Vol 9 No 1, January 2025

ANDALAS OBSTETRICS AND GYNECOLOGY JOURNAL
Correspondence Address:
Editorial Room Andalas Obstetrics and Gynecology Journal, 2nd Floor Obstetrics and Gynecology Department. M. Djamil Central General Hospital Padang, Jl. Perintis Kemerdekaan Padang, West Sumatra 25127
Website:
http://jurnalobgin.fk.unand.ac.id/

eISSN : 2579-8324 pISSN : 2579-8413

RESEARCH ARTICLE

Lactobacillus species and Clamydia trachomatis characterisation in premature rupture of membranes and normal pregnancy

Prima Indra[1], Roza Sri Yanti[2,*], Andani Eka Putra[3]

[1] *Department of Obstetrics and Gynecology, Faculty of Medicine, Andalas University/Dr. M. Djamil Hospital, Padang, West Sumatra, Indonesia*

[2] *Division of Fetomaternal of Obstetrics and Gynecology, Faculty of Medicine, Andalas University/Dr. M. Djamil Hospital, Padang, West Sumatra, Indonesia*

[3] *Center for Infectious Disease Diagnostics and Research, Faculty of Medicine, Andalas University, Padang, West Sumatra, Indonesia*

Corresponding Author: *Roza Sri Yanti; rozasyahrial@gmail.com ; +62 812-6631-253*

Received : October 3, 2024; **Accepted:** December 29, 2024; **Published:** January 22, 2025
Doi : https://doi.org/10.25077/aoj.9.1.95-104.2025

Abstract

The cause of premature rupture of membranes (PROM) remains uncertain. The vaginal microbiota might possess a significant influence on the vaginal environment and can impact the overall health of the female reproductive system.

Objective: *This study aims to determine the difference in the concentration of lactobacillus crispatus, lactobacillus vaginalis, and chlamydia trachomatis between patients with premature rupture of membranes and normal pregnancies;*

Methods: *This study is an analytic study with a case-control design that was conducted at Dr. M. Djamil Hospital Padang during the period January 2024 to June 2024. This study performed DNA isolation using conventional PCR;*

Results: *Lactobacillus crispatus, Lactobacillus vaginalis, and Chlamydia trachomatis reached 42,124,873.86/mL, 179.41/mL, and 287,062.30/mL, respectively in preterm rupture of membranes patients. In normal pregnancy, Lactobacillus crispatus, Lactobacillus vaginalis, and Chlamydia trachomatis reached 75,717,348.80/mL, 704,147.66/mL, and 0/mL, respectively. A significant difference in Lactobacillus vaginalis concentrations was found between the case and control groups, with the control group having a greater average concentration (28.88) compared to the case group (36.13), with a p-value <0.018. The case group had a significantly greater concentration of Chlamydia trachomatis (37.50) compared to the control group (27.50), with a p-value <0.001. The case and control groups had significantly different lactobacillus crispatus concentrations. The case group had 24.88 times less lactobacillus crispatus than the control group, which had 40.13 times more, with p-value <0.001;*

Conclusion: *In pregnant women, an increase in Chlamydia trachomatis and a reduction in Lactobacillus crispatus and Lactobacillus vaginalis can be an indicator of probable PROM.*

Keywords: *Lactobacillus vaginalis, chlamydia trachomatis, Lactobacillus crispatus, PROM, normal pregnancy.*

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

https://doi.org/10.25077/aoj.9.1.95-104.2025

INTRODUCTION

Amniotic rupture that happens spontaneously before the start of labor is referred to as preterm rupture of membranes (PROM).[1] Pregnancy-related complications (PROM) occur in around 5% to 15% of all pregnancies globally. Worldwide, preterm delivery ranks among the top three causes of newborn mortality, and PROM accounts for almost 40% of preterm cesarean deliveries.[2] The prevalence of PROM in Indonesia remains rather high, accounting for approximately 4.5% - 7.6% of all pregnancies. In the year 2020, the incidence rate in DKI Jakarta was recorded at 4.6%, however, in Pelni Hospital it was 7.9%.[3] Based on a study conducted by Juan Habli Soufal et al (2016), Dr. M. Djamil Padang Hospital recorded a total of 94 instances of premature rupture of membranes.[4] A total of 77 cases of PROM were reported at RSUD dr. Rasidin Padang in 2014.[5]

