# Prevalence and risk factors for *Ureaplasma urealyticum* infection among women of childbearing age, attending the Sino-Gabonese Friendship Hospital in Franceville, Southeast Gabon.

## Arnaud Brice Pambo-Pambo[1], Hilaire Moundounga Kenguele[1], Thiéry Ndong Mba [1,2*], Ulrick Nzamba[3], Simon Mapasu[3].

1. Molecular and Cellular Biology Laboratory (MBBL) University of Science and Technology of Masuku (USTM), Franceville, Gabon

2. Biochemistry Research Laboratory (BRL), University of Science and Technology of Masuku (USTM) Franceville, Gabon

3. Sino-Gabonese Friendship Hospital in Franceville (SGFHF), Franceville Gabon

Corresponding author: **Dr Thiéry Ndong Mba**

E-mail: tndongmba2021@gmail.com

## ABSTRACT

*Ureaplasma urealyticum*, an often asymptomatic intracellular bacterium, can cause urogenital disorders in both men and women. This study aimed to investigate the epidemiological and clinical profile of *Ureaplasma urealyticum* infection among women of childbearing age at the Sino-Gabonese Friendship Hospital in Franceville, Southeast Gabon. In a prospective cross-sectional study conducted between June and September 2024, a sample of women of childbearing age attending the Sino-Gabonese Friendship Hospital in Franceville completed a questionnaire on their medical and sociodemographic history and underwent vaginal swab collection. The presence of *Ureaplasma urealyticum* was detected using the MYCOFAST® Screening RevolutioN+ kit. Data were analyzed statistically using R software to identify factors associated with infection. Of the 164 women included, 26.21% (95% CI: [0.2, 0.34]) were positive for *U. urealyticum*. Statistical analyses showed that a history of sexually transmitted infections (STIs) (adjusted OR = 2.62, 95% CI: [1.08, 6.37], p = 0.034) and lack of contraception (adjusted OR = 3.22, 95% CI: [1.3, 7.97], p = 0.012) were significantly associated with an increased risk of infection. These findings highlight the importance of screening for U. urealyticum in women, particularly those with a history of STIs or who do not use contraception. Targeted prevention programs, including sexual education campaigns and systematic screening, are needed to reduce the prevalence of this infection and its impact on reproductive health.

## INTRODUCTION

Genital infections in women of childbearing age represent a significant public health problem, affecting their reproductive and overall well-being. Among the pathogens involved, *Ureaplasma urealyticum,* a bacterial species belonging to the class of mycoplasmas [1], plays a crucial role. This microorganism is known for its ability to colonize the female genital tract, leading to a variety of often insidious clinical manifestations such as bacterial vaginosis, cervicitis, and more complex infections like salpingitis and pelvic inflammatory disease (PID) [2] [3]. The significance of *Ureaplasma urealyticum* infection lies not only in its potentially debilitating clinical manifestations but also in its implications for reproductive health, including increased risks of preterm birth, miscarriage, and infertility [4]. Varying across different populations and geographic regions, a better understanding of the factors influencing the prevalence of *Ureaplasma urealyticum* infection is essential for developing effective prevention and treatment strategies [5]. Indeed, studies have shown prevalence rates of *Ureaplasma urealyticum* among pregnant women ranging from 10% to 70% [6], appearing to be higher in low- and middle-income countries [7]. In Gabon, the

understanding of the epidemiology of *Ureaplasma urealyticum* is still incomplete. Although some studies conducted in other regions of the country have suggested a prevalence of *Ureaplasma urealyticum* among pregnant women ranging from 20% to 40% [1] [8], there is a lack of precise data on the prevalence of *Ureaplasma urealyticum,* making it difficult to assess its impact on reproductive and neonatal health and limiting the implementation of appropriate prevention and treatment strategies. In this context, this study aimed to characterize the epidemiological and clinical profile of *Ureaplasma urealyticum* infection in women of childbearing age attending the Sino-Gabonese Friendship Hospital in Franceville, Southeast Gabon.

