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Concomitance of Hematological and Urinary Parameters with Human Immunodeficiency Virus (HIV) among Pregnant Women in Ikere-Ekiti, Ekiti State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors CAO and FTA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author FTA managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

The hematological and urinary parameters can serve as indicators of susceptibilities of pregnant women to infectious diseases. Early detection of such fatal infections like Human Immunodeficiency Virus (HIV) can go a long way in mitigating perinatal mortality. This study evaluates the frequency of occurrence of HIV in pregnant women with a set of hematological and urinary parameters. Four hundred (400) pregnant women in Ikere-Ekiti in Ekiti-state, stratified in age groups were recruited in the study. Blood and urine samples were examined for blood group, packed cell volume (PCV), HIV status and some urine parameters. In the results, the age range (25-29) had the highest number (144) among the pregnant women while age range ≥35 had the least. Women in blood group O had the highest number (54%), this is followed by group B (21.5%) and group A while group AB (4.5%) had the least. The prevalence of HIV among the different blood groups (A, B, AB and O) was respectively 0.5%, 1.5%, 2.0% and 0.3%, the overall prevalence of

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HIV was 17(4.3%) and the highest occurred in the age group ≥35. Women of rhesus positive had the highest prevalence of HIV (4.0%). The 3.0% of 49% who were anemic had HIV infection. The incidence of positivity to some urine parameters among the pregnant women who were positive to HIV were glucose (0.3%), protein (0.5%), ketone and nitrite 0%. From these results, there might be a relationship between some hematological and urinary parameters with HIV status among the pregnant women, further studies will involve carrying out metabolomics study to ascertain the real relationship.

Keywords: Hematological parameters; human immunodeficiency virus; pregnant women; urinary parameters.

1. INTRODUCTION

Pregnancy is a state in which an embryo implants unto maternal uterus and subsequently develops into a foetus [1]. It is one of the physiological conditions capable of causing remarkable and dramatic changes in hematological and urinary parameters of the mothers. In normal pregnancy the hematological and urinary indices of an individual to a large extent reflect their general health [2]. During pregnancy, great changes occur in the physiology, hematological and urinary parameters of the mothers. The measure of these changes is considered to have relationship with some infections, including HIV, which is the most dreaded [3]. The assessment of the changes is done through a series of tests measuring different variables. The hematological parameters include Packed Cell Volume (PCV) level to determine whether a person is anemic or not. Anemia in pregnancy is defined as hemoglobin (HB) concentration of less than 11 g/dL. It makes the pregnant woman more vulnerable to the risk of maternal and perinatal mortality [4].

The urinary parameters provide important information about diseases or conditions that could potentially affect the mother or growing babies. These parameters include urine nitrite, protein, glucose and ketone contents. Abnormal urinalysis result may point to a disease or illness such as urinary tract infection (UTI). UTI is one of the most common bacterial infections and a cause of morbidity and hospitalization in HIV positive individuals [5]. The presence of nitrites in urine during pregnancy most commonly means there is bacterial infection in the urinary tract (UTI). Some disease causing bacteria like the lactose-positive enterobactericeae, *Staphylococcus*, *Proteus*, *Salmonella* and *Pseudomonas* are able to reduce nitrate in urine to nitrite. A positive test for nitrite indicates bacteriuria in the urinary tract [6].

The presence of protein in urine is a sign of kidney disease or renal damage. Under this condition, the ability of the kidney to filter protein during the process of urine formation is impaired. This situation leads to proteinuria, which is indicated by a high level of protein in urine [7]. Also the presence of glucose in the urine may be an indication of diabetic condition. Hence, the glucose test is used to monitor the condition of persons with diabetes. When the blood glucose level above 160 mg/dL is detected in a urine sample, it indicates high risk of diabetic condition that may lead to fatal complications.

The presence of ketone in the urine portends poor condition of health, which is akin to diabetes. Ketones are compounds resulting from the breakdown of fatty acids in the body. They are produced in excess as a result of carbohydrate metabolism disorders, especially in type 1 diabetes mellitus [8]. In diabetic condition, excess ketoacids in the blood may cause life-threatening acidosis and coma. The presence of these ketoacids and their salts in the urine causes condition known as ketonuria [9]. According to Chris [10], excess ketones in pregnant women's urine may affect developing brain cells and lead to babies with a lower IQ and future learning disabilities.

