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Urinary Infection during Pregnancy: Case-Control Study in the Maternity Wards of the Teaching Hospitals of Yaoundé Cameroon

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Abstract

Introduction: Acute pyelonephritis in pregnancy (APN) is a bacterial infection of the upper urinary tract (pyelitis) and renal parenchyma (nephritis), complicating or associated with an infection of the lower urinary tract. **Objective:** Study the clinical and para-clinical profile linked to their occurrence of APN during pregnancy in the city of Yaoundé. **Methodology:** This was a case-control analytical study lasting 07 months with retrospective data collection and covering a period of six years from January 2015 to December 2020 in 03 teaching hospitals in the city of Yaoundé. The data was recorded on a pre-tested technical sheet. We recruited the files of pregnant women in whom a urinary infection had been diagnosed using urine culture. The cases were the files of pregnant women with signs of APN and the controls were the files of pregnant women without signs of APN. The matching criteria were: recruitment site, age and term of pregnancy. Incomplete files were excluded. Statistical analyzes were carried out with Epi-Info 7 and Excel 2016 software. Statistical significance was set at a P value < 0.05. **Results:** We recruited: 55 cases and 110 controls. The factors associated with the occurrence of APN in pregnancy after logistic regression were: free union (OR: 2.19; P = 0.030), sexual intercourse during pregnancy (OR: 4.47; P = 0.001), positive HIV serology (OR: 5.52; P = 0.001), pre-gestational diabetes (OR: 10.9; P = 0.02) and a

history of urinary infection during pregnancy (OR: 11.86; P = 0.001). **Conclusion:** Acute pyelonephritis in pregnancy is an uncommon but serious pathology. Its risk factors in our context are free union, sexual intercourse during pregnancy, positive HIV serology, pre-gestational diabetes, and a history of urinary infection during pregnancy.

Keywords

Associated Factors, Acute Pyelonephritis, Pregnancy, Yaoundé

1. Introduction

Urinary infection (UI) corresponds to the attack on a tissue of the urinary tree by one or more microorganisms generating an inflammatory response, as well as signs and symptoms of variable nature and intensity depending on the background [1]. During pregnancy, it can manifest in several forms, the most serious of which is acute pyelonephritis of pregnancy (APN) [2] [3]. APN is a bacterial infection of the upper urinary tract (Pyelitis) and renal parenchyma (nephritis), complicating or associated with an infection of the lower urinary tract [4].

The annual incidence of APN worldwide is 10.5 to 25.9 million [5]. The number of deaths caused by it is estimated at 4000 per year [6]. The risk of ANP is increased during pregnancy due to anatomical and physiological changes in the urinary tract [7]. The frequency of ANP during pregnancy ranges from 0.5% to 2% worldwide. In Algeria, 0.3% of pregnant women were hospitalized for APN [8]; while Tchente *et al.* [9] reported a hospital prevalence of 0.6%. Several factors associated with the occurrence of APN have been found in the literature, notably sociodemographic and clinical factors. In California, black or Hispanic race, smoking, low education level and age less than 20 years were significantly associated with the occurrence of APN [10]. While in Jamaica, the age group between 20 and 29 was a risk factor [11]. Traore found that in Mali, the profession of housewife was significantly associated with the risk of occurrence of APN [12]. For some authors, the majority of APN occurred in the second trimester of pregnancy [11] [13]; on the other hand, for others, they frequently occurred in the third trimester [14]. Additionally, some studies found that nulliparity was a risk factor while others showed an inverse relationship between parity and APN [13] [15].

In Cameroon, few studies are available on this subject; for this reason, we proposed to conduct a case-control study in order to study the clinical and para-clinical profile linked to the occurrence of APN in the city of Yaoundé.

2. Materials and Methods

2.1. Type and Place of Study

We conducted a multicenter analytical case-control study with retrospective data

collection in the maternity wards of three teaching hospitals in the city of Yaoundé (Centre Hospitalier et Universitaire de Yaoundé (CHUY), the Central Hospital of Yaoundé (CHY), and the Gyneco-Obstetric and Pediatric Hospital of Yaoundé (GOPHY).

2.2. Period and Duration of the Study

Our study covered a period of 06 years from January 1, 2015 to December 31, 2020 with data collection and duration of 7 months from January 2021 to July 2021.

2.3. Study Population

2.3.1. General Population

Was made up of all pregnant women monitored and/or hospitalized in the three hospitals selected for our study.

2.3.2. Target Population

It consisted of pregnant women in whom a urinary infection had been diagnosed by urine culture during our study period.

2.3.3. Inclusion Criteria

Inclusion criteria for cases: included in our study were the files of pregnant women in whom the diagnosis of APN had been made and who presented at admission:

- A fever.
- Pain when shaking a lumbar fossa (kidney Murphy punch positive).
- A positive urine culture.

Inclusion criteria for controls: included in our study were the files of pregnant women followed for urinary infection (with positive urine culture) in the absence of signs of APN (fever and/or pain when shaking a lumbar fossa).

2.3.4. Exclusion Criteria

Exclusion criteria for cases: was excluded from our study:

- Incomplete files.
- Records of pregnant women presenting a differential diagnosis of APN such as: malaria, pulmonary infection, diverticular sigmoiditis, spondylodiscitis, psoas abscess or hematoma, and degenerative spinal pathology.
- Records of pregnant women with comorbidities (postpartum hemorrhage, chorioamnionitis) that could lead to complications that can be confused with APN.

Exclusion criteria for controls: were excluded, incomplete files.

