Prevalence of anemia among informal primary school children: a community based study in rural Upper Egypt

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ABSTRACT

Background: Anemia is recognised as a major public health problem in developing countries. The prevalence of anemia among school children has received less attention compared to preschoolers and pregnant women. This study aimed to estimate the prevalence of anemia and to identify its associated factors among informal school children in rural Upper Egypt.
Methods: A cross sectional descriptive study was conducted in a randomly selected Girls Education Initiative schools in three Egyptian governorates for a duration of 11 months. A structured questionnaire was used to collect sociodemographic data from 2826 children aged 6-19 years. Hemoglobin concentration and anthropometric indicators were assessed using the World Health Organization guidelines. Stool samples were examined for parasitic infestations, using the Kato Katz technique. The objective of the study was adequately explained to participants' guardian and their consensus was obtained with assured confidentiality.
Results: The prevalence of anemia was 59.3%, out of which, 82.5% had mild anemia and 17.4% had moderate anemia. It was significantly higher among 64% of children in the age group 6-9 years and 61.3% of the females. Most of underweight children (75.8%) and 66.4% of children with parasitic infestation were found anemic. Female gender and parasitic infestations were identified as the predicators of anemia among the studied children.
Conclusion: Anemia remains a common problem in Girls Education Initiative school particularly among girls of low income household. School children should be screened periodically and appropriate measures should be taken in order to promote health and guide effective education sector reform initiatives.

Key words: Anemia, Girls Education Initiative school, Rural Upper Egypt

INTRODUCTION

Anemia in childhood has a significant impact on lifelong health. It affects physical, mental, social well-being, and child's development [1]. Anemia, defined by low hemoglobin or hematocrit, is a wide spread public health problem both in developing and developed countries. It affects more than 2 billion people worldwide with an estimated 36% of developing world's population suffering from this disease [2, 3].It occurs in all age groups, but

it is more prevalent in pregnant women and children. Specially, young children from low income families who have a higher risk for developing iron deficiency anemia as a result of high demand for iron during the period of rapid growth [4]. Anemia is known to be a significant global problem affecting 305 million (25.4%) school age children with an estimated prevalence of 40% in developing countries [3]. Lack of awareness among mothers about the problem coupled with their low educational status [5], poor nutritional practices and unhealthy food habits, decreased physical activities [6] and parasitic infestations [7] are additional factors associated with lower hemoglobin level in children. Interestingly, overweight and obese children are at risk of anemia because they tend to consume unbalanced meals, particularly rich in carbohydrates and fat [8].

As the wealth of nations is to a large extent determined by the educational attainment and the health status of its population. The Millennium Development Goals (MDGs) encouraged significant resource allocation to both sectors, which are closely related to long-term reduction of poverty, and considerable progress has been made. Nevertheless, many developing countries are unlikely to achieve the health-related and education-related targets to which they have committed. The 2012 United Nations MDGs report clearly stated that 'Despite real progress, we are failing to reach the most vulnerable' [9]. Egypt has made significant progress, particularly in expanding access to basic education and closing the gap between boys' and girls' enrollment. In the year 2012/13, the net enrolment rate in primary education was 93.3% [10]. While in preparatory schools, it was lower at a rate of 83.7%.Yet, high dropout rates from basic education is a major problem facing the stakeholders in Egyptian governorates. According to the census, the percentage of children in the age 6-17 years who never enrolled or have dropped out of basic education was 8.1%, which is equivalent to around 1.4 million children [11]. Indeed, most of these children have come from poor families and lived in remote rural communities. To overcome this problem, a number of innovative projects have been implemented. The United Nations Girls' Education initiative (GEI) was one of the learning series initiated by UNICEF in the Middle East and North Africa (MENA) to match the need for knowledge generation and management in education. Egypt was one of the first countries to take off with this initiative in 2000. The GEIs aimed to provide access to education in rural and hard-to-reach areas with small numbers of schools, offering multi-grade classes admitting pupils of different ages and ability at the primary education level, with a special focus on girls [12].

