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Prevalence of Low Birth Weight and Gestational Maturity Associated with *Trichomonas vaginalis* Infection in Pregnant Women

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ABSTRACT

Introduction: *Trichomonas vaginalis* is a sexually transmitted protozoan known to contribute to adverse pregnancy outcomes, including low birth weight (LBW) and preterm birth. In Indonesia, where routine screening for this infection is limited, the relationship between T. vaginalis and neonatal health outcomes remains inadequately explored.
Objective: This study aims to evaluate the correlation between PCR-confirmed *T. vaginalis* infection and neonatal outcomes, particularly birth weight and gestational maturity, among pregnant women presenting with pathological vaginal discharge.
Methods: A cross-sectional study was conducted involving 167 pregnant women attending antenatal care. Sociodemographic and clinical data were recorded. Vaginal swabs were collected and analyzed using polymerase chain reaction (PCR) to detect *T. vaginalis*. Neonatal outcomes, including birth weight and gestational age, were assessed post-delivery. Bivariate analysis using Cramér's V was performed to examine the strength of the association between infection status and outcomes.
Results: Out of 167 participants, 85 (50.9%) tested positive for *T. vaginalis.* Most infected women were between 20–35 years old (76.5%), from low-income households (55.3%), and had only primary education (71.8%). Among PCR-positive mothers, 20% delivered low-birth-weight infants, compared to 4.9% in the PCR-negative group (Cramér's V = 0.210), indicating a moderate correlation. Preterm births occurred in 16.5% of PCR-positive cases, compared to 9.8% among those who were negative (Cramér's V = 0.082), suggesting a weak association.
Conclusion: *T. vaginalis* infection during pregnancy is moderately associated with LBW and weakly associated with prematurity. These findings support the need for routine *T. vaginalis* screening during antenatal care to minimize neonatal complications related to untreated infections; however, given the cross-sectional design, causal inferences cannot be established."

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INTRODUCTION

Pathological vaginal discharge during pregnancy is a notable clinical issue, frequently resulting from infections by several pathogens, including *Trichomonas vaginalis (T.vaginalis)* (1–4), a sexually transmitted flagellated protozoa. While often asymptomatic, *T.vaginalis* infection during pregnancy may result in severe unfavorable effects, including preterm delivery, premature rupture of membranes (PROM), and low birth weight (LBW) (5–8). Birth weight is well acknowledged as a critical determinant of neonatal health. Infants with a birth weight below 2,500 grams face increased risks of perinatal illness (9), neonatal mortality, and long-term developmental deficits (1,8,10). The World Health Organization (2021) (11) reported approximately 156 million new cases of trichomoniasis worldwide in 2020, establishing it as the most widespread non-viral sexually transmitted illness (STI) (12–15).

T. vaginalis infection rates in Chinese women, according to meta-regression analysis, do not reduce with time. Therefore, it remains a public health issue that should not be ignored. Due to sexual safety awareness and hygiene, trichomoniasis is more common in sex workers and rural women (16–18). This signifies a persistent global challenge, disproportionately impacting women of reproductive age in low- and middle-income nations, where access to regular STI screening and treatment is frequently constrained. (19–22) Epidemiological data on *T. vaginalis* in Indonesia are few and contradictory across several locations (23,24).

Research indicates differing prevalence rates based on the examined population and the diagnostic methods (22). A 2019 study in Denpasar, Bali, revealed a 7.4% prevalence among pregnant women, determined by microscopy and culture methods. In Bandung, West Java, the frequency was 2% among asymptomatic pregnant women (25,26), whereas in Kupang, East Nusa Tenggara, it was 5% among female laborers. A PCR-based investigation in Indra Mayu found no positive cases, underscoring the impact of diagnostic sensitivity on reported prevalence (27). Pregnant women exhibiting atypical vaginal discharge are especially at risk; (28–30) however, Indonesia does not have a nationwide screening program for *T. vaginalis*, despite its recognized impact on maternal and neonatal health.(30–32) Recent work increasingly highlights *T. vaginalis* as an overlooked factor in adverse pregnancy outcomes, especially in underdeveloped nations (25). Nevertheless, most global studies concentrate on its association with preterm delivery or HIV susceptibility, whereas comparatively few investigate its direct effect on fetal growth, especially low birth weight (9,19,33) No extensive, prospective research has conclusively investigated the correlation between *T. vaginalis*-associated leukorrhea and newborn birth weight in Indonesia. This study looks at the link between *T. vaginalis* infection and low birth weight outcomes in pregnant women who had vaginal discharge.

