

## GLOBAL EVIDENCE ON UROGENITAL INFECTIONS IN MALE INFERTILITY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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### Abstract

Urogenital infections are increasingly recognized as an important contributor to male infertility, yet their global prevalence remains variably reported. This systematic review and meta-analysis aimed to evaluate the worldwide burden of urogenital infections among infertile males and to assess associated microbial profiles and diagnostic approaches. A comprehensive literature search was conducted using Google Scholar and PubMed, including studies published between 2010 and 2024 that reported quantitative data on infection prevalence in infertile men. A total of 40 studies from Asia, Africa, Europe, North America, and South America were included. The findings revealed substantial variability in prevalence across regions, with higher rates observed in parts of Europe and South America and comparatively lower rates in some regions of Africa and Asia. Bacterial pathogens, particularly *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus* species, were most frequently identified, alongside sexually transmitted organisms such as *Chlamydia trachomatis* and *Mycoplasma* species. Diagnostic methods varied widely, with culture techniques commonly used and polymerase chain reaction (PCR) increasingly applied in recent studies, contributing to higher detection rates. Overall, the results indicate that urogenital infections represent a significant and globally prevalent factor associated with male infertility, highlighting the need for standardized diagnostic protocols, routine screening, and targeted treatment strategies to improve reproductive health outcomes.

### Introduction

Infertility in males, defined as the inability to achieve a pregnancy after a year or more of regular

unprotected intercourse, is a multifaceted issue with far-reaching implications for reproductive health [1]. While the prevailing narrative has often

focused on female fertility, male infertility is increasingly recognized as a significant factor contributing to difficulties in conception. Causes of male infertility can range from hormonal imbalances and genetic factors to anatomical abnormalities and reproductive tract obstructions [2]. Infertility has two types primary and secondary infertility, primary infertility factors sperm production problems, anatomical issues, hormonal imbalances, genetic disorders, lifestyle factors, medical conditions and treatments while the factors of secondary infertility are aging, changes in health status, lifestyle changes, treatment side effects, changes in reproductive health of the partner [2]. Despite advancements in reproductive medicine, there exists a notable gap in our understanding of the global prevalence and specific determinants of male infertility, necessitating comprehensive research efforts to address this knowledge deficit [3]. Male infertility is a condition that impacts a considerable proportion of couples worldwide, posing challenges to their aspirations of building a family. The inability to conceive after a year of regular unprotected intercourse is the clinical definition of infertility. Within this context, male infertility specifically refers to cases where the primary factor hindering conception lies with the male partner [4]. This condition can manifest due to various factors, including abnormalities in sperm production or function, anatomical issues such as blockages in the reproductive tract, hormonal imbalances, and genetic factors. Understanding the intricate web of factors contributing to male infertility is crucial for developing effective interventions and strategies. In recent years, research has begun to shed light on the importance of considering male reproductive health in the broader context of fertility treatments. This shift in focus recognizes the significant impact that male infertility can have on a couple's journey to parenthood and the need for

comprehensive approaches to address these challenges [5].

Urogenital infections, encompassing a spectrum of conditions affecting the urinary and reproductive systems, constitute a critical aspect of male reproductive health. These infections can result from various pathogens, including bacteria, viruses, fungi, and parasites. Notable examples include sexually transmitted infections (STIs) such as *Chlamydia trachomatis*, *Neisseria gonorrhoeae* (*Gonorrhea*), *Escherichia coli* (*E. coli*), *Mycoplasma genitalium* and *Ureaplasma urealyticum* etc [5]. Viruses including Human Papillomavirus (HPV), Herpes Simplex Virus (HSV), Mumps Virus and the fungi *Candida* spp and the parasites *Trichomonas vaginalis*, *Schistosoma* spp. Urogenital infections have been implicated in causing inflammation, scarring, and other detrimental effects on the reproductive organs, potentially leading to male infertility. These infections primarily involve the organs responsible for the production, storage, and excretion of urine. They can affect the kidneys (pyelonephritis), the bladder (cystitis), or the urethra (urethritis). Common symptoms include pain during urination, frequent urination, urgency to urinate, and sometimes, fever or flank pain [6]. Despite the recognized impact of urogenital infections on male reproductive health, there exists a substantial gap in our understanding of the global prevalence of these infections in infertile males [7].

