BMC Infectious Diseases

RESEARCH

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The prevalence trends of *Trichomonas vaginalis* infection among women in Jingzhou, central of China, 2019–2023

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Abstract

Background *Trichomonas vaginalis* (*T. vaginalis*) is one of the most prevalent sexually transmitted infections globally, with significant regional variations in its prevalence. This study aimed to examine the epidemiological characteristics of *T. vaginalis* infection in Jingzhou, Hubei Province, China.

Methods To obtain the prevalence of *T. vaginalis* infection among age groups and different years, a total of 115,775 patients from 2019 to 2023 were included in this study. Two detection methods including immunochromatographic assay and wet mount microscopy were used to detect the pathogens in vaginal swabs samples including *T. vaginalis* with other vaginal pathogens, such as *Candida albicans* (*C. albicans*) and *Gardnerella Vaginalis* (*G. vaginalis*).

Results The overall prevalence of *T. vaginalis* in Jingzhou was 3.41%, demonstrating a decreasing trend from 2019 to 2023, with a particularly significant decrease during the COVID-19 pandemic in 2020–2022 ($P < 0.001$). The highest positive rate of *T. vaginalis* was observed in the 45–54 years age group (4.87%), while the lowest rate was observed in the 25–34 years age group (2.37%). The prevalence of *T. vaginalis* in pregnant women (0.83%) was lower than that in non-pregnant women (1.87%), with a statistically significant difference ($P < 0.001$). *T. vaginalis* had co-infection with other pathogens (2.76%) compared to single infection (0.65%), and the most common co-infection pattern was *T. vaginalis* and *G. vaginalis* (2.09%). The results showed that there was relative high consistency (Kappa: 0.841) between the immunochromatographic assay and wet mount microscopy method for the detection of *T. vaginalis*. Additionally, elevated leukocyte levels were associated with a higher prevalence of *T. vaginalis*.

Conclusion The overall infection rate of *T. vaginalis* was 3.41%, showing a decreasing trend in prevalence in Jingzhou from 2019 to 2023. The prevalence was the highest in the 45–54 years age group. The study suggested that the immunochromatographic assay should be widely implemented as a screening method for *T. vaginalis* in primary healthcare facilities.

Keywords Prevalence, *Trichomonas vaginalis*, Wet mount microscopy, Immunochromatographic assay, COVID-19

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Introduction

Sexually transmitted diseases (STDs) cause a significant number of infections each year. The World Health Organization (WHO) estimated that there were 376 million new cases of chlamydia, gonorrhoea, syphilis and trichomoniasis in 2016, of which 156 million cases were attributed to *Trichomonas vaginalis* (*T. vaginalis*, *Donné*, 1836) infection [1]. *T. vaginalis* is a unicellular parasite that parasitizes the human genitourinary tract and can cause trichomoniasis, which is one of the most common non-viral STDs pathogens worldwide [2]. A previous study had shown that 12.1% of women with *T. vaginalis* infection were asymptomatic [3]. As a result, a portion of the infected population may go undiagnosed, leading to delays in diagnosis and treatment. Meanwhile, the Centers for Disease Control and Prevention (CDC) has placed trichomoniasis on its list of Neglected Parasitic Infections (NPI) [4]. However, the public health and economic consequences of *T. vaginalis* infection cannot be overlooked. Recent studies have demonstrated that *T. vaginalis* infection is associated with vaginitis, pelvic inflammatory disease, and poor birth outcomes, and this infection can also increase the risk of HIV, *Treponema pallidum*, and *Human papillomavirus* infection [5, 6]. The WHO has also published a global health strategy for STDs control, which aims to substantially reduce new cases of trichomoniasis before 2030 [7]. Therefore, further researches are needed on the epidemiological characteristics of *T. vaginalis* infection in different regions.