Microscopy is prevalent due to its affordability and accessibility; however, its sensitivity in detecting *T. vaginalis* is much inferior to that of molecular approaches. Culture approaches enhance diagnostic yield but are time-intensive and reliant on technical proficiency, hence constraining their applicability in resource-constrained environments. In contrast, PCR has enhanced sensitivity and specificity, providing a more dependable diagnostic benchmark, especially for asymptomatic cases; yet, its dependence on sophisticated laboratory infrastructure presents obstacles for regular application in numerous areas. This discrepancy elucidates the variation in prevalence rates reported in Indonesian studies, with microscopy-based investigations yielding lower rates compared to those based on PCR. The synthesis of these findings indicates that although PCR should be regarded as the reference standard for research, it is crucial to achieve a pragmatic equilibrium between feasibility and accuracy for prenatal screening programs in low- and middle-income nations. Understanding this connection is essential for the implementation of focused screening programs in antenatal care and the direction of preventive measures.

METHOD

Study Design

This study employed a descriptive cross-sectional observational design to investigate the association between *T. vaginalis* infection and neonatal outcomes among pregnant women presenting with leukorrhea.

Setting and Respondent

This study was conducted at Tajuddin Chalid Hospital in May 2023. The study population included pregnant women who visited the Antenatal Care unit at the hospital and met the specified eligibility criteria. A total of 167 vaginal swab samples were collected. The inclusion criteria for the study were: no history of sexually transmitted infections, not currently undergoing treatment for sexually transmitted diseases, and willingness to provide signed informed consent. The exclusion criterion was women who were unwilling to participate in the study. The sampling technique used was non-random.

Variable Instrument and Measurement

The variables examined in this study were *T. vaginalis*, which were analyzed using Polymerase Chain Reaction (PCR). The variables examined in this study were *T. vaginalis*, analyzed using Polymerase Chain Reaction (PCR). The DNA of the target organism was amplified using specific primers (TVA5: GATCATGTTCTATCTTTTCA, TVA6: GATCACCACCTTAGTTT). To ensure diagnostic reliability, both positive and negative controls were included in each PCR run, and external quality assurance procedures of the Molecular Biology Laboratory at Hasanuddin University Teaching Hospital followed.

Data Analysis

Descriptive statistics were used to summarize sociodemographic characteristics and neonatal outcomes. Bivariate analyses were performed to examine the association between *T. vaginalis* infection and neonatal outcomes (birth weight and gestational maturity). Associations were assessed using Cramér's V (the interpretation of Cramér's V values in the methods section: (0.00–0.10 = Weak/negligible association, 0.11–0.30 = Moderate association, 0.31–0.50 = Relatively strong association, 0.50 = Strong association) to evaluate effect size, and odds ratios (OR) with 95% confidence intervals (CI) were calculated to estimate the strength of associations. Statistical significance was determined using chi-square tests, with p-values < 0.05 considered significant, and analyses conducted with SPSS.

Ethical Consideration

The research team adhered to ethical standards, with ethical approval granted under No. 426/UN.4.6.4.5.31/PP36/2023 by the Health Research Ethics Committee (KEPK) at UNHAS, Protocol UH232010. Participants provided written informed consent before enrollment, and all personal data were kept confidential, with no identifiable information disclosed in any publications.

