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PREVALENCE AND FACTORS ASSOCIATED WITH HELMINTH INFECTION AFTER DEWORMING AMONG CHILDREN AGED 2-10 YEARS IN KASHKADARYA REGION, UZBEKISTAN

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Abstract. Background: Helminth infections remain an important public health problem among children, especially in settings where deworming is not fully supported by hygiene education, household-level prevention, and follow-up laboratory screening. Evidence on infection after deworming among young children in Uzbekistan remains limited.

Objective: This study aimed to estimate the prevalence of laboratory-confirmed helminth infection and identify factors associated with infection after deworming among children aged 2-10 years in Kashkadarya Region, Uzbekistan.

Methods: An analytical cross-sectional study was conducted among 195 children aged 2-10 years who had received deworming within the previous six months. Laboratory assessment included stool examination and perianal scraping. Parents or guardians completed a structured questionnaire on socio-demographic characteristics, treatment history, hygiene practices, household environment, animal contact, and knowledge, attitudes, and practices. Prevalence ratios (PRs) with 95% confidence intervals (CIs) were calculated. Multivariable Poisson regression with robust standard errors was used to estimate adjusted prevalence ratios (aPRs).

Results: Helminth infection was detected in 32 of 195 children, corresponding to an overall prevalence of 16.4% (95% CI: 11.5-22.4). Enterobiasis accounted for 75% of positive cases, hymenolepiasis for 22%, and ascariasis for 3%. Higher prevalence was observed among children aged 6-7 years (22.6%), girls (21.3%), and children living in rural areas (21.5%). In univariable analysis, irregular handwashing before meals, nail-biting, regular contact with cats, and parental belief that reinfection is impossible were associated with infection. In multivariable analysis, parental belief that reinfection is impossible remained independently associated with infection (aPR = 3.21; 95% CI: 1.21-8.43; p = 0.017).

Conclusion: Helminth infection was common among children after deworming in Kashkadarya Region. The findings suggest that deworming alone is insufficient without continued hygiene practices, correction of parental misconceptions, household-level prevention, and active follow-up screening.

Keywords: helminth infection; enterobiasis; deworming; children; prevalence; risk factors; Kashkadarya; Uzbekistan

Introduction. Helminth infections remain among the most common parasitic diseases affecting children worldwide. These infections are associated with chronic morbidity and may contribute to anemia, impaired growth, reduced physical activity, and decreased cognitive and educational performance. Children are particularly vulnerable because of frequent hand-to-mouth behavior, close contact with peers, and dependence on household and institutional hygiene conditions.

Preventive chemotherapy and periodic deworming are widely used strategies for controlling helminth infections in children. However, the effect of deworming may be limited when treatment is not accompanied by improved hygiene practices, health education, environmental sanitation, and timely diagnostic follow-up. Persistent or newly acquired infection after treatment may therefore indicate ongoing transmission in the household or community environment.

In Uzbekistan, parasitic infections such as enterobiasis, hymenolepiasis, and ascariasis remain relevant for public health. Kashkadarya Region includes both urban and rural populations, and many communities have household-level risk factors such as animal contact, variable access to sanitation, and differences in hygiene practices. Although routine medical statistics provide useful information, passive reporting may underestimate the true burden of infection because many children may have mild symptoms or may not seek medical care.

The present study focused on children aged 2-10 years who had received deworming within the previous six months. The study aimed to estimate the prevalence of laboratory-confirmed helminth infection in this group and to identify behavioral, household, and parental factors associated with infection after deworming.

Materials and Methods

Study design and setting

An analytical cross-sectional study was conducted in Kashkadarya Region, Uzbekistan, during 2024-2025. The study assessed the prevalence of helminth infection among children after deworming and analyzed factors associated with infection. The design provided a snapshot of the current infection status and allowed estimation of associations between exposure variables and laboratory-confirmed infection.

Study population and sample size

The study population included children aged 2-10 years who lived in Kashkadarya Region and had received deworming within the previous six months. The planned sample size was 200 children. A total of 195 children were included in the final analysis; five children were excluded because parents or guardians refused participation. The participation rate was 97.5%.