Reducing the burden of anemia will make a major contribution towards achieving several United Nation Millennium Development Goals [5]. The prevalence of anemia in school-aged children has been estimated to be as high as 9% in some industrialized, developed countries [13]. However, the school-aged children have received less attention compared with preschoolers and women of child-bearing age [14, 15]. In Egypt, the prevalence of anemia among school age children particularly in the informal schools is inadequately addressed.

Therefore, the present study was undertaken to estimate the prevalence of anemia among children aged 6-19 years old who are attending informal primary schools in rural Upper Egypt and to identify its association to variables such as age, gender, parental education, body mass index (BMI) and parasitic infestations.

METHODS

Design and setting

A cross sectional survey was conducted from October, 2013 to September, 2014 at a randomly selected Girls Education initiative (GEI) schools in a three Egyptian governorates, namely, Fayoum, BeniSuef, and Minia.

The schools implementing GEI in Egypt provide classes for reading and writing for children of both genders, aged from 6-18 years old. These schools are not part of the Egyptian Ministry of Education, and not covered by school health insurance Program. This innovative strategy was supported by partnerships with many stakeholders, traditionally not involved in education.

Sampling design

The sampling frame was schools implementing GEI in Fayoum, Minia, and Beni Suief governorates. A sample of 197 schools that representing 20% of total schools was selected based on a 90% confidence interval with a 50% response rate, 5% margin error [16]. Subsequently, schools were selected by a systemic random sampling technique to ensure adequate coverage of all the studied governorates. All students in the selected schools were included. The Ministry of Health and Population (MOHP) authorities at the district level helped in the process of listing to ensure that all schools within governorates were covered.

Ethical consideration

The required administrative regulations were fulfilled. The schools administrations were informed about the purpose and the content of the study. An informed consent was obtained from class teachers and school heads considering them as guardians. The Egyptian Ministry of Health ethical committee approved the content of the study before it was conducted.

Data collection

Data collection tools included:

1. A self-administrative questionnaire was used to

collect socio-demographic data of participants. For students who couldn't fill the questionnaire, data was obtained from their parents or teachers.

2. A portable hemoglobin meter instrument (HemoCue Ltd, Angelholm, Sweden) was used to assess the hemoglobin concentration. A drop of capillary blood was collected from the fingertip of each child and the readings were obtained within half a minute and estimated to an accuracy of 1 g/dl. Mild anemia was defined as hemoglobin level of 10-12.9 g/dL in males and 10-11.9 g/dL in females, moderate anemia was defined as hemoglobin of less than 7-9.9 g/dL and severe anemia as hemoglobin less than 7 g/dL [17].
   The Kato–Katz test was used to diagnose parasitic infestations. Each student was given a labeled, clean, dry, and leak proof stool cup and was asked to bring in about 2 grams of fresh stool the following day. The stool samples were examined for intestinal parasites using direct and concentration methods by two senior clinical laboratory technicians independently [18].Based on the recommendations of American Family Physicians [19] and the Ministry of Health policies for intestinal parasitic infections which stated that any patient with a complaint of perianal itching is considered to be an Enterobius Vermicularis infection. Accordingly, any history of perianal itching among the study participants was confirmed from their mothers. If the answers of both the student and the mothers were in agreement, these students were considered to have E. vermicularis infections. Students found to be positive were treated with appropriate anti parasitic therapy.
3. A calibrated electronic scale was used to measure anthropometric parameters.
   The height and weight were used to assess the body size and physical growth of the children. The students were instructed to stand straight with their heads, backs and buttocks vertically aligned to the height gage, and then their heights were taken and rounded to the nearest 0.5 cm. The students' weights were recorded from the digital screen and rounded to the nearest 0.5 kg. Body mass index (BMI), the ratio of weight to height squared [weight (kg)]/ [height2 (m)], was calculated to the nearest decimal place. The children's BMI for age was classified according to World Health Organization growth reference 5-19 years for boys and girls [20].