2.3.5. Matching Criteria

Cases and controls were matched according to: recruitment site, maternal age (±2 years), gestational age (±1 week) with a matching coefficient of one case for two controls.

2.3.6. Sampling

Our sampling was non-probabilistic based on the consecutive recruitment of files

of pregnant women meeting the selection criteria. The calculation was done with the Schlesselman formula.

The minimum sample size required for this study was 48 participants in the case group and 96 participants in the control group, for a minimum total size of 144 pregnant women.

2.3.7. Procedure

Once research authorizations had been obtained, we began by examining the registers of the gyneco-obstetrics departments of the CHUY, CHY and GOPHY, in order to identify the patients who would be part of our study. These were pregnant women who were followed for urinary infections during our study period and who presented significant bacteriuria on the urine culture. We then went to the archives service to search for the files of these pregnant women. Information that we could not find in the files was obtained by telephone call. Based on our selection criteria, we chose the files that would be part of our study. We divided them into two groups: cases and controls.

2.3.8. Study Variables

The questionnaire made it possible to collect information on:

- Sociodemographic variables.
- Obstetric and gynecological history.
- Pregnancy monitoring.
- Symptoms, Parameters and Physical Signs on Admission.
- Para-clinical results.

2.3.9. Statistical Analysis

The data were collected on a structured and pre-tested technical sheet conceived by Mve, Essome and Mbog, and data recorded and analyzed by Epi Info statistical computer software version 3.5.4. We used a 95% confidence interval, a margin of error α of 5%. Differences were considered statistically significant for values of $P \leq 0.05$.

2.3.10. Ethical Considerations

Our study was previously submitted to the validation of the ethics and institutional committee of the University of Douala, with a view to obtaining ethical clearance. Authorizations for recruitment in the study sites were also obtained from the managers of the said hospitals.

3. Results

We used 236 files and retained 165 (Figure 1).

We recruited in three teaching hospitals affiliated with the Faculty of Medicine of the University of Yaoundé 1 and as follows: 18 cases and 36 controls at the CHY; 22 cases and 44 controls at CHUY; 15 cases and 30 controls GOPHY (Table 1).

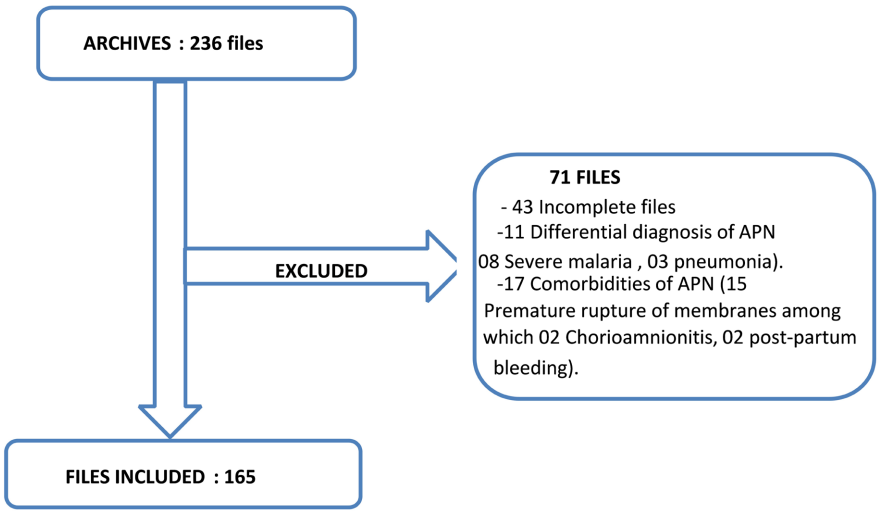

Figure 1. Sociodemographic characteristics.

Table 1. Distribution of cases and controls by recruitment sites.

RECRUITMENT SITES	Case n = 55 (%)	Controls n = 110 (%)	Total N = 165 (%)
CHY	18 (32.7)	36 (32.7)	54 (32.7)
CHUY	22 (40)	44 (40)	66 (40)
GOPHY	15 (27.3)	30 (27.3)	45 (27.3)

The average age was 26.7 ± 5.3 (16 - 38) in cases and 26.5 ± 4.9 (16 - 36) in controls.

The mean gestational age at admission was 26.95 ± 7.91 (6.28 - 36.42) in cases and 27.48 ± 7.51 (7.42 - 37.14) in controls (Table 2).

Cohabitation increased the risk of APN [OR: 2.19; 95% CI (1.03 - 4.62); P = 0.030] as opposed to age and level of education which were not associated with it (Table 3).

Table 2. Mean gestational age of cases and controls at admission.

Mean gestational age at admission	Mean	Standard deviation	Minimum	Maximum	Median	Mode
Case	26.9558	7.9171	6.2857	36.4286	29.1429	35.4286
Controls	27.4857	7.5179	7.4286	37.1429	29	32.2857

Table 3. Correlation between age, marital status, level of education, and the occurrence of APN.