## II. Materials and Methods

### II.1. Study Area

This study was conducted in Franceville, the capital of Haut-Ogooué province, a region covering 36,547 km² and home to nearly 128,729 inhabitants [9]. Crossed by the Ogooué River, Haut-Ogooué is characterized by an equatorial climate with alternating wet and dry seasons. Its natural resources, particularly forests and minerals, play a major role in its economy. However, like other regions of Gabon, it faces challenges related to the sustainable management of these resources and the impact of climate change.

### II.2. Presentation of the Sino-Gabonese Friendship Hospital of Franceville (HASGF)

The Sino-Gabonese Friendship Hospital of Franceville (HASGF) is a public health facility located in the 2nd district of the city. With a capacity of 110 beds, it offers a wide range of services, including gynecology-obstetrics, general medicine, pediatrics, and surgery. The hospital has modern medical equipment and provides care for a large number of pathologies, including infectious diseases and psychiatric emergencies.

### II.3. Study type, period, population, and inclusion criteria

This analytical, cross-sectional study was conducted over a three-month period in a sample of women over 18 years of age. Participants, randomly recruited from those consulting the HASGF laboratory for a diagnosis of *Ureaplasma urealyticum* infection, were included if they met the following inclusion criteria: age over 18 years and consent to participate in the study.

### II.3.2. Sample size determination

To determine the sample size required for this study, we used the classic statistical formula for populations with a single proportion [10] [11]. In the absence of precise data on the local prevalence of *Ureaplasma urealyticum* infection, we estimated this prevalence at 50%. A 95% confidence level was chosen, corresponding to a margin of error of 5%. The initial calculation yielded a sample size of 149 women. However, to account for potential dropouts or missing data, we increased this size by 10%, bringing the final number of participants to 164.

### II.4. Survey questionnaire

In order to identify risk factors associated with *Ureaplasma urealyticum* infection, participants completed a questionnaire on their sociodemographic characteristics (age, marital status, occupation, etc.), medical history (STIs, abortions), sexual behaviors (number of partners, contraceptive use), and lifestyle habits (alcohol consumption).

### II.4.1. Operational definitions

Alcohol consumption was defined as a frequency of more than 3 (2 for women) standard glasses of wine per day or more than 10 (5 for women) local beers per week. Traditional alcoholic beverages were not evaluated.

### II.5. Sample collection and diagnosis

### II.5.1. Sample collection

After signing the informed consent, endocervical samples were collected at the HASG laboratory in Franceville.

### II.5.2. Diagnosis of *Ureaplasma urealyticum* infection

### II.5.2.1. Materials used for the diagnosis of *Ureaplasma urealyticum*.

The MYCOFAST RevolutioN ATB+ kit was used to diagnose *Ureaplasma urealyticum* infection. This is a miniaturized gallery containing the nutrients necessary for the growth of these bacteria, as well as a range of antibiotics to determine their sensitivity. This device allowed for the precise identification and quantification of *Ureaplasma urealyticum* and *Mycoplasma hominis* present in the sample.

### II.5.2.3. Operating procedure

The operating procedure is as follows:

- Preparation: Bring reagents to room temperature. Remove the adhesive film and distribute 100 µL of seeded UMMt medium and 2 drops of mineral oil into each well.
- Incubation: Cover the gallery and incubate at 37°C for 24 hours (48 hours maximum for negative liquid samples).
- Reading: Read the results for the enumeration of *U. urealyticum* and *M. hominis* after 24 hours of incubation.

### II.5.2.4. Interpretation of diagnostic results with the MYCOFAST RevolutioN ATB+ kit:

Examination of the 164 samples revealed that 43 of them showed growth of *Ureaplasma urealyticum*, evidenced by a color change to red of the culture medium in the specific wells. These results suggest a significant prevalence of this bacterium in the study population. It should be noted that the generally accepted pathological thresholds for *Ureaplasma urealyticum* vary depending on the type of sample.

### II.6. Quality assurance :

Data quality was ensured through a series of rigorous measures, including preliminary tests on a sample of questionnaires, in-depth training of personnel, and the application of standardized procedures in a certified laboratory environment.