Statistical analysis

The data were entered in IBM compatible computer, using the Statistical Package for Social Science (SPSS), version18. Descriptive analysis using frequency counts, percentages and means with standard deviations (SD) was carried out. Bivariate analysis using chi-square test was used to find out the association between the independents variables and the outcome variable (anemia). Variables found to have statistically significant association during bivariate analysis were entered to multiple logistic regressions to identify the independent predictors of anemia. The strength of statistical association was measured by adjusted odds ratios (AOR) and 95% confidence intervals (CI).Statistical significance was set at $p< 0.05$.

RESULTS

The study included 2826 students aged 6-19 years who were recruited from three governorates, namely, Al Fayoum (n=1062), Beniswief (n=1174), and Al Menia (n=590). The mean age of the students was 10.1±2.68; with 56.5% of them in the age group 6-9 years, 36.6% aged 10-14 years and 6.9% of them aged 15-19 years. The majority of the studied students (87%) were females. More than ninety percent of their parents were illiterate and Farming was the father's occupation among almost of the students (94.9%).

The study results showed that, the overall prevalence of anemia among the studied children was 59.3%. Most of them (82.5%) diagnosed with mild anemia. Severe anemia was observed only in 0.1% children. The mean hemoglobin levels were 10.9±1.2 and 10.7±1.1 mg for boys and girls, respectively. BMI was used as a criterion to classify underweight, overweight and obesity. The study results showed that, 1.3% children were underweight, 7.2% were overweight and 14.4% were obese. One third (33%) of children was diagnosed with parasitic infestations .The highest percentage of intestinal parasitism was for E. Vermicularis (80.1%), followed by Ascaris Lumbricoids (10.9%),Hymenolepis Nana (6%), Fasciola (1.7%), Trichinella (0.7%) and Schistosomiasis (0.6%). The mean weight in kilograms was 29.1±7.6 and 28.6±8.3 for boys and girls respectively. The mean height in centimeters was 126.2±19.8 and 125.1±17.8 cm for boys and girls respectively.

It was found that, the prevalence of anemia was significantly higher among 64%, 54% and 42.0% of children in the studied age groups, respectively ($p<0.05$) [Table1].The prevalence of anemia was significantly higher in females when compared to males (61.3% Vs 45.6%, $p<0.05$). No significance difference was found as regards to parents' education or occupation and the prevalence of anemia. Children with parasitic infestation were more likely to have anemia than children without infestation (66.4% Vs 59.9%, $p<0.05$).The result findings showed that, 75.8% of underweight children were anemic, 63.1% of overweight children were anemic and 60.2% of

obese were anemic. Also, 66.7% of children with normal BMI were found to be anemic and all these findings were statistically significant (p<0.05) (Table1).

In multivariate logistic regression analysis, parasitic infestation (AOR=2.72, 95%CI=1.01-7.25) and female gender (AOR=1.56, 95%CI=1.03-2.37) remained being the independents predictors of anemia among the studied children (Table2).

DISCUSSION

The long-term partnership between UNICEF, the Ministry of Education and Civil Society has resulted in modelling the best practices and supporting the national capacity to scale-up. The most relevant to our study is the GEIs which were launched in 1995 in the Upper Egypt. The initiatives targeted the out of schools children aged 4-14 years in rural areas with particular focus on girls [21].Therefore, the current study results revealed that, most of the studied population was females. These children have lived in rural communities and came from poor families with farming, the main fathers' occupation.

The most commonly used anthropometric parameters to assess the growth status in children are weight and height. Weight may undergo great variations in a relatively short period due to dehydration and other factors. On the other hand height once gained, does not alter and hence it promises to be a better standard for detection of malnutrition during growth and adolescence [22, 23].The low height for age which was observed among the studied children reflected a state of failure to grow or "being stunted". This is, however, to be expected since stunted growth is associated with poor socioeconomic conditions and increased risk of frequent and early exposure to adverse conditions such as illness [23].

