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Temporal Trends and Demographic Determinants of Intestinal Protozoan Infections in the Eastern Cape, South Africa: A Retrospective Laboratory-Based Study (2021–2024)

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Abstract

Background: Intestinal protozoan infections are a major cause of gastrointestinal disease in low- and middle-income countries, particularly in sub-Saharan Africa, where inadequate sanitation, unsafe water, and socioeconomic inequalities facilitate transmission. In South Africa, updated epidemiological data on temporal trends and demographic risk factors, especially in rural provinces such as the Eastern Cape, remain limited. This study assessed the prevalence, temporal patterns, and demographic determinants of intestinal protozoan infections using laboratory surveillance data. **Methods:** A retrospective laboratory-based study was conducted using stool examination records from 1,909 individuals tested for intestinal parasites in healthcare facilities across the Eastern Cape Province (2021–2024). Demographic variables, including age, sex, and facility type, were extracted from laboratory records. Annual prevalence trends were described, and associations between infection status and demographic variables were assessed using chi-square tests and relative risk estimates with 95% confidence intervals. **Results:** Of the 1,909 stool samples, 404 were positive for intestinal protozoa, yielding an overall prevalence of 21.2%. Identified species included *Cryptosporidium parvum* (55.2%), *Cystoisospora belli* (44.1%), and *Blastocystis hominis* (0.7%). Infection prevalence increased from 17.1% in 2021 to 37.6% in 2022, declined to 21.3% in 2023, and rose slightly to 24.0% in 2024. Age was significantly associated with infection ($\chi^2 = 132.6$, $p < 0.001$), with the 31–40 year age group at highest risk (RR = 2.60; 95% CI: 2.04–3.31). Gender was not significantly associated with infection ($p = 0.65$). Facility type was significantly associated with infection ($\chi^2 = 21.32$, $p < 0.001$), with suburban healthcare attendees at higher risk than rural attendees (RR = 1.66; 95% CI: 1.31–2.11). **Conclusions:** Intestinal protozoan infections remain prevalent in the Eastern Cape, with *C. parvum* predominating. Temporal fluctuations and associations with age and healthcare facility type suggest environmental and socioeconomic factors influence transmission. Strengthened surveillance, improved water and sanitation infrastructure, and targeted public health interventions are essential to reduce the burden of protozoan infections in rural South African communities.

Keywords: intestinal protozoan infections; epidemiology; Eastern Cape; South Africa; laboratory surveillance

Introduction

Intestinal parasitic infections (IPIs) remain a major global public health challenge, particularly in low- and middle-income countries where poor sanitation, limited access to safe drinking water, and inadequate hygiene practices facilitate transmission. It is estimated that approximately 3.5 billion

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people worldwide are infected with intestinal parasites, with nearly 450 million individuals experiencing clinical illness and over 200,000 deaths annually [1]. These infections are caused by a diverse group of helminths and protozoa, including *Ascaris lumbricoides*, *Trichuris trichiura*, *Giardia lamblia*, *Entamoeba histolytica*, and *Cryptosporidium* spp., and are closely associated with environmental and socioeconomic determinants of health [1,2]. The burden is disproportionately higher in sub-Saharan Africa, where between 200 and 500 million people are affected, reflecting persistent inequalities in access to clean water, sanitation, and healthcare services [2].

Protozoan parasites, including *Cryptosporidium* spp., *Giardia lamblia*, and *Blastocystis hominis*, are among the most frequently reported causes of intestinal infections and are commonly associated with contaminated water and food sources [3]. In recent years, waterborne protozoan parasites have gained increasing attention due to their persistence in the environment and resistance to conventional water treatment processes. *Cryptosporidium* species, in particular, have been recognised as major contributors to diarrhoeal disease outbreaks worldwide, especially in areas with compromised water sanitation infrastructure [3]. The burden of intestinal protozoan infections remains high across many African countries, where environmental, socioeconomic, and infrastructural challenges create favourable conditions for transmission [2].

