Prevalence and morphological types of anaemia and hookworm infestation in the medical emergency ward, Mulago Hospital, Uganda

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Introduction. Anaemia is common worldwide, although the burden is highest in developing countries where nutrient deficiencies and chronic infections are prevalent.

Objective. To determine the prevalence and morphological types of anaemia and assess the hookworm burden among patients in the medical emergency ward at Mulago national referral hospital, Uganda.

Methods. In a cross-sectional descriptive study 395 patients were recruited by systematic random sampling and their socio-demographic characteristics and clinical details collected. A complete blood count and peripheral film examination were done and stool examined for hookworm ova.

Statistical analysis. Data were processed using Epi-Info version 6 and Stata version 9. The chi-square test was used for categorical variables and Student's *t*-test for non-categorical variables. Multiple logistic regression was used to determine factors predictive of anaemia.

Results. Of the patients 255 (64.6%) had anaemia. The prevalence was higher among males (65.8%) than females (63.7%). Fatigue (odds ratio (OR) 2.1, confidence interval (CI) 1.37 - 3.24), dizziness (OR 1.64, CI 1.07 - 2.44), previous blood transfusion (OR 2.83, CI 1.32 - 6.06), lymphadenopathy (OR 2.99, CI 1.34 - 6.66) and splenomegaly (OR 5.22, CI 1.78 - 15.28) were significantly associated with anaemia. Splenomegaly, low body mass index (BMI) (<19) and being HIV positive were independently associated with anaemia. The commonest type of anaemia was hypochromic microcytic (34.1%). Only 10.6% of anaemic patients had hookworm infestation.

Conclusions. In our study the prevalence of anaemia (64.6%) was very high. Splenomegaly, HIV infection and low BMI were independently associated with anaemia. The commonest type of anaemia was microcytic hypochromic (34.1%). There was a low prevalence of hookworm infestation.

S Afr Med J 2009; 99: 881-886.

Anaemia is a common problem in Africa, with prevalences ranging from 21.1% to 64.4% [1-6] and a significant impact on morbidity and mortality.[7,8] In patients with AIDS low haemoglobin levels are associated with poor outcomes.[9-12] However, anaemia in Africa has multiple causes, with infectious diseases such as HIV, tuberculosis and malaria contributing significantly to the anaemia burden.[13] Hookworm is a major contributor to anaemia and even light hookworm loads are associated with low haemoglobin levels,[14-18] although Lewis *et al*. reported that hookworm was not a common cause of anaemia among medical patients in Malawi.[19] In Uganda the prevalence of anaemia continues to rise despite widespread control measures for hookworm.[20] There are no recent data on the prevalence of anaemia among medical patients and the burden of hookworm infestation among anaemic patients in Mulago Hospital, and the present study sought to investigate these.

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Methods

Study setting

The study was conducted in the emergency medical ward of Mulago Hospital, the national referral and teaching hospital for Makerere University Medical School, Uganda. On average 40 patients are admitted on the emergency ward every day, of whom 50% have HIV/AIDS-related conditions.

Study design

Between September 2007 and mid-January 2008, patients aged 18 years and over were recruited by systematic random sampling. Using the patient register on the emergency ward in order of admission, a number (*N*) was randomly selected from the first 5 patients and thereafter every fifth patient

(*N*+5, *N*+10) was selected. This was done until a sample size of 400 patients was attained. Patients who required immediate resuscitation were stabilised before the questionnaire was administered, and patients too ill to undergo study procedures were excluded.

Clinical assessment

On enrolment, a questionnaire including demographic data, symptoms, medical history and physical examination was completed. For all 395 patients, 3 ml of blood and a stool sample were collected in an EDTA vacutainer and stool container, respectively. Even though our intention was to screen for hookworm among anaemic patients, it was easier to collect stool samples from all the patients since haemoglobin levels were not available at the time of specimen collection. In the Mulago Hospital emergency ward complete blood counts are not done routinely because of cost. Blood and stool tests were done specifically for the study and results were given to the attending physicians to enhance patient care. Patients were weighed wearing light clothing and no shoes using a calibrated Seca scale, height was measured in metres using a Seca height board, and body mass index (BMI) was calculated using the formula weight (kg)/height (m^2). Records were reviewed to obtain results of HIV tests and the presumptive diagnosis made on admission.

