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Original article

Comparison of *Enterobius vermicularis* Infection Rates among Schoolchildren in Tocra and Al Marj, Libya

Eman EL Frragani*, Amal AL-Mayar, Heba Idris, Reem Faraj, Suha Muftah

Higher Institute of Science and Technology-Tocra, Libya
Corresponding email. Eman6317@gmail.com

Abstract
Enterobius vermicularis infection remains a common intestinal parasitic disease among schoolchildren worldwide, yet it is often underestimated in public health programs. This study investigated the prevalence and distribution of *E. vermicularis* among 131 schoolchildren in Al Marj and Tocar cities, Libya. Data were analyzed by age, gender, and geographic location, and statistical tests were applied to assess associations. The overall prevalence was 69.5%, with 91 children testing positive and 40 negatives. Infection rates were slightly higher among females (57.1%) compared to males (42.9%), though the difference was not statistically significant (p = 0.820). Age distribution showed the highest prevalence among children aged 5–15 years, while those ≥15 years had lower rates, but again without a significant association (p = 0.951). Geographic comparison revealed nearly equal infection rates between Al Marj and Tocar (p = 0.954). These findings confirm that *E. vermicularis* infection is widespread across demographic groups and highlight the need for integrated school-based interventions, including routine screening, hygiene education, and incorporation of pinworm control into broader deworming programs.
Keywords. *Enterobius vermicularis, Enterobiasis*, Schoolchildren, Libya, Prevalence.

Introduction

Enterobiasis, caused by *Enterobius vermicularis* (pinworm), is one of the most common intestinal helminthic infections worldwide, particularly among school-aged children. The parasite has a cosmopolitan distribution and is transmitted primarily through the fecal–oral route, with high prevalence in environments where hygiene practices are limited and close contact is frequent. Although often considered a mild infection, enterobiasis can lead to pruritus ani, irritability, sleep disturbances, and secondary bacterial infections, thereby affecting the quality of life of infected children and their families [1-5].

Globally, enterobiasis remains a neglected parasitic disease despite its high prevalence. A recent meta-analysis reported that infection rates among young children continue to be significant across both developed and developing countries, underscoring its persistent public health importance [5-7]. In Africa and Asia, the burden of intestinal parasitic infections, including *E. vermicularis*, is substantial, with school-aged children being the most vulnerable group [6,7].

In Libya, several studies have confirmed the endemic nature of enterobiasis. Investigations in Sebha revealed infection rates exceeding one-third of schoolchildren [1], while research in El-Marj reported similar findings among children aged 1–7 years [2]. Histopathological studies in Benghazi have also demonstrated the presence of *E. vermicularis* in appendicitis specimens, highlighting its clinical relevance beyond simple intestinal infestation [3]. Comparable results have been reported in neighboring regions such as Palestine, where preschool children showed high infection rates associated with environmental and behavioral risk factors [4].

Despite these findings, enterobiasis continues to be underdiagnosed and underreported in North Africa, partly due to reliance on symptomatic diagnosis rather than laboratory confirmation. The persistence of infection in school settings reflects gaps in health education, hygiene practices, and preventive interventions. Addressing these gaps requires epidemiological studies that not only measure prevalence but also analyze demographic and geographic factors influencing transmission. The present study aims to determine the prevalence of *E. vermicularis* infection among schoolchildren in Al Marj and Tocar cities, Libya, and to examine its relationship with age, gender, and city of residence. By combining descriptive epidemiology with statistical analysis, this work contributes to a clearer understanding of the local burden of enterobiasis and provides evidence to guide school health programs and public health interventions.

Methods

Study Site and Data Collection

The study was conducted in Tocar City and Al Marj City, Libya. A total of 131 samples were collected by visiting district schools. Data collection involved administering structured questionnaires and interviewing randomly selected students.

Study Population

Data were obtained from students of various ages, ranging from 5 to ≥15 years. The study population consisted of 57 males and 74 females, all participating under strict sterile conditions. For analysis, the age groups were categorized into three ranges: 5–10 years, 11–15 years, and 15 years or older.