Infections with human immunodeficiency virus (HIV) during pregnancy can affect the wellbeing of the mothers, the pregnancy outcome and the child. It can also have some particular serious health consequences for both mothers and the infants [11]. HIV infection has become the most common complication of pregnancy in some developing countries especially in Nigeria, with an estimated one and a half million HIV-positive number of women becoming pregnant each year [12]. The normal human gestation period lasts for about 280 days (40 weeks) and has a large impact on the well-being of a woman. During this period, the foetus is vulnerable to the change in the mother's internal and external physiological

status [13]. Both mother and the foetus are a major consideration in the management of pregnancy, and HIV is a ravaging scourge among pregnant women. It is therefore necessary to assess the hematological and urinary parameters, as it relates to HIV prevalence among pregnant women in Ikere-Ekiti in Ekiti State.

2. MATERIALS AND METHODS

2.1 Study Area and Population

This study was carried out among 400 pregnant women of different ages in Ikere local Government of Ekiti State. The study area, Ikere–Ekiti, Ekiti State Nigeria is situated between latitudes 7° 15°- 8.10°N and longitude 4° 45°E. Ekiti- state is bounded by Osun, Ondo, Kwara and Kogi State.

2.2 Retroviral Screening (RVS)

The patient's thumb was swabbed with methylated spirit and pricked with a sterile lancet. Thirty 30 µl of blood was collected with sterile serological pipette. A new sterile Stat packwas detached and the sample was dropped into the sample port. Three (3) drops of Stat pack chase buffer solution was added to the sample for quick and easy flow into the test window (T) and control window (C). A distinct red line appearing only in the control window indicates a negative result while two distinct red lines appearing at both control (C) and test (T) windows indicate a positive result.

2.3 Packed Cell Volume (PCV)

Blood samples were collected from the patient thumbs into separate heparinized capillary tubes, the second edge of the capillary tubes were sealed by using plasticin and spun at 11000 rpm for 10 minutes in a Micro-Haematocrit Centrifuge. The result was read using Micro Haematocrit Reader.

$$\mathrm{PCV} = \frac{\text{Height of packed cell}}{\text{Height of whole blood volume (litre)}}$$

2.4 Blood Group Determination

Blood samples were collected from the thumb by means of micro pipette, the micro pipette was used to place a drop of blood on the tile in three (3) spots and a drop of anti-serum was added to each of the drop of blood accordingly. A stirrer was used to mix it thoroughly after which it was rocked for two (2) minutes; it was then observed for the presence of agglutination.

2.5 Urinalysis

Fresh morning urine samples were collected in sterile universal bottles; the reagent strip was dipped into the sample till the demarcation line was reached for three seconds. The strip was removed and immediately compared with the colour chart on the kit.

2.6 Statistical Analysis

Data obtained from this study were analyzed by descriptive statistical methods.

3. RESULTS AND DISCUSSION

A total number of 400 pregnant women were recruited in this study; they were placed in ranges in accordance with their ages. The age ranges were 15-19 (17), 20-24 (77), 25-29 (144), 30-34 (101) and ≥35 (61) (Table 1). The age range (25-29) had the highest number (144) among the pregnant women while age range ≥35 had the least. This is so because women younger than 30 years have about a 20 percent chance of getting pregnant naturally each month [14]. At age 30 years, fertility starts to decline and by age 40 the chance of pregnancy is about five percent each month. This decline becomes more rapid once as a woman reaches the mid-30s. By *age* 45 years, fertility has declined so much that getting *pregnant* naturally is unlikely for most women.

Table 1. Study population of 400 pregnant women stratified by age in Ikere-Ekiti

Age (years)	Total	Percentage (%)
15-19	17	(4.3)
20-24	77	(19.3)
25-29	144	(36.0)
30-34	101	(25.3)
≥35	61	(15.3)

Fig. 1 shows the prevalence of HIV infection among the pregnant women, the overall prevalence of HIV was 17(4.3%) and the highest prevalence occurred in the age group (≥35) which was 6(1.5%). Older women were at higher risk of HIV infection; this implies that the risk of infection with HIV among the pregnant women increased with age. Therefore, *HIV* infection is associated with *age*. The odds of being infected

with HIV increased with age, women aged 25 years and above are at least two times more at risk of being infected with HIV compared with those that are younger. This result is in line with Anoubissi, et al. [3] who revealed that the reason for the high prevalence of HIV among the older women may be due to increased gravidity, that is, more exposure to unprotected sex, hence higher risk of being infected with the HIV virus.