In sub-Saharan Africa, and particularly in South Africa, IPIs remain endemic in rural and socioeconomically disadvantaged communities. Factors such as poverty, overcrowding, inadequate waste management, and limited access to potable water contribute significantly to sustained transmission cycles [4,5]. Within South Africa, the Eastern Cape province is among the most affected regions, characterised by high levels of poverty, underdeveloped infrastructure, and constrained healthcare access, particularly in rural settings [4]. These contextual factors increase vulnerability to both helminthic and protozoan infections.

Several studies conducted in South Africa have reported the presence and distribution of intestinal protozoan parasites in both rural and urban communities. Investigations have demonstrated considerable prevalence of *Cryptosporidium* spp. and *Giardia lamblia* across different provinces, highlighting the ongoing public health significance of these infections [6,7]. Furthermore, a recent systematic review and meta-analysis of *Cryptosporidium* infections in South Africa emphasised the widespread occurrence of this parasite in both human and animal hosts and underscored the need for improved surveillance and control strategies [8]. In the Eastern Cape specifically, studies among school children and HIV-infected populations have reported a substantial burden of intestinal parasitic infections, reinforcing the need for continued monitoring and targeted interventions [9,10].

Despite this existing body of evidence, there remains a paucity of recent, comprehensive data describing the temporal trends and epidemiological patterns of intestinal parasitic infections in the Eastern Cape. This gap is particularly important in the context of the coronavirus disease 2019 (COVID-19) pandemic and its aftermath, which may have influenced healthcare access, hygiene practices, and disease transmission dynamics [11]. While previous studies have identified associations between IPIs and socioeconomic factors such as unemployment, low educational attainment, and poor sanitation, limited attention has been given to recent temporal trends and demographic determinants of infection [9].

The lack of up-to-date epidemiological data poses a significant challenge for public health planning and intervention. Without reliable information on prevalence trends and risk factors, efforts to design targeted interventions, allocate resources effectively, and evaluate control strategies remain constrained. This is particularly critical in underserved communities, where the burden of disease is often greatest and health systems are least equipped to respond [5]. Additionally, much of the existing literature has focused predominantly on helminth infections, with comparatively less emphasis on intestinal protozoan infections despite their substantial contribution to gastrointestinal morbidity, especially among immunocompromised populations [3].

In light of these gaps, there is a need for updated laboratory-based surveillance data to better understand the burden and distribution of intestinal protozoan infections in the Eastern Cape.

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Retrospective analyses of routine diagnostic data provide valuable insights into temporal trends and demographic risk patterns and can support evidence-based public health interventions.

Therefore, the present study aimed to investigate the prevalence, temporal trends, and demographic determinants of intestinal protozoan infections in the Eastern Cape Province of South Africa between 2021 and 2024 using retrospective laboratory-based data. By generating updated epidemiological evidence, this study aims to strengthen surveillance and inform targeted strategies to prevent and control intestinal parasitic infections in vulnerable communities.

Methods

Study Design

This study employed a retrospective, descriptive, laboratory-based design to assess temporal trends and demographic determinants of intestinal protozoan infections in the Eastern Cape Province of South Africa. The retrospective approach allowed the use of existing laboratory data to determine prevalence patterns over a four-year period (2021–2024) without the need for primary sample collection, making it practical, cost-effective, and ethically sound. The descriptive design facilitated characterisation of infection rates, parasite distribution, and associations with demographic variables, while trend analysis enabled examination of temporal changes.

Study Setting

The study was conducted across multiple healthcare facilities in the Eastern Cape, the second-largest province in South Africa by land area, with an estimated population of approximately 7.2 million. The province includes diverse geographical settings, encompassing rural, suburban, and urban areas, which allowed the study to capture variation in infection risk across populations with differing socioeconomic, environmental, and healthcare access conditions. Laboratory data were obtained from the National Health Laboratory Service (NHLS) database, which routinely collects and stores diagnostic results from public health facilities throughout the province.

Study Population and Inclusion Criteria

The study population consisted of all patients residing in the Eastern Cape who submitted stool samples for parasitological examination between January 2021 and December 2024. Only records with complete demographic data, including age, gender, and facility name, were included. Additionally, laboratory records had to indicate that stool samples were tested for intestinal protozoan parasites. Records with missing key demographic or diagnostic information, or samples from non-residents of the Eastern Cape, were excluded from the analysis.

