

# Anaemia among young male workers in Alexandria, Egypt

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فقر الدم بين العمال الذكور صغار السن في الإسكندرية، جمهورية مصر العربية  
فليبو كورتالي ومعتز عبد الفتاح ومدحت الشاذلي ومجدي يوسف شامي وفكرات الصحن

**خلاصة:** في مسح مقطعي بحثنا مدى التعرض للعوامل المصاحبة لفقر الدم (الأنيميا) مثل الأحوال الاجتماعية الاقتصادية والعادات الغذائية والإصابة بالطفيليات المعوية والتعرض للرصاص، كما بحثنا عن وجود هذه العوامل بين 355 عاملاً من الذكور صغار السن (7-19 سنة من العمر) العاملين في ورشات خاصة. واتقد وجدنا بين افراد عينة الدراسة أن 44.5% (158 مشاركاً) كانوا مصابين بفقر الدم. وكانت عوامل الاختطار الرئيسية المؤدية لفقر الدم هي الإصابة بطفيليات متعددة، وارتفاع كثافة العدوى بطفيليات الصفر الخراطيسي (الأسكارس)، وشرب الشاي بعد تناول الطعام مباشرة. وقد لوحظ انخفاض معدل انتشار فقر الدم انخفاضاً جوهرياً بعد شهر رمضان، نظراً لتحسن غذاء الناس كماً وكيفاً في شهر الصيام.

**ABSTRACT** In a cross-sectional survey, we investigated exposure to and the presence of factors associated with anaemia, such as socioeconomic conditions, dietary habits, intestinal parasitic infections and lead among 355 young male workers (7-19 years of age) employed in private workshops. Of the total study sample, 44.5% (158 participants) were found to be anaemic. The major risk factors for anaemia were multiple parasitic infection, high intensity of parasitic (*Ascaris lumbricoides*) infection and drinking tea soon after a meal. A significantly lower prevalence of anaemia was noted after Ramadan; it appeared to be the main factor associated with the presence or absence of anaemia and warrants further attention.

## L'anémie chez les jeunes travailleurs à Alexandrie (Egypte)

**RESUME** Dans une enquête transversale, nous avons étudié la présence des facteurs associés à l'anémie, tels que les conditions socio-économiques, les habitudes alimentaires, les parasitoses intestinales et le plomb, et l'exposition à ces facteurs chez 355 jeunes travailleurs (7-19 ans) employés dans des ateliers privés. Sur l'échantillon total de l'étude, on a trouvé que 44,5% (158 participants) étaient anémiques. Les principaux facteurs de risque de l'anémie étaient les parasitoses multiples, la forte intensité de la parasitose (*Ascaris lumbricoides*) et la consommation de thé rapidement après le repas. On a noté une prévalence considérablement plus faible de l'anémie pendant le Ramadan; cela semblait être le principal facteur affectant la présence ou l'absence d'anémie et justifie qu'on lui accorde davantage d'attention.

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## Introduction

An estimated 2000 million people suffer from anaemia, making it the world's most common nutritional disorder [1]. The highest prevalence is among women of reproductive age, infants and young children, especially those of low socioeconomic status. In tropical and subtropical countries the disorder also affects schoolchildren and working males. If not corrected, anaemia can lead to absenteeism, diminished learning ability, increased susceptibility to infection [2], reduced work performance and increased accident rates [3].

Anaemia is a result of insufficient iron intake in the diet (due to either consumption of foods with insufficient iron or limited dietary iron availability) and to blood loss caused by parasitic infections. These factors often operate concurrently, with their individual importance varying from region to region.

In the Eastern Mediterranean Region (EMR), more than 140 million people are estimated to be anaemic according to World Health Organization (WHO) estimates [4]. The supply of iron in the EMR, while higher per capita than in some other regions, comes primarily from vegetables. Iron from vegetables has a low bioavailability compared with haem iron. The bioavailability of the ingested iron is further lowered by the high consumption in the Region of foods rich in iron absorption inhibiting factors such as tea (tannin) and unleavened and unrefined bread (phytate, bran).