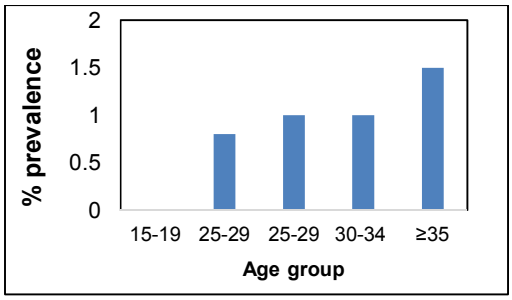

Fig. 1. Prevalence of HIV infection stratified by age among the pregnant women

The Blood group values among the pregnant women is shown in Fig. 2, women in blood group O had the highest number (54%), this is followed by group B (21.5%) while group AB (4.5%) had the least. A woman's blood group could influence her chances of getting pregnant as result; pregnant women with blood group O may have high quality eggs and conceptive abilities. This result contradicts the earlier findings of Jane Kirby Press Association [15], who discovered that women with blood type O struggled to conceive due to poorer eggs quality and lower eggs count.

Table 2. The relationship between rhesus factor and HIV prevalence among the pregnant women

Rhesus factor	Total %	HIV +
Positive	384 (96.0)	16 (4.0)
Negative (-)	16 (4.0)	1 (0.3)
Total	400 (100)	17 (4.3)

The highest prevalence of HIV occurred in rhesus positive with a prevalent value of 16(4.0%) (Table 2). This implies that pregnant women with rhesus positive were more susceptible to HIV infection; scientific evidence showed that the level of natural antibodies resistant to viral antigens depends on the individual blood group and Rhesus factor, this is attributed to the main cause for natural resistance towards the infection [16]. This result corroborates the earlier findings of Abdulazeez, et al. [17] who revealed that blood group AB and rhesus positive individuals were more susceptible to HIV infections.

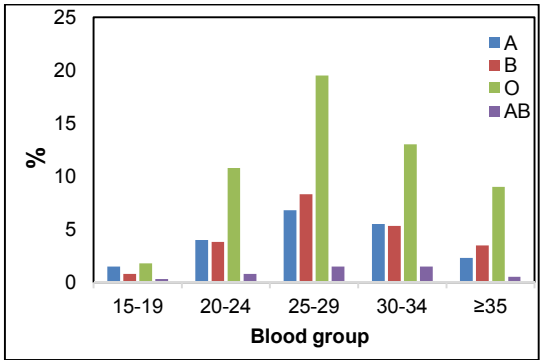

Fig. 2. Blood group values stratified by age among the pregnant women

The prevalence of HIV among the different blood groups (A, B, AB and O) were respectively 0.5%, 1.5%, 2.0% and 0.3% (Fig. 3). Pregnant women with blood group O were less susceptible to HIV infection while blood group AB had the greatest risk of HIV infection in this study. It is generally believed that blood group O are less susceptible to infections than people in any other blood groups which could be as a result of higher rates of inflammation of these blood types. Blood groups can play a direct role in infection by serving as receptors and co-receptors for microorganisms, parasites, viruses, bacteria and toxins [18]. This result is in line with Glenn [19] who found out that people with blood group B and AB are at the greatest risk of infections.

Table 3 shows the relationship between HIV and PCV level among the pregnant women, 196(49%) of the 400 pregnant women had low PCV level (anemic), 175(44.5%) had normal PCV level while 26(6.5%) were polycythaemic. Anemia is a decrease in the total amount of red blood cells in the body, the anemic condition of these pregnant women may be due to iron deficiency or folic acid deficiency. Anemia in pregnancy can lead to premature birth, low birth weight and placental abruption. Pregnant women who were anemic had the highest prevalence of HIV infection 12(3.0%) while those with polycythaemia had the least 1 (0.3%). This implies that anemia may be a complication of infection with the human immunodeficiency virus (HIV) because there is a decrease in the blood PCV levels during HIV infection, the low level of PCV may be due to autoimmune destruction of

red blood cells. There is a relationship between PCV and HIV, HIV infection may lead to anemia in many cases, it may be due to changes in cytokine production with subsequent effect on haematopoiesis or erythropoiesis concentration. This result is in line with Obinkorang and Yeboah [20] who observed low level of PCV during infections.

Table 3. The relationship between HIV and PCV level of the pregnant women

PCV level	Number (%)	HIV + (%)
Normal	178 (44.5)	4 (1.0)
Anaemic	196 (49.0)	12 (3.0)
Polycythaemia	26 (6.5)	1 (0.3)

The prevalence of HIV with some urinary parameters are shown in Fig. 4 and Table 4, pregnant women with acidic pH level has the highest prevalence of 50.2% while 10% had basic pH level, low urine pH implies a urine sample that is acidic while high urine pH implies a urine sