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A Review on Trichomonas vaginalis and The Impact of Some Demographic Variables on The Prevalence in Iraq

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REVIEW

A Review on *Trichomonas vaginalis* and the Impact of Some Demographic Variables on the Prevalence in Iraq

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Abstract

Trichomoniasis is a parasitic disease that infects the genitourinary system in humans and is caused by *Trichomonas vaginalis*. This disease has a high classification among non-viral sexually transmitted diseases in the world comprising Iraq. The Data in the present review about prevalence of *T. vaginalis* in Iraq were collected using databases such as (Iraqi Academic scientific Journals, Google scholar, Medline and pubMed) based on the recent studies. The current review exhibited that the highest infection rate by this parasite in females was 75.22%, 62% in Maysan and Tikrit provinces respectively, and the lowest infection rate was 1.6% and 1.66% in Basrah and Sulaimania province, while the infection rate is ranged between 2.3 and 63.8% in males of Basrah province. The incidence of *T. vaginalis* is affected by diagnostic methods and some demographic variables such as gender, residence, educational, economic level, occupation and pregnancy. The prevention strategy for *T. vaginalis* includes maintaining personal hygiene, treating both partners, not just the infected, abstaining from sexual contact during the treatment period and using condoms.

Keywords: Demographic variables, *Trichomonas vaginalis*, Iraq

1. Introduction

Trichomonas vaginalis is a protozoan parasite, has a simple life cycle without necessity an intermediate host, described by the presence of only trophozoite stage that infects the genital tract of the human female and male, and there is no cystic stage. Sexual contact is the most common method of transmission of the *T. vaginalis* between people [1]. *T. vaginalis* is also a common parasitic pathogen of sexually transmitted diseases (STDs). Females are usually affected more than males. It was first discovered by Donne in 1836 from the purulent genital excretion of female [2]. *T. vaginalis* infection was first diagnosed as a venereal disease in the mid-20th century and is presently the most common non-viral sexually transmitted diseases (STDs) [3]. Interaction between the protozoan parasite and other sexually transmitted organisms especially, *T. vaginalis* is thought to increase the transmission of human immunodeficiency virus (HIV) [4].

The life cycle of *T. vaginalis* includes only trophozoite form while there is no cystic form [2]. *T. vaginalis* has a teardrop shape and has five flagella that protrude in the anterior part: four flagella are free whereas the fifth flagellum curves back to form a short undulating membrane that stretches just over half the length of the cell [5]. Trophozoites may appear in ovoid, round, or pear shape. The average length of trophozoites ranges from 8 to 15 um. Trophozoites can reach 30 um in length [6]. Recent studies have proposed formation of cyst-like structure or pseudocysts which are characterized as spherical structures containing internalized axostyle and flagella [7,8]. Pseudocysts appear in round, non-motile shape, and they lack a true cyst wall [9]. Pseudocysts are watched principally under undesirable growth conditions like temperature differ-

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ences and iron depletion in the media of *T.vaginalis* culture (in-vitro) [7,10]. Pseudocysts in *T.vaginalis* have been showed naturally in patients with cervical neoplasia [11] or caused *in vitro* by iron depletion [12].

The incubation period of *T. vaginalis* ranges from 4 days to 4 weeks, and especially affects squamous epithelium and not columnar epithelium. It liberates acetic acid, lactic acid and cystine proteases which disrupt the glycogen levels and lower the pH of the vaginal fluid and damage innate protective immunity versus infection [13,14]. Majority of infections (25–50% of patients) are asymptomatic but concealing the trophozoites can transmit the infection [2,15]. Females are usually affected and are exhibited as vulvovaginitis in acute infection, distinguished by abundant foul odor purulent vaginal discharge and 10% of discharge cases may be foamy and yellowish green color combined with polymorphonuclear leukocytes, whereas, chronic infection is moderated with itching and pain during copulation. Also, vaginal discharge is limited, combined with mucus [2].

Signs of acute infection in males comprise dysuria, nocturia, epididymitis, prostatitis and prostate cancer, as well, patients frequently release a transparent white urethral discharge that contains trophozoites [6,16]. Longtime infection with *T. vaginalis* may also lead to infertility in both males and females [15]. During pregnancy, infection is frequently linked with indigent outcomes like premature delivery and low rate of birth weight for the baby, in spite of whether the parasite practically causes these effects is ambiguous [5]. Tinidazole and metronidazole are the drugs presently confirmed for the therapy of *T. vaginalis* infection, despite of the resistance that has been observed [17,18].

Infections are appraised at more than 500 million people [15]. The prevalence of *T. vaginalis* varies among population, but the ranges from 5 to 29% in men and 5–74% in women [19]. The worldwide prevalence of *T. vaginalis* infection multiplied between 1999 and 2005. In 1999 the overall incidence was 54 cases per 1000 person-years [20]. Another study appraises (82.2 cases per 1000 person-years) for men and (63 cases per 1000 person-years) for females in 2005 [3]. Incidence of *T. vaginalis* varies according to: geographical site, study setting, for instance sexual health clinic or community setting; gender, age and type of diagnostic method [21–23]. The factors that cause the high incidence of *T. vaginalis* are the same as those that cause sexually transmitted diseases such as multiple sexual partners, poor personal hygiene and low economic and social status [24].

The traditional techniques for diagnosis include the direct microscopic examination of wet mount or culture relied methods for vaginal swabs [25]. Diagnosis of *T.vaginalis* in women is depended on microscopic examination of wet mount preparations made immediately from vaginal secretions. This method is quick and inexpensive, but has a low sensitivity of 36–75% [26,27]. Culture method is the gold standard one for the diagnosis of *T.vaginalis* [28]. This method has a high diagnostic sensitivity towards *T. vaginalis*. Suitable conditions are required in this method comprising components of culture media, culture temperature, incubation time and the rapid transmission of the parasite after collecting sample to culture medium. However, culture method is not applied as a routine diagnosis of *T. vaginalis* since it wastes much time [29]. Unluckily, culture method is time-consuming, and the results generally are obtainable within 48–72 h after inoculation of the culture medium [30]. Whiff test is one of the conventional tests and the positivity of it shows through the appearance of malodor [31]. Different methods have been used to detect antibodies versus *T. vaginalis*; all of them comprise indirect hemagglutination, complement fixation, gel diffusion, enzyme-linked immunosorbent assay (ELISA) and fluorescent-antibody assay [32].The molecular methods have been employed in the diagnosis of *T. vaginalis* such as hybridization assay and polymerase chain reaction (PCR) in various sittings [33].