This gap hinders the development of targeted interventions and comprehensive public health strategies to address the specific challenges faced by this population. The limited knowledge in this area highlights the urgent need for a systematic review and meta-analysis that can consolidate existing data, identify patterns, and provide a comprehensive understanding of the prevalence of urogenital infections in infertile males on a worldwide scale [8]. The complex interplay between male infertility and urogenital infections forms the crux of this research initiative. Male

reproductive health is intricately connected to the health of the urogenital system, and infections in this region can have profound implications for fertility. Infections may lead to inflammation, scarring, and obstruction of reproductive organs, contributing to difficulties in conception. It outlines the proposed objectives of the study, emphasizing the importance of exploring the relationship between male infertility and urogenital infections [9].

The primary aim is to conduct a systematic review and meta-analysis to synthesize existing data, providing a detailed analysis of the prevalence and patterns of urogenital infections among infertile males globally. By doing so, the research seeks to uncover the nuanced associations between urogenital infections and male infertility, contributing valuable insights for clinical understanding and guiding public health interventions. The justification for undertaking this study lies in its potential to significantly advance our understanding of the complex interplay between urogenital infections and male infertility, providing a foundation for informed strategies to improve reproductive health outcomes worldwide. The findings are expected to inform future research endeavors, shape clinical practices, and contribute to the broader landscape of male reproductive health [10].

Detecting urogenital infections in infertile males involves a comprehensive and multifaceted approach. Semen analysis is pivotal, assessing parameters like leukocytospermia to indicate inflammation and potential infection. Microbiological cultures of urine or urethral swabs identify specific pathogens such as chlamydia, gonorrhea, or mycoplasma [11]. Blood tests detect elevated levels of antibodies or markers linked to systemic or chronic infections. Imaging studies like ultrasound or MRI may reveal structural abnormalities predisposing to infections [12]. Additionally, clinical history and physical examination, including symptoms like

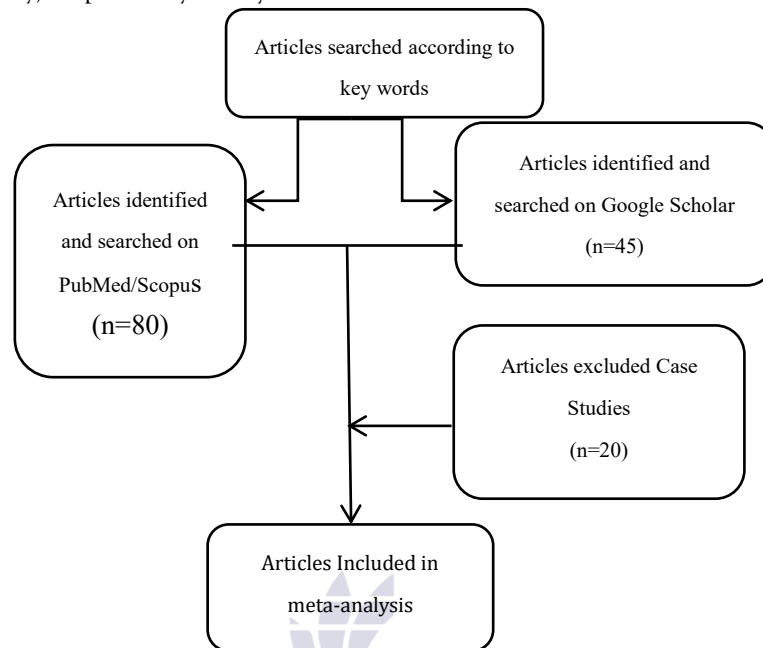
genital discharge or pain, are fundamental. A thorough clinical assessment, including specialized tests like PCR assays targeting specific pathogens, is indispensable. Collaborative efforts between urologists, microbiologists, and reproductive specialists are crucial to interpret results accurately and devise tailored treatment strategies addressing both the infection and its potential impact on fertility [13].

