

Anaemia among Egyptian adolescents: prevalence and determinants

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فقر الدم بين المراهقين المصريين: معدل انتشاره ومحدداته
فكرات الصحن وسنى سلام وأحمد أمين منديل وعثمان جلال

خلاصة: كان هدف الدراسة تقدير معدل انتشار فقر الدم بين المراهقين في أنحاء مصر ودراسة عوامل الاختطار الممكنة. ولقد اتبعنا أسلوب الدراسة المقطعية. وتم أخذ عينات دم من 1980 مراهقاً لتقدير مستوى الهيموغلوبين لديهم. وتبين أن معدل الانتشار الإجمالي لفقر الدم يبلغ 46.6%، وكان أغلبها حالات خفيفة أو عوسطة، بينما وُجدت حالات وخيمة في أقل من 1.0% من أفراد العينة. وتكاد لم توجد - تقريباً - أية فروق بين الجنسين. ولوحظت علاقة عكسية يعتد بها إحصائياً بين مستوى فقر الدم والعمر (وخاصة بين الذكور) والمستوى الاقتصادي الاجتماعي والمستوى التعليمي. وكان فقر الدم أكثر انتشاراً في المناطق الريفية وفي صعيد مصر. إن فقر الدم مشكلة صحية عمومية كبرى بين المراهقين المصريين، الأمر الذي يتطلب تثقيفاً صحياً بشأنه على نطاق واسع.

ABSTRACT We aimed to estimate the nationwide prevalence of anaemia among adolescents in Egypt and to study possible risk factors. A cross-sectional approach was used. Blood samples were collected from 1980 adolescents for haemoglobin estimation. The overall prevalence of anaemia was 46.6%, most of which was mild or moderate, with severe cases in less than 1.0% of the sample. Gender difference was almost nonexistent. A significant inverse relationship was observed between the level of anaemia and age (especially among boys), socioeconomic level and educational level. Anaemia was more prevalent in rural areas and in Upper (southern) Egypt. Anaemia is a major public health problem among Egyptian adolescents and wide-scale public health education is warranted.

L'anémie chez les adolescents égyptiens: prévalence et déterminants

RESUME Le but de cette étude était d'estimer la prévalence de l'anémie chez les adolescents en Egypte au niveau national, et d'étudier les facteurs de risque possibles. Une approche transversale a été utilisée. Des prélèvements sanguins ont été effectués sur 1980 adolescents pour mesurer l'hémoglobine. La prévalence globale de l'anémie était de 46,6%, pour la plupart légère ou modérée, avec des cas graves dans moins d'un pour cent de l'échantillon (1,0%). La différence entre les sexes était pratiquement inexistante. Une relation inversement significative a été observée entre le niveau d'anémie et l'âge (notamment chez les garçons), le niveau socio-économique et le niveau d'éducation. L'anémie était davantage prévalente dans les zones rurales et en Haute Egypte (Sud). L'anémie est un problème de santé publique majeur chez les adolescents égyptiens et une large éducation du public est justifiée.

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Introduction

One of the most common and widespread public health problems in the world today, both in industrialized and developing countries, is anaemia. In the Eastern Mediterranean Region (EMR), a total of 149 million people are estimated to be anaemic [1] according to World Health Organization (WHO) criteria [2]. Iron deficiency anaemia is the most common type of nutritional anaemia in the world, affecting more than two billion people globally [3]. It can have a profound negative impact on psychological and physical development, behaviour and learning capacity, working performance and reproductive health [4]. It results from inadequate iron intake, reduced bioavailability of dietary iron, increased need for iron, chronic blood loss and parasitic infections [5].

Adolescence is a transitional period from childhood to adulthood, during which certain health problems and risk behaviours prevalent among adolescents may influence their future health [6]. According to WHO, adolescence is defined as the period between 10 years and 19 years [7]. Adolescents of both sexes are particularly vulnerable to developing anaemia because of rapid growth, and in girls additionally because of the onset of menstruation. Despite strong reasons for focusing on anaemia among adolescents, little research has been done.

In Egypt, national data on anaemia prevalence are limited and outdated. However, according to the last national survey, conducted in 1978, and other smaller surveys, anaemia prevalence is considered to be moderate to severe among preschool children, women and schoolchildren [8]. This study is part of a national survey on adolescents carried out in 1997, one of the objectives of which was to estimate the

prevalence of anaemia and to study the possible risk factors for this important public health problem.

