ORIGINAL ARTICLE

PREVALENCE OF IRON DEFICIENCY ANEMIA AND ASSOCIATED FACTORS AMONG URBAN SCHOOL CHILDREN IN KENITRA, NORTH WEST OF MOROCCO

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ABSTRACT

Background: Iron deficiency anemia is the most common type of nutritional anemia; it has been recognized as an important health problem in Morocco. **Objective:** This study aimed to estimate the prevalence of iron deficiency anemia among school children in Kenitra city, North West of Morocco and its association with socioeconomic, educational level, anthropometric and diet factors. **Methods:** The sample represents 271 school children randomly chosen of all educational levels, aged 6 to 15 years (Mean= 10.75 years ± SD=1.40). The level of haemoglobin, was measured. Anemia was defined when haemoglobin ≤ 11.5 g/dl. A questionnaire was developed to obtain information about educational level of the parents, socio-economic and daily food consumption from plant and animal source. Anthropometric measurements were carried out according to the WHO standards. Anthropometric indices were determined by Z scores calculated by the WHO growth references 2007. **Results:** The mean hemoglobin concentration was 12.45 g/dl: 12.52 g/dl for boys and 12.41 g/dl for girls. The prevalence of iron deficiency anemia was 16.2%: There is a significant difference of anemia prevalence between girls (12.3%) and boys (19.5%). It is directly correlated to educational level of mothers, sex, anthropometric and diet factors. **Conclusions:** It is concluded that anemia is less prevalent in this study and it was found to be higher in children who take foods of both plant and animal sources less frequently.

***Key words**: Prevalence, Iron deficiency, Anemia, School children, Morocco.*

1. INTRODUCTION

Iron deficiency anemia (IDA) is considered the major public health problem and the most common nutritional deficiency around the word [1]. It is still important globally, and regionally [2] with higher rates in the developing countries [3,4]. The prevalence of anemia in the world is 24.8 % [5]. Furthermore, it is estimated that iron deficiency contributes towards 50% of the approximated 600 million global anemia cases in preschool and school-aged children [6]. The population groups which are most affected are pregnant women, infants and young children [7,8]. This high prevalence of IDA in developing countries is associated with poor sanitation conditions, low socio-economic conditions, restricted access to food and lack of knowledge for good dietary practices [9]. Anemia has multiple consequences which can be extremely severe [10,11]. It affects the physical and mental development of an individual leading to decreased working capacity , which in turn affects the development of the country [12].
The objectives of the present study were to determine the prevalence of iron deficiency among school children in Kenitra city, North West of Morocco and its association with socioeconomic, educational level, anthropometric and diet factors.

2. MATERIALS AND METHODS

2.1 Place and the sample of study: A cross sectional descriptive survey was conducted among 271 school children aged 6 to 15 years old in Kenitra city, located in the North West of Morocco.

2.1 Questionnaire: This questionnaire was tested and validated locally, covering the following parameters: Demographic and anthropometric indicators including age, sex, weight and height; socioeconomic indicators including the parent educational level, family income and food consumption.

2.3 Anthropometric measurements: The children's height and weight were measured according to the WHO's guideline [13], with minimal clothing and without shoes. Weight was measured to the nearest 0.1 kg with an electronic

scale. Student height was measured to the nearest 0.1 cm with a wooden stadiometer placed on a flat surface. Weight, height, and age data were used to calculate z-scores of the three different nutritional indicators in comparison to the newly published World Health Organization/National Center for Health Statistics (WHO/NCHS) reference population [14] using the WHO AnthroPlus Software (Version 10.4, 2010) [15]. The anthropometric measurement of the study population were determined using z-scores in accordance with the world health organization, 2007 for 5-19 years [17].
Stunting and thinness were defined as Height-for-Age (HAZ) and Body Mass Index-for-Age (BAZ) Z-scores < –2, respectively, according to the World Health Organization (WHO) [16].