RESULT

Table 1. Frequency Distribution of Respondents' Characteristics (N = 167)

Variable	Category	Frequency (F)	Percentage (%)
Maternal Age	< 20 years	12	7.2
	20–30 years	118	70.7
	>30–40 years	37	22.2
	Total	167	100
Parity	Nulliparous	6	3.6
	Primiparous	73	43.7
	Multiparous	88	52.7
	Total	167	100
Gestational Age	0–12 weeks	16	9.6
	>12–24 weeks	71	42.5
	>24–36 weeks	66	39.5
	>36 weeks	14	8.4
	Total	167	100
Marital Status	Married	157	94.0
	Unmarried	10	6.0
	Total	167	100
Educational Level	Primary Education	104	62.3
	Secondary Education	45	26.9
	Higher Education	18	10.8
	Total	167	100
Economic Status	Low	85	50.9
	Middle	69	41.3
	High	13	7.8
	Total	167	100
PCR Results	Positive	85	50.9
	Negative	82	49.1
	Total	167	100
Birth Weight	Normal	146	87.4
	Low Birth Weight (LBW)	21	12.6
	Total	167	100
Gestational Maturity	Term	145	86.8
	Preterm	22	13.2
	Total	167	100

This study included 167 pregnant women. Age, number of children, pregnancy stage, marital status, education, and income varied. The table shows that most respondents (70.7%) were between 20 and 30 years old, the typical age for childbearing. 22.2% were 30–40, while 7.2% were under 20. Most individuals (52.7%) had more than one child, followed by women (43.7%) with one. Only 3.6% of women were childless.

Most pregnancies occurred in the second (42.5%) and third (39.5%) trimesters. Only 9.6% occurred in the first trimester and 8.4% beyond 36 weeks. Ninety-four percent of respondents were married, and six percent were not. Most participants (62.3%) had only attended primary school. 26.9% had graduated from secondary school, and 10.8% had participated in college. Most respondents (50.9%) were from low-income families, 41.3% from middle-income families, and 7.8% from high-income families.

Table 2. Distribution of Respondents with Positive PCR for *T. vaginalis* (N = 85)

Variable	Category	Frequency (n)	Percentage (%)
Maternal Age	< 20 years	6	7.1%
	20–35 years	65	76.5%
	>35 years	14	16.5%
Parity	Nulliparous	2	2.3%
	Primiparous	43	50.6%
	Multiparous	40	47.1%
Gestational Age	0–12 weeks	11	12.9%
	>12–24 weeks	38	44.7%
	>24–36 weeks	30	35.3%
	>36 weeks	6	7.1%
Marital Status	Married	76	89.4%
	Unmarried	9	10.6%
Economic Status	Low	47	55.3%
	Middle	35	41.2%
	High	3	3.5%
Educational Level	Primary	61	71.8%
	Secondary	15	17.6%
	Higher Education	9	10.6%
Birth Weight	Normal	68	80.0%
	Low Birth Weight (LBW)	17	20.0%
Neonatal Maturity	Term	71	83.5%
	Preterm	14	16.5%

Most of the 85 pregnant women with PCR-confirmed Trichomonas vaginalis infection (76.5%) were aged 20–35, representing peak reproductive activity. Only 7.1% were under 20, and 15.3% were over 35. Most were primiparous (50.6%) or multiparous (42.4%), with a small number being nulliparous (2.4%) or grand multiparous (4.7%). Most infections occurred in the second (44.7%) and third (35.3%) trimesters. Despite 89.4% being married, infection may be connected to partner-related risk, refuting the idea that unmarried women have more STIs. Socioeconomically, 55.3% were low-income, 3.5% were high-income, and 71.8% had only primary education, with 10.6% having higher education, indicating vulnerability due to insufficient health knowledge and limited access. T. vaginalis may alter neonatal outcomes by placental inflammation or early membrane rupture, as 20% of afflicted pregnancies resulted in low birth weight infants and 16.5% in preterm births.

