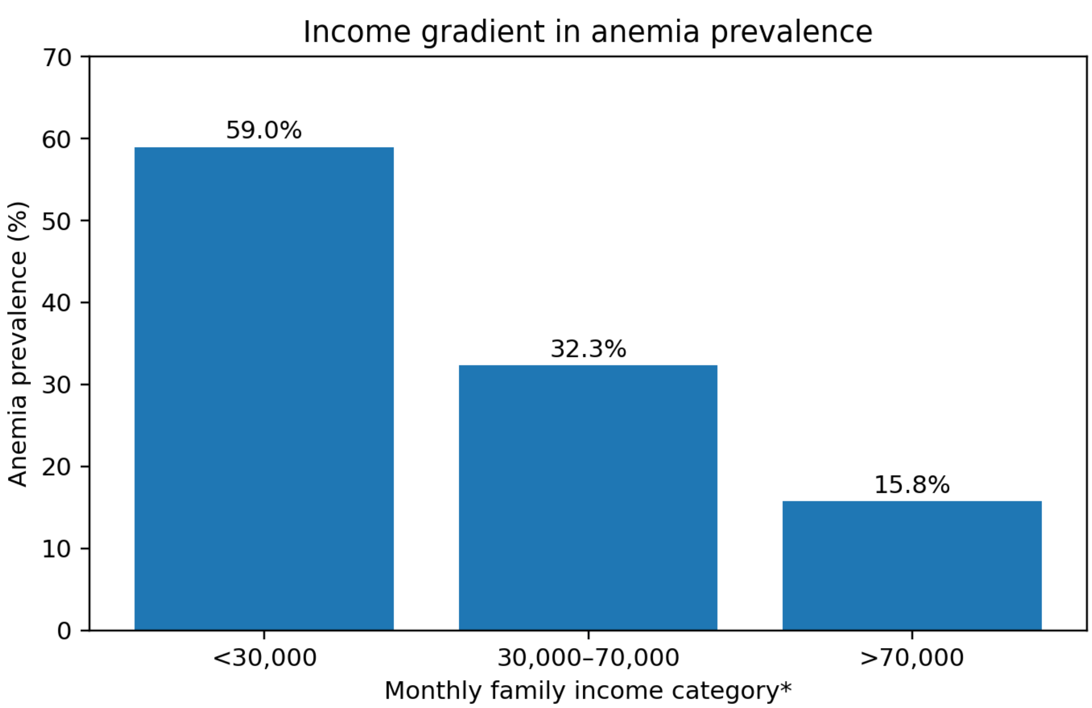

Figure 3. Anemia prevalence across monthly family income categories.

3.6 Subgroup prevalence estimates

Table 5. Selected subgroup anemia prevalence with 95% confidence intervals.

Subgroup	n	Anemic n	Prevalence (%)	95% CI (%)
Male	88	26	29.5	21.0–39.8
Female	112	50	44.6	35.8–53.9
Urban	142	46	32.4	25.2–40.5
Rural	58	30	51.7	39.2–64.1
Governmental school	136	66	48.5	40.3–56.9
Private school	64	10	15.6	8.7–26.4
Lower father education	134	60	44.8	36.6–53.2
Higher father education	66	16	24.2	15.5–35.8
Lower mother education	165	70	42.4	35.1–50.1
Higher mother education	35	6	17.1	8.1–32.7
Low income (<30,000 source units)	78	46	59.0	47.9–69.2
High income (>70,000 source units)	57	9	15.8	8.5–27.4

3.7 Unadjusted associations with anemia

Table 6. Unadjusted odds ratios for selected sociodemographic contrasts.

Contrast	OR	95% CI	Statistically significant
Female vs male	1.92	1.07–3.47	Yes
Rural vs urban	2.24	1.20–4.17	Yes
Governmental vs private school	5.09	2.40–10.82	Yes
Lower vs higher father education	2.53	1.31–4.89	Yes
Lower vs higher mother education	3.56	1.40–9.04	Yes
Father not employed vs employed	1.20	0.62–2.29	No
Mother not employed vs employed	1.43	0.62–3.33	No
Low vs high income	7.67	3.30–17.81	Yes
Middle vs high income	2.55	1.05–6.15	Yes
Crowding >4 vs ≤2	1.20	0.56–2.58	No

The largest unadjusted effect estimate was observed for the lowest versus highest income category (OR 7.67, 95% CI 3.30–17.81), followed by governmental versus private school attendance (OR 5.09, 95% CI 2.40–

10.82). Lower maternal education, lower paternal education, rural residence, and female sex also showed statistically significant positive associations with anemia. These estimates are unadjusted and may be confounded because participant-level joint covariate data were unavailable.

