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Survey of iodine deficiency and intestinal parasitic infections in school-going children: Bie Province, Angola

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Abstract

Objective: To obtain baseline pre-intervention prevalence levels of iodine deficiency and parasitic and helminth infections in school-going children in Bie Province, Angola.
Design: A cross-sectional study conducted in randomly selected schools. The target population was children aged 6–10 years.
Setting: Bie Province, Angola.
Subjects: A total of 1029 children sampled, with 791 stool samples and 826 urine samples collected from twenty-four schools.
Results: Widespread severe and moderate deficiencies in iodine. Children in five schools were severely iodine deficient. All sampled schoolchildren were iodine deficient to a greater or lesser extent. In all, 80% of all children across the twenty-four schools were infected with one or a combination of intestinal helminths and intestinal protozoa.
Conclusions: These findings have serious implications for the cognitive development of Angolan children, as well as for Angola's development in terms of productivity and economic potential. It is strongly recommended that the provincial and national Ministries of Health, in collaboration with international health agencies, immediately plan and implement a strategy to provide sufficient iodine through iodised oil capsules and iodised salt to the iodine-deficient population. National coalitions need to be strengthened among the government, partners and salt producers. It is also recommended that all the children in schools be de-wormed for multiple helminth species at least twice a year.

Keywords
Iodine
Deficiency
Helminths
Children
Angola

Despite significant oil and mineral reserves, Angola is placed 162nd out of 177 countries on the Human Development Index[1]. Only 39% of rural Angolans have access to improved water sources and even fewer (16%) have access to adequate sanitation[1]. In addition, over 70% of the population is living below the national poverty line and 35% of the population is undernourished[1]. In a survey conducted in Kuito Province in 2004, 41·5% of children were found to be chronically malnourished and 17·9% had severe stunting[2]. Although there are no national data on iodine deficiency in Angola, there is obvious iodine deficiency[3]. Iodine deficiency is the most common preventable cause of mental retardation, and there is overwhelming evidence of a significant effect of iodine deficiency on cognition and behaviour[4]. It is well documented that both iodine deficiency and long-term parasitic infections will have a devastating effect on health and physiological development, especially children and women of childbearing age[5]. In addition, even low prevalence of intestinal parasitic infection will compromise the effectiveness of food-aid supplements[5].

The present study was initiated by the World Food Programme (WFP) as part of their Food Plus Initiative. The objectives of the initiative include the implementation of public health activities that are intended to enhance the effectiveness of WFP food aid and to have additive or synergistic impacts on the nutritional status of beneficiaries[6]. The aim of the present study was to obtain baseline pre-intervention prevalence levels of iodine deficiency and parasitic and helminth infections in school-going children in Bie Province, Angola.

Subjects and methods

Study area

The data were collected in February 2006 (during the summer rainfall season) in Bie Province, which is located

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Table 1 Epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentration (UIC) of school-age children (≥6 years)*

Median UIC (μg/l)	Iodine intake	Iodine status
<20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Adequate iodine nutrition
200–299	Above requirements	Likely to provide adequate intake for pregnant/lactating women, but may pose a slight risk of more than adequate intake in the overall population
>300	Excessive	Risk of adverse health consequences (iodine-induced hyperthyroidism, autoimmune thyroid diseases

Source: reference (9).
*Applies to children and adults, but not to pregnant and lactating women[9].

in the central highlands of Angola at an altitude of 1700 m. During the course of the Angolan civil war, Bie Province was the site of fierce fighting and suffered extensive infrastructural damage. The population of Bie Province has been estimated at 1 171 000, with the largest municipality being Kuito (where the provincial capital Kuito City is located), which has a population of 310 000*. Access is limited due to the prevalence of landmines and infrastructural problems such as poor roads and inadequate bridges (due to the civil war), as well as collapsed bridges during the rainy season. The true nutritional situation in many areas therefore remains unknown. School feeding is one of the core activities of the WFP. One of the characteristics of the WFP's Food Plus School Nutrition project is the use of micronutrient-fortified maize meal, i.e. produced in-country under WFP contract.