## MATERIALS AND METHODS

The present systematic review was conducted by including studies published between **2010 and 2024**, covering a period of 14 years to ensure the inclusion of recent and relevant data on urogenital infections in infertile males. A comprehensive literature search was performed using major electronic databases, including Google Scholar and PubMed, employing a combination of keywords and Medical Subject Headings (MeSH) terms such as “urogenital infections,” “male infertility,” “bacteriospermia,” and “sexually transmitted infections,” along with Boolean operators (AND, OR) to refine the search. Studies were selected based on predefined criteria, where only original research articles involving human participants, reporting quantitative data on the prevalence of urogenital infections in relation to male infertility, were included, while studies with insufficient data, case reports, reviews, conference abstracts, and non-English publications were excluded. Following title and abstract screening, full-text articles were assessed for eligibility. Data extraction was carried out systematically using a standardized format, capturing information such as author details, year of publication, study location, sample size, number of positive cases, type of infertility, diagnostic methods (PCR or culture), and identified microorganisms. The quality of the included studies was evaluated based on methodological rigor, including study design, sample size, and reliability of diagnostic

techniques. The extracted data were then synthesized both descriptively and quantitatively, with prevalence calculated from reported cases and comparative analyses conducted across different geographical regions to identify global trends. Additionally, exploratory analyses were

performed to assess regional variations, the influence of diagnostic methods on detection rates, and the distribution of microbial pathogens, providing deeper insight into heterogeneity among the included studies.



RESULTS

The present systematic review included 40 studies conducted across Asia, Africa, South America, North America, and Europe, published between 2010 and 2021, revealing considerable global variation in the prevalence of urogenital infections among infertile men. The reported prevalence ranged widely, from low levels in countries such as Mexico and Greece to markedly high rates in Canada, France, Argentina, and the United States, reflecting differences in study populations, diagnostic approaches, and healthcare settings. Overall, a substantial proportion of infertile males tested positive for urogenital infections, as also illustrated in the graphical analyses, where positive cases consistently outweighed negative findings. Bacterial pathogens, particularly *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus* species, were the most commonly identified organisms,

although sexually transmitted pathogens such as *Chlamydia trachomatis*, *Mycoplasma* species, and *Trichomonas vaginalis* were also frequently reported. Diagnostic methods varied considerably, with culture techniques being the most widely used, while polymerase chain reaction (PCR) was increasingly applied in more recent studies, leading to improved detection rates. Regional patterns indicated a relatively higher burden in Europe and South America compared to Africa and parts of Asia. Additionally, only a limited number of studies differentiated between primary and secondary infertility, restricting detailed subgroup analysis. Overall, these findings highlight that urogenital infections represent a significant and globally prevalent factor associated with male infertility, with variability largely influenced by diagnostic methodologies and regional healthcare differences.

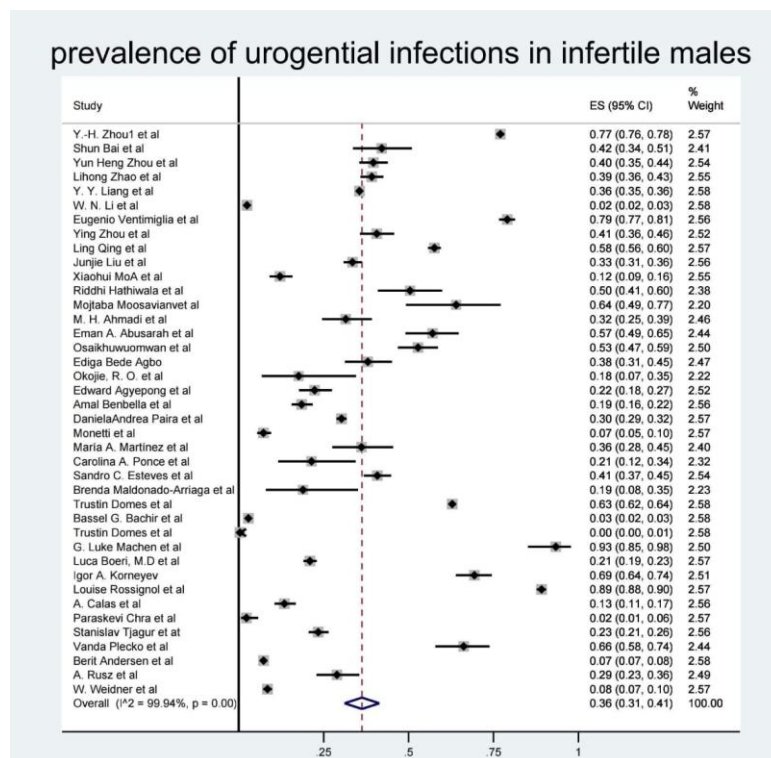


Figure.1 The results of the meta-analysis of the search data

Table.1 Distribution of Articles reviewed regarding presence of urogenital infection infertile male worldwide.