### II.7. Ethical considerations :

The study was authorized by the South-East Regional Director of Health, in letter no. 0345/PHO/SG/DRSSE/SGP/D, and approved by the management of the Sino-Gabonese Friendship Hospital in Franceville (SGFHF). The data collected did not include patient identities or personal information. Patient anonymity was guaranteed to avoid any stigmatization. Written informed consent was obtained from each participant. She was informed in advance of her right to withdraw from the study at any time.

### II.8. Statistical analysis of data

Entered in a Microsoft Excel 2016 format, data were then analyzed with R software version 3.6.1, including measurement of rates and associations. Descriptive statistics were used and comparisons between qualitative data were made to determine factors associated with the prevalence of *Ureaplasma urelyticum* infection A 95% confidence interval was estimated and a p≤0.05 value was considered statistically significant.

## III. RESULTS

### III.1 Overall Prevalence of *Ureaplasma urealyticum* Infection among Study Participants (n = 164)

A total of 164 women, with an average age of 27.9 ± 7.1 years, who met the inclusion criteria and were seen at the Sino-Gabonese Friendship Hospital, were included in this study. With a 100% response rate, the diagnosis of *Ureaplasma urealyticum* (U.u.) infection was positive for 43 participants, indicating an overall prevalence of 26.21% (95% CI: [0.2 - 0.34]).

### III.2 Overall Prevalence of *Ureaplasma urealyticum* Infection According to Sociodemographic Characteristics of Study Participants (N = 146)

Bivariate analysis of the overall prevalence of *Ureaplasma urealyticum* infection according to the sociodemographic characteristics of the participants showed that those aged between 21 and 30 years (OR = 2.75; 95% CI: [1.26-6.07] p = 0.007*), students (OR = 2.65; 95% CI: [1.14-6.15] p = 0.002*), or unemployed (OR = 2.33; 95% CI: [1.08-5.09] p = 0.024*), or working in small businesses (OR = 0.2; 95% CI: [0.05-0.62] p = 0.0014*), and single (OR = 3.18; 95% CI: [1.4-7.2] p = 0.004*) had a higher risk of *Ureaplasma urealyticum* infection (Table 1).

**Table 1**: Seems to present results from a statistical analysis, likely a bivariate analysis, examining the association between various sociodemographic factors and the prevalence of *Ureaplasma urealyticum* infection.

| Variable | Prevalence of *Ureaplasma urealyticum* infection % (n/N) | Crude OR CI 95 % | p-value |
|---|---|---|---|
| **Age Group (years)** | | | |
| ≤20 | 30.77 (4/13) | 1.27 [0.27-4.89] | 0.74 |
| 21- 30 | 40.39 (21/52) | 2.75 [1.26- 6.07] | **0.007*** |
| 31- 40 | 25 (15/60) | 0.91 [0.40-1.97] | 0.86 |
| 41-43 | 7.69 (3/39) | Reference | - |
| **Occupation** | | | |
| Unemployed | 37.5 (21/56) | 2.33 [1.08-5.09] | **0.024*** |
| Student | 43.24 (16/37) | 2,65 [1.14-6.15] | **0.02*** |
| Small business | 8.88 (4/45) | 0.2 [0.05-0.62] | **0.0014*** |
| Public servant | 7.69 (2/26) | Reference | - |
| **Marital Status** | | | |
| Single | 44.19 (19/43) | 3.18 [1.4-7.2] | **0.004*** |
| Cohabitation | 27.66 (13/47) | 1,11 [0.47- 2.5] | 0.85 |
| Engaged | 21.88 (7/32) | 0.75 [0.25-1.98] | 0.66 |
| Married | 9.52 (4/42) | Reference | - |
| **Residence** | | | |
| Franceville (Urban) | 27.34 (35/128) | Reference | - |
| Other (Rural) | 24.62 (8/37) | 1.32 [0.52-3.67] | 0.67 |
| **Alcohol consumption** | | | |
| Yes | 35 (28/80) | 2.46 [1.14-2.57] | **0.014*** |
| No | 21.74 (15/69) | Reference | - |

