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Prevalence and risk factors of *Strongyloides stercoralis* infection among kidney transplant candidates in a tertiary hospital: a cross-sectional study

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ABSTRACT:

Objective: *Strongyloides stercoralis* infection poses a serious risk to kidney transplant (KT) candidates due to the potential for hyperinfection under immunosuppression, yet Philippine data remain limited. This study estimated the prevalence of *S. stercoralis* infection and identified associated risk factors among KT candidates in a tertiary transplant center.

Patients and Methods: A cross-sectional study was conducted among 236 Filipino KT candidates evaluated at the National Kidney and Transplant Institute from September 2024 to September 2025. Stool samples were examined using direct smear and Harada-Mori culture, while sera were tested for anti-*Strongyloides* IgG by ELISA. Logistic regression was used to assess crude and adjusted associations between demographic, environmental, and clinical variables and seropositivity.

Results: No infections were detected by stool-based methods. ELISA identified 45 positive (19.1%) and 16 borderline (6.8%) results, yielding a combined seroprevalence of 25.8%. In univariable analysis, walking barefoot increased the odds of infection (OR 2.43, 95% CI 1.34-4.42, $p = 0.003$), while female sex was associated with lower odds (OR 0.54, 95% CI 0.29-0.96, $p = 0.044$). In multivariable analysis, walking barefoot remained an independent risk factor (aOR 2.85, 95% CI 1.51-5.35, $p = 0.001$), while female sex was associated with lower odds (aOR 0.49, 95% CI 0.26-0.91, $p = 0.025$). Other sociodemographic and clinical characteristics were not significantly associated with seropositivity.

Conclusions: A substantial burden of *S. stercoralis* infection was observed among asymptomatic Filipino KT candidates, detectable only through serology. The strong association with walking barefoot highlights a modifiable behavioral risk factor. Given the potential for fatal hyperinfection, serological screening with consideration of giving prophylaxis to both positive and borderline cases should be evaluated for integration into pre-transplant protocols. Larger multicenter studies incorporating molecular diagnostics are needed to refine screening strategies and confirm the clinical impact.

Keywords: *Strongyloides stercoralis*, Kidney transplant, Prevalence, Risk factors, Philippines.

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— ***List of Abbreviations:*** AFR: African Region; CAR: Cordillera Administrative Region; C: Confidence Interval; CKD: Chronic Kidney Disease; DS: Disseminated Strongyloidiasis; ELISA: Enzyme-Linked Immunosorbent Assay; ESRD: End-Stage Renal Disease; GCP: Good Clinical Practice; HD: Hemodialysis; HTLV-1: Human T-Lymphotropic Virus Type 1; IQR: Interquartile Range; IRB: Institutional Review Board; KDIGO: Kidney Disease: Improving Global Outcomes; KT: Kidney Transplant / Kidney Transplantation; NKTI: National Kidney and Transplant Institute; OR: Odds Ratio; PD: Peritoneal Dialysis; RRT: Renal Replacement Therapy; SEAR: South-East Asia Region; SHS: Strongyloides Hyperinfection Syndrome; STH: Soil-Transmitted Helminths; STROBE: Strengthening the Reporting of Observational Studies in Epidemiology; WPR: Western Pacific Region; WHO: World Health Organization.

INTRODUCTION

Strongyloidiasis, a neglected tropical disease caused by *Strongyloides stercoralis*, affects over 100 million people worldwide, mainly in Africa, Asia, and Latin America[1]. In 2017, its estimated global prevalence was 8.1% (95% CI: 4.2-12.4%), equivalent to 613.9 million cases, with most infections occurring in the WHO South-East Asia Region (SEAR), Western Pacific Region (WPR), and African Region (AFR), representing 76.1% of global infections[2]. The disease is more common in rural areas with poor sanitation[3].

A 2022 meta-analysis by Chan et al[4] reported limited data from Southeast Asia, with only one study each from Timor-Leste, the Philippines, and Singapore, reporting prevalences of 0.4%, 0.8%, and 3.7%, respectively. The Philippine study, conducted among schoolchildren in Laguna, found a 0.8% prevalence using qPCR and Kato-Katz stool methods, underscoring the lack of standardized detection and limited local surveillance[5].

S. stercoralis has a complex life cycle involving skin penetration, migration to the lungs, and intestinal autoinfection that allows persistent infection for decades. Most immunocompetent individuals are asymptomatic, but immunocompromised hosts, such as transplant recipients, are at risk of severe complications like *Strongyloides* hyperinfection syndrome (SHS) and disseminated strongyloidiasis (DS)[6].

