Risk Factors of Anaemia Among Rural School Children in Kenitra, Morocco

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Abstract

Objective: To determine the prevalence of anaemia and factors associated with iron deficiency among school children in rural Kenitra, Morocco.
Methods: 295 students between 6 and 16 years old composed the study group. The level of haemoglobin was measured in a group of 295 school children. The iron status was determined by ferritin level in serum, and anaemia was defined when haemoglobin <11.5 g/dl. Iron deficiency was defined as ferritin level <15 µg/l. A questionnaire was developed to obtain information on the socio-economic and demographic status of the family such as the size of household, the income and possessions as well as educational status of the parents.
Results: The mean haemoglobin concentration was 12.4 g/dl in boys and 12.5 g/dl in girls, whereas the mean ferritin level was 26.7 µg/l in boys and 27.9 µg/l in girls. The overall prevalence of anaemia in the studied population was 12.2 % and iron deficiency was 20.4 %. There was a significant relationship between education of the mother and anaemia in children (p= 0.01). Serum ferritin (SF), serum iron concentrations and mean corpuscular volume (MCV) were significantly correlated with haemoglobin by multiple regression analysis. However, using logistic regression analysis, the results showed that anaemia was not significantly associated with gender, parents' employment and monthly family income.
Conclusion: Anaemia remains a common problem in the young children particularly the primary education school boys of the households of low income. The results suggest also, that iron deficiency is an important determinant of anaemia in this population; however, whole anaemia cannot be solely explained by iron deficiency. Further studies are needed to consider micronutrients status and exposure to environmental pollutants

Conflict of interest: There is no conflict of interest

Key words: Anaemia, Iron deficiency, Serum ferritin, School children, Morocco

Introduction

Iron deficiency is the commonest form of malnutrition worldwide and according to the World Health Organization affects 43% of the world's children (1). Deficiency may be due to inadequate dietary intake of iron, low level of absorption because of small bowel pathology, increased physiological requirements during rapid growth in infancy and adolescence and chronic blood loss usually from the gastrointestinal or urinary tracts or because of menorrhagia in adolescent girls (2). Iron-deficiency anaemia is a major nutritional problem throughout the world and leads to serious health problems, such as poor cognitive and motor development and behavioural problems, in children (3). The demographic, and Health Surveys in Morocco (4) reported that 31.6 % of children aged less than 5 years were anaemic. In a previous study in rural and urban Morocco, we observed a positive correlation between serum ferritin (SF) and haemoglobin (Hb) concentrations, suggesting that a significant proportion of anaemia cases might be related to iron deficiency (4). Another study showed that higher iron intake is associated with a decreased prevalence of anaemia. However, only one-third of the incidence of anaemia in this study was attributed to iron deficiency suggesting the existence of other causal factors (5).

This study was undertaken to estimate the prevalence of anaemia and iron deficiency among schoolchildren in the Oulad Berjal, Kenitra region and to determine the various factors associated with anaemia in this population.

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Subjects and Methods

Study groups

This study was conducted in the Oulad Berjal region. All the 300 pupils enrolled in primary school and aged between 6 and 16 years old were recruited for this study with parent consents. But 5 children dismissed and refused for blood venipuncture. Socio demographic data were collected with questionnaire filled out by the parents. The socio economic status was defined by the following parameters: the family income, the parent educational status, the number of family members and the working status of the parents.

Anthropometric data

Body size and growth were assessed through height and weight measurements. Anthropometric index of weight-for-age (WHZ) and height-for-age (HAZ) were calculated as indicators of growth status of the children. The anthropometric measurements of the study population were determined using z-scores in accordance with the World Health Organization International Reference Population (6,7) while z-scores less than -2 z-scores were used as cut-off points for growth retardation.

Blood test

One of blood samples 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 performed in private laboratory of medical analysis under suitable conditions. An automated cell counter (Coulter Sysmex) was used for this purpose.

The prevalence of anaemia is defined as the percentage of children with haemoglobin values below 2 standard deviations (SD) of the reference range. The lower limit for the haemoglobin (Hb) level in 6–8.9 year-old children was accepted as 11.5 g/dl and for mean cell volume (MCV) a value of 75 fl. The values for 9–11.9 years were 12 g/dl for Hb and 76 fl for MCV. For ages 12–13.9 the lower limits were different according to sex. For girls the lower limits were 12 g/dl for Hb and 77 fl for MCV; for boys the limits were 12.5 g/dl for Hb and 76 fl for MCV. For ages 14–16, the lower limits for girls were 12 g/dl for Hb and 78 fl for MCV, for boys the lower limits were 13 g/dl for Hb and 77 fl for MCV. The severity of anaemia was classified as mild (Hb>10.5 g/dl), moderate (Hb ≤10.5 g/dl), and severe (Hb<7.5 g/dl) depending on the haemoglobin value of anaemic children. Iron deficiency was defined as plasma ferritin level <15 µg/L. Anaemia, iron depletion, iron deficiency and iron deficiency anaemia were defined according to World Health Organization criteria (8).