Laboratory studies

A complete blood count was done on a Coulter counter and a Giemsa-stained thin blood film was studied to determine the blood cell morphology and anaemia type. A senior hospital laboratory technologist read the films, and samples were analysed within 1 - 2 hours of being drawn. Stool was examined for hookworm ova using the Kato Katz method[21] by one laboratory technologist with experience in parasitology. The intensity of hookworm infestation was estimated from the number of eggs per gram of faeces, being classified as light, moderate or heavy according to World Health Organization criteria[22] (light 1 - 1 999 eggs/gram (epg), moderate 2 000 - 4 999 epg, heavy ≥5 000 epg).

Statistical methods

All data were checked for completeness, sorted, coded and entered into Epi-Info version 6. Analysis was done using the STATA version 9 software package.

Univariate analysis was utilised to describe the patient population. Numerical data were expressed as means and medians and categorical variables as frequencies and percentages.

Bivariate analysis was done to determine associations with anaemia. Variables that were significant on bivariate analysis, except for the physical signs of anaemia, were selected for multivariate analysis to assess independent factors that predict anaemia by logistic regression. A *p*-value of <0.05 was considered statistically significant.

Ethical considerations

The study was approved by the Mulago Hospital Research Committee and the Makerere University Faculty of Medicine Research and Ethics Committee. Written or thumbprint (for patients who could not write) informed consent was obtained from all enrolled patients. Strict confidentiality was observed.

Results

We evaluated 395 patients for the presence of anaemia and hookworm infestation; 400 patients were screened, but 5 were excluded because they were too sick to give informed consent and undergo study procedures (Fig.1).

Socio-demographic characteristics

The socio-demographic characteristics of the study group are set out in Table I. The median age was 37 years, with a range of 18 - 90 years and a mean of 40.7 years (standard deviation (SD) 15.8) years; 237 (60.0%) were female.

Clinical diagnoses of patients with anaemia at presentation

These were presumptive diagnoses made by attending physicians on admission of the patient. Tuberculosis was the commonest diagnosis (22.7%) in anaemic patients. One patient had a haemoglobin concentration in the normal range but was clinically misdiagnosed as anaemic (Table II).

Prevalence of anaemia

Anaemia was defined as a haemoglobin concentration <12 g/dl for males and <11 g/dl for females;[23] 255 patients (64.6%) were found to be anaemic.

Anaemia was classified as severe (haemoglobin <7 g/dl), moderate (7 - 9.9 g/dl) and mild (≥10 g/dl); 82 patients (32.2%) had severe anaemia, 114 (44.7%) had moderate anaemia and 59 (23.1%) had mild anaemia. The prevalence of anaemia was higher among males (65.8%) than females (63.7%), but the difference was not significant (*p*=0.668). The prevalence was highest in the group 18 - 49 years of age and decreased with age. Patients aged <50 years were more likely to be anaemic than those aged 50 years and over (*p*=0.0018) (Fig. 2).

Morphological types of anaemia

Typing of anaemia was by morphological examination of the peripheral blood film, done by one independent senior laboratory technologist; 87 patients (34.1%) had hypochromic microcytic anaemia and 29 (11.4%) hypochromic normocytic anaemia. A total of 45.5% of the patients with anaemia therefore had some degree of hypochromasia. Eighty-one (31.8%) had normocytic normochromic anaemia, 13 (5.1%)

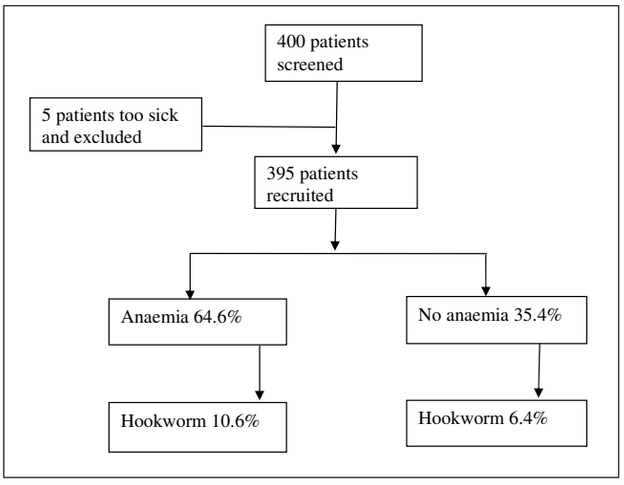

Fig. 1. Study profile.

