**PREVALENCE OF *Proteus* SPECIES ASSOCIATED WITH POSTPATUM INFECTION IN WOMEN ATTENDING MATERNITY CLINIC IN BENUE STATE, NIGERIAN.**

**ABSTRACT**

The study investigates the prevalence of *Proteus* *species* associated with postpartum infection in women attending maternity clinic in the three Senatorial Zones (A, B and C) in Benue State. The objectives of this study are to: isolate and identify the *Proteus* *species* associated with uterine postpartum infections, determine the prevalence of these infections across the three senatorial zones, compare the prevalence rates between the hospitals and private maternity homes. The study was conducted across three Zones: Zone A (Katsina Ala), Zone B (Makurdi) and Zone C (Otukpo). A total of 500 clinical samples (high vaginal swab and urine) were collected from postpartum women attending maternity clinics in the hospital facilities and private maternity homes for routine checkup. Standard microbiological procedures were used for sample analysis. *Proteus* *mirabilis* was isolated from 70 out of the 500 specimens resulting in a prevalence rate of 14.0%. The most commonly reported clinical symptoms among participants were foul-smelling discharge (24.4%), hemorrhage (23.0%) and abdominal pain (22.2%). Prevalence rates varied across zones and facility types. Zone A recorded 15% prevalence in private maternity homes. Zone B exhibited a consistent prevalence rate of 14% across all facilities. In Zone C, *Proteus* *mirabilis* was detected in 15% of cases at Federal University of Health Sciences Teaching Hospital Otukpo, while Private Maternity Homes had a lower prevalence of 10%. Notably, 28.6% of *Proteus* *mirabilis* from Benue State University Teaching Hospital (BSUTH) were extended-spectrum beta-lactamase (ESBL) producers. These findings highlight potential transmission routes of *Proteus* *mirabilis* strains within health care facilities, emphasizing the need for improved infection control measures to reduce postpartum infections in maternity settings.

**KEY** **WORDS**: Prevalence, Postpartum infection, *Proteus* *species*, Maternity Clinic

**INTRODUCTION**

The World Health Organization (WHO), defines the postpartum period or puerperium as the period which begins one hour after the delivery of the placenta and continuing until 6 weeks (42 days) after the birth of the infant. Although important, it seems the most neglected part of obstetric care.

Postpartum infections are relatively common, affecting an estimated 5 to 7% of women during this time. Postpartum endometritis infection occurs in the lining of the uterus (endometrium) and has been identifying as the most frequent occurring postpartum infections, since the lining of the uterus is usually subjected to trauma and tear during the birthing process. This infection can also be initiated in the uterus following the rupture of the membrane (amniotic sac). This is the membrane that contains the foetus and fluids. Infected amniotic sac and its fluid can equally infect the uterus (Emma *et* *al*., 2022; Marina *et* *al*., 2022).

According to (Emma *et* *al*., 2022; Michael *et* *al*.,2023) there are three types of postpartum infections described based on the three different areas they occur; endometritis occurs at the uterine lining, myometritus occurs at the uterine muscles and parametritus (also called pelvic cellulitis) occurs at the supporting tissues around the uterus.

 Bacteria species isolated in polymicrobial endometritis include: Gram-positive cocci: Groups A and B S*treptococci, Staphylococcus, Enterococcus.* Gram-negative bacilli: *Escherichia coli, Klebsiella, Proteus.* Anaerobic organisms: *Bacteroides*, *Peptostreptococcus*, *Peptococcus, Prevotella*, and *Clostridium* Others: *Mycoplasma*, *Chlamydia* (Micheal *et* *al*., 2023).

