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Anemia among Primary School Children (5 -12 years) in Riyadh Region, Saudi Arabia: A Community-Based Study

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ABSTRACT

Background: Anemia among school aged children is known to be an important global public health problem in both developing and developed countries. It affects the physical and intellectual functions of the affected children. School years are ideal opportune time to intervene to prevent and control anemia. **Objectives:** The objective of the study is to investigate the frequency of anemia and the associated dietary and medical risk factors in school aged children in Riyadh region. **Subject and Methods:** A cross sectional survey was carried out in Riyadh region. The study sample was selected using the two stages of cluster sampling technique. Standardized Arabic questionnaire was completed by parents of school aged children by two well trained nurses. Dietary frequency was requested for the last week prior to the interview. A venous blood sample was taken for hemoglobin estimation. Anemia in school aged children was defined according to the WHO definition. **Results:** The total sample was 1117 children, 49.9% males and 50.1% females. Prevalence of anemia was 22.3% (22.4% in males & 22.2% in females). Frequent eating of red meat reduced the risk of anemia (OR=0.8). Frequent drinking of cola or sour milk (Laban) with lunch meal significantly increased the risk of anemia (OR=1.52, 1.06-2.16 and OR=1.55, 1.07-2.25 respectively). Family history of hereditary blood disorders or iron deficiency anemia increased the risk of anemia in school aged children (OR=5.48, 1.02-31.21 and OR= 3.38, 1.74-6.54 respectively). **Conclusions:** Anemia in school children is a moderate public health problem in Riyadh region. Drinking sour milk with lunch and positive family history increases the risk of anemia in school children.

Key words: *Anemia, School-aged Children, Diet.*

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INTRODUCTION

Anemia prevalence rate in pediatric population can be an important indicator of nutritional status (1). Iron deficiency is the main cause of anemia; therefore anemia prevalence can be used as a proxy for prevalence of iron deficiency anemia (2). Anemia among school-aged children is known to be a significant global public health problem affecting 305 million people around the world. In developing countries its prevalence ranges from 29.2% to 79.6%

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(3). Even in USA as many as 20% of children are assumed to become anemic at some point by the age of 18 years (4). It can cause many adverse effects on child health, including delayed psychomotor development, impaired cognitive function, IQ loss and increased susceptibility to lead toxicity (5, 6). Correction of iron deficiency at this age group enhances children's learning potential in schools, increases their fitness and work capacity. In addition improvement of girls' iron status may help to prevent anemia during the reproductive years (7-10).

The prevalence of anemia as a public health problem is categorized as follows: <5% no public health problem; 5-19.9% mild public health problem; 20-39.9% moderate public health problem and ≥40% severe public health problem (8-11). Only two countries among 192 WHO member states anemia is not a public health problem. It is mild in 40, moderate in 81 and severe in 69 states (11). The school years are an opportune time to intervene, and indeed the school setting offers an ideal distribution system, and interventions must be based on sound epidemiological understanding of the problem at this age group (11). Nutritive status of school aged children is vulnerable (3); we therefore conducted this cross sectional survey to investigate the frequency of anemia and the associated dietary and medical risk factors in school aged children in Riyadh.

SUJECTS AND METHODS

Study design and setting

A Community based household cross sectional survey was conducted over a period of 4 months. Saudi subjects from Riyadh region, older than one year, were recruited on voluntary basis as a reference population for this study. Riyadh region, with a population amounted to 3.726.523 Saudi persons (Ministry of Planning, preliminary results of 1425 (2004 G) census. The study was approved by Ministry of Health.

Sampling

The sample size was calculated on the assumption of 30% prevalence of IDA in Riyadh (5). At 95% confidence level and acceptance of 2% as degree of precision, the sample size was 2016 persons if the simple random method was used. Due to the large reference population, cluster sampling technique was applied and a design effect of 2 was used. The sample size increased to 4032. A response rate for blood extraction was assumed to be 60-70% and accordingly the final sample size was calculated to include 6204 participants. Out of these 1117 school aged children were included in this study. Two stage cluster sampling technique was used to accomplish the study. In the first stage 36 clusters were selected proportionally allocated with the number of population in each PHCC catchments area. In the second stage a constant number was selected per cluster. Assuming that the average Saudi family in Riyadh region is 7 persons, 25 households were included in each cluster.

