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Prevalence of Iron Deficiency Anaemia Among School Children in Kenitra, Northwest of Morocco

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ABSTRACT
Iron deficiency anaemia is an important health problem in Morocco. This study was conducted to estimate the prevalence of anaemia among school children in Kenitra. The sample represents school children of all educational levels and age ranged between 6-15 years. The level of hemoglobin, haematocrit, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration was measured in a group of 271 school children. The seric iron was assessed and anaemia was defined when hemoglobin <11.5 g dL^{-1}. A questionnaire was developed to obtain information about the daily food consumption and socio-economic conditions. The prevalence of anaemia was 16.2%. The mean hemoglobin concentration was 12.53 g dL^{-1} in boys and 12.52 g dL^{-1} in girls. The results suggest that iron deficiency is an important determinant of anaemia in this population. There was a significant relationship between education of the mother and anaemia in children (p = 0.004) but not with the family income. It is concluded that improving the economic status of the family, women education and health education about balanced animal and plant food consumption are recommended strategies to reduce the burden of anaemia.

Key words: Iron deficiency, anaemia, school children, Morocco

INTRODUCTION

Iron Deficiency (ID) and Iron Deficiency Anaemia (IDA) are considered the major public health problems and the most common nutritional deficiency around the world (DeMaeyer *et al*., 1989). The prevalence of anaemia in the world is 24.8% (WHO., 2008). Furthermore, it is estimated that iron deficiency contributes towards 50% of the approximated 600 million global anaemia cases in preschool and school-aged children (WHO., 2011). The population groups which are most affected are pregnant women, infants and young children (Dillon *et al*., 2000; Chhabra *et al*., 2012). 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 (Finch, 1977). Anaemia has multiple consequences which can be extremely severe (Goudarzi *et al*., 2008; Ahmadi *et al*., 2010). It affects the physical and mental development of an individual leading to decreased working capacity, which in turn affects the development of the country (WHO., 2001).

The objective of the present study was to determine the prevalence of iron deficiency anaemia on school children in Kenitra, Northwest of Morocco.

MATERIALS AND METHODS

Place and the sample study: This study was conducted among school-age children aged 6-15 years old in Kenitra city, located in the Northwest of Morocco.

Study setting: The survey took place in Kenitra, located in the Northwest of Morocco.

Type of study: A cross sectional descriptive survey was conducted using a structured questionnaire covering the following parameters:

- Demographic and anthropometric indicators including age, sex, weight and height
- Socioeconomic indicators including the educational level, family income and food consumption

Anthropometric measurements: The children's height and weight were measured according to the WHO's guideline (WHO., 2007). 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 (WHO. and UNICEF., 2009) using the WHO AnthroPlus Software (Version 10.4, 2010). Underweight, stunting and wasting were defined as WAZ<-2.0, HAZ<-2.0 and WHZ<-2.0 Standard Deviation (SD) below the 2006 WHO reference, respectively. Body Mass Index (BMI) was used to diagnose the degree of thinness and overweight in children as prescribed by WHO (2007).

Weight-for-age reference data are not available beyond age 10 because this indicator does not distinguish between height and body mass in an age period where many children are experiencing the pubertal growth spurt and may appear as having excess weight (by weight-for-age) when in fact they are just tall (Blossner *et al*., 2010, 2009).

Blood test: Blood 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. All these blood analysis were done by trained and experienced laboratory technicians in private laboratory of medical analysis under suitable conditions.

Anaemia was defined as hemoglobin level below 12 g dL^{-1} in children of 12-14 years and below 11.5 g dL^{-1} in children aged 6-11 years. The severity of anaemia was classified as mild (Hb>10.5 g dL^{-1}), moderate (Hb≤10.5 g dL^{-1}) and severe (Hb<7.5 g dL^{-1}) (WHO., 2001).

Statistical analysis: The statistical analysis was carried out using the SPSS 21.0 statistical software package for Windows. Descriptive statistics of continuous variables were expressed as Mean±Standard Deviation (SD). Chi-square test was used to assess the association between independent and outcome variables. $p<0.05$ was taken as a minimum level of significance.

RESULTS

Sociodemographic and anthropometric characteristics of the study participants: A total of 340 children were selected, among whom complete response of the anthropometric measurements and blood samples were obtained from 271 children. The Mean±SD was 10.75±1.40 years ranged between 6 and 15 years.

From the total of 271 respondents, 142 (52.4%) children were male and 129 (47.6%) were female and 226 (83.4%) were younger than 12 years old. As to the income, 182 (82.7%) of the parents have a temporary income. The prevalence of anaemia among children whose parents had a temporary income were 16.5%. Regarding the educational status of the parents of the sampled children, 139 (63.2%) of the fathers had formal education; 19.1% had attended secondary school; 143 (65%) mothers of the children were illiterate. The prevalence of anaemia in children whose father's are illiterate was 19.8% and that of children whose mothers are illiterate was 16.2% (Table 1).