SHS and DS carry high mortality among immunocompromised hosts, including kidney-transplant (KT) candidates, due to the potential reactivation of undiagnosed chronic infection. Effective treatment is available, with ivermectin as the first-line therapy and albendazole or thiabendazole as alternative agents[7].

In immunocompromised patients, corticosteroid use is the leading trigger of SHS, with mortality up to 60-85%[8]. Among hemodialysis patients, prevalence can reach 18.8% serologically, supporting presumptive antiparasitic therapy to prevent fatal complications[9]. KT, while lifesaving, markedly increases the risk of SHS and DS. Additional risk factors include malignancy, human immunodeficiency virus (HIV), human T cell leukemia virus type 1 (HTLV-1) infection, diabetes, and malnutrition[10,11].

A review by Abad et al[12] identified 108 cases of *S. stercoralis* infection in solid organ and stem cell transplant recipients, 75% of which occurred in KT patients, with overall mortality of 43.5%. These findings reinforce the need for pre-transplant screening and timely prophylaxis. The purpose of pre-transplant screening is to identify recipients at higher risk of *Strongyloides* reactivation who would benefit from prophylactic treatment and closer surveillance, particularly in the early post-transplant period. Some medical societies have recommended pre-transplant screening in recipients and donors from endemic areas[13]. International[14] and U.S.[15] transplantation guidelines pragmatically recommend serological screening for potential recipients, while alternative approaches advocate presumptive treatment with ivermectin, a safe and effective drug for chronic strongyloidiasis[16]. The United Kingdom (UK) guidelines, on the other hand, recommend testing for tropical infections only in prospective donors[17]. Clinicians are therefore urged to consider strongyloidiasis in renal transplant recipients who have lived in tropical areas. Serological screening, or treatment based on epidemiologic risk factors alone, may be beneficial and should be incorporated into local transplantation protocols[18].

The World Health Organization (WHO)[19] has recently included strongyloidiasis as a soil-transmitted helminth (STH) targeted for control, emphasizing its medical importance and potential for transmission. While the Harada-Mori method increases larval detection in stool, serological assays (IgG ELISA) remain more sensitive (94-96%) and specific (93-96%), making them a useful complement to parasitological methods[20]. Understanding local epidemiology is vital for preventing severe complications through early detection and treatment, especially in high-risk groups such as hemodialysis and transplant candidates. Given the scarcity of national data[21-23], this study aimed to determine the prevalence and risk factors of *S. stercoralis* infection among KT candidates in a tertiary institution to aid in the development of recommendations and to reinforce the importance of including *S. stercoralis* infection screening in pre-transplantation protocols.

Objectives

To estimate the prevalence and associated risk factors of *S. stercoralis* infection among KT candidates in a tertiary hospital specializing in kidney and transplant-related medical services. Specifically:

1. To describe the sociodemographic, lifestyle, clinical characteristics, and geographic distribution by residence of KT candidates.
2. To estimate the prevalence of *S. stercoralis* infection among KT candidates using the Harada-Mori stool exam technique and ELISA serological test.
3. To identify the crude associations between demographic, environmental and behavioral risk factors (e.g., endemic residence, travel history, soil-contact occupation, sanitation, barefoot walking, deworming history) and *S. stercoralis* infection positivity.

PATIENTS AND METHODS

Study Design, Setting and Population

This cross-sectional study followed STROBE reporting guidelines and included Filipino kidney transplant (KT) candidates aged 19 years or older who underwent evaluation at the National Kidney and Transplant Institute (NKTI) in Quezon City, Philippines, from September 2024 to September 2025. Eligible participants were individuals undergoing pre-KT workup who were considered suitable for transplantation due to chronic kidney disease (CKD) G4-G5 (glomerular filtration rate < 30 mL/min/1.73 m²), anticipated progression to end-stage kidney disease (ESRD), or irreversible kidney failure requiring daily dialysis when medically stable[24]. Patients with incomplete medical records or insufficient follow-up data were excluded.

Sampling Method

Consecutive convenience sampling was used. All eligible patients attending the NKTI pre-transplant clinic were approached and invited to participate until the target sample size was reached. This approach was due to time-bound recruitment and the fixed scheduling of pre-transplant evaluations.

