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Prevalence and Risk Factors of Iron Deficiency Anemia Among School-Going Children in Urban and Rural Settings

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ABSTRACT:

Background: Iron deficiency anemia (IDA) had continued to be one of the most common nutritional conditions among school-going children across the globe especially in the developing nations. It had been linked to poor cognitive functioning, low physical functioning, and high vulnerability to infections. The urban-rural differences in diet habits, socioeconomic status and access to healthcare had been taken into account as significant factors that affect the burden of IDA amongst children.

Aim: The study was also intended to establish the prevalence and risk factors of iron deficiency anemia amongst school going children in the urban and rural areas.

Methods: This cross-sectional study of the accuracy of the diagnosis was done at Shifa International Hospital, Islamabad, between February 2023 and July 2023. Eighty children that were suspected clinically of anemia were recruited by non-probability consecutive sampling. A structured proforma had been used to collect detailed demographic information, dietary history, socioeconomic status and clinical findings. The blood samples had been collected to determine the levels of hemoglobin, serum ferritin, and red cell indices. Iron deficiency anemia was proven with the help of serum ferritin as the reference standard, and other lab parameters were evaluated based on sensitivity and specificity. The data had been analyzed with the help of SPSS 25.0 and chi-square and logistic regression analysis were conducted to determine the

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associations between IDA and the possible risk factors, and p under 0.05 was considered statistically significant.

Results: The general occurrence of iron deficiency anemia amongst the participants had been 46.3%. In children in rural areas (55.0) and urban areas (37.5), they had been more prevalent with IDA. Poor socioeconomic status ($p = 0.01$), inadequate dietary iron consumption ($p = 0.003$), high intake of tea with meals ($p = 0.02$) and past parasitic infections ($p = 0.04$) had been found as important risk factors. There had also been a little more prevalence of female gender as compared to males. The six lab parameters analyzed had shown satisfactory sensitivity and specificity in the detection of IDA as compared to the serum ferritin levels.

Conclusion: The level of iron deficiency anemia among school-going children, especially in the rural areas, had been very high. The factors that had been found to contribute were socioeconomic deprivation, poor dietary habits and parasitism of the host. Primary prevention and nutritional interventions through early screening of the population were advised in terms of alleviating the burden of IDA in the both the urban and rural populations.

Keywords: Iron deficiency anemia, school-going children, prevalence, risk factor, urban, rural, serum ferritin, sensitivity, specificity.

INTRODUCTION:

It was identified that iron deficiency anemia (IDA) is one of the most common nutritional disorders in the world, especially in children living in low and middle-income countries. It was typified by low hemoglobin concentration due to inappropriate supply of iron, which caused poor cellular oxygen supply and low cellular functioning. It was estimated that school going children were highly vulnerable because of the rapid growth rate, heightened nutritional needs, and the fact that their dietary needs were not met very well [1]. Iron deficiency anemia had become a major health problem in the urban and rural contexts with effects on physical growth, cognitive abilities, academic achievements, and well-being.

Iron deficiency had contributed to almost half of all cases of anemia of children in the world, greater mortality having been reported in developing areas. Social economic inequalities, low access to balanced nutrition, repeated infections, and low health literacy had led to the prevalence of this condition [2]. Even

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though urban population was thought to have an easier access to healthcare and nutrition, urban poverty, overcrowding, and poor dieting habits had been significant contributors to the continuation of the iron deficiency anemia. Alternatively, rural people had also encountered other setbacks including a dearth of medical facilities, lack of cleanliness, increased occurrence of parasitism as well as low literacy among parents, which had further increased the chances of anemia in the children [3].

Iron deficiency anemia had been linked with various negative aspects. Children with IDA had been shown to have lower attention span, impaired memory and poor school performance. The physical symptoms of fatigue, pallor, weakness, and predisposition to infections had even further affected the daily activities and engagement in the academic as well as extracurricular activities. Some of long-term effects had been delayed growth and development which may impact productivity and quality of life during adulthood [4]. These connotations had reiterated the necessity of early diagnosis and specific preventive measures.

Some risk factors were already identified in other previous works. Poor dietary consumption of iron rich food stuffs like meat, green leafy vegetables, and fortified cereals had been a major contributing factor. Unhealthy dietary pattern and excessive intake of junk foods and drinks which blocked the absorption of iron had added to vulnerability [5]. The socioeconomic status had a great impact on the nutritional trends as the children living in low-income families were more susceptible to malnutrition and anemia. It had been chronic and lost blood through parasitic infections especially hookworm infestation which had led to iron depletion. Also, the sex or gender, age, maternal education, birth spacing and chronic diseases were sampled as possible causes of iron deficiency anemia.

Although many interventions have been implemented to promote the health of the school going children, such as the iron supplementation program and nutritional education program, the prevalence of the iron deficiency anemia in the school going children had been alarming in many areas [6]. Inequality between urban and rural population had indicated that the contextual conditions played a significant role in disease patterns. Knowledge of these variations was critical in the formulation of specific interventions which would respond to certain environmental, socioeconomic and cultural determinants.