Concerning the results of the anthropometric measurements among anemic children 11 (4.1%) were thin, that is BMI for age <-2 Z-score and the prevalence of stunting that is height for age<-2 Z-score was 17 (6.3%) (Table 1).

Prevalence of anaemia: The distribution of haemoglobin concentration shown in Fig. 1 and global results of Hb in Table 2. The mean hemoglobin concentration was 12.52 g dL^{-1} in boys and 12.41 g dL^{-1} in girls. The prevalence of anaemia among children was 16.2%. The Mean±SD value of Hb, Hct, MCV, MCH, MCHC and serum Iron,

Table 1: Socio-economic and anthropometric characteristics of children

	All children		Children with anaemia			
Parameters	No.	(%)	No.	(%)	X^2	p
Sex						
Male	142	52.4	53	37.3	4.92	0.027
Female	129	47.6	32	24.8		
Age (years)						
≤12	226	83.4	68	30.1	1.03	0.31
>12	45	16.6	17	37.8		
Educational level (fathers)						
Illiterate	81	36.8	16	19.8	3.455	3.455
Primary level	83	37.7	14	16.9		
Secondary level	42	19.1	6	14.3		
Tertiary level	14	6.4	5	35.7		
Educational level (mothers)						
Illiterate	143	65	23	16.2	3.307	0.004
Primary level	46	20.9	11	23.4		
Secondary level	20	9.1	3	14.3		
Tertiary level	11	5	4	40.0		
Family income						
Temporary	182	82.7	30	16.5	3.22	0.073
Permanent	38	17.3	11	28.9		
Consumption of food from plant source						
Less than once a day	95	35.1	32	31.4	10.52	0.001
Once a day or more	176	64.9	25	14.8		
Consumption of food from animal source						
Less than once a week	56	20.7	18	32.1	5.245	0.022
Once a week or more	215	79.3	39	18.7		
BMI for age <-2 Z score						
Yes	11	4.1	7	63.6	5.54	0.019
No	260	95.9	78	30.0		
Height for age <-2 Z score						
Yes	17	6.3	11	64.7	9.36	0.002
No	254	93.7	74	29.1		

X = mean , p: Significant levels, BMI: Body mass index

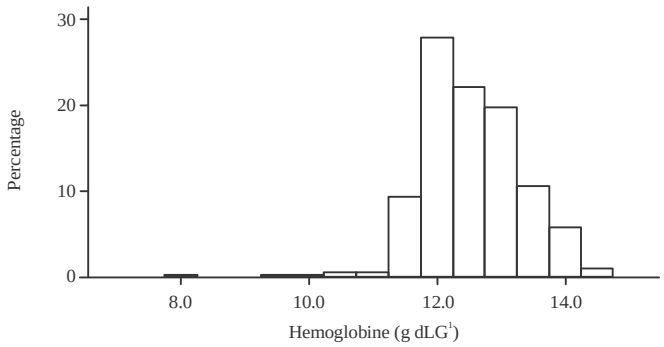

Fig. 1: Distribution of haemoglobin concentration in school children

Table 2: Global results haemoglobin of the studied population

Haemoglobin (g dL^{-1})	Values
Mean	12.45
Standard deviation	0.90
Minimum	8.00
Maximum	14.00
All the cases	271.00

Table 3: Stepwise multiple regression for haemoglobin concentration of school-aged children in Kenitra

Variables	B	SE	β	T	p	95% CI for B
Hct (%)	0.324	0.005	0.759	63.16	0.000	(0.313, 0.334)
MCV (fl)	-0.058	0.009	-0.309	-6.05	0.000	(-0.076, -0.039)
MCH (pg)	0.180	0.027	0.449	6.454	0.000	(0.125, 0.236)
MCHC (g dL^{-1})	0.201	0.024	0.247	8.232	0.000	(0.152, 0.249)
Serum iron (µg dL^{-1})	0.033	0.036	0.011	0.930	0.354	(-0.038, 0.104)

B: Ordinary least-squares regression coefficient, SE: Standard error of B, β: Standardised β coefficient, T: Observed t-value, p: Significance level, CI: Confidence interval, Hct: Hematocrit, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular haemoglobin concentration

Table 4: Hematological parameters

Parameters	Boys (n = 58)	Girls (n = 53)	p
Hb (g dL^{-1})	12.52±0.78	12.41±1.00	>0.05
Hct (%)	38.58±1.82	38.30±2.37	>0.05
MCV (fl)	82.34±4.19	81.75±5.39	>0.05
MCH (pg)	26.75±2.00	26.58±2.46	>0.05
MCHC (g dL^{-1})	32.44±1.04	32.39±1.16	>0.05
Serum iron (µg dL^{-1})	0.81±0.30	0.76±0.27	>0.05

Hb: Haemoglobin, Hct: Hematocrit, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular haemoglobin concentration, p: Significant level

according to sex are given in Table 4. There was no significant difference between girls and boys according to the variables.