#	Region	Publis h Year	Study Year	Authors	Sampl e size	Positive Patient s	Pathogens						Most Prevalent	
							1. MG	2. MH	3. CT	4. UU	5. US	6. NG		Other
	ASIA													
1	China	2018	2011 to 2016	Y.-H. Zhou1 et al [1]	5016	3,863	Yes	Yes	No	No	Yes	No	No	MH
2	China	2021	2019 to 2020	Shun Bai et al [7]	133	56	Yes	Yes	Yes	Yes	Yes	No	HSV-2	No
3	China	2016	2010 to 2011	Yun Heng Zhou et al [16]	540	214	No	No	No	Yes	Yes	No	No	US
4	China	2020	2020	Lihong Zhao et al [24]	817	320	No	No	No	Yes	Yes	No	UP	No
5	China	2018	2013 to 2016	Y. Y. Liang et al [41]	23,860	8481	No	No	Yes	Yes	No	Yes	No	CT,UU
6	China	2019	2016 to 2017	W. N. Li et al [48]	30,794	749	Yes	No	Yes	No	No	No	No	No
7	China	2021	2007 to 2016	Eugenio Ventimiglia et al [91]	1,174	928	No	No	No	No	No	No	No	No

8	China	2019	2017 to 2018	Ying Zhou et al [99]	379	154	No	No	Yes	No	No	Yes	No	CT,NG
9	China	2017	2017	Ling Qing et al [108]	2607	1502	Yes	No	Yes	Yes	No	Yes	No	UU
10	China	2013	2011 to 2013	Junjie Liu et al [123]	1236	414	No	Yes	Yes	Yes	No	No	No	No
11	China	2016	2013 to 2014	Xiaohui MoA et al [124]	387	47	Yes	No	No	Yes	No	No	UP	No
12	India	2018	2015 to 2016	Riddhi Hathiwal et al [50]	115	58	No	No	No	No	No	No	ES,SA	No
13	Iran	1-Jan-29	2016 to 2017	Mojtaba Moosavian et al [42]	50	32	No	Yes	Yes	Yes	No	No	No	No
14	Iran	2018	2001 to 2009	M. H. Ahmadi et al [46]	165	52	No	No	Yes	No	No	No	No	CT
15	Jordan	2013	2011	Eman A. Abusarah et al [115]	163	93	Yes	No	Yes	Yes	Yes	Yes	No	No
	<b>AFRICA</b>													
16	Nigeria	2019	2015 to 2017	Osaikhuwuomwan et al [27]	288	152	No	Yes	Yes	Yes	No	No	CMV, HIV	No
17	Nigeria	2021	2020 to 2021	Ediga Bede Agbo [88]	200	76	Yes	Yes	No	No	No	Yes	Strep & Stap	No
18	Nigeria	2018	2018	Okojie, R. O. et al [95]	34	6	No	No	No	No	No	No	E.Coli, SA	No
19	Ghana	2018	2017 to 2018	Edward Agyepong et al [53]	300	67	No	No	Yes	Yes	No	No	E. coli, SA, PS, PS, KS, MM	No
20	Morocco	2018	2013 to 2017	Amal Benbella et al [73]	632	117	No	No	Yes	No	No	Yes	No	No
	<b>SOUTH AMERICA</b>													
21	Argentina	2021	2015 to	Daniela Andrea	3610	1092	No	Yes	Yes	No	Yes	No	No	US