This review aims to study the prevalence of *T. vaginalis* and the extent of the impact of some demographic variables on the spread of the disease in Iraq relied on the recent studies.

2. Review methodology

The data in this review were collected from (Iraqi Academic scientific journals, Google scholar, Medline and pubMed) which dealt with the prevalence of *T. vaginalis* in different Iraqi provinces using different methods (microscopic examination, culture, PCR technique, RT-PCR, ELISA, staining and Whiff test) based on the recent studies during the period 2010 to 2022. The majority of studies showed that the prevalence of *T. vaginalis* were conducted on women and only six studies dealt with men.

2.1. *Prevalence of* T. vaginalis *in Iraq*

Table 1 summarize: prevalence of *T.vaginalis* in Iraqi provinces, number tested, the year in which the study was conducted, diagnostic methods and reference.

Table 1. Prevalence and diagnostic methods of T. vaginalis *in different Iraqi provinces.*

Province	Number tested	Prevalence %	Year	Type of sample	Diagnostic Methods	Reference
AL-Anbar (Ramadi)	449 women	141(38.1%)	2001	Vaginal swab	Microscopic examination	[34]
Dohok	425 women	23(5.4%)	2006–2007	Vaginal swab	Wet smear (2.4%), H&E stain (3.55), Pap. Stain (4.0%), Modified Diamond culture(5.4%)	[35]
Sulaimania	600 women	10(1.66%)	2007	Vaginal swab	direct microscopic examination and culture.	[36]
Thi-Qar	650 women	34(5.23%)	2012–2013	Vaginal discharge	wet mount method (5.23%)	[37]
Erbil	440 women	14 (3.18%) 12 (2.73%)	2012–2013	Vaginal discharge	culture 14(3.18%) direct wet mount 12 (2.73%)	[38]
Wasit (Kut)	60 women	12(20%)	2013–2014	Vaginal samples	wet mount 7(11.7%), Whiff test 5(8.3%)	[39]
Wasit (Kut)	60 women	Wet mount microscopy 5(8.33%) and RT-PCR 13(21.67%)	2013–2014	Vaginal swab	Wet mount microscopy (8.33%) and RT-PCR (21.67%)	[40]
Diyala (Baqubah city)	1192 women	148 (12.41%)	2016	Vaginal swab	wet mount examination (12.41%)	[41]
Tikrit (Samarra city)	100 women	62(62%)	2016–2017	Vaginal swab	direct wet mount (62%) and liquid cultivate (62%)	[42]
Al - Najaf	86 women	24 (27.90%)	2018	vaginal discharge	Wet mount Examination (27.90%)	[43]
Al-Muthana	150 women	Wet smear 39 (26%) PCR48 (32%)	2018	vaginal swab	Wet smear (26%) PCR (32%)	[44]
Kirkuk	185 women	52(28.10%)	2018	Endocervical, high vaginal swabs and urine	microscopic examination: Endocervical swabs 14(7.56%), Vaginal swabs 29(15.67%) and urine 9(4.86%).	[45]
Basrah	600 women	1.6% in vaginal samples and 0.5% in urine samples	2019	vaginal swab and urine	Wet mount preparation (direct microscopic examination)	[46]
Babylon (AL-Hilla city)	255 women	67(26.27%)	2019	vaginal swab	Wet mount preparation (26.27%)	[47]
Maysan	226 women	170(75.22%)	2019–2020	Vaginal smear	Microscopic examination and Cultivation	[48]
Al-Qadisiyah	200 women	Wet smear 51(25.5%) RT-PCR 59(29.5%)	2017–2018	vaginal swab	Wet smear (25.5%) RT-PCR (29.5%)	[49]
Baghdad	114 women	19(16.6%) vaginal discharge, 10 (8.7%) urine and 46(40.35%) in blood samples	2018–2019	vaginal discharge urine Blood	microscopic examination: Vaginal swabs(16.6%) and urine (8.7%). Indirect ELISA (40.35%).	[50]
Holy Karbala	232 women	Wet mount technique for vaginal swab 20(8.62%), Wet mount and gram stain 20(8.62%) and general urine 16(6.89%)	2020–2021	vaginal swab and urine	Wet mount technique for vaginal swab(8.62%), Wet mount and gram stain (8.62%) and general urine (6.89%).	[51]
Baghdad	108 married couples	6(5.5%)	2020–2021	cervical swabs from women and Semen from men	PCR technique 6(5.5%)	[52]
Mosul city	120 women	4(3.3%)	2022	vaginal swab	Wet mount examination	[53]

The current review exhibited variation in the prevalence of *T.vaginalis* among Iraqi provinces and for different years. From available data, the highest prevalence rate was 75.22%, 62% and 38.1% in Maysan, Tikrit and Al-Anbar provinces respectively, while the lowest infection rate was 1.6% and 1.66% in Basrah and Sulaimania provinces, respectively. The difference in prevalence of *T. vaginalis* between studies which conducted in Iraqi provinces may be due to the difference in the geographical location, period of the study, size of study sample and diagnostic method. The difference in prevalence of *T. vaginalis* attributed to many factors, comprising the size and the type of the sample, and the period of study, as well as the method used in diagnosis and the nature of social traditions prevalent in community like religion or cultural level [54].