Subjects and methods

Sample design

This study of adolescents aged 10–19 years of both sexes was a cross-sectional household nationally representative survey carried out from March to July, 1997 in 21 Egyptian governorates.

The survey sample was a nationally representative multistage, stratified probability cluster sample. A total of 50 primary sampling units (PSUs) were selected, proportional to population size, using an updated census frame compiled by the Central Agency for Public Mobilization and Statistics (CAPMAS). The PSUs were stratified by 21 governorates and by type of residence (urban/rural) within each governorate. Only the frontier governorates were excluded. A total of 2323 adolescents (1070 boys and 1253 girls) were successfully interviewed.

Data collection

A specially designed questionnaire was used to collect data regarding age, sex, education and socioeconomic conditions. Haemoglobin (Hb) level was determined using the HemoCue photometer (HemoCue AB, Ängelholm, Sweden). A total of 1980 adolescents (947 boys and 1033 girls) offered a blood sample.

Cut-off levels of anaemia

Anaemia was considered to be present if the Hb value was below 12 g/dL for adolescent girls and adolescent boys aged less than 14 years, and below 13 g/dL for adolescent boys above 14 years, as proposed by WHO [2]. Anaemia is classified into

three categories, according to severity [4]: mild (Hb level between 10 g/dL to the cut-off); moderate (Hb level 7–9.9 g/dL); and severe (Hb level < 7 g/dL).

Statistical analysis

Data were coded and checked and analysed using SPSS (version 6.0). Data relevant to adolescents with anaemia were compared with those without anaemia. The crude odds ratio (OR) as an estimate of relative risk was calculated using simple logistic regression to identify the independent variables significantly related to outcomes. The regression coefficient obtained in the analysis was transformed to and interpreted as an odds ratio:

$$OR = e^B$$

$$95\% \text{ CI} = e(B \pm 1.96 s_B)$$

where B = regression coefficient and s_B = standard error of the coefficient.

An odds ratio with a 95% confidence interval (CI) excluding 1 was considered statistically significant. All variables found

to be significant were included in the multivariate analysis and final models were selected using SPSS forward stepwise logistic regression procedures [9].

Results

Based on the Hb cut-off levels, the overall prevalence of anaemia among adolescents in Egypt was estimated at 46.6%. The mean Hb level among boys less than 14 years was 12.04 g/dL (standard error of the mean, $s_{\bar{x}} = 0.06$), and for those above 14 years it was 13.14 g/dL ($s_{\bar{x}} = 0.09$). For girls, the mean Hb level was 11.97 g/dL ($s_{\bar{x}} = 0.06$) for girls less than 14 years and 11.97 g/dL ($s_{\bar{x}} = 0.08$) for those above 14 years.

Figure 1 shows that in terms of severity, the majority of anaemic adolescents had a mild degree of anaemia (84.7% of boys and 82.7% of girls). Moderate anaemia was found in 16% of adolescents (14.9% of boys and 16.5% of girls), while severe anaemia was found in less than 1% (0.4% for both sexes).

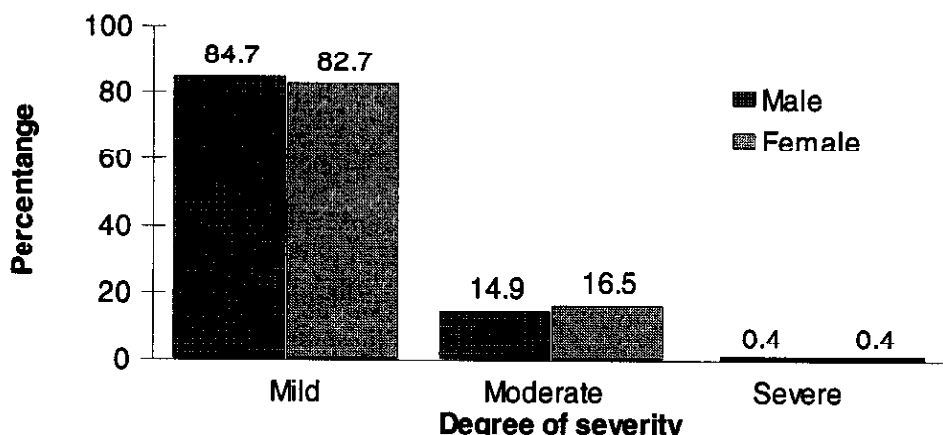


Figure 1 Distribution of anaemia among Egyptian adolescents by severity of anaemia and sex, 1997–98