At present, there are several testing methods to identify *T. vaginalis* infection, such as PCR, with higher sensitivity than other traditional methods [8, 9], whereas no diagnosis kit has been approved by National Medical Products Administration (NMPA) in China so far. Therefore, the main clinical detection methods are immunochromatographic assay and wet mount microscopy in China. The advantage of immunochromatographic assay is that it is not limited by time and place, so patients can complete the test in primary healthcare facilities or even at home. Although the immunochromatographic assay has higher sensitivity, there are also false positives exiting, and positive samples should be added for supplementary experiments. As a classical method, wet mount microscopy has been used as the important standard for the detection of *T. vaginalis* [5]. Although the sensitivity of wet mount microscopy is influenced by the experience of the technician and has been reported to be between 69.7% and 75% compared to nucleic acid amplification tests [10, 11], its specificity can be up to 100%, and is still the fastest and the most widely used method for the diagnosis of trichomoniasis in China. Few studies have compared the consistency of immunochromatographic assay and wet mount microscopy in the detection of *T. vaginalis*.

Trichomoniasis is not considered as a notifiable infectious disease, and there is a lack of reliable data on the global and national prevalence, and the infection rate of *T. vaginalis* varies greatly in different regions [12, 13]. According to the WHO, the overall prevalence of *T. vaginalis* infection is higher in underdeveloped regions [14]. Currently, research on the prevalence of *T. vaginalis* in China is limited [15, 16], and there are no relevant reports in Jingzhou especially. This study aimed to reveal the epidemiological characteristics of *T. vaginalis* infection in Jingzhou, and evaluate the consistency of immunochromatographic assay and wet mount microscopy method for the detection of *T. vaginalis*. Additionally, we analyzed the co-infection of *T. vaginalis*, *C. albicans* and *G. vaginalis*. These results can provide an important guiding basis for the epidemiology and diagnosis of *T. vaginalis* in Jingzhou, central of China.

Methods

Study participant

The study population was female patients who visited the Jingzhou Hospital Affiliated to Yangtze University for various reasons and underwent vaginal discharge testing from January 2019 to December 2023. The inclusion criteria: (1) females aged over 18 years, (2) sexual abstinence over 24 h, (3) at least one clinical symptom such as abnormal vaginal discharge, vaginal bleeding, pruritus, and pain. The exclusion criteria: (1) under 18 years, (2) virgin, (3) immune deficiencies, (4) with vaginal medication less than 72 h.

Population settings

A total of 115,775 patients were included in this study. The patients were divided into six groups according to age: 18–24 years age group ($n = 7,877$), 25–34 years age group ($n = 33,603$), 35–44 years age group ($n = 30,876$), 45–54 years age group ($n = 30,535$), 55–64 years age group ($n = 9,854$), ≥65 years age group ($n = 3,030$). Additionally, the patients were divided into four groups according to leukocyte level in the vaginal sample, 0–1+(0 ~ 5/HPF), 2+(> 5 ~ ≤ 15/HPF), 3+(> 15 ~ ≤ 30/HPF), 4+(> 30/HPF).

Samples collection

The samples were collected by an experienced clinician using a specialized vaginal swab (Gongdong Medical Technology Co., Ltd, Zhejiang, China). The patient was instructed to lie down, after which the swab was inserted into the vagina and rotated for 20 s. The swab was then carefully removed and placed into the sampling tube (Gongdong Medical Technology Co., Ltd, Zhejiang, China) and immediately sent for testing. All procedures were explained to the patients and informed consent was obtained prior to samples collection. This study was

approved by the Ethics Committee of Jingzhou Hospital Affiliated to Yangtze University (2024-131-01).

Immunochromatography

All samples were tested using immunochromatographic assay with the triple detection card kit (Tigsun, Beijing, China) to simultaneously detect *T. vaginalis*, *C. albicans* and *G. vaginalis* antigens. The samples were processed according to the kit instructions, and the results were detected using a Tigsun-1000 immunochromatographic analyzer (Tigsun, Beijing, China).

Wet mount microscopy

All samples were analyzed using wet mount microscopy method by trained and qualified technicians. Briefly, samples were directly smeared onto glass slides, followed by the addition and mixing of 1–2 drops of physiological saline. A coverslip was placed on top to prevent air bubbles. All the prepared slides were examined for *T. vaginalis* trophozoites and leukocytes using optical microscopy (Olympus, Japan).