Sample size was calculated using OpenEpi version 3 for estimation of prevalence in a population. The calculation assumed a population size of 16,000, expected prevalence of 15%, 5% margin of error, design effect of 1, and 95% confidence level. The minimum required sample size was 194 participants; therefore, the final sample of 195 children met the minimum

requirement.

Eligibility criteria

Children were included if they were aged 2-10 years, lived in Kashkadarya Region, had received deworming within the previous six months, and had written informed consent from a parent or legal guardian. Children were excluded if consent was not provided, laboratory data were incomplete, or the family refused participation.

Laboratory assessment

Laboratory-confirmed helminth infection was defined as detection of Enterobius vermicularis, Hymenolepis nana, or Ascaris lumbricoides by the diagnostic methods used in the study. Stool examination was used to detect intestinal helminths, while perianal scraping was used for diagnosis of enterobiasis. The primary outcome was the presence of laboratory-confirmed helminth infection after deworming.

Questionnaire and variables

Parents or guardians completed a structured questionnaire. The questionnaire covered socio-demographic characteristics, residence, household conditions, water sources, hygiene practices, animal contact, treatment history, simultaneous treatment of family members, symptoms after treatment, and parental knowledge, attitudes, and practices related to helminth infections.

Statistical analysis

Categorical variables were summarized as frequencies and percentages. Prevalence was calculated with 95% confidence intervals. Associations between potential risk factors and infection were assessed using prevalence ratios and 95% confidence intervals. Chi-square or Fisher exact tests were applied where appropriate. Because the outcome prevalence was 16.4%, prevalence ratios were preferred to odds ratios to avoid overestimation of effect size. Multivariable analysis was performed using Poisson regression with robust standard errors, producing adjusted prevalence ratios. The model included key significant variables from univariable analysis and relevant potential confounders such as age, sex, and place of residence.

Results. A total of 195 children aged 2-10 years were included. Of these, 106 (54.4%) were boys and 89 (45.6%) were girls. Rural residents accounted for 93 children (47.7%), while 51 children (26.2%) lived in urban areas and 51 (26.2%) lived in district centers. The most represented age group was 2-3 years, followed by 4-5 and 6-7 years.

Table 1. Socio-demographic characteristics of study participants (n = 195)

Characteristic	Total, n = 195	Infected, n = 32 (16.4%)	Non-infected, n = 163 (83.6%)	PR	95% CI	p-value
Gender						
Male	106	13 (12.3%)	93 (87.7%)	(ref.)	—	—
Female	89	19 (21.3%)	70 (78.7%)	1.74	0.91–3.32	0.120
Age groups						
2–3 years	67	12 (17.9%)	55 (82.1%)	(ref.)	—	—
4–5 years	56	5 (8.9%)	51 (91.1%)	0.50	0.19–1.33	0.193

6–7 years	53	12 (22.6%)	41 (77.4%)	1.26	0.62–2.58	0.647
8–9 years	17	2 (11.8%)	15 (88.2%)	0.66	0.16–2.66	0.725
Place of residence						
Urban area	51	5 (9.8%)	46 (90.2%)	(ref.)	—	—
District center	51	7 (13.7%)	44 (86.3%)	1.40	0.48–4.12	0.760
Rural area	93	20 (21.5%)	73 (78.5%)	2.19	0.88–5.50	0.107
Type of housing						
Private house	175	31 (17.7%)	144 (82.3%)	(ref.)	—	—
Apartment	20	1 (5.0%)	19 (95.0%)	0.28	0.04–1.96	0.207
Mother's education						
Higher education	50	11 (22.0%)	39 (78.0%)	(ref.)	—	—
Primary education	38	6 (15.8%)	32 (84.2%)	0.72	0.29–1.77	0.589
Secondary education	107	15 (14.0%)	92 (86.0%)	0.64	0.32–1.29	0.251
Number of children aged 2–10 years in the household						
1 child	75	12 (16.0%)	63 (84.0%)	(ref.)	—	—
2 children	100	17 (17.0%)	83 (83.0%)	1.06	0.54–2.09	1.000
3 children	16	3 (18.8%)	13 (81.2%)	1.17	0.37–3.68	0.723
4 or more children	4	0 (0.0%)	4 (100%)	—	—	—

The highest prevalence was observed in children aged 6-7 years (22.6%), followed by children aged 2-3 years (17.9%). Girls had higher prevalence than boys (21.3% versus 12.3%). Children living in rural areas had the highest prevalence by residence category (21.5%), compared with 13.7% in district centers and 9.8% in urban areas.

