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Frequency of *Enterobius vermicularis* Detection and Histopathological Findings among Appendectomy Patients in Al-Kut City

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Abstract

Pinworms (*Enterobius vermicularis*) can be found in surgically excised appendices, but their presence does not prove that they cause appendicitis. This cross-sectional descriptive study included 100 patients who underwent appendectomy at Al-Kut Teaching Hospital and Al-Zahra Teaching Hospital from September 2025 to April 2026. Stool microscopy and appendix histopathology were performed for all patients, and histopathological confirmation was the main diagnostic criterion. *E. vermicularis* was detected in 20/100 (20%). Positivity was 9/40 (22.5%) among males and 11/60 (18.3%) among females (Yates-corrected chi-square p = 0.799). By age, positivity was 1/12 (8.3%) in those younger than 5 years, 10/38 (26.3%) in those aged 5–12 years, and 9/50 (18.0%) in those aged 13–24 years (Fisher–Freeman–Halton exact p = 0.434). Of the 20 parasite-positive patients, 14 (70%) had histologically normal appendices and 6 (30%) had inflamed appendices. These findings describe the frequency and histopathological pattern of *E. vermicularis* in appendectomy patients but do not establish the parasite as a cause of appendicitis.

Keywords

Appendicitis,
Enterobius vermicularis,
Histopathology,
Pinworm.

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1. Introduction

Acute appendicitis remains one of the leading causes of emergency abdominal surgery, particularly in young people [1]. Its pathogenesis is mainly attributed to luminal obstruction by lymphoid hyperplasia, fecaliths or, less commonly, parasitic infection. Reported risk factors include younger age, diet and genetic predisposition [2]. *Enterobius vermicularis* is one of the most common intestinal nematodes infecting humans and occurs worldwide in both developed and developing countries. An estimated 200 million people are infected, mostly children [3], and more than 30% of cases occur in children aged 5–10 years [4]. Children are the most vulnerable group because of habits such as finger sucking and biting toys, together with poor personal hygiene [5]. The life cycle is direct; transmission occurs mainly through person-to-person contact, and infection is common in primary schools where health care and health awareness are limited [6,7]. Eggs are also transmitted through contaminated food or hands [8,29], or indirectly via contaminated surfaces such as toys, clothing and bedding [9]. Most infections are asymptomatic. However, the presence of *E. vermicularis* in the appendiceal lumen may produce symptoms that mimic acute appendicitis, even though the parasite does not usually invade the mucosa [10].

In Iraq, *E. vermicularis* is highly prevalent among children, with high infection rates reported in the southern and central provinces [28]. A prevalence of 73.77% was reported among 122 children aged 1–14 years in Baghdad [11], whereas a prevalence of 18.01% was found among 261 children aged 3–11 years in Duhok, northern Iraq [12]. Another Iraqi study reported a prevalence of 14% among children aged 6–12 years [13].

The aim of the present study was to estimate the frequency of *E. vermicularis* detection among appendectomy patients in Al-Kut city and to describe the histopathological findings in patients in whom the parasite was detected. Because no non-appendectomy comparison group was included, the study was not designed to infer the risk or causation of appendicitis.

2. Materials and Methods

2.1 Specimens Collection

The study involved a total of 100 patients who underwent appendectomy (60 females and 40 males), recruited by cross-sectional convenience sampling from Al-Kut Teaching Hospital and Al-Zahra Teaching Hospital in Al-Kut city from September 2025 to April 2026. All 100 enrolled patients had stool microscopy and histopathological examination of the excised appendix. Participants were classified into three mutually exclusive age groups: <5 years, 5–12 years and 13–24 years.

2.2 Microscopic Examination

Stool samples were collected in labelled containers. For microscopic examination, 1–2 g of stool was emulsified in normal saline, and a thin wet mount was prepared on a glass slide and examined under a light microscope using 10× and 40× objective lenses. Because stool microscopy is less sensitive than the perianal adhesive tape test for detecting *E. vermicularis*, histopathological examination of the appendix was used as the reference diagnostic method in this study. Stool microscopy was used as an adjunctive screening test; when the two methods disagreed (e.g., stool microscopy negative and appendix histology positive), histology was used as the final criterion of positivity.