Data Collection

Upon written informed consent, sociodemographic, environmental, and clinical information relevant to *S. stercoralis* risk assessment were collected through structured interviews and medical chart review. Variables included demographic factors [age, sex, body mass index (BMI)][2,9]; geographic and environmental exposures such as region of residence for more than 6 months – particularly endemic areas (Region V, Region IV-B, Region VIII)[20-23] – residence in rural *vs.* urban settings, and travel to endemic regions within the past 12 months[25]; socioeconomic indicators including educational attainment, soil-contact occupations, and walking barefoot[2,9]; and clinical characteristics such as primary renal diagnosis, mode and duration of renal replacement therapy [hemodialysis (HD) or peritoneal dialysis (PD)][9], comorbidities (e.g., diabetes mellitus), use of immunosuppressive drugs within the past three months, and prior organ transplantation[10]. Preventive factors such as deworming history in the past 12 months[2] were also recorded. Exploratory variables collected for contextual interpretation included chronic infection (e.g., chronic hepatitis B)[2], recent infection within the past three months[2], and gastrointestinal symptoms such as abdominal pain or diarrhea in the past month[2].

Sample Collection and Specimen Handling

Stool samples routinely submitted for pre-transplant examination were analyzed in the NKTI laboratory using the Harada-Mori technique. Patients provided fresh, unpreserved stool (≥ 6 g), which was processed within two hours. Trained medical technologists prepared tapered filter paper strips, incubated them in distilled water at room temperature (25-28°C) for up to 10 days, and microscopically examined the fluid for *S. stercoralis* filariform larvae. Serum obtained from standard pre-transplant testing was analyzed in the NKTI Laboratory using a semiquantitative *Strongyloides* IgG ELISA (EUROIMMUN). Based on manufacturer criteria, ratios < 0.8 were considered negative, 0.8-1.1 borderline, and ≥ 1.1 positive; both positive and borderline IgG results were interpreted as indicative of current or past infection. When recent specimens were unavailable, additional stool or blood samples were voluntarily collected and processed following the same procedures.

Sample Size Determination

A minimum required sample size of 235 participants was calculated to estimate the prevalence of *S. stercoralis* infection with a 5% margin of error and 95% confidence level, assuming an expected prevalence of 18.8% among adult patients with renal failure on hemodialysis[9].

Statistical Analysis

Descriptive statistics were used to summarize participant characteristics. Categorical variables were presented as frequencies and percentages, while continuous variables were assessed for normality using the Shapiro-Wilk test and summarized as median and interquartile range (Q1-Q3) due to non-normal distribution. The prevalence of *S. stercoralis* infection was expressed as a point estimate with 95% confidence intervals (CIs). Univariable logistic regression was performed to evaluate crude associations between candidate risk factors and infection, with odds ratios (ORs) and 95% CIs reported. For the primary analysis, ELISA-positive and borderline IgG results were combined and classified as indicative of infection; this conservative definition aligns with recommendations for immunocompromised populations. A sensitivity analysis was conducted in which only ELISA-positive results were considered infected, and borderline results were analyzed separately, with corresponding prevalence estimates reported. A multivariable logistic regression model was then constructed to identify independent risk factors. Variables were selected *a priori* based on biological plausibility and recommendations (sex, walking barefoot, rural residence, educational attainment, and chronic glomerulonephritis as the primary renal diagnosis). Adjusted odds ratios (aORs), 95% CIs, and *p*-values were reported. Model fit was assessed using the likelihood ratio test and pseudo-R^2. Missing data were not imputed. All analyses were performed using STATA version 17.0 (College Station, TX, USA), with statistical significance set at $\alpha = 0.05$.

Ethical Consideration

The study was conducted in accordance with the principles of International Council for Harmonisation – Good Clinical Practice (ICH-GCP) and the Declaration of Helsinki (2013), and was approved by the NKTI Institutional Review Board (IRB). All investigators and key personnel completed Good Clinical Practice (GCP) training on responsible research conduct. Primary data were collected through questionnaires and secondary data through medical chart review; thus, the principles of beneficence and non-maleficence were indirectly applicable. To uphold data privacy, integrity, and confidentiality, the study complied with the Philippine Data Privacy Act. Patient identifiers were removed and replaced with alphanumeric codes accessible only to the primary investigators. Records were stored in a locked cabinet with restricted access to the research team and the NKTI-REC. Participants were followed from consent until the release of their *Strongyloides* IgG serology and Harada-Mori stool results (approximately 12-14 days) and were informed of their findings. Those who tested positive or borderline for *S. stercoralis* received free medical consultation and advice from the primary researcher under the supervision of an Infectious Disease consultant. Due to the unavailability of ivermectin during the study period, albendazole 400 mg orally twice daily for seven days was prescribed as prophylaxis.