**Explanation:**

- **Variables:** These are the different obstetrical factors being studied (e.g., number of pregnancies, history of STIs).
- **Prevalence:** The percentage of women in each group who had a *Ureaplasma urealyticum infection*.
- **Crude OR:** The odds ratio, a measure of association, comparing the odds of having the infection in one group versus another.
- **95% CI:** The 95% confidence interval, which gives a range of plausible values for the true odds ratio.
- **p-value:** This indicates the statistical significance of the association. A p-value less than 0.05 is typically considered statistically significant.
- **Reference**: This category serves as a point of comparison for the other categories. For example, for

the variable "History of STI", the "No" group is the reference, and the odds ratio for the "Yes" group is compared with this reference group.

- *= Significant result.

**III.3. Overall Prevalence of *Ureaplasma urealyticum* Infection According to Obstetrical Characteristics of Study Participants (N = 146)**

Table 2 shows that, women with a history of spontaneous abortions (OR = 3.83; 95% CI: [1.75-8.54] p=0.00*) or STIs (OR = 5.8; 95% CI: [2.56-12.86] p≤0.001*), were significantly more likely to have a *Ureaplasma urealyticum* infection compared to those without these histories. Additionally, women who were not using any form of contraception had a lower risk of infection. However, the associations for other factors like parity, number of pregnancies, and specific contraceptive methods were not statistically significant.

**Table 2**: Association Between Obstetrical *Characteristics and Ureaplasma urealyticum* Infection.

| Variable | Prévalence of *Ureaplasma urealyticum infection* % (n/N) | Crude OR, CI 95 % | p-value |
|---|---|---|---|
| **Parity (number of live births)** | | | |
| 0 – 5 | 27.5 (11/40) | 1,09 [0.44 -2.57] | 0.84 |
| 6 – over | 25.81 (32/124) | Reference | - |
| **Pregnancy (number of pregnancies)** | | | |
| 0 – 3 | 26.21 (27/103) | 0.99 [0,46-2.21] | 1 |
| 4 – 6 | 26.23 (16/61) | Reference | - |
| **History of spontaneous abortion** | | | |
| Yes | 43.86 (25/57) | 3,83 [1.75-8.54] | **0,000*** |
| No | 27.66 (13/107) | Reference | - |
| **History of sexually transmitted infections (STIs)** | | | |
| Yes | 45.59 (31/68) | 5,8 [2.56-12.86] | **≤0.001*** |
| No | 12.5 (12/96) | Reference | 0.67 |
| **Contraception method used** | | | |
| IUD (intrauterine device) | 50 (3/6) | 2.92 [0.38-22.75] | 0.18 |
| Condom | 25 (8/32) | Reference | - |
| Pill | 40 (4/10) | 1,96 [0.39-8.75] | 0.29 |

| | | | |
|---|---|---|---|
| None | 22.23 (28/111) | 0.25 [0.09-0.69] | **0.004*** |
| **Vaginal flora** | | | |
| Normal | 26.81 (8/31) | Reference | - |
| Abnormal | 26.32 (35/133) | 0.25 [0.09-0.69] | 1 |

**Explanation:**

- **Variables:** These are the different obstetrical factors being studied (e.g., number of pregnancies, history of STIs).
- **Prevalence:** The percentage of women in each group who had a *Ureaplasma urealyticum infection*.
- **Crude OR:** The odds ratio, a measure of association, comparing the odds of having the infection in one group versus another.
- **95% CI:** The 95% confidence interval, which gives a range of plausible values for the true odds ratio.
- **p-value:** This indicates the statistical significance of the association. A p-value less than 0.05 is typically considered statistically significant.
- **Reference**: This category serves as a point of comparison for the other categories. For example, for the variable "History of STI", the "No" group is the reference, and the odds ratio for the "Yes" group is compared with this reference group.
- *= Significant result

**Note:** The term "IUD" in the table refers to an intrauterine device, a type of long-acting reversible contraception

**III-4. Multivariate Logistic Regression Analysis of Risk Factors Associated with *Ureaplasma urealyticum* Infection among Study Women (n = 164)**

Multivariate logistic regression analysis of all variables that were significant in the bivariate analysis indicated that only women of childbearing age with a history of sexually transmitted infections (STIs) (Adjusted OR = 2.62 ; 95% CI: [1.08-6.37] p=0.034*) and those who did not use any form of contraception (Adjusted OR = 3.22 ; 95% CI: [1.3-7.97] p=0.012*) were at a higher risk of *Ureaplasma urealyticum* infection compared to other participants (Table 3).