2.4 Blood test: A 5-ml blood sample was collected by antecubital venipuncture and drawn into a container with EDTA for red blood cell (RBC), haemoglobin (Hb), haematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) analyses. These blood analysis were measured using an automated cell counter (MS9-5S, Osny, France) by trained and experienced laboratory technicians in private laboratory of medical analysis under suitable conditions.
The Hemoglobin level was determined by cyanmethemoglobin method using a Drabkin reagent (D5941) containing potassium ferricyanide $K_3Fe(CN_6)$ and potassium cyanide (KCN). the potassium ferricyanide oxidizes iron to form methemoglobin. The potassium cyanide then combines with methemoglobin to form cyanmethemoglobin; a stable compound which was measured by spectrophotometrically at 540 nm.
Children included into the study were divided into 2 groups according to age: Group 1: 6-11 years, and Group 2: 12-14 years. Anemia was defined as: (Hb<12 g/dl for children 12-14 years old, Hb<11.5 g/dl for children 6-11 years old). The severity of anemia was classified as mild (12>Hb>10.5 g/dl), moderate (7.5<Hb ≤10.5 g/dl), and severe (Hb<7.5 g/dl) [12].
2.5 Statistical analysis: The statistical analysis were performed using the software IBM SPSS Statistics version 21 (Statistical Package for the Social Sciences). The results are given as figures and tables. Anthropometric measurements were analyzed by AnthroPlus (WHO standards) [15]. The association between nutritional status, socioeconomic, educational level, anthropometric and diet factors were analyzed by the Pearson chi-square test. The student t test was used to compare hemoglobin with males and females and a p value < 0.05 was considered statistically significant.

3. RESULTS

3.1 Haemoglobin by sex: The mean hemoglobin concentration shown in figure 1 was 12.45 g/dl: 12.52 g/dl for boys and 12.41 g/dl for girls.

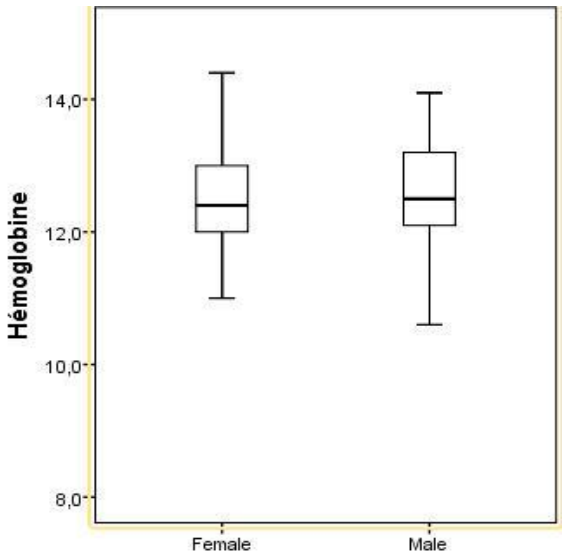

Figure 1: The figure shows the distribution of haemoglobin concentration between male and female children.

The comparison of the haemoglobin concentration between boys and girls by test of student is shown in table 1. There is no significant difference between male and female children according to the results of blood test (p> 0.05).

Table 1: The table shows the comparison of the Haemoglobin concentration between boys and girls.

Blood test	Mean±SD			Test of student
	All(271)	Boys(n=142)	Girls(n=127)	P
Haemoglobin (Hb) g/dl	12.45±0.81	12.52 ± 0.78	12.41 ± 1.00	T=-0.36 ;p> 0.05

3.2 Prevalence of iron deficiency anemia by sex: The figure 1 show the distribution of anemic children (HB ≤11.5), and non-anemic (HB> 11.5) according to the sex. The prevalence of anemia was 16.2%: boys (19.5%); girls (12.3%). There was a significant difference of anemia prevalence between girls and boys (t= -2.06 ;p< 0.05).

3.3 Prevalence of iron deficiency anemia by sex and class: The figure 2 shows the severity of anemia class between boys and girls. No single case of severe anemia (Hb< 7.5%) was detected in this study (figure 2).