Data Collection

A Standardized Arabic questionnaire-interview was designed to satisfy the study objectives. It investigated about socio-demographic characteristics, dietary, medical history of each child 5-12 years old within the family. Data were collected by two well trained nurses. For nutritional status assessment the dietary frequency was requested for the last week prior to interview. A venous blood sample was taken for hemoglobin estimation. Anemia was defined according to WHO hemoglobin level in Children 5-11.99 years (< 11.5 g/dl) (12).

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Statistical Analysis

The data was entered and analyzed, using SPSS PC version 17.0 statistical software. The outcome variable was dichotomized as anemia (presence or absence). The study variables related to socio-demographic, medical history and dietary assessments were used to observe and quantify the statistical association. Odds ratio (OR) was used to measure an association between the two categorical variables. To adjust odds ratios of the variables that proved to be statistically associated with the occurrence of anemia in the bivariate, analysis were entered into multivariate logistic regression model. The 95% confidence intervals for adjusted odds ratios were calculated. A p-value of <0.05 was considered as statistically significant.

RESULTS

Total 1117 school aged children were included for this study. Out of this 557 (49.9%) were males and 560 (50.1%) were females. Only 753 (67.4%) parents gave consent for blood sampling. Prevalence of anemia was 168 (22.3%), with no statistically significant difference between males and females (P>0.05).Table 1 shows that frequent eating of red meat reduced the risk of anemia (OR=0.8), however this risk reduction was not statistically significant (CI=0.56 -1.14). Frequent drinking of cola or sour milk (Laban) with lunch meal significantly increased the risk of anemia (OR=1.52, 1.06-2.16 and OR=1.55, 1.07-2.25 respectively).

Blood related disorders in the child and/or his family are shown in Table 2. Family history of hereditary blood disorders or iron deficiency anemia increased the risk of anemia in school aged children (OR=5.48, 1.02-31.21 and OR= 3.38, 1.74-6.54 respectively). Personal history of blood transfusion and IDA were risk factors for anemia in the studied children (OR=11.48, 1.06-288.4 and OR=3.11, 1.57-6.17 in order).

Table 3 displays results of multivariate logistic regression analysis and revealed that drinking sour milk (Laban) with lunch and family history of anemia were independent risk factors for developing anemia in school aged children in Riyadh region.

DISCUSSION

The present study revealed that anemia is a moderate public health problem among school aged children in Riyadh region (22.3%). A national study conducted eleven years ago reported prevalence of anemia of similar figure of 24.8% among Saudi children younger than 14 years with the highest prevalence being in the Eastern region (41.3%) (13). The former study used hemoglobin level of 11.2 gm/dl as a threshold for anemia which is lower than the current WHO (11.5 gm/dl) used in the current study. Also another study in Jeddah that included 2000 school children found that 20.5% of them were anemic (14). The low prevalence of anemia in North America may be attributed to the fortification of iron in most of the available foods there (15).

Al-Othaimeen *et al*., conducted a study among 1210 school girls aged 7-14 years old in Riyadh city and found that 30% had hemoglobin level <11 gm/dl. Prevalence rate of the latter study is higher than the present work (22.2%) (16), this may be attributed to the inclusion of girls aged 12-14 years where most of them were menstruating. Higher rate was also reported by Rasheed *et al.*, who investigated 285 primary school girls in urban area of Al-Khober in the Eastern province of Saudi Arabia. They found that 26.4% of girls had anemia (hemoglobin level <11 gm/dl) (17).

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Haemoglobin level was used in this study as an indicator for Iron status in the body. Kihli-Kumar recommended the assessment of hemoglobin as the most common method of assessing anemia (3, 18). School children were chosen for the study as rapid growth in school aged children increases the demand for iron (19) and anemia is estimated to affect one half of school age children in developing countries (20). The school years are an opportune time to intervene, and interventions must be based on sound epidemiologic understanding of the problem in this age group (2). It has been suggested that when anemia prevalence is 20%, iron deficiency exists in 50% of the population and when anemia prevalence is greater than 40% the entire population suffers from some degree of iron deficiency.