Statistical analysis

Categorical variables were analyzed using the Pearson chi-square test. Kappa consistency tests were utilized to evaluate the agreement between the immunochromatographic assay and wet mount microscopy. According to Cohen's suggestion for Kappa values ≤ 0 indicates no agreement, 0.01–0.20 represents none to slight agreement, 0.21–0.40 signifies fair agreement, 0.41–0.60 denotes moderate agreement, 0.61–0.80 reflects substantial agreement, and 0.81–1.00 corresponds to almost perfect agreement. A *P*-value of less than 0.05 was considered statistically significant. Data were analyzed using SPSS version 23 (IBM, USA).

Results

The overall prevalence of *T. vaginalis*

A total of 115,775 patients were included in this study, of which 3,946 were positive for *T. vaginalis* infection with immunochromatographic assay, showing the overall prevalence of 3.41%. As shown in Fig. 1, the positive rates in different years were listed below: 2019 (6.19%), 2020 (3.74%), 2021 (4.22%), 2022 (1.89%), and 2023 (1.30%) respectively. The overall incidence rate showed a significant decreasing trend from 2019 to 2023 ($\chi^2 = 1053.71$, $P < 0.001$). The results showed that the positive rate in January and February was higher than in other months of each year.

Consistency between immunochromatographic assay and wet mount microscopy

In this study, immunochromatographic assay and wet mount microscopy method for diagnosing trichomoniasis both had positive results in 438 patients (1.01%), and a total of 42,666 patients (98.61%) had negative results in both tests. Additionally, 156 patients (0.36%) were positive by immunochromatographic assay and negative in wet mount microscopy method, while only 7 patients (0.02%) were positive by wet mount microscopy but negative in immunochromatographic assay, as shown in Table 1. In this study, the results indicated a relatively high consistency between the immunochromatographic assay and wet mount microscopy methods (Kappa: 0.841). The microscopic view of the *T. vaginalis* trophozoites observed using the wet mount microscopy was presented in Fig. 2.

T. vaginalis infection in different age groups

The results showed that the highest prevalence of *T. vaginalis* was observed in the 45–54 years age group (4.87%),

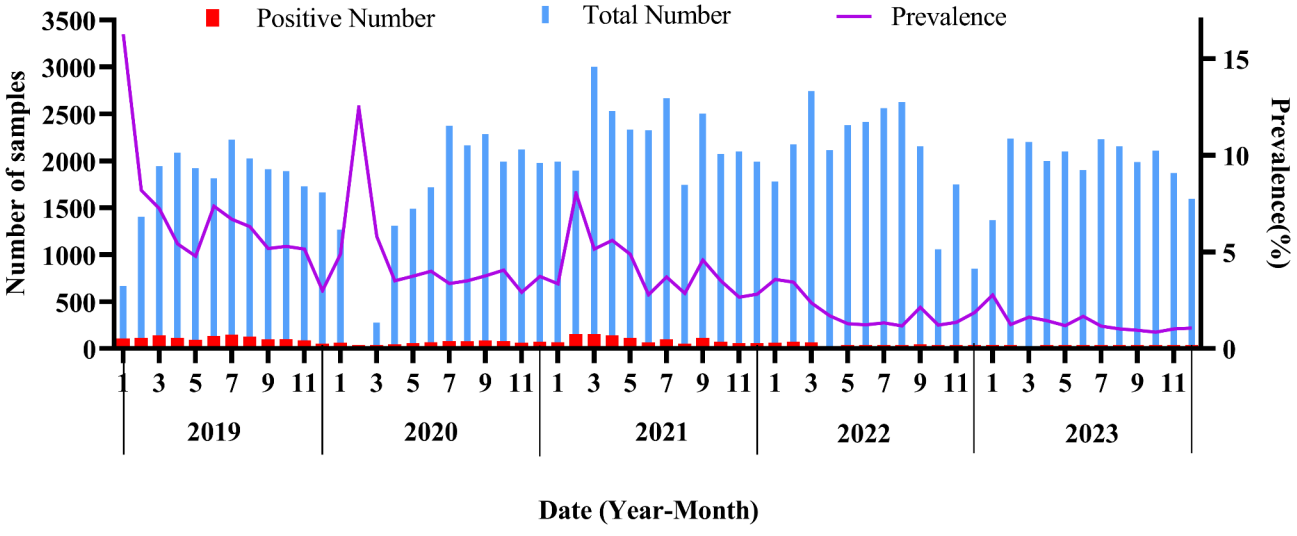

Fig. 1 The prevalence of *T. vaginalis* with seasons in Jingzhou, 2019–2023

Table 1 Consistency between immunochromatographic assay and wet Mount microscopy method