Variables	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Age					
<20	4 (7.3)	8 (7.3)	12 (7.3)	1 (0.25 - 3.47)	0.610

Continued

[20 - 25]	18 (32.7)	34 (30.9)	52 (31.5)	1.09 (0.54 - 2.17)	0.470
[25 - 30]	14 (25.5)	32 (29.1)	46 (27.9)	0.83 (0.39 - 1.73)	0.380
[30 - 35]	15 (27.3)	32 (29.1)	47 (28.5)	0.91 (0.44 - 1.88)	0.480
[35 - 40]	4 (7.3)	4 (3.6)	8 (4.8)	2.08 (0.45 - 9.51)	0.250
Marital Status					
Married	18 (32.7)	45 (40.9)	63 (38.2)	0.7 (0.35 - 1.39)	0.200
Single	19 (34.5)	43 (39.1)	62 (37.6)	0.82 (0.41 - 1.62)	0.350
Divorced	0 (0)	2 (1.8)	2 (1.2)	0 (0 - 6.95)	0.440
Free Union	**18 (32.7)**	**20 (18.2)**	**38 (23)**	**2.19 (1.03 - 4.62)**	**0.030***
Level of study					
Not scolarised	5 (9.1)	6 (5.5)	11 (6.7)	1.73 (0.46 - 6.2)	0.280
Primary	5 (9.1)	9 (8.2)	14 (8.5)	1.12 (0.33 - 3.53)	0.530
Secondary	24 (43.6)	43 (39.1)	67 (40.6)	1.21 (0.62 - 2.33)	0.350
Higher education	21 (38.2)	52 (47.3)	73 (44.2)	0.69 (0.35 - 1.34)	0.170

* is for figures with statistical significance (the same as in the following tables).

Having sexual intercourse during pregnancy increased the risk of occurrence of APN [OR: 54.47; 95% CI (142.31 - 340.86); P = 0.01 as much as pre-gestational diabetes [OR: 10.9; 95% CI (1.44 - 261.43); P = 0.020] (Table 4 and Table 5). However, there was no correlation between the trimester of pregnancy at admission and the occurrence of APN (Table 6).

Table 4. Correlation between reproductive characteristics and the occurrence of APN.

Variables	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Gravidity					
Primigravid	18 (32.7)	24 (21.8)	42 (25.5)	1.74 (0.83 - 3.6)	0.090
Paucigravid	13 (23.6)	28 (25.5)	41 (24.8)	0.91 (0.42 - 1.92)	0.480
Multigravid	16 (29.1)	37 (33.6)	53 (32.1)	0.81 (0.39 - 1.63)	0.340
Grand Multigravid	8 (14.5)	21 (19.1)	29 (17.6)	0.72 (0.28 - 1.73)	0.310
Parity					
Nulliparous	22 (40)	42 (38.2)	64 (38.8)	1.08 (0.55 - 2.1)	0.480
Primiparous	15 (27.3)	25 (22.7)	40 (24.2)	1.28 (0.6 - 2.68)	0.320
Pauciparou	6 (10.9)	20 (18.2)	26 (15.8)	0.55 (0.19 - 1.43)	0.160
Multiparous	6 (10.9)	18 (16.4)	24 (14.5)	0.63 (0.22 - 1.65)	0.240
Grand Multipara	6 (10.9)	5 (4.5)	11 (6.7)	2.57 (0.71 - 9.51)	0.110
Sex during pregnancy					
Yes	**53 (96.4)**	**36 (32.7)**	**89 (53.9)**	**54.47 (14.31 - 340.86)**	**0.001***
No	2 (3.6)	74 (67.3)	76 (46.1)		

Table 5. Correlation between medical history and occurrence of APN.

Medical history	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
HTN					
Yes	2 (3.6)	1 (0.9)	3 (1.8)	4.11 (0.3 - 122.33)	0.260
No	53 (96.4)	109 (99.1)	162 (98.2)		
Diabetes					
Yes	**5 (9.1)**	**1 (0.9)**	**6 (3.6)**	**10.9 (1.44 - 261.43)**	**0.020***
No	50 (90.9)	109 (99.1)	159 (96.4)		
Sickle cell anemia					
Yes	1 (1.8)	0 (0)	1 (0.6)	Undefined	0.330
No	54 (98.2)	110 (100)	164 (99.4)		
Others					
Yes	20 (36.4)	15 (13.6)	35 (21.2)	3.62 (1.65 - 7.92)	0.110
No	35 (63.6)	95 (86.4)	130 (78.8)		

Table 6. Correlation between the trimester of pregnancy at admission and the occurrence of APN.

Trimester on admission	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
1st Trimester	5 (9.1)	9 (8.2)	14 (8.5)	1.12 (0.33 - 3.53)	0.530
2nd Trimester	20 (36.4)	39 (35.5)	59 (35.8)	1.04 (0.52 - 2.04)	0.520
3rd Trimester	30 (54.5)	62 (56.4)	92 (55.8)	0.93 (0.48 - 1.79)	0.480

On the other hand, having had your first ANC after 15 weeks increased the risk of occurrence of APN by three times. [OR: 3.19; 95% CI (1.52 - 6.67); P = 0.001] while having done it before 15 weeks was a protective factor.

Having ANC in a district hospital increased the risk of occurrence of APN [OR: 7.4; 95% CI (2.3 - 27.49); P = 0.001]. Whereas, doing your ANC in a first category hospital was a protective factor.

Having your pregnancy monitored by a midwife/nurse increased the risk of occurrence of ANC [OR: 6.07; 95% CI (1.57 - 29.03); P = 0.01]. On the other hand, being followed by a gynecologist was a protective factor (Table 7).

Table 7. Correlation between the characteristics of ANC and the occurrence of APN.