Several dietary factors can influence iron absorption. Enhancing factors are ascorbic acid which is found in citric fruits, meat, fish and poultry. Inhibitory factors include tannic acid which is found in tea, coffee and chocolate, and calcium which is present in milk and dairy products (21, 22). Cross sectional surveys revealed that the frequency of meat and dairy consumption determines hemoglobin values in school age children (23). In the present work meat was a protective factor in bivariate analysis (OR=0.8). Sour milk called Laban by the Saudi public was approved to be a risk factor for anemia in school aged children (OR=1.48). Its high contents of calcium may explain this finding particularly as it is used during or just after lunch meal which is the main meal of the Saudi population, thus inhibiting the absorption of iron.

Drinking tea or coffee in the current work did not influence the prevalence of anemia ($p>0.05$). On the same line Temme and Van Hoydonck conducted a PubMed search and reported that tea consumption does not influence iron status in Western countries in which people have adequate iron stores. Only in populations with marginal iron status there seems to be a negative association between tea consumption and iron status (24). Poulter J and Nelson M reviewed 35 references investigating the impact of drinking tea on iron status and reported that according to the available evidence restriction of drinking tea is advised only to groups at risk of iron deficiency. It is advised to drink tea between meals or to wait at least one hour after eating before drinking tea (25).

Presence of positive family history of anemia is an independent risk factor for occurrence of anemia in school aged children in the current work (OR=2.42, 1.18-4.94). This may be due to common exposure to iron deficient diets by the family or presence of hereditary blood diseases within the family. In addition, this diagnosis of IDA in Saudi Arabia is more complicated with the high incidence of hemoglobin disorders such as sickle cell and thalassemia traits (26, 27).

CONCLUSION

Anemia is a moderate public health problem among school aged children in Riyadh region. Iron fortification is highly recommended. Health education programs should be conducted in schools to highlight the risk factors of anemia particularly drinking sour milk with meals. Children with family history of anemia should be screened for anemia and treated if indicated.

Conflicts of Interest

The authors indicated no potential or actual conflict of interest pertaining to this study.

Authors' Contributions

All authors made full contribution to data acquisition, interpretation of results, drafting and revising the final manuscript. All authors read and approved the final manuscript.

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Limitation of the Study

The limitations of the present study are the relatively low response rate due to fear of children and their parents from blood extraction, and the lack of classification of nutritional anemia into IDA and non-iron deficiency anemia as ferritin level estimation was not done.

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Table 1: Dietary factors and anemia in school children, Riyadh, Saudi Arabia

Food	Intake	Status		Odds Ratio	95% Conf. Interval	P
		Anemic	healthy			
Frequent eating of red meat	Yes No	93 83	341 243	0.8	0.56 -1.14	0.19
Frequent eating of vegetable	Yes No	115 60	358 223	1.19	0.83 – 1.73	0.33
Frequent drinking of Tea & coffee	Yes No	34 141	145 435	0.72	0.47 – 1.12	0.13
Frequent drinking of Cola	Yes No	86 86	229 347	1.52	1.06 – 2.16	0.017
Frequent drinking of sour milk (Laban) with lunch	Yes No	115 57	328 252	1.55	1.07 – 2.25	0.016
Frequent drinking of juice	Yes No	49 123	133 442	1.32	0.89 – 1.98	0.15

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Table 2: Blood related disorders and anemia in school children, Riyadh, Saudi Arabia

Health problem	presence	Status		Odds Ratio	95% Conf. Interval	P
		Anemic	Healthy			
Personal history of hereditary blood disorder	Yes No	8 143	14 558	2.23	0.84 – 5.8	0.10
Family history of hereditary blood disorder	Yes No	4 128	3 526	5.48	1.02 – 31.21	0.01
History of blood transfusion	Yes No	3 151	1 578	11.48	1.06 – 288.4	0.008
Current blood disorder	Yes No	6 156	2 592	11.38	2.00 – 115.9	0.002
Past history of IDA	Yes No	18 131	24 544	3.11	1.57 – 6.17	0.0005
Family history of IDA	Yes No	20 129	25 545	3.38	1.74 – 6.54	0.00005

Table 3: Results of logistic regression analysis

Variable	Adjusted Odds Ratio	95% Conf. Interval	P
Drinking cola with lunch	1.36	0.94 – 1.99	0.108
Drinking sour milk (laban) with lunch	1.48	1.00 - 2.19	0.050
Family history of anemia	2.42	1.18 – 4.94	0.015

NB. The model explains 79.2% of occurrence of anemia.

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