Intestinal parasitic infections are another cause of anaemia, especially among school-age children and adolescents, who usually present a higher intensity and prevalence of infection than do adults [5].

Lead exposure is also known to induce anaemia by interfering with iron absorption

and haemoglobin synthesis [6]. Lead is a major component of the pollutants in the mega cities of the EMR, such as Alexandria [4], where it is also present in drinking water because of the use of lead pipes [7]. However, its role in the epidemiology of anaemia under field conditions has not been studied.

In Egypt, anaemia is considered to be a moderate to severe problem in all age groups. A recently conducted national survey detected a prevalence of anaemia of 46.6% among adolescents (i.e. 10–19 years old) [8].

Although Egyptian law prohibits the employment of children under 12 years of age (except in the agriculture sector) and requires compulsory education until age 15 years, a substantial number of children and adolescents are currently working in Egypt in other economic sectors. Most are employed in small workshops, which are much more difficult to control than large factories [9].

In 1990, a nutritional study conducted at Abou El-Dardar (an industrial area in the city of Alexandria) of 154 males aged 8–18 years working in small workshops [10] detected a prevalence of anaemia of 77% applying WHO criteria [11]. This was despite the fact that the average iron intake in the diet was estimated to be above the recommended daily allowance [12].

The present study was implemented in 1996 among young male workers exposed to occupational hazards, such as toxic substances, with consequently greater nutritional and health problems than schoolchildren [13]. The workers were employed in private workshops in different urban slums and two rural settlements on the outskirts of the city of Alexandria, in the Alexandria Governorate. The aim of the study was to investi-

gate and identify, in a particularly vulnerable sector of the population, the presence of and exposure to factors associated with anaemia, such as socioeconomic conditions, dietary habits, intestinal parasitic infections and lead.

## Participants and methods

The study was a cross-sectional survey conducted from January to April 1996. During Ramadan (the holy month of fasting for Muslims), February 1996, fieldwork was suspended.

### Participants

The minimum sample size was calculated to be 340 participants, given an expected prevalence of anaemia of 50% and 95% confidence limit [14]. The total sample included 355 individuals, all young male workers (7–19 years of age) employed in private workshops in the Alexandria Governorate. The majority (255) of them lived in seven urban districts within the Alexandria city area, (El-Gomrouk, Mahmoudia, Abou El-Dardar, El-Kabbary, El-Matar, Nadi El-Sed, and Souk El-Goma). The remaining 100 participants lived in two villages close to the city. Participants were randomly chosen from males under the age of 20 years employed in industrial and handicraft workshops and commercial activities and services.

### The questionnaire

A questionnaire was used to collect demographic and socioeconomic information (age, place of residence, education, levels of crowding and sanitation in the household, type and duration of employment), and information on dietary habits (drinking of tea after meals, use of lemon on beans, types of bread eaten, smoking habits).

### Blood analysis

Haemoglobin (Hb) was determined by the cyanmethaemoglobin method, using a spectrophotometer on samples of venous blood (5 mL) [15]. Anaemia was considered to be present if the Hb value was less than 12 g/dL for boys aged 6–14 years and less than 13 g/dL for boys older than 14 years of age, as proposed by WHO [11]. Blood lead (BPb) levels were assessed by atomic absorption spectrophotometry, after digesting the venous blood sample in nitric acid and perchloric acid [16]. This procedure appears to be the most accurate for assessing the level of lead in biological fluids [17].

### Faecal analysis

The Kato-Katz thick-smear technique was used for diagnosis of intestinal helminth infection, allowing for indirect assessment of intensity of infection, expressed in eggs per gram of faeces (epg) [18]. A double reading of the slides was conducted within 30–90 minutes of preparation of the smear to detect hookworm eggs, and after 24 hours to detect all other parasites [5]. Intensity of infection for each parasite was categorized as light, moderate or heavy [19]. All children found to be infected with parasites and/or anaemic were treated according to WHO guidelines.