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Sampling and Stool Sample Analysis

Stool samples were analyzed in two phases. In the visual inspection, each sample was examined macroscopically. The natural color is typically brown with a smooth texture, although variations in color and consistency may occur depending on diet or underlying gastrointestinal conditions, and the presence of mucus was also recorded. In the microscopic examination, slides were prepared by placing two to three drops of distilled water on a glass slide and mixing in a small amount of stool until the suspension became cloudy, ensuring no solid particles remained. A cover slip was then placed on top, and the sample was examined under a microscope using a 10× objective lens, followed by a 40× objective lens, to detect pinworms or their eggs. When eggs were not clearly visible, iodine dye was applied by placing two drops at the edge of the cover slip, allowing the dye to diffuse and stain the eggs for improved visibility.

Ethical Approval

This study was conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. Ethical approval was obtained from the Research Ethics Committee of Higher Institute of Science and Technology-Tocra, Libya, prior to data collection.

Statistical Analysis

Data were analyzed using a descriptive analytical approach, including graphs and frequency tables. The Chi-square test was applied to examine relationships between variables. Statistical analyses were performed using SPSS software, version 27.

Results

The study included 131 schoolchildren from Al Marj and Tocar cities. Of these, 57 were males (43.5%) and 74 were females (56.5%). The age distribution showed that 51 children (38.9%) were between 5 and 10 years, 53 (40.5%) were between 11 and 15 years, and 27 (20.6%) were 15 years or older. By location, 66 children (50.4%) were from Al Marj and 65 (49.6%) were from Tocar. Overall, 91 participants (69.5%) tested positive for *E. vermicularis* infection, while 40 (30.5%) were negative. These findings are summarized in Table 1.

Table 1. E. vermicularis Infection Rates Among Schoolchildren

Category	Subgroup	N	%
Gender	Male	57	43.5
	Female	74	56.5
Age	5–10 years	51	38.9
	11–15 years	53	40.5
	≥15 years	27	20.6
City	Al Marj	66	50.4
	Tocar	65	49.6
Overall prevalence	Negative	40	30.5
	Positive	91	69.5

Table 2 presents the distribution of *E. vermicularis* infection according to age groups where negative cases included 15 cases in the 5–10 years group representing 37.5% 17 cases in the 11–15 years group representing 42.5% and 8 cases in those older than 15 years representing 20.0% while positive cases included 36 cases in the 5–10 years group representing 39.6% 36 cases in the 11–15 years group representing 39.6% and 19 cases in those older than 15 years representing 20.9% these results show a very similar distribution of infection across age groups with a slightly higher proportion among younger age categories however the chi square value of 0.100 with two degrees of freedom and a P value of 0.951 indicates that there is no statistically significant association between age and infection rate.

Table 2. Relationship Between Gender and E. vermicularis Infection Status

Infection Status	Male (N, %)	Female (N, %)	Total (N)	Total (%)
Negative	18 (45.0)	22 (55.0)	40	30.5
Positive	39 (42.9)	52 (57.1)	91	69.5
Total	**57 (43.5)**	**74 (56.5)**	**131**	**100.0**

Statistical analysis: Chi-square = 0.052, degrees of freedom = 1, p-value = 0.820.

Table 3 shows that negative cases of *E. vermicularis* infection included 18 males representing 45.0% and 22 females representing 55.0% while positive cases included 39 males accounting for 42.9% and 52 females accounting for 57.1% these findings indicate a close distribution of infection between genders with a slightly higher number and %age among females however the chi square value of 0.052 with one degree of freedom

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and a P value of 0.820 confirms that there is no statistically significant association between gender and infection rate.

Table 3. Relationship Between Age and E. vermicularis Infection Status with Statistical Analysis

Infection Status	5–10 years (N, %)	11–15 years (N, %)	≥15 years (N, %)	Total (N)	Total (%)
Negative	15 (37.5)	17 (42.5)	8 (20.0)	40	30.5
Positive	36 (39.6)	36 (39.6)	19 (20.9)	91	69.5
Total	**51 (38.9)**	**53 (40.5)**	**27 (20.6)**	**131**	**100.0**

Chi-square test; $x^2 = 0.100$; df = 2; p = 0.951

Table 4 presents the relationship between city of residence and E. vermicularis infection status among schoolchildren. The distribution of negative cases was equal, with 20 children from Al Marj and 20 from Tocar, each representing 50.0 % of the total negatives. Among the positive cases, 46 were from Al Marj (50.5 %) and 45 from Tocar (49.5 %), showing a nearly identical distribution between the two cities. The totals confirm balance in sampling, with 66 children from Al Marj and 65 from Tocar. The Chi-square test result ($x^2 = 0.003$, df = 1, p = 0.954) indicates that there was no statistically significant difference in infection rates between the two cities. This suggests that geographic location within the study area did not influence the prevalence of E. vermicularis infection.