**MATERIALS AND METHOD**

The study was carried out in the three senatorial zones (A, B, & C) of Benue state, Nigeria. A questionnaire was generated to assess potential risk factors associated with *Proteus* *species*. All enrolled patients in the selected hospitals were required to complete a face-to-face questionnaire interview at the time of enrolment after meeting the eligibility criteria and providing written informed consent. The questionnaire included five primary domains: (a) Demographic data such as age, education level, marital status, and single parenthood: (b) Compare the prevalence rate of uterine postpartum infections between hospitals, maternity clinics and private home operated by the unlicensed ( unskilled) personnel: (c) Prevalence of uterine postpartum infections in the three zones: (d) self-reported symptoms and signs such as fever, increased vaginal discharge, vaginal odour, abdominal pain, lower urinary tract symptoms and bleeding.

**Ethical Approval of the Study Protocol**

Ethical clearance was collected from Federal Ministry of Health Nigeria or ethical committee of Federal Medical Centre Makurdi, Benue State University Teaching Hospital Makurdi, Federal University of health Science Teaching Hospital Otukpo and General Hospital Katsina Ala. Written informed consent will be provided by all eligible participants before enrolment. The participating clinics includes; Federal Medical Centre, General Hospital, Teaching Hospitals and Private Maternity Homes operated by unlicensed midwives in the zones.

 **Sample Collection**

High vaginal swab and urine samples of women presented with signs and symptoms of postpartum infections were taken from five hundred (500) postpartum women using sterile swab and sterile EDTA bottle for inoculation onto the appropriate agar.

**Inoculation and incubation**

Collected samples were streaked on blood agar and MacConkey agar using a sterile loop or swab. The incubated plates were then incubated at the optimal temperature for Proteus growth, which is usually 370C for 24 to 48hours

**Colony identification**

After incubation, colonies with characteristic features of *Proteus* *mirabilis* were identified based on their swarming growth, fishy odor and a yellowish-brown color. The following biochemical characteristics was carried out on the isolate; Indole, Urease, Motility, Catalase, Capsule, Nitrate, Citrate and Triple Sugar Iron (TSI) agar test.

**Data Analysis**

IBM SPSS Statistics 23 (IBM Corp. Released 2016, IBM SPSS Statistics for Windows, Version 23, Armonk, NY; IBM Corp.) was used for statistical analysis. Data were reported as number (percentage) with the corresponding 95% confidence interval (CI). The Chi-square test was performed to compared categorical variables between groups. Logistic regression analysis was used to assess the associations of *Proteus* *species* with demographic and behavioral variables. *p* < 0.05 indicated statistical significance.

**RESULTS**

High vaginal swab and urine samples from 500 postpartum women in various hospitals within Benue States were culture for presence of *Proteus* *mirabilis*.

**Table 1: Cultural, Morphological and Biochemical Characteristics of *Proteus* *mirabilis.***

|  |  |  |
| --- | --- | --- |
| **Cultural Characteristics** | **Morphological** | **Biochemical Characteristics** |
| Form pale white colonies with swarming growth on blood agar. Form smooth and colorless colonies, but without swarm on MacConkey agar | Gram negative rod shape | Mot+ | Cat+ | Ind-  | Ure+ | Cit+ | TSI+ | Nit+ | Cap-  |

Table 1 displays the morphological and biochemical characteristics of *Proteus* *mirabilis.*

The organism is Gram negative, non-capsulated, rod shape, form pale white colonies with swarming growth on blood agar and smooth colorless colonies but without swarm on MacConkey agar. It is motile, indole negative and urease positive.

**Table 2: Incidence of *P*. *mirabilis* in Postpartum Women in Benue State**

|  |  |  |
| --- | --- | --- |
| **Occurrence of *P*. *mirabilis***  | **Frequency**  | **percent** |
| Present | 70 | 14.0 |
| Absent | 430 | 86.0 |
| Total | 500 | 100.0 |

Table 2 displays the number of postpartum women who had *P*. *mirabilis* infection. Out of the 500 women examined, 70 (14.0%) had *P*. *mirabilis* infection. Overall, the incidence of the infection was 14.0% in the study area.

