Abstract

Background: Anemia is a significant public health problem in developing countries, especially in children, where soil-transmitted helminthes are also rampant. In school-age children, anemia is associated with increased mortality, growth retardation, poor cognitive abilities, reduced school performance, and impaired immune system. Hence, monitoring the burden of anemia in children is indispensable. Objective: This study aimed at determining the prevalence of anemia and assessing associated risk factors among children visiting Jimma University Specialized Hospital (JUSH) pediatric outpatient department. Methods: A facility-based cross-sectional study was conducted involving 369 children visiting JUSH from December 2012 to February 2013. Structured questionnaire was used to gather demographic information and data on risk factors of anemia. Moreover, venous blood and stool specimens were collected for hematological and parasitological investigations, respectively. Data were analyzed using SPSS version 16. Results: Overall, prevalence of anemia was 33.3% and 17.1% of the children had intestinal parasitic infection (IPIs). After a multivariate logistic regression, younger age (AOR=3.25, 95%CI=1.44-7.35), male gender (AOR=2.44, 95%CI=1.39-4.31), children with illiterate mothers (AOR=2.38, 95%CI=1.27-4.46), IPIs (AOR=3.05, 95%CI=1.56-5.95), being stunted (AOR=3.29, 95%CI=1.77-6.11) and underweight (AOR=3.63, 95%CI=1.97-6.69) were identified as independent predictors of anemia in the study participants. Conclusion: This study revealed high prevalence of anemia among the children. Screening of children for anemia is recommended. Moreover, creating awareness on the predisposing factors is essential to prevent the long-term tragic outcomes of anemia in the children.

Anemia and Intestinal Parasitic Infections among Children in Jimma University Specialized Hospital, Southwest Ethiopia: A Cross-sectional Study

Lealem Gedefaw*, Endalew Zemene†, Getnet Tesfawa*, Mulatu Gashaw*, Netsanet Fentahun*, Alemayehu Reta†, Daniel Yilma‡

1. Introduction

Anemia is a global public health problem particularly in developing countries with major consequences on human health and socioeconomic development. It occurs in all ages of life, but is more prevalent in pregnant women and young children [1].

Globally, anemia affects an estimated 1.62 billion people with the highest prevalence in preschool children. The World Health Organization (WHO) estimates that the highest proportion of individuals affected are in Africa (47.5-67.6%) [2]. Anemia among school-age children is a significant global problem affecting 305 million school-age-children [1]. In developing countries, the prevalence of anemia among school-age children and adolescents ranges from 29.2% to 79.6% [3, 4].

Prevalence of anemia in the developing countries tends to be three to four times higher than in the developed countries [5]. Anemia is one of the most common health problems in Ethiopia. The 2011 Ethiopian Demographic and Health Survey report indicated that 44% of children aged 6-59 months are anemic, out of which 21%, 20% and 3% have mild, moderate and severe anemia, respectively [6].

Several factors are associated with anemia in children. The main determinant factors predisposing to childhood anemia are dietary factors, malaria infection, intestinal parasitosis and human immunodeficiency virus (HIV) infection among others [7]. Anemia is an indicator of both poor nutrition and health, which has multiple consequences. It is associated with impaired mental and physical development, reduced work capacity, and low tolerance to infections which leads to increased morbidity and mortality [1, 8]. WHO considers anemia prevalence over 40% in a population to be a major public health problem, prevalence from 20% to 40% as a medium-level, and 5% to 20% as a mild public health problem [9].

Although anemia is an important public health problem, yet it is under recognized and under treated condition that reduces...
Recognizing and treating anemia in children is therefore essential. The developmental and behavioral damages that result from untreated childhood anemia may have long lasting effects into adulthood\cite{11-13}. Due to the long-term effects, anemia may hinder children's economic and social mobility \cite{14}. The burden of anemia in children at Jimma University Specialized Hospital (JUSH) is not explored. Therefore, this study is aimed at determining prevalence of anemia and related risk factors among children visiting JUSH pediatric outpatient department.

**METHODS**

**Study design and setting**

A facility based cross-sectional study was conducted in Jimma University Specialized Hospital from December 2012 to February 2013. The hospital is found in Jimma Town which is located 354Kms southwest of the capital Addis Ababa. Annually, the hospital serves approximately 9,000 inpatients and 80,000 outpatients.

