ARTICLE ORIGINAL

Prevalence and Risk Factors of Intestinal Helminthiasis among Children Aged 5 to 15 Years in the Rural Commune of Ampefy, Madagascar

Prévalence et facteurs de risque de l'helminthiase intestinale chez les enfants âgés de 5 à 15 ans dans la commune rurale d'Ampefy, Madagascar

Norosoa Julie Zafindraibe[1,2]
Fenosoa Anita Mireille Tsatoromila[1,2]
Masy Nasandratra Razafindrakotosoa[2]
Aliniaina Randrianomenjanahary[2]
Njariharinjakamampionona Rakotozandrindrainy[2,3]
Raphael Rakotozandrindrainy[2,3]
Lala Rasoamialy Soa. Razanakolona[1,2]

1 Laboratory of Bacteriology, Parasitology and Mycology, University Hospital Joseph Ravoahangy Andrianavalona (CHU-JRA), Antananarivo, 101,Madagascar

2 Department of Biology, Faculty of Medicine,101, University of Antananarivo, Madagascar

3 Madagascar Institute for Vaccine Research, 101,University of Antananarivo, Madagascar

Corresponding author:
Norosoa Julie Zafindraibe

Email Address: juliemail_21@yahoo.fr / njzafindraibe@gmail.com

Abstract

Introduction : Intestinal helminthiasis remains a major public health issue in tropical countries, particularly affecting children in Madagascar. This study aimed to determine the prevalence of intestinal helminthiasis among children aged 5–15 years in the rural commune of Ampefy, and to explore associated sociodemographic, clinical, and environmental factors.

Methods : A cross-sectional study was conducted from August to September 2022, including 107 children after parental consent. Data were collected using structured questionnaires and parasitological stool examinations.

Results : The overall prevalence of intestinal helminthiasis was 40.2% (43/107). *Schistosoma mansoni* was most frequent (24.3%), followed by *Ascaris lumbricoides* (17.76%) and *Trichuris trichiura* (3.74%). Polyparasitism occurred in 6.53%, mainly *Ascaris-Schistosoma* co-infections. Boys were more affected than girls (58%, p=0.048), with the highest prevalence among 5-year-olds (81.82%, p=0.030). Infection prevalence decreased with higher education levels (p=0.035). Significant risk factors included absence of latrines (p=0.043), use of non-potable water (p=0.002), and abdominal symptoms (p=0.044). Clinically, 72.09% of infected children reported abdominal symptoms, and 17.65% exhibited stunting.

Conclusion : Intestinal helminthiasis is endemic in Ampefy, with a high burden among young children. Interventions should focus on improving sanitation, access to clean water, health education, and mass deworming. Strengthening national strategies is essential to reduce the impact of helminthiasis on child health and local socio-economic development.

Key words *: helminthiasis, Prevalence, Children, Risk factors, Schistosoma mansoni, Madagascar*

Résumé

Introduction : L'helminthiase intestinale reste un problème majeur de santé publique dans les pays tropicaux, affectant particulièrement les enfants à Madagascar. Cette étude visait à déterminer la prévalence de l'helminthiase intestinale chez les enfants âgés de 5 à 15 ans dans la commune rurale d'Ampefy, ainsi qu'à determiner les facteurs sociodémographiques, cliniques et environnementaux associés.

Matériel et Méthodes : Une étude transversale a été menée d'août à septembre 2022, incluant 107 enfants après consentement parental. Les données ont été collectées à l'aide de questionnaires structurés et un examen parasitologique des selles a été effectué.

