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Iron Deficiency and Anaemia in Rural School Children in a Coastal Area of Morocco

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Abstract: Iron deficiency anaemia is the major public health problem encountered in the world. In Children, this trouble has deleterious consequences on the global health and weak cognitive development. This study aims to determine the prevalence of anaemia and iron deficiency and its association with socio-economic and anthropometric parameters of the Schoolchildren in a rural coastal region of Morocco. 295 students between 6 and 16 years old composed the study sample. The level of Haemoglobin was measured in a sub group of 280 school children. The iron status was determined by ferritin level in serum. A questionnaire was developed to collect information on the socio-economic and demographic status of the family such as the size of household, the working status of parents and their level of education. The mean haemoglobin concentration was 12.41 g/dl in boys and 12, 5 g/dl in girls, whereas the mean seric ferritin level was 26, 7 µg/l in boys and 27, 9 µg/l in girls. The overall prevalence of anaemia was 12, 2 % and iron deficiency was found in 20.4 %. Serum ferritin (SF), serum iron concentrations and mean corpuscular volume (MCV) were significantly correlated with Hemoglobin There was an inversely significant relationship between education of the mother and anaemia in children (p=0.01) but not with gender, nor parents' employment. It is concluded that anaemia is relatively less prevalent in this study population. Further studies are needed to explore the dietary determinants of this situation.

Key words: Anaemia, iron deficiency, serum ferritin, schoolchildren and morocco

Introduction

Iron deficiency is the commonest form of malnutrition worldwide and according to the World Health Organization it affects 43% of the world's children (De Maeyer and Adiels-Teasman, 1985). Iron deficiency may be due to inadequate dietary intake of iron, the 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 (World Health Organization/United Nations University/UNICEF, 2001). Iron-deficiency anaemia leads to serious health problems, such as poor cognitive and motor development and behavioural problems, in children (Grantham-McGregor and Ani, 2001). The demographic and Health Surveys in Morocco (Ministry for the Public Health, 2001) reported that 31, 6 % of younger children than 5 years were anaemic. In a previous study in rural and urban Moroccan, 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 (Ministry for the Public Health, 2001). 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 (Aboussaleh *et al*., 2004).

This study was undertaken to estimate the prevalence of anaemia and iron deficiency among rural schoolchildren in the OULAD BERJAL KENITRA region and to determine the various factors associated with anaemia in this population.

Materials and Methods

Study sample: This study was conducted in the district of Menasra, WELAD BERJAL. All the pupils of the unique school of the village are integrated to the study. The sick one are eliminated but treated with the medical staff. The sample was 295 pupils aged between 6 and 16 years old enrolled in a primary school.

Socio demographic data were collected with questionnaire filled out by the parents. The household socio economic status was defined by the following parameters: The income, the parent educational status, the size and the working status of the parents outside the household since women declared not active are working mainly in the house and the garden nearby without any direct cash income. They may however get returns from eggs or poultry sold in the village.

Table 1: Socio-economic and anthropometric characteristics of children

	All children		Children with anaemia				
	N	%	N	%	X^2	P	CI 95%
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	0.104	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
Household size							
= 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	17	5.8	3	17.6			-0.85- (-0.35)
No	278	94.2	33	12	-0.59	0.43	
Stunting < -2Z (Z-H)							
Yes	16	5.4	2	12.5			-0.82- (-0,61)
No	279	94.6	34	12.1	1.1	0.29	

* P< 0, 05 significantly level, Z-W, weight-for-age Z score, Z-H, height-for-age Z score

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 the growth status of the children. The anthropometric measurements of the study population were determined using Z scores, based upon the World Health Organization International Reference Population (WHO, 1983; UNICEF, 1986) and less than minus 2 z score from the mean was used as the cut-off point for growth retardation.

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.

The prevalence of anaemia is defined as the percentage of children with hemoglobin values below 2 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.

The values for 9-11.9 years were 12 g/dl for Hb. 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 for boys the limits were 12.5 g/dl for Hb. For ages 14-6, the lower limits for girls were 12 g/dl for Hb, for boys the lower limits were 13 g/dl for Hb.

The severity of anemia 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 hemoglobin value of anemic 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 (World Health Organization, 2002).

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 level of 0.05.

Results

Initially, 295 students between 6 and 16 years included in the study, 41.7 per cent (123 subjects) were male and 58.2 per cent (172 subjects) were younger than 11 years old. The distribution of risk factors for anaemia between the anaemic and non-anaemic participants is shown in Table 1.