The sample size for this study was estimated using single population proportion formula (taking proportion of 50%, at 95% confidence level and 5% margin of error). The calculated sample size was 384 children. Children who visited the hospital pediatric outpatient department and fulfilled the inclusion criteria were consecutively included in the study. Children who had been on treatment for anemia within 3 months prior to data collection and those with age less than 2 years were excluded from the study. Children aged less than 2 years were excluded from the study because of difficulty in getting sufficient blood specimen for laboratory analyses.

**Data collection and laboratory processing**

Socio-demographic profile of the study participants was gathered by interviewing their parents/guardians using pre-tested structured questionnaires. Anthropometric parameters (height for age, weight for age, and BMI for age) were also measured. Trained nurses collected the socio-demographic and anthropometric data.

**RESULTS**

The presence and quantities of the different metallic elements in the calabash chalk is presented in Table 2. Analysis revealed the following; magnesium (1100±100 mg/kg±SD), aluminium (16000±500 mg/kg±SD), potassium (5500±00 mg/kg±SD), calcium (160±14 mg/kg±SD), titanium (1100±100 mg/kg±SD), vanadium (125±10 mg/kg±SD), chromium (130±10 mg/kg±SD), manganese (40±5 mg/kg±SD), iron (15000±1500 mg/kg±SD), cobalt (4.1±0.2 mg/kg±SD), nickel (25.5±1.3 mg/kg±SD), copper (15.5±0.7 mg/kg±SD), arsenic (11.5±0.8 mg/kg±SD), silver (0.50±0.03 mg/kg±SD), cadmium (0.76±0.04 mg/kg±SD), antimony (0.42±0.02 mg/kg±SD), barium (200±10 mg/kg±SD), thallium (0.33±0.02 mg/kg±SD), lead (57±3 mg/kg±SD), zinc (<100mg/kg).

The mice were administrated a calabash chalk suspension of 40 grams dissolved in 1000 mL distilled water, and the groups were administered a maximum of 5000 mg/kg body weight calabash chalk suspension. At 5000 mg/kg body weight of the single dose treatment of calabash chalk, no mortality and/or toxicity was recorded. Therefore, calabash chalk may have a median lethal dose (LD50) of over 5000 mg/kg body weight (Table 3).

<table>
<thead>
<tr>
<th>Element</th>
<th>Within sample variation Mean±sd (mg/kg) (n = 5)</th>
<th>Between sample variation Mean±sd (mg/kg) (n = 5)</th>
<th>Comparison of two experimental means t-Test significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (Al)</td>
<td>8856±176</td>
<td>8630±152</td>
<td>No</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>1618±25</td>
<td>1372±63</td>
<td>Yes</td>
</tr>
<tr>
<td>Titanium (Ti)</td>
<td>8052±134</td>
<td>7230±198</td>
<td>Yes</td>
</tr>
<tr>
<td>Chromine (Cr)</td>
<td>52±5±1.6</td>
<td>49.6±5.9</td>
<td>No</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>24±1±2.2</td>
<td>24.0±2.1</td>
<td>No</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>14 770±86</td>
<td>14 402±155</td>
<td>No</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>15.5±0.8</td>
<td>15.0±1.3</td>
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</tr>
<tr>
<td>Copper (Cu)</td>
<td>1.8 ±0.5</td>
<td>3.1±0.5</td>
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</tr>
<tr>
<td>Zinc (Zn)</td>
<td>26.9±0.9</td>
<td>25.6±1.8</td>
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</tr>
<tr>
<td>Arsenic (As)</td>
<td>Nd</td>
<td>nd</td>
<td>No</td>
</tr>
<tr>
<td>Rubidium (Rb)</td>
<td>13.4±0.2</td>
<td>12.0±0.6</td>
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</tr>
<tr>
<td>Strontium (Sr)</td>
<td>85.9±1.1</td>
<td>78.2±3.8</td>
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</tr>
<tr>
<td>Yttrium (Y)</td>
<td>17.4±0.3</td>
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</tr>
<tr>
<td>Zirconium (Zr)</td>
<td>355.3±14.4</td>
<td>337.7±24.2</td>
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</tr>
<tr>
<td>Niobium (Nb)</td>
<td>72.9±0.62</td>
<td>67.1±2.6</td>
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</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Tin (Sn)</td>
<td>6.2±0.7</td>
<td>6.2±0.7</td>
<td>No</td>
</tr>
<tr>
<td>Antimony (Sb)</td>
<td>nd</td>
<td>nd</td>
<td>No</td>
</tr>
<tr>
<td>Barium (Ba)</td>
<td>226.5±6.0</td>
<td>230.9±5.9</td>
<td>No</td>
</tr>
<tr>
<td>Cerium (Ce)</td>
<td>266.2±7.4</td>
<td>243.6±9.6</td>
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</tr>
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<td>Mercury (Hg)</td>
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<tr>
<td>Lead (Pb)</td>
<td>42.5±1.2</td>
<td>36.4±2.8</td>
<td>No</td>
</tr>
</tbody>
</table>

nd- Arsenic, cadmium, antimony and mercury were not detected in the samples analyzed.