**Table 3: Some Socio- demographic Characteristics of the Study Population**

|  |  |  |
| --- | --- | --- |
| **CHARACTERISTICS** | **Frequency** | **Percent (%)** |
|  |  |  |
| **Marital status** |  |  |
| Divorced | 2 | .4 |
| Married | 412 | 82.4 |
| Single | 85 | 17.0 |
| Widowed | 1 | .2 |
| Total | 500 | 100.0 |
| **Level of Education** |  |  |
| Primary School | 28 | 5.6 |
| Secondary | 206 | 41.2 |
| Tertiary | 266 | 53.2 |
| Total | 500 | 100.0 |
| **Religion** |  |  |
| Christianity | 395 | 79.0 |
| Muslim | 105 | 21.0 |
| Total | 500 | 100.0 |
| **Occupation** |  |  |
| Business | 118 | 23.6 |
| Civil Servant | 121 | 24.2 |
| Teaching | 56 | 11.2 |
| Unemployed | 205 | 41.0 |
| Total | 500 | 100.0 |

Some socio- demographic characteristics of the study population area summarized in Table 3.

A large proportion (82.4%) of the women were married, unemployed (41.0%) and have had tertiary institution education (41.2%). A higher percentage (79.0%) of them were of the Christian faith.

Majority of the women were married, educated and were Christians.

**Table 4: Extent of Postnatal Care received by the postpartum women**

|  |  |  |
| --- | --- | --- |
| **Period Spent in the Hospital after Delivery** |  **frequency**  |  % |
| Four days | 93 | 18.6 |
| One day | 194 | 38.8 |
| Three days | 82 | 16.4 |
| Two days | 131 | 26.2 |
| Total | 500 | 100.0 |
| **Period Discharged from the Hospital after Delivery** |  |  |
| A day after delivery | 194 | 38.8 |
| Four days after delivery | 93 | 18.6 |
| Three days after delivery | 82 | 16.4 |
| Two days after delivery | 131 | 26.2 |
| Total | 500 | 100.0 |
| **Routine checkup after delivery for possible Infections** |  |  |
| No | 102 | 20.4 |
| Yes | 398 | 79.6 |
| Total | 500 | 100.0 |

Table 4 summarizes the extent of postnatal care given to the postpartum women. A higher proportion of the women (38.8%) spent only one day in the hospital after delivery, and were followed by those who spent two days (26.2%). Fewer number of the women spent between three days (16.4%) and four (18.6%) days in the hospital after delivery. Majority of the women (79.6%) admitted going to the hospital for routine postnatal checkups.

A good number of the women were discharged from hospital a day or two after the delivery, and many reported going for routine checkup after delivery.

**Table 5: Clinical History of the Postpartum Women.**

|  |  |  |
| --- | --- | --- |
| **Did you undergo caesarean delivery frequency**  | **Percentage %** |  |
|  |  |  |
| No | 295 | 59.0 |
| Yes | 205 | 41.0 |
| Total | 500 | 100.0 |
|  |  |  |
| **If Yes how many times** | 295 | 59.0 |
| Four times | 1 | .2 |
| Once | 104 | 20.8 |
| Three times | 20 | 4.0 |
| Twice | 80 | 16.0 |
| Total | 500 | 100.0 |
| **Did you have vaginal delivery** |  |  |
| No answer | 5 | 1.0 |
| No | 129 | 25.8 |
| Yes | 366 | 73.2 |
| Total | 500 | 100.0 |
| **If yes how many times** |  |  |
| No answer | 135 | 27.0 |
| Four Times | 20 | 4.0 |
| Once | 135 | 27.0 |
| Three times | 67 | 13.4 |
| Twice | 143 | 28.6 |
| Total | 500 | 100.0 |
| **Place of residence** |  |  |
| Katsina-Ala | 120 | 24.0 |
| Makurdi | 250 | 50.0 |
| Otukpo | 130 | 26.0 |
| Total | 500 | 100.0 |
| **Where the complications after the deliveries** |  |  |
| No | 1 | .2 |
| Yes | 499 | 99.8 |
| Total | 500 | 100.0 |
|  |  |  |
|  |  |  |
|  |  |  |

As shown in Table 5, most of the postpartum women (73.2%) reported having had vaginal delivery. Some (41.0%) had undergone caesarean delivery whereas a larger proportion (59.0%) had not.