Variables	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Number of ANC					
<4	37 (67.3)	63 (57.3)	100 (60.6)	1.53 (0.78 - 3.06)	0.140
[4 - 7]	17 (30.9)	47 (42.7)	64 (38.8)	0.6 (0.3 - 1.19)	0.100
> 7	1 (1.8)	1 (0.9)	2 (1.2)	2.02 (0.05 - 79.39)	0.560

Continued

Gestational age at first ANC					
≤15 SA	**23 (41.8)**	**83 (75.5)**	**106 (64.2)**	**0.23 (0.12 - 0.47)**	**0.001***
>15 SA	**22 (40)**	**19 (17.3)**	**41 (24.8)**	**3.19 (1.52 - 6.67)**	**0.001***
ANC location					
1st category hospital	**20 (36.4)**	**64 (58.2)**	**84 (50.9)**	**0.41 (0.21 - 0.8)**	**0.010***
2nd category hospital	12 (21.8)	30 (27.3)	42 (25.5)	0.74 (0.34 - 1.59)	0.290
District hospital	**12 (21.8)**	**4 (3.6)**	**16 (9.7)**	**7.4 (2.3 - 27.49)**	**0.001***
Medical Center	3 (5.5)	0 (0)	3 (1.8)	undefined	0.040
Health center	8 (14.5)	12 (10.9)	20 (12.1)	1.39 (0.51 - 3.65)	0.330
ANC provider					
Gynecologist	**36 (65.5)**	**94 (85.5)**	**130 (78.8)**	**0.32 (0.15 - 0.7)**	**0.001***
General practitioner	11 (20)	13 (11.8)	24 (14.5)	1.87 (0.75 - 4.53)	0.120
Mid-wife/nurse	**8 (14.5)**	**3 (2.7)**	**11 (6.7)**	**6.07 (1.57 - 29.03)**	**0.010***

Pregnant women who had a genital infection during pregnancy had a 10 times higher risk of developing APN [OR: 9.94 95% CI (3.2 - 36.1); P = 0.001]. Having had a urinary infection during pregnancy increased the risk of developing APN [OR; 11.86 95% CI (3.87 - 42.6); P = 0.001]. Gestational diabetes increased the risk of occurrence of APN [OR; 5.37 95% CI (1.91 - 16.06); P = 0.001] (Table 8).

Table 8. Correlation between maternal pathologies during pregnancy and the occurrence of APN.

Pathologies during pregnancy	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Threatened premature delivery					
Yes	1 (1.8)	4 (3.6)	5 (3)	0.49 (0.02 - 4.03)	0.460
No	54 (98.2)	106 (96.4)	160 (97)		
Threatened abortion					
Yes	12 (21.8)	18 (16.4)	30 (18.2)	1.43 (0.61 - 3.23)	0.260
No	43 (78.2)	92 (83.6)	135 (81.8)		
Genital infection Yes					
	15 (27.3)	**4 (3.6)**	**19 (11.5)**	**9.94 (3.2 - 36.1)**	**0.001***
No	40 (72.7)	106 (96.4)	146 (88.5)		
Urinary infection					
Yes	**17 (30.9)**	**4 (3.6)**	**21 (12.7)**	**11.86 (3.87 - 42.6)**	**0.001***
No	38 (69.1)	106 (96.4)	144 (87.3)		
Malaria					
Yes	14 (25.5)	25 (22.7)	39 (23.6)	1.16 (0.54 - 2.46)	0.420
No	41 (74.5)	85 (77.3)	126 (76.4)		

Continued

Gestational Diabetes					
Yes	**13 (23.6)**	**6 (5.5)**	**19 (11.5)**	**5.37 (1.91 - 16.06)**	**0.001***
No	42 (76.4)	104 (94.5)	146 (88.5)		
HTN					
Yes	1 (1.8)	4 (3.6)	5 (3)	0.49 (0.02 - 4.03)	0.460
No	54 (98.2)	106 (96.4)	160 (97)		

In pregnant women with a urinary infection, the occurrence of fever, chills, lumbar pain, urinary burn and asthenia was significantly similar to APN (Table 9).

Table 9. Correlation between symptoms on admission and the occurrence of APN.

Reason for consultation	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Fever					
Yes	**53 (96.4)**	**1 (0.9)**	**54 (32.7)**	**2888.5 (270.75 - 58356)**	**0.001***
No	2 (3.6)	109 (99.1)	111 (67.3)		
Chills					
Yes	**31 (56.4)**	**1 (0.9)**	**32 (19.4)**	**140.79 (23.97 - 2920.9)**	**0.001***
No	24 (43.6)	109 (99.1)	133 (80.6)		
Nausea					
Yes	3 (5.5)	9 (8.2)	12 (7.3)	0.65 (0.14 - 2.41)	0.390
No	52 (94.5)	101 (91.8)	153 (92.7)		
Pelvic Pain					
Yes	19 (34.5)	47 (42.7)	66 (40)	0.71 (0.36 - 1.39)	0.200
No	36 (65.5)	63 (57.3)	99 (60)		
Vomitting					
Yes	4 (7.3)	13 (11.8)	17 (10.3)	0.59 (0.16 - 1.83)	0.270
No	51 (92.7)	97 (88.2)	148 (89.7)		
Lumbar pain					
Yes	**27 (49.1)**	**0 (0)**	**27 (16.4)**	**undefined**	**0.001***
No	28 (50.9)	110 (100)	138 (83.6)		
Urinary burn					
Yes	**5 (9.1)**	**68 (61.8)**	**73 (44.2)**	**0.06 (0.02 - 0.16)**	**0.001***
No	50 (90.9)	42 (38.2)	92 (55.8)		
Asthenia					
Yes	**33 (60)**	**15 (13.6)**	**48 (29.1)**	**9.5 (4.38 - 20.6)**	**0.001***
No	22 (40)	95 (86.4)	117 (70.9)		