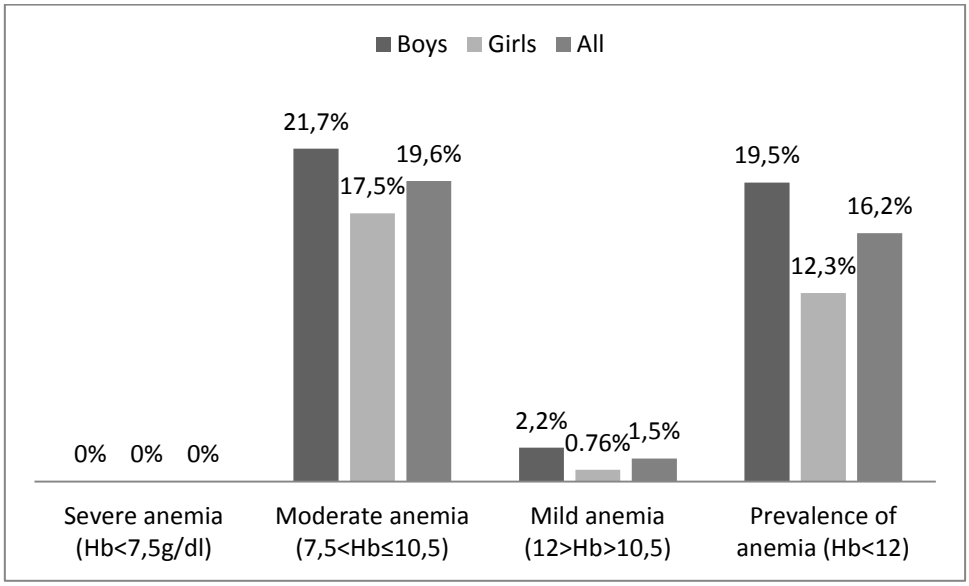

Figure 2: The figure shows the percentage of severe, moderate and mild anemia by sex.

Table 2: The table shows the distribution prevalence of anemia class between boys and girls.

	severe Anemia (Hb<7.5 g/dl)	moderate Anemia (7.5 <Hb ≤10.5)	mild Anemia (12 >Hb>10.5)	Prevalence of anemia (Hb<12)
Boys(n=142)	0%	21.7%	2.2%	19.5%
Girls(n=129)	0%	17.5%	0.76%	12.3%
All	0%	19.6%	1.5%	16.2%

3.4 Prevalence of iron deficiency anemia and associated factors

The age of 271 respondents is ranged between 6 to 15 years (Mean= 10.75 years ± SD=1.40). 52.4% of boys and 47.6% of girls. 83.4% were under the age of 12. As to the income, anemia was found in 16.5% of children whose parents had a temporary income. 19.8% fathers and 16.2% mothers of anemic children were illiterate. The percentage of thinness and stunting among children were 4.1% and 6.3% respectively. 64.9% of children ate plant food at least once a day. The occurrence rate of anemia was higher in children who consumed vegetables and animal source foods less frequently. The results of Chi-squared test of independence at 5% error show a dependence between nutritional status and educational level of mothers, sex, anthropometric and diet factors (P <0.05) (table 3).

Table 3: The table shows the socio-economic and anthropometric characteristics of anemic and non-anemic children.

		Nutritional status			
	All Children	Children without anemia	Children with anemia	Chi-squared test	*P*
Sex					
Male	142(52.4%)	114(62.7%)	28(19.5%)	4.92	0.027*
Female	129(47.6%)	113(76.2%)	16(12.3%)		
Age					
≤ 12	226(83.4%)	158(69.9%)	68(30.1%)	1.03	0.31