Most of the women had vaginal delivery, resided in Makurdi and had complications after delivery.

**Table 6: Symptoms of Infection Experienced by the Postpartum Women**

|  |  |  |
| --- | --- | --- |
| **Where you treated following signs and symptoms of this infection** | **Frequency percent** |  |
|  |  |  |
| Abdominal pain | 111 | 22.2 |
| Fever | 82 | 16.4 |
| Fever and Hemorrhage | 70 | 14.0 |
| Foul discharge | 122 | 24.4 |
| Hemorrhage | 115 | 23.0 |
| Total | 500 | 100.0 |

Table 6 displays the number of study respondents who had presented with some symptoms of infection after delivery. Large proportions of the respondents reported having foul discharge (24.4%), hemorrhage (23.0%) and abdominal pain (22.2%0. Fewer numbers reported fever (16.4%) and fever and hemorrhage (14.0%). Most predominant symptoms shown by the women examined were foul discharge and hemorrhage

**Table 7: Incidence of *Proteus* *mirabilis* isolates based on Specimens**

|  |  |  |  |
| --- | --- | --- | --- |
| Specimen | No. Examined | No. Positive (%) | No. Negative (%) |
| Urine | 300 | 50 (16.7) | 250 (83.3) |
| HVS | 200 | 20 (10.0) | 180 (90.0) |
| Total | 500 | 70 (14.0) | 430 (86.0) |

X2=4.430, P=0.035

As shown in table 7, most of the positive cases (16.7%) were isolated from urine samples whereas (10,0%) were from swab.

*P*. *mirabilis* was more in urine.

**Table 8: Occurrence of *Proteus* *mirabilis* Isolates according to age**

|  |  |  |  |
| --- | --- | --- | --- |
| Age | No. Examined | No. Positive (%) | No. Negative (%) |
| < 20 | 67 | 11 (16.4) | 56 (83.6) |
| 21-30 | 208 | 28 (13.5) | 180 (86.5) |
| 31-40 | 181 | 25 (13.8) | 156 (86.2) |
| 41-50 | 44 | 6 (13.6) | 38 (86.4) |
| Total | 500 | 70 (14.0) | 430 (86.0) |

X2=0.386, P=0.943

Table 8 revealed the occurrence of *P*. *mirabilis* isolates according to age.

Out of the number examined 16.4% was observed among the age group <20 follow by 31-40 age (13.8%).

The infections rate was common among the younger women.

**Table 9: Distribution of *Proteus* *mirabilis* isolates based on the Facilities**

|  |  |  |  |
| --- | --- | --- | --- |
| Facilities | No. Examined | No. Positive (%) | No. Negative (%) |
| FMC | 50 | 7 (14.0) | 42 (84.0) |
| BSUTH | 150 | 21 (14.0) | 128 (85.3) |
| FUHSTHO | 100 | 15 (15.0) | 85 (85.0) |
| GH. K / ALA | 100 | 14 (14.0) |  85 (85.0) |
| PMH | 100 | 13 (13.0) | 90 (90.0) |
| Total | 500 | 70 (14.0) | 430 (86.0) |

X2=0.166, P=0.997

Table 9 shows the presence of *P*. *mirabilis* isolated from the various facilities used in the research. Majority (15.0%) of the positive samples were isolated from FUHSTHO. Fewer samples (13.0%) were from PMH. A good number of the samples were found in FUHSTHO.

**Keys**

FMC – Federal Medical Center Makurdi

BSUTH – Benue State University Teaching Hospital Makurdi.

FUHSTHO – Federal University of Health Science Teaching Hospital Otukpo.

GH K/ ALA – General Hospital Katsina Ala

PMH – Private Maternity Homes.