Table I. Socio-demographic characteristics of the study patients

Characteristics	Patients with anaemia (*N* (%)) (*N*=255)	Patients without anaemia (*N* (%)) (*N*=140)
Age groups (yrs)		
>30	68 (26.7)	33 (23.6)
30 - 39	83 (32.5)	38 (27.1)
40 - 49	46 (18.0)	17 (12.1)
50 - 59	25 (9.8)	23 (16.4)
≥60	33 (12.9)	29 (20.7)
Gender: female	151 (59.2)	86 (61.4)
Marital status		
Married	127 (49.8)	74 (52.9)
Single	38 (14.9)	20 (14.3)
Separated	65 (25.5)	24 (17.1)
Widowed	25 (9.8)	22 (15.7)
Occupation		
Peasant	65 (25.5)	40 (28.6)
Business/trader	38 (14.9)	31 (22.1)
Casual labourer	54 (21.2)	25 (17.9)
Civil servant	24 (9.4)	8 (5.7)
Other	74 (29.0)	36 (25.7)
Education level		
None	33 (12.9)	13 (9.3)
Primary	125 (49.0)	88 (62.9)
Secondary	76 (29.8)	31 (22.1)
Tertiary	21 (8.2)	8 (5.7)

had normochromic features with anisocytosis, 15 (5.9%) had normochromic macrocytic anaemia, 8 (3.1%) had polychromasia with anisocytosis, and 22 (8.6%) had dimorphic features.

Prevalence of hookworm infestation

Overall 36 (9.1%) of the patients had hookworm infestation. Of the anaemic patients 10.6% had hookworm infestation. All the patients had a light hookworm load (<500 epg). The majority (75%) of patients with hookworm infestation had anaemia,

Table II. Clinical diagnosis of the patients at presentation

Diagnosis	With anaemia (*N* (%)) (*N*=255)	No anaemia (*N* (%)) (*N*=140)
Tuberculosis	58 (22.7)	15 (10.7)
Anaemia	33 (12.9)	1 (0.7)
Pneumonia	30 (11.8)	18 (12.9)
Malaria	28 (11.0)	29 (20.7)
AIDS/immuno-suppression syndrome	13 (5.1)	2 (1.4)
Diabetes	13 (5.1)	10 (7.1)
Liver disease	12 (4.7)	10 (7.1)
Gastro-enteritis	11 (4.3)	6 (4.3)
Cardiac disease	9 (3.5)	14 (10.0)
Sepsis	7 (2.7)	4 (2.9)
Hypertension	7 (2.7)	13 (9.3)
Cryptococcal meningitis	7 (2.7)	6 (4.3)
Other	27 (10.6)	12 (8.6)

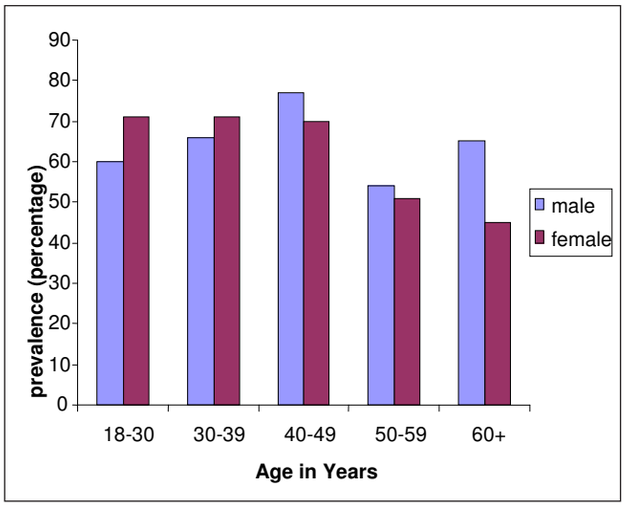

Fig. 2. Prevalence of anaemia according to age group in patients admitted to the medical emergency ward at Mulago Hospital, Uganda.

but the contribution of hookworm infestation to anaemia was not statistically significant (p=0.169). Of the patients 30.6% had received deworming medicine within 6 months prior to the study.

Seven patients (1.8%) had *Schistosoma mansoni* infestation.

Clinical characteristics of the study group

History. A history of fatigue, dizziness, blood transfusion and use of haematinics were more common among patients with anaemia than among those without, with statistically significant differences. Anaemic patients also more commonly reported pica, melaena and palpitations, but this was not statistically significant (Table III).

Physical signs. Lymphadenopathy, splenomegaly, koilonychia and a low BMI were significantly associated with anaemia (Table IV).