2.3 Histopathological Examination

A total of 100 appendix specimens were fixed in 10% neutral buffered formalin, processed, embedded in paraffin, sectioned and stained with hematoxylin and eosin (H&E). Two to three serial sections of each specimen were examined by light microscopy. An appendix was classified as inflamed when transmural infiltration of polymorphonuclear neutrophils (PMNs) extended into the muscularis propria, and as normal when no neutrophilic infiltration was present and the mucosal architecture was intact.

2.4 Ethics Approval & Consent

This work was approved by the Scientific Research Ethics Committee of the College of Science, University of Wasit, Iraq (Approval Number: wasci-323, Date: September 2025). All adult participants gave written informed consent before enrolment. Written informed consent was obtained from the parents or legal guardians of participants under the age of 18. All procedures involving human participants were performed in accordance with the ethical standards of the institutional research committee

and with the 1964 Declaration of Helsinki and its later amendments.

2.5 Statistical Analysis

Data are presented as frequencies and percentages. The chi-square test with Yates' continuity correction was used to compare positivity between males and females. The Fisher–Freeman–Halton exact test (the extension of Fisher's exact test to a 3 × 2 table) was used to compare positivity across age groups because some expected cell counts were small. A two-sided p-value < 0.05 was considered statistically significant. The overall frequency of positive and negative specimens (Table 1) and the histological categories among positive specimens (Table 4) are presented descriptively without inferential testing. Statistical analyses were performed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA).

3. Results

3.1 Overall Frequency of E. vermicularis Detection

A cross-sectional evaluation of *E. vermicularis* detection was performed in patients who underwent appendectomy. A patient was classified as *E. vermicularis*-positive when the parasite was confirmed by histopathological examination of the appendix; stool microscopy served only as an adjunctive screening test.

A total of 100 patients underwent appendectomy, of whom 20 (20%) were *E. vermicularis*-positive and 80 (80%) were *E. vermicularis*-negative (Table 1, Figure 1). These figures reflect detection among the sampled appendectomy patients and do not represent the infection rate in the general population.

Table 1: Frequency of reported *E. vermicularis* positivity among appendectomy patients (n = 100).

Infection status	No. of cases	Percentage (%)
E. vermicularis (+)	20	20
E. vermicularis (–)	80	80
Total	100	100

Descriptive frequencies only; no inferential hypothesis test was specified.



Figure 1: Reported *E. vermicularis* positivity among appendectomy patients (n = 100).

3.2 Frequency of E. vermicularis Positivity According to Sex

The proportion classified as E. vermicularis positive was numerically higher among males (9/40; 22.5%) than females (11/60; 18.3%). This difference was not statistically significant (Yates-corrected $\chi^2(1)$ = 0.065, p = 0.799; Table 2).

Table 2: Frequency of *Enterobius vermicularis* positivity according to sex.

Infection status	Males n (%)	Females n (%)	Total
E. vermicularis (+)	9 (22.5)	11 (18.3)	20
E. vermicularis (–)	31 (77.5)	49 (81.7)	80
Total	40	60	100
P value	0.799		

No statistically significant sex-group difference (Yates-corrected chi-square p = 0.799).

3.3 Frequency of E. vermicularis Positivity According to Age Group

Reported positivity was highest in the 5–12-year group (10/38; 26.3%), followed by the 13–24-year group (9/50; 18.0%) and the younger-than-5-year group (1/12; 8.3%). The difference across age groups was not statistically significant (Fisher–Freeman–Halton exact test, two-sided p = 0.434; Table 3).

Table 3: Frequency of *Enterobius vermicularis* positivity according to age group.

Age group (years)	Examined (n = 100)	Infected with E. vermicularis n (%) (n = 20)
<5	12	1 (8.3)
5–12	38	10 (26.3)
13–24	50	9 (18.0)
Total	100	20 (20.0)
P value		0.434

Fisher–Freeman–Halton exact test (two-sided).

3.4 Histopathological Findings in E. vermicularis-Positive Cases

The distribution of the *E. vermicularis*-positive cases among histopathological categories is shown in Table 4.