**Table 10: Prevalence of *Proteus* *mirabilis* isolates in Zone A (Katsina- Ala)**

|  |  |  |  |
| --- | --- | --- | --- |
| Facilities |  No. Examined | No. Positive (%)  | No. Negative (%) |
| GH K / ALA | 100 | 15 (15.0) | 85 (85.0) |
| PMH | 20 | 2 (10.0) | 18 (90.0) |
| Total | 120 | 17 (14.2) | 103 (85.8) |

X2=0.343, P=0.558

Table 10 summarizes occurrence *P*. *mirabilis* isolates in Zone A. Among the facilities used, 15.0% of the positive samples were isolated from General Hospital Katsina Ala. The samples were high in this facility

**Table 11: Presence of *Proteus* *mirabilis* isolate in Zone B (Makurdi)**

|  |  |  |  |
| --- | --- | --- | --- |
| Facilities | No. Examined | No. Positive (%) |  No. Negative (%) |
| FMC | 50 | 7 (14.0) | 43 (86.0) |
| BSUTH | 150 |  21 (14.0) | 129 (86.0) |
| PMH | 50  | 7 (14.0) | 43 (86.0) |
| Total | 250 | 35 (14.0) | 215 (86.0) |

X2=0.000, P=1.000

 Table 11 shows presence of *P*. *mirabilis* isolates in Zone B. Percentage proportions of the isolates (14.0 %) was observed across the facilities. All the facilities used had the same prevalence rate

**Table 12: Prevalence of *Proteus* *mirabilis* isolates in Zone C (Otukpo)**

|  |  |  |  |
| --- | --- | --- | --- |
| Facilities | No. Examined |  No. Positive (%) |  No. Negative (%) |
| FUHSTHO | 100 | 15 (15.0) | 85 (85.0) |
| PMH | 30 | 3 (10.0) | 27 (90.0) |
| Total | 130 | 18 (13.8) | 112 (86.2) |

X2=0.484, P=0.487

Distribution of *P*. *mirabilis* isolates in Zone C as shown in Table 12. High incidence rate (15.0%) was recorded in Federal University of Health Science Teaching Hospital compared to 10.0% in Private maternity Homes. Positive samples were more in FUHSTHO.

**Table 13: Compared the prevalence rates of *Proteus mirabilis* isolates Between the three Zones**

|  |  |  |  |
| --- | --- | --- | --- |
| Zones | No. Examined |  No. Positive (%)  | No. Negative (%) |
| A | 120 | 17 (14.2) | 103 (85.8) |
| B | 250 | 35 (14.0) | 215 (86.0) |
| C | 130 | 18 (13.8)  | 112 (86.2) |
| Total | 500 | 70 (14.0) | 430 (86.0) |

X2=0.005, P=0.997

Table 13 summarizes the prevalence rates observed among the three Zones. Zone A had 14.2% followed by Zone B (14.0%) and Zone C (13.8%). More of the isolates were found in Zone A.

**Table: 14 Distribution of ESBL *Proteus* *mirabilis* Producers Based on the Facilities**

|  |  |  |  |
| --- | --- | --- | --- |
| Facilities | No. Examined | ESBL Producers (%) |  Non ESBLS (%) |
| FMC | 7 | 1 (14.3) | 6 (85.7) |
| BSUTH | 21 | 6 (28.6) | 15 (71.4) |
| FUHSTHO | 15 | 3 (20.0) | 12 (80.0) |
| GH K /ALA | 14 | 3 (21.0) | 12 (80.0) |
| PMH | 13 | 2 (15.4) | 11 (84.6) |
| Total | 70 | 15 (21.4) | 55 (78.6) |

X2=1.149, P=0.886

Table 14 shows the distribution of ESBL *P*. *mirabilis* producers based on the facilities. Higher percentage (28.6%) was found in Benue State University Teaching Hospital. A good number of ESBL *P*. *mirabilis* producers were recorded in BSUTH.