RESULTS

A total of 277 KT candidates were recruited between September 2024 and September 2025. Of these, 11 patients did not comply with the submission of both stool and blood samples, 12 patients failed to provide blood samples, 14 patients failed to provide stool samples and 4 patients refused. Consequently, 236 patients were included in the final analysis, meeting the required sample size (Figure 1).

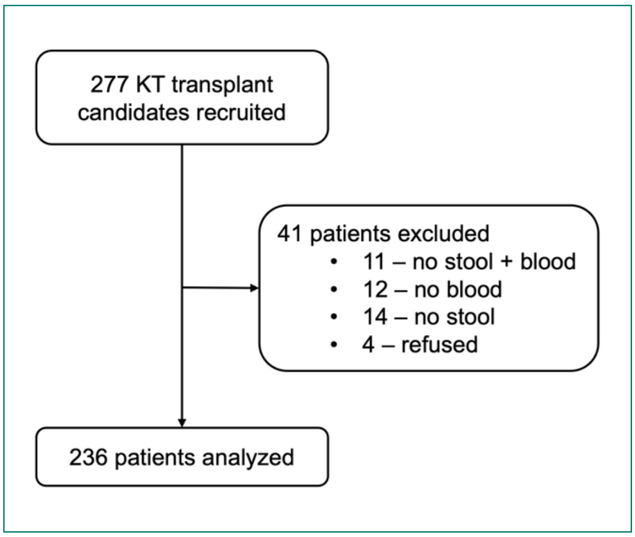

Figure 1. Recruitment of study participants.

The median age of participants was 35 years (IQR 13). More than half were female (55.1%). The median BMI was 22.15 kg/m² (IQR 5.8). Over half attained tertiary/university education (56.4%), while 18.6% lived in rural areas and 62.3% in urban areas. Walking barefoot was common, with 44.5% sometimes and 0.9% frequently doing so. Occupations with frequent soil exposure were rare (farming 0.9%, military 1.3%, drivers 1.7%). Only 2.5% resided in endemic regions (Region V, IV-B, VIII), and 4.7% had traveled to these areas within the past year (Table 1).

The most common primary renal diagnosis was chronic glomerulonephritis (61.4%), followed by diabetes (17.4%) and hypertension (14.8%). Hypertension (67.8%) and diabetes (32.2%) were the most frequent comorbidities. Symptoms in the past month were uncommon (abdominal pain 3.0%, diarrhea 3.4%). HD was the predominant mode of renal replacement therapy (89.8%), with most on treatment for >1 year. PD accounted for 3.8% of patients, while 6.8% were not on dialysis. A small proportion reported recent immunosuppressive drug use, and no patients reported deworming in the past 12 months. Three patients had a history of prior organ transplantation, all of whom were KT recipients with graft failure and were being evaluated for re-transplantation (Table 2).

Direct fecal smear and Harada-Mori stool examinations did not detect any positive cases. In contrast, ELISA IgG testing identified 45 patients (19.1%) as positive, 16 (6.8%) as borderline, and 175 (74.2%) as negative. Using our primary definition, in which positive and borderline results were combined, 61 patients (25.8%) were classified as having *S. stercoralis* infection (Table 3). In a prespecified sensitivity analysis that considered only ELISA-positive results as infection, the prevalence was 19.1% (45/236; 95% CI 14.6-24.6), compared with 25.8% (61/236; 95% CI 20.7-31.8) under the combined definition.

Prevalence varied by region, ranging from 0% (Central Visayas, Eastern Visayas, Zamboanga, CAR) to 100% in the single patient from MIMAROPA. Higher proportions of positivity were noted in Cagayan Valley (57.1%), Western Visayas (66.7%), and Bicol Region (50.0%), though sample sizes were small. The NCR accounted for the largest subgroup

Table 1. Sociodemographic and lifestyle of KT candidates.