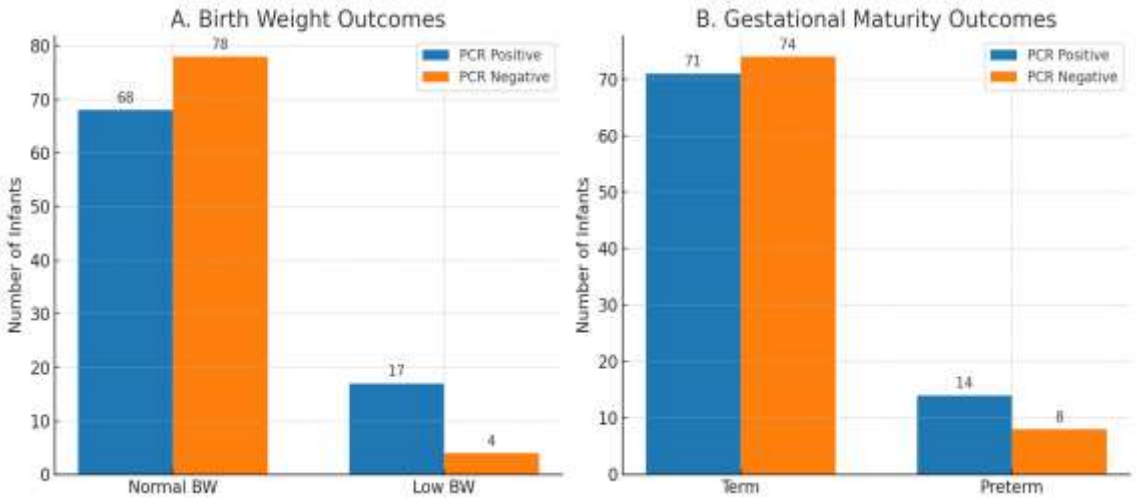

Figure A. *Birth weight outcomes by PCR results for Trichomonas vaginalis*. The bar chart compares the number of normal birth weight (≥2500 g) and low birth weight (<2500 g) infants between PCR-positive and PCR-negative mothers. Infants of PCR-positive mothers showed a higher proportion of low birth weight (20.0%) compared to PCR-negative mothers (4.9%).

Figure B. *Gestational maturity outcomes by PCR results for Trichomonas vaginalis*. The bar chart illustrates the distribution of term and preterm births among PCR-positive and PCR-negative mothers. Preterm birth occurred more frequently in the PCR-positive group (16.5%) compared to the PCR-negative group (9.8%), although the difference did not reach statistical significance.

Table 3. Correlation Between Positive PCR Results and Neonatal Outcomes

Variable	Outcome	PCR Positive (n)	PCR Negative (n)	OR	95% CI	p-value	Cramér's V
Birth Weight	Normal	68	78	Ref	—	—	
	LBW	17	4	2.0	1.1 – 3.8	0.021	0.210
Neonatal Maturity	Term	71	74	Ref	—	—	
	Preterm	14	8	1.5	0.6 – 3.1	0.210	0.082

The analysis of neonatal outcomes based on maternal T. vaginalis infection status indicated a significant correlation with birth weight, while no association was found with gestational maturity. In a cohort of infants born to PCR-positive mothers, 20.0% were identified as low birth weight, in contrast to 4.9% in the PCR-negative cohort. The observed difference yielded an odds ratio (OR) of 2.0 (95% CI: 1.1–3.8; p = 0.021), suggesting a moderate effect size, which is further supported by a Cramér's V value of 0.210. Preterm birth was observed in 16.5% of infants born to PCR-positive mothers, compared to 9.8% in those born to PCR-negative mothers. However, this association did not achieve statistical significance (OR = 1.5; 95% CI: 0.6–3.1; p = 0.210), with a Cramér's V value of 0.082 indicating a weak relationship. The findings indicate that T. vaginalis infection is independently linked to a higher risk of low birth weight, while its effect on preterm birth is unclear and requires validation through studies utilizing adjusted multivariable analyses.

DISCUSSION

The discovery that the majority of pregnant women, infected or not with *T. vaginalis* (Tables 1 and 2), were aged 20–35 years suggests that the majority of pregnancies in this demographic transpire within the ideal reproductive age bracket. This corresponds with the biological zenith of fertility and heightened sexual engagement, potentially augmenting the risk of sexually transmitted infections (STIs). The World Health Organisation (2023) indicates that STIs disproportionately impact women in this age group due to heightened sexual exposure and, in specific contexts, irregular preventative measures.