Measurement of hemoglobin level is a vital physiological parameter that helps to diagnose the extent and severity of anemia. The magnitude of anemia in this study (59.3%) is considered a severe public health problem according to the World Health Organization standards [17].This finding is higher than other related studies done in developing

TABLE 1. Association of socio-demographic, clinical characteristics with anemia in school children implementing GEI, Rural Upper Egypt (N=2826).

STUDY VARIABLE	NON ANEMIC (N=1151)		ANEMIC (N=1675)		p* VALUE
	NO.	%	N0.	%	
Age (years)					
6-9 (1598)	576	36.0	1022	64.0	0.01
10-14 (1033)	466	45.1	567	54,9	
15-19 (195)	112	57.4	83	42.6	
Gender					
Male (368)	200	54.4	168	45.6	0.026
Female (2458)	952	38.7	1506	61.3	
Father education					
Illiterate (2596)	1065	41.1	1531	58.9	0.5
Educated (230)	144	62.6	86	37.4	
Mother education					
Illiterate (2669)	1086	40.7	1583	59.3	0.9
Educated (157)	64	41.3	91	58.7	
Mother job					
Worker	17	31.5	37	68.5	0.2
Housewife	1134	40.9	1637	59.1	
Parasitic infestations					
Yes (935)	313	33.6	621	66.4	0.05
No (1891)	759	40.1	1132	59.9	
BMI					
Underweight (33)	8	24.2	25	75.8	
Normal (2183)	727	33.3	1456	66.7	0.03
Overweight (203)	75	36.9	128	63.1	
Obese (407)	162	39.8	245	60.2	

** Statistical significant at p< 0.05*

countries. The prevalence of anemia was 35% among rural school aged children in Morocco [24] and 39.1% among 271 school-age children age 7–14 years in south-west of Ethiopia [25]. It was 35.8% among Saudi Arabia female aged 6-12 years and 36.4% among Vietnamese school age children [26].However, this result corroborated the findings of studies in South East Asia. The prevalence of anemia in 900 students in the 8-16 years age group of urban school children in Kattankulathur, India was 52.88% [27]. It was 66.4% amongst 393 primary school children aged 6-11 years in Delhi [28] and 76% in school children from urban slums of India [29]. Similarly, the prevalence of anemia was high (62.3%) among 3595 school children from Pemla Island and Zanzibar [30].

Mild grade anemia accounted for 82.5% of the studied children diagnosed with anemia. A study in young adolescent school children documented the prevalence of anemia as 67.8% where in the prevalence of mild, moderate and severe anemia was 38.4%, 20.8% and 0.6% respectively [31]. Most children with mild anemia have no signs or symptoms [32] and the majority of them continue unaware of being anemic. High prevalence of mild and moderate anemia in children needs due emphasis so as to bring down the total prevalence of anemia. School children should be screened periodically and appropriate measures should be taken.

The mean hemoglobin concentration in both boys and girls in the present study was lower than the normal values for the corresponding age groups [17]. Although they were expected to have lower values, the dietary supplementation of iron tablets and biscuits fortified with iron in their schools could be attributed to the mild decrease in hemoglobin levels.

While prevalence decreased in both genders between 1990 and 2010, the changes were more pronounced for males, while female prevalence remained higher in most regions and age groups.

Early adolescence is a critical period for developing anemia in girls and boys due to growth spurt. Additionally, the onset of menstruation in girls results in reduced ferritin levels. According to the New Report on Global Prevalence of Anemia 1990-2010, the prevalence of anemia decreased in both gender, the changes were more pronounced for males, while female prevalence remained higher in most regions and age groups [33]. The present study findings showed that the prevalence of anemia was more among females. Similar studies also reported that, the prevalence of anemia was significantly higher in girls when compared to boys [34- 36].