By reviewing the studies, it was found that the prevalence of *T. vaginalis* infection is affected by the type of sample: vaginal secretions, urine, semen and blood, which is relatively higher in vaginal secretions compared to urine samples. Salman et al. [45], Bedair and Ali [50], Kadhum et al. [46] and Alhusseini & Alquraishi [51] reported that the prevalence of *T.vaginalis* in women was higher when used vaginal swabs compared to endocervical swabs and urine samples, but, Bedair and Ali [50] exhibited high prevalence when used the blood samples. Amadi & Nwagbo [55] reported that either urine sample or vaginal swab is insufficient for proper diagnosis of *T.vaginalis* infection and have suggested that for better results both urine and vaginal swab should be used. *T. vaginalis* specifically inhabits the vaginal tissues. Anyway, it has been mentioned that *T. vaginalis* is able to reach and infect the urinary tract [56]. The presence of the parasite in urine samples is evidence of contamination and transmission of the parasite from the vaginal canal to the urethra. *T.vaginalis* cannot be diagnosed only depended on signs and symptoms observed during clinical assays due to most of the symptoms registered through these tests can be shown by patients with other sexually transmitted diseases [57].

2.2. *Diagnosis of* T. vaginalis *in Iraq*

In Iraq, studies have used more than one method (wet mount microscopy, culture, PCR technique, RT-PCR, ELISA, Pap smear, staining) to detect incidence of *T. vaginalis*. The majority of the Iraqi studies in the present review used mainly microscopic examination (wet mount preparation) and culture. At least two techniques are necessary for precise diagnosis such as wet mount microscopy and culture [58,59]. The culture method showed a higher rate of infection compared to microscopic examination in many studies in Iraq like AL-Saeed [35] in Dohok, Nouraddin and Alsakee [38] in Erbil, and this is due to the high sensitivity of the culture method in identifying the parasite. Culture method with modified Diamond's medium has high sensitivity of 92–95% and specificity near 100% [60], while, the factor of time and the vitality of the parasite is an important necessity towards diagnostic sensitivity using microscopic examination. Krieger et al. [61] and Kingston et al. [62] exhibited that the microscopic examination must be completed within 10–20 min of collecting the sample because the parasite loses its vitality and cause false negative results. One study in Wasit province by Rahi et al. [39] demonstrated that the infection rate of *T.vaginalis* was 5(8.3%) using whiff test was less than what is recorded by the microscopic examination 7(11.7%). Wang [63] reported that the appearance of an malodor is not necessarily an indication of parasite infection, because the smell may be related with bacterial infections. On the other hand, Bedair & Ali [50] demonstrated the high sensitivity of immunological assays in diagnosis of *T.vaginalis* based on the presence of antitrichomonal antibodies when compared to microscopic examination.

In this review, numerous studies used the PCR technique in detection of *T.vaginalis* in addition to traditional methods. Rahi et al. [40], Al-abodi et al. [44], Al-Khalidy & Al-Abodi [49] and Ali and Ghaima [52] showed that the high diagnostic sensitivity and specificity in detection of *T.vaginalis* in vaginal swab when compared with wet mount method, because the molecular techniques are newer and more accurate in diagnosis of microorganisms relying on the very small amount of DNA.

Many studies reported that the PCR represent to be the technique of choice for the diagnosis of *T. vaginalis* infections with high sensitivity and specificity for both vaginal swab and male urethral samples [64]. Depended on various studies, PCR is very sensitive and specific for revelation of *T. vaginalis* suggesting this technique as the gold standard instead of other diagnostic methods [57]. For the purpose of rapid and accurate detection of *T. vaginalis*, at least two methods are needed like microscopic examination and culture, On the other hand, PCR has high sensitivity and specificity in detecting *T. vaginalis* parasite, but it is expensive be used in routine diagnostic laboratories [58,59].

2.3. *Some socio-demographic data affected in prevalence of* T.vaginalis

There is some socio-demographic and risk factors which causes increase in the infection rate of

Table 2. Prevalence of T. vaginalis *according the sex.*

Province	Year	Females %	Males %	References
Baghdad	1989	15.6%	10.3%	[68]
Basrah	1992–1993	11.3%	63.8%	[71]
Basrah	2010	-	2.3%	[72]
Al-Najaf	2012	-	17.64%	[73]
Babylon	2012–2013	7.38%	4.2%	[69]
Al-Qadisiyah	2020	31.7%	24.2%	[70]

T.vaginalis especially in developing countries such as poor sexual health and multiple sexual partners, Poorness, low socioeconomic status and illiteracy [58,65]. Also, sex without a condom, prior infection with *T. vaginalis* and ethnicity represent risk factors for acquisition and transmission of *T. vaginalis* [66,67].

Estimates of infection rate with *T. vaginalis* among populations are various worldwide, but the prevalence rate ranges from 5 to 29% in men and 5–74% in women is observed [19]. In Iraq, many studies have reported that the rate of infection in females with *T.vaginalis* is higher than males, such as Ali et al. [68] in Baghdad, Al-Quraishi [69] in Babylon, and Al-Ardi [70] in Al-Qadisiyah while, Mahdi [71] exhibited that the prevalence in males higher than females, and this may be due to the symptoms that appear clearly in females, while most cases of infection in males are asymptomatic. The vaginal swab also represents a good sample for diagnosing the parasite compared to examining urine in males. Zeibig [6] showed that the asymptomatic infections of *T. vaginalis* most repeatedly occur in males (Table 2).

According to residence, many studies in Iraq recorded the highest incidence in rural areas compared to urban areas like Khalaf et al. [72], Kadhum et al. [46], in Basra, Kadhum [74] and Ali et al. [75] in Baghdad, AL-Abady and AL-Khazrajee [37] in Thi-Qar, AL-Nasiri [76] in Tikrit, Taher et al. [77] in AL-Najaf, AL-Majidii and AL-Saady [48] in Maysan, ALHamzawi and AL-Awsi [78] in Al-Diwaniya except Salman and Kareem [79] in Kirkuk, AL-Hussuny [80] in Diyala and Alhusseini and Alquraishi [51] in Karbala, who reported the highest frequency in urban area. Ray et al. [81] and Dahab et al. [54] indicated that these differences are due to the different level of awareness between rural and urban communities, in addition to socio-economic level, poor health conditions and most significantly absence of treatment. Table 3.