The cause of PROM remains uncertain. However, it is believed that several variables contribute to its occurrence, such as vaginal and cervical infections, aberrant membrane physiology (apoptosis caused by oxidative stress), an incompetent cervix, and nutritional abnormalities.[6] Several pathogenic pathways, either operating alone or in conjunction with other variables, can lead to the development of PROM. An important explanation is that the vaginal microbiota possesses a significant influence on the vaginal environment and can impact the overall health of the female reproductive system.[7]

A correlation exists between dysbiosis of the vaginal microbiota and PROM observed in preterm infants.[8] The vaginal microbiota works crucially for maintaining a healthy female reproductive system. By and large, *Lactobacillus* species, including *L. iners, L. crispatus, L. gasseri, and L. jensenii*, are the predominant bacteria in the vaginal environment.[9] PROM, occurring before 30% of all spontaneous preterm births, is linked to a significant level of vaginal bacterial diversity before to rupture.[10] Liu et al. (2022) performed a study using 16s rDNA sequencing to characterize the vaginal microbiota in individuals with preterm rupture diagnosed during the third trimester. The results indicated that Lactobacillus conferred a reduced risk of PROM, whereas *Gardnerella, Prevotella, Megasphaera, Ureaplasma*, and *Dialister* were linked to an elevated risk of PROM.[9]

The study conducted by Paramel Jayaprakash et al. (2016) revealed the widespread presence of *Prevotella spp*. and *Megasphaera* type I in individuals diagnosed with PROM.[11] The research conducted by Lee et al. (2016) revealed a high incidence of preterm premature rupture of the membrane in patients who were infected by *Ureaplasma*.[12] Chronic *Chlamydia trachomatis* infection during pregnancy has been linked to a range of issues such as fetal demise, early rupture of the membranes, premature labor, and low birth weight. The uncontrolled presence of *chlamydia* infection during pregnancy can significantly raise the likelihood of preterm labor by 2-4 times, mostly because of the elevated death and morbidity rates among newborns born prematurely.[13] The study conducted by Brown et al. (2019) revealed that premature labor is linked to dynamic changes in the composition of the bacterial population throughout pregnancy and a notable increase in variety, particularly in the second trimester. The observed phenomenon was marked by a rise in the proportionate presence of disease-causing organisms such as *Prevotella, Peptoniphilus, Streptococcus,* and *Dialister*. Brown et al. (2019) also found a decrease in the number of

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

https://doi.org/10.25077/aoj.9.1.95-104.2025

Lactobacillus spp and an increase in the diversity of vaginal bacteria as prominent early risk factors for PROM.[10] Based on the links found from previous studies, this study aims to Identify differences in bacterial concentrations as a guide for clinical management strategies.

METHODS

This study is an analytic study with a case-control design in 64 women with premature rupture of membranes and women with normal pregnancies. This study was conducted at Dr. M. Djamil Hospital Padang during the period from January 2024 to June 2024. The sample for this study was all pregnant women who sought treatment at Dr. M. Djamil Hospital in Padang from January 2024 to June 2024 with the inclusion criteria of women who were not diagnosed with premature rupture of membranes, willing to become research samples, and pregnant women with gestational age 28-42 weeks with normal fetal presentation, single fetus, alive and intrauterine. Exclusion criteria were pregnant women who suffered from chronic diseases, mothers who received antibiotic therapy, mothers with incompetent cervix, history of trauma in pregnancy, and fetuses suffering from congenital abnormalities.

Samples were selected by consecutive sampling. Patients who have given informed consent are taken vaginal swab samples and samples will be cultured on MRS agarose. Furthermore, the number of the vaginal microbiota, *Lactobacillus crispatus*, *Lactobacillus vaginalis*, and *Chlamydia trachomatis* was counted. This study performed DNA isolation using conventional PCR with 16s RNA primers (63E / 1387 R). Data were analyzed univariate and bivariate using the SPSS version 26 program in 2019.