	Median (IQR); Frequency (%)
Age, years	35 (29-42)
Sex	
Male	106 (44.92%)
Female	130 (55.08%)
BMI, kg/m^2	22.15 (19.53-25.34)
Educational level	
No schooling	8 (3.39%)
Primary	2 (0.85%)
Secondary	72 (30.51%)
Technical/Vocational	21 (8.90%)
Tertiary/University	133 (56.36%)
Living area	
Rural	44 (18.64%)
Urban	147 (62.29%)
Both rural and urban	45 (19.07%)
Walks without shoes	
Never	129 (54.66%)
Sometimes	105 (44.49%)
Frequently	2 (0.85%)
Occupation with frequent soil exposure	
Farming	2 (0.85%)
Military	3 (1.27%)
Driver (truck, tricycle, jeepney)	4 (1.69%)
Residence > 6 months in endemic region (Region V, IVB, VIII)	6 (2.54%)
Travel in the past 12 months to the endemic regions	11 (4.66%)

(n=104) with a prevalence of 24.04% [95% CI 17.00-32.99], followed by CALABARZON at 27.08% [95% CI 15.02-42.66] and Central Luzon at 18.52% [95% CI 7.08-36.40] (Table 4).

In the univariate analysis, sex was significantly associated with infection, with females having 45% lower odds of *S. stercoralis* positivity compared to males (OR 0.54, 95% CI 0.29-0.96, p = 0.044). Likewise, walking barefoot was identified as a significant behavioral risk factor, as patients who sometimes or frequently walked without footwear had 2.4 times higher odds of infection compared to those who never did (OR 2.43, 95% CI 1.34-4.42, p = 0.003). In contrast, other sociodemographic, behavioral and clinical characteristics did not demonstrate statistically significant associations with infection among the study participants (Table 5).

In a multivariable logistic regression model including sex, walking barefoot, rural residence, higher educational attainment, and chronic glomerulonephritis as covariates, walking barefoot remained independently associated with *S. stercoralis* infection (aOR 2.85, 95% CI 1.51-5.35, p = 0.001), while female sex remained associated with lower odds of infection (aOR 0.49, 95% CI 0.26-0.91, p = 0.025). Rural residence showed a non-significant trend toward higher infection risk (aOR 1.98, 95% CI 0.94-4.16, p = 0.072). Higher education and chronic glomerulonephritis were not significantly associated with infection after adjustment (aOR 0.79, 95% CI 0.42-1.48, p = 0.455 and aOR 0.64, 95% CI 0.34-1.19, p = 0.160, respectively) (Table 6).

DISCUSSION

This study provides the first local estimate of *S. stercoralis* seroprevalence among asymptomatic KT candidates in the Philippines, demonstrating a substantial burden of infection detectable only through serology. Using our primary definition, which combined ELISA-positive and borderline results, prevalence was 25.8%; when only ELISA-positive results were considered in a sensitivity analysis, prevalence remained notable at 19.1%. The absence of positive stool findings reflects the limited utility of conventional parasitological techniques in chronic or low-burden infections, particularly among immunocompromised hosts in whom larval shedding may be minimal[26,27].

Although grouping borderline with positive results may overestimate the proportion with active infection, this operational definition prioritizes clinical safety in transplant candidates, where undetected latent infection may precipitate hyperinfection following immunosuppression. Presenting both the combined and ELISA-positive estimates offers a more balanced interpretation of disease burden and reflects the inherent balance between diagnostic specificity and pre-transplant risk mitigation.

The seroprevalence observed in this predominantly urban population underscores that relevant exposure persists outside conventionally recognized endemic zones. The elevated burden, despite limited rural residence or soil-contact occupations, suggests that environmental contamination and persistent behavioral exposures remain risk factors in metropoli-

Table 2. Clinical characteristics of KT candidates.