Sampling Method

To ensure that the dataset was representative of the population served by the health facilities, a stratified random sampling method was employed. Data were stratified by facility type—rural, suburban, and urban—to capture geographic variation in infection risk. Within each stratum, records were randomly selected using Microsoft Excel's random number generator to minimize selection bias and ensure unbiased sampling.

Sample Size

The calculated minimum sample size was 385 records. To enhance statistical power, accuracy, and representativeness, 1,909 records meeting the inclusion criteria were retrieved from the NHLS database.

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Data Instrumentation

Data were extracted from the NHLS database in Microsoft Excel format, which contained routinely collected laboratory results. Extracted variables included the year of stool examination, parasite species identified, patient age and gender, and facility location classified as rural, suburban, or urban. The dataset was carefully reviewed to remove duplicate entries and records with missing information.

Data Collection Procedures

The NHLS provided de-identified datasets in Excel format. Each record was assigned a unique identifier to maintain patient confidentiality. Relevant variables were systematically extracted, coded, and organised for analysis. The dataset underwent cleaning to remove inconsistencies and prepare it for statistical evaluation.

Data Analysis

Data were analysed using SPSS version 28.0. Descriptive statistics were used to calculate frequencies, percentages, and prevalence rates for each parasite species annually. Temporal trends in infection prevalence were visualized using line graphs. Associations between infection status and demographic variables, including age, gender, and facility type, were evaluated using chi-square tests, while relative risk estimates with 95% confidence intervals quantified the strength of observed associations. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Walter Sisulu University Health Research Ethics Committee (WSU HREC Ref. 020/2025, 09 July 2025). As this study used secondary data, there was no direct patient contact. Confidentiality and privacy were strictly maintained through the de-identification of records and the use of unique study codes. Access to the dataset was restricted to the principal investigator and supervisor, and data were stored on a secure, password-protected computer. Permissions for data use were also obtained from the Eastern Cape Department of Health (EC_202507_043, 17 July 2025) and the National Health Laboratory Services (PR2560704, 12 September 2025)

Results

Demographic Characteristics

A total of 1,909 individuals submitted stool samples for parasitological examination between 2021 and 2024. The age distribution of participants showed that 29.8% were aged 0–5 years, 4.5% were 6–15 years, 14.2% were 16–30 years, 17.7% were 31–40 years, 13% were 41–50 years, 15.4% were 51–70 years, and 5.4% were 71–95 years. Female participants comprised 55.4% (1,057/1,909) of the study population, while males accounted for 44.6% (852/1,909) (Table 1).

Table 1. Demographic characteristics of study participants (n=1,909).

Variable	n	%
Age (years)		
0–5	568	29.8
6–15	86	4.5
16–30	272	14.2
31–40	337	17.7
41–50	248	13.0
51–70	294	15.4
71–95	104	5.4

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Gender		
Male	852	44.6
Female	1,057	55.4

Prevalence and Species Distribution of Intestinal Parasites

Among the 1,909 stool samples, 404 tested positives for intestinal parasites, yielding an overall prevalence of 21.2%. Three protozoan species were identified: *Cryptosporidium parvum* (55.2%, 223/404), *Cystoisospora belli* (44.1%, 178/404), and *Blastocystis hominis* (0.7%, 3/404). The highest number of infections occurred in 2022 (37.6%), while the lowest prevalence was observed in 2021 (17.1%).

Table 2. Annual distribution of intestinal protozoan infections in the Eastern Cape.