Résultats : La prévalence de l'helminthiase intestinale était de 40,2 % (43/107). *Schistosoma mansoni* a été le plus fréquent (24,3 %), suivi par *Ascaris lumbricoides* (17,76 %) et *Trichuris trichiura* (3,74 %). Le polyparasitisme a été observé chez 6,53 % des enfants, principalement des co-infections *Ascaris-Schistosoma*. Les garçons ont été plus affectés que les filles (58 %, p=0,048), avec la proprotion la plus élevée chez les enfants de 5 ans (81,82 %, p=0,030). La prévalence de l'infection diminuait avec un niveau d'éducation plus élevé (p=0,035). Les facteurs de risque significatifs comprenaient l'absence de latrines (p=0,043), l'utilisation d'eau non potable (p=0,002) et la présence de symptômes abdominaux (p=0,044). Cliniquement, 72,09 % des enfants infectés ont rapporté des symptômes abdominaux et 17,65 % présentaient un retard de croissance.

Conclusion : L'helminthiase intestinale est endémique à Ampefy, avec une forte charge chez les jeunes enfants. Les interventions doivent se concentrer sur l'amélioration de l'assainissement, l'accès à l'eau potable, l'éducation sanitaire et le déparasitage de masse. Il est essentiel de renforcer les stratégies nationales pour réduire l'impact de l'helminthiase sur la santé des enfants et le développement socio-économique local.

Mots-clés : Helminthiase, Prévalence, Enfants, Facteurs de risque, Schistosoma mansoni, Madagascar

BACKGROUND

Intestinal helminth infections, classified among the neglected tropical diseases by the World Health Organization (WHO), remain a major public health burden in developing countries, particularly in tropical regions such as Madagascar (1, 2). These infections are primarily transmitted through two main routes: oral ingestion (e.g., of soil, water, or food contaminated with helminth eggs) and transcutaneous penetration of larval stages. In the specific case of schistosomiasis, transmission occurs exclusively through skin contact with freshwater contaminated by cercariae released from infected snails (3). This transcutaneous route underscores the critical role of exposure to contaminated freshwater—during activities such as swimming, bathing, or walking barefoot—as a key risk factor for infection.

In 2009, soil-transmitted helminth infections affected approximately one-sixth of the global population, while schistosomiasis was estimated to affect 207 million people worldwide (3). The WHO recommends periodic deworming in regions where the prevalence of these infections exceeds 20% (3). In Madagascar, 113 out of 114 districts are endemic for soil-transmitted helminthiasis, and 107 are endemic for schistosomiasis (4). Despite the implementation of national mass drug administration (MDA) programs, about 10 million people remained at risk in 2007 (5).

Several other factors contribute to the persistence of these infections, including the tropical climate, low educational levels, poor sanitation, and limited access to safe water (6). Intestinal helminth infections not only impair children's physical and cognitive development but also perpetuate the cycle of poverty (6).

The rural commune of Ampefy, located in the Itasy region, provides favorable conditions for the transmission of these diseases due to its proximity to Lake Itasy and the Lily waterfall, its predominantly agricultural economy (85% of the population), and limited access to potable water (only 37.37% of residents) (7). To date, no study has investigated intestinal helminth infections in this area.

The main objective of this study was to determine the prevalence of intestinal helminth infections among children aged 5 to 15 years living in Ampefy in 2022.

The secondary objectives were to describe the sociodemographic and clinical profiles of infected children, to identify the predominant helminth species, and to analyze the associated risk factors.

MATERIALS AND METHODS

Study setting

This cross-sectional descriptive study was conducted over a 11-months period, from November 2021 to September 2022, with data collection concentrated during two months (August–September 2022). The study took place in three *fokontany or villages* of the rural commune of Ampefy, located in the Itasy region, Soavinandriana district, Madagascar: Avaratriniavo, Avarabohitra, and Manjakasoa. These sites were selected because of their proximity to potentially contaminated water sources, namely Lake Itasy and the Lily River (Figure 1) (11).

