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Intestinal parasitic infections in adolescent girls from two boarding schools in southern Benin

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Summary Intestinal parasitic infections (IPI), especially helminths, represent a major public health problem that increase iron deficiency anaemia in developing countries. This study investigated the prevalence, risk factors and nutritional consequences of IPIs in 180 adolescent girls aged 12—17 years living in two boarding schools in southern Benin. Data were collected using a structured questionnaire and laboratory analysis of blood and faecal samples. The relationships between socioeconomic indicators, IPIs and iron status were analysed using logistic regression analysis. Fifty percent of the subjects were infected with at least one IPI: 2% with helminths, 41% with protozoa and 7% with two or more intestinal parasites. Adolescent girls from a large family and those whose mothers were manual workers showed a higher risk of intestinal parasitism (odds ratio (OR) = 3.5, 95% CI 2.5—5.2 ($P = 0.02$) and OR = 2.4, 95% CI 2.0—3.0 ($P = 0.03$), respectively). Likewise, drinking untreated water was also a high risk factor for infection (OR = 2.3, 95% CI 1.5—2.4; $P = 0.03$). No significant association was observed between IPIs and iron deficiency or iron deficiency anaemia, which can be explained by the low wormload observed. These findings reinforce the need to involve mothers in health initiatives to control intestinal parasitism in Benin.

1. Introduction

Intestinal parasitic infections (IPI) constitute a global health burden causing clinical morbidity in 450 million people, many of these women of reproductive age and children in developing countries (Quihui et al., 2006). Indeed, IPIs, mostly helminths, have been linked with an increased risk

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for nutritional anaemias, protein—energy malnutrition and growth deficits in children, low pregnancy weight gain and intrauterine growth retardation followed by low birth weight (Rodríguez-Morales et al., 2006; Sackey et al., 2003). Less is known about the impact of these infections in adolescent girls.

IPIs, especially helminths, increase iron deficiency anaemia in developing countries. Some studies have found a significant correlation between lower haemoglobin (Hb) levels and higher hookworm faecal egg counts (Aikawa et al., 2006; Alarcon-Fernandez et al., 2006). However, Stoltzfus et al. (1997) reported that the relationship between hookworm infection and Hb concentration may be apparent only above a threshold worm burden. Moreover, heavy intensity *Trichuris* infection, which is associated with decreased food intake and blood loss, has also been associated with anaemia (Ramdath et al., 1995).

Finally, it is important to note that infections caused by parasites, bacteria and viruses were ranked as the primary leading cause of mortality in children and women in Benin (Fourn, 2005). However, despite their assumed importance for public health, only two studies have determined the prevalence of IPIs and have examined their impact on iron status in Beninese populations (Alaofè et al., 2007; Hercberg et al., 1986). Among 434 subjects living in a rural district of Benin, helminth infection was present in 83%, with 42% for hookworm and 80% for protozoa (Hercberg et al., 1986). There was no significant association between IPI and anaemia (Alaofè et al., 2007; Hercberg et al., 1986). Moreover, to our knowledge, no studies have examined the different factors associated with risk of IPI. Thus, the purpose of this study was to determine the prevalence of IPIs and to investigate their predictors as well as consequences on iron status in adolescent girls from two boarding schools in southern Benin.

2. Methods

2.1. Study population

This cross-sectional study was carried out from October—November 2005. The study population consisted of adolescent girls aged 12—17 years living in two boarding schools in southern Benin, namely Lycée Toffa 1er of Porto-Novo ($n = 80$) and CEG1 Bertrand Dagnon of Ouidah ($n = 100$). The selected schools were located in two departments, Ouémé and Littoral, which are 70 km apart. These schools were selected on the basis of the similarity of their cafeteria menus and supply of local foods.

2.2. Recruitment

Meetings with personnel from the two boarding schools as well as with adolescent girls and their parents were carried out in order to explain the study protocol. Participants were selected from the lists of students from each of the selected boarding schools, which included names and dates of birth. Only girls aged 12—17 years were included in the study. At the beginning of the study, Lycée Toffa 1er of Porto-Novo included 140 boarding girls aged 12—17 years, whilst CEG1 Ouidah counted 148 girls (total = 288). One hundred and ninety-two girls (67%) were eligible: 85 (61%) in Lycée Toffa 1er and 107 (72%) in CEG1. One hundred and eighty girls (63%) participated in the study (80 (57%) and 100 (68%) in Lycée Toffa 1er and CEG1 Ouidah, respectively), giving a participation rate of 94%. Twelve girls (6%) did not participate in the study: seven refused to participate, three suffered from malaria and two were not present at the time of the study.

Written consent was required from both parents in order for their child to participate in the study. Baseline data were collected using a structured questionnaire and laboratory analysis of blood and faecal samples. Subjects received oral and written notification of test results. Girls diagnosed with IPI were given written referrals to school health services and received the appropriate antiparasitic treatment. Girls who were suffering from mild iron deficiency anaemia (Hb level 100—120 g/l combined with either a serum ferritin (SF) <20 μg/l or 20—50 μg/l plus two abnormal values among the three following biochemical parameters: serum iron (SI) <11 μmol/l, total iron binding capacity (TIBC) >73 μmol/l or transferrin saturation (TS) <20%) were selected to participate in a 22-week nutrition intervention programme (34 intervention girls from Lycée Toffa 1er and 34 control girls from CEG1 Ouidah). Intervention girls received individual nutrition counselling combined with an increase in the content and bioavailability of dietary iron in the cafeteria menu for 22 weeks, whilst control girls received the nutrition education lessons at the end of the 22-week period and were given iron supplements if necessary. Control girls also received an additional blood test after 11 weeks to eliminate those with a Hb level <100 g/l. Results of the nutrition intervention programme will be published elsewhere. Finally, girls who were not selected for the nutrition intervention programme but who were diagnosed with iron deficiency anaemia were given written referrals to school health services and received the appropriate treatment, including iron supplementation.

2.3. Socioeconomic data

Collection of socioeconomic data for the participants was undertaken with a structured questionnaire that was previously pre-tested in the study setting to detect and correct problems. Socioeconomic information included questions related to age, religion, primary occupation of both parents, level of education, household conditions, sewage system in the house, water source, drinking water treatment and type of domestic animals living in the home.

2.4. Blood sampling

Venous blood samples were collected in non-fasting adolescents and sent to TOXI-LABO in Cotonou (Benin). A blood sample (≈5 ml) was collected using EDTA-containing Vacutainer™ tubes (Becton Dickinson, Plymouth, UK) for automated blood analysis. A haematology analyser (Sysmex KX-21™; Sysmex Corporation, Kobe, Japan) was used for full blood count and differential white blood cell count analysis.

For serum collection, a blood sample (≈5 ml) was collected using trace mineral-free Vacutainer™ tubes (Becton