



## Evaluation of a Mass Deworming Program Achieving Zero Prevalence of Soil-Transmitted Helminth Infections among Primary School Children in Flood-Prone Areas

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### ABSTRACT

**Background:** Soil-Transmitted Helminth (STH) infections remain a significant public health problem in tropical regions, particularly in areas with poor sanitation and susceptibility to flooding. Evaluating STH control programs is essential to measure the effectiveness of interventions.

**Objective:** To evaluate the effectiveness of the mass deworming program in reducing STH prevalence among primary school children in flood-prone areas.

**Methods:** An analytical observational cross-sectional study was conducted in Umatoos Village, Malaka District, from September to October 2025. The sample consisted of 194 primary school students (from SDK Umatoos, SDI Beilout, and SDK Loomota) selected from a population of 311 students. Stool samples were examined microscopically using the 2% Lugol method to detect STH infections. Risk factor data were collected using a structured questionnaire. Descriptive data analysis was performed using SPSS version 25.

**Results:** None of the 194 stool samples examined tested positive for STH, resulting in a prevalence of 0%. A total of 85.6% of respondents reported taking deworming medication regularly every six months. Hygienic behavior indicators showed that 91.2% washed their hands before meals, 95.4% washed their hands after defecation, 73.7% trimmed their nails regularly, and 87.1% consistently wore footwear. Environmental sanitation conditions were relatively good, with 93.3% of households having latrines and 93.8% using piped water or well water.

**Conclusion:** The mass deworming program implemented consistently since 2016, combined with good personal hygiene practices and adequate environmental sanitation, successfully achieved zero STH prevalence among primary school children in flood-prone areas. These findings support a comprehensive approach integrating medical interventions and behavioral changes in controlling neglected tropical diseases.

**KEYWORDS:** Soil-Transmitted Helminths, mass deworming program, zero prevalence, flood-prone areas, primary school children.

### INTRODUCTION

Soil-transmitted helminth (STH) infections, primarily caused by *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms, remain a major public health concern in tropical and subtropical regions.<sup>1</sup> The World Health Organization estimates that more than 1.5 billion people worldwide are infected with STH, with school-aged children representing the most vulnerable population due to frequent exposure to contaminated soil and suboptimal hygiene practices.<sup>2</sup> Chronic STH infection in children is associated with anemia, growth retardation, impaired cognitive development, and reduced educational performance.<sup>3</sup>

Flood-prone areas pose a particular challenge for STH control. Periodic flooding alters soil structure, increases moisture retention, and facilitates the survival and dispersion of helminth eggs, thereby enhancing transmission risk<sup>4</sup>. Several studies have demonstrated that STH eggs can persist longer in waterlogged or muddy soil environments following floods, increasing the likelihood of reinfection even in areas with ongoing control programs.<sup>5</sup> Consequently, populations living in flood-prone settings often require more intensive and sustained interventions.

Mass deworming through preventive chemotherapy using albendazole or mebendazole has been the cornerstone of global STH control strategies.<sup>6</sup> While this approach has proven effective in reducing infection intensity and prevalence, its long-term success depends heavily on treatment coverage, adherence, environmental sanitation, and hygiene behavior.<sup>7</sup> Recent evidence emphasizes that mass drug administration alone may be insufficient to achieve elimination unless combined with improvements in water, sanitation, and hygiene (WASH) practices.<sup>8</sup>

In Indonesia, STH prevalence remains heterogeneous, with higher burdens reported in rural and environmentally vulnerable regions, particularly in areas with inadequate sanitation and limited access to clean water, as documented in national surveillance reports.<sup>3,9</sup> However, evidence documenting the achievement of zero STH prevalence, particularly in flood-prone areas, is scarce. Evaluating long-term deworming programs in such high-risk settings is therefore essential to assess program effectiveness and inform sustainable elimination strategies.

Therefore, this study aimed to evaluate the effectiveness of a long-term mass deworming program in achieving zero prevalence of soil-transmitted helminth infections among primary school children living in a flood-prone area of Umatoos Village, Malaka District, Indonesia.

**METHODS**

An analytical observational cross-sectional study was conducted from September to October 2025 in Umatoos Village, West Malaka Subdistrict, Malaka District, East Nusa Tenggara Province, Indonesia, an area classified as flood-prone due to its low elevation and seasonal flooding.