To control the effect and predict the factors influencing hemoglobin levels, a stepwise multiple regression analysis was performed (Table 3).

Model summary: Multiple R = 0.9; R^2 = 0.98; adjusted R^2 = 0.964; F-ratio = 37.57; p = 0.000. Hct, MCV, MCH and MCHC were significantly related to Hb level. The overall F-ratio for all variables was 37.57 and was highly significant (p = 0.000) (Table 3) and hematological parameters are shown in Table 4.

Diet: About 64.9% of the study samples reported that they consumed plant food at least once a day; 79.3% of them consume animal food at least once a week. The occurrence rate of anaemia was higher in children who take foods of both plant and animal sources less frequently (Table 1).

DISCUSSION

Iron deficiency is the most widespread and common nutritional disorder in the world. In spite of the efforts to decrease the frequency, the prevalence varies in different parts of the world with higher rates in the developing countries (Lerner and Sills, 2011; WHO., 1989).

The objective of this study was to investigate the frequency of iron deficiency anaemia in school children (6-15 years) in Kenitra and its association with sociodemographic parameters.

We found that boys are more affected than girls. Similar findings have been documented in a previous studies which revealed that the prevalence of anaemia increased among male children (Nicklas *et al*., 1998; Ayoya *et al*., 2013; Leite *et al*., 2013). These differences can be attributed to genetics or an increased incidence of iron deficiency in boys (Siegel *et al*., 2006). Hassan and Khalique (2002) found anaemia in 24.8% of children. Similarly, a study by Gomber *et al*. (2003), stated that the prevalence of anaemia in school children from urban slums, aged 5-10.9 years was 41.8%. Srivastava *et al*. (2012) found anaemia in 37.5% of

children (2012). It was 39.1% in a group of 271 school age children (age range: 7-14 years) in Asendabo Town, Southwest of Ethiopia (Alemayehu, 2005) and 36,4% among Vietnamese school age children (Le *et al*., 2006). In the present study, 16.2% of children were anemic. This difference in the prevalence of IDA in these regions may be due to difference in the study area, sample size, the food consumption and other factors.

In Northern Morocco, Zimmermann *et al*. (2003) reported prevalence of anaemia as 35%. This rate is comparable to the national prevalence reported by the Ministry of Health (MPH., 2001). Comparing with these studies, the prevalence of IDA which is lower in our study, this may be due to the iron fortification project of the health ministry which was started in 2005 to reduce micronutrients malnutrition. The result of this study also revealed that the prevalence rates of mild and moderate anaemia were 1.5 and 19.6%, respectively. No single case of severe anaemia (Hb<7.5%) was detected in this study.

The prevalence of anaemia changed according to sociodemographic characteristics of children which showed statistically significant differences for some sort of variables. The distribution of anemic children by age group shows that 30.1% were age lower than 12 years whereas, 37.8% had age between 12 and 15 years and the difference was statistically not significant. There was a significant relationship between education of the mother and anaemia in children ($p = 0.004$). In line 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 mother's educational level is found important determinant of anaemia. There was no significant relationship between the prevalence of anaemia and family income.

Furthermore, this study showed that 20.7% children with anaemia had lower intake of foods from animal sources, which is a source of heme iron. There are two forms of dietary iron: Non-heme and heme iron. Non-heme iron takes the simplest form of free iron atoms such as ferric (Fe^{3+}) or ferrous (Fe^{2+}) iron. Non-heme iron is obtained from foods such as grains, legumes, fruits and vegetables (Neumann *et al*., 2003). Consumption of animal source foods was found to be associated with a decreased risk of stunting and underweight. A study that was conducted by Dror and Allen (2011), reported that consuming animal source foods not only decreased stunting but also improved other anthropometric indices toward the reduction of morbidity and mortality among undernourished children (2011).

Reports of Djokic *et al*. (2010), Kaya *et al*. (2006) and Tiwari and Seshadri (2000) show irregular consumption of meat and vegetable were found to be important correlates of anaemia among school-age children. This fact supports the finding of this study.

CONCLUSION

Iron deficiency anaemia, is a serious health problem affecting mostly infant, children and women of reproductive age and requires urgent attention. It was established that occurrence of anaemia is directly correlated with maternal literacy status.

Participants who consumed animal and plant foods less frequently were more likely to develop anaemia than that of more frequent users of these foods. This shows that the problem of anaemia is linked with food insecurity.

Our findings suggest that current public-health strategies such as food fortification are necessary but not sufficient to reduce childhood anaemia. Instead, combining iron fortification and iron supplementation programs with efforts to reduce maternal anaemia, family poverty and food insecurity may yield optimal improvement of children's hemoglobin levels.

Additional studies are needed on micronutrients deficiency, parasite infections, hereditary disorders and environmental pollutants.

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