Table 1 shows the percentage distribution of anaemia among adolescents by selected background variables. Gender difference in the overall prevalence was almost nonexistent. However, gender differ-

Table 1 Distribution of Egyptian adolescents with anaemia by selected demographic characteristics, 1997-98

Demographic characteristic	Total no.	Percentage anaemic
<i>Overall prevalence^a</i>	1949	46.6
Males		47.7
Females		46.6
<i>Males</i>		
10-12 years	375	53.2
13-15 years	303	53.1
16 + years	269	33.3
<i>Females^a</i>		
10-12 years	396	46.5
13-15 years	330	48.0
16 + years	270	41.5
<i>Socioeconomic status (n = 1749)^b</i>		
Low	550	52.2
Middle	627	43.3
High	572	43.4
<i>Education</i>		
No schooling	414	52.2
Primary/preparatory	839	47.7
Preparatory/ secondary	457	47.9
Secondary	172	31.0
Intermediate/university	67	24.2
<i>Residence</i>		
Urban	665	40.7
Rural	1284	49.4
<i>Region</i>		
Urban governorate	318	32.1
Lower Egypt	961	45.0
Upper Egypt	670	55.0

^aPregnant women and women lactating for less than 6 months were excluded from the analysis (n = 31).

^bData were missing for 200 adolescents.

entials were evident across age groups. Although anaemia prevalence was higher among adolescents in the lowest socioeconomic stratum (52.2%), it was also high among adolescents in the highest stratum (43.4%). An inverse relationship was found between prevalence of anaemia and adolescents' education. The lowest prevalence of anaemia was found among adolescents with intermediate education or attending university (24.2%), while the highest prevalence was found among adolescents with no education (52.2%). Adolescents from rural areas showed a higher prevalence of anaemia (49.4%) compared to those residing in urban areas (40.7%). Regional variation was also quite significant, with a higher prevalence in Upper Egypt (55.0%) compared to urban governorates (32.1%).

Prevalence of anaemia by age and sex is presented in Figure 2. It is apparent that anaemia prevalence is higher among boys up to age 16 years, after which the situation changes. For boys, anaemia prevalence ranged between 44% and 63% until age 15 years, after which there was a sharp decline, reaching 18% at age 19 years. A different pattern emerged among girls. At 10 years of age, 48% of girls were anaemic. This declined until age 13 years then rose sharply at 14 years to 55%, probably due to menarche and consequent blood loss. It declined to a low of 33% at 18 years, but then rose dramatically by 19 years to 49%. The trends of anaemia prevalence in urban and rural areas were quite similar in different age groups (Figure 3). Generally, the prevalence of anaemia was lower in urban areas for all age groups except for age 11 years.

Simple logistic regression analysis of factors potentially associated with anaemia among Egyptian adolescents revealed that all variables were statistically associated

with anaemia except gender (Table 2). Although adolescent girls were estimated to be at greater risk of anaemia than boys, it was not significant (OR = 1.08, 95% CI: 0.91–1.3). Adolescents in the age group 13–15 years showed a 1.7 times higher estimated risk of anaemia compared to those

16 years and above. The estimated risk of anaemia increased significantly with decreased level of education. Adolescents who were illiterate were at an approximately 3.5 times higher risk of anaemia than those who attended university (95% CI 1.90–6.32). The risk of anaemia decreased

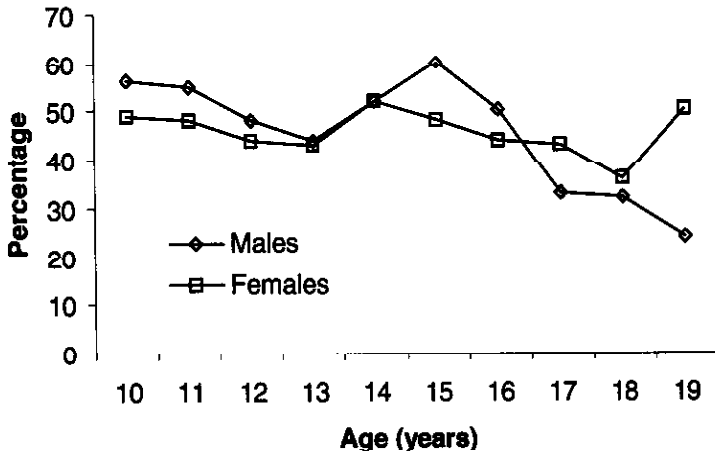


Figure 2 Prevalence of anaemia among Egyptian adolescents by age and sex, 1997-98