**Table 3:** Multivariate logistic regression analysis of risk factors for *Ureaplasma urealyticum* infection among study women.

| Variable | Prévalence of *Ureaplasma urealyticum* infection % (N) | Ajusted OR, 95 % CI | p-value |
|---|---|---|---|
| **History of sexually transmitted infections (STIs)** | | | |
| Yes | 45.59 (31/68) | 2.62 [1.08 –6.37] | **0.034*** |
| No | 70.73 (29/41) | 1 | - |
| **Contraception method used** | | | |
| IUD (intrauterine device) | 50 (3/6) | - | - |
| Condom | 25 (8/32) | 1 | - |
| Pill | 40 (4/10) | - | - |
| None | 22.23 (28/111) | 3.22 [1.3 –7.97] | **0.012*** |

**Explanation:**

- **Adjusted Odds Ratios:** This term clearly indicates that the results have been adjusted for other factors in the logistic regression model
- **Reference**: This category serves as a point of comparison for the other categories. For example, for the variable "History of STI", the "No" group is the reference, and the odds ratio for the "Yes" group is compared with this reference group.
- **Absence of adjusted odds ratios for certain contraception categories**: In this case, it seems that these categories were not included in the final logistic regression model, or that their odds ratios were not significant. It is therefore preferable not to include adjusted odds ratios for these categories

## DISCUSION

A frequent colonizer of the urogenital tract, particularly in women, *Ureaplasma urealyticum* is an infectious agent belonging to the mycoplasma family and implicated in various pathologies, notably urogenital ones. To design, plan, and evaluate appropriate intervention strategies against this disease, it was crucial to understand the epidemiology, transmission, distribution, prevalence of this bacterium, as well as associated risk factors among women of childbearing age [12]. Consequently, the present study aimed to establish the epidemiological and clinical profile of *Ureaplasma urealyticum* infection in women of childbearing age consulting at the Sino-Gabonese Friendship Hospital in Franceville, Southeastern Gabon. Higher than the 22.01% demonstrated by other researchers in China [13] and lower than the 52% found in a study conducted in Libya [4], the present study indicated an overall prevalence of *Ureaplasma urealyticum* infection of 26.21% (95% CI: [0.2 - 0.34]) among women of childbearing age. This result aligns with a study conducted in Romania, which reported a prevalence of 26.12% [14]. in the same population. The variability of prevalences observed in different studies could be attributed to several interdependent factors, which can be grouped into several categories. First, geographic and ethnic variations in the populations studied may be linked to differences in sexual practices, hygiene, and the prevalence of *Ureaplasma urealyticum* and other infectious agents [5]. Second, the sensitivity and specificity of the tests used to detect *Ureaplasma urealyticum* vary from one study to another, which can lead to different prevalence estimates [15]. Finally, the difference in the sizes of the samples collected, and the criteria

used to select participants can influence the representativeness of the sample and, consequently, the observed prevalences of *Ureaplasma urealyticum* [16]. Bivariate analysis of the overall prevalence of *Ureaplasma urealyticum* infection according to the sociodemographic and obstetrical characteristics of women of childbearing age in the study indicated that those aged between 21 and 30 years, students, or unemployed, or engaged in small trades, who had a history of spontaneous abortion, a history of sexually transmitted infections, and who did not use any contraception had a very high probability of being infected with *Ureaplasma urealyticum* [17]. Further analysis, using multivariate logistic regression of all significant variables in the bivariate analysis, showed that only women of childbearing age who had a history of sexually transmitted infections (STIs) and who did not use any contraception were, respectively, 2.62 and 3.22 times more at risk of infection by *Ureaplasma urealyticum* than other participants. These results are similar to those found in studies conducted by Moridi et al [18], and that conducted in Cuenca, Ecuador [5]. The vulnerability of women in the study with this profile could justify the fact that STIs can cause chronic inflammation in the genital organs, which can weaken local immune defenses and make the body very vulnerable to new infections, including those caused by *Ureaplasma urealyticum* [19]. STIs can disrupt the balance of the vaginal microbiota, promoting the proliferation of opportunistic bacteria such as *Ureaplasma urealyticum* [20]. Moreover, the absence of contraception is often associated with a higher number of sexual partners. However, multiplying sexual partners significantly increases the risk of exposure to multiple infectious agents, including Ureaplasma urealyticum [21].