### Data analysis

Data were analysed using *SPSS* (version 6.0). First, bivariate associations were tested, calculating the odds ratio (OR) and 95% confidence interval (CI) for qualitative variables (dietary habits, hygienic standards, area of residence, intestinal helminth infection, etc.) and the presence of anaemia. Variables with five or fewer positive cases were not included in the analysis. Continuous variables (BPb levels, education, crowding index, intensity of intestinal

helminth infection) were categorized and tested as above. A logistic regression model was then applied to estimate the independent effect of each relevant factor in predicting anaemia among young workers. The significance level specified for a covariate to remain in the logistic model was 0.10.

## Results

### Characteristics of the study sample

According to WHO cut-off points for anaemia [11], 158 (44.5%) of the study sample were anaemic. Anaemia was more prevalent among participants above 14 years of age (56.2%) compared to those aged 14 years or under (38.5%). Mean Hb ( $\pm$  standard deviation) was  $12.55 \pm 1.36$  g/dL. BPb levels were high by any standard, with 87% above  $10 \mu\text{g/dL}$ , and 18%  $\geq 25 \mu\text{g/dL}$ . The mean BPb level for the entire study sample was  $18.44 \pm 6.77 \mu\text{g/dL}$ .

Kato-Katz analysis showed that 206 (58.0%) of the participants were excreting eggs of at least one parasite, while 15.2% harboured multiple infections. Infections were more prevalent in urban slums (63.0%) compared to rural areas (45.0%). The parasites detected in the area were *Ascaris lumbricoides* (133, 37.5%), *Trichuris trichiura* (66, 18.6%), *Schistosoma mansoni* (33, 9.3%), *Enterobius* spp. (13, 4.3%), *Hymenolepis nana* (12, 3.9%), *Fasciola* spp. (5, 1.4%), hookworms (4, 1.1%) and *Heterophyes heterophyes* (2, 0.6%).

Most of the participants worked in car service and repair workshops (52.4%) and car painting workshops (8.5%) followed by blacksmith, metal and copper workshops, battery shops and carpentry shops. The total duration of employment (including previous employment) ranged from less than 6 months (17.7%) to more than 5 years (10.7%), with most participants hav-

ing started work 12–24 months prior to the interview.

The average number of individuals sleeping together in a room was 4.2, with 21.9% sleeping five or more per room. Internal piped water was present in 77.5% of households, a latrine for exclusive use of the household was present in 85.6%, and 98.6% of households had electricity.

Drinking tea soon after each meal was reported by 76.9% of the respondents as being a 'usual' occurrence, while 23.1% reported doing so 'sometimes' or 'never'. The number of cups drunk in a day ranged from 1 to 12 cups (average 1.5 cups). One person reported drinking coffee rather than tea. Smoking was reported by 5.1% of the sample, with an average of 8.7 cigarettes per day.

The association between socio-demographic characteristics, personal habits, dietary factors, work-related factors, infection with intestinal parasites and presence of anaemia is presented in Tables 1–4. Significant differences emerged in every group of variables, except for work-related factors, including BPb levels.

Anaemia was more prevalent among participants in the following groups: those above 14 years of age (OR = 2.1, 95% CI: 1.3–3.2); those living in urban areas (OR = 3.1, 95% CI: 1.6–5.9); those with a crowding index higher than three (OR = 1.7, 95% CI: 1.1–2.6); those reporting drinking tea soon after a meal (OR = 1.8, 95% CI: 1.05–2.9); and those excreting *A. lumbricoides* eggs (OR = 2.5, 95% CI: 1.5–4.4).