Immunochromatography assay	wet mount microscopy		Total
	Positive	Negative	
Positive	438 (1.01%)	156 (0.36%)	594 (1.37%)
Negative	7 (0.02%)	42,666 (98.61%)	42,673 (98.63%)
Total	445 (1.03%)	42,822 (98.97%)	43,267 (100%)

followed by the 55–64 years age group (3.34%) and 18–24 years age group (3.31%). As shown in Fig. 3, the lowest prevalence of *T. vaginalis* was found in the 25–34 years age group. A significant difference in the prevalence of *T. vaginalis* infection was observed among the six age groups ($\chi^2 = 314.74$, $P < 0.001$).

Association between *T. vaginalis* infection and leukocytes level

The results showed a statistically significant difference among the different leukocyte level groups ($\chi^2 = 343.42$, $P < 0.001$), with the highest positive rate was in the 4+(> 30/HPF) group (3.79%) and the lowest in the 0–1+(0 ~ 5/HPF) group (0.19%), as shown in Table 2.

Single infection and multiple infections

Single infection with *T. vaginalis* (0.65%) was lower than *C. albicans* (12.35%) and *G. vaginalis* (21.47%). The highest rate of co-infection was *T. vaginalis* and *G. vaginalis* pattern (2.09%), whereas the lowest rate of co-infection pattern was *T. vaginalis* and *C. albicans* (0.09%). The prevalence of triple pathogens co-infection was 0.58%, as shown in Table 3. Furthermore, the study revealed that the association between leukocyte levels and the multiple infection pattern was not statistically significant ($\chi^2 = 14.42$, $P > 0.05$), as shown in the Additional file 1.

T. vaginalis infection in pregnant women

The results showed that only 29 patients (0.83%) in the pregnant women group were infected by *T. vaginalis*, while 1.87% in the non-pregnant women group. This suggested that the rate of *T. vaginalis* infection in pregnant women was significantly lower than in non-pregnant women ($\chi^2 = 19.76$, $P < 0.001$), as shown in Table 4.

Discussion

In this study, we analyzed the prevalence trends of *T. vaginalis* in Jingzhou, China, from 2019 to 2023. The results indicated that the overall infection rate was 3.41%, which was higher than that in Xinxiang (1.64%) Henan Province [17] and Beijing (1.70%) [18], but lower than that in Egypt (8.0%) [8] and South Africa (12.9%) [19]. As previous studies reported, the prevalence of *T. vaginalis* also varied widely among different ethnic groups [20–22]. In addition, it was observed that the positive rates in January and February were higher than that in other months. It was speculated that during the winter months, people preferred to stay at home and only sought medical services when they felt significantly unwell, which could explain the higher positive rate in winter season. This is also consistent with the lower total number of tests conducted in January and February compared to other months.

There was a significant difference in the prevalence of *T. vaginalis* infection during and after the COVID-19 pandemic. During the COVID-19 pandemic, the prevalence of *T. vaginalis* declined significantly and showed a downward trend from 2020 to 2022, consistent with a previously reported study that showed a significant negative correlation between COVID-19 and STDs [23]. This may be related to the non-pharmaceutical interventions (NPIs) during the COVID-19 pandemic, such as prohibiting social gatherings, maintaining social distancing, and imposing travel restrictions, which contributed to the decrease in infection rates [24–26]. It was worth noting that in January 2020, the SARS-CoV-2 outbreak occurred in Wuhan, China, and the number of samples decreased significantly in February and March, with only 8 and 276 cases were collected, respectively. The sharp drop in total number of samples led to a temporary increase in *T. vaginalis* infection rates. A possible explanation was that patients with obvious clinical symptoms sought medical examination, leading to a high positive rate of 12.5% in February and 5.8% in March. After the COVID-19 epidemic in 2023, the prevalence rate of *T. vaginalis* in Jingzhou remained relatively low (1.30%) and it was illustrated that the prevalence showed a declining trend year by year from 2019 to 2023. It was speculated that the possible reason might be the impact of the COVID-19 pandemic on people's lifestyles and social behaviors. However, continuous monitoring of the *T. vaginalis* infection rate is necessary, and whether the infection rate will increase again in Jingzhou remains a concern. Further investigations are needed to estimate whether the community-based infection of COVID-19 in China may reshape immunity against STDs pathogens in the future studies.

