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THE INTRAUTERINE DEVICE (IUD) USE AND BACTERIAL VAGINOSIS INCIDENCE, INSIGHTS FORM 2023 STUDY IN A SURABAYA, INDONESIA

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Abstract

Background: The Intrauterine device (IUD) is one of the most widely used and effective long-term contraceptive methods, with a success rate exceeding 99%. However, prolonged copper IUD use has been associated with an increased risk of bacterial vaginosis (BV), with users reportedly 1.28 times more likely to develop BV than users of other contraceptive methods.This study aims to assess the association between IUD usage and the incidence of BV. **Methods:** This cross-sectional analytic observational study included 50 participants using IUDs, recruited from three public health centers in Surabaya between May and December 2023. Vaginal swab samples from suspected BV cases were examined independently by two observers. Data were analyzed using the Chi-square test to assess associations and Cronbach's Alpha to evaluate inter-observer reliability, with significance set at $p < 0.05$. **Results:** Most BV cases were found among women aged 30–39 years (40%) and among users of non-hormonal IUDs (76%). Based on Nugent scoring, 26 participants (52%) were diagnosed with definitive BV. The association between IUD use and BV incidence was not statistically significant ($p = 0.090$). Inter-observer reliability was high, with a Cronbach's Alpha of 0.963. **Conclusion:** The study concludes that IUD use is not significantly associated with the occurrence of bacterial vaginosis, based on Nugent score evaluation.

Keywords: *intrauterine device, bacterial vaginosis, Nugent score, contraception*

INTRODUCTION

The intrauterine device (IUD) is the most widely used method of Long-Acting Reversible Contraception (LARC) globally, with an estimated 159 million women of reproductive age (15–49 years) relying on IUDs as their primary form of contraception. It is also one of the most effective, with a success rate exceeding 99%. The World Health Organization (WHO) recommends two main types of IUDs: the levonorgestrel-releasing hormonal IUD (LNG-IUD) and the copper-based non-hormonal IUD (Cu-IUD). Proper IUD insertion requires trained healthcare professionals to ensure optimal placement and prevent complications

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(Bowman & Thwaites, 2023).

Several studies have linked prolonged use of copper IUDs to an increased risk of bacterial vaginosis (BV). IUD users are reported to have a 1.28 times higher risk of BV compared to users of other contraceptive methods (Peebles *et al.*, 2021). Additional risk factors such as the number of sexual partners and IUD usage have also been identified as significant contributors to BV incidence (Salsabila *et al.*, 2024). The use of non-hormonal, copper-based IUDs may particularly increase BV risk, potentially due to their side effects such as prolonged or heavier menstrual bleeding (Peebles et al., 2021).

Bacterial vaginosis is the most common vaginal infection among women of reproductive age and has notable clinical implications. It has been associated with complications such as pelvic inflammatory disease, preterm birth, and an increased risk of acquiring or transmitting HIV and other sexually transmitted infections (Peebles *et al.*, 2021; Salsabila *et al.*, 2024). Non-sexual causes of BV, such as vaginal douching, recent antibiotic use, and IUD insertion, have also been documented (Abu *et al.*, 2021). A healthy vaginal microbiome is predominantly composed of hydrogen peroxide–producing *Lactobacillus* species, which help maintain low pH and inhibit the growth of anaerobic organisms such as *Gardnerella vaginalis*, *Mobiluncus* spp., *Bacteroides* spp., and *Mycoplasma hominis*. When Lactobacilli are depleted, this balance is disrupted in what is known as a "vaginal flora shift," often leading to BV, although the exact etiology remains unclear (Falconi-McCahill, 2019). BV is characterized by the formation of a polymicrobial biofilm primarily composed of Gardnerella vaginalis, which adheres to the vaginal epithelium and protects bacterial colonies from antimicrobial treatment. The shedding of biofilm-covered epithelial cells often presents as a fishy-smelling, moist discharge and contributes to recurrence (Muzny dan Sobel, 2023).