Participants whose samples were collected in the first month of fieldwork (before Ramadan) showed a prevalence of anaemia significantly higher than did those whose samples were collected after Ramadan. This also held true when the analysis was limited to urban dwellers (255) (OR =

Table 1 Sociodemographic characteristics and prevalence of anaemia among young male workers in Alexandria, Egypt, 1996

Characteristic	Not anaemic		Anaemic		OR	95% CI
	No.	%	No.	%		
<b>Age (years)</b>						
≤ 14®	144	62	90	38	1.0	
> 14	53	44	68	56	2.1	1.3–3.2 <sup>a</sup>
<b>Residence</b>						
Desert village®	50	75	17	25	1.0	
Rural village	23	70	10	30	1.3	0.5–3.5
Town slums	124	49	131	51	3.1	1.6–5.9 <sup>a</sup>
<b>Education</b>						
Illiterate®	162	58	119	42	1.0	
≤ 6 years of school	12	41	17	59	1.9	0.8–4.5
> 6 years of school	23	51	22	49	1.3	0.7–2.6
<b>Crowding index<sup>b</sup></b>						
≤ 3 people/room®	91	63	54	37	1.0	
> 3 people/room	103	50	103	50	1.7	1.1–2.6 <sup>a</sup>
<b>Sanitary facilities<sup>c</sup></b>						
All present®	153	56	119	44	1.0	
Not all present	44	53	39	47	1.1	0.7–1.9
<b>Total sample</b>	<b>197</b>	<b>55</b>	<b>158</b>	<b>45</b>		

<sup>a</sup>Statistically significant result.

<sup>b</sup>Missing information in four cases.

<sup>c</sup>Toilet for each household and piped water inside the household.

OR = odds ratio.

CI = confidence interval.

® = reference group.

2.5, 95% CI: 1.5–4.1) and was confirmed by the difference in mean Hb levels, calculated by the two-tailed *t*-test. The mean Hb level of samples collected in urban areas before Ramadan (11.86 ± 1.04 g/dL) was lower than those collected after Ramadan (12.64 ± 1.35 g/dL), the difference being highly significant ( $P < 0.0001$ ).

### Logistic regression model

The results of the logistic regression analysis, conducted with anaemia as the dependent variable and the factors significantly associated with anaemia as independent

variables, are presented in Table 5. The date of blood collection (before versus after Ramadan) emerged as the main associated factor, Ramadan seeming to be protective against anaemia. This independent variable presented a higher OR (3.5, 95% CI: 2.08–5.98) compared with the results of the bivariate analysis.

The importance of intestinal helminth infections as determinants of anaemia was confirmed for the three most prevalent parasites, with the presence of *A. lumbricoides* eggs in stools ranking first among all the parasites detected. The effect of *A.*

**Table 2 Personal habits, dietary factors and prevalence of anaemia among young workers in Alexandria, Egypt, 1996**

Factor	Not anaemic		Anaemic		OR	95% CI
	No.	%	No.	%		
<i>Smoking</i>						
No®	184	55	153	45	1.0	
Yes	13	72	5	28	0.5	0.20-1.30
<i>Tea after meals</i>						
Never/sometimes®	54	66	28	34	1.0	
Usually	143	52	130	48	1.8	1.05-2.90 <sup>a</sup>
<i>Lemon on beans</i>						
Usually®	49	53	44	47	1.0	
Never/sometimes	148	57	114	43	0.8	0.50-1.40
<i>Type of bread</i>						
Only white®	83	54	72	46	1.0	
Only brown	78	55	65	45	0.9	0.60-1.50
White and brown	36	63	21	37	0.7	0.40-1.30
<i>Month of Ramadan<sup>b</sup></i>						
After®	90	57	68	43	1.0	
Before	34	35	63	65	2.5	1.50-4.10 <sup>a</sup>
<i>Total sample</i>	197	55	158	45		

<sup>a</sup>Statistically significant result.

OR = odds ratio.

<sup>b</sup>Only participants living in town slums (n = 255).

CI = confidence interval.

® = reference group.