Study design

This was a cross-sectional study. We randomly selected twenty-four out of eighty-seven schools. As a result of landmine blasts in the vicinity of two schools which made assessments at these schools impossible, two additional schools were chosen. The target population was children aged 6–10 years (the key age range for school feeding) attending the selected schools where school feeding and other Food Plus Initiative activities were to be implemented in 2006.

Sample size

The aim was to collect urine and stool samples from thirty-five children per school (ranges of urine and stool samples collected were from twenty-two to forty per school). A total of 1029 children were sampled (50·1% boys and 49·9% girls) and the mean age was 9·28 (95% CI 9.23, 9.32) years. In total, 791 (76·9% of total) stool samples from twenty-four schools were examined, and 826 (80·3%) urine samples were collected.

Data collection

Three teams of assessors were trained over the course of 2 d in data collection methods, and data were collected over the course of a week in February 2006. Urine and stool samples were collected from at least thirty-five children per school, with equal numbers of boys and girls. Stool samples were processed according to standard methods after being weighed and placed in formalin[7]. In order to assess the concentration of iodine in commercially available salt, salt samples were purchased at markets in the close vicinity of the participating schools.

Ethical permission was received from the Ministry of Health (Government of Angola) and from the principals of all sampled schools. All findings were presented to WFP Angola in order to provide feedback to schools.

Iodine deficiency and iodised salt

Iodine status of schoolchildren was assessed by means of the urinary iodine concentration (UIC). The UIC were measured in these samples using the Sandell–Kolthoff reaction with microplate reading of the optical density[8]. In addition, the iodine content of salt purchased at markets in the close vicinity of the schools was assessed by the iodometric titration method for iodised salt[9]. Urinary iodine and salt iodine analyses were performed at the iodine laboratory of the Nutritional Research Intervention Unit of the Medical Research Council of South Africa. This laboratory forms part of the International Resource Laboratory for Iodine Network, and it participates in the international quality control programme run by the Centers for Disease Control and Prevention in Atlanta, USA. Table 1 presents the WHO guidelines on how to interpret urinary iodine levels.

Intestinal parasites and protozoa

Results for *Trichuris trichiura* and *Ascaris lumbricoides* are expressed in prevalence and eggs per gram (epg) of stool. Intensity of infection at the individual level is expressed as epg, whereas at community level it is expressed as mean epg, as per the results. This is the sum of each individual epg divided by the number of subjects investigated. Morbidity from these infections and the rate of transmission are directly related to the number of worms harboured in the host. Therefore, intensity of infection is the main epidemiological index used to

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describe soil-transmitted helminth (STH) infection[10]. The WHO categories for light, moderate and heavy levels of intensity were additionally used for STH as well as protozoa infections[11].

Schistosomiasis

A 10 ml aliquot of urine was preserved with 1% merthiolate and 2% formalin solution in conical tubes, which were subsequently centrifuged at 2000 rpm for 5 min. The supernatant was poured off; a wet preparation was made from the deposit and the slide was viewed under the microscope. If present, *Schistosoma* eggs were counted and the intensity was simply quantified as light (1–50 eggs per 10 ml urine), moderate or heavy (≥50 eggs per 10 ml urine or visible haematuria) levels of infection.

Results

Urinary iodine status

In total, 826 children of twenty-four primary schools, ranging from twenty-two to forty per school, gave urine samples. Two urine samples were not identified and subsequently could not be allocated to a specific school. The overall median UIC was 28·7 μg/l, which indicates a moderately deficient population. Of these children, 92% had UIC below 100 μg/l and 78% had UI below 50 μg/l (Fig. 1).

The median UIC in all schools were below 100 μg/l. Children in five schools were severely iodine deficient with median UIC below 20 μg/l, and seventeen schools had median UIC between 20 and 49 μg/l (Fig. 2).