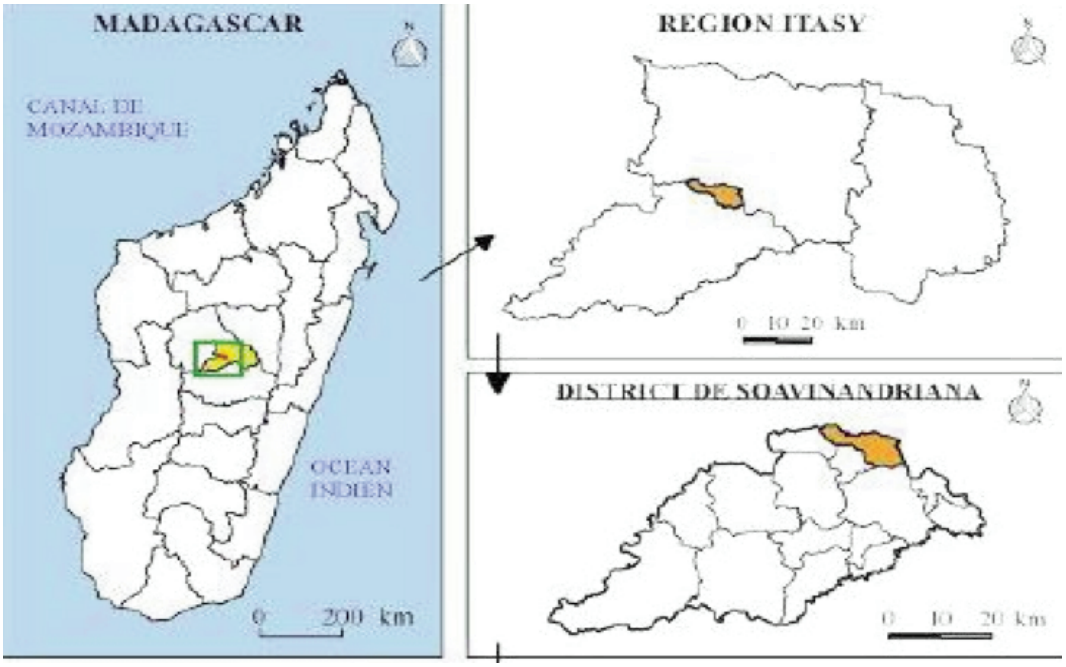

Figure 1: Geographical location of the rural commune of Ampefy, Itasy Region (11). Fokontany of the Ampefy Region - Residence location of the study population

Study population and sampling

The target population consisted of all children aged 5 to 15 years who were permanent residents of the selected *fokontany*. An exhaustive sampling approach was applied, resulting in the inclusion of 107 children out of 110 assessed: 27 from Manjakasoa, 30 from Avarabohitra, and 50 from Avaratriniavo.

Inclusion criteria were: (1) age between 5 and 15 years, (2) permanent residence in Ampefy, (3) written informed consent from parents or legal guardians, and (4) provision of a stool sample. Exclusion criteria included: absence of consent, non-permanent residence, or absence of a stool sample for analysis.

Parasitological positivity was defined as the detection of helminth eggs by microscopic examination or the presence of adult worms visible macroscopically, following standard parasitological procedures (7).

The main parameter analysed was the presence of helminth eggs. Additional variables included sociodemographic factors (age, sex, residence, school level, maternal education, and source of drinking water), clinical features (abdominal pain, diarrhoea, vomiting), nutritional status (BMI, Z-score for children ≤120 cm), hygiene practices (latrine use, handwashing frequency and soap use), and parental knowledge and preventive practices regarding intestinal parasitic infections.

Nutritional status was assessed using Z-scores based on the WHO Child Growth Standards (8). These standards provide age- and sex-specific reference medians and standard deviations, allowing the calculation of a child's deviation from the healthy reference population in standard deviation units (Z-scores) for indicators such as height-for-age and weight-for-height

Data collection

After obtaining authorization from the Faculty of Medicine of the University of Antananarivo, the mayor of the commune, and the heads of the *fokontany*, community sensitization was carried out through local agents. Sociodemographic and clinical data were collected using structured questionnaires administered to parents or guardians, and anthropometric measurements (weight, height) were taken for all participating children.

Stool samples (one per child) were collected in clean, coded containers distributed the day before sampling. The samples were transported in a cool box with ice packs within five hours and stored at –20°C at the Madagascar Institute for Vaccine Research, University of Antananarivo, until parasitological examination.