**Table 3 Work-related factors and prevalence of anaemia among young male workers in Alexandria, Egypt, 1996**

Factor	Not anaemic		Anaemic		OR	95% CI
	No.	%	No.	%		
<i>Occupation</i>						
Metal work®	40	61	26	39	1.0	
Car services	132	57	98	43	1.1	0.60-2.10
Carpenter/others	25	42	34	58	2.1	0.96-4.60
<i>Duration of work</i>						
> 1 year®	146	58	107	42	1.0	
≤ 1 year	51	50	51	50	1.4	0.90-2.10
<i>Blood lead level</i>						
< 25 µg/dL®	164	56	127	44	1.0	
≥ 25 µg/dL	33	52	31	48	1.2	0.70-2.10
<i>Total sample</i>	197	55	158	45		

OR = odds ratio.

CI = confidence interval.

® = reference group.

*lumbricoides* infection was related to the intensity of infection ( $\chi^2$  for trend = 10.7,  $P = 0.001$ ) or to the worm load (indirectly measured as the mean epg for groups of individuals) as shown in Figure 1. The presence of multiple parasitic infection was also significantly associated with anaemia, at a higher level than in the bivariate analysis (OR = 2.3, 95% CI: 1.07–4.86)

Habitual tea consumption soon after a meal and age group maintained their importance and remained in the equation, while duration of employment, although included in the equation, was not significant.

## Discussion

The study analysed a large number of potential risk factors for anaemia in a particularly vulnerable population. No attempt was made to diagnose haemoglobinopathies or genetic forms of anaemia considered to be prevalent in the area [4]. We cannot assess the possible effect of this variable on the study population. However, the sample size appeared to be adequate for the study objectives and a number of significant associations were detected. A dietary assessment was not conducted on the sample, one rea-

Table 4 Intestinal parasitic infections and prevalence of anaemia among young male workers in Alexandria, Egypt, 1996

Factor	Not anaemic		Anaemic		OR	95% CI
	No.	%	No.	%		
<i>Presence of parasite</i>						
Free®	99	66	50	34	1.0	
<i>Ascaris lumbricoides</i>	61	46	72	54	1.9	1.2–2.9 <sup>a</sup>
<i>Trichuris trichiura</i>	35	53	31	47	1.1	0.7–1.9
<i>Schistosoma mansoni</i>	16	48	17	52	1.4	0.7–2.8
Multiple infection <sup>b</sup>	29	54	25	46	1.7	0.9–3.4
<i>Intensity of A. lumbricoides infection</i>						
Free®	136	61	86	39	1.0	
Light (< 100 epg)	59	48	63	52	1.7	1.1–2.7 <sup>a</sup>
Moderate/heavy	2	18	9	82	7.1	1.4–48.9 <sup>a</sup>
$\chi^2$ for trend = 10.7, $P = 0.001$						
<i>Intensity of S. mansoni infection</i>						
Free®	181	56	141	44	1.0	
Light (< 100 epg)	9	60	6	40	0.9	0.3–2.7
Moderate/heavy	7	39	11	61	2.0	0.7–5.9
$\chi^2$ for trend = 1.4, $P = 0.2$						
<i>Intensity of T. trichiura infection</i>						
Free®	162	56	127	44	1.0	
Light (< 100 epg)	35	53	31	47	1.1	0.6–2.0
<i>Total sample</i>	197	55	158	45		

<sup>a</sup>Statistically significant result.

<sup>b</sup>Presence of eggs of two or more parasites among the eight detected in the sample.

OR = odds ratio.

CI = confidence interval.

® = reference group.

epg = eggs per gram of faeces.

**Table 5 Logistic regression analysis of factors related to anaemia (dependent variable) among young male workers in Alexandria, Egypt, 1996**

Independent variable	Beta	OR	95% CI	P-value
Month of Ramadan*	1.2626	3.53	2.09-5.98	0.0000
<i>Asoaris lumbrioides</i> infection	1.0630	2.69	1.65-5.08	0.0002
Age	0.9657	2.63	1.59-4.34	0.0002
Tea after meals	0.7246	2.06	1.16-3.68	0.0141
Multiple infection	0.8233	2.28	1.07-4.86	0.0332
<i>Trichuris trichiura</i> infection	0.8297	2.29	0.98-5.34	0.0545
<i>Schistosoma mansoni</i> infection	0.7240	2.06	0.80-5.30	0.1327
Duration of work	0.4700	1.60	0.95-2.70	0.0789

\*All participants, town and village residents.