The Nugent scoring system remains the gold standard for diagnosing BV in clinical research. It involves Gram staining of vaginal swabs and evaluating the presence of bacterial morphotypes under a microscope (Falconi-McCahill, 2019).

This study aims to investigate the association between intrauterine device (IUD) use and the incidence of bacterial vaginosis (BV) in patients attending community health centers offering basic emergency obstetric and neonatal care services in

Surabaya—specifically Balongsari Health Centre, Simomulyo Health Centre, and Tanah Kali Kedinding Health Centre Surabaya Indonesia—during the period from September to December 2023.

METHOD

This study employed an analytical observational design with a cross-sectional approach. The research was conducted at three community health centers in Surabaya—Balongsari Health Centre, Simomulyo Health Centre, and Tanah Kali Kedinding Health Centre—from September to December 2023.

The study population consisted of all women using intrauterine devices (IUDs) who presented with complaints of vaginal discharge. Purposive sampling was used to recruit participants who met the inclusion criteria. The inclusion criteria were: (1) using IUDs for more than 3 months, (2) experiencing abnormal vaginal discharge, and (3) providing informed consent to participate. Exclusion criteria included: (1) use of other contraceptive methods, (2) diagnosis of vaginal discharge due to fungal infections or sexually transmitted infections (e.g., gonorrhea, chlamydia), and (3) a history of prior treatment for vaginal infections. A total of 50 respondents were included in the final sample.

Eligible participants underwent vaginal swab collection performed by trained health personnel at each center. Two vaginal swab samples were obtained per participant using sterile technique. Swabs were immediately fixed on microscope slides, Gram-stained according to standard procedures, and assessed for bacterial vaginosis using the Nugent scoring method. Interpretation of results was conducted independently and blindly by two trained observers.

The Nugent score, considered the gold standard for diagnosing bacterial vaginosis, is based on microscopic identification of vaginal flora morphotypes. Scores range from 0–10, where 0–3 indicates normal flora, 4–6 intermediate flora, and 7–10 definitive bacterial vaginosis (Theiler et al., 2024; Watanabe et al., 2025).

The tools and materials used in this study included: a speculum, sterile cotton swabs, bacterial dye solution, 70% alcohol, glass slides and cover slips, pipettes, inoculating loops (ose needles), microscopes, and sterile gloves.

Primary data were obtained through physical examinations and laboratory analysis of vaginal swabs. Prior to examination, informed consent was obtained from all participants. After data collection, data processing was carried out in several stages: editing, coding, entry, cleaning, and scoring.

Statistical analysis was performed using SPSS version 23. Univariate analysis was conducted to describe the frequency distribution of study variables. Bivariate analysis was used to examine the association between IUD use and BV incidence using the Chi-Square test, with a significance level of $p < 0.05$.

This study received ethical approval from the Surabaya City Health Office Ethics Committee with reference number: 000.9.2/27621/436.7.2/2023.

RESULT AND DISCUSSION

Bacterial vaginosis (BV) is a condition involving multiple microorganisms that leads to a reduction in Lactobacilli and an increase in facultative and anaerobic bacteria in vaginal fluids. Lactobacilli are diminished, while facultative and anaerobic bacteria flourish in plenty, whether independently or together. Included are Gardnerella vaginalis, Bacteroides fragilis, species of Mobiluncus, and various other bacteria. (Regassa *et al.*, 2024) In new cases, BV has a low incidence and mostly affects women of reproductive age. It presents no symptoms. (Manuputty and Matodiharjo, 2020) The results of the study obtained from the Nugent score criteria examination data of patients using IUDs at the Balongsari Puskesmas, Simomulyo Puskesmas, and Tanah Kali Kedinding Surabaya Puskesmas in the September-December 2023 period, obtained a total sample of 50 patients consisting of 26 definitive bacterial vaginosis, 14 intermediate bacterial vaginosis, and 10 negative bacterial vaginosis.