Many studies in Iraq have shown that the infection rate decreases as one advances in educational level such as Kadir and Fattah [36] in Sulaiminia, Al-Abady and Al-Khazrajee [37] in Thi-Qar, ALNasiri [76], in Tikrit, Al-Hamzawi and Al-Awsi [78] in Al-Diwaniya, Kadhum et al. [46] in Basrah and AL-Taei [53] in Mosul while, Ali et al. [75] in Baghdad and Taher et al. [77] in AL-Najaf reported that the infection rate among illiterate women is higher than the infection rate among women at the primary level. The high incidence of *T. vaginalis* among women with a low educational level may be due to their lack of health awareness, especially sexual awareness (Table 4).

Some studies have shown that the infection rate is high in females with a low economic level, but other studies have recorded a high infection rate in females with a moderate and high economic level. The reason behind the high rates of infection in women of low economic level may be due to deteriorating health conditions and lack of visits to hospitals and health centers, as well as lack of awareness about sexually transmitted diseases [83] (Table 5).

Table 3. Prevalence of T. vaginalis *in relation to residence area.*

Province	Year	Females		Males		References
		% Rural area	% Urban area	% Rural area	% Urban area	
Tikrit	2008–2009	15.24%	7.62%	–	–	[76]
Baghdad	2010	63.07%	36.93%	–	–	[74]
Basrah	2010			58.3%	41.6%	[72]
Kirkuk	2011–2012	35.41%	64.59%			[79]
Thi-Qar	2012–2013	6.62%	4.81%	–	–	[37]
Diyala	2013	12.5%	29.1%	–	–	[80]
Baghdad	2013–2014	41.37%	30.2%	–	–	[82]
Babylon	2014	12.16%	7.38%	5.09%	4.2%	[69]
Baghdad	2014–2015	33.0%	4.5%	–	–	[75]
Al-Diwaniya	2015–2017	9%	2.2%	–	–	[78]
Al-Najaf	2016–2017	42.2%	29.8%	–	–	[77]
Basrah	2019	3.1%	1.4%			[46]
Maysan	2019–2020	81.54%	72.67%	–	–	[48]
Karbala	2020–2021	7.43%	10%	–	–	[51]

Table 4. Prevalence of T. vaginalis *according to Levels of education.*

Province	Year	Level of Education					References
		Illiterate	Primary	Intermediate	Secondary	University Education	
Sulaiminia	2007	2.19	0.55			0.0	[36]
Tikrit	2008–2009	13.33	4.76	1.91	1.91	0.95	[76]
Thi-Qar	2012–2013	7.28	6.01	–	3.77	2.80	[37]
Baghdad	2014–2015	22.0	31.5	–	16.0	8.5	[75]
Al-Diwaniya	2015–2017	10.7	3.6			0.0	[78]
AL-Najaf	2016–2017	35.00	45.00		20.5	24.0	[77]
Basrah	2019	3.33	1.5	–	1.3	0.85	[46]
Maysan	2019–2020	77.67	77.64	–	50.00	69.23	[48]
Karbala	2020–2021	5.12	7.86	6.66	14.63	8.33	[51]
Mosul	2022	–	4.4	3.4		2.1	[53]

Table 5. Prevalence of T. vaginalis *in relation to Socioeconomic Level.*

Province	Year	Socioeconomic Level			References
		Low	Moderate	High	
Baghdad	2010	63.07	13.84	23.09	[74]
Thi-Qar	2012–2013	4.39	4.63	7.32	[37]
Baghdad	2013–2014	44.6	24.65	37.5	[82]
Baghdad	2014–2015	31.0	38.5	8.5	[75]
AL-Najaf	2016–2017	45.2	25.60	38.0	[77]
Basrah	2019	3.68	1.02	0.69	[46]

Table 6 shows that the infection rate was higher among housewives compared to employees women in all Iraqi studies. The low infection rate among female employees is due to their participation in health education courses about sexually transmitted diseases, as well as the use of vaginal douches and antiseptics, especially after intercourse [84].

Table 6. Prevalence of T. vaginalis *in relation to occupation.*

Province	Year	house wife %	Employed women %	References
Baghdad	2010–2011	32.7	22.2	[85]
Thi-Qar	2012–2013	5.45	4.52	[37]
Al-Diwaniya	2015–2017	9.9	1.1	[78]
Basrah	2019	2.2	0.5	[46]
Maysan	2019–2020	78.00	57.14	[48]
Karbala	2020–2021	9.64	3.44	[51]
Mosul	2022	3.9	2.9	[53]

According to the state of marriage, most studies recorded infection rates in married women compared to unmarried women. In addition, Jarallah [86] and AL-Majidii and ALSaady [48] showed high infection rates in unmarried women. Nash and Weller [87] explained that the increase in infection among married women may be due to behavioral reasons, including sexual intercourse with an infected person, the husband or someone else may have previously had sexual intercourse with an infected woman, or perhaps the frequent visits of married women to hospitals and private women's clinics, and thus they are exposed to infection as a result of contaminated tools, such as medical paws and the dilating speculum during the examination (Table 7).

According to pregnancy, infection with *T.vaginalis* is known to be a risk factor as well. Many studies in Iraq such as Kadhum et al. [46], in Basra, Al-Ammash [42] in Tikrit, Al-Hussuny [80] and Hussein and Shaker [41] in Diyala, AL-Majidii & ALSaady [48] in Maysan showed that the infection rate with *T.vaginalis* among non pregnant women is higher than the infection rate in the pregnant women, while, Kadir et al. [89] in Kirkuk, Kadir & Fattah [36] in Sulaimania, Kadhun [74] and AL-Muathen and Sachit [90] in Baghdad, Al-Abady and Al-Khazrajee [37] in Thi-Qar and Alhusseini and Alquraishi [51] in Karbala found out that the infection rate between pregnant women was higher than that of non-pregnant women.