The results showed that the positive rate of *T. vaginalis* using the immunochromatographic assay was 1.37%, while the wet mount microscopy method was 1.03%, showing good consistency between the two methods. The immunochromatographic assay has developed rapidly and can diagnose multiple pathogen antigens in a single swab test simultaneously. Our results indicated that the immunochromatographic assay was more convenient for use in primary healthcare facilities compared to wet mount microscopy method.

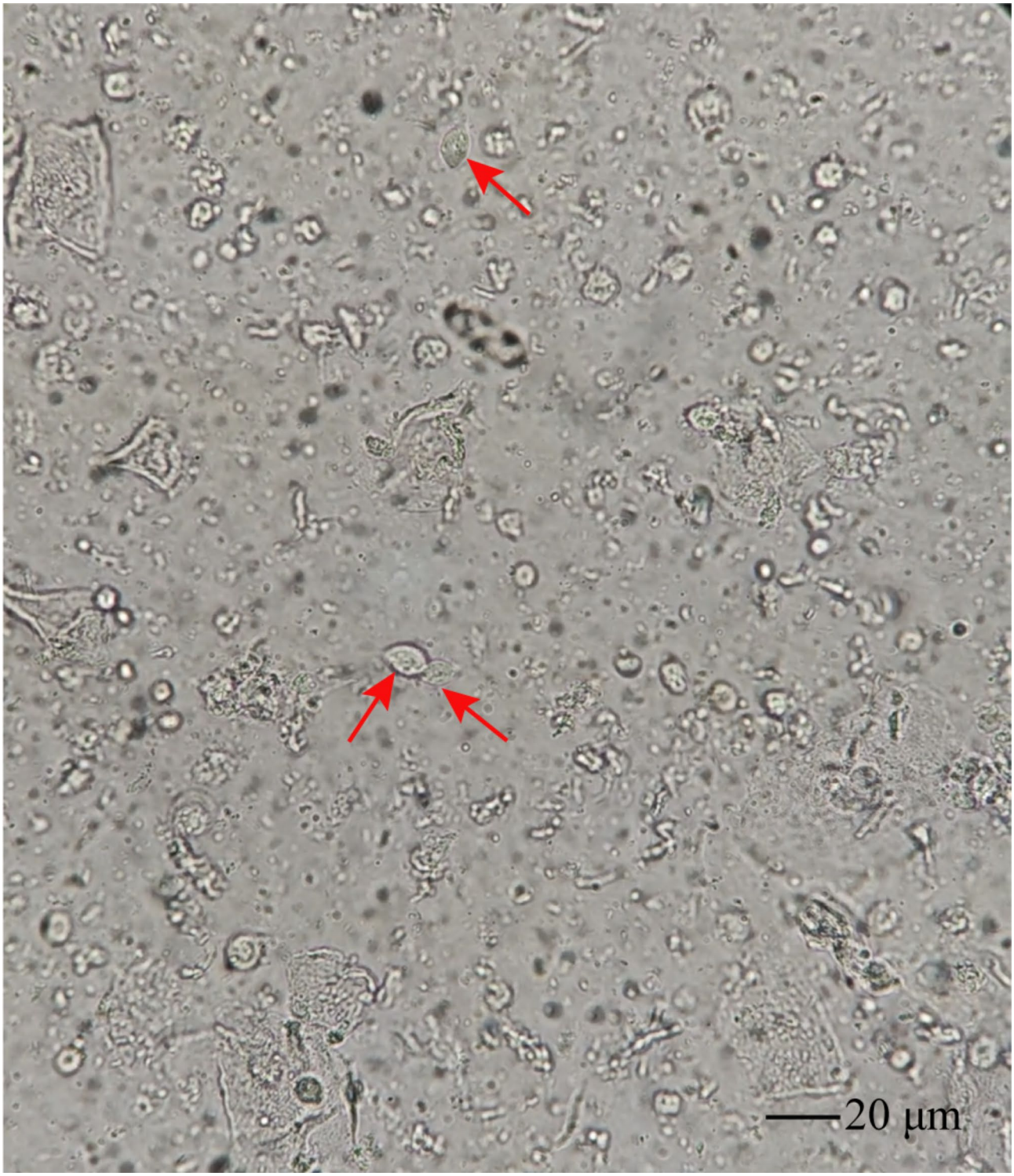

Fig. 2 Microscopic view of *T. vaginalis* trophozoites. The vaginal discharge sample was prepared and examined directly by wet mount microscopy (4× ocular lens, 10× objective lens). Scale bar = 20 μm. The red arrow indicates *T. vaginalis* trophozoites