Parasite species	2021 n (%)	2022 n (%)	2023 n (%)	2024 n (%)	Total n (%)
Cryptosporidium parvum	19 (4.7)	105 (26.0)	49 (12.1)	50 (12.4)	223 (55.2)
Cystoisospora belli	49 (12.1)	46 (11.4)	36 (8.9)	47 (11.6)	178 (44.1)
Blastocystis hominis	1 (0.2)	1 (0.2)	1 (0.2)	0 (0.0)	3 (0.7)
Total	69	152	86	97	404

Annual Prevalence of Intestinal Protozoan Infections

Figure 1 illustrates the annual prevalence of intestinal protozoan infections stratified by age groups over the four-year study period. Participants aged 16–40 years consistently had the highest infection prevalence, peaking in 2022 at approximately 20%, followed by a decline in 2023 and a modest increase in 2024. The >40 years age group showed a moderate prevalence, ranging from 4.5% in 2021 to 8.9% in 2022 and a gradual increase to 9% in 2024. Children aged ≤5 years had a lower prevalence overall, peaking at 7.1% in 2022 and declining steadily thereafter. The 6–15-year age group had the lowest infection rates throughout the study period, remaining below 1% in all years. These trends indicate a pronounced vulnerability among young and middle-aged adults, while younger children and adolescents exhibited comparatively lower infection rates. The observed peak in 2022 across most age groups may reflect temporal fluctuations in exposure risk, environmental conditions, or healthcare-seeking behaviour during that period.

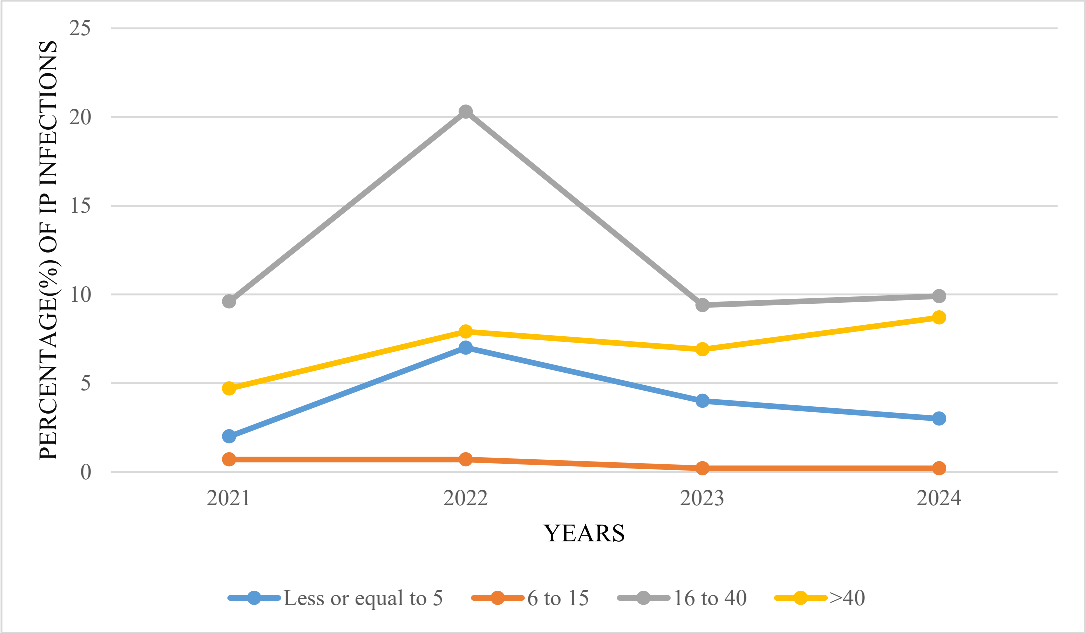

Figure 1. Annual prevalence of intestinal protozoan infections in the Eastern Cape (2021–2024).

Annual Prevalence of Intestinal Protozoan Infections by Gender in the Eastern Cape

Figure 2 illustrates the yearly distribution of intestinal protozoan infections among male and female participants from 2021 to 2024. Across all years, males consistently had a higher infection prevalence than females. In 2021, infection prevalence was 10.4% among males and 6.7% among females. The highest prevalence for males occurred in 2022 at 14.8%, followed by a decline to 7.7% in 2023 and a slight increase to 10.9% in 2024. Female participants had lower and more stable prevalence rates, ranging from 2.5% in 2022 to 4.5% in 2024. These patterns suggest a gender-specific vulnerability to intestinal protozoan infections, with males consistently at higher risk throughout the study period. Temporal fluctuations may reflect changes in exposure, behavioral factors, or other environmental determinants influencing infection risk.