Statistical analysis

The chi-squared test and logistic regression analysis were used to investigate the relationship between the prevalence of anaemia and the socio demographic factors. Differences were considered statistically significant at a p-value ≤ 0.05.

Results

The findings demonstrate that 41.7 per cent (123 cases) were male and 58.2 per cent (172 cases) were younger then 11 years old. The distribution of risk factors for anaemia between the anaemic and non-anaemic participants is shown in Table 1.

Socio demographic status

Sixty-seven (23.1 %) mothers and 109 (37 %) fathers received more than 5 years of education. The prevalence of anaemia in children whose parents had been to school for 5 years or less was 9.7 per cent and 9.8 per cent for mothers and fathers, respectively. In comparison, prevalence of anaemia in children whose mothers and fathers had more than 5 years of education was 20.9 % and 15.6 % respectively (Table 1). Fourteen (4.7 %) mothers and 275 (92.9 %) fathers were active workers. The prevalence of anaemia among children whose mothers and fathers were employed were 7.1% and 12.4%, respectively. Comparatively, the prevalence proportions of anaemia in children whose mothers and fathers were unemployed were 12.5% and 9.5% respectively. In 59.3% of families the number of family members was greater than five. The prevalence of anaemia among children who had five or less family members was 11.7 per cent, while for those with more than five family members this figure was 12.6 %.

Physical growth

Physical growth was assessed by weight for age and height for age. Results show that 12.6% of children were stunted and almost the same percentage wasted according to WHO references integrated in Epi Info 2000 software. These results should be carefully taken because WHO is renewing its growth charts. But this process has not attained School age children yet.

Table 1. Socio-demographic characteristics of the study population

	All cases	Cases with anaemia			
	N (%)	N (%)	χ^2	P	95% CI
Sex					
Male	123 (41.7)	14(11.4)			
Female	172 (58.3)	22 (12.8)	0.06	0.72	1.53 – 1.64
Age (years)					
≤ 12	159 (53.9)	26 (16.3)			
> 12	136 (46.1)	10 (7.3)	4.22	0.012*	9.70 -10.28
Mother's education					
Primary (0 - 5 years)	227 (76.9)	22 (9.7)			
Secondary (5-10 years)	68 (23.1)	14 (20.9)	6.56	0.010**	1.15 -1.26
Father's education					
Primary (0 - 5 years)	186 (63)	18 (9.8)			
Secondary (5-10 years)	109 (37)	17 (15.6)	4.25	0.10	1.27 – 1.40
Mother's working status					
Yes	14 (4.7)	1 (7.1)			
No	281(95.3)	35(12.5)	0.61	0.44	0.99 – 1.04
Father's working status					
Yes	274(92.9)	34 (12.4)			
No	21 (7.1)	2 (9.5)	0.42	0.51	2.08 - 2.28
No. of family members					
≤ 5	120 (40.7)	14 (11.7)			
>5	175 (59.3)	22 (12.6)	0.78	0.71	5.89 – 6.40
Wasting< -2Z (Z-W)					
Yes	37 (8.9)	4 (17.6)			
Non	256 (91.1)	32 (12)	0.49	NS	-0.85- (-0.35)
Stunting< -2Z (Z-H)					
Yes	26 (12.6)	3 (12.5)			
Non	267 (87.4)	33 (12.1)	0.36	NS	-0.82- (-0,61)

*** P< 0.05 significance level; ** P < 0. 01 high significance level; Z-W, weight-for-age Z score, Z-H, height-for-age Z score; NS, Non-significant difference**

Prevalence of anaemia

The anthropometric and biochemical indices included in the nutritional assessment are presented in Table 2. There was difference in the prevalence of stunting between age groups (4.4 % for 6-10 year-olds, 14.2% for 11- 16 year-olds (P= 0.0034), but the prevalence of wasting was significantly different between age groups (8.2% for 6–10-year-olds, 15.1% for 11–16-year-olds; (P=0.012) and 0% for 14–17-year-olds (P< 0.001). The distribution of Hb concentration shown in Figure 1 are mean haemoglobin concentration was 12.41 g/dl in boys and 12.5 g/dl in girls, whereas the mean ferritin level was 26.7 µg/l and 27.9 µg/l respectively (Table 2). The prevalence of anaemia was 12.2 % while iron deficiency was found in 20.4 % of the children and the prevalence of iron-deficiency anaemia was 7.7 % (Table 4).