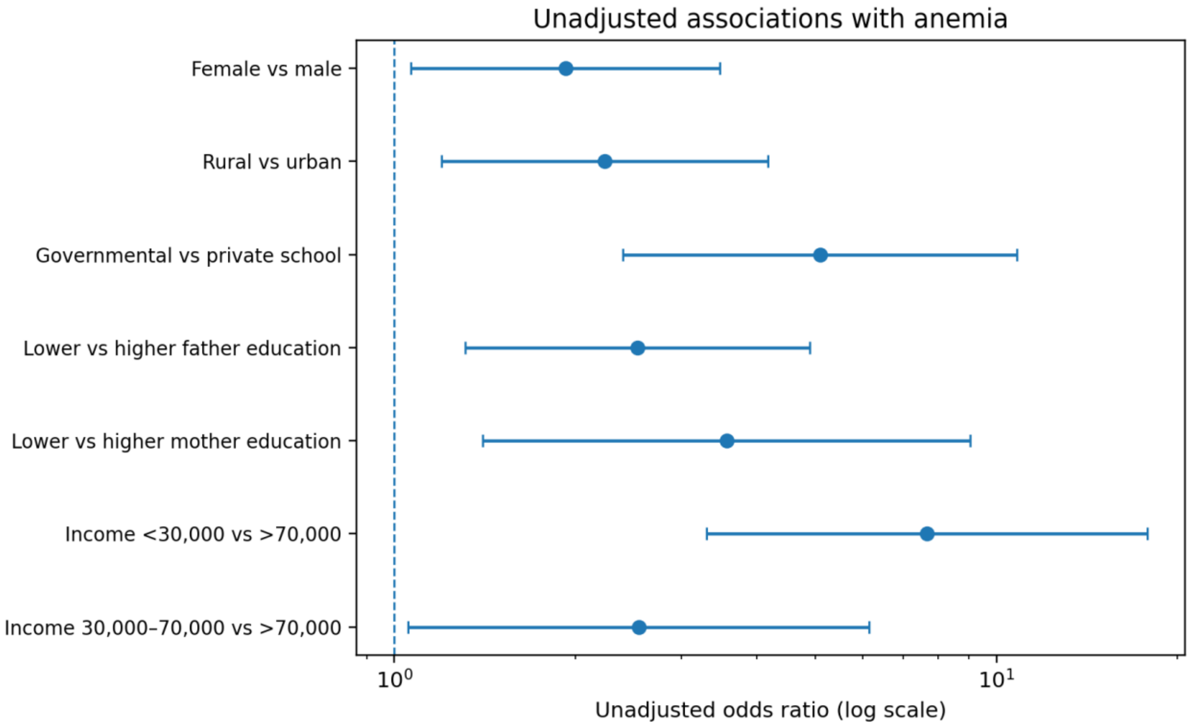

Figure 4. Forest plot of selected unadjusted odds ratios for anemia.

4. Discussion

The harmonized analysis suggests that anemia is common among adolescents in Al-Kufra, with an overall prevalence of 38.0%. This point estimate is above the approximately 30–33% pooled prevalence reported in recent meta-analyses of adolescent girls in sub-Saharan and East/West African settings, although direct comparison should be cautious because the present sample includes both sexes and the n=200 analysis is derived from aggregate rather than participant-level data [10,11].

The sex difference was clinically and epidemiologically plausible: females had nearly twice the unadjusted odds of anemia compared with males. Adolescent girls face additional iron losses through menstruation and often have higher iron requirements during rapid growth. These findings are directionally consistent with broader evidence identifying menstruating adolescent girls as a high-risk group and with data from Tobruk showing a substantial burden of anemia and iron deficiency among Libyan adolescent girls [1,5,9].

Rural residence was associated with greater anemia prevalence. Rural–urban differences may reflect disparities in diet diversity, access to fortified foods, screening, laboratory services, transportation, household resources, or exposure to infection and other causes of anemia. A 2025 meta-analysis from East and West Africa similarly identified rural residence as an important risk marker among adolescent girls [10].

The strongest school-level association was observed for governmental versus private-school attendance. School type can act as a proxy for household socioeconomic position, school resources, health-service access, and nutrition environments. A recent nationwide study from Tunisia also reported a higher risk of iron deficiency among children in public schools than private schools, supporting the relevance of school context for micronutrient risk [12].

Parental education showed a consistent relationship with anemia. Higher educational attainment may influence nutrition knowledge, household food choices, health-seeking behavior, and the ability to recognize symptoms or adhere to supplementation. Similar associations between maternal education and anemia or iron deficiency have been described in North African school populations [13].

The steep income gradient was one of the most important findings. Adolescents in the lowest income category had substantially higher anemia prevalence and a markedly elevated unadjusted odds ratio compared with the highest-income group. This is consistent with the broader concept that anemia is both a nutritional disorder and a marker of social disadvantage. WHO guidance emphasizes multisectoral approaches that combine screening and treatment with improvements in diet quality, supplementation where

anemia cutoff, ethics information, and income currency still require confirmation from primary study documentation. In addition, no participant-level laboratory indices, dietary variables, menstrual variables, infection markers, or inflammatory biomarkers were available, limiting etiologic and causal interpretation.