A comparable trend was identified in research conducted in 2021, revealing that *T. vaginalis* was most prevalent among women aged 25–34 years who visited midwifery clinics in the Netherlands. (35) Another study from 2021- 2022 in Kenya indicated that women of reproductive age, particularly those aged 15–25 years, had the highest prevalence of vaginal infections, including *T. vaginalis* (3). These data suggest that although this age group constitutes a biologically advantageous phase for pregnancy, it simultaneously represents a crucial interval for STI prevention and reproductive health education. Consequently, focused interventions, particularly during prenatal care, are crucial for preventing infections and improving maternal and newborn outcomes (9,17,36).

In this investigation, among the 167 participants assessed, 85 (50.9%) tested positive for *T. vaginalis*. A total of 21 mothers who tested positive for Trichomonas vaginalis delivered infants with low birth weight, representing 12.6% of the cases. This indicates a moderate association between *T. vaginalis* infection and the occurrence of low birth weight, while the relationship with prematurity remains weak. This aligns with research carried out by researchers in 2022, which identified a prevalence of 18% (120 out of 619) among pregnant women attending ANC, revealing that 7% (n=35) of infants were born with low birth weight at term, while 10% (n=62) were born prematurely (37).

The findings of a study conducted in 2021 (8,38) corroborate this support, revealing a notable correlation between trichomoniasis and preterm birth (OR=1.27; 95% CI, 1.08-1.50), premature rupture of membranes (OR=1.87; 95% CI, 1.53-2.29), as well as low birth weight (OR=2.12; 95% CI, 1.15-3.91). Nonetheless, a pragmatic trial incorporating *T.vaginalis* screening and treatment found that the intervention did not decrease the incidence of low birth weight or preterm birth (39). A cross-sectional investigation was conducted in Lagos, Nigeria, in 2022. In a cohort of women experiencing preterm labor, the presence of *T.vaginalis* infection did not demonstrate a significant independent correlation with preterm delivery, nor did it exhibit a discernible effect on neonatal maturity or low birth weight following appropriate adjustments (40).

Consistent supporting evidence establishes a correlation between *T.vaginalis* infection and low birth weight, as demonstrated in both meta-analyses and cohort studies, indicating a moderate to strong effect (10,30). Conflicting results frequently arise from intervention-based or asymptomatic screening trials, demonstrating no notable effect on birth outcomes.

This disparity suggests that although infection appears to increase risk, randomized treatments and public health interventions do not consistently lead to improved neonatal outcomes, underscoring the complexities inherent in this area of research.

This study possesses several aspects that enhance the validity of the findings. Applying the PCR method for detecting *T. vaginalis* is a significant advantage due to its superior sensitivity and specificity compared to traditional techniques, such as microscopy or culture, thereby ensuring diagnostic accuracy. The emphasis on pregnant women as the study population is highly pertinent, given that infections during pregnancy can directly affect both fetal and maternal health. Evaluating newborn clinical outcomes, including birth weight and prematurity, has substantial practical value in formulating interventions for maternal and child health. Applying bivariate tests utilizing Cramér's V method facilitates an objective measurement of the strength of association between variables.

This study offers new methodological insights for detecting *T. vaginalis* infection via PCR; however, the interpretation of the results necessitates careful consideration. The findings demonstrate a notable correlation with low birth weight, indicating the potential advantages of integrating screening for *T. vaginalis* into antenatal care, especially in resource-constrained environments where preventive measures are critically required. These findings may guide initial maternal health strategies, encompassing focused education and early detection initiatives. The dependence on unadjusted bivariate analyses constitutes a significant limitation. Unaccounted potential confounding factors, including maternal nutritional status, co-infections, anemia, socioeconomic disparities, and lifestyle

characteristics (e.g., smoking), may have influenced the observed associations. Thus, the evidence ought to be considered exploratory rather than conclusive. Future studies should utilize multivariable statistical models, including logistic regression, and implement prospective or longitudinal designs to assess the independent contribution of *T. vaginalis* infection to adverse pregnancy outcomes.