Prevalence of helminth infection

Laboratory-confirmed helminth infection was detected in 32 of 195 children. The overall prevalence of infection after deworming was 16.4% (95% CI: 11.5-22.4). Enterobiasis was the dominant infection, accounting for three quarters of all positive cases. Hymenolepiasis accounted for approximately one fifth of positive cases, while ascariasis was detected in only one child. No mixed infections were recorded.

Table 2. Distribution of detected helminth species among positive cases

Species	Number of cases	% of positive cases	Prevalence in total sample, %	95% CI
Enterobius vermicularis	24	75	12.3	8.1-17.8
Hymenolepis nana	7	22	3.6	1.5-7.3
Ascaris lumbricoides	1	3	0.5	0.01-2.8

Total	32	100	16.4	11.5-22.4

Note. Percent of positive cases was calculated using 32 laboratory-confirmed infections as the denominator.

Factors associated with infection after deworming

In univariable analysis, several behavioral and household factors were associated with infection after deworming. The strongest associations were observed for irregular handwashing before meals, parental belief that reinfection is impossible, nail-biting, and regular contact with cats. These findings indicate that persistent risk after deworming is closely related to modifiable hygiene behavior and parental perception of reinfection risk.

Table 4. Key factors associated with helminth infection after deworming: univariable analysis

	Comparison category	Infected, %	PR	95% CI	p-value
Nail-biting	Rarely vs never	1.9	0.09	0.02-0.38	<0.001
Nail-biting	Sometimes vs never	57	2.62	1.47-4.64	0.002
Regular contact with cats	Yes vs no	88	11.5	5.61-23.49	<0.001
Handwashing before meals	Sometimes vs always	42	8.04	3.68-17.55	<0.001
Belief that reinfection is impossible	Agree vs disagree	89	9.83	5.99-16.13	<0.001
Rural residence	Rural vs urban	21.5	2.19	0.88-5.50	0.107
Sex	Girls vs boys	21.3	1.74	0.91-3.32	0.120

Note. PR, prevalence ratio; CI, confidence interval. The table includes selected variables most relevant for interpretation and discussion.

Multivariable analysis

After adjustment, parental belief that reinfection after deworming is impossible remained independently associated with laboratory-confirmed infection. Nail-biting and irregular handwashing before meals showed elevated adjusted prevalence ratios and borderline statistical evidence, suggesting that these variables may be important contributors to infection risk even when other factors are considered.

Table 5. Multivariable Poisson regression analysis of independent factors

Factor	Adjusted PR (aPR)	95% CI	p-value	Interpretation
Parental belief that reinfection is impossible	3.21	1.21-8.43	0.017	Independent risk factor

Nail-biting	3.11	0.95-10.49	0.060	Trend toward association
Irregular handwashing before meals	2.70	0.89-8.21	0.075	Trend toward association

Note. Poisson regression with robust standard errors was used to estimate adjusted prevalence ratios.

Knowledge, attitudes, and practices

The knowledge, attitudes, and practices assessment suggested that infection was not explained by knowledge alone. Rather, practical behaviors and parental attitudes were more closely related to infection status. This finding is important because it indicates that health education should not only provide information but also correct misconceptions and support consistent preventive behavior at home.

Table 6. Interpretation of KAP findings among parents or guardians

KAP component	Main finding	Public health interpretation
Knowledge	No meaningful difference between infected and non-infected groups	Information alone may not be sufficient to prevent infection
Attitudes	Worse attitudes were observed among families of infected children	Misconceptions may reduce preventive behavior after treatment
Practices	Preventive practices were poorer among families of infected children	Hand hygiene and household prevention should be strengthened

Note. This table summarizes the practical interpretation of the KAP analysis for article presentation.