	Frequency (%)
Primary renal diagnosis/etiology of renal failure	
Diabetes	41 (17.37%)
Hypertension	35 (14.83%)
Diabetes and hypertension	11 (4.66%)
Chronic glomerulonephritis	145 (61.44%)
IgA nephropathy	*11 (4.66%)*
Focal segmental glomerulosclerosis	*3 (1.27%)*
Lupus nephritis	*5 (2.12%)*
Other chronic glomerulonephritis	*126 (53.39%)*
Adult polycystic kidney disease	3 (1.27%)
Obstructive uropathy from nephrolithiasis	1 (0.42%)
Comorbidities	
Diabetes	76 (32.20%)
Hypertension	160 (67.80%)
Cerebrovascular disease	2 (0.85%)
Peripheral arterial disease	6 (2.54%)
Coronary artery disease	6 (2.54%)
Bronchial asthma	2 (0.85%)
Symptoms in the past month	
Abdominal pain	7 (2.97%)
Diarrhea	8 (3.39%)
Recent infection in the past 3 months	
Community acquired infections	2 (0.85%)
Urinary tract infections	6 (2.54%)
Bloodstream infections	3 (1.27%)
Presence of chronic infection	
Chronic hepatitis B	6 (2.54%)
PTB on maintenance phase	1 (0.42%)
Renal replacement therapy	
Hemodialysis	212 (89.83%)
More than 1 year	186 (78.81%)
Peritoneal dialysis	9 (3.81%)
More than 1 year	9 (3.91%)
Not in RRT	15 (6.55%)
Immunosuppressive drug in the past 3 months	
Calcineurin inhibitors	
Cyclosporine	1 (0.42%)
Tacrolimus	3 (1.27%)
Antiproliferative agents	
Azathioprine	1 (0.42%)
Mycophenolate mofetil	7 (2.97%)
Corticosteroids	
Prednisone	2 (0.85%)
Methylprednisolone	1 (0.42%)
Previous history of organ transplantation	3 (1.27%)
History of deworming in the past 12 months	0

Table 3. Diagnostic results summary.

	Frequency (%)
Direct fecal smear	
Positive	0
Negative	236 (100.00%)
Harada-Mori stool analysis	
Positive	0
Negative	236 (100.00%)
ELISA IgG	
Positive	45 (19.07%)
Borderline	16 (6.78%)
Negative	175 (74.15%)
Strongyloides infection positive	**61 (25.85%)***

*Primary analysis defined infection as ELISA-positive or borderline Strongyloides IgG results [61/236; prevalence 25.85% (95% CI 20.7-31.8)]. In a sensitivity analysis classifying only ELISA-positive results as infection, prevalence was 19.1% (45/236; 95% CI 14.6-24.6).

tan settings[20]. Walking barefoot was strongly associated with seropositivity, consistent with the parasite's soil-transmitted route[3,4], and represents a modifiable behavior that may be integrated into pre-transplant counseling. Female sex was associated with lower odds of infection, consistent with reports that men may have greater exposure to soil and outdoor environments[18]. Sociocultural patterns in the Philippines, including footwear practices and occupational roles, may partly explain this difference, although these factors were not directly measured. Biological and immunologic mechanisms cannot be excluded and require further investigation.

These associations persisted after adjustment for rural residence, educational attainment, and chronic glomerulonephritis, supporting barefoot exposure

Table 4. Prevalence of *S. stercoralis* infection among KT candidates by Region based on area of residence.

Region	n	Positive	Negative	Prevalence [95% CI]
Region I – Ilocos Region	5	1	4	20.00% [3.62, 62.45]
Region II – Cagayan Valley	7	4	3	57.14% [25.05, 84.18]
Region III – Central Luzon	28	6	22	21.43% [10.21, 39.54]
Region IV A - CALABARZON	75	19	56	25.33% [16.86, 36.21]
Region IV B – MIMAROPA	1	1	0	100.00% [2.65, 100.00]
Region V – Bicol Region	4	2	2	50.00% [15.00, 85.00]
Region VI – Western Visayas	3	2	1	66.67% [20.79, 93.85]
Region VII – Central Visayas	2	0	2	0.00% [0.00, 65.76]
Region VIII – Eastern Visayas	1	0	1	0.00% [0.00, 79.35]
Region IX – Zamboanga Peninsula	1	0	1	0.00% [0.00, 79.35]
Region XII - SOCCSKSARGEN	2	1	1	50.00% [9.45, 90.55]
CAR – Cordillera Administrative Region	3	0	3	0.00% [0.00, 56.20]
NCR – National Capital Region	104	25	79	24.04% [17.00, 32.99]
Total	236	61	175	25.85% [20.58, 31.79]

and male sex as independent correlates of seropositivity in this population. Chronic glomerulonephritis was not independently associated with infection, suggesting that potential ELISA cross-reactivity due to immune-mediated renal disease is unlikely to fully account for the observed seroprevalence[28]. All variables included in the multivariable model had complete data, and no participants were excluded from the adjusted analysis due to missingness, minimizing concerns regarding bias from incomplete observations.

The observed seroprevalence exceeded the 0.8% reported among Laguna schoolchildren using molecular diagnostics[5], likely reflecting both heightened vulnerability in immunocompromised patients[11-13] and the greater sensitivity of serologic assays compared with stool-based tests[20]. Regional variability in seropositivity aligns with previous national reviews[21,22], although zero cases in some regions likely reflect small sample sizes rather than the absence of transmission.