Continued

Pollakiuria					
Yes	37 (67.3)	81 (73.6)	118 (71.5)	0.74 (0.36 - 1.51)	0.250
No	18 (32.7)	29 (26.4)	47 (28.5)		
Other Symptoms					
Yes	14 (25.5)	25 (22.7)	39 (23.6)	1.16 (0.54 - 2.46)	0.420
No	41 (74.5)	85 (77.3)	126 (76.4)		

In pregnant women with a urinary infection:

A normal temperature on admission was a protective factor for APN. A Heart Rate > 100 bpm [OR: 42.25; 95% CI (15.48 - 121.08); P = 0.001] and a FR > 20 cpm [OR: 4.85; 95% CI (2.34 - 10.25); P = 0.001] increased the risk of occurrence of APN. Fetal tachycardia increased the risk of finding APN [OR: 4.92; 95% CI (4.92 - 133.33); P = 0.001]. A normal fetal heart rate was a protective factor (Table 10).

Table 10. Correlation between vital parameters on admission and the occurrence of APN.

Variables	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Temperature					
[36˚ - 38.5˚]	**3 (5.5)**	**29 (26.4)**	**32 (19.4)**	**0.16 (0.04 - 0.51)**	**0.001***
>38.5˚	52 (94.5)	0 (0)	52 (31.5)	/	0.001
Heart rate					
≤100	**16 (29.1)**	**104 (94.5)**	**120 (72.7)**	**0.02 (0.01 - 0.06)**	**0.001***
>100	**39 (70.9)**	**6 (5.5)**	**45 (27.3)**	**42.25 (15.48 - 121.08)**	**0.001***
Respiratory rate					
≤20 cpm	**13 (23.6)**	**66 (60)**	**79 (47.9)**	**0.21 (0.1 - 0.43)**	**0.001***
>20 cpm	**42 (76.4)**	**44 (40)**	**86 (52.1)**	**4.85 (2.34 - 10.25)**	**0.001***
Systolic BP					
<90	1 (1.8)	0 (0)	1 (0.6)	/	0.330
[90 - 139]	52 (94.5)	107 (97.3)	159 (96.4)	0.49 (0.08 - 2.93)	0.320
[140 - 159]	0 (0)	2 (1.8)	2 (1.2)	0 (0 - 6.95)	0.440
[160 - 179]	2 (3.6)	1 (0.9)	3 (1.8)	4.11 (0.3 - 122.33)	0.260
Diastolic BP					
<60	4 (7.3)	4 (3.6)	8 (4.8)	2.08 (0.45 - 9.51)	0.250
[60 - 89]	49 (89.1)	103 (93.6)	152 (92.1)	0.56 (0.17 - 1.85)	0.230
[90 - 99]	1 (1.8)	3 (2.7)	4 (2.4)	0.66 (0.02 - 6.36)	0.590
[100 - 109]	1 (1.8)	0 (0)	1 (0.6)	Undefined	0.330
FHR					
<120	0 (0)	1 (0.9)	1 (0.6)	0 (0 - 38)	0.670
[120 - 160]	**28 (50.9)**	**85 (77.3)**	**113 (68.5)**	**0.31 (0.15 - 0.61)**	**0.001***
>160	**15 (27.3)**	**2 (1.8)**	**17 (10.3)**	**20.25 (4.92 - 133.33)**	**0.001***

In pregnant women with a urinary infection:

Altered general state increased the risk of occurrence of APN [OR: 23.82; 95% CI (9.35 - 63.4); P = 0.001]. The Giordano sign was positive in 67.3% of cases on the right and in 32.7% of cases on the left. When they were in labor on admission, the risk of finding APN was increased [OR: 27.25; 95% CI (4.37 - 59.64); P = 0.001] (Table 11).

Table 11. Correlation between physical examination findings and occurrence of APN.

Physical Signs	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
Altered general state					
Yes	**34 (61.8)**	**7 (6.4)**	**41 (24.8)**	**23.82 (9.35 - 63.4)**	**0.001***
No	21 (38.2)	103 (93.6)	124 (75.2)		
Lumbar shaking pain					
Yes	**55 (100)**	**0 (0)**	**55 (33.3)**	**Undefined**	**0.001***
No	0 (0)	110 (100)	110 (66.7)		
Patient in labor on admission					
Yes	**11 (20)**	**1 (0.9)**	**12 (7.3)**	**27.25 (4.37 - 596.47)**	**0.001***
No	44 (80)	109 (99.1)	153 (92.7)		

We found no correlation between the organisms isolated at urine culture and the occurrence of APN. The germs most encountered in our population were:

- Escherichia coli: 52.7% in cases and controls.
- Proteus mirabilis: 21.8% in cases and 23.6% in controls.

Klebsiella pneumoniae: 12.7% in cases, and 10.9% in controls (Table 12).

Table 12. Correlation between germs isolated at urine culture and the occurrence of APN.