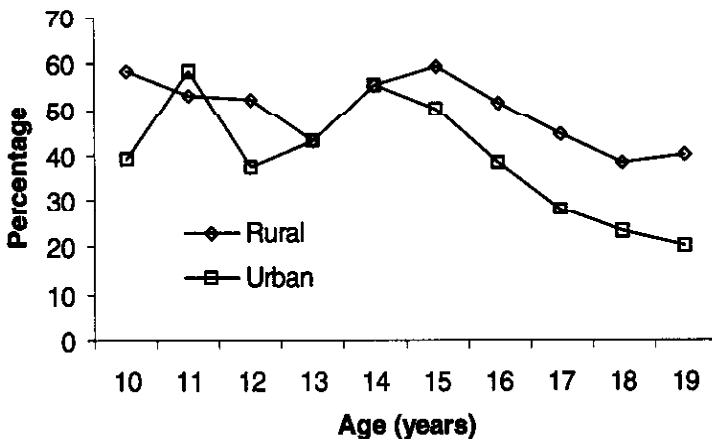


Figure 3 Prevalence of anaemia among Egyptian adolescents by age and residence, 1997-98

as educational level increased. Socioeconomic level was a significant determinant of anaemia risk. Adolescents from the low socioeconomic stratum had a 1.4 times greater risk of anaemia than those from the high stratum (95% CI 1.13–1.81). Resi-

dence in urban areas was associated with a significantly decreased risk of anaemia among adolescents (OR = 0.7, 95% CI 0.58–0.85). Similarly, living in an urban governorate or in Lower (northern) Egypt was associated with a significantly de-

Table 2 Simple logistic regression analysis of anaemia among Egyptian adolescents, 1997–98

Variable	B	s _B	P	OR	95% CI	Model χ^2
Sex						
Male®				1.00		0.81
Female	0.0814	0.0907	0.3696	1.08	0.91–1.3	
Constant	-0.1747	0.0635	0.0059			
Age (years)						
16+®				1.00		25.14 ^a
10–12	0.4994	0.1148	0.0000	1.65	1.32–2.06	
13–15	0.5346	0.1190	0.0000	1.71	1.35–2.16	
Constant	0.5128	-0.5128	0.0000			
Education						
University®				1.00		37.39 ^a
No schooling	1.2416	0.3071	0.0001	3.46	1.90–6.32	
Primary	1.0431	0.2998	0.0005	2.84	1.58–5.11	
Preparatory	1.0532	0.3060	0.0006	2.84	1.57–5.22	
Intermediate	0.3371	0.3363	0.3161	1.40	0.73–2.71	
Constant	-1.1366	0.2916	0.0001			
Socioeconomic status						
High®				1.00		12.17 ^b
Low	0.3572	0.1193	0.0028	1.43	1.13–1.81	
Middle	-0.0011	0.1167	0.9928	0.99	0.80–1.26	
Constant	-0.2673	0.0843	0.0015			
Residence						
Rural®				1.00		13.16 ^a
Urban	-0.3540	0.0980	0.0003	0.70	0.58–0.85	
Constant	-0.0224	0.0549	0.6835			
Region						
Upper Egypt®				1.00		46.18 ^a
Urban governorate	-0.9506	0.1467	0.0000	0.39	0.29–0.52	
Lower Egypt	0.4010	0.0999	0.0001	0.67	0.80–1.26	
Constant	0.2007	0.0761	0.0084			

^aP < 0.001.

^bP < 0.01.

® = reference category.

OR = odds ratio.

CI = confidence interval.

creased risk of anaemia among adolescents compared to those living in Upper Egypt (OR = 0.39, 95% CI 0.29–0.52; OR = 0.67, 95% CI 0.550–0.814 respectively).

Stepwise logistic regression of anaemia among Egyptian adolescents is presented in Table 3. The most significant predictors of anaemia occurrence were found to be age and region. Adolescents in the age group 10–12 years and 13–15 years were at a 1.5 and 1.6 times higher risk of anaemia than older adolescents aged 16 years and above (OR = 1.47, 95% CI 1.15–1.88; OR = 1.64, 95% CI 1.28–2.11 respectively). The second predictor was region, where adolescents from urban governorates and Lower Egypt had a lower risk of anaemia than adolescents from Upper Egypt (OR = 0.42, 95% CI 0.31–0.57; OR = 0.70, 95% CI 0.57–0.86 respectively). The model was statistically significant ($\chi^2 = 54.053$, $P < 0.001$).