Table III. Findings in the history of anaemic and non-anaemic patients

Variable	Anaemia (*N* (%))	No anaemia (*N* (%))	OR (CI)	*p*-value
Fatigue	176 (69.0)	72 (51.4)	2.1 (1.37 - 3.24)	0.001†
Dizziness	161 (63.1)	72 (51.4)	1.64 (1.07 - 2.44)	0.020†
Palpitations	157 (61.6)	80 (57.1)	1.2 (0.79 - 1.83)	0.390
Dyspnoea	113 (44.3)	49 (35.0)	1.48 (0.96 - 2.27)	0.070
Pica	37 (14.5)	15 (10.7)	1.41 (0.75 - 2.68)	0.290
Previous blood transfusion	41 (16.1)	9 (6.4)	2.83 (1.32 - 6.06)	0.005†
Use of haematinics	96 (37.6)	35 (25.0)	1.81 (1.14 - 2.88)	0.011†
History of deworming	80 (31.4)	41 (29.3)	1.10 (0.70 - 1.73)	0.660
Malaena stool	34 (13.3)	13 (9.3)	1.51 (0.77 - 2.97)	0.229
Alcohol use	69 (27.1)	43 (30.7)	0.84 (0.53 - 1.33)	0.440
HIV positive*	153 (67.7)	41 (32.8)	4.29 (2.62 - 7.05)	<0.001†
Age <50 years	197 (77.3)	88 (62.8)	1.000	
Age ≥50 years	58 (22.7)	52 (37.1)	0.49 (0.309 - 0.774)	0.0018†

*Total number of patients = 351.
†Statistically significant ($p<0.05$).
OR = odds ratio, CI = 95% confidence interval.

Table IV. Physical findings of study patients

Variable	Anaemia (N (%))	No anaemia (N (%))	OR (CI)	*p*-value
Jaundice	24 (9.4)	9 (6.4)	1.51 (0.68 - 3.36)	0.305
Lymphadenopathy	39 (15.3)	8 (5.7)	2.99 (1.34 - 6.66)	0.005*
Koilonychia	22 (8.6)	2 (1.4)	6.5 (1.48 - 28.54)	0.004*
Hepatomegaly	49 (19.2)	21 (15.0)	1.34 (0.77 - 2.35)	0.300
Splenomegaly	34 (13.3)	4 (2.9)	5.22 (1.78 - 15.28)	0.001*
BMI				
<19	91 (35.7)	28 (20.0)	1.0000	
19 - 24.9	139 (54.5)	85 (60.7)	0.503 (0.303 - 0.837)	0.0069*
≥25	24 (9.4)	27 (19.3)	0.262 (0.126 - 0.546)	0.0001*

*Statistically significant ($p<0.05$).
OR = odds ratio, CI = 95% confidence interval; BMI = body mass index.

Factors independently associated with anaemia

Since we thought there might be an interaction among factors associated with anaemia, logistic regression was carried out to establish which factors were independently associated with anaemia. Splenomegaly, HIV infection and a low BMI (<19) were significantly associated with anaemia (Table V).

Table V. Factors independently associated with anaemia

Variable	OR	95% CI	*p*-value
Lymphadenopathy	1.225	0.501 - 2.995	0.656
Splenomegaly	3.999	1.299 - 12.318	0.016*
BMI >19	0.635	0.43 - 0.938	0.023*
HIV infection	3.771	2.269 - 6.266	< 0.001*

*Statistically significant ($p<0.05$).
OR = odds ratio; CI = confidence interval; BMI = body mass index.

Discussion

Prevalence and morphological types of anaemia

We demonstrated a high prevalence of anaemia (64.6%) among patients admitted to the emergency medical ward at Mulago Hospital, comparable to the 64.4% in a study among postnatal mothers in Tororo district, Uganda.[6] This could be explained by the fact that both studies were carried out in clinical settings. However, the prevalence rate in this study is much higher than that reported in the Uganda Demographic and Health Survey (UDHS), where 28.4% of men and 41% of women were anaemic.[20] The UDHS was population based, which may explain the lower levels of anaemia compared with our study, in which patients were ill.

Similarly, the prevalence rate in our study was higher than in population-based studies in Kenya and Tanzania. In Tanzania[18] the prevalence of anaemia among people aged 15 - 65 years was 43.4%, while in Kenya[14] the prevalence was 22% among adolescents and adults aged 16 years and over.