Variables not included in the equation were: crowding ( $P = 0.2403$ ), residence ( $P = 0.3392$ ) and blood lead levels ( $P = 0.5051$ ).

Residual  $\chi^2 = 3.901$ .

Categories of independent variables are the same as for Tables 1 to 4.

Backward stepwise (WALD) was used for the analysis.

Anaemia was defined as: haemoglobin < 12 g/dL for 6-14 year-olds; haemoglobin < 13 g/dL for those over 14 years of age.

OR = odds ratio.

CI = confidence interval.

son being that even very accurate dietary assessments often fail to detect cross-sectional relationships between iron intake and Hb levels.

As expected, anaemia was highly prevalent (44.5%) among participants in the study sample. However, the prevalence detected by the study was lower than that detected by a 1991 study of a similar population (77%) using identical cut-off points [10]. A more recent national adolescent survey on a similar age group (10-19 years) which used the same criteria to define anaemia, detected a similar prevalence (47.7%) among male adolescents [8]. Thus, the study sample, although considered to be a vulnerable sector of the urban population, appeared to have higher Hb levels than a few years ago and the levels were in line with the national average. However, the same national survey of adolescents de-

tected a lower prevalence of anaemia in those above age 14 years, results which are not consistent with our study. Taking into account that working under 15 years of age is illegal, it is reasonable to assume that children younger than 15 years reported an older age to the interviewer. The higher prevalence among older participants may not, therefore, necessarily indicate a higher risk of anaemia in older age.

All other health indicators analysed are serious cause for concern. The prevalence and intensity of infection with intestinal parasites was very high, as were BPb levels. Living conditions were poor, with a high crowding index and inadequate sanitation.

A number of risk factors were associated with anaemia in the univariate analysis. Among socioeconomic factors, two variables were significant, residence and crowding. The area of residence reporting



the highest prevalence of anaemia also had the highest intensity and prevalence of infection with intestinal parasites, especially for soil-transmitted helminths (*A. lumbricoides* and *T. trichiura*), as emerged in the previous analysis of the data set [20]. A similar effect was reported for the crowding index with a higher prevalence of intestinal parasitic infections and anaemia in crowded households. It is reasonable to assume that the association between residence in urban slums, crowded households and anaemia was due to the effect of a higher prevalence and intensity of infection with intestinal parasites and not actually indicative of a direct association.

Among the parasites detected, *A. lumbricoides* emerged as the most important risk factor, even in the presence of *T. trichiura* and *S. mansoni*, which are known to be potential determinants of anaemia when intensity of infection is high [5]. In our sample, both *T. trichiura* and *S. mansoni* showed low prevalence and intensity of infection. Two other parasites in other studies associated with anaemia, *Fasciola* spp. [21] and hookworms [5], were present in four and five participants respectively and were not included in the statistical analysis, although they may have played a role in the association between multiple parasitic infection and anaemia which emerged in the logistic regression model.