	na		2019	Paira et al [5]										
22	Argentina	2013	2013	Monetti et al []	660	48	No	No	Yes	No	No	No	No	No
23	Chile	2015	2014	María A. Martínez et al [120]	119	43	No	No	Yes	No	No	No	No	No
24	Chile	2017	2002 to 2010	Carolina A. Ponce et al [121]	56	12	No	No	No	No	No	No	SP, KP	No
25	Brazil	2015	2015	Sandro C. Esteves et al [119]	593	242	No	No	Yes	No	No	No	No	No
	<b>NORTH AMERICA</b>													
26	Mexico	2019	2018	Brenda Maldonado-Arriaga et al [65]	37	7	No	No	No	Yes	No	No	No	No
27	Canada	2012	2001 to 2010	Trustin Domes et al [111]	7,852	4,935	No	No	No	No	No	No	EF, E. coli, SA & SA	EF, E. coli, SA & SA
28	Canada	2014	1971 to 2006	Bassel G. Bachir et al [116]	8232	234	Yes	Yes	Yes	Yes	No	Yes	No	No
29	Canada	2012	2003 to 2010	Trustin Domes et al [117]	5,588	20	No	No	Yes	No	No	Yes	No	CT
30	USA	2018	2018	G. Luke Machen et al [96]	75	70	Yes	Yes	Yes	Yes	Yes	No	E.coli, SA SA	Strep, Stap
	<b>EUROPE</b>													
31	Italy	2020	2010	Luca Boeri, M.D et al [6]	1689	354	Yes	Yes	Yes	Yes	Yes	No	GV, CA	MG, MH, CT
32	Russian	2018	2018	Igor A. Korneyev [10]	307	213	Yes	Yes	Yes	No	Yes	Yes	TV	Herpes virus
33	France	2019	2007 to 2017	Louise Rossignol et al [64]	1944	1733	Yes	No	Yes	No	No	Yes	No	No
34	France	2021	2017 to 2018	A. Calas et al [84]	484	65	Yes	No	Yes	No	No	Yes	No	No
35	Greece	2018	2017	Paraskevi Chra et al [66]	176	4	Yes	No	Yes	Yes	Yes	Yes	No	No
36	Estonia	2017	2017	Stanislav Tjagur et at [13]	825	193	Yes	No	Yes	No	No	Yes	No	CT, NG

37	Denmark	2014	2011	Vanda Plecko et al [110]	145	96	Yes	Yes	Yes	Yes	Yes	No	No	No
38	Denmark	2010	1997	Berit Andersen et al [112]	14,980	1093	No	No	Yes	No	No	No	No	No
39	Netherlands	2011	2000 to 2011	A. Rusz et al [109]	211	61	No	No	Yes	No	No	No	No	No
40	Germany	2013	2012	W. Weidner et al [113]	1,834	155	No	No	Yes	No	No	No	No	CT

Table .2 the method used in detection of urogenital infection

Region	Authors	Infertility		Diagnosis tests	
		Primary	Secondary	PCR	Culture
<b>ASIA</b>					
China	Y.-H. Zhou1 et al	No	No	No	Yes
China	Shun Bai et al	Yes	Yes	Yes	Yes
China	Yun Heng Zhou et al	No	No	Yes	Yes
China	Lihong Zhao et al	No	No	Yes	Yes
China	Y. Y. Liang et al	Yes	No	Yes	No
China	W. N. Li et al	No	No	Yes	Yes
China	Eugenio Ventimiglia et al	Yes	Yes	No	Yes
China	Ying Zhou et al	Yes	No	Yes	No
China	Ling Qing et al	No	No	Yes	Yes
China	Junjie Liu et al	No	No	No	Yes
China	Xiaohui MoA et al	No	No	Yes	No
India	Riddhi Hathiwala et al	Yes	No	No	Yes
Iran	Mojtaba Moosavianvet et al	No	No	Yes	Yes
Iran	M. H. Ahmadi et al	No	No	Yes	No
Jordan	Eman A. Abusarah et al	No	No	Yes	Yes
<b>AFRICA</b>					
Nigeria	Osaikhuwuomwan et al	No	No	No	No
Nigeria	Ediga Bede Agbo	Yes	Yes	No	Yes
Nigeria	Okojie, R. O. et al	No	No	Yes	Yes
Ghana	Edward Agyepong et al	Yes	No	No	Yes
Morocco	Amal Benbella et al	Yes	Yes	No	Yes
<b>SOUTH AMERICA</b>					
Argentina	DanielaAndrea Paira et al	Yes	No	Yes	Yes
Argentina	Monetti et al	No	No	Yes	No
Chile	María A. Martínez et al	No	No	Yes	No
Chile	Carolina A. Ponce et al	No	No	Yes	No
Brazil	Sandro C. Esteves et al	No	Yes	No	No
<b>NORTH AMERICA</b>					