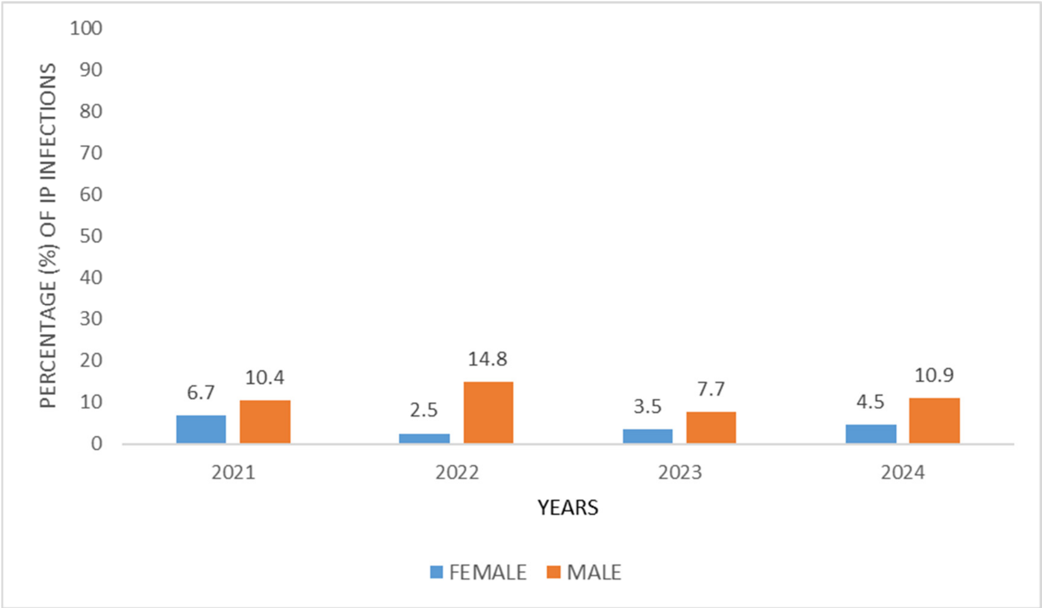

Figure 2. Annual prevalence of intestinal protozoan infections by gender in the Eastern Cape (2021–2024).

Infection Trends by Age and Gender

Analysis of infection patterns by demographic variables showed that age was significantly associated with infection ($\chi^2 = 132.6$, df = 8, $p < 0.001$). Individuals aged 31–40 years had the highest risk (RR = 2.60; 95% CI: 2.04–3.31), while participants aged 61–70 and 71–80 years had a lower risk compared with children aged ≤5 years (Table 3). No significant association was observed between infection status and gender ($\chi^2 = 0.20$, df = 1, $p = 0.65$).

Table 3. Association of intestinal protozoan infection with age and gender (2021–2024).

Variable	Infected n	Non-infected n	Total n	Relative Risk (95% CI)	p-value
Gender					
Male	177	675	852	Reference	-
Female	229	830	1,057	0.96 (0.81–1.14)	0.69
Age (years)					
≤5	83	485	568	Reference	-
6–15	8	78	86	0.64 (0.32–1.27)	0.24
16–30	71	201	272	1.79 (1.35–2.37)	<0.001
31–40	128	209	337	2.60 (2.04–3.31)	<0.001
41–50	74	174	248	2.04 (1.55–2.69)	<0.001

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51–60	28	136	164	1.17 (0.79–1.73)	0.46
61–70	9	121	130	0.47 (0.24–0.92)	0.02
71–80	3	79	82	0.25 (0.08–0.77)	0.004
81–99	0	22	22	-	0.06

Association with Healthcare Facility Type

The type of healthcare facility was significantly associated with infection status ($\chi^2 = 21.32$, df = 2, $p < 0.001$). Participants attending suburban facilities were at higher risk of infection than those attending rural facilities (RR = 1.66; 95% CI: 1.31–2.11), whereas urban facilities did not differ significantly from rural facilities (RR = 0.94; 95% CI: 0.78–1.14) (Table 4).