Parasitological examination

Macroscopic examination assessed stool consistency, colour, appearance, and the presence of adult worms. Direct microscopic examination was performed on fresh samples by placing a small amount of stool on a slide with a drop of physiological saline water and Lugol's iodine, covered with a coverslip, and examined under ×10 and ×40 objectives (9). In addition, all samples were processed using the ether-formalin concentration technique to enhance parasite detection.Only one stool sample per child was examined, which may lead to an underestimation of the true prevalence due to day-to-day variation in egg shedding

Statistical analysis

Data were entered and processed using Microsoft Excel 2013 and analysed with SPSS Statistics version 21 (IBM Corp., Armonk, NY, USA). Descriptive statistics such as frequencies, means, and standard deviations were calculated. Associations between variables were assessed using the Chi-square test or Student's *t*-test, as appropriate. A *p*-value of <0.05 was considered statistically significant, with a 95% confidence interval. This study followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational studies (10).

Ethical considerations

Authorization for this study was obtained from the Mayor of the rural commune of Ampefy.

Written informed consent in Malagasy was obtained from parents or legal guardians after providing detailed information about the study objectives and potential benefits. Anonymity and confidentiality were ensured through coded identification forms. All children who tested positive for intestinal helminths received appropriate treatment-Albendazole or Praziquantel, depending on the identified parasite species.

RESULTS

A total of 107 children out of 110 assessed were included in the study. The overall prevalence of intestinal helminth infections was 40.2% (n = 43/107).

The distribution by fokontany showed significant disparities: Avaratriniavo recorded the highest prevalence (54%, n = 27/50), followed by Avarabohitra (43%, n = 13/30) and Manjakasoa (11.11%, n = 3/27) (Table 1). A Chi-square test confirmed that these differences were statistically significant ($\chi^2 = 13.59$; $p = 0.001$) (Table 1).

The identified helminth species were *Schistosoma mansoni* (24.30%), *Ascaris lumbricoides* (17.76%), and *Trichuris trichiura* (3.74%). Polyparasitism, mainly the *Ascaris–Schistosoma* association, was observed in 6.53% of cases.

The percentage for each helminth species was calculated based on the total number of children included in the study (n=107).