Table 7. Prevalence of T. vaginalis *according to marital status.*

Province	Year	Females %		Males %		References
		Married	Non married	Married	Non married	
Mosul	1997–1999	76.47	2.95	–	–	[88]
Basrah		61.58	31.81	–	–	[86]
Basrah	2010	–	–	100	0.0	[72]
Thi-Qar	2012–2013	6.18	0.0	–	–	[37]
Basrah	2019	1.82	0.0			[46]
Maysan	2019–2020	80.92	40.62	–	–	[48]
Karbala	2020–2021	8.81	0.0	–	–	[51]

Table 8. Prevalence of T. vaginalis *according to pregnancy.*

Province	Year	Pregnant women %	Non Pregnant women %	References
Mosul city	1997–1999	45.6	–	[88]
Kirkuk	2004	42.55%	25.15	[89]
Sulaimania	2007	1.77%	1.33%	[36]
Baghdad	2010	17.2%	8.8	[74]
Baghdad	2010	5.71	1.8	[90]
Thi-Qar	2012–2013	7.52	4.88	[37]
Baqubah city Diyala	2013	7.5	34.1	[80]
Diyala	2016	24.32%	75.67%	[41]
Sammarra city	2016–2017	0.0	62.00	[42]
Basrah	2019	0.54	2.2	[46]
Maysan	2019–2020	78.57	81.11	[48]
Karbala	2020–2021	11.17	6.9	[51]

Adeoye et al. [91] indicated that the low rate of infection among pregnant women may be due to regular visits to hospitals, private clinics and health centers, and this shows the importance of clinical examination and early detection and treatment of the disease (Table 8).

3. Conclusion

The current review gave sufficient data on the prevalence of *T. vaginalis* in all province of Iraq. Weak health awareness, especially in rural communities with a low level of education, about sexually transmitted diseases has increased the burden of infection. The study recommends conducting a survey on the infection of *T. vaginalis* in women in health care centers in order to contribute to the implementation of programs to control sexually transmitted diseases. The PCR, culture, and microscopic examination is necessary for better diagnosis of *T. vaginalis*.

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Conflict of interest

None declared.

References

[1] Yazar S, Dagel I, Aksoy U, Ustun S, Daldal N. Frequency *Trichomonas vaginalis* among women having vaginal discharge. Izmir, Turkey, Inonu Univ Tip Fakultesi Derg 2002;9(3):159–61.
[2] Sastry AS, Bhat S. Essentials of medical parasitology. New Delhi. London. Philadelphia. Panama: Jaypee Brothers Medical Publishers (P) Ltd; 2014. p. 55–8.
[3] WHO. Prevalence and incidence of selected sexually transmitted infections, *Chlamydia trachomatis, Neisseria gonorrhoeae, syphilis* and *Trichomonas vaginalis*: methods and results used by WHO to generate 2005 estimates. 2011. 2011.
[4] Lewis DA. Trichomoniasis. Medicine 2010;38:291–3. https://doi.org/10.1016/j.mpmed.2014.04.004.
[5] Gunn A, Pitt SJ. Parasitology an integrated approach. 1th ed. Wiley – Blackwell. A John Wiley and Sons, Ltd, Publication. UK.; 2012. p. 37–8.
[6] Zeibig EA. Clinical Parasitology. A practical approach. Second Edition. Philadelphia: WB. B. Saunders Company; 2013. p. 97–100.
[7] Pereira-Neves A, Ribeiro KC, Benchimol M. Pseudocysts in trichomonads–new insights. Protist 2003;154:313–29. https://doi.org/10.1078/143446103322454095.
[8] Munsch M, Lotfi A, Hafez HM, Al-Quraishy S, Mehlhorn H. Light and transmission electron microscopic studies on trophozoites and cyst-like stages of *Histomonas meleagridis* from cultures. Parasitol Res 2009;104:683–9.
[9] Dias-Lopes G, Saboia-Vahia L, Margotti ET, Fernandes NS, Castro CLF, Oliveira FO, et al. Morphologic study of the effect of iron on pseudocyst formation in *Trichomonas vaginalis* and its interaction with human epithelial cells. Mem Inst Oswaldo Cruz 2017;112:664–73. https://doi.org/10.1590/0074-02760170032.
[10] Ribeiro KC, Arnholdt AC, Benchimol M. *Tritrichomonas foetus*: induced division synchrony by hydroxyurea. Parasitol Res 2002;88:627–31. https://doi.org/10.1007/s00436-002-0628-1.
[11] Afzan MY, Suresh K. Pseudocyst forms of *Trichomonas vaginalis* from cervical neoplasia. Parasitol Res 2012;111(1):371–81.
[12] De Jesus JB, Cuervo P, Junqueira M, Britto C, Silva-Filho FC, Soares MJ. A further proteomic study on the effect of iron in the human pathogen *Trichomonas vaginalis*. Proteomics 2007;7(12):1961–72.
[13] Adad SJ, de Lima RV, Sawan ZT, Silva ML, de Souza MA, Saldanha JC, et al. Frequency of *Trichomonas vaginalis, Candida* sp and *Gardnerella vaginalis* in cervical-vaginal smears in four different decades. Sao Paulo Med J 2001;119:200–5.
[14] Paniker CKJ. Textbook of medical parasitology. 7th ed. New Delhi: Jaypee Brothers Medical Publishers (P) LTD.; 2013. p. 276.
[15] Mehlhorn H. Human parasites diagnosis, treatment, prevention. 7th ed. Springer; 2016. p. 20–3.
[16] Sutcliffe S, Neace C, Magnuson NS, Reeves R, Alderete JF. Trichomonosis, a common curable STI, and prostate carcinogenesis– a proposed molecular mechanism. PLoS Pathog 2012;8(8):1–4.
[17] Kirkcaldy RD, Augostini P, Asbel LE, Bernstein KT, Kerani RP, Mettenbrink CJ, et al. *Trichomonas vaginalis* antimicrobial drug resistance in 6 US cities, STD surveillance network, 2009–2010. Emerg Infect Dis 2012;18(6):939–43. https://doi.org/10.3201/eid1806.111590.
[18] Workowski KA, Bolan GA. Sexually transmitted diseases treatment guidelines. MMWR Recomm Rep 2015;64:1–137. PMID: 26042815.
[19] Vos T, Flaxman AD, Naghavi M, Lozano R, Mich-aud C, Ezzati M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380(9859):2163–96.
[20] Sutton M, Sternberg M, Koumans EH, McQuillan G, Berman S, Markowitz L. The prevalence of *Trichomonas vaginalis* infection among reproductive-age females in the United States, 2001-2004. Clin Infect Dis 2007;45(10):1319–26. https://doi.org/10.1086/522532.
[21] Van Der Pol B, Williams JA, Orr DP, Batteiger BE, Fortenberry JD. Prevalence, incidence, natural history, and response to treatment of *Trichomonas vaginalis* infection among adolescent females. J Infect Dis 2005;192:2039–44. https://doi.org/10.1086/498217.