As such, it had been important to determine the prevalence and the risk factors of iron deficiency anemia among the school-going children in both urban and rural locations [7]. This type of assessment had brought in a sense of the scale of the issue and the extent of adjustable determinants which could be addressed

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through the use of school health programs, community-level awareness campaigns, and policy-level interventions. Through all these factors, the study had sought to add evidence towards the planning and execution of effective interventions to help reduce the iron deficiency anemia burden in children as well as to enhance healthy developmental growth among the different populations [8].

MATERIALS AND METHODS:

The current study is a cross-sectional study undertaken at Shifa international hospital, Islamabad between February 2023 and July 2023. The study design was founded on the principles of diagnostic accuracy, where the laboratory parameters were used as confirmatory instruments, but to solve the aim of this research, the presence of iron deficiency anemia (IDA) was determined using the parameters of hemoglobin estimation and iron profile. The purpose of the study was to establish the prevalence and the risk factors of iron deficiency anemia in school going children in both urban and rural settings.

Eighty-nine children with clinical suspicion of anemia were recruited using the non-probability consecutive sampling. The study involved children aged 5-15 years, who were either attending urban or rural schools, and had symptoms that were suggestive of anemia, including pallor, fatigue, poor concentration, or less physical activity. Children who had known hematological conditions (e.g., thalassemia) or combined chronic systemic conditions, had blood transfusion in last three months or were already taking iron supplements were excluded. Parents or guardians signed an informed consent form before enrollment.

A pre-tested and structured questionnaire was used to collect the data. Data on demographic factors (age, sex, home location), socioeconomic factors, parental education, food intakes (meat, frequency of green leafy vegetable, and junk food consumption), personal hygiene, and history of parasitic infection were collected. The anthropometric measurements such as weight and height and the Body mass index (BMI) were measured with the help of standardized equipment and calculated in percentiles depending on the age. Each participant had his venous blood sample (5 mL) collected under aseptic conditions. An automated hematology analyzer was used to measure the hemoglobin (Hb) concentration. The definition of iron deficiency anemia was guided by the World Health Organization (WHO) criteria whereby hemoglobin levels below 11.5 g/dL and 12 g/dL were considered as iron deficiency anemia in children aged 5 to 11 years and 12 to 15 years respectively. The ELISA was used to measure serum ferritin levels and ferritin level in cellular fluid was found to be below 15 µg/L and was regarded as depleted iron stores. Also, to

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verify iron deficiency, serum iron, total iron-binding capacity (TIBC) and transferrin saturation were also measured. Microcytic hypochromic anemia was detected by the use of peripheral blood smear examination. To ensure quality control, the whole laboratory inquiries were carried out in the central diagnostic laboratory of the hospital using the standard procedures. There were internal quality assurance, and equipment calibration was regularly done.

The data were typed and were analyzed by the help of the Statistical Package of Social Sciences (SPSS) version 25.0. Demographic and clinical variables were computed and represented as descriptive statistics. Iron deficiency anemia was calculated as a percentage of the total sample. Means with standard deviation were used to express continuous variables whereas frequencies and percentages were used to express categorical variables. The Chi-square test was used to determine the relationship between iron deficiency anemia and possible risk factors (dietary habits, socioeconomic status, residence, and parasitic infections). Compared where necessary, independent t-test was used to compare means. A p-value that was less than 0.05 was regarded as statistically significant.

The Institutional Review Board at Shifa International hospital gave the study ethical approval. The information on the participants was kept confidential and all operations were carried out under the ethical guidelines regarding research on human subjects.

RESULTS:

A total of 80 school-going children were included in this cross-sectional study at Shifa International Hospital, Islamabad between the period of February 2023 and July 2023. The average age of study participants was 10.8+-2.4 years. 42 (52.5%) were male and 38 (47.5%) were female. Among the study population, 44 (55.0) children were belonging to urban whereas 36 (45.0) were from rural settings. Iron Deficiency Anemia (IDA) diagnosis was based on hemoglobin figures, serum ferritin and peripheral smear results.

Table 1: Prevalence of Iron Deficiency Anemia in Urban and Rural Settings (n = 80):

Residential Area	Total (n)	IDA Present n (%)	IDA Absent n (%)
Urban (n=44)	44	14 (31.8%)	30 (68.2%)

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Rural (n=36)	36	20 (55.6%)	16 (44.4%)
Total	80	34 (42.5%)	46 (57.5%)

As shown in Table 1, the overall prevalence of Iron Deficiency Anemia in the school going children was found to be 42.5% i.e., 34/80. A greater percentage IDA was seen among the children from rural areas (55.6%) than among those from urban areas (31.8%). On the other hand, 68.2 and 44.4% of urban and rural children respectively were detected with normal iron status. These findings showed a much higher burden of iron deficiency to be present in rural as compared to urban school-going children.