The research was conducted after the research subjects were given information and a statement of consent stating that they were willing to take part in the study, after this study received research approval (ethical clearance) from the Health Research Ethics Committee of the Faculty of Medicine, Andalas University /RSUP Dr. M. Djamil Padang with number: DP.04.03/D/XVI.XI/288/2024.

RESULT AND DISCUSSION

A total of 32 research subjects were examined for vaginal swab samples and the maximum number of *Lactobacillus vaginalis, Chlamydia trachomatis,* and *Lactobacillus crispatus* in patients with premature rupture of membranes was 179.41/mL, 287,062.30/mL, and 42,124,873.86, respectively (Table 1).

Table 1. Concentration of *Lactobacillus vaginalis*, *Chlamydia trachomatis,* and *Lactobacillus crispatus* in patients with premature rupture of membranes (n = 32)

Microbiota in patients with premature rupture of membranes	Max (total/mL)
Lactobacillus vaginalis	179.41
Chlamidya trachomatis	287,062.30
Lactobacillus crispatus	42,124,873.86

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

https://doi.org/10.25077/aoj.9.1.95-104.2025

Table 2 shows the maximum number of *L Lactobacillus vaginalis, Chlamydia trachomatis,* and *Lactobacillus crispatus* in normal pregnancy was 704,147.66/mL, 0/mL, and 75,717,348.80, respectively.

Table 2. Concentration of *Lactobacillus vaginalis*, *Chlamydia trachomatis,* and *Lactobacillus crispatus* in normal pregnancy

Microbiota in patients with normal pregnancy	Max (total/mL)
Lactobacillus vaginalis	704,147.66
Chlamidya trachomatis	0.00
Lactobacillus crispatus	75,717,348.80

Further analysis was carried out to see the difference in the concentration of *Lactobacillus vaginalis* and *Chlamidya trachomatis* in patients with premature rupture of membranes and patients with normal pregnancies. Where there is a significant difference in the concentration of *lactobacillus vaginalis* in the case and control groups with an average concentration of *lactobacillus vaginalis* higher in the control group (28.88) compared to the case group (36.13) with a p-value <0.018 and there is a significant difference in the concentration of *chlamydia trachomatis* in the case and control groups with an average concentration of *chlamydia trachomatis* higher in the case group (37.50) compared to the control group (27.50) with a p-value <0.001. The case and control groups had significantly different *lactobacillus crispatus* concentrations. The case group had 24.88 times less lactobacillus crispatus than the control group, which had 40.13 times more, with p-value <0.001 (Table 3).

Table 3. Differences in *Lactobacillus vaginalis* and *Chlamydia trachomatis* concentration in patients with premature rupture of membranes and patients with normal pregnancy

Variable	Mean Rank		P-Value
	PROM	Normal	
Lactobacillus vaginalis	28.88	36.13	0.018
Chlamidya trachomatis	37.50	27.50	0.001
Lactobacillus crispatus	24.88	40.13	0.001

In this study, the highest recorded concentration of *Lactobacillus vaginalis* in patients with premature rupture of membranes was 179.41/mL. Despite the absence of any other study providing the precise concentration of *Lactobacillus vaginalis* in women with premature rupture of membranes (PROM), it has been demonstrated that *Lactobacillus levels* significantly decline in women with PROM. *Lactobacillus spp.* Often dominate the vaginal microbiota of healthy pregnant women with normal pregnancy outcomes throughout pregnancy. During early pregnancy, there is a noticeable shift towards the dominance of *Lactobacillus spp*. This transformation is particularly evident in women of African heritage. Following childbirth, the levels of maternal estrogen decrease to levels

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

https://doi.org/10.25077/aoj.9.1.95-104.2025

similar to those seen at menopause. This is accompanied by the drainage of lochia, which changes the vaginal environment and decreases the presence of Lactobacillus spp. This results in a shift towards a community ecology characterized by a lack of *Lactobacillus spp*., which is documented to endure for a period of up to one year after childbirth.[14]