Urine culture	Case n = 55 (%)	Control n = 110 (%)	Total N = 165 (%)	OR (95% CI)	P-value
E coli					
Yes	29 (52.7)	58 (52.7)	87 (52.7)	1 (0.52 - 1.92)	0.570
No	26 (47.3)	52 (47.3)	78 (47.3)		
Klebsiella P					
Yes	7 (12.7)	12 (10.9)	19 (11.5)	1.19 (0.42 - 3.22)	0.460
No	48 (87.3)	98 (89.1)	146 (88.5)		
Proteus Mirabilis					
Yes	12 (21.8)	26 (23.6)	38 (23)	0.9 (0.4 - 1.95)	0.480
No	43 (78.2)	84 (76.4)	127 (77)		
Other Germ					
Yes	7 (12.7)	13 (11.8)	20 (12.1)	1.09 (0.38 - 2.9)	0.520
No	48 (87.3)	97 (88.2)	145 (87.9)		

4. Discussion

Sociodemographic characteristics

The latter being regularly reported in the literature as significantly associated with the occurrence of APN, they have been particularly studied.

Maternal age

The average maternal age was 26.7 ± 5.3 in the cases with extremes of 16 and 38 years. A look at studies carried out in the same geographical context would have given us more information on this. We unfortunately did not see any. However, our results are in agreement with the findings of Farkash *et al.* in Israel in 2012 where the average age of onset of APN was 26.3 ± 6.0 years [16]. Other authors such as Gang Jee Ko *et al.*, on the other hand, have reported average ages higher or even lower than that of our study. In 2020, 31 ± 4 years for Gang Jee ko in a global cohort, while in Nepal and Texas, the average maternal ages were 22 ± 3.41 and 23.1 ± 5.1 years respectively [13] [17]. Unlike other authors such as Wing *et al.*, we did not find a correlation between maternal age and the occurrence of APN. This data is found differently among all the authors we consulted. For Wing in California, women under 20 were more likely to have APN (OR = 2.0; CI = 95%, 1.8 - 2.3) [9]; while Dawkins and Sharma the age range between 20 to 29 years is significantly associated with the risk of APN [11] [13].

Level of education

In contradiction with literature data, we found no correlation between educational level and the occurrence of APN. However, some authors have dealt with this association in the literature, such as Wing *et al.*, who found that compared to women who had 13 years of formal education, women who had only 12 years of education or less had a significantly increased risk of acute pyelonephritis (OR: 1.3; 95% CI: 1.2 - 1.5) [10]. Several other studies have found associations with low levels of education [18]-[20]. On the other hand, following Tchente *et al.*, the high level of education was protective: primary level (P = 0.037; OR = 0.088; CI = 0.009 - 0.872) secondary level (P = 0.036; OR = 0.113; CI = 0.015 - 0.874) and university level (P = 0.03; OR = 0.106; CI = 0.014 - 0.81).

Marital status

This variable is variously reported by different authors regarding their association with APN. In our study we found that free union increased the risk of occurrence of APN [OR: 2.19; 95% CI (1.03 - 4.62); P = 0.030]. However, Labi *et al.* in their series found no link between marital status and APN [21]. Unlike Scholes in a case control study carried out in Washington which found an association between being single and the significant risk of having an APN [OR: 1.4; 95% CI (1.0 - 1.8); P = 0.005] [22].

Clinical factors associated with APN

Parity

Like Tchente, we found no correlation between parity and the occurrence of APN [8]. However, from the work of Western authors, it appears that nulliparity increased the risk of occurrence of APN like Wing *et al.* who found that nulliparity

was significantly associated with the risk of developing APN and represented 48.6% cases [10]. As did Hill and Farkash who reported that nulliparity represented 50% to 75% of cases of APN in their respective series [16] [18].

For some, however, primiparity increased the risk of developing APN (OR [95% CI] 1.61 [1.55 - 1.67]) [17]. It should be noted that the average age of the pregnant women in these studies varied from 18 to 23 years; which is lower than the average age of our study which was 26 years and that of Tchente *et al.* which was 28 years.

Sexual intercourse

In our series, we found a correlation between sexual intercourse during pregnancy and the occurrence of APN (OR [95% CI] 54.47 [14.31 - 340.86]). These findings are in agreement with those of several authors in the literature including Fatton, Bethel, as well as Scholes *et al.* who described a link between sexual intercourse during pregnancy and APN [22]-[24]. Unlike Michel-Claire in a series in Clermont-Ferrand for whom no link existed between these two entities [25].

The term of pregnancy

This data is reported differently by the literature consulted about. In our series, the mean gestational age at admission was 26.9 ± 7.9 weeks of amenorrhea (WA) in cases with extremes of 6 and 36 weeks, close to 27.7 ± 7.4 weeks in Saleh's series [26]. But higher than the 22 ± 7.8 and 24.1 ± 4.7 WA found in the Dawkins and Zanatta studies; and lower than the 37.8 ± 6 found in Israel [11] [16] [27]. In our series, APN occurred in 90.9% of cases in the last two trimesters; this result is in line with the data in the literature because the authors agree on the fact that APN occurs most of the time during the last two trimesters of pregnancy; these two quarters also represent 90.8%, 90%, 88.5% of cases for some [10] [13] [28]; and 79% of cases for others [18]. These results can be explained by the presence of certain hormonal and mechanical factors which predispose the pregnant woman to APN during the second half of pregnancy.

Prenatal follow-up

In our series, late initiation of ANC was weakly associated with the occurrence of APN while starting ANC before 15 weeks was a protective factor. The same goes for the Californian authors who, in an 18-year retrospective series, found that late initiation of prenatal visits increased the risk of having APN by 1.1 times (OR [95% CI] 1.4 [1.3 - 1.5]) [10].