Discussion. This study found that helminth infection remained common among children aged 2-10 years in Kashkadarya Region after deworming. The overall prevalence of 16.4% indicates that a considerable proportion of children had laboratory-confirmed infection within six months after treatment. This finding suggests that deworming alone may not be sufficient to interrupt transmission when environmental and behavioral risk factors persist.

Enterobiasis was the predominant infection, accounting for 75% of positive cases. This result is epidemiologically plausible because Enterobius vermicularis is easily transmitted among young children through contaminated hands, household objects, bedding, and close contact in family or school settings. The absence of mixed infections in the study may reflect the limited sample size and the dominance of enterobiasis in the examined population.

The highest prevalence was observed among children aged 6-7 years. Children at this age may have increased contact with peers in preschool or early school environments, while still requiring supervision for hygiene practices. Higher prevalence among girls and rural children was also observed, although these differences did not reach statistical significance. The rural-urban difference is consistent with the hypothesis that household environment, sanitation, and animal contact may contribute to ongoing exposure.

The most important analytical finding was the independent association between parental

belief that reinfection is impossible and infection after deworming. This misconception may lead parents to underestimate the need for continued hygiene measures after treatment. If families believe that medication provides long-term protection, they may be less likely to maintain preventive behaviors such as regular handwashing, washing bedding, controlling nail-biting, and seeking follow-up testing when symptoms occur.

Irregular handwashing before meals and nail-biting also showed strong associations in univariable analysis and elevated adjusted prevalence ratios in multivariable analysis. These behaviors provide direct mechanisms for fecal-oral transmission and autoinfection, especially for enterobiasis. Therefore, hygiene education should be practical and behavior-oriented rather than limited to general awareness.

Regular contact with cats was strongly associated with infection in univariable analysis, but this finding should be interpreted cautiously because the number of children in this exposure category was small. The association may reflect a broader household hygiene context rather than a direct causal relationship. Further studies with larger samples are needed to clarify the role of animal contact in this setting.

The study has several practical implications. First, deworming programs should be combined with targeted education for parents, emphasizing that reinfection is possible after treatment. Second, prevention messages should focus on daily handwashing with soap, short fingernails, prevention of nail-biting, cleaning of bedding and underwear, and timely laboratory testing when symptoms appear. Third, follow-up screening may be particularly useful in rural areas and among younger school-age children.

Limitations.

This study had several limitations. The cross-sectional design does not allow causal conclusions. The study included only children who had received deworming within the previous six months, so the results cannot be generalized to all children in Kashkadarya Region. Some exposure categories included small numbers of children, producing wide confidence intervals and unstable estimates. Hygiene practices and parental beliefs were self-reported and may be affected by recall bias or social desirability bias. Finally, the study did not include repeated laboratory testing over time, which limits the ability to distinguish between persistent infection and newly acquired infection.

Conclusion. Helminth infection was detected in 16.4% of children aged 2-10 years after deworming in Kashkadarya Region, Uzbekistan. Enterobiasis was the dominant infection. Higher prevalence was observed among children aged 6-7 years, girls, and rural residents. The most important independent factor associated with infection was parental belief that reinfection after deworming is impossible. Irregular handwashing and nail-biting also appeared to contribute to infection risk.

The findings show that deworming should be supported by continuous hygiene education, correction of parental misconceptions, improved household prevention, and targeted follow-up screening. Prevention programs should emphasize that treatment does not provide permanent protection and that reinfection can occur if hygiene and environmental risk factors persist.

Practical recommendations

Parents should be informed that reinfection after deworming is possible and that preventive measures must continue after treatment. Children should wash hands with soap before meals and

after using the toilet. Parents should keep children's nails short, discourage nail-biting, wash underwear and bedding regularly, and seek medical consultation and laboratory testing if symptoms recur. Public health programs should combine deworming with practical hygiene education and follow-up screening among children at increased risk.

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