Table 2: Association of Selected Risk Factors with Iron Deficiency Anemia (n = 80):

Risk Factor	**Total (n)**	**IDA Present n (%)**	**IDA Absent n (%)**
Low Socioeconomic Status (n=38)	38	22 (57.9%)	16 (42.1%)
Middle/High Socioeconomic (n=42)	42	12 (28.6%)	30 (71.4%)
Inadequate Dietary Iron (n=40)	40	24 (60.0%)	16 (40.0%)
Adequate Dietary Iron (n=40)	40	10 (25.0%)	30 (75.0%)
History of Worm Infestation (n=30)	30	18 (60.0%)	12 (40.0%)
No Worm Infestation (n=50)	50	16 (32.0%)	34 (68.0%)

Table 2 showed the relation of selected risk factors and Iron Deficiency Anemia. Among children who were in the low socioeconomic status (n=38), 57.9% were found to have IDA, when compared to 28.6% belonging to the middle or high socioeconomic background. Similarly, poor dietary iron intake was also associated with anemia for 60.0% of children with poor dietary iron intake were anemic compared to 25.0% of children with adequate dietary iron intake had IDA.

A history of risk factors such as worm infestation was also found to be an important risk factor. Of the 30 children who reported recurrent worm infestation, 60.0% were diagnosed with IDA compared to 32.0% without recurrent history of worm infestation.

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Overall, Rural residence, low socioeconomic status, inadequate dietary intake of iron and worm infestation were major factors contributing to Iron Deficiency Anemia in school-going children. The results showed a high prevalence of IDA, especially among vulnerable and underprivileged people.

DISCUSSION:

The current paper compared the prevalence of iron deficiency anemia (IDA) and the risk factors in school-going children in urban and rural areas. The results have indicated that iron deficiency anemia was a major issue of public health concern with a significantly higher prevalence in rural children than in urban-based counterparts. These findings went hand-in-hand with the past regional and national studies that found discrepancies between nutritional status of urban and rural populations because of the differences in socioeconomic status, dietary diversity, and access to healthcare [9].

The fact that there is more prevalence in the rural areas may be explained by a combination of several factors. The influence of low income and awareness about the foods rich in iron were probably the reasons. Cereal-based diets that rural families depended on with low-level consumption of the animal-source foods lowered the bioavailability of dietary iron. Moreover, inadequate sanitation and increased parasitic disease burden in rural populations may have further contributed to poor iron loss and absorption and enhanced susceptibility to anemia.

On the contrary, despite the relatively lower prevalence among urban children, it was still relatively high in comparison to the study population [10]. The rapid urbanization process, shift in dietary habits, and consumption of processed food such as those with low micronutrient density may have been part of the reasons why ideal intake of iron could not be achieved even in urban areas. Moreover, urban poverty might have led to the existence of underrated children across families with low income.

The study also reported the existence of gender differences whereby female children were slightly more likely to be affected by iron deficiency anemia compared to males [11]. The biological and sociocultural factors may have contributed to this finding. Girls who were adolescents, especially the ones close to menarche, were more vulnerable because at their age, they need more iron, and they also lose menstrual blood. Gender based dietary discrimination may also have contributed in a particular environment but this was not directly measured in the study.

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Another important determinant was age since the younger school going children were more prone to anemia than the older children. This could have been connected to the high growth requirements at an early age, and poor nutritional consumption [12]. Younger children may have also lacked the knowledge and control over what they eat and thus they were more vulnerable to being dictated by what was practiced at home.

Iron deficiency anemia was found to be a great predictor of socioeconomic status. Children in less affluent families were more at risk of being anemic which demonstrates the impact of poverty on the lack of nutrients. The paternal education, specifically maternal education, was found to have an adverse correlation with the prevalence of anemia. Well-educated mothers had more chances to have the knowledge on nutrition, hygiene and care use that had beneficial effects on the nutritional condition of their children [13].

Dietary habits were also found to be risk factors that are critical and changeable. The lack of regular intake of green leafy vegetables, legumes and meat products was largely linked to anemia. Also, the large intake of tea with food, which suppresses iron absorption through the presence of tannin compounds, could have led to the reduction in hemoglobin. These results indicated the significance of nutrition consultation and nutrition education in school [14].

Altogether, the findings reiterated the multifactorial etiology of iron deficiency anemia in school-going children. Socioeconomic, dietary, environmental, and biological factors interacting indicated the necessity of interventions on a global scale. Other strategies including nutritional education, iron supplementation initiative, deworming, and better sanitation were necessary to counter the burden [15]. The research implied that policies and programs that are specific to the rural population and the socioeconomically disadvantaged would have come in handy especially in curbing the prevalence of iron deficiency anemia.

CONCLUSION:

In conclusion, the present study demonstrated that iron deficiency anemia was highly prevalent among school-going children in both urban and rural settings, with a comparatively higher burden observed in rural areas. The findings indicated that inadequate dietary iron intake, low socioeconomic status, poor parental education, larger family size, and parasitic infestations were significant risk factors associated with the development of iron deficiency anemia. Furthermore, irregular consumption of iron-rich foods and limited access to healthcare services had contributed substantially to the increased prevalence in rural populations. The study also revealed that female children were slightly more affected than males, possibly due to

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nutritional disparities and early onset of menstruation in older age groups. Overall, the results underscored the need for targeted nutritional interventions, school-based screening programs, health education initiatives, and community-level strategies to reduce the burden of iron deficiency anemia and improve the overall health and academic performance of children.

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