Table 1 Distribution of Respondent Characteristics

Variable	**N**	**%**
Age		
20-29 years	14	28
30-39 years	20	40
≥ 40 years	16	32

Total	50	100
Types od IUD use		
Hormonal IUD	12	24
Non hormonal IUD	38	76
Total	50	100
Incidence of Bacterial Vaginosis based on Nugent Score		
BV Negative	10	20
BV Intermediate	14	28
BV Definitif	26	52
Total	50	100

Based on table 1 on the distribution of respondent characteristics, it was found that in the age group, the majority of respondents were in the age group 30-39 years, namely 20 people (40.0%), > 40 years as many as 16 people (32.0%) and the least were in the age group 20-29 years, namely 14 people (28.0%). The significant occurrence of BV in women of reproductive age is linked to multiple factors. (Adk dan H, 2024) Sexual intercourse, vaginal douching, contraception, and the use of antibiotics contribute to BV. (Abou Chacra *et al.*, 2023). Sexual behavior is closely linked to BV; alterations in vaginal microbiota in those with new or multiple sexual partners, absence of condom use, and female-to-female sexual contact are all factors contributing to BV. (Kairys N, Carlson K, 2023) Even though BV is not classified as a sexually transmitted infection, it raises a woman's likelihood of acquiring *Chlamydia trachomatis* and *Neisseria gonorrhoeae* by 3.4 to 4 times. (Abou Chacra *et al.*, 2023) These factors will reduce the effectiveness of the primary defense barrier against the invasion of harmful microbes. (Adk dan H, 2024) A significant presence of Lactobacillus helps maintain a healthy vaginal flora. BV will result in physiological changes. The production of antimicrobials by lactobacillus will decrease, accompanied by a reduction in lactic acid sourced from glycogen in the vaginal mucosa, causing a shift in vaginal pH from acidic (4.5 or lower) to alkaline. (Abou Chacra *et al.*, 2023) This imbalance will result in an increase of anaerobic bacteria in the BV, causing the formation of amine compounds that produce a fishy smell in the vaginal discharge. (Adk dan H, 2024) In the post-menopausal vagina, *Lactobacillus* shows low growth, which is affected by the amount of free glycogen used by Lactobacillus. During menopause, vaginal glycogen levels decline. (Gandhi *et al.*, 2022) This aligns with the low prevalence

of BV in individuals over 40 years in the research. Nonetheless, it requires additional focus, as menopause leads to dysregulation, reduced vaginal immune response, and alterations in vaginal microbiota, rendering a person susceptible to BV. (Gandhi *et al.*, 2022)

Based on the type of use of IUD used by respondents, this study shows that the type of IUD most widely used by respondents is non-hormonal IUD used by 38 people (76.0%). While hormonal IUD was used by 12 respondents (24.0%). Based on the Nugent score criteria, the majority of respondents experienced bacterial vaginosis or definitive BV, namely 26 people (52.0%). The results of the examination in 14 respondents (28.0%) showed intermediate BV results or intermediate flora. While 10 other respondents (28.0%) did not experience BVor only had normal flora based on the results of the examinations carried out in this study.

Table 2 Relationship between IUD Use and the Incidence of Bacterial Vaginosis

	Nugent Score Criteria								***P Value (<0,05)***
	BV Negative		**BV intermediet**		**Bacterial Vaginosis**		**Total**		
	n	**%**	**n**	**%**	**n**	**%**	**N**	**%**	
Hormonal IUD	5	41,7	3	25,0	4	33,3	12	24	0,090
Non-hormonal IUD	5	13,2	11	28,9	22	57,9	38	76	
Total	**10**	**20,0**	**14**	**28,0**	**26**	**52,0**	50	100	