[22] Workowski KA, Berman SMC. Sexually transmitted diseases treatment guidelines. Morb Mortal Wkly Rep 2006;55:52–4.
[23] Sena AC, Miller WC, Hobbs MM, Schwebke JR, Leone PA, Swygard H, et al. *Trichomonas vaginalis* infection in male sexual partners: implications for diagnosis, treatment, and prevention. Clin Infect Dis 2007;44:13–22. https://www.jstor.org/stable/4485189.
[24] Bowden FJ, Garnett GP. *Trichomonas vaginalis* epidemiology: parameter sing and analysis a model of treatment interventions. Sex Transm Dis 2000;76:248–56. https://doi.org/10.1136/sti.76.4.248.
[25] Hardick J, Yang S, Lin S, Duncan D, Gaydos C. Use of the Roche Light Cycler instrument in a Real-time PCR for *Trichomonas vaginalis* in urine sample from females and males. J clini Microbial 2001;41:5619–22. https://doi.org/10.1128/jcm.41.12.5619-5622.2003.
[26] Kurth A, Whittington WLH, Golden MR, Thomas KK, Holmes KK, Schwebke. Performance of a new rapid assay for detection of *Trichomonas vaginalis*. J Clin Microbiol 2004;42(7):2940–3.
[27] Jill SH, Byron EB, Braslins P, Feldman JA, Hobbs MM, Sankey HZ, et al. Use of an immunochromatographic assay for rapid detection of *Trichomonas vaginalis* in vaginal specimens. J Clin Microbiol 2005;43:684–7.
[28] Draper D, Parker R, Patterson E, Jones W, Beutz M, French J, et al. Detection of *Trichomonas vaginalis* in pregnant women with the InPouch TV system. J Clin Microbiol 1993;31:1016–8.
[29] Safayi delouyi Z, Valadkhani Z, Sohrabi M. Analysis the prevalence of *Trichomonas vaginalis* in women clinics of Tehran city's referents by PCR. Horizon Med Sci 2015;20(4):223–9.
[30] Madico G, Quinn TC, Rompalo K, McKee T, Gaydos CA. Diagnosis of *Trichomonas vaginalis* infection by PCR using vaginal swab samples. J Clin Microbiol 1998;36:3205–10.
[31] Schwebke J, Burgess D. Trichomoniasis. Clin Microbiol Rev 2004;17:794–803.
[32] Garcia LS. Diagnostic medical parasitology. 5th ed. Library of Congress Cataloging-in-Publication Data Washington; 2007. p. 123–30.
[33] Ojuromi O, Oyibo W, Tayo D. Reliance on microscopy in *Trichomonas vaginalis* diagnosis and its prevalence in females presenting with vaginal discharge in Lagos, Nigeria. J infect Devel Coun 2007;1:210–3.
[34] Al-Ani SFI, AL-Hadithi IAW, AL-Hadithi RJK. Factors affecting vaginal trichomoniasis among women in Ramadi. J Basrah Res 2001;27:24–35.
[35] Al-Saeed WM. Detection of *Trichomonas vaginalis* by different methods in women from Dohok province, Iraq. East Mediterr Health J 2011;17(9):706–9. https://iris.who.int/handle/10665/118144.
[36] Kadir MA, Fattah CO. *Trichomonas vagina*lis among women in Sulaimania governorate-Iraq. Tikr J Pharma Sci 2010;6(1):1–9.
[37] Al-Abady FA, Al-Khazrajee ZA. Epidemiology study parasite *Trichomonas vaginalis* at Thi-Qar province. J Thi-Qar Univ 2014;9(1):1–9.
[38] Nouraddin AS, Alsakee HM. Immunological aspects of *Trichomonas vaginalis* infection in women attending maternity teaching hospital and some public health centers in Erbil governorate, northern Iraq. Cihan Univ Erbil Sci J 2019;3(1):56–60. https://doi.org/10.24086/cuesj.v3n1y2019.pp56-60.
[39] Rahi AA, Kadhim RW, Sajad H. Prospective study of *Trichomonas vaginalis* infection. Scholars J Appl Med Sci 2014;2(1D):455–60.
[40] Rahi AA, Ali MA, Khamesipour A. Comparison of Real time PCR with traditional tools for diagnosis of *Trichomonas vaginalis* in patient with vaginal discharge at Kut city, Iraq. J Adv Biol 2014;5(3):697–702.
[41] Hussein AA, Shaker MJ. Infection rate of *Trichomonas vaginalis* among women in Baqubah city. Int J Sci Res 2017;6(8):1954–7.
[42] Al-Ammash MSJ. Study on prevalence of *Trichomomas vaginalis* in Samarra city with observation of alcoholic extract effect of *Peganum harmala* plant *in vitro*. Tikrit J Pharma Sci 2017;12(1):31–47.