> 12	045(16.6%)	28(62.2%)	17(37.8%)		
Educational level(Fathers)					
Illiterate	81(36.8%)	65(80.2%)	16(19.8%)	3.46	3.455
Primary level	83(37.7%)	69(83.1%)	14(16.9%)		
Secondary level	42(19.1%)	36(85.7%)	06(14.3%)		
Tertiary level	14(06.4%)	9(64.3%)	05(35.7%)		
Educational level (Mothers)					
Illiterate	143(65.0%)	119(83.8%)	23(16.2%)	3.31	0.004*
Primary level	046(20.9%)	36(76.6%)	11(23.4%)		
Secondary level	020(09.1%)	18(85.7%)	3(14.3%)		
Tertiary level	011(05.0%)	6(60%)	04(40.0%)		
Family income					
Temporary	182(82.7%)	152(83.5%)	30(16.5%)	3.22	0.073
Permanent	038(17.3%)	27(27.1%)	11(28.9%)		
Consumption of food from plant source					
Less than once a day	095(35.1%)	63(68.6%)	32(31.4%)	10.52	0.001*
Once a day or more	176(64.9%)	151(85.2%)	25(14.8%)		
Consumption of food from animal source					
Less than once a week	056(20.7%)	38(67.9%)	18(32.1%)	5.25	0.022*
Once a week or more	215(79.3%)	176(81.3%)	39(18.7%)		
BMI for age < -2 Z score					
Yes	011(04.1%)	4(36.4%)	07(63.6%)	5.54	0.019*
No	260(95.9%)	182(70%)	78(30.0%)		
Height for age < -2 Z score					
Yes	017(06.3%)	6(35.3%)	11(64.7%)	9.36	0.002*
No	254(93.7%)	180(70.9%)	74(29.1%)		

4. DISCUSSION

The school children in the present study were aged 6 to 15 years (Mean= 10.75 years ± SD=1.4), (52.4% boys; 47.6% girls). 83.4% were younger than 12 years old, the prevalence of anemia was 16.2%. There was a significant difference of anemia between girls and boys according to the result of blood test, This is comparable to the previous studies which revealed that the rates of anemia among boys are higher than among girls [17-19]. These differences can be attributed to genetics factors [20]. The present study also showed that the prevalence rates of mild and moderate anemia were 1.5% and 19.6% respectively. No single case of severe anemia (Hb< 7.5%) was detected.

The prevalence of anemia (16.2%) in the present study is less than numerous similar study. Zimmermann et al. (2003) in Northern Morocco reported that anemia prevalence was 35% [21] and more than 30% of 306 pupils from seven primary schools in province of Kenitra had anemia [22], and it was observed in 23.4% of the pupils in urban area of Kenitra [23]. These rates are consistent with the national prevalence (31.5%) reported by the Ministry of Public Health of Morocco in 2000 [24]. This prevalence of anemia (16.2%) may be due to the iron fortification project of the health ministry started in 2005, to reduce micronutrients malnutrition. In the other place of the world: Hassan and Khalique (2002) found anemia in 24.8% of children [25]. Gomber et al. (2003), reported that the prevalence of anemia in school children, from urban slums, aged 5-10.9 years, was 41.8% [26]. Srivastava et al. (2012) found anemia in 37.5% of children [27]. The results of a study in Southwest of Ethiopia indicated that 39.1% of children aged between 7 and 14 years were anemic

[28], and 36.4% among Vietnamese school age children [29], this difference in the prevalence, may be due to differences in study setting, sample size, the diet consumed and other associated factors.

The results of Chi-squared test of independence at 5% error show a dependence between nutritional status and educational level of mothers, sex, anthropometric and diet factors (P <0.05). In comparison with this finding, El Hioui et al. (2008), Choi et al. (2011), Alemayehu (2005), Kaya et al. (2006), Al-Zain (2009) and Male et al. (2001), reported that mothers' educational level is a determinant factor of anemia [30,31,28,32,33,34].

Consumption of animal source foods was found to be associated with a decreased risk of stunting and improved other anthropometric indices [35]. Reports of Djokic et al. (2010), Kaya et al. (2006), and Tiwari and Seshadri (2000), showed that irregular consumption of meat and vegetables were found to be important correlates of anemia among school-age children [36-32-37]. This fact supports the finding of this study. There was no significant relationship between the prevalence of anemia and family income, age group (≤12; >12) and educational level (fathers).

5. CONCLUSION

The present study highlights the prevalence of anemia among school children in Kenitra in Morocco (16.2%), which was significantly more frequent among boys than girls. Our finding showed that mothers' educational level and malnutrition were determinants factors of this health problem.

Even though the rate of anemia in this study is lower than the previous studies in the same region, strategies are needed such as improving the women's education**,** the nutritional awareness and combining iron fortification and iron suplementation programs to reduce the prevalence of anemia in school children.

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