Lactobacilli metabolize glycogen breakdown products in the vagina to generate lactic acid, which establishes an acidic pH that suppresses the proliferation of many bacteria and stimulates autophagy, therefore eliminating intracellular pathogens from vaginal epithelial cells. In addition, *lactobacilli* synthesize bacteriocins to eradicate other bacteria and enhance their proliferation. *Lactococcus crispatus, Lactococcus gasseri,* and *Lactococcus jensenii* are capable of producing both l and d isomers of lactic acid. In contrast, *Lactococcus iners* having a smaller genome does not possess the gene necessary for the production of d-lactic acid. Significantly impacting reproductive tract health, the d isomer of lactic acid has been demonstrated to reduce the synthesis of matrix metalloproteinase-8 (MMP-8), which is responsible for the degradation of the cervical plug that prevents bacteria from entering the upper vaginal tract. Furthermore, women with a vaginal microbiota primarily composed *of L. crispatus* exhibited higher levels of autophagy and reduced cellular stress compared to women with a dominance of *L. iners*.[14]

Bacteria of the genus *Lactobacillus* have been shown to suppress the attachment and growth of both opportunistic and primary infections. The predominant hypothesis is that vaginal *lactobacilli* provide resistance to colonization by synthesizing several antibacterial substances, including hydrogen peroxide, lactic acid, and/or bacteriocins.[15]

The highest recorded concentration of *Chlamydia trachomatis* in patients with premature rupture of membranes was 287,062.30/mL. PROM is frequently linked to a heightened susceptibility to infection, particularly by *Chlamydia trachomatis*. Variations in the vaginal microbiological environment, a reduction in *Lactobacillus spp*., and augmentation in microbial variety with elevated levels of *C. trachomatis* can potentially precipitate the occurrence of PROM in pregnant women. Consequently, there is an elevated likelihood of the infection spreading to the amniotic membrane, leading to problems such as intraamniotic infection and premature birth. Ensuring comprehensive monitoring and appropriate management of *C. trachomatis* infection during pregnancy is crucial to minimize the likelihood of PROM and its related consequences. A study conducted by Rocca et al revealed that the occurrence of *Chlamydia trachomatis* in women with PROM was 45%, whereas in the control group, it was merely 20%.[16]

Chlamydia trachomatis can induce PROM by many biological processes that impair the integrity and functional properties of the amniotic membrane. First, infection *with C. trachomatis* can spread from the vagina to the uterus and amniotic membrane, resulting in an ascending infection. The infection elicits an inflammatory reaction that generates proteolytic enzymes, such as metalloproteinases, leading to the degradation of collagen and elastin proteins in the membrane, therefore compromising the membrane's integrity. Moreover, infection also compromises the defensive mucosal barriers in the cervix and vagina, therefore enabling the infiltration of various microorganisms that exacerbate the symptoms. Infections can equally disturb the hormonal equilibrium necessary for preserving the integrity of the amniotic membrane. Collectively, these

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

elements heighten the susceptibility to preterm labor.[17]

This study revealed that the maximum concentration of Lactobacillus crispatus in individuals with preterm rupture of membranes was 42,124,873.86/mL. The vaginal microbiota has a substantial impact on both the health status and the occurrence of disease in the female genital tract. The composition of the vaginal microbiota of a woman is influenced by both inherent and external factors across her whole live. These variables may have either a positive or negative numeric value. It is widely accepted that Lactobacillus species play a crucial role in the vaginal microbiome during a woman's reproductive years. These microorganisms are commonly associated with human health and the human immune response to illnesses.[9,18]

The study revealed that the highest recorded count of *Lactobacillus vaginalis* during a normal pregnancy was 704,147.66/mL. An investigation carried out by Yeruva et al. (2017) revealed that *Lactobacillus vaginalis* was among the Lactobacillus species identified in the vaginal microbiota of pregnant women with normal flora. Among the 67 pregnant women examined in this study, 27 maintained a normal vaginal flora according to Nugent's scoring criteria. *L. vaginalis, together with L. crispatus, L. iners, L. jensenii,* and *L. helveticus*, were the predominant microorganisms in the vaginal microbiota of this group.[19,23]