Iodine content of salt

Twenty-two salt samples were purchased at markets in the close vicinity of the participating schools. Iodine content in salt varied considerably from 0 to 81 ppm, with a median iodine content of 4 ppm. Eighteen samples had very low iodine concentrations (<10 ppm).

Intestinal parasite infections

At baseline screening, 80% of all children (*n* 791) across the twenty-four schools were infected with intestinal helminths or intestinal protozoa or a combination of the two. The most prevalent helminths found in these schools were *A. lumbricoides* (roundworm; 39%) and *T. trichiura* (whipworm; 30%). The prevalence of hookworm and *Hymenolepis nana* was relatively low at 7% and 10%, respectively. A 1% prevalence was observed for *Strongyliodes stercoralis*, *Taenia* and *Enterobius vermicularis*.

Among the six protozoa identified in the stool samples, *Entammoeba coli* (a non-pathogenic protozoa) and *Gardia intestinalis*, which can be associated with gastrointestinal distress, were the most prevalent at 24% and 18%, respectively. The majority of STH were of lighter intensities than the protozoa infections, which showed intensities of light, moderate and heavy (Table 1 and Fig. 3). There was a moderate prevalence of schistosomiasis (from ≥20% to ≤50%) across all schools.

The estimations for *E. vermicularis* (pinworm) are underestimations, because ordinary faecal examinations are usually unproductive as few eggs are deposited within the intestine and passed in the faeces[12].

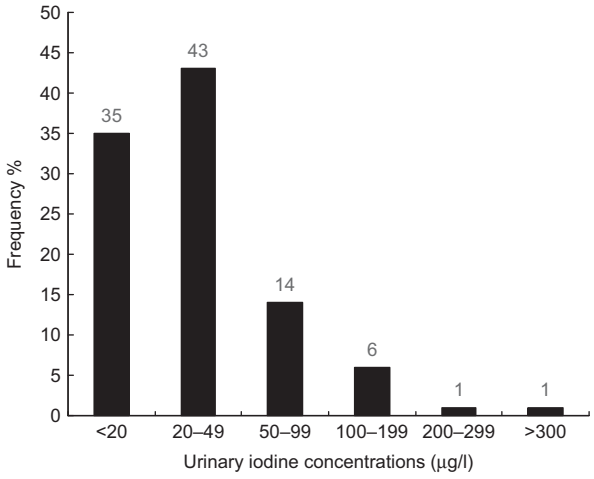

Fig. 1 Distribution of urinary iodine values in children (*n* 826)

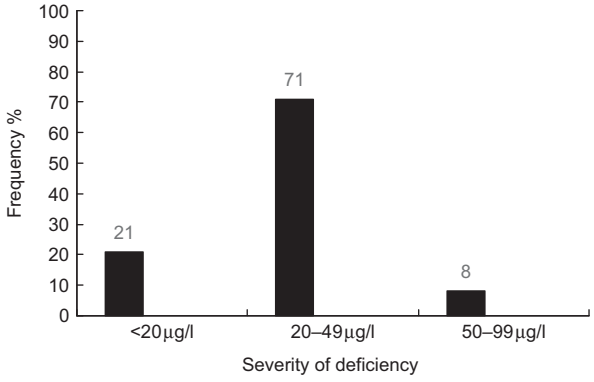

Fig. 2 Percentages of schools with severe (<20 μg/l), moderate (20–49 μg/l) and mild iodine deficiency (50–99 μg/l)

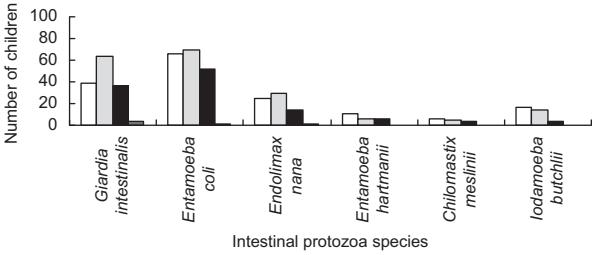

Fig. 3 Intensity of protozoa infections (□, light; ▫, moderate; ■, heavy; ▪, extremely heavy)