To support causal inference, it is advised that future research employ case-control studies or prospective cohort designs. Multivariate analysis should also be conducted to account for potential confounding variables that may influence the outcomes. To assess the combined impact on pregnancy, it would be preferable to screen for *T. vaginalis* in addition to other diseases such as *Chlamydia trachomatis, Neisseria gonorrhoeae*, and bacterial vaginosis. It's also critical to expand the study venues and sample size to increase the generalizability of the findings. As an evidence-based preventive strategy, more research may even assess how infection treatment affects the risk of LBW and preterm birth.

CONCLUSION

This study indicates that *T. vaginalis* infection, validated by PCR in 50.9% of the surveyed pregnant women, is more common in individuals aged 20–35 years, which is considered the optimal reproductive age group. The majority of affected individuals came from low socioeconomic and educational backgrounds, indicating a vulnerable population regarding reproductive and sexual health awareness. In the infected group, neonatal outcomes such as low birth weight (20%) and preterm birth (16.5%) were observed more frequently, with Cramér's V values reflecting a moderate association with low birth weight and a weak association with prematurity. The findings align with previous research indicating that *T. vaginalis infection* may play a role in adverse birth outcomes via inflammatory or placental mechanisms. The study's cross-sectional design restricts causal inference, and the absence of control for confounding variables may compromise the reliability of the observed associations. Additional research employing prospective or case-control designs alongside multivariate analysis is essential to elucidate the role of *T. vaginalis* in neonatal health. Routine screening for *T. vaginalis* infection may be considered a preventive measure for pregnant women, particularly those presenting with symptoms of abnormal vaginal discharge. Such screening has the potential to reduce adverse neonatal outcomes by enabling timely diagnosis and treatment. However, these recommendations must be interpreted with caution, as the current evidence is derived from a cross-sectional design that does not establish causality. Moreover, the absence of adjustments for potential confounders limits the strength of the conclusions.

Given these methodological constraints, policy implementation should remain tentative until stronger evidence becomes available. Without controlling for maternal, behavioral, and socioeconomic factors, the observed associations may be influenced by unmeasured variables. As a result, while the findings provide important preliminary insights, they cannot yet serve as a definitive basis for national screening policies.

To address these gaps, future investigations should prioritize three key directions. First, large-scale prospective cohort studies are needed to clarify the causal pathways linking *T. vaginalis* infection with adverse neonatal outcomes. Second, the application of multivariable models—such as logistic regression or Cox proportional hazards models—will allow for proper adjustment of maternal, behavioral, and socioeconomic confounders. Third, interventional studies should evaluate the effectiveness of targeted screening and treatment programs for *T. vaginalis* within antenatal care, particularly in reducing the risk of low birth weight and preterm birth.

AUTHOR'S CONTRIBUTION STATEMENT

All authors are significant contributors. Author 1: conceived and designed the study, developed the research proposal, conducted data analysis, and prepared the manuscript. Author 2: participated in sample recruitment, clinical diagnosis, and physical examinations. Author 3: performed laboratory procedures and sample processing. Author 4: reviewed and finalized the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

CONFLICTS OF INTEREST

The authors confirm that they have disclosed to everyone any potential conflicts of interest that might have compromised the study's objectivity. The authors make it clear that they have no personal or financial ties to any groups that could influence their objectivity. This statement protects the study's ethics by being transparent about any factors that might have influenced the results, which also enhances the article's credibility and trustworthiness.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors affirm that generative artificial intelligence (AI) tools or AI-assisted technologies, such as Grammarly and DeepL, were utilized solely to support language refinement, enhance clarity, and improve the overall readability and structure of the manuscript. These tools were not used for data analysis, interpretation, or the generation of original scientific content. The final content remains the sole responsibility of the authors, who have critically reviewed and approved all parts of the manuscript to ensure accuracy and integrity.

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