The prevalence of intestinal parasites (33.3%) was within the range reported in developing countries from 16.6 to 62.9% [37]. The variations in the prevalence of infection may be due to differences in behavioral, hygienic, environmental or climatic conditions. Students' stool samples were examined using the Kato technique. Most of the studies are in agreement that this test has low sensitivity for E. vermicularis infection since pinworm eggs and worms are often sparse in stool. However, any student who reported having perianal itching was considered to have the infection according to the policies of the Egyptian Ministry of Health. This explained the higher rates of Enterobius infections among the studied children. Other studies in developing countries [38-40] also showed that, the most common intestinal parasitic infection among school children was Ascaris lumbricoides, either alone or in various combinations. Intestinal parasitic infection, due to poor hygienic conditions interferes with iron absorption, thus expanding the prevalence of iron deficiency anemia

TABLE 2. Factors associated with anemia among school children implementing GEI, Rural Upper Egypt, using multivariate logistic regression.

VARIABLES	COR (95%CI)	AOR (95%CI)	p VALUE
Child age (Years)			
6-9	1.55 (0.93-2.57)	1.13 (0,60-2.11)	0.1
10-14	1.02 (0.67-1.57)	0.93 (0.54-1.59)	
15-19	1	1	
Gender			
Male	1	1	0.02
Female	2.09 (1.53-2.86)	1.56 (1.03-2.37)	
Body Mass index (BMI)			
Underweight	2.42 (1.03-5.64)	2.27 (0.83-6.21)	
Normal	1	1	0.08
Overweight	1.43 (0.88-2.32)	1.59 (0.84-2.98)	
Obese	0.87 (0.59-1.28)	0.74 (0.46-1.20)	
Parasitic infestation			
Yes	3.01 (1.2-7.52)	2.72 (1.01-7.25)	0.05
No	1	1	

in the developing world [41-43]. In the present study, the observed association between parasitic infestations and anemia has been reported in several other studies worldwide [44-46].

The prevalence of anemia in the current study was higher among underweight children when compared to children with normal BMI, overweight and obese children. Sudhagandhi et al. indicated similar results that underweight children were anemic [27]. It is worth mentioning that in developing countries, like rural Egypt, the irregular eating habits and the lower consumption of animal source foods are contributing to the development of anemia [47, 48]. It is also evident from this study results that a significant proportion of apparently healthy children suffered from anemia. The rising trend of consuming snacks like chips, biscuits and food which supply empty calories is responsible for healthy children being anemic. Therefore, BMI did not continue as a predictor of anemia among the studied age group in multivariate analysis.

Our findings should be viewed in the context of some limitations. First, we couldn't inquire about the dietary intake of energy and nutrients as the majority of the children have poor socioeconomic status as reflected from parents' education and occupation. However parental education and occupation were not significantly associated with the prevalence of anemia. Secondly, a cross-sectional design was employed, and the data, therefore, did not provide an opportunity to determine the changes in the prevalence over time. Longitudinal studies to test the determinants of anemia prevalence according to changing conditions in demographic and clinical characteristics of children in informal schools are recommended.

CONCLUSION

The present study highlights that anemia is a major health problem among GEI primary schools children. Continued anemic situation in children specifically among girls results in lack of concentration, short attention span and easy distractibility, which are eventually result in high school dropouts. Anemia also adversely affects the immune system and increasing the susceptibility to infection and poor physical fitness. These health problems dispute the strategy of implementing the GEI schools. The initiative should demonstrate child friendly schools model that is safe, healthy and gender sensitive. It is important to scrutinize the factors of exclusion from schooling, and to develop relevant policies and strategies to guide effective education sector reform initiatives.

Although the present study was not designed specifically to study all the risk factors for anemia in this population, we stipulate that the high prevalence of anemia could be due to poor diets combined with worm infestation. Thus, prevention of anemia in this age group is an urgent need.

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