Table 4. Association of intestinal parasitic infection with healthcare facility type.

Facility Type	Number of Participants with Infection	Relative Risk (RR) (95% CI)	P-value
Rural	159	Reference (REF)	—
Suburban	66	1.66 (1.31–2.11)	<0.001
Urban	179	0.94 (0.78–1.14)	0.54

Discussion

This retrospective laboratory-based study provides important insights into the prevalence, temporal trends, and demographic determinants of intestinal protozoan infections in the Eastern Cape Province, South Africa. The overall prevalence of 21.2% observed in this study is consistent with reported estimates from Southern Africa and other sub-Saharan African regions, where protozoan prevalence ranges from 15% to 30% depending on the study population and diagnostic approach [12,13]. For instance, studies conducted in Limpopo and KwaZulu-Natal provinces have reported prevalence rates ranging from 18% to 28%, particularly among symptomatic patients and immunocompromised individuals [13,14]. Similarly, systematic reviews across Africa have estimated pooled prevalence values of approximately 20–25%, reinforcing the persistent burden of intestinal protozoa across the continent [15].

Globally, the burden of protozoan infections remains substantial, particularly in low-resource settings where water, sanitation, and hygiene (WASH) infrastructure is inadequate. Comparable prevalence estimates have been reported in parts of Asia and Latin America, although variability exists depending on environmental and socioeconomic contexts [16]. The concordance of our findings with both regional and global data underscores the endemic nature of intestinal protozoan infections and highlights the continued relevance of these pathogens as major contributors to gastrointestinal disease.

The predominance of *Cryptosporidium parvum* (55.2%) and *Cystoisospora belli* (44.1%) in this study aligns with findings from other African and global studies that identify these protozoa as important opportunistic pathogens, particularly among immunocompromised populations such as people living with HIV [12,15,17]. In South Africa, *Cryptosporidium* species have consistently been reported as leading causes of diarrhoeal disease in both paediatric and adult populations, particularly in high HIV-burden settings [14,17].

However, the relatively low prevalence of *Blastocystis hominis* (0.7%) observed in this study contrasts with findings from other regions, where prevalence rates of 10–30% have been reported [16,18]. This discrepancy may be attributed to differences in diagnostic techniques, as microscopy-based methods used in routine laboratory settings may underestimate *Blastocystis* detection compared to molecular methods such as PCR [18]. Additionally, regional variations in environmental exposure, host immunity, and gut microbiota composition may influence the distribution of this organism.

The significant association between age and infection risk observed in this study, with the highest burden among adults aged 31–40 years, is consistent with emerging evidence from sub-

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Saharan Africa indicating increased exposure among economically active populations [19]. This pattern differs from traditional assumptions that children bear the highest burden of intestinal parasitic infections. While paediatric populations remain vulnerable, particularly to helminth infections, protozoan infections in adults may reflect occupational exposure, mobility, and increased interaction with contaminated environments [15,19].

Conversely, some studies in Africa and Asia have reported higher prevalence among children under five years of age, particularly for *Cryptosporidium* infections associated with poor sanitation and childcare environments [16,20]. The difference observed in this study may be explained by healthcare-seeking behaviour, as adults are more likely to present for testing in facility-based settings, or by differences in immunity, exposure patterns, and ART coverage among HIV-infected populations.

The lack of a significant association between gender and infection status in this study is consistent with several regional and global studies reporting no clear sex-based differences in protozoan infections [13,15]. However, some studies have reported higher prevalence in males, potentially linked to occupational exposure and behavioural factors [19]. The absence of gender disparity in this cohort suggests relatively equal exposure patterns between males and females within the study population.

One notable finding of this study is a higher risk of infection among individuals attending suburban healthcare facilities compared with those attending rural facilities. This observation contrasts with many studies that report higher prevalence in rural areas due to limited infrastructure and sanitation challenges [14,15]. However, similar patterns have been observed in peri-urban settings, where rapid urbanisation, informal settlements, and inadequate service delivery create environments conducive to disease transmission [21].