### Limitations of the Study

This study, which focused on the epidemiological and clinical profile of Ureaplasma urealyticum infection in women of childbearing age consulting at the Sino-Gabonese Friendship Hospital in Franceville, southeastern Gabon, provided essential information for a better understanding of this bacterium, its interactions with the human host, and its role in various pathologies. However, like any scientific study, it is subject to certain limitations. First, the frequent presence of co-infections with other pathogens made it difficult to specifically attribute symptoms to *Ureaplasma urealyticum*. A significant proportion of women colonized by Ureaplasma urealyticum were asymptomatic, which can make it difficult to estimate the true prevalence of infection in the studied population. Moreover, the definition of a case of *Ureaplasma urealyticum* infection varies from one study to another, making it difficult to compare results with other studies. The MYCOFAST RevolutioN ATB+ kit used in this study is not the only diagnostic method for mycoplasma infections. Other methods, such as culture, PCR, or serological tests, should be used in addition or as an alternative. The limited time allotted for conducting this study meant that it was carried out with a small sample size, not powerful enough to detect weak associations or subtle differences. Potential risk factors, such as socioeconomic status, sexual behaviors, frequent use of sanitary napkins, purulent cervical discharge, etc., were not addressed. Since the study was conducted in a city hospital, the results obtained cannot be generalized to other populations or other contexts. The participants in this study were not representative of the general population of women of childbearing age in the city of Franceville, which may bias the results. Although a structured questionnaire was used in this study, participants may not have reported all of their symptoms or sexual behaviors, which may underestimate the overall prevalence of *Ureaplasma urealyticum* infection obtained.

## CONCLUSION

Frequently implicated in lower genital tract infections in women of childbearing age, Ureaplasma urealyticum has an impact on reproductive health, a subject of active research, and the conclusions to date are nuanced. The present study indicated that women of childbearing age with a history of sexually transmitted infections (STIs) and who did not use any contraception were 2.62 and 3.22 times more likely, respectively, to be at increased risk of infection by *Ureaplasma urealyticum* than other participants. Consequently, it is recommended to systematically use condoms, which is the best method to prevent the transmission of many STIs, including *Ureaplasma urealyticum*. A good understanding of STIs and prevention methods is essential to protect women's sexual health. Finally, regular screening will allow for early detection of infections and the institution of appropriate treatment.

### PERSPECTIVES

For a better understanding of *Ureaplasma urealyticum* infection and its impact on human health, research on this bacterium offers promising perspectives. Here are some research areas that could be prioritized in the coming years:

- Deepen the study of the molecular mechanisms by which *Ureaplasma urealyticum* adheres to epithelial cells, induces an inflammatory response, and disrupts the host's immune defenses.
- Identify new molecules involved in virulence and develop strategies to block their interactions with host cells.
- Study the influence of *Ureaplasma urealyticum* on the vaginal microbiota and its role in dysbiosis associated with urogenital infections.
- Develop rapid and easy-to-use diagnostic tests for broader screening and faster management of infections.
- Identify new biomarkers specific to *Ureaplasma urealyticum* infection to improve diagnosis and therapeutic monitoring.

### Authors' contributions

All authors contributed equally to the manuscript. They have read, appreciated, and approved its final version.

### Disclosure of interest

The authors declare no conflicts of interest.