**Key**

ESBL = Extended Spectrum Beta Lactamase Producers

**DISCUSSION**

In this study, *Proteus* *mirabilis* was isolated from 70 out of the 500 specimens analyzed, yielding a prevalence rate of 14.0%. This rate is significantly higher than the incidence reported in a study conducted in Sokoto, Northwest Nigeria and Port Harcourt, South- South Nigeria, which documented prevalence rates ranging between 0.9% and 9.34% (Olutoye *et* *al.,* 2022). It also exceeds the prevalence of postpartum fever reported in Cameroon following caesarean sections and vaginal deliveries (Vannick *et* *al*. (2020). The elevated prevalence rates observed in this study could be linked to factors such as multiple vaginal examinations, [Chorioamnionitis](https://www.msdmanuals.com/professional/gynecology-and-obstetrics/abnormalities-of-pregnancy/intraamniotic-infection), postpartum hemorrhage and [caesarean deliveries, which were identified as predisposing conditions in the study areas. However, this rate is lower than the 23.63% prevalence of postpartum hemorrhage reported in a separate study conducted in.](https://www.msdmanuals.com/professional/gynecology-and-obstetrics/abnormalities-and-complications-of-labor-and-delivery/cesarean-delivery) Cameroun (Halle-Ekane *et* *al*., 2016).

Furthermore, a significant proportion of respondents in this study reported clinical symptom such as foul-smelling discharge (24.4%), hemorrhage (23.0%) and abdominal pain (22.2%). These findings align with those reports of Samuel *et* *al*. (2019) who identified Puerperal fever and postpartum hemorrhage as the direct contributors of maternal mortality in postpartum women. The observed symptom patterns highlight the clinical burden of postpartum infections and underscore the importance of timely intervention and improved management practices to reduce associated risks.

 The study revealed that 15% of the samplesin Zone A tested positive for *Proteus* *mirabilis* in private maternity homes. This could be attributed to low patronage of General Hospital Katsina Ala and the corresponding low prevalence rate (14%) reported for such facilities. In contrast, Zone B exhibited a consistent prevalence rate of 14% across all sampled facilities, indicating a more uniform distribution of cases in this Zone. In Zone C, an incidence rate of 15% was recorded in the Federal University of Health Sciences Teaching Hospital Otukpo, while Private Maternity Homes in the same Zone had a lower rate of 10%. The observed variations in prevalence rates across the Zones may be influenced by difference in sample sizes and types of health facilities sampled. Larger or more diverse sample sizes might provide a more accurate representation of the prevalence, while smaller samples or limited facility types could skew results. These findings emphasize the importance of considering sampling methodologies and facility characteristics when interpreting prevalence data. The study detected a significant proportion (28.6%) of *Proteus* *mirabilis* producing extended spectrum beta lactamase (ESBL) in Benue State University Teaching Hospital (BSUTH). This result corroborates the report by Boudiemaa *et* *al*. (2019) which highlighted the presence of ESBL genotypes in such isolates. Similarly, it is consistent with the findings of Kanayama *et* *al*. (2015) who reported the prevalence of *Proteus mirabilis* strains producing ESBL in Japan in the year 2009-2010.

**CONCLUSION**

The findings of this research underscore the critical role of *Proteus* *species* in postpartum infections, emphasizing the need for targeted surveillance and intervention strategies. The findings provide valuable insights into the distribution and characteristics of *Proteus* *species* implicated in postpartum infections. By analyzing the prevalence rates, significant variations were observed between the zones and facilities, which may be attributed to differences in healthcare practices, hygiene standards, or demographic factors. High prevalent rate recorded in Benue State indicate that the infectious pose a significant risk of morbidity to women in the state. Postpartum women are specifically vulnerable to infection and all health care personnel caring for these women must be informed of the particular risk factors, presentations, and treatment options adopted in order to avoid hospitalization and complications that will arise from the infections. All postpartum infections, if not properly treated can lead to sepsis, bacteremia, shock, and death.

 ( Alkema *et* *al*., 2017; and Aworinde *et* *al*., 2016).

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