Discussion

Anaemia is the most common and widespread nutritional problem in both industrialized and developing countries, with the vast majority of anaemia due to iron defi-

ciency [3]. The results of this national survey indicate that anaemia among adolescents in Egypt must be considered, according to WHO criteria, a serious public health problem [10, 11]. High rates of anaemia have been found in other developing countries, such as India (55%), Nepal (42%) and Cameroon (32%) [12]. Among schoolchildren in EMR, the prevalence of anaemia ranges from 32% in Bahrain to 78% in Oman [1].

The high prevalence of anaemia among adolescents may be attributed to increased needs for iron due to rapid growth and menarche [13]. Less than optimal dietary habits, such as drinking tea after meals and poor nutritional information about the increased nutritional requirements during this stage of life, may also be contributing factors to the high prevalence. Although boys and girls showed a similar prevalence of anaemia in our study, differences were evident within each gender across age groups. Age appears to be the most accurate predictor of anaemia (Table 3). The peak of anaemia was below the age of 16 years (Table 1). The prevalence of anaemia declined sharply in boys after age 16 years, at the time when the growth spurt almost ends and body growth slows down, at

Table 3 Stepwise logistic regression analysis of anaemia among Egyptian adolescents, 1997–98

Variable	B	s_B	P	OR	95% CI
Age (years)					
10–12	0.3878	0.1252	0.0020	1.47	1.15–1.88
13–15	0.4965	0.1277	0.0001	1.64	1.28–2.11
Region					
Urban governorate	-0.8743	0.1595	0.0000	0.42	0.31–0.57
Lower Egypt	-0.3574	0.1070	0.0008	0.70	0.57–0.86
Constant	-0.1746	0.1240	0.1590		

OR = odds ratio.

CI = confidence interval.

Model $\chi^2 = 54.053$, $P < 0.001$

which point iron status appears to improve. Nevertheless, it is not known whether there are functional consequences of anaemia among boys during adolescence [13]. Although gender differences in anaemia prevalence were insignificant, the prevalence among girls started to rise after 18 years of age. While the cause of the increase was not investigated in this survey, it is apparent that Egyptian girls are not in the best of health as they proceed to marriage and childbearing.

In practice, the use of the terms anaemia, nutritional anaemia and iron deficiency anaemia are used interchangeably in most parts of the world, since it is suspected that iron deficiency is highly prevalent particularly compared to the prevalence of other nutritional or genetic causes [4]. In the present study, Hb determination was used to measure for anaemia. Although Hb alone cannot be used to identify the particular type of anaemia, anaemia prevalence is generally taken as an indicator of the extent of iron deficiency [1]. In the EMR, the overall supply of iron per capita is higher than in other areas, but it is mainly from cereals, pulses and vegetables which are low in iron bioavailability. The benefits of iron of plant origin are diminished by the frequent consumption of foods high in substances which inhibit the absorption of plant-sourced iron, such as unleavened bread (phytate) and tea (tannin) [5]. This may be the cause of the high prevalence of anaemia among adolescents.

The most striking finding in our survey was that anaemia prevalence was relatively high among adolescents from the higher socioeconomic stratum (43.4%), compared to those from the low stratum (52.3%). This suggests that for the latter, the lack of availability of iron-rich foods might be the main cause of the problem [14], whereas among those in the higher

stratum, anaemia may be more directly related to choice in dietary habits.

Anaemia prevalence is high among adolescents from rural areas, especially in Upper Egypt, compared to urban governorates. This may indicate that economic development is higher in urban governorates and Lower Egypt, which may in turn be reflected in better nutrition.

Conclusion and recommendations

The results of this national survey show that anaemia, although mainly of mild severity, is still a major public health problem among Egyptian adolescents. Anaemia was found to be more prevalent among adolescents in younger age groups, in those of low educational and socioeconomic levels and in residents of Upper Egypt and rural areas. Age and region were the factors most predicative of anaemia among Egyptian adolescents. Girls were especially at risk as they approached the responsibilities and stresses of marriage, pregnancy and lactation.

Appropriate programmes for wide-scale nutrition education should be especially targeted at young adolescents and residents in rural areas and in Upper Egypt. These programmes should be carried out in schools, in the community and through the mass media. Nutrition education should focus on good eating habits. One short-term solution to anaemia would be a weekly iron supplementation programme for all adolescents.

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