The present work employed the multiplex PCR technique to detect and characterize several species of *Lactobacillus*, including *L. vaginalis*. Findings indicated that *L. vaginalis*, while not as prevalent as *L. crispatus* or *L. iners*, remains a significant component of the vaginal microbial ecology in pregnant women in good health. *L. vaginalis* contributes to the maintenance of a low vaginal pH and synthesizes antimicrobial substances that defend against the colonization of infection-causing bacteria.[21,25]

In normal pregnancy, the occurrence of *Chlamydia trachomatis* infection is rather infrequent because of the presence of a healthy vaginal microbiota and the prevalence of *Lactobacillus spp.* These microorganisms contribute to the maintenance of microbiological equilibrium and an acidic pH in the vagina, therefore preventing the growth of pathogens. The presence of low or undetectable levels of *C. trachomatis* in pregnant women suggests a robust physiological defense mechanism that effectively maintains a balanced microbiota and prevents the colonization of pathogens.[16]

The present study revealed that the maximum concentration of *Lactobacillus crispatus* detected in women undergoing a normal pregnancy was 75,717,348.80/mL. These results align with the conclusions of several studies that have established the substantial role of the vaginal microbiota in the health and disease of the female genital tract. The composition of the vaginal microbiota of a woman is influenced by both inherent and external factors across her whole lifespan. These variables may have either a positive or negative numeric value. It is widely accepted that Lactobacillus species play a crucial role in the vaginal microbiome during a woman's reproductive years. These microorganisms are commonly associated with human health and the human immune response to illnesses. *Lactobacillus crispatus* is the predominant microorganism often found in the vaginal flora of healthy women.[19]

A statistically significant difference in *Chlamydia trachomatis* concentration was observed

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

https://doi.org/10.25077/aoj.9.1.95-104.2025

between the case and control groups. The average concentration of *Chlamydia trachomatis* was higher in the control group (37.50) compared to the case group (27.50), with a p-value less than 0.001 and a notable disparity in the levels of lactobacillus crispatus between the case and control groups. The average concentration of lactobacillus crispatus was higher in the control group (40.13) compared to the case group (24.88), with a p value less than 0.001. Significant alterations in the makeup of vaginal microbiota were seen in instances of PROM. An often-seen phenomenon is a decline in the prevalence of *L. crispatus* and *L. vaginalis*, accompanied by an increase in microbial diversity and increased concentration of pathogens such as *Chlamydia trachomatis*. The prevalence of *C. trachomatis*, often low in normal pregnancies, can rise dramatically in cases of PROM. The proliferation of opportunistic infections is facilitated by a disturbance in the equilibrium of the microbiota. Studies indicate that reduced levels of *Lactobacillus spp*. and elevated levels of pathogens such as *C. trachomatis* promote damage to the amniotic membrane, which in turn triggers PROM.[23]

There is evidence to suggest that women with PROM have a greater incidence of *C. trachomatis* infection in comparison to those who had normal pregnancies without PROM. A study by Rocca et al reported that the occurrence of *C. trachomatis* in women with PROM was 45%, whereas in the control group, it was just 20%. Nevertheless, the existing data is inadequate to conclusively establish a causative link, but it implies that infection with *C. trachomatis* may be a contributing factor to the development of PROM.[16]

Under normal pregnancy conditions, the predominant vaginal microbiota consists of Lactobacillus species, particularly *L. crispatus*, which has a crucial function in regulating the acidic pH of the vagina and preventing the growth of harmful microorganisms. Evidence indicates that *L. crispatus* is present in significant quantities (log10 Median Concentration (MC) = 8.8 cells/ml) when the microbiota is well-balanced, suggesting its efficient protective role.[23]

Important considerations in evaluating the results and their consequences are the many limitations of this study. An inherent constraint of the study is its case-control design. Although this study successfully identified risk variables for PROM simultaneously, the data was derived from medical records, which may not provide optimal accuracy, and obtaining validation of the information is challenging. A separate investigation conducted by Yan C, et al. encountered the same challenges, but using a cross-sectional research methodology. This approach had constraints in identifying temporal variations in vaginal microbiota, which could be crucial for comprehending the progression of PROM.[7]