Suburban areas in the Eastern Cape may represent transitional zones where overcrowding, inconsistent water supply, and poor waste management intersect, thereby increasing exposure risk. In contrast, some rural communities may benefit from targeted public health interventions, such as community-based water programs and outreach services, which can mitigate infection risk [21]. This finding highlights the need to reconsider traditional rural–urban dichotomies and adopt more nuanced approaches to understanding environmental risk factors.

The observed temporal fluctuations, particularly the 2022 peak, may reflect a combination of environmental and systemic factors. Changes in rainfall patterns, water quality, and sanitation conditions have been shown to influence protozoan transmission dynamics [16]. Additionally, the COVID-19 pandemic may have disrupted routine healthcare services, sanitation programs, and health-seeking behaviours, thereby affecting disease reporting and transmission patterns [11,22].

Similar post-pandemic fluctuations in infectious disease patterns have been reported globally, with some studies noting increased incidence of waterborne infections following disruptions in public health systems [22]. These findings underscore the importance of resilient health systems and continuous surveillance to detect and respond to emerging trends.

Overall, the findings of this study are largely consistent with regional and continental evidence highlighting the persistent burden of intestinal protozoan infections in Africa. However, differences in species distribution, age patterns, and facility-based risk suggest that local environmental and socioeconomic contexts play a critical role in shaping epidemiological patterns.

Globally, studies from high-income countries report lower prevalence rates (<10%), largely due to improved sanitation, water treatment systems, and robust surveillance mechanisms [16]. The higher prevalence observed in this study reinforces the ongoing disparities between high- and low-resource settings and highlights the need for targeted interventions in endemic regions.

Public Health Relevance

The findings of this study have important implications for public health planning, policy formulation, and intervention strategies. The persistently high prevalence of intestinal protozoan infections underscores the urgent need to strengthen water, sanitation, and hygiene (WASH) systems,

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particularly in peri-urban and underserved communities where transmission risk remains elevated. Improving access to safe water, adequate sanitation, and hygiene practices is essential for reducing the burden of these infections.

Given the strong association between protozoan infections and immunocompromised states, particularly HIV/AIDS, there is a clear need to integrate routine screening, prevention, and management of these infections into HIV care and broader primary healthcare services. Such integration would facilitate early detection and treatment, thereby reducing morbidity among vulnerable populations.

The observed higher burden among adults further underscores the importance of expanding public health interventions beyond the traditional focus on children. Targeted strategies should include working-age populations, especially those with increased environmental or occupational exposure, to ensure a more comprehensive and inclusive approach to disease control.

In addition, the potential underestimation of certain protozoa, such as *Blastocystis hominis*, points to the need for improved diagnostic capacity. Strengthening laboratory systems through the incorporation of more sensitive techniques, including molecular methods, alongside robust surveillance systems, will enhance the accuracy of disease monitoring and inform evidence-based interventions.

The study also highlights the importance of context-specific risk assessment. The increased risk observed in suburban settings suggests that public health strategies should move beyond the conventional rural–urban dichotomy and instead focus on identifying and addressing peri-urban hotspots where infrastructural and environmental challenges intersect.

Furthermore, the temporal variations observed, particularly in relation to the COVID-19 pandemic, emphasize the need for resilient health systems capable of maintaining essential services, sanitation programs, and disease surveillance during public health emergencies. Strengthening system resilience is critical to ensuring continuity of care and effective response to emerging health threats.

Ultimately, controlling intestinal protozoan infections requires a multi-sectoral approach that addresses broader social and environmental determinants of health. Interventions must extend beyond the health sector to include improvements in housing, water supply, waste management, and urban planning, thereby tackling the root causes of transmission and promoting sustainable public health outcomes.

Public Health Significance

This study demonstrates that intestinal protozoan infections remain endemic and epidemiologically important in the Eastern Cape, with a prevalence (21.2%) consistent with regional and continental estimates. This confirms that these infections continue to contribute substantially to the burden of gastrointestinal disease in low-resource settings.

The predominance of opportunistic pathogens such as *Cryptosporidium parvum* and *Cystoisospora belli* highlights their critical role in vulnerable populations, particularly individuals living with HIV/AIDS. These infections are associated with chronic diarrhoea, malnutrition, and increased morbidity, reinforcing their importance in settings with a high HIV burden.