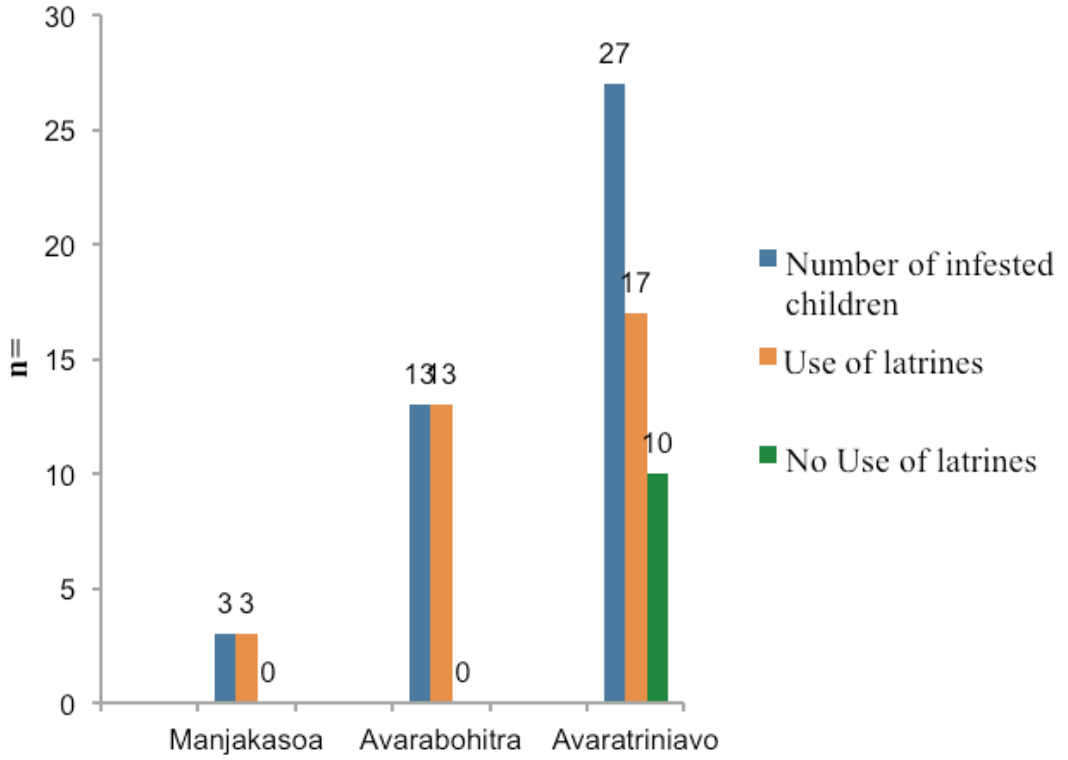

Figure 2 : Frequency of latrine use by place of residence among infected children in Ampefy, 2022

Table 1. Prevalence of intestinal helminth infections among children by *fokontany (residence)*

Village	Children Examined	Positive cases (n = 43)	Negative cases (n = 64)	Prevalence (%)	*p -value*
Avaratriniavo	50	27	23	54.0	0.001
Avarabohitra	30	13	17	43.0	
Manjakasoa	27	3	24	11.1	

Sociodemographic characteristics

Among the infected children (n = 43), boys were significantly more affected than girls (n = 25; 58%, $p = 0.048$). The mean age of infected children was 9.10 ± 3.13 years. The peak prevalence was observed at 5 years of age, where 28 out of the 34 children (81.82%) in that age group were infected (p=0.030). No significant difference was observed in the distribution of helminth species across age groups.

The prevalence varied by school attendance level: 32.6% (n = 14) among non-schooled children, 55.8% (n = 24) in primary school, and 11.6% (n = 5) in secondary school ($p = 0.035$). The mother's educational level (n = 23; 53.5% with primary education) showed no significant association with the children's infection status ($p = 0.617$) (Table 3).

Risk factors

The associations between intestinal helminth infection and various risk factors were explored using univariate analyses. The results of these tests are presented in Table 3.

The absence of latrines in 23% of households (n = 10) was significantly associated with a higher prevalence of intestinal helminth infections ($p = 0.043$) (Figure 2, Table 3). Use of unsafe water sources, primarily *loharano* spring water (n = 29; 67.4%) and wells (n = 14; 32.6%), was strongly correlated with infection ($p = 0.002$).

In contrast, the frequency of handwashing (n = 38; 88.4% washed hands <5 times/day) and use of soap (n = 26; 60%) were not significantly associated with infection (Table 3).

Table 2. Proportion of helminth infections by children's age group and parasite species.

Age group (years)	Number of infected children	*Schistosoma mansoni*	*Trichuris trichiura*	*Ascaris lumbricoides*
5–9	28	17 (60.7%)	4 (14.3%)	14 (50.0%)
10–15	15	8 (53.3%)	1 (6.7%)	7 (46.6%)

Table 3: Sociodemographic, clinical, and Hygienic factors associated with intestinal helminths infections among children in Ampefy

Characteristics	Category	Infected children (n = 43)	Percentage (%)	*p*-value
Gender	Male	25	58.2	0.048
	Female	18	41.8	
Age group (years)	5–9	28	65.1	0.030
	10–15	15	34.9	
Children's school level	Not enrolled	14	32.6	0.035
	Primary	24	55.8	
	Secondary	5	11.6	
Mother's education level	Not enrolled	2	4.7	0.617
	Primary	23	53.5	
	Secondary	18	41.8	
Abdominal symptoms	Absent	9	20.9	0.044
	Present < 3 months	31	72.1	
	Present > 3 months	3	7.0	
Drinking water source	Well	14	32.6	0.002
	River	29	67.4	
Handwashing frequency	<5 times/day	38	88.4	0.924
	>5 times/day	5	11.6	
Use of soap	No	17	40.0	0.894
	Yes	26	60.0	
Last antiparasitic treatment	<6 months	12	27.9	0.205
	>6 months	31	72.1	