The relationship between IUD use and the incidence of bacterial vaginosis based on Nugent score criteria is shown in table 2. This study shows that based on the use of hormonal and non-hormonal IUDs, the majority of respondents experienced bacterial vaginosis, namely 26 people (52.0%), then intermediate BV as many as 14 people (28.0%) and only a few who had negative BV, namely only 10 people (20.0%). This study also showed that based on the type of use of IUD, respondents who used non-hormonal IUDs were the group that experienced the most bacterial vaginosis, namely 22 people (57.9%). Data analysis using the Chi square test obtained p = 0.090 which means the p value> 0.05 so that it can be said that there is no relationship between the use of IUDs and the incidence of bacterial vaginosis at the Balongsari Community Health Centre, Simomulyo Community Health Centre, and Tanah Kali Kedinding Community Health Centre Surabaya in

September-December 2023. IUDs are a contraceptive options for preventing pregnancy, particularly copper IUDs. The use of IUDs is said to elevate the risk of BV and BV linked with alterations in vaginal microbiota, in comparison to women using hormonal contraception. After over 6 months of use, there was a 5.5-fold rise in inflammation caused by anaerobic bacteria in users of copper-based IUDs. (Brown *et al.*, 2023) This process takes place when copper, as an external substance in the uterus and vagina, promotes the proliferation of facultative and anaerobic bacteria linked to BV. The menstrual cycle will lead to a relative increase in the morphotypes of Gardnerella vaginalis and a decrease in Lactobacillus species, with Gardnerella vaginalis becoming more abundant and Lactobacillus species less so. The copper in the IUD may lead to a decrease in Lactobacillus species and an increase in Gardnerella vaginalis, resulting in vaginal dysbiosis.(Peebles *et al.*, 2021) Differences in TNFα levels among various contraceptive methods and vaginal microbiomes indicate the existence of distinct regulatory mechanisms relative to other proinflammatory cytokines. TNFα production, affected by immune and epithelial cells, fluctuates with the local vaginal microbiome and systemic contraceptive influences. The copper IUD might trigger a distinct immune response, unlike hormonal contraceptives. Interactions between the vaginal microbiome and the immune system further influence TNFα in the promotion and inhibition of vaginal bacterial populations. (Serrano *et al.*, 2025)

Intrauterine devices (IUDs) have emerged as the preferred method for many women regarding long-term pregnancy prevention. (Golden *et al.*, 2025) Two types of IUDs available are copper-based options and levonorgestrel-releasing devices. (Ketvertis., 2025) In this study, copper-based IUDs were chosen by a majority of participants (76%), and they were associated with a higher occurrence of BV (57.9%). The oxidation of copper in the IUD has led to the release of cupric ions (Cu2+), resulting in a localized sterile inflammatory response. (Bunting *et al.*, 2024) IUDs additionally facilitate the movement of microorganisms from the lower tract to the upper genital tract. Copper in IUD viewed as a foreign entity, leads to the colonization of microorganisms. An increased volume and duration of menstruation elevate iron-containing metalloproteins, fostering an environment that promotes the growth of G. vaginalis as a pathogen in the vaginal microbiota.

(Bakus *et al.*, 2022) The hormonal IUD helps maintain the stability of the vaginal microbiota by releasing progestin, though it may still lead to changes in vaginal dysbiosis. (Bakus *et al.*, 2022; Serrano *et al.*, 2025) This was observed in this research with a BV occurrence of 76%. The relationship between IUD usage and the prevalence of bacterial vaginosis in this study showed p = 0.090, suggesting no notable difference in the rates of BV among IUD and non-IUD users. Moreover, users of hormonal IUDs reported a reduced occurrence of BV. The key aspect is to focus on which elements can influence alterations in vaginal microbiota in both IUD and non-IUD users.