None of the participants reported deworming in the preceding year, illustrating a gap in routine helminth control among KT candidates. While this raises the possibility of integrating targeted parasitic evaluation into transplant workups, the present data are insufficient to justify practice-changing recommendations without broader validation[7,12].

Overall, these findings suggest that serologic screening may have a role in pre-KT workups, particularly in populations with demonstrable risk factors; however, the optimal screening strategy, timing, and prophylactic approach require further evaluation. Given the high mortality associated with SHS in immunosuppressed patients[7], precautionary strategies remain plausible, but their implementation should be supported by multicenter, longitudinal, and cost-effectiveness studies.

Strengths and Limitations

This study is the first in the Philippines to evaluate *S. stercoralis* among KT candidates using both parasitological and serologic approaches. Limitations include its single-center design, convenience sampling constrained by clinic scheduling, and reliance on serology without confirmatory molecular diagnostics, which may affect generalizability. ELISA may overestimate prevalence through detection of prior exposure or potential cross-reactivity in immune-mediated renal disease; however, primary renal diagnosis did not independently predict seropositivity. Conversely, stool-based diagnostics such as direct smear and Harada-Mori have limited sensitivity in asymptomatic or low-burden infections, likely explaining the absence of stool positives in this cohort[26,27]. These methodological constraints underscore the need for cautious interpretation of prevalence estimates while recognizing the clinical relevance of seropositivity in transplantation, where latent infection may reactivate and prophylaxis is recommended for seropositive or borderline patients[11-13].

Recommendations

Future research should include multicenter cohorts to generate national prevalence estimates, evaluate the cost-effectiveness of screening strategies, and determine the clinical impact of prophylaxis on graft and patient outcomes. Incorporating molecular diagnostics such as qPCR may help differentiate active from past infections. A follow-up cohort is recommended to monitor clinical course, serologic response, and post-treatment outcomes. A prospective design would better define the effectiveness of pre-transplant prophylaxis in this population.

CONCLUSIONS

This study demonstrated a considerable prevalence of *S. stercoralis* infection (25.85%) among asymptomatic Filipino KT candidates, detected exclusively through serology. Walking barefoot emerged as a significant modifiable risk factor, while female sex was associated with lower odds of infection

Table 5. Sociodemographic, clinical and lifestyle factors associated with *S. stercoralis* infection among KT candidates.