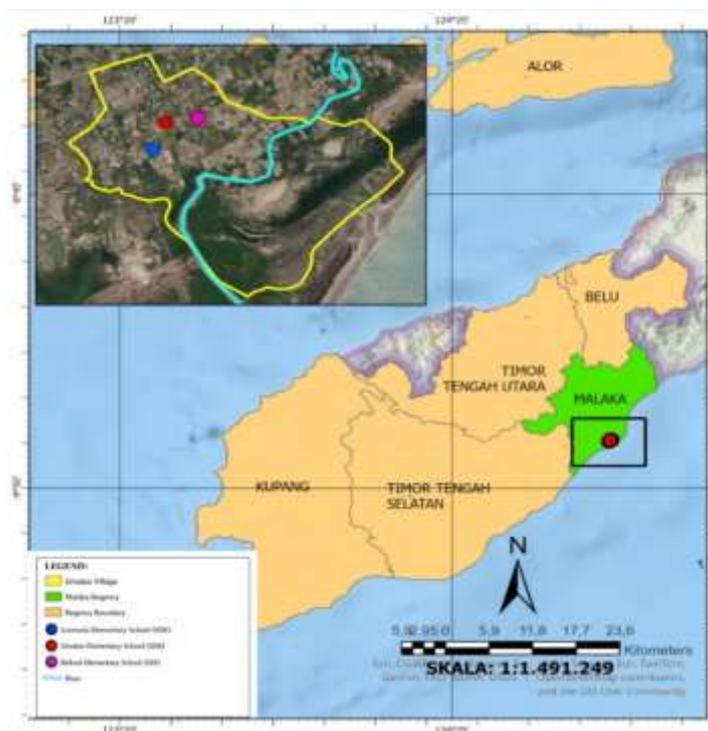


Figure 1. Geographical location of the study area in Umatoos Village, Malaka District, East Nusa Tenggara Province, Indonesia, including the distribution of the selected primary schools and major water bodies.



The study population consisted of all primary school children enrolled in three schools in the village, namely SDK Umatoos, SDI Beilout, and SDK Loomota. From a total population of 311 students, a minimum sample size of 175 participants was calculated, and after accounting for a potential 10% non-response rate, the target sample was increased to 193. A total of 194 children were successfully recruited and included in the analysis.

Eligible participants were children aged 6–12 years who were registered as primary school students, present during the study period, whose parents or guardians provided written informed consent, and whose stool samples were collected within six hours after defecation. Children with incomplete questionnaire data or stool samples contaminated with urine were excluded from the study.

Data collection involved two main components. Hygiene behaviors, sanitation conditions, dietary practices, and adherence to the mass deworming program were assessed using a structured questionnaire completed by parents or guardians. Stool samples were collected in sterile containers and examined microscopically using a direct smear technique with 2% Lugol solution to detect eggs of *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms. All laboratory examinations were performed at the West Malaka Primary Health Center.

The primary outcome variable was the prevalence of soil-transmitted helminth infection. Independent variables included personal hygiene practices, environmental sanitation characteristics, dietary habits, and participation in the mass deworming program. Data were analyzed descriptively using SPSS version 25, with categorical variables presented as frequencies and percentages. Inferential statistical analysis was not conducted because no positive cases of soil-transmitted helminth infection were identified.

Ethical approval for the study was obtained from the Health Research Ethics Committee of the Faculty of Public Health, Nusa Cendana University (No. 004614/KEPK FKM UNDANA/2025). Written informed consent was obtained from parents or guardians prior to participation.

## RESULTS

A total of 194 elementary school children from three schools in Umatoos Village, Malaka Regency, were included in the final analysis. The sociodemographic characteristics of the respondents are presented in Table 1.

**Table 1. Sociodemographic Characteristics of Respondents (n = 194)**

Characteristic	n	%
<b>Age (years)</b>		
6–7	67	34.5
8–9	75	38.7
10–11	42	21.6
12	10	5.2
<b>Sex</b>		
Male	108	55.7
Female	86	44.3
<b>School</b>		
SDK Umatoos	97	50.0
SDI Beilout	37	19.1
SDK Loomota	60	30.9

Microscopic examination of all stool samples revealed negative results for *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm eggs. Accordingly, the prevalence of soil-transmitted helminth infection in the study population was 0%.

Personal hygiene practices, compliance with mass deworming, household environmental sanitation, and soil-transmitted helminth infection status are summarized in Table 2. As all respondents tested negative for soil-transmitted helminth infection, there was no variation in the outcome variable; therefore, bivariate and multivariate analyses were not performed.



**Table 2. Soil-Transmitted Helminth Infection Status, Personal Hygiene, Deworming Compliance, and Environmental Sanitation (n = 194)**

Variable	n	%
<b>Soil-transmitted helminth infection status</b>		
Positive	0	0.0
Negative	194	100.0
<b>Handwashing before meals</b>		
Yes	177	91.2
No	17	8.8
<b>Handwashing after defecation</b>		
Yes	185	95.4
No	9	4.6
<b>Regular nail trimming</b>		
Yes	143	73.7
No	51	26.3
<b>Use of footwear outdoors</b>		
Yes	169	87.1
No	25	12.9
<b>Deworming medication every 6 months</b>		
Yes	166	85.6
No	28	14.4
<b>Household latrine ownership</b>		
Yes	181	93.3
No	13	6.7
<b>Access to improved clean water source</b>		
Yes	182	93.8
No	12	6.2
<b>Permanent household flooring</b>		
Yes	178	91.8
No	16	8.2

Handwashing before meals was reported by 177 children (91.2%), while 17 children (8.8%) did not report this practice. Handwashing after defecation was reported by 185 children (95.4%), whereas 9 children (4.6%) did not report performing this practice. Regular nail trimming was reported by 143 children (73.7%), while 51 children (26.3%) did not report routine nail trimming.