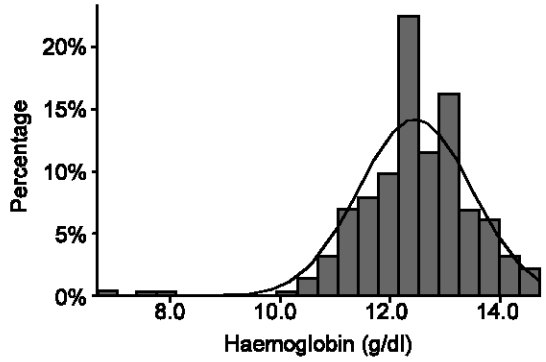

Fig. 1: Distribution of haemoglobin (g/dl) concentration

Socio demographic status

Parent education: Only 23.1 % of the mothers and 37% of fathers went beyond 5 years of formal education but do not go further to get jobs outside the village. The prevalence of anaemia in children is paradox ally inversely associated to parents' education level. Indeed children anaemia prevalence is only about 10% for less educated men or women and increases to 15% and to 20 % in kids whose mothers and fathers completed more than 5 years of instruction.

Most parents who got secondary education are younger than those who got only primary education because the high school is far from the village. These young parents do not complete education and come back to the village to get married and build a family. Their nutrition status is worse may be because they spend money in extra nutritional items (cigarettes, coffee etc.).

Fourteen (4.7 %) mothers and 275 (92.9 %) fathers were active workers. The prevalence of anaemia among children whose mothers and fathers were working found to be 7.1 % and 12.4%, respectively. Comparatively, the anaemia prevalence in children whose mothers and fathers were unemployed was 12.5 % and 9.5 % respectively. Here again the trend is that employment seems not associated or inversely but not significant to the occurrence of anaemia in children. It is worth to note that the majority of active workers are seasonal workers in agriculture or fisheries.

In 59.3 % of families, household size is 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 this figure was 12.6 %. No significant difference was observed.

Physical growth: Physical growth was assessed by Weight for age and height for age. Results show that only 5 % of children were stunted and almost the same percentage wasted according to WHO references integrated in Epi info 2000. These results should be carefully taken because WHO is undergoing a renewal in growth charts.

Prevalence of anaemia and Iron deficiency: The 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. The prevalence of anaemia was 12.2 %. Regarding the severity of anaemia, the mild type is the major one with 98% of cases.

Iron deficiency was found in 20.4 % of the children. It was associated with anaemia in 85% of the subjects.

No gender differences were revealed by these findings according to iron status though a slight difference is noted 12.8% for girl's vs 11.4% for boys.

Backward-stepwise multiple regression analysis (Table 2) 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).

Young children (under 12) are more exposed to anaemia than their elders with 16.3% vs 7.3 % respectively. Among the parents education, only the Mother one is significantly related to the prevalence of anaemia. Anthropometric status are found not to be associated statistically to anaemia.

Discussion

The current study reports on the prevalence of anaemia and iron deficiency among schoolchildren in this rural region of Morocco. In contrast in many developing regions of the world, the prevalence of anaemia in 5-12-year's old is estimated of 46 %, with the highest rates found respectively in Africa and in South Asia at 49 % and 50 % (De Maeyer *et al*., 1985).

However Zimmermann *et al*. (2003) suggested lower prevalence's 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 (Ministry for the Public Health, 2001). Surprisingly the figures found here are very low relatively. Only 12.2% of children were anaemic though almost a fifth has iron reserves limited. Theses results are comparable to a 7.4 % prevalence reported by WHO and MDI (2005) in Tunisia among children aged 6-10 years assessed by the same WHO cut off points(Hb <11.5g/dl).

When simple correlation tests were used, we observed a highly signification between Hb and SF, suggesting that iron status was likely to be an important determinant of Hb and hence anaemia.

It seems that the prevalence of anaemia is not uniform through the whole age specific population in Morocco and some pockets of extreme prevalence coexit with some pockets of improved situations such as the area studied.

Our area of study is a rural area with very tiny agricultural areas or gardens. But the species cultivated are mainly

Table 2: Backward-stepwise multiple regression for haemoglobin concentration of schoolaged children in rural Kenitra

Variable	B	SE	ß	T	p	95% CI for B
Serum ferritin (µg/l)	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 ß 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.

green vegetables, beans and some cereals. Moreover our study area is a coastal territory where the fish consumption is a habit. This may enhance the bioavailability of iron in the diet. A detailed study on food intake is needed to confirm the findings on iron status deficiencies.

Conclusion: The results suggest that iron deficiency is an important factor of anaemia in this population. However, whole anaemia cannot be solely explained by iron deficiency. Further studies are needed to consider micronutrients status, parasite infestation, hereditary disorders and environmental pollutants. A positive deviation study is needed to investigate the factors involved in improving nutritional status is this rural area.

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