Fig.1. Distribution of Hb concentration (g/dl)

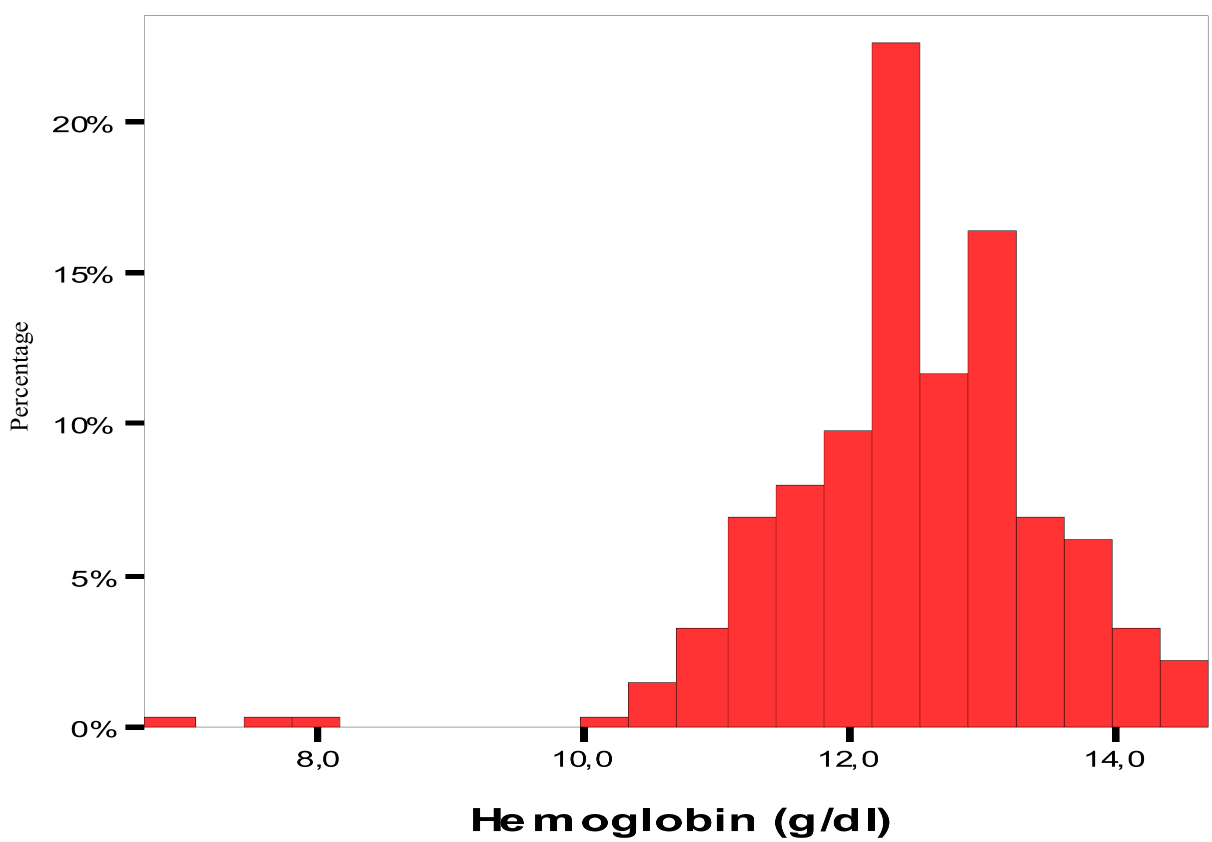

Table 2. Anthropometric and haematological indices of school-aged children in rural Kenitra

	Boys		Girls	
Variable	Mean	SD	Mean	SD
Anthropometry				
Height-for-age Z score	-0.60	1.03	-0.63	2.12
weight-for-age Z score	-1.038	6.1	-0.98	1.2
Body mass index (kgm^{-2})	27.5	25.3	27.3	24.0
Blood analysis	12.41	1.07	12.5	0.95
Haemoglobin (g/dl)	36.0	2.88	36.54	2.48
Haematocrit (%)	79.25	4.95	79.6	7.6
Mean corpuscular volume (fl)	27.35	2.22	27.4	2.2
Mean corpuscular haemoglobin (pg)	34.65	2.63	34.15	1.6
Mean corpuscular haemoglobin concentration				
(g/ dl)	26.7	16.27	27.9	17.66
Serum ferritin (µg /1)	2.54	10.66	2.2	9.11
Serum iron (µg/dl)				

SD – standard deviation.