Furthermore, the study was greatly limited by the sample size. While a minimal sample size was determined and employed, the limited sample size of 32 samples per group could hinder the statistical power of the study and compromise the generalizability of the results to a broader population. One possible explanation for this is that the authors relied on available sources, which may not accurately represent the actual occurrence of premature rupture of membranes in the specified research region. The potential for participant attrition, however being predicted and estimated, can nonetheless impact the credibility of the empirical findings. A relatively small sample size (48 patients with PROM and 54 controls) in the Yan C, et al. study may restrict the statistical

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

power and generalizability of the findings.[7]

The measurement of study variables is likewise a prominent obstacle. Quantification of bacterial concentrations, such as *Chlamydia trachomatis*, using RT-PCR is subject to sensitivity and specificity limitations influenced by laboratory procedures and testing conditions. This study explores potential factors that may disrupt the process of preparing, storing, and transporting samples to the intended analysis site. Discrepancies in sampling methods and laboratory analysis can potentially impact the reliability of research findings. The work conducted by Yan C, et al. also included 16S rRNA gene sequencing, therefore introducing the potential influence of laboratory technological variances.[7]

Given these constraints, some caution should be exercised when interpreting the findings of the study. Additional investigations using more rigorous methodologies and larger sample sizes are necessary to validate the results and enhance the practical application in clinical settings. It is vital to consider the limitations of this study while interpreting its significant findings.

CONCLUSION

There was a significant difference in *Lactobacillus vaginalis*, *Chlamydia trachomatis, and Lactobacillus crispatus* between patients with premature rupture of membranes and normal pregnancy. *Lactobacillus vaginalis* and *Lactobacillus crispatus* is more abundant in normal pregnancy and *Chlamydia trachomatis* is more abundant in patients with PROM.

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

REFERENCES

1. Gabbe SG, Niebyl JR, Simpson JL, et al. *Obstetrics: Normal and Problem Pregnancies*. Elsevier; 2016.
2. Tiruye G, Shiferaw K, Tura AK, Debella A, Musa A. Prevalence of premature rupture of membrane and its associated factors among pregnant women in Ethiopia: A systematic review and meta-analysis. *SAGE Open Med*. 2021;9:1-9.
3. Margono RS, Sukrisno A, Nugrohowati N, Lestari W. Relationship Between A Premature Rupture Of Membranes And The Increase Of Leucocyte Levels In Pregnant Women During COVID-19 Pandemic. *J Kebidanan dan Kesehat Tradis*. 2021;(September):127-134.
4. Soufal JH, Ariadi A, Rusdan S. Hubungan Antara Lamanya Ketuban Pecah Dini dengan Keberhasilan Induksi Persalinan pada Pasien Aterm di RSUP Dr. M. Djamil Padang. *Andalas J Heal*. 2016;5(1).
5. Rasidin R. *Medical Record RSUD Dr. Rasidin*.; 2015.
6. Hacker NF, Gambone JC, Hobel CJ. *Hacker & Moore's Essentials of Obstetrics and Gynecology*. 6th ed. Elsevier; 2015.
7. Yan C, Hong F, Xin G, Duan S, Deng X, Xu Y. Alterations in the vaginal microbiota of patients with preterm premature rupture of membranes. *Front Cell Infect Microbiol*. 2022;8(12):858732.
8. Bennett PR, Brown RG, MacIntyre DA. Vaginal Microbiome in Preterm Rupture of Membranes. *Obstet Gynecol Clin North Am*. 2020;47(4):503-521.
9. Liu L, Chen J, Chen Y, et al. Characterization of Vaginal Microbiota in Third Trimester Premature Rupture of Membranes Patients through 16S rDNA Sequencing. Published online 2022:1-15.
10. Brown RG, Al-Memar M, Marchesi JR, et al. Establishment of vaginal microbiota composition in early pregnancy and its association with subsequent preterm prelabor rupture of the fetal membranes. *Transl Res*. 2019;207:30-43.
11. Jayaprakash TP, Wagner EC, Van Schalkwyk J, et al. High Diversity and Variability in the Vaginal Microbiome in Women following Preterm Premature Rupture of Membranes (PPROM): A Prospective Cohort Study. *PLoS One*. 2016;11(11):e0166794.
12. Lee MY, Kim MH, Lee WI, Kang SY, Jeon Y La. Prevalence and Antibiotic Susceptibility of Mycoplasma hominis and Ureaplasma urealyticum in Pregnant Women. *Yonsei Med J*. 2016;57(5):1271-1275. doi:1271
13. Adachi KN, Nielsen-Saines K, Klausner JD. Chlamydia trachomatis Screening and Treatment in Pregnancy to Reduce Adverse Pregnancy and Neonatal Outcomes: A Review. *Front Public Heal*. 2021;9(June):7-18.
14. Ravel J, Gajer P, Abdo Z, et al. Vaginal microbiome of reproductive-age women. *Proc Natl Acad Sci U S A*. 2011;108(SUPPL. 1):4680-4687.
15. Pacha-Herrera D, Vasco G, Cruz-Betancourt C, Galarza JM, Barragán V, Machado A. Vaginal Microbiota Evaluation and Lactobacilli Quantification by qPCR in Pregnant and Non-pregnant Women: A Pilot Study. *Front Cell Infect Microbiol*. 2020;10(June):1-13.