Our study found that the prevalence of *T. vaginalis* increased with the age of the patient among the 25–54 years age groups and it was the highest in the 45–54 years age group, which was consistent with reported study in the USA [21]. Unlike acute sexually transmitted diseases caused by *Neisseria gonorrhoeae*, and *Chlamydia trachomatis*, which showed a high prevalence in the younger population [27], the prevalence of *T. vaginalis* was higher

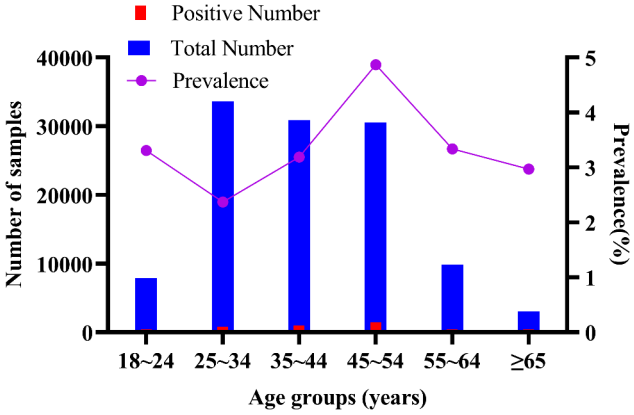

Fig. 3 The prevalence of *T. vaginalis* among women by age groups

Table 2 Association between *T. vaginalis* infection and leukocytes level

Leukocytes	Total number	No. of Positive	Prevalence(%)	*P*-Value
0–1+(0～5/HPF)	27,962	64	0.19	χ^2=343.42
2+(>5～≤15/HPF)	7,751	53	0.68	*P*<0.001
3+(>15～≤30/HPF)	5,604	56	1.00	
4+(>30/HPF)	1,950	64	3.79	
Total	43,267	237	0.55	

HPF: High Power Field

Table 3 Single infection and co-infection of *T. vaginalis*, *C. albicans* and *G. Vaginalis*

	Pathogens	No. of positive	Prevalence(%)
Single infection	*T. vaginalis*	750	0.65
	C. albicans	14,299	12.35
	G. vaginalis	24,855	21.47
Multiple infections	*T. vaginalis* and *C. albicans*	99	0.09
	T. vaginalis and *G. vaginalis*	2,422	2.09
	T. vaginalis, *C. albicans* and *G. vaginalis*	675	0.58

Table 4 The prevalence of *T. vaginalis* in pregnant and non-pregnant women

	Total number	No. of positive	Prevalence(%)	*P*-Value
Pregnant	3,474	29	0.83	χ^2=19.76
Non-pregnant	53,751	1,006	1.87	*P*<0.001

in the middle-aged population. Specifically, screening populations at high risk of *T. vaginalis* infection and providing targeted education and effective intervention measures could greatly enhance the prevention and transmission of *T. vaginalis* infection.

In addition, the results indicated a higher prevalence in the 18–24 years age group (3.31%) compared to the 25–34 years age group, which could explained that *T. vaginalis* infection is strongly associated with increased sexual activity, more sex partners, and having sex at a young age [28]. Additionally, some studies have reported that factors such as various contraceptive methods, vaginal douching and special material underwear may be related to *T. vaginalis* infection [29], but further studies and data are needed to confirm this.

The results revealed that *T. vaginalis* infection was positively correlated with the level of leukocytes, primarily neutrophils. *T. vaginalis* induces the production of inflammatory cytokines, such as IL-8 in neutrophils, promoting neutrophils to phagocytose *T. vaginalis* [30, 31]. Therefore, when a large number of neutrophils appear in the vaginal samples, we should also be alert to the possibility of *T. vaginalis* infection, which can help reduce missed detections.