Importantly, the study identifies shifting epidemiological patterns, with the highest infection rates occurring among adults aged 31–40 years. This challenges the conventional focus on children and suggests that protozoan infections also significantly affect the economically productive segment of the population, with potential implications for workforce productivity and healthcare demand.

The higher infection risk observed in suburban settings further underscores the role of peri-urbanisation, inadequate sanitation, and service delivery gaps as key drivers of transmission. This finding highlights that protozoan infections are not limited to rural poverty but are also shaped by urban inequalities and transitional living environments.

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Additionally, the temporal fluctuations observed, particularly around the COVID-19 pandemic period, demonstrate the sensitivity of these infections to environmental changes and disruptions in health systems, emphasizing their value as indicators of public health system resilience.

Overall, intestinal protozoan infections serve as important markers of environmental health, socioeconomic inequality, and gaps in basic public health infrastructure.

Public Health Implications

The high prevalence of protozoan infections observed in this study underscores a significant public health concern with implications for clinical management, surveillance, and prevention. Protozoan infections contribute to chronic diarrhoea, malnutrition, and impaired quality of life, particularly among vulnerable populations such as children and immunocompromised individuals [15,17].

Targeted interventions should prioritise improvements in water, sanitation, and hygiene (WASH) infrastructure, particularly in peri-urban and underserved communities. Strengthening laboratory diagnostic capacity, including the integration of molecular methods, may improve detection and surveillance. Furthermore, community-based health education programs focusing on hygiene practices and safe water use are essential for reducing transmission.

The findings also support the adoption of a One Health approach, recognising the interconnected roles of human, animal, and environmental health in the transmission of protozoan infections [15].

Strengths and Limitations

This study has several strengths, including the use of a large, multi-year dataset that enables robust assessment of temporal trends and demographic determinants. The use of routine laboratory data provides real-world insights into infection patterns in a region with limited surveillance data.

However, several limitations should be considered. The retrospective design limits access to individual-level clinical, behavioural, and socioeconomic data, which may influence infection risk. Selection bias may have occurred, as only individuals who submitted stool samples were included. Additionally, reliance on microscopy-based diagnostic methods may underestimate the true prevalence of protozoan infections compared to more sensitive molecular techniques [18]. Finally, the use of data from a single regional laboratory may limit the generalisability of findings to other settings.

Conclusions

This study provides comprehensive epidemiological evidence that intestinal protozoan infections remain a persistent and significant public health concern in the Eastern Cape Province of South Africa. The findings demonstrate that these infections are not only widespread but also shaped by a complex interplay of demographic, environmental, and health system factors.

The observed distribution of infections highlights important shifts in risk patterns, particularly the notable burden among economically active adults and populations residing in peri-urban settings. These patterns suggest that exposure is increasingly linked to mobility, occupational activities, and infrastructural challenges associated with rapid urbanisation, rather than being confined to traditionally recognised high-risk groups or rural environments. The prominence of opportunistic protozoa further emphasises the ongoing vulnerability of individuals living with HIV/AIDS, reinforcing the need for integrated and context-sensitive healthcare approaches.

Temporal variations in infection trends indicate that protozoan transmission is responsive to broader environmental and systemic influences, including disruptions associated with the COVID-19 pandemic. This underscores the importance of resilient health systems and sustained surveillance mechanisms that can adapt to changing public health conditions.

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Taken together, these findings highlight that intestinal protozoan infections are closely linked to underlying inequalities in access to safe water, sanitation, and healthcare services. Addressing this burden will require coordinated, multi-sectoral strategies that extend beyond clinical management to include improvements in environmental health infrastructure, strengthened diagnostic and surveillance capacity, and targeted community-level interventions.

Future research should prioritise prospective and community-based studies incorporating molecular diagnostic methods and detailed socio-environmental data to better elucidate transmission dynamics and inform tailored interventions. Ultimately, sustained investment in both public health systems and social infrastructure will be essential to reduce the burden of protozoan infections and improve population health outcomes in endemic settings.

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