Clinical and nutritional characteristics

Nutritional assessment of infected children (n=34 with available data) using Z-scores revealed that 4.17% (n=1) had very severe malnutrition (VSM), 16.67% (n=4) had moderate acute malnutrition (MAM), and 12.50% (n=3) had recently exited the PECMA program. Using the median Z-score as a reference, 20.83% (n=5) of children had a score below or equal to the median, while 45.83% (n=11) had a score above it. No cases of severe acute malnutrition (SAM) were recorded. Regarding body mass index (BMI)-for-age, 17.6% (n=6) of infected children had a BMI below the 3rd percentile, suggesting probable stunting and underweight, whereas 82.4% (n=28) were above this threshold. BMI data were unavailable for 9 children (Table 4)

Table 4 : Nutritional status of infected children based on Z –score and BMI for ages

Variables	Category	n	%
Z-score (nutritional status)	Very severe malnutrition (VSM)	1	4.17
	Severe acute malnutrition (SAM)	0	0
	Moderate acute malnutrition (MAM)	4	16.67
	Recently exited PECMA program	3	12.50
	≤ Median Z-score	5	20.83
	> Median Z-score	11	45.83
	Not assessed	19	–
Body Mass Index (BMI)-for-age	< 3rd percentile	6	17.6
	≥ 3rd percentile	28	82.4
	Not assessed	9	–

*** Z-score based on WHO growth charts**

**** PECMA = Program for the Management of Acute Malnutrition**

DISCUSSION

This study represents the first epidemiological assessment of intestinal helminthiasis among children aged 5 to 15 years in the rural commune of Ampefy, an endemic area of Madagascar characterized by a lacustrine environment conducive to transmission. With an overall prevalence of 40.19%, our findings highlight the persistent endemicity of these infections, in line with the WHO intervention thresholds (prevalence >20% for periodic deworming) (3). This prevalence is consistent with recent studies in Madagascar, such as in the Ambatoboeny district in 2024, reporting 61.5% intestinal parasitic infections in children, including 15.2% caused by helminths, or in the northern region of the island with 71% overall prevalence and 27% for pathogenic helminths (12). These results indicate stagnation despite mass drug administration (MDA) programs, potentially due to reinfections linked to persistent environmental factors.

Compared to other developing countries, the prevalence in Ampefy aligns with sub-Saharan African trends, where overall geohelminth prevalence declined from 44% in 2000 to 13% in 2018, yet with high local variability. For example, Ethiopia reported 32.7% prevalence of helminthiasis in 2021, while in Tanzania in 2022, prevalence ranged from 0.7% to 20% depending on the district. In West Africa, combined prevalence of schistosomiasis and STH reaches 15.6% and 2.5%, respectively(13,14).

These comparisons underscore the uniqueness of Ampefy, where *Schistosoma mansoni* predominates (24.3%), surpassing *Ascaris lumbricoides* (17.76%) and *Trichuris trichiura* (3.74%). This contrasts with many African studies where *Ascaris* is dominant (23.6% in Ethiopia (15), 43.5% in Kenya (16)). The high proportion of schistosomiasis is explained by the proximity to Lake Itasy, favoring transmission, as observed in other African settings (11). Polyparasitism (6.53%, mainly *Ascaris–Schistosoma*) indicates multiple exposures, consistent with concurrent or staggered oro-fecal contaminations (20), and resembles higher co-infection rates in Africa (54.7% in Cameroon). These findings emphasize the need for combined treatment strategies (praziquantel–albendazole).Regarding sociodemographic factors, male predominance (58%, p=0.048) aligns with literature (35.5% in Ethiopia (18), 17.1% in Italy (19)), likely due to riskier behavior. The infection peak at age 5 (81.82%, p=0.030) contrasts with maxima at