Mexico	Brenda Maldonado-Arriaga et al	No	No	Yes	Yes
Canada	Trustin Domes et al	No	No	No	Yes
Canada	Bassel G. Bachir et al	No	No	No	Yes
Canada	Trustin Domes et al	No	No	No	No
USA	G. Luke Machen et al	No	No	No	Yes
<b>EUROPE</b>					
Italy	Luca Boeri, M.D et al	Yes	No	Yes	Yes
Russian	Igor A. Korneyev	Yes	Yes	Yes	Yes
France	Louise Rossignol et al	No	No	No	Yes
France	A. Calas et al	No	No	Yes	No
Greece	Paraskevi Chra et al	No	No	Yes	Yes
Estonia	Stanislav Tjagur et at	No	No	Yes	No
Denmark	Vanda Plecko et al	No	No	Yes	Yes
Denmark	Berit Andersen et al	No	No	No	No
Netherlands	A. Ruzs et al	No	No	No	Yes
Germany	W. Weidner et al	No	No	Yes	Yes

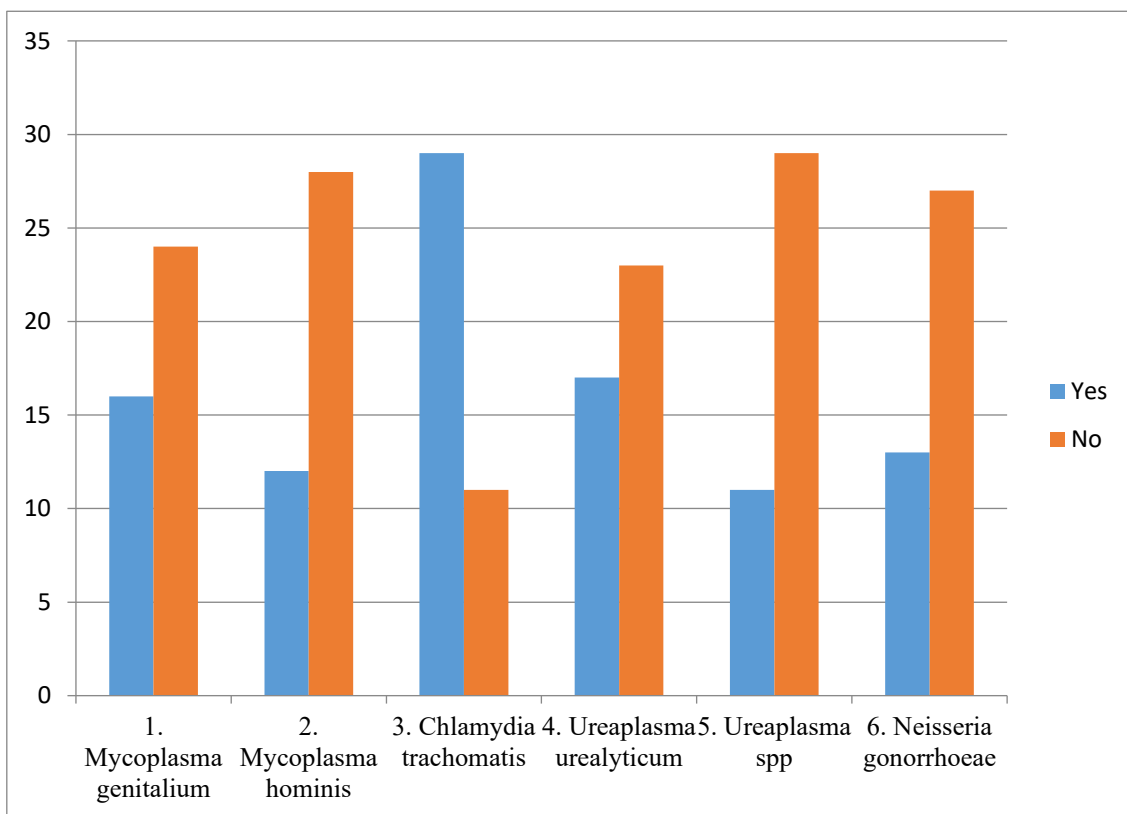


Figure .2 The Figure show the Positive (blue) and negative (red) value of the infection