Generally the prevalence of anaemia was highest among younger age groups and decreased with age, in contrast to a study by Guralnik *et al.*,[24] in which the prevalence increased

with age. Our high prevalence among young people could be explained by the fact that many of them had infectious diseases that could have played a major role in causing anaemia.

In the age groups 18 - 39 years the prevalence of anaemia was higher among females than males, as would be expected because of blood loss during these reproductive years. However, after 40 years the trend reversed and more males had anaemia. The higher cut-off haemoglobin level for defining anaemia in males could explain this difference.

The commonest type of anaemia was microcytic hypochromic. A mixture of nutrient deficiency and infections is likely to have contributed to the high prevalence of microcytosis.

Clinical characteristics of patients with anaemia

The most frequent findings were fatigue, dizziness, a history of previous blood transfusion or use of haematinics, pallor, lymphadenopathy, splenomegaly, koilonychia and a low BMI. A low BMI was significantly associated with anaemia in this study, as in studies in Kenya[14] and Tanzania.[18,25] These patients could have had dietary deficiencies, especially of iron and vitamins, predisposing them to anaemia. Most of the patients with anaemia were diagnosed with an infectious disease, tuberculosis (22.7%) being the commonest clinical diagnosis. However, this figure is lower than that in a study in Malawi,[19] where one-third of the patients with severe anaemia had tuberculosis; this may be because their patients were severely anaemic and were actively investigated for tuberculosis. In our study the diagnosis was presumptive and some cases may well have been missed.

HIV infection and anaemia

HIV infection was significantly associated with anaemia in this study, a finding similar to studies on severe anaemia in children[26] and adults in Malawi,[19] which were also carried out in areas of high HIV seroprevalence. The HIV itself, other HIV-associated factors such as zidovudine-containing antiretrovirals, opportunistic infections and nutrient deficiencies, or a combination of these could have contributed to anaemia in these patients. Among pregnant women with HIV in Tanzania,[25] iron deficiency and infections appeared to be the predominant causes of anaemia. We did not collect data on patients' medications and level of immunosuppression, making it difficult to explain further the observed relationship between anaemia and HIV infection.

Prevalence of hookworm infestation and its association with anaemia

Hookworm ova were detected in a small number of patients (9.1%). Only 10.6% of the anaemic patients had hookworm infestation. The low prevalence could be explained by the fact that Mulago, being a referral hospital, receives patients from peripheral health units, many of whom may have been dewormed before referral in line with the National Anaemia Policy. Indeed, 30.6% of the patients in this study had received deworming medicine in the 6 months before admission.

The prevalence of hookworm infestation in this study is much lower than that found by Sturrock, also in Uganda, in 1966.[17] This study was community based and conducted in areas where sanitation was likely to have been poor, as indicated in the UDHS. Other community-based studies[14,18] have also reported higher prevalences of hookworm than we found in our study. All the hookworm loads in our study were light. Hookworm infestation was therefore probably not a major contributor to anaemia in these patients. It is likely that the anaemic patients had other factors such as nutrient deficiencies and infection contributing to their anaemia. There is a need for more studies on factors causing anaemia in areas with a high prevalence of HIV.

Conclusions

We found a very high prevalence of anaemia among medical patients in the Mulago Hospital emergency ward. Only 10.6% of the anaemic patients had hookworm ova in their stool. This study could not confirm causative factors, but we found that HIV infection and low BMI were significant associations with anaemia. We can therefore suggest that infections, especially HIV and tuberculosis, as well as nutritional deficiency may be causes of anaemia in this population. The high prevalence of microcytic anaemia could be explained by iron deficiency states. Only a small number of our patients had macrocytic anaemia. It is possible that even in nutritional deficiency states vitamin B_{12} deficiency may not be common except among strict vegetarians.

Infections such as HIV and tuberculosis are usually associated with anaemia of chronic inflammation, which is normocytic-normochromic. However, when chronic inflammation coexists with iron deficiency microcytic features predominate, as in the current study.

Given its high prevalence, clinicians need to evaluate all patients in emergency wards for anaemia, especially HIV-infected patients, and manage them accordingly. More studies to evaluate causes of anaemia in the era of HIV are needed.

Limitations

Information on HIV serostatus was missing for 44 of our patients, we had only one observer for the peripheral film and stool microscopy, and the clinical diagnoses were presumptive and not confirmed by further investigations.

We thank the patients who participated in this study, Mr Andama Alfred and all the participating laboratory staff, and Mr Ouma Joseph for the statistical analysis.

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Accepted 9 July 2009.