Diabetes mellitus

Diabetes is the bedrock of infections; this assertion is accepted by all [29] [30]. But in our series, we did not find an association between this metabolic disorder and the occurrence of APN; as much as Farkash reported in his series in Iran (P = 0.45) [15]. Pre-gestational diabetes, however, increased the risk of occurrence of APN (OR [95% CI] 10.9 [1.44 - 261.43]). Wing *et al.* confirmed this in their 18-year retrospective series where pre-gestational diabetes increased the risk of occurrence of APN by 1.7 times (95% CI, 1.3 - 2.1) [10]. Ditto for Hill *et al.* who, in Texas, pre-gestational diabetes mellitus increased the risk of having APN in the first trimester of pregnancy (P = 0.013) [15] While other authors like Dawkins, found no association between diabetes mellitus and the occurrence of serious

urinary infections in pregnancy [11].

History of urinary infection

In our study, a history of urinary infection during pregnancy emerged as a risk factor for APN (OR [95% CI] 11.86 [3.87 - 42.6]). Similar results are reported by Farkash (P = 0.001; OR = 10.3; CI = 4.8 - 22.1) [16]; as well as by Gang jee ko in South Korea [17].

HIV infection

HIV infection in our series with its deleterious effects on immune defense predisposed to a higher risk of developing APN (OR [95% CI] 5.52 [2.09 - 15.28]). This result is in agreement with data from the relevant international literature [31] [32]. The associated reduction in the immune system in addition, 20% to 30% of affected women may develop acute pyelonephritis [16].

5. Conclusion

At the end of this research work, the objective of which was to study the factors associated with the occurrence of APM during pregnancy in three hospitals in the city of Yaoundé, it emerged that: free union, sexual intercourse during pregnancy, positive HIV serology, pre-gestational diabetes and a history of urinary infection during pregnancy were significantly associated with the occurrence of APN in pregnancy in Yaoundé.

6. Limitations of the Study

The retrospective nature of our study imposes a certain number of inadequacies compared to that of the different authors, in particular the quality of the urine sample which was taken from pregnant women. Compared to those of other authors, the small size of our series, due to the deterioration of the files, could constitute a bias on our results due to a lack of statistical power.

Contribution to Science

Our study sheds light on this unexplored theme in our environment while opening the prospect of subsequent studies thus making it possible to develop operational strategies for prevention and early management of this condition with formidable impact for the mother and child.

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Contribution of the Authors

Essome and Mve supervised the study and writing of the manuscript, Mbog collected the data and wrote the manuscript, Tocki ensured the translation of the manuscript into English, as well as its formatting, Moustapha, Boten, Ofakem Ilick,

Ndolo, Mangala, Ekono, Ngalame, Tchounzou, Ngaha, Ngono, Mounchikpou, Nana read and corrected the manuscript.

All authors have read and approved the final version.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix: Survey Sheet

THEME: Factors associated with the occurrence of acute pyelonephritis in pregnancy in three hospitals in the city of Yaoundé.

INVESTIGATION SHEET NO.	CODIFICATION: TELEPHONE: DATE OF RECRUTMENT:

N°	Indicator	Reponses
SECTION 1: CARACTERISTIQUES SOCIO-DEMOGRAPHIQUES		
S1Q1	Age (in years)	
S1Q2	Group	1-Cases 2-Controls
S1Q3	Hospital	1-CHUY 2-CHY 3-GOPHY
S1Q4	Profession	1-Public sector 2-Private sector 3-Pupil/Student 4-Trade 5-Housewife 6-Farmer
S1Q5	Level of education	1-Not scolarised 2-Primary 3-Secondary 4-Higher education
S1Q6	Marital status	1-Married 2-Single 3-Divorced 4-Widow(er) 5-Free uniom
S1Q7	Religion	1-Catholic 2-Protestant 3-Muslim 4-Jehovah witness 5-Others
S1Q8	If other religion, precise:	
S1Q9	Region of origin	1-Far north 6-West 2-North 7 East 3-Adamawa 8-South West 4-Centre 9-North-west 5-South 10-Littoral
SECTION 2: OBSTETRICAL ET GYNECOLOGICAL HISTORY		
S2Q1	Gestation	
S2Q2	Parity	
S2Q3	Number of prematures	

Continued

S2Q4	If prematurity, last event dates back to how many months:	
S2Q5	Number of abortions	
S2Q6	If abortion, last event dates back to how many months:	
S2Q7	Number of live children	
S2Q8	Number of sexual partners	
SECTION3: FOLLOW UP OF CURRENT PREGNANCY		
S3Q1	Gestational age on admission	
S3Q2	ANC realised	1 = yes 2 = no
S3Q3	If yes, number of ANC realised	
S3Q4	Age at first ANC	
S3Q5	Hospital where pregnancy is followed up:	1-1st category hospital 2-2nd category hospital 3-Regional hospital 4-District hospital 5-District medical center 6-Integrated health center 7-Private clinic
S3Q6	Pregnancy followed by:	1-Obstetrician-gynecologist 2-General practitioner 3-Midwife 4-Nurse
S3Q7	Multiple pregnancy:	1 = yes 2 = no
S3Q8	If yes, number of fetuses:	
S3Q9	Macrosomia	1 = yes 2 = no
S3Q10	Hydramnios	1 = yes 2 = no
S3Q11	HIV	1-Positive 2-Negative 3-Not available
S3Q12	Hbs Ag	1-Positive 2-Negative 3-Not available
S3Q13	HCV Ab	1-Positive 2-Negative 3-Not available
S3Q14	Toxoplasmosis	1-Positive 2-Negative 3-Not available
S3Q15	Rubella	1-Positive 2-Negative 3-Not available