[43] Al-Abbas WDS, Radhi OA. Incidence of *Chlamydia trachomatis* and *Trichomonas vaginalis* genital infections among non-pregnant women in Al – Najaf province. Kufa J Nursing Sci 2019;9(1).
[44] Al-Abodi HRJ, Al-Shaibani KTM, Shaker EM. Molecular investigation of Trichomoniasis in women in Al-Muthana province/Iraq. In: The 1st international scientific conference on pure science; 2019.
[45] Salman YJ, Ahmed ES, Taqi RH. ABO blood group and incidence of *Chlamydia trachomatis, Trichomonas vaginalis* infections among child bearing women in Kirkuk Province. J Medi Sci Clini Res 2019;7(4):1106–16.
[46] Kadhum NJ, AL-Mayah SH, Raisan SJ. Epidemiological study on *Trichomonas vaginalis* among the women who attended the hospitals of Basra province. J Basrah Res (Sciences) 2020;46(2):64–73.
[47] Al-Kahfaji MSA. Infection rate of trichomoniasis among women in AL Hilla city. Indian J Pub Heal Res Develop 2020;11:2.
[48] AL-Majidii NKS, ALSaady HAM. The prevalence of *Trichomonas vaginalis* parasite among women in some regions of Maysan province. Periodico Tche Quim 2020;17(36):784–97.
[49] Al-Khalidy KAH, Al-abodi HR. Effect of vaginal trichomoniasis on women who suffer from delayed pregnancy. Europ J Mole Clini Medi 2020;7(1):45–50.
[50] Bedair NH, Ali HZ. Comparison of trichomoniasis diagnosis by microscopic methods and indirect ELISA technique in a sample of Iraqi women. Iraqi J Sci 2020;61(4):742–8.
[51] Alhusseini ZA, Alquraishi MA. Epidemiological study and detection of *Trichomonas vaginalis* parasite in holy Karbala governorate. Teikyo Medi J 2021;44(6):3297–305.
[52] Ali RB, Ghaima KK. Molecular detection of some sexually transmitted bacteria and *Trichomonas vaginalis* in Iraqi married couples. Iraqi J Biotechnol 2022;21(2):136–44.
[53] AL-Taei KA. Detection of *Trichomonas vaginalis* in women with vaginitis in Mosul city. Intern J Appl Sci Technol 2022;4(3):428–40.
[54] Dahab MM, Koko WS1, Osman EE, Hilali AHM. Prevalence and transmission of *Trichomonas vaginalis* infection among women in Khartoum State, Sudan. J Pub Health Epidemiol 2012;4(2):34–8. https://doi.org/10.5897/JPHE10.042.
[55] Amadi ANC, Nwagbo AK. *Trichomonas vaginalis* infection among women in Ikwuano, Abia State, Nigeria. J Appl Sci Environ Manag 2013;17:389–93. https://doi.org/10.4314/jasem.v17i3.7.
[56] Muller M. The hydrogenosome. J Gen Microbiol 1993;139(12):2879–89.
[57] Patel SR, Wiese W, Patel SC, Ohl C, Byrd JC, Estrada CA. Systematic review of diagnostic tests for vaginal trichomoniasis. Infect Dis Obstet Gynecol 2000;8(5–6):248–57. https://doi.org/10.1155/S1064744900000375.
[58] Poole ND, Mc Clelland RS. Global epidemiology of *Trichomonas vaginalis*. Sex Transm Infect 2013;89(6):418–22. https://doi.org/10.1136/sextrans-2013-051075.
[59] Arbabi M, Fakhrieh Z, Delavari M, Abdoli A. Prevalence of *Trichomonas vaginalis* infection in Kashan city, Iran (2012-2013). Iran J Reproduct Med 2014;12(7):507–12. PMID: 25114674.
[60] Pillay A, Lewis J, Ballard RC. Evaluation of Xenostrip-Tv, a rapid diagnostic test for *Trichomonas vaginalis* infection. J Clin Microbiol 2004;42(8):3853–6.
[61] Krieger JN, Tam MR, Stevens CE, Nielsen IO, Hale J, Kiviat NB, et al. Diagnosis of trichomoniasis. JAMA 1988;259:1223–7.
[62] Kingston MA, Bansal D, Carlin EM. Shelf life of *Trichomonas vaginalis*. Int J STD AIDS 2003;14(1):28–9.
[63] Wang J. Bacterial vaginosis. Prim Care Ate Obstet Gynecol 2000;7:181–5.
[64] Shipitsyna E, Zolotoverkhaya E, Chen CY, Chi KH, Grigoryev ASavicheva A, Ballard R, et al. Evaluation of polymerase chain reaction assays for the diagnosis of