Table 4. Relationship Between City and E. vermicularis Infection Status with Statistical Analysis

Infection Status	Al Marj (N, %)	Tocar (N, %)	Total (N)	Total (%)
Negative	20 (50.0)	20 (50.0)	40	30.5
Positive	46 (50.5)	45 (49.5)	91	69.5
Total	**66 (50.4)**	**65 (49.6)**	**131**	**100.0**

Chi-square test; $x^2 = 0.003$; df = 1; p = 0.954

Discussion

The present study revealed a high prevalence of *Enterobius vermicularis* infection among schoolchildren in Al Marj and Tocar cities, with an overall positivity rate of 69.5%. This figure is notably higher than those reported in several regional and international studies, underscoring the endemic nature of enterobiasis in Libya. For example, Kang et al. in Korea reported lower prevalence rates among rural schoolchildren, suggesting that local environmental and behavioral factors strongly influence transmission dynamics [8]. Similarly, Al-Delaimy et al. in Iraq found gender differences in intestinal parasitic infections, but overall prevalence was lower than that observed in our cohort [9].

Age distribution in our study showed that children between 5 and 15 years were the most affected, which is consistent with the global epidemiological pattern where school-aged children serve as the primary reservoir of infection. This finding parallel results from Egypt, where El-Khaldy et al. documented high infection rates in primary schoolchildren, emphasizing the role of close contact and inadequate hygiene practices in sustaining transmission [10]. The slightly higher prevalence among females in our study, although not statistically significant, mirrors observations from Iraq and Palestine, where female children were marginally more affected, possibly due to differences in exposure patterns or cultural practices [4,9].

Geographic comparison between Al Marj and Tocar revealed nearly identical infection rates, suggesting that transmission dynamics are similar across these urban centers. This finding aligns with Egyptian studies that reported comparable prevalence across different schools, indicating that community-level factors such as sanitation infrastructure, household crowding, and school hygiene practices are more influential than city-specific conditions [10].

The persistence of enterobiasis despite its relatively simple diagnostic and treatment protocols highlights a broader public health challenge. Global burden estimates of soil-transmitted helminths have shown substantial reductions following mass drug administration programs, yet enterobiasis often remains overlooked in such initiatives [11]. Hotez et al. emphasized that pinworm infections are frequently excluded from large-scale deworming campaigns, despite their high prevalence and impact on child health [12]. Our findings reinforce the need to integrate *E. vermicularis* into school-based health programs, combining pharmacological treatment with hygiene education and environmental sanitation.

Diagnostic methodology also warrants consideration. While stool microscopy was employed in this study, the Scotch tape method is generally recognized as more sensitive for detecting *E. vermicularis* eggs. Cook highlighted that reliance on stool examination alone may underestimate prevalence, as eggs are more reliably recovered from perianal samples [13]. Future studies in Libya should incorporate both diagnostic approaches to improve accuracy and provide more reliable prevalence estimates.

Beyond epidemiological significance, enterobiasis carries important clinical implications. Chronic infection has been associated with appendicitis, urinary tract infections, and impaired growth in children. Arca et al. demonstrated that *E. vermicularis* can be identified in appendectomy specimens, linking the parasite to

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acute abdominal presentations [14]. This underscores the importance of addressing enterobiasis not only as a nuisance infection but also as a potential contributor to more serious pediatric conditions.
Taken together, our results confirm that *E. vermicularis* remains a significant public health issue among Libyan schoolchildren. The high prevalence, coupled with its persistence across age, gender, and geographic categories, highlights the urgent need for targeted interventions. Integrating pinworm control into broader parasitic disease programs, improving diagnostic strategies, and strengthening hygiene education in schools are essential steps toward reducing the burden of enterobiasis in Libya and similar endemic regions.

Conclusion

This study confirms that *Enterobius vermicularis* infection is highly prevalent among schoolchildren in Al Marj and Tocar, affecting nearly 70% of participants. No significant differences were observed across age, gender, or city, indicating widespread transmission. These findings highlight the need for routine screening, improved hygiene education, and integration of pinworm control into school health programs to reduce its burden on child health.

Consent to Participate

Informed consent was obtained from all participants and their guardians prior to inclusion in the study. Participation was voluntary, and confidentiality of data was strictly maintained throughout the research process.

Conflict of Interest

The authors declare that they have no conflict of interest related to this study.

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