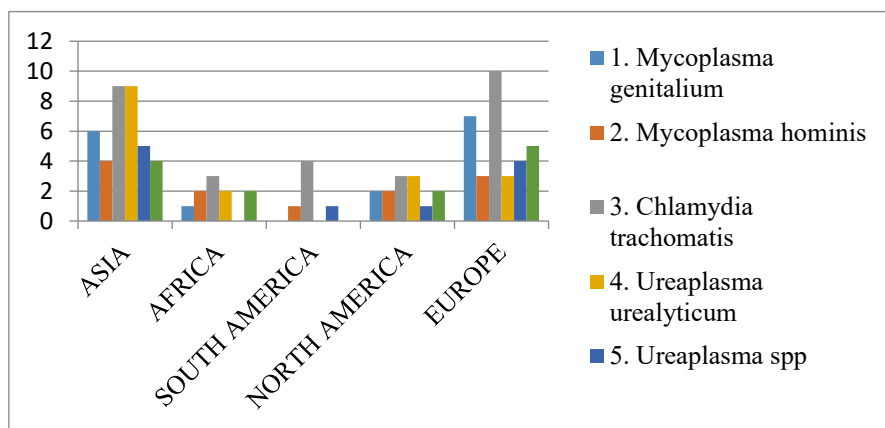


Figure .3 Show the positive values of infection worldwide

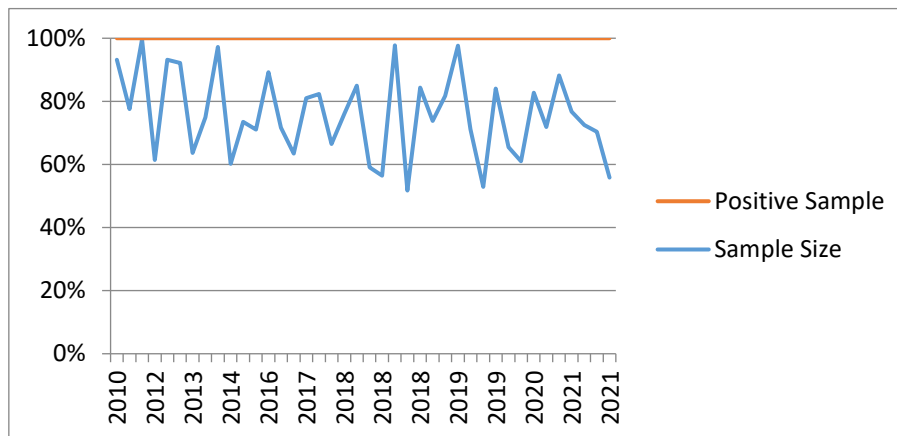


Figure .4 The increase and decrease of the case of urogenital infection

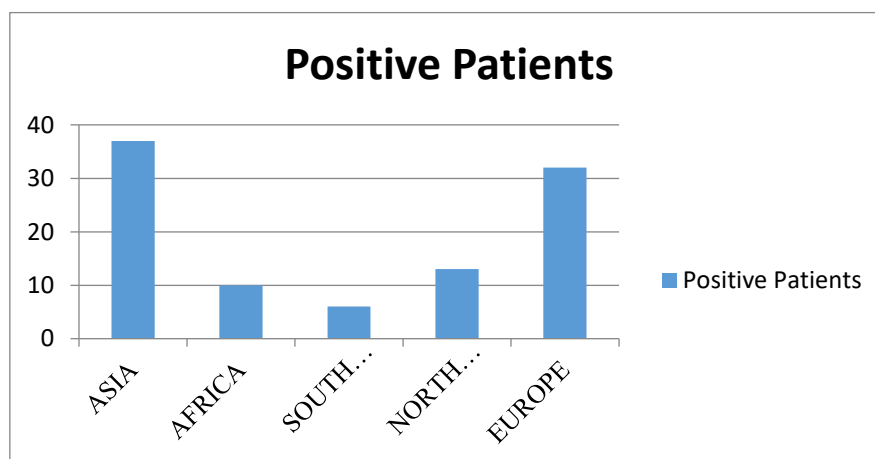


Figure .5 The positive results worldwide

DISCUSSION

The present systematic review and meta-analysis provides a comprehensive evaluation of the global prevalence of urogenital infections among

infertile males, highlighting their significant yet often underappreciated role in male reproductive dysfunction. By synthesizing data from studies conducted across Asia, Africa, Europe, North

America, and South America, this study demonstrates that urogenital infections are widely prevalent among infertile men, although the magnitude of prevalence varies considerably across regions. This variability reflects differences in study populations, healthcare infrastructure, socioeconomic conditions, and, importantly, diagnostic methodologies employed in the included studies.