10–15 years elsewhere, highlighting preschool children as a vulnerable group in Ampefy, exposed through outdoor play and lack of schooling. Prevalence decreased with educational level (p=0.035), demonstrating the protective effect of education (21,22), with 32.6% among unschooled versus 11.6% at secondary level. Identified risk factors such as absence of latrines (p=0.043) and use of unsafe drinking water (p=0.002) confirm established correlations (73.5% without latrines in India (23); untreated water in Central Africa (24)). Local disparities by fokontany (54% in Avaratriniavo with low latrine usage) underline the importance of geographic-targeted interventions. Handwashing frequency was not significant, suggesting that contaminated water may be the predominant factor.

However, it should be noted that our risk factor analysis relied solely on univariate tests. While significant associations were found, multivariate analysis would be needed to control for potential confounding factors such as age, residence, and water source, and to identify independent risk factors.

Clinically, 72.09% of infected children presented recent (<3 months) abdominal symptoms (p=0.044), indicating high morbidity compared with predominantly asymptomatic infections elsewhere. Malnutrition (17.65%) aligns with known parasite–nutrition associations (10% in Peru (25), 18.9% in Kenya (26)), supporting the value of nutritional assessment to prioritize interventions.

The lack of significant association with recent antiparasitic treatment (p=0.205) suggests reinfection, particularly from untreated adults (26), reinforcing the need to extend community-wide MDA programs.

This study fills an epidemiological gap in Ampefy, demonstrating high prevalence despite national efforts, and provides actionable data for targeted interventions, contributing to the literature on neglected tropical diseases in rural Madagascar.

Limitations

Several limitations should be noted. Selection bias arises from limiting the sample to three villages, reducing generalizability to all of Madagascar. Information bias may have led to underestimation of prevalence due to parental reporting inaccuracies (fear or embarrassment) and limited parasitological examinations (single direct smear and sedimentation, without specific techniques such as Baermann or Graham sticky tape test). Confounding bias is possible, as abdominal symptoms could be attributable to other pathologies. Missing anthropometric data limited the completeness of nutritional assessment. Furthermore, the study did not assess specific high-risk behaviors such as freshwater bathing, which is a major risk factor for schistosomiasis transmission through the transcutaneous penetration of cercariae. This limitation may have underestimated the association between exposure to contaminated water and Schistosoma mansoni infection.

Future Perspectives

These findings open avenues for future research, including longitudinal studies to assess the impact of interventions such as mass drug administration (MDA) and sanitation improvements, as well as multidisciplinary approaches integrating education and access to safe water. Expanding studies to other endemic communes, using advanced diagnostic methods (e.g., PCR for subclinical detection), could refine national strategies. Policy-wise, promoting public–private partnerships for hygiene infrastructure and targeting adults as potential reservoirs of reinfection could strengthen control efforts.

CONCLUSION

In conclusion, this descriptive prospective study revealed a crude prevalence of 40.2% of intestinal helminthiasis among children aged 5–15 years in Ampefy, with a predominance of *Schistosoma mansoni*. Significant associations were observed with male gender, preschool age, low educational level, absence of latrines, and use of unsafe drinking water. Clinically, high rates of abdominal morbidity and nutritional impact highlight the consequences on child health. As the first data from this endemic area, these results confirm the persistence of neglected tropical diseases (NTDs) in Madagascar despite MDA programs and call for strengthened multisectoral interventions: improved sanitation, universal access to safe water, health education targeting unschooled children and communities, and expansion of deworming to adults to break cycles of reinfection. Ultimately, these measures could reduce the health burden, promote child growth, and contribute to sustainable socio-economic development, aligning with WHO targets for helminthiasis elimination by 2030.

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Author Contributions

Study conception: NJZ, NR; Data collection: AR; Analysis and interpretation: AR, NJZ; Manuscript writing: NJZ; Critical revision: All authors. All authors approved the final version and take responsibility for the content.

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Conflicts of Interest

The authors declare no financial or personal conflicts of interest.

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