## REFERENCES

- 1. Romeo Wenceslas Lendamba, Pierre Philippe Mbeang Nguema, Richard Onanga, Landry-Erik Mombo, **Determination of the prevalence of Mycoplasma hominis and Ureaplasma species in patients with bacterial vaginosis in association with antibiotic resistance profile in Franceville, Gabon,** Microbial Pathogenesis, Volume 166, 2022, 105528, ISSN 0882-4010,https://doi.org/10.1016/j.micpath.2022.105528
- 2. Baek JC, Jo HC, Lee SM, Park JE, Cho IA, Sung JH. **Prevalence of pathogens and other microorganisms in premenopausal and postmenopausal women with vulvovaginal symptoms: A retrospective study at a single institute in South Korea**. Medicina (Kaunas). 2021 Jun 4;57(6):577. doi: 10.3390/medicina57060577. PMID: 34199976; PMCID: PMC8229179
- 3. Matasariu DR, Ursache A, Agache A, Mandici CE, Boiculese VL, Bujor IE, Rudisteanu D, Dumitrascu I, Schaas CM. **Genital infection with Ureaplasma urealyticum and its effects on pregnancy.** Exp Ther Med. 2022 Jan;23(1):89. doi: 10.3892/etm.2021.11012. Epub 2021 Nov 26. PMID: 34934454; PMCID: PMC8652385
- 4. Bartkeviciene D, Opolskiene G, Bartkeviciute A, Arlauskiene A, Lauzikiene D, Zakareviciene J, Ramasauskaite D. **Impact of Ureaplasma infections on pregnancy complications**. Libyan J Med. 2020 Dec;15(1):1812821. doi: 10.1080/19932820.2020.1812821. Epub 2020 Aug 28. PMID: 32854606; PMCID: PMC7646542
- 5. Abad S, Neira E, Viñansaca L, Escandón S, Neira VA. **Prevalence of Chlamydia trachomatis, Ureaplasma urealyticum and Neisseria gonorrhoeae in asymptomatic women from urban-peripheral and rural populations of Cuenca, Ecuador. Infectious disease reports.** 2022 ; 14(5) : 646-654. https://doi.org/10.3390/idr14050070

- 6. Rak K, Kiecka A, Białecka J, Kawalec A, Krzyściak P, Białecka A. **Retrospective analysis of the prevalence of Ureaplasma spp. compared with other genital tract infections in women of childbearing age.** Pol J Microbiol. 2022 Nov 20;71(4):509-518. doi: 10.33073/pjm-2022-044. PMID: 36401536; PMCID: PMC9944971

- 7. Jonduo ME, Vallely LM, Wand H, Sweeney EL, Egli-Gany D, Kaldor J, Vallely AJ, Low N. **Adverse pregnancy and delivery outcomes associated with Mycoplasma hominis, Ureaplasma urealyticum and Ureaplasma parvum: a systematic review and meta-analysis.** BMJ Open. 2022 Aug 26;12(8):e062990. doi: 10.1136/bmjopen-2022-062990. Erratum in: BMJ Open. 2023 Sep 22;13(9):e062990corr1. doi: 10.1136/bmjopen-2022-062990corr1. PMID: 36028274; PMCID: PMC9422885

- 8. Baraïka & Richard, Onanga & Bivigou Mboumba, Berthold & Mabika, Arsène & Bisvigou, Ulrick & Touré, Ndouo & Touré, Kane. (2020). **Prevalence and antimicrobial susceptibility profile of Mycoplasma hominis and Ureaplasma urealyticum in the female population, Gabon.** Journal of Applied Biology & Biotechnology. 10.7324/JABB.2020.80605.