Utilizing nucleic acid amplification to identify sequences from vaginal microbiota is a method that demonstrates high sensitivity and specificity. The technique can be applied to normalize the Nugent score. (Melo *et al.*, 2021) Nonetheless, the study's setting, which took place in primary health care, restricts the method's applicability. To lessen these constraints, we performed a reading agreement of vaginal swab slides and achieved a reading concordance of 92% between 2 observers. This reading agreement aims to enhance objectivity in assessing readings. The examination of reading alignment between two observers carried out in Chile showed a reduced agreement of 63.2%. (Melo *et al.*, 2021) While the agreement of findings in our research is greater, it is still noted that the Gram stain utilized in BV is significantly influenced by the observer, their expertise, and subjective interpretation. (Elvy *et al.*, 2025) Enhanced techniques are required to verify this. (Abou Chacra *et al.*, 2024)

This study has several limitations that should be considered when interpreting the findings. First, the relatively small sample size (n=50) may limit the generalizability of the results, and may not accurately reflect the true prevalence of bacterial vaginosis (BV) among IUD users in broader populations. Second, important confounding factors such as sexual behavior, frequency of intercourse, menstrual history and cycle regularity, genital hygiene practices, and other lifestyle or clinical variables were not assessed. These unmeasured variables may influence the risk of BV but were beyond the scope of this study.

Additionally, the study population was drawn exclusively from a single city in Indonesia, which may reduce the external validity of the findings and limit their

applicability to other regions or countries with different demographic and cultural contexts. Furthermore, the study did not stratify or control for known risk factors for BV such as recurrent antibiotic use, smoking, sexual activity, or vaginal douching. These were also not included as exclusion criteria, which may have introduced confounding bias.

Lastly, while the Nugent scoring system remains the gold standard for BV diagnosis, it relies on microscopic interpretation of Gram-stained vaginal swabs, which may be subject to inter-observer variability despite efforts to blind assessments. Future research should consider incorporating more objective or molecular-based diagnostic tools to enhance diagnostic accuracy.

Despite these limitations, this study provides important insights into the potential association between IUD use and bacterial vaginosis in a real-world primary care setting. It highlights the need for larger, multicenter studies with comprehensive risk factor assessments to better understand and manage reproductive tract infections among contraceptive users.

CONCLUSION AND SUGGESTION

Based on the results of the study, it was found that there was no relationship between the use of IUD and the incidence of bacterial vaginosis at the Balongsari Health Centre, Simomulyo Health Centre, and Tanah Kali Kedinding Surabaya Health Centre in the September-December 2023 period, it can be concluded that the type of IUD used at the Balongsari Health Centre, Simomulyo Health Centre, and Tanah Kali Kedinding Surabaya Health Centre in September-December 2023 was copper non-hormonal IUD with a percentage of 76% and hormonal IUD with a percentage of 24%. The frequency or incidence of definitive BV in IUD users in Community Health Centre Balongsari, Simomulyo Community Health Centre, Tanah Kali Kedinding Community Health Centre Surabaya in September-December 2023 reached 52% of the total 50 patients.

DECLARATION

Acknowledge

We acknowledge all participants and their parents for supporting and cooperating with this study. Due to the study's exclusive use of anonymised data, the Research Ethics Committee waived the subjects' written informed consent requirement. I certify that the relevant institutional forms have been archived and that all required patient/participant consent has been obtained. I also attest that any patient/participant/sample identifiers included were unknown to anyone outside the research group (such as hospital staff, patients, or participants themselves), so they cannot be used to identify specific individuals.

Conflict of Interest

no conflicts of interest arose during the study

Author contributions: All authors contributed to the study conception and design. VB, FEH, EAH and FOH: material preparation, data collection and analysis were performed. VB, FEH and RPA: the first draft of the manuscript was written. All authors have read and agreed to the published version of the manuscript.

Ethics statement: We obtained approval from health department of surabaya city government 000.9.2/27621/436.7.2/2023

Data avaibility

The data supporting the findings of this study are available upon reasonable request to the corresponding author

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