	Positive	Negative	Crude OR	95% CI	*p*-value
Age					
< 40 years	44 (26.04%)	125 (73.96%)	Reference		
≥ 40 years	19 (28.36%)	48 (71.64%)	1.12	0.60, 2.12	0.716
BMI					
Underweight	6 (28.57%)	16 (72.72%)	1.29	0.46, 3.65	0.633
Normal	27 (23.68%)	88 (76.52%)	Reference		
Overweight	10 (30.30%)	24 (70.59%)	1.40	0.59, 3.31	0.442
Obese	19 (29.23%)	46 (70.77%)	1.33	0.67, 2.65	0.415
Sex					
Male	34 (32.08%)	72 (67.92%)	Reference		
Female	27 (20.77%)	103 (79.23%)	0.54	0.29, 0.96	0.044
Educational level					
No schooling/ Primary	2 (20.00%)	8 (80.00%)	Reference		
Secondary	23 (31.94%)	49 (68.06%)	1.88	0.37, 9.55	0.448
Technical/Vocational	5 (23.81%)	16 (76.19%)	1.25	0.20, 7.92	0.813
Tertiary/University	33 (24.81%)	100 (75.19%)	1.32	0.27, 6.53	0.734
Living area					
Rural	16 (36.36%)	28 (63.64%)	Reference		
Urban	32 (21.77%)	115 (78.23%)	0.49	0.24, 1.01	0.053
Both rural and urban	15 (33.33%)	30 (66.67%)	0.87	0.37, 2.09	0.764
Walks without shoes					
Never	24 (18.90%)	103 (81.10%)	Reference		
Sometimes/Frequently	38 (36.19%)	67 (63.81%)	2.43	1.34, 4.42	0.003
Occupation with frequent soil exposure					
Yes	4 (44.44%)	5 (55.56%)	2.28	0.59, 8.77	0.231
No	59 (25.99%)	168 (74.01%)	Reference		
Abdominal pain in the past month					
Yes	0 (0.00%)	7 (100.00%)	*		
No	63 (27.51%)	166 (72.49%)			
Diarrhea in the past month					
Yes	2 (25.00%)	6 (75.00%)	0.91	0.18, 4.64	0.912
No	61 (26.75%)	167 (73.25%)	Reference		
Recent infection un the past 3 months					
Yes	4 (36.36%)	7 (63.64%)	1.61	0.45, 5.69	0.462
No	59 (26.22%)	166 (73.78%)	Reference		
Chronic infection					
Yes	2 (28.57%)	5 (71.43%)	1.10	0.21, 5.83	0.909
No	61 (26.64%)	168 (73.36%)	Reference		
Residence > 6 months in endemic region					
Yes	3 (50.00%)	3 (50.00%)	2.83	0.56, 14.42	0.210
No	60 (26.09%)	170 (73.91%)	Reference		
Travel in the past 12 months to the endemic regions					
Yes	4 (36.36%)	7 (63.64%)	1.61	0.45, 5.69	0.462
No	59 (26.22%)	166 (73.78%)	Reference		
Immunosuppressive drugs in the past 3 months					
Yes	1 (10.00%)	9 (90.00%)	0.31	0.04, 2.48	
No	60 (26.53%)	166 (73.47%)	Reference	0.268	
Renal Replacement Therapy					
Yes					
Hemodialysis	56 (26.41%)	156 (73.59%)	1.36	0.49, 3.83	0.555
Peritoneal dialysis	4 (44.44%)	5 (55.55%)	2.39	0.62, 9.19	0.206
Not in RRT	2 (12.50%)	13 (86.67%)	0.39	0.09, 1.77	0.222
Duration of RRT					
Hemodialysis					
Less than 1 year	5 (19.23%)	21 (80.77%)	Reference		
More than 1 year	51 (27.37%)	135 (72.63%)	1.59	0.57, 4.43	0.380
Peritoneal dialysis					
Less than 1 year	0 (0.00%)	0 (0.00%)	*		
More than 1 year	4 (44.44%)	5 (55.56%)	2.39	0.62, 9.19	0.206
Previous history of organ transplantation					
Yes	1 (33.33%)	2 (66.67%)	1.44	0.13, 16.19	
No	60 (25.76%)	173 (74.24%)	Reference	0.767	

*Odds ratio cannot be computed.

Table 6. Multivariable logistic regression of factors associated with *S. stercoralis* infection among KT candidates.

	Adjusted OR	95% CI	*p*-value
Female sex (*vs.* male)	0.49	0.26-0.91	0.025
Walking barefoot (sometimes/frequently *vs.* never)	2.85	1.51-5.35	0.001
Rural residence (*vs.* non rural)	1.98	0.94-4.16	0.072
Higher education (tertiary/technical *vs.* ≤ secondary)	0.79	0.42-1.48	0.455
Chronic glomerulonephritis (*vs.* other primary renal diagnoses)	0.64	0.34-1.19	0.160

Model fit: Likelihood ratio $\chi^2 = 19.4$, $p < 0.001$; Pseudo $R^2 = 0.078$.

compared to males, consistent with prior literature suggesting gender-related differences in exposure and susceptibility. Stool-based diagnostic methods failed to detect any cases, underscoring their limited sensitivity in asymptomatic, low-burden infections. Given the single-center design, convenience sampling, and absence of confirmatory parasitological or molecular diagnostics, these findings should be interpreted as preliminary and hypothesis-generating. Serologic screening and prophylaxis remain promising strategies for reducing the risk of post-transplant hyperinfection, but their routine use cannot be recommended on the basis of this study alone. Larger multicenter and longitudinal studies are needed to validate these associations, determine the clinical impact of seropositivity, and assess the feasibility, cost-effectiveness, and outcomes of proposed screening and management strategies. Incorporating molecular techniques such as PCR may help distinguish active from past infections and further refine pre-transplant evaluation protocols.

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The study protocol was approved by the NKTI Research Ethics Committee (REC) and IRB during their monthly meeting in July 2024 (Protocol and Informed Consent version 3, July 2024, Protocol number: REC 2024-41).

Informed Consent:
Written informed consent was obtained from all participants following a thorough explanation of the study's objectives and procedures.

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Conflict of Interest:
The authors report no conflicts of interest relevant to this study.

Data Availability:
The datasets generated and analyzed during the current study contain sensitive patient information and are therefore not publicly available. De-identified data may be provided by the corresponding author upon reasonable request and with permission from the National Kidney and Transplant Institute Institutional Review Board.

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