One of the most notable findings of this review is the consistently high prevalence of infections reported in several regions, particularly in parts of Europe and South America, as well as selected studies from North America. For instance, studies from France, Canada, and Argentina reported markedly elevated infection rates, suggesting that urogenital infections may play a more substantial role in male infertility than previously recognized. In contrast, relatively lower prevalence rates were observed in certain studies from Africa and Asia; however, these differences should be interpreted cautiously, as they may be influenced by limited diagnostic sensitivity, underreporting, or smaller sample sizes. The observed global heterogeneity underscores the complexity of accurately estimating the true burden of infection-related infertility.

The microbial profile identified across the included studies further supports the multifactorial nature of urogenital infections. Bacterial pathogens such as *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus* species were the most frequently reported organisms, consistent with their known role in genitourinary tract infections and semen contamination. In addition, sexually transmitted pathogens including *Chlamydia trachomatis*, *Mycoplasma genitalium*, *Mycoplasma hominis*, and *Trichomonas vaginalis* were also commonly identified, indicating the importance of sexual health in the etiology of male infertility. The presence of viral agents, such as herpes viruses in some studies, further highlights the diversity of infectious

contributors. These findings align with existing literature suggesting that infections can impair sperm function through multiple mechanisms, including inflammation, oxidative stress, and direct damage to spermatozoa.

A critical factor influencing the variability in reported prevalence is the difference in diagnostic approaches used across studies. Traditional culture-based methods, while widely utilized, have limited sensitivity and may fail to detect fastidious or intracellular organisms. In contrast, molecular techniques such as polymerase chain reaction (PCR) offer higher sensitivity and specificity, enabling the detection of a broader range of pathogens, including those that are difficult to culture. The increasing use of PCR in more recent studies likely contributes to the higher detection rates observed, suggesting that earlier studies relying solely on culture methods may have underestimated the true prevalence of infections. This highlights the need for standardized diagnostic protocols that integrate both conventional and molecular techniques to ensure accurate and comprehensive detection.

Another important observation from this review is the limited reporting of infertility types across the included studies. Only a small proportion of studies distinguished between primary and secondary infertility, restricting the ability to assess whether urogenital infections differentially impact these subgroups. This represents a significant gap in the literature, as understanding such distinctions could provide valuable insights into the pathophysiology and progression of infection-related infertility. Additionally, variations in study design, sample size, and population characteristics further contribute to heterogeneity, emphasizing the importance of methodological consistency in future research.

From a clinical perspective, the findings of this study have important implications for the management of male infertility. The high prevalence of urogenital infections observed

suggests that routine screening for infectious agents should be considered an integral component of infertility evaluation. Early detection and appropriate treatment of these infections may improve semen quality and enhance the chances of successful conception, either naturally or through assisted reproductive techniques. Furthermore, the identification of specific pathogens can guide targeted antimicrobial therapy, reducing unnecessary or empirical treatment approaches.

Despite its strengths, including the inclusion of a wide range of studies from diverse regions, this review has certain limitations. The heterogeneity among studies in terms of diagnostic methods, study populations, and reporting standards may affect the comparability of results. Additionally, the exclusion of non-English publications may have introduced language bias, potentially limiting the inclusion of relevant data from certain regions. Publication bias is also a consideration, as studies reporting higher prevalence rates may be more likely to be published. These limitations should be taken into account when interpreting the findings.

Future research should focus on conducting large-scale, multicenter studies with standardized methodologies to better estimate the global burden of urogenital infections in infertile males. The incorporation of advanced molecular diagnostic tools, along with detailed reporting of clinical and demographic variables, will be essential for improving data quality and comparability. Moreover, longitudinal studies are needed to establish causal relationships between specific pathogens and infertility outcomes, as most existing studies are cross-sectional in nature. Investigating the role of host immune response, microbiome alterations, and antimicrobial resistance patterns may also provide deeper insights into the pathogenesis of infection-related infertility.

In conclusion, this systematic review and meta-analysis highlight that urogenital infections represent a significant and globally prevalent factor associated with male infertility. The findings emphasize the need for improved diagnostic strategies, routine screening, and targeted treatment approaches to address this important but often overlooked aspect of reproductive health. Strengthening research efforts and clinical practices in this area has the potential to significantly reduce the burden of male infertility and improve reproductive outcomes worldwide.

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