5. Conclusions

In the harmonized n=200 analysis, anemia affected approximately two in five adolescents aged 15–19 years

appropriate, education, infection control, and broader social determinants [1,4,5].

The findings support school-based and primary-care strategies in Al-Kufra. Practical priorities include targeted hemoglobin screening for high-risk adolescents, assessment of iron status when feasible, evaluation of menstrual blood loss in girls, nutrition education, promotion of affordable iron-rich foods, and evidence-based iron/folic-acid interventions where indicated. WHO guidance supports iron supplementation approaches for menstruating women and adolescent girls in settings where anemia is a public-health problem [5].

Interpretation must remain conservative. The n=200 analysis was harmonized from aggregate tables rather than generated from 200 participant records, so exact estimates may differ from those obtained from a true random or prespecified participant-level subset. Arithmetic inconsistencies in the source table were resolved before analysis using the consistency rules described in the Methods, but the original study period, in Al-Kufra. Higher prevalence clustered among females, rural residents, governmental-school students, adolescents with less-educated parents, and those from lower-income households. The pattern supports integrated school-health and primary-care interventions combining screening, nutrition education, evaluation of iron status and menstrual blood loss, and evidence-based supplementation where appropriate. The findings should be verified against the intended participant-level n=200 sample before journal submission or use as a definitive report.

References

World Health Organization. Anaemia. Fact sheet. Geneva: WHO; 2025.

World Health Organization. Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. Geneva: WHO; 2024. ISBN 978-92-4-008854-2.

World Health Organization, UNICEF. Best practices for haemoglobin measurement in population-level anaemia surveys: technical brief. Geneva: WHO; 2023/2024.

World Health Organization. Guideline: implementing effective actions for improving adolescent nutrition. Geneva: WHO; 2018. ISBN 9789241513708.

World Health Organization. Guideline: daily iron supplementation in adult women and adolescent girls. Geneva: WHO; 2016. ISBN 9789241510196.

Samson KLI, Fischer JAJ, Roche ML. Iron Status, Anemia, and Iron Interventions and Their Associations with Cognitive and Academic Performance in Adolescents: A Systematic Review. Nutrients. 2022;14(1):224. doi:10.3390/nu14010224.

Chen Z, Yang H, Wang D, Sudfeld CR, Zhao A, Xin Y, et al. Effect of Oral Iron Supplementation on Cognitive Function among Children and Adolescents in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. Nutrients. 2022;14(24):5332. doi:10.3390/nu14245332.

El Ati J, Doggui R, Mourou B, El Ati-Hellal M. Prevalence and Predictors of Anemia and Iron Deficiency in Children Aged 6 to 12 Years in Tunisia: A Nationwide Cross-Sectional Study. Nutrients. 2025;17(21):3399. doi:10.3390/nu17213399.

Achouri I, Aboussaleh Y, Sbaibi R, Ahami A, El Hioui M. Prevalence of Iron Deficiency Anaemia Among School Children in Kenitra, Northwest of

Safiri S, Amiri F, Karamzad N, Sullman MJM, Kolahi AA, Abdollahi M. Burden and trends of dietary iron deficiency in the Middle East and North Africa region, 1990–2021. Front Nutr. 2025;11:1517478. doi:10.3389/fnut.2024.1517478.

Aldareh M, Wahab Saleh MA. Prevalence of Iron Deficiency and Iron Deficiency Anaemia in Adolescent Girls in Tobruk, Libya. Libyan Journal of Science. 2024;27(2):35–40.

Belay DG, Amlak BT, Chilot D, Alem AZ, Merid MW. Pooled prevalence of anaemia and its associated factors among adolescent girls in East and West Africa: a systematic review and meta-analysis. BMC Public Health. 2025;25(1):2482. doi:10.1186/s12889-025-23701-4.

Dagnaw M, Belay DG, Degu T, Angaw DA, Tsheten T. Prevalence of Anemia Among Adolescent Girls in Sub-Saharan Africa: Systematic Review and Meta-Analysis. Public Health Rev. 2025;46:1608303. doi:10.3389/phrs.2025.1608303.

Morocco. Pak J Biol Sci. 2015;18(4):191–195. doi:10.3923/pjbs.2015.191.195.

Saad Elabidi J, Saied Abdulali H, Fouad Mohamed I, Sulaiman G, Hamad Attitalla I. Blood indices and levels of erythropoietin in cystic kidney disease. GPH-International Journal of Biological & Medicine Science. 2024;7(08):13-26. doi:10.5281/zenodo.13752917.