Trichomonas vaginalis infection in Russia. J Eur Acad Dermatol Venereol 2012:1468–3083.
[65] Van der Pol B. *Trichomonas vaginalis* infection: the most prevalent nonviral sexually transmitted infection receives the least public health attention. Clin Infect Dis 2007;44(1):23–5. https://doi.org/10.1086/509934.
[66] Helms DJ, Mosure DJ, Metcalf CA, Douglas Jr JM, Malotte CK, Paul SM, et al. Risk factors for prevalent and incident *Trichomonas vaginalis* among women attending three sexually transmitted disease clinics. Sex Transm Dis 2008; 35(5):484–8. https://doi.org/10.1097/OLQ.0b013e3181644b9c.
[67] Krashin JW, Koumans EH, Bradshaw-Sydnor AC, Braxton JR, Secor WE, Sawyer MK, et al. *Trichomonas vaginalis* prevalence, incidence, risk factors and antibiotic-resistance in an adolescent population. Sex Transm Dis 2010;37(7):440–4.
[68] Ali NMH, Dakheel ISH, Abdul-Kareem FA. The incidence of *Trichomonas vaginalis* in Baghdad among random sample of the population with special reference to malt infection. Technol Respir J 1989;2:276–87.
[69] Al-Quraishi MA. Epidemiology study of *Trichomonas vaginalis* in Babylon province and the efficiency of *Mentha Spicata* leafs extracts in vivo. J Nat Sci Res 2014;4(2):72–82.
[70] Al-Ardi MH. Seroprevalence and risk factors of *Trichomonas vaginalis* among couples in Al-Hamza city-Iraq. Al-Kufa Univ J Bio 2021;13(1):35–44.
[71] Mahdi NK, Gany ZH, Sharief M. Risk factors for vaginal trichomoniasis among women in Basra, Iraq. La Rev Sante Mediterr Orient 2001;7(6):918–24.
[72] Khalaf AK, Al-Asadi SAM, Al-Yaaqub AJ, Al-Mayah SH. Use PCR technique to detect *Trichomonas vaginalis* among men in Basrah province. Thi-Qar Medi J 2010;4(2):29–36.
[73] Al-Hadraawy SK, Al-Kafagy SMM, Al-Hadraawy MKA. Molecular and immunological study for detection of IL-6 in men infected with *Trichomonas vaginalis* parasite in Al-Najaf province; Iraq. AL-Qadisiya Medi J 2014;10(18):144–8.
[74] Kadhum SA. Epidemiological study of *Trichomonas vaginalis* in married females. Proceeding of the Eleventh Veterinary Scientific Conference; 2012. p. 293–8.
[75] Ali MK, Hathal HD, Almoayed HA. Prevalence and diagnosis of sexually transmitted pathogens in A sample of Iraqi women: a molecular study. Ir J Med Sci 2017;15(4):364–76.
[76] Al-Nasiri FS. Prevalence of infection with *Trichomonas vaginalis* in Tikreet city, Salah AlDeen province. Tikrit J Pure Sci 2015;3(20):1–4.
[77] Taher JH, Shaker MA, Noora M, Sahib NM, Sarhan NG. Epidemiological study of *Trichomonas vaginalis* and other microorganisms isolated from genital tract of women in Najaf province – Iraq. Al-Kufa Univ J Bio 2018;10(2):1–10.
[78] Al-Hamzawi SA, Al-Awsi GRL. Prevalence of *Trichomonas vaginalis* and its correlation with socio-demographic variables in pregnant women in Al-Diwaniya, Iraq. Mater Today Proc 2023;80:3847–50. https://doi.org/10.1016/j.matpr.2021.07.399.
[79] Salman YJ, Abdul Kareem E. Detection of *Trichomonas vaginalis* among females attending private gynaecological clinics in Kirkuk province using different laboratory methods. J Kirkuk Med Coll 2013;1(2):1–8.
[80] Al-Hussuny EM. An epidemiological study of *Trichomonas vaginalis* in among women living in Baquba City, Diyala Province, Iraq. Diyala J Pure Sci 2015;11(3):13–25.
[81] Ray K, Bala M, Bhattacharya M, Muralidhar S, Kumari M, Salhan S. Prevalence of RTI/STI agents and HIV infection in symptomatic and asymptomatic women attending peripheral health set-ups in Delhi, India. Epidemiol Infect 2008; 136(10):1432–40.
[82] Merdaw MA, Al-Taei LH, Al-Bashier NT, AlMayah QS. Epidemiological study of *Trichomonas vaginalis* infection among Iraqi women. Int J Adv Res 2014;2(9):920–5.
[83] Wolner-Hanssen P, Krieger JN, Stevens CE, Kiviat NB, Koutsky L, Critchlow C, et al. Clinical manifestations of vaginal trichomoniasis. J Am Med Assoc 1989;261(4):571–6.
[84] Buve A, Weiss HA, Laga M, Van Dych E, Musonda R, Zekeng L, et al. The epidemicology of Trichomoniasis in women in four African cities. AIDS 2001;15(4):89–96.
[85] Khalil HI, Al-Kuraishi AH, AI-Naimi UAM, AI-Naimi SA. Trichomoniasis vaginalis in women attending family planning unit in AL-Liqa'a hospital. Iraqi J Sci 2012;53(2):747–54.
[86] Jarallah HM. *Trichomonas vaginalis* infections among women in Basrah Marshes villages South Iraq. Egypt. J Exp Biol 2013; 9(1):71–4.
[87] Nash TE, Weller PF. Protozoal internal infections and trichomoniasis. In: Fauci AS, Braunwald E, Isselbacher KJ, Wilson JD, Martin JB, kasper DL, Hauser SL, Longo DL, editors. Harrison's principles of internal medicine. 14th ed. New York: McGraw-Hill; 1998. p. 1202–5. vol. 1.
[88] Al-Habib HM, Al-Dabbagh NY, Al-Daheen GA. The prevalence of *Trichomonas vaginalis* in association with other microorganisms among women with vaginal discharge in Mosul. Ann Coll Med Mosul 2005;31(1):37–44.
[89] Kadir MA, Ghalib AKH, Tahir SSH, AL-Dalableh F. A study on *Trichomonas vaginalis* and comparison between the efficacy of metronidazole and secnizole on women in Kirkuk province. J Fac Med Baghdad 2006;48(1):94–7. https://doi.org/10.32007/jfacmedbagdad.4811566.
[90] AL-Muathen DM, Sachit HG. Prevalence trichomoniasis and candidiasis for symptomatic pregnant and non pregnant women in Iraq. Al-Mustansiriyah J Pharma Sci 2016;16(2): 21–6.
[91] Adeoye G, Akande A, Pak J. Epidemiology of *Trichomonas vaginalis* among women in lagos metropolis, Nigeria. Pakistan. J Bio Sci 2007;10(13):2198–201. https://doi.org/10.3923/pjbs.2007.2198.2201.