Continued

S3Q16	Syphilis	1-Positive 2-Negative 3-Not available
	Maternal pathologies in pregnancy:	
S3Q17	Threatened premamture delivery	1 = yes 2 = no
S3Q18	Threatened abortion	1 = yes 2 = no
S3Q19	Genital infection	1 = yes 2 = no
S3Q20	Urinary infection	1 = yes 2 = no
S3Q21	Malaria	1 = yes 2 = no
S3Q22	Gestational diabetis	1 = yes 2 = no
S3Q23	HTN	1 = yes 2 = no
S3Q24	Other pathology:	1 = yes 2 = no
S3Q25	If other, which one:	
SECTION4: MEDICAL HISTORY		
S4Q1	HTN	1 = yes 2 = no
S4Q2	Diabetis	1 = yes 2 = no
S4Q3	Sickle cell	1 = yes 2 = no
S4Q6	Other medical history	1 = yes 2 = no
S4Q7	If yes, precise:	
SECTION5: SYMPTOMS ON ADMISSION		
S5Q1	Fever	1 = yes 2 = no
S5Q2	Chills	1 = yes 2 = no
S5Q3	Asthenia	1 = yes 2 = no
S5Q4	Anorexia	1 = yes 2 = no
S5Q5	Nausea	1 = yes 2 = no
S5Q6	Vomitting	1 = yes 2 = no
S5Q7	Lumbar pain	1 = yes 2 = no
S5Q8	Lombo-pelvic pain similar to uterine contractions	1 = yes 2 = no
S5Q9	Dysuria	1 = yes 2 = no
S5Q10	Urianry burn	1 = yes 2 = no
S5Q11	Pollakuria	1 = yes 2 = no
S5Q12	Others:	1 = yes 2 = no
S5Q13	If others precise:	
SECTION6: PARAMETERS ON ADMISSION		
S6Q1	Temperature	
S6Q2	Hr	
S6Q3	RR	

Continued

S6Q4	BP	
S6Q5	Glycemia	
S6Q6	BMI	1-Underweight (<18.5) 2-Normal (18.5 to 24.9) 3-Overweight (25 to 29.9) 4-Obese (≥30)
SECTION7: PHYSICAL SIGNS ON ADMISSION		
S7Q1	Altered general state	1 = yes 2 = no
S7Q2	Lumbar shaking pain	1 = yes 2 = no
S7Q3	If yes, wich lumbar fossa:	1-Right 2-Left 3-Bilateral
S7Q4	Fundal height:	
S7Q5	FHR	
S7Q6	Presence of fetal movements	1 = yes 2 = no
S7Q7	Patient in labor	1 = yes 2 = no
S7Q8	If yes,	1-Active phase 2-Latent phase
SECTION8: PARACLINICAL		
S8Q1	Isolated germ at urine culture	1-Escherichia coli 2-Klebsiella 3-Proteus mirabilis 4-Other
S8Q2	If other, precise	
S8Q3	FBC realised:	1 = yes 2 = no
	If yes:	
S8Q4	Hemoglobine:	
S8Q5	WBC:	
S8Q6	Platelets:	
S8Q7	CRP realised:	1 = yes 2 = no
S8Q8	If yes, the value:	
S8Q9	Hemoculture realised:	1 = yes 2 = no
S8Q10	If realised:	1-Positive 2-Negative
S8Q11	If positive, isolated germ	1-Escherichia coli 2-Klebsiella 3-Proteus mirabilis 4-Autre
S8Q12	If other, precise:	
S8Q13	Abdominal echography realised	1 = yes 2 = no
S8Q14	If yes, APN confirmed:	1 = yes 2 = no

Continued

S8Q15	Obstetrical echography realised during hospitalisation:	1 = yes 2 = no
	Fœtal complications identified:	
S8Q16	Acute fœtal distress	1 = yes 2 = no
S8Q17	Intra-uterine growth retardation	1 = yes 2 = no
S8Q18	Intra-uterine death	1 = yes 2 = no
S8Q19	Others:	1 = yes 2 = no
S8Q20	If others, precise:	
SECTION9: MANAGEMENT		
	Antibiotics used:	
S9Q1	Penicillines	1 = yes 2 = no
S9Q2	Cephalosporines	1 = yes 2 = no
S9Q3	Macrolides	1 = yes 2 = no
S9Q4	Aminosides	1 = yes 2 = no
S9Q5	Autres	1 = yes 2 = no
S9Q6	If others, precise:	
S9Q7	Parenteral treatment	1 = yes 2 = no
S9Q8	If yes, duration (in days):	
S9Q9	Enteral treatment	1 = yes 2 = no
S9Q10	If yes, duration (in days):	
S9Q11	Hospitalisation:	1 = yes 2 = no
S9Q12	If yes, duration (in days):	
S9Q13	Progress during hospitalisation	1-Favorable 2-Complicated
S9Q14	Surgical drainage	1 = yes 2 = no
SECTION10: COMPLICATIONS MATERNELLES		
S10Q1	Preeclampsia	1 = yes 2 = no
S10Q2	Anemia	1 = yes 2 = no
S10Q3	Premature delivery	1 = yes 2 = no
S10Q4	Septic shock	1 = yes 2 = no
S10Q5	Acute renal failure	1 = yes 2 = no
S10Q6	Death	1 = yes 2 = no
S10Q7	Others:	
S10Q8	If others precise:	