Of the 20 *E. vermicularis*-positive cases, 14 (70%) had histologically normal appendices and 6 (30%) had inflamed appendices (Table 4). Although all 100 appendices underwent histopathological evaluation, Table 4 presents only the 20 parasite-positive cases; it is descriptive, and no inferential comparison was performed.

Table 4: Histopathological changes in *E. vermicularis*-positive samples.

Appendix form	E. vermicularis-positive cases, n (%) (n = 20)
Normal appendix	14 (70)
Inflamed appendix	6 (30)
Total	20

Histopathological examination was performed on all 100 appendectomy specimens; this table shows the histological categories (normal vs. inflamed) for the 20 *E. vermicularis*-positive cases only.

4. Discussion

Several studies worldwide have examined whether appendicitis is associated with pinworm infection [14,15,16,17]. Pinworm infection is a public health issue in many countries, both rich and poor [18]. Appendicitis is one of the most common surgical emergencies, with an incidence of approximately 100 per 100,000 people [19,20,21]. In the present study, *E. vermicularis* was detected in 20 of 100 appendectomy patients (20%). This frequency is comparable to the 15.0% (30/200) reported in the Gaza Strip, Palestine [22], and higher than the rates reported in Iran (2.9%; 144/5048) [23], Benghazi, Libya (7.2%; 18/250) [24], Turkey (3.8%, 4/104 [25]; 0.74%, 24/3222 [26]) and Columbus, Ohio, USA (1.4%; 21/1549) [27]. The relatively high frequency in our series may partly reflect its young study population (all patients were 24 years or younger) and the high prevalence of enterobiasis in Iraq [28]. Differences in sanitation, lifestyle, geography, nutrition and socioeconomic conditions may also influence the prevalence of *E. vermicularis* between regions, as may differences in sample size and data collection procedures [22].

Positivity was 9/40 (22.5%) in males and 11/60 (18.3%) in females. Although positivity was numerically higher in males, the difference was not significant (p = 0.799). Differences reported in other populations [22,24,28] may reflect study setting, patient selection or diagnostic techniques rather than a true sex-related effect, and the present data provide no evidence of differential susceptibility by sex.

E. vermicularis positivity was observed in 10/38 (26.3%) of the 5–12-year group, 9/50 (18.0%) of the 13–24-year group, and 1/12 (8.3%) of those younger than 5 years. The difference between age groups was not statistically significant (Fisher–Freeman–Halton exact test, two-sided p = 0.434). The highest positivity among children aged 5–12 years is consistent with the known peak of pinworm infection in school-aged children [4,6], although the small number of children younger than 5 years (n = 12) limits the precision of this comparison. Differences in population and diagnostic methods should be considered when comparing these findings with other studies [30].

Of the 20 parasite-positive cases, 14 (70%) had histologically normal appendices and 6 (30%) had inflamed appendices. This predominance of normal appendices agrees with reports that *E. vermicularis* more often produces appendicitis-like symptoms than true appendiceal inflammation [10,26]. However, because histological classification was presented only for parasite-positive cases, the association between parasite positivity and appendiceal inflammation cannot be estimated from these data. In addition, no non-operated control group was enrolled; therefore, the study can neither establish nor exclude a causal role of *E. vermicularis* in the pathogenesis of appendicitis.

This study has several limitations. It was conducted in two hospitals using a convenience sample of 100 patients, which limits the generalizability of the findings. Stool examination relied on direct saline wet mounts, and the more sensitive perianal adhesive tape test was not performed. Histopathological categories were not reported for parasite-negative appendices, and no non-appendectomy comparison group was available. Larger multicentre studies that report

histological findings for all specimens and use more sensitive diagnostic methods are recommended.

5. Conclusion

E. vermicularis was detected in 20 of 100 (20%) appendectomy patients in Al-Kut City. Positivity was slightly higher in males (22.5%) than in females (18.3%) and was highest in the 5–12-year group (26.3%), but neither the sex nor the age-group differences were statistically significant (p = 0.799 and p = 0.434, respectively). Of the 20 parasite-positive cases, 14 (70%) had histologically normal appendices and 6 (30%) had inflamed appendices. These findings describe the frequency and histopathological pattern of *E. vermicularis* in appendectomy patients and do not establish the parasite as a cause of appendicitis.

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