The proportion of *T. vaginalis* and *G. vaginalis* co-infection was the highest pattern(2.09%), and the proportion of *T. vaginalis* and *C. albicans* co-infection was the lowest pattern(0.09%), which differs from a reported study in Cameroon [29]. The pathogenesis of trichomoniasis is closely related to the vaginal flora, and it has been reported that the vaginal parasite can disrupt the vaginal microbial ecology, activate the host's immune response and cause inflammation [32, 33]. In general, *T. vaginalis* infection causes a shift in the vaginal microbiota from a lactobacillus-dominated environment to one primarily composed of *G. vaginalis* and other facultative anaerobic, small rod-shaped bacteria. *T. vaginalis* can inhibit the growth of *Lactobacillus*, and similarly, *Lactobacillus* can reduce the adhesion of *T. vaginalis* to host epithelial cells [34, 35]. Therefore, the competitive relationship between *T. vaginalis* and *Lactobacillus* leads to the most common co-infection of *T. vaginalis* and *G. vaginalis*. Co-infection of *T. vaginalis* and *C. albicans* was an uncommon pattern(0.09%), and the possible reason is the a conflict in the pH value of the growth environment of *T. vaginalis* and *C. albicans*. The optimal pH for *C. albicans* is 4.0-4.7, whereas pH < 5.0 inhibits the growth of *T. vaginalis*.

As is well known, the body is affected by endocrine metabolism. Estrogen levels in pregnant women are maintained at high levels during pregnancy, which reduces the activity of the cell detachment factor (CDF) released by *T. vaginalis* and alleviates clinical symptoms [36, 37], making the ineffective symptomatic infection difficult to detect. Therefore, the number of *T. vaginalis* infections in pregnant women may be underestimated. Some studies have also found that *T. vaginalis* infection is strongly associated with adverse pregnancy outcomes and can hamper fertility [38]. *T. vaginalis* is often co-infected with other pathogens [39], and patients infected with *T. vaginalis* during pregnancy should be screened for the presence of other STDs.

There were some limitations existing in the study. Firstly, only patients with clinical symptoms were recruited, without including individuals from routine physical examination, which does not accurately reflect the overall prevalence of *T. vaginalis* infection in the total population of Jingzhou. Secondly, another method, such as qPCR, should be introduced for further verification when the results of the two methods are inconsistent, which can enhance the accuracy of the results. Continuous observation of the epidemiological characteristics of *T. vaginalis* infection is also needed in the future to estimate prevalence changes after the COVID-19 pandemic in Jingzhou, China.

Conclusion

This study retrospectively analyzed the prevalence of *T. vaginalis* infection among women in Jingzhou from 2019 to 2023. The overall infection rate was about 3.41%, and the prevalence showed a decreasing trend year by year. The prevalence was the highest in the 45–54 years age group. Among the co-infections caused by *T. vaginalis*, the most common co-infection pattern was *T. vaginalis* and *G. vaginalis.* Pregnant women infected with *T. vaginalis* had a significantly lower infection rate than non-pregnant women. The immunochromatographic assay can be widely applied in primary healthcare facilities for routine screening of *T. vaginalis*.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12879-025-10815-8.

Supplementary Material 1

Acknowledgements
We thank those who contributed to the publication of the article.

Author contributions
Yan Yang, Yue Qu and Shun Liu conceived the experiments and drafted the initial manuscript. Yan Yang, Changzheng Wang complete the specimens detection and collected the data from patients. Yue Qu and Bin Yan analyzed the data. Shun Liu supervised the research, and contributed to the discussion and interpretation of the results. All authors approved the final manuscript.

Funding
Open Research Fund Program of the State Key Laboratory of Virology of China (Grant number: 2023KF007), Science and Technology Program of Jingzhou (Grant number: 2024HD05).

Data availability
All data analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate
All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki. The study was approved by the Ethical Committee of Jingzhou Hospital Affiliated to Yangtze University (2024-131-01).

Consent for publication
Not applicable. This manuscript does not contain any personal data in any form.

Competing interests
The authors declare no competing interests.

Clinical trial number
Not applicable.

Received: 1 November 2024 / Accepted: 17 March 2025
Published online: 28 March 2025

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