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Discussion

The present study indicated widespread, severe and moderate deficiencies in iodine, as well as high levels of helminthic infections. All sampled schoolchildren were iodine deficient to a greater or lesser extent. As iodine deficiency impairs learning and adversely affects school performance[9], these findings have serious implications for the cognitive development of Angolan children, as well as for Angola's development in terms of productivity and economic potential. Of great concern are the five schools that were severely iodine deficient. Under these circumstances, there is a likelihood that, in these areas, children with developmental disorders may be born due to maternal and fetal iodine deficiency[13,14]. Children suffering from moderate iodine deficiency, seen in 71 % of the schools, may have cognitive impairment and other abnormalities related to iodine deficiency. Furthermore, recent data from a number of countries showed that the iodine status of women is usually lower than that of primary-school children[15], which makes the iodine situation even more serious in Angola.

The low levels of iodine in salt available in the market means that local children are not receiving any benefits[16]. From these data, it is clear that the responsible authorities should immediately take urgent public health measures to eliminate the iodine deficiency in the study areas. The appropriate short-term solution would be to issue iodised oil capsules to all women of childbearing age and to all children, but first to those living in severely iodine-deficient areas. The longer-term strategy should be aimed at providing adequately iodised salt to the entire population living in this area. It has recently been shown that despite the improving conditions in Angola since the end of the civil war, low and deficient niacin status and pellagra are endemic in Bie Province[17].

STH infections are common in Bie (levels up to 66 % in some schools), and in the light of these prevalence levels it is likely that every child has at least one infection. The three main STH infections present in communities where sanitary practices are inadequate are ascariasis, trichuriasis and hookworm[10]. These results are in line with the national survey findings in which the prevalence of intestinal helminth and urinary schistosomiasis was 40 % and 28 %, respectively[18]. In Bie Province, the most prevalent helminth species is STH. These levels of helminthic infections are in line with levels in other parts of Africa[19]. Both ascariasis and trichuriasis were prevalent in all twenty-four schools, ranging from 9 % to 66 %, whereas hookworm was only prevalent in eighteen schools, followed by *H. nana* in nineteen schools. *Taenia*, *Strongyloides* and *Enterobius* were prevalent in only six, eight and five schools, respectively. *G. intestinalis* infection was prevalent in twenty-two schools ranging, from 9 % to 33 %. *Giardia* was absent in the single stool samples of the participating subjects of these two schools, namely Sachipanguele and Ngonga.

The presence of helminth infection has significant implications for nutrition supplementation, as nutritional improvement and de-worming go hand in hand. The WHO has argued that nutritional supplementation in the context of high helminth prevalence is akin to feeding the worms or trying to fill a leaking bucket[5]. In addition, vaccination against several diseases (including cholera, which is widespread in Angola) is known to be more effective in children who are not infected with worms.

Limitations

Many schools were not accessible at the time of the survey, and as a result the sample cannot be seen as truly representative of the entire Bie Province. In addition, we were not able to collect important household data due to inaccessibility, and were therefore unable to establish possible correlations among socio-economic status, iodine deficiency and helminthic infections.

Implications

As a result of donor recommendations that the Angolan government put more of its financial reserves received from its oil and mineral reserves towards social services, the WFP has adapted its operations in Angola and significantly reduced its school feeding programmes. This is of particular concern in the light of the findings of the present study that children in some areas of Bie Province are severely iodine deficient and are moderately deficient in other areas. It is strongly recommended that the provincial and national Ministries of Health, in collaboration with international health agencies, immediately plan and implement a strategy to provide sufficient iodine through iodised oil capsules (supplementation) and salt to the iodine-deficient population. It must be ensured that if supplementation does occur, this does not have the effect of delaying efforts to get salt iodised. National coalitions need to be strengthened among the government, partners and salt producers[3]. Finally, it is recommended that all children in these schools be dewormed for multiple helminth species at least twice a year and treated for urinary schistosomiasis. In addition, parasite status should be reassessed after 6 months.

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