systems of both plants and animals. These minerals are known to be beneficial in the biological systems of both plants and animals by providing essential nutrients such as magnesium, potassium, manganese, calcium, copper, zinc among others. These minerals play a critical role in various physiological processes, including bone formation, muscle function, and immune system health.

The presence of these minerals portrays the chalk as useful for nutritional purposes, which may justify its consumption.

Other elements present, and whose effects on biological system is uncertain includes; barium and titanium. However, the presence of metals such as aluminium, lead, arsenic, chromium, vanadium, and cadmium in the chalk depending on its composition and bioavailability, may however not be beneficial. The harmful/toxic nature of these metals have also been established. Thus, the usefulness of the chalk may not supercede the potential toxic effects due to the presence of these adverse elements. However, it is reported that the bioavailability of these elements in similar chalk samples may not result in any serious consequences, a situation that may also apply in this study. Hence, calabash chalk may play a dual role in the biological system due to its mixed beneficial and adverse chemical composition.

The calabash chalk sample in this study exhibited concentration values for trace elements in soil sample generally, which indicates its soil-like nature. However, this is at variance with a previous report where the concentration values for trace elements was below the average. The clay-rich calabash chalk sample in this study also showed probably significant absorption potential for other pollutants not reported. Previous reports has shown the likely presence of microbes, as well as persistent organic pollutants.

The difference between this study and the previously reported ones could be due to differences in the environment where both chalks were obtained. In the study by [32], the samples were obtained in Jos and Zaria in northern Nigeria, while Dean et al [4] obtained theirs in a retail store in Newcastle upon Tyne, with its origin not known. Campbell [5] also did not reveal the origin of the calabash chalk analyzed. In the present study, the chalk was obtained in southern Nigeria which is replete with crude oil and other natural mineral reserves. Campbell [5] did not reveal the origin of the calabash chalk analyzed. In the present study, the chalk was obtained in southern Nigeria which is replete with crude oil and other natural mineral reserves. The clay-rich calabash chalk sample in this study also showed probably significant absorption potential for other pollutants not reported. Previous reports has shown the likely presence of microbes, as well as persistent organic pollutants.

The calabash chalk is reported to be eaten by pregnant and breastfeeding women, respectively. The high lead level may also affect the mental development of their developing unborn babies and breast feeding infants, respectively. The harmful/toxic nature of these metals have also been established. Thus, the usefulness of the chalk may not supercede the potential toxic effects due to the presence of these adverse elements. However, it is reported that the bioavailability of these elements in similar chalk samples may not result in any serious consequences, a situation that may also apply in this study. Hence, calabash chalk may play a dual role in the biological system due to its mixed beneficial and adverse chemical composition.
result cancers of the urinary bladder, lungs and skin [7], because lead, a toxic metal is known to induce a broad range of physiological, biochemical, and behavioural dysfunctions in laboratory animals and humans [9], including central and peripheral nervous systems [40], haematopoietic system [41], cardiovascular system [42], kidneys [43], liver [44], and reproductive systems [45, 46]. However, the nervous system damage is considered the most serious. Neurological and visual alterations (including retina) have been reported with low lead concentration particularly in the developing nervous system [40].

In this study, calabash chalk showed the LD50 of over 5000 mg/kg body weight. This indicates that calabash chalk has low acute toxicity hazard because of the high LD50 of over 5000 mg/kg body weight. Thus, this chalk may be classified under 'Hazard Category 5' in the Globally Harmonised Classification System for Chemical Substances and Mixtures (GHS) [14, 15, 16].

CONCLUSIONS

Analysis of calabash chalk has shown several metals and metalloid with many being biologically beneficial, and some either of unknown function or adverse. Though it may be relatively non-toxic in acute usage, the chronic usage may be toxic; hence, its consumption is discouraged.

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