- **9. Gabon Population Census 2014.** (2014)

- **10.** Sitotaw, B., Mekuriaw, H., & Damtie, D. (2019). **Prevalence of intestinal parasitic infections and associated risk factors in children at Jawi elementary school, town of Jawi, northwest Ethiopia.** *Maladies infectieuses BMC, 19*(1), pp.1-1

- **11. Mba, T., Obiang, C., Kenguele, H., Pambo-Pambo, A., Mba, I., Sah, U., . . . Mickala, P.** (2023). **Prevalence of pulmonary tuberculosis and associated factors in patients admitted to the Amissa Bongo University Hospital in Franceville, Gabon.** *Journal of Biosciences and Medicines, 11,* 160-173. doi:10.4236/jbm.2023.117014

- 12. Beayni NE, Hamad L, Nakad C, Keleshian S, Yazbek SN, Mahfouz R. **Molecular prevalence of eight different sexually transmitted infections in a large Lebanese tertiary care center: impact on public health.** Int J Mol Epidemiol Genet. 2021 Apr 15;12(2):16-23. PMID: 34093967; PMCID: PMC8166729

- 13. Zeng X.-Y., Xin N., Tong X.-N., Wang J.-Y., Liu Z.-W. **Prevalence and antibiotic susceptibility of Ureaplasma urealyticum and Mycoplasma hominis in Xi'an, China.** *Eur. J. Clin. Microbiol. Infect. Dis.* 2016 ; 35 : 1941–1947. doi : 10.1007/s10096-016-2745-2.

- 14. Doroftei B, Ilie OD, Armeanu T, Anton E, Scripcariu I, Maftei R. **Prevalence of Ureaplasma Urealyticum and Mycoplasma Hominis infections in infertile patients in the north-eastern region of Romania.** Medicina (Kaunas). 2021 Feb 26;57(3):211. doi: 10.3390/medicina57030211. PMID: 33652790; PMCID: PMC7996858.

- 15. Song J, Wu X, Kong Y, Jin H, Yang T, Xie X, Zhang J. **Prévalence et résistance aux antibiotiques des espèces *d'Ureaplasma* et de *Mycoplasma hominis* à Hangzhou, en Chine**, de 2013 à 2019. Microbiole frontale. 15 septembre 2022;13:982429. DOI : 10.3389/fmicb.2022.982429. PMID : 36187990 ; PMCID : PMC9520197.

- 16. Hong, X., Zhao, J., Ding, X., Yin, J., Ma, X., & Wang, B. (2021). **A preliminary study on the associations between Ureaplasma, Mycoplasma and the vaginal microbiome.** *Medicine in Microecology, 8,* 100041.

- 17. Liu T, Lai SY, Zhou W, Liu YL, Chen SS, Jiang YM. **Analysis of Ureaplasma urealyticum, Chlamydia trachomatis, Mycoplasma genitalium and Neisseria gonorrhoeae infections in obstetric and gynecological outpatients in southwest China: a retrospective study.**. BMC Infect Dis. 2022 25 mars ; 22(1):283. DOI : 10.1186/s12879-021-06966-z. PMID : 35337285 ; PMCID : PMC8957164.

- 18. Moridi K., Hemmaty M., Azimian A., Fallah MH, Khaneghahi Abyaneh H., Ghazvini K. **Epidemiology of genital infections caused by Mycoplasma hominis, M. genitalium and Ureaplasma urealyticum in Iran; systematic review and meta-analysis study.** (2000-2019) *BMC Public Health.* 2020 ; 20 : 1020. doi : 10.1186/s12889-020-08962-5.

- 19. Workowski KA, Bachmann LH, Chan PA, Johnston CM, Muzny CA, Park I, Reno H, Zenilman JM, Bolan GA. **Treatment of sexually transmitted infections Guidelines, 2021.** MMWR Recomm Rep. 2021 Jul 23;70(4):1-187. doi: 10.15585/mmwr.rr7004a1. PMID: 34292926; PMCID: PMC8344968.

- 20. Holdcroft AM, Ireland DJ, Payne MS. **The vaginal microbiome in health and disease: what role do routine intimate hygiene practices play? Microorganisms.** 2023 ; 11(2) : 298. https://doi.org/10.3390/microorganisms11020298

- 21. Van Gerwen OT, Muzny CA, Marrazzo JM. **Sexually transmitted infections and women's reproductive health.** Nat Microbiol. 2022 Aug;7(8):1116-1126. doi: 10.1038/s41564-022-01177-x. Epub 2022 Aug 2. PMID: 35918418; PMCID: PMC9362696.