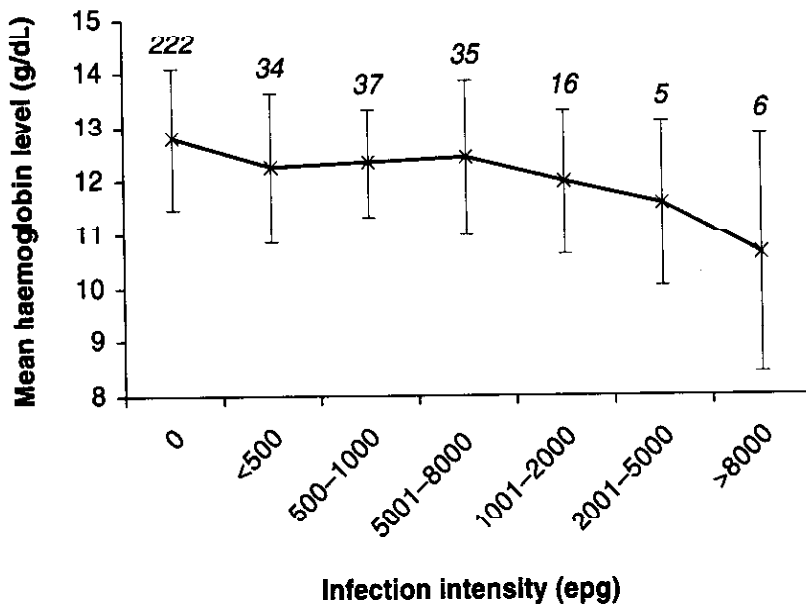


Figure 1 Relationship between mean haemoglobin levels ( $\pm 1$  SD) and intensity of *Ascaris lumbricoides* infection, expressed as a group of individuals for increasing number of eggs per gram of faeces (epg). The number of cases in each group is given in italic at the top of the range I-bar, the total being 355. Significance was tested by one-way analysis of variance (ANOVA):  $F = 4.86$ .  $P = 0.0001$ .

The risk of being anaemic for a child infected with *A. lumbricoides* increased with the intensity of infection, which supports a cause and effect relationship. To validate this observation, an analysis of the mean Hb levels for increasing intensity of infection was performed, assuming that mean egg count for groups of individuals can be considered representative of mean worm burden [22]. The result, shown in Figure 1, clearly demonstrates Hb levels decreasing as worm burden increases, falling especially sharply after 5000 epg. Several reports have associated *A. lumbricoides* infection with child malnutrition [23] and a negative correlation between intensity of infection and Hb levels has been reported in a previous study [24]. Our results confirm these findings, but do not clarify the mechanism behind the association. Blood loss, common in other helminth infections, does not seem to occur during *A. lumbricoides* infection. Competition in iron absorption [25], low food intake due to anorexia as a result of the infection [26], changes in the integrity of intestinal mucosa or other concurrent mechanisms may be responsible for the association.

Work-related factors were not apparently associated with anaemia, including BPb levels. Previous studies have demonstrated an increased risk of anaemia in people with high levels of BPb. However, most of these studies have been conducted on children [6], and the impact of lead toxicity on Hb levels among adolescents may be limited compared to children.

Among dietary factors, drinking tea soon after a meal appeared to be more important than consuming bread made from unrefined flour. The use of lemon on beans was not associated with higher Hb levels. The importance of tea as an iron absorption inhibitor has already been demonstrated [27,28]. Our study confirms this effect on population-based data.

The effect of Ramadan, which emerged as the most important factor in the equation, needs more attention. During this period, which lasts 1 month, the diet changes drastically, usually including daily consumption of meat and a greater variety and quantity of foods than usual. A pilot study among young Saudis has reported a significant increase in caloric, fat, carbohydrate and protein intake during the month of Ramadan, with significant increases in body weight during the period [29]. The lower prevalence of anaemia reported among workers recruited just after Ramadan suggests that increased consumption of meat and a generalized increase in food intake might overcome local factors competing in iron absorption (intestinal helminth infection) or inhibiting it (tea after meals).

Logistic regression confirmed the finding of the univariate analysis—that improved diet during Ramadan was associated with a lower prevalence of anaemia. The role of *A. lumbricoides* infection emerged, after adjusting for possible confounders, as more important than the other two intestinal helminths (*T. trichiura* and *S. mansoni*) both of which showed lower prevalence and intensity of infection than *A. lumbricoides* in our sample. While the variable “tea after meals” maintained and reinforced its association with anaemia, “place of residence” and “crowding” were excluded from the equation, confirming that their effect on the study sample was due to the higher intensity of intestinal helminth infections detected in urban slums and crowded households. Just one variable, “work duration”, not significantly associated with anaemia in the univariate analysis, was included in the equation. This probably reflects an increased availability of food and better diet for young workers compared to the unemployed.

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