Table 3. Backward-stepwise multiple regression for haemoglobin concentration of school-aged children in rural Kenitra.

Variable	B	SE	B	T	p	95% CI for B
Serum ferritin (µg /1)	1,520	0,004	0,246	3,88	0,000	(0.007, 0.023)
Serum iron (µg/dl)	1,145	0,007	0,99	1,66	0,097	(-0.002, 0.025)
MCV (fl)	3,68	0,010	2,24	3,54	0,000	(0.016, 0.057)

B=Ordinary least-squares regression coefficient; SE B = standard error of B; Beta = standardised β coefficient; CI = confidence interval.

Model Summary: Multiple R = 0.4; R^2 = 0.16; adjusted R^2 = 0.149; F-ratio = 15.04 (df =3); P = 0.000. Backward-stepwise multiple regression analysis (Table 3) was used to identify the factors influencing Hb levels. Serum ferritin (SF), serum iron concentrations and MCV were significantly related to Hb level. The overall F-ratio for all variables was 15.04 (df =3) and was highly significant (P =0.000).

Table 4. Anaemia, iron deficiency and iron deficiency anaemia

% of anaemia	12.2
% of moderate to severe anaemia (Hb ≤ 10,5 g/dl)	1.4
% of severe anaemia (Hb < 7,5 g/dl)	0.6
% of iron deficiency : Ferritin < 15 µg/l	20.4
% of iron deficiency anaemia	7.7

Discussion

This study reports on the extent of iron deficiency and anaemia among school children in the Oulad Berjal site, Kenitra. In developing regions of the world, the prevalence of anaemia in 5–12-year's old is estimated at 46 %, with the highest rates found in Africa and South Asia at 49 % and 50 % respectively (9). However Zimmermann *et al* (10) suggested that the prevalence of anaemia among rural school age children in a mountainous region from northern Morocco was 35 per cent. This rate is comparable to the national prevalence reported by The Ministry of Health in 2000 (4). Surprisingly the figures found are relatively very low. Only 12.2 % of children were anaemic though almost a fifth had iron reserves limited. WHO and MDIS (11) assessed the prevalence of anaemia (Hb <11.5g/dl) among children aged 6-10 years in Tunisia and found 7.4%. Emel et *al* (12) demonstrated that the prevalence of anaemia among 1531 school children aged 6- 16 years from Istambul was 27.6 per cent. Stoltzfus et *al* (13) found that the overall prevalence of anaemia was 62.3 % among 3595 school children from Pemba Island and Zanzibar. They defined anaemia as haemoglobin level of less than 11 g/dl for all age groups. They found higher anaemia prevalence rates compared to the present study although their cut-off point level was lower. Verma *et al* (14) assessed the prevalence of anaemia (Hb<12g/dl) among 2000 urban school children aged between 5 and 15 years from Punjab. They found that the prevalence of anaemia was 51.5 per cent and it was significantly higher in girls. In comparison with our results no significant difference between girls and boys in the rate of anaemia is found. However, in Tanzania (15) and in KSA (16) the prevalence of anaemia in school children is very high. The anaemia rate in Bangladesh school girls of 27% is similar to our results (17). These results are from under-developed regions and countries such as India, Pakistan, and Bangladesh. The prevalence of anaemia in our study site is lower than those reported from elsewhere. A possible explanation of it is the difference in socio-economic and cultural development. When simple correlation tests were used however, we observed a highly significant association between Hb and SF, suggesting that iron status was likely to be an important determinant of Hb and hence anaemia.

The prevalence of anaemia changed according to socio-demographic characteristics of children which showed statistically significant differences for some sort of variables and not for others. The prevalence rate of anaemia was more frequent for girls (12.8%) while it was 11.4% among boys. No significant sex difference was observed in prevalence rates of anaemia. The distribution of anaemic children by age group shows that 16.3% were aged lower than 12 years whereas 7% had ages between 12 and 16 years and the difference was statistically significant (p= 0.012). There was a significant relationship between education of the mother and anaemia in children (p= 0.01). There was no significant relationship between the prevalence of anaemia and gender and parents' employment and monthly family income.

Conclusion

Because of the severity of the public-health problem and the potential threat to health, survival and development of present and future generations, the prevention and the control of anaemia should be given immediate priority in the health and nutrition sectors of Morocco, particularly school children who are not currently the target of anaemia-prevention. The participants were sampled from all identified School children in an area with a low socio-economic profile, typical of rural Morocco. The results suggest that iron deficiency is an important risk factor for anaemia in this population. However, the observed prevalence of anaemia in this population cannot be solely explained by iron deficiency. Further studies are needed to consider micronutrients status, parasite infestation, hereditary disorders, and environmental pollutants.

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