The use of footwear during outdoor activities was reported by 169 children (87.1%), whereas 25 children (12.9%) did not consistently use footwear. Compliance with mass deworming medication administered every six months was reported by 166 children (85.6%), while 28 children (14.4%) did not report regular consumption.

Regarding environmental sanitation, household latrine ownership was reported by 181 respondents (93.3%), while 13 respondents (6.7%) did not have a latrine. Access to an improved clean water source was reported by 182 households (93.8%), whereas 12



households (6.2%) did not report such access. Permanent household flooring was reported in 178 households (91.8%), while 16 households (8.2%) had non-permanent flooring.

## DISCUSSION

This study demonstrated a zero prevalence of soil-transmitted helminth (STH) infection among primary school children in Umatoos Village, a flood-prone area in Malaka District. This finding is noteworthy given that STH transmission is commonly associated with tropical environments characterized by high humidity, poor sanitation, and periodic flooding, which facilitate the survival and dissemination of helminth eggs in the soil.<sup>1,2</sup> In flood-prone settings, waterlogging and soil disturbance have been reported to prolong the viability of *Ascaris lumbricoides* and *Trichuris trichiura* eggs, thereby increasing the risk of reinfection<sup>5,6</sup>. Similar environmental risks have also been documented in other flood-prone regions, where altered soil and water physicochemical conditions were associated with an increased potential for helminth transmission.<sup>14</sup> The absence of detectable infection in this context therefore suggests a marked suppression of local transmission.

The observed zero prevalence is likely attributable to the long-term implementation of a mass deworming program that has been conducted consistently since 2016. Preventive chemotherapy using single-dose albendazole remains the primary strategy recommended by the World Health Organization for controlling STH infection among school-aged children.<sup>2,11</sup> Albendazole disrupts helminth energy metabolism through inhibition of tubulin polymerization, resulting in parasite death and reduced environmental egg contamination.<sup>8,11</sup> High reported adherence to six-monthly deworming in the study population likely contributed to repeated clearance of infection reservoirs and sustained interruption of the transmission cycle.

Beyond pharmacological intervention, personal hygiene behaviors and environmental sanitation conditions appear to have played an important complementary role. Most respondents reported regular handwashing before meals and after defecation, consistent use of footwear, and access to household latrines and improved water sources. Previous studies have shown that adequate hygiene practices and sanitation significantly reduce STH transmission by limiting fecal–oral exposure and soil contamination.<sup>4,13</sup> The combined effect of preventive chemotherapy and relatively favorable water, sanitation, and hygiene (WASH) conditions is consistent with evidence indicating that integrated approaches are more effective than mass deworming alone in sustaining low STH prevalence.<sup>8,12</sup>

Interpretation of zero prevalence should nevertheless consider diagnostic constraints. Stool examination using direct smear with Lugol solution is practical and widely applied in primary health-care settings but has reduced sensitivity for detecting light-intensity infections compared with other microscopic techniques.<sup>6,10</sup> As transmission declines, infections tend to be of lower intensity, increasing the likelihood of false-negative results. Accordingly, while the findings strongly indicate effective control, the presence of very low-level infections cannot be entirely excluded.

Behavioral heterogeneity within the study population also merits attention. Despite generally favorable hygiene profiles, a proportion of children reported behaviors such as nail biting, thumb or finger sucking, and frequent contact with soil. These behaviors have been identified as risk factors for STH transmission and may predispose certain individuals to reinfection, even in settings with ongoing deworming programs.<sup>7,9</sup> Continued health education and behavior change interventions are therefore essential to sustain elimination gains, particularly in flood-prone environments where environmental exposure persists.

From an analytical perspective, the absence of any positive STH cases resulted in a lack of outcome variability, precluding bivariate or multivariable statistical analysis. This represents a recognized statistical condition in elimination or near-elimination studies and does not indicate a methodological weakness. Cross-sectional surveys remain an appropriate and recommended approach for assessing point prevalence and evaluating program impact in STH control settings.<sup>2,9</sup> In this context, zero prevalence should be interpreted as a programmatic outcome rather than an epidemiological association measure. Overall, these findings provide evidence that sustained mass deworming, supported by adequate hygiene practices and environmental sanitation, can effectively suppress STH transmission even in ecologically high-risk, flood-prone areas. Continued monitoring, periodic reassessment, and reinforcement of integrated deworming and WASH strategies are essential to maintain these gains and prevent recrudescence.<sup>1,2,8</sup>

## CONCLUSION

This study demonstrates that a long-term mass deworming program implemented consistently since 2016 was associated with the achievement of zero prevalence of soil-transmitted helminth infection among primary school children living in a flood-



prone area of Malaka District. The findings indicate that sustained preventive chemotherapy, when supported by adequate personal hygiene practices and environmental sanitation, can effectively suppress STH transmission even in ecologically high-risk settings. Maintaining regular deworming coverage, strengthening hygiene education, and ensuring continuous access to sanitation facilities are essential to sustain these gains and prevent reinfection. Continued surveillance remains necessary to confirm long-term transmission suppression and support progress toward sustainable elimination of soil-transmitted helminth infections.

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