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.

16. Rocca MM, El Sersy MA, El Habashy AM, Kholeif DA, Ismail MK. The association between Chlamydia trachomatis in late pregnancy and the development of premature rupture of membranes (PROM). *Microbes Infect Dis*. 2023;4(2):611-616.
17. Adachi KN, Nielsen-Saines K, Klausner JD. Chlamydia trachomatis Screening and Treatment in Pregnancy to Reduce Adverse Pregnancy and Neonatal Outcomes: A Review. *Front Public Heal*. 2021;9:1-15.
18. Liu X, Si S, Huang L, et al. Vaginal flora during pregnancy and subsequent risk of preterm birth or prelabor rupture of membranes: a nested case–control study from China. *BMC Pregnancy Childbirth*. 2023;23(1):1-9.
19. Bayar E, Bennett PR, Chan D, Sykes L, MacIntyre DA. The pregnancy microbiome and preterm birth. *Semin Immunopathol*. 2020;42(4):487-499.
20. Putri MF, Haviz Yuad, Andani Eka Putra. Comparison Of Lactobacillus Plantarum, Lactobacillus Mucosae And Lactobacillus Farciminis Bacteria Between Polycystic Ovary Syndrome And Non Polycystic Ovary Syndrome Students At Medical Faculty Of Andalas University. *Andalas Obstet Gynecol J*. 2024;8(2):732-745. doi:10.25077/aoj.8.2.732-745.2024
21. Yeruva T, Rajkumar HVD. Vaginal lactobacilli profile in pregnant women with normal & abnormal vaginal flora. *Indian J Med Res*. 2017;(October):534-540.
22. Gumilar RW, Utama BI, Bachtiar H. Correlation of Colony Lactobacillus spp. with The Incident of Overactive Bladder with OBSS Score at Pauh Primary Health Center Padang. *Andalas Obstet Gynecol J*. 2021;5(1):56-62. doi:10.25077/aoj.5.1.56-62.2021
23. De Backer E, Verhelst R, Verstraelen H, et al. Quantitative determination by real-time PCR of four vaginal Lactobacillus species, Gardnerella vaginalis and Atopobium vaginae indicates an inverse relationship between L. gasseri and L. iners. *BMC Microbiol*. 2007;7:1-13.
24. Putri MF, Haviz Yuad, Andani Eka Putra. Comparison Of Lactobacillus Plantarum, Lactobacillus Mucosae And Lactobacillus Farciminis Bacteria Between Polycystic Ovary Syndrome And Non Polycystic Ovary Syndrome Students At Medical Faculty Of Andalas University. *Andalas Obstet Gynecol J*. 2024;8(2):732-745. doi:10.25077/aoj.8.2.732-745.2024
25. Gumilar RW, Utama BI, Bachtiar H. Correlation of Colony Lactobacillus spp. with The Incident of Overactive Bladder with OBSS Score at Pauh Primary Health Center Padang. *Andalas Obstet Gynecol J*. 2021;5(1):56-62. doi:10.25077/aoj.5.1.56-62.2021

© 2025 Author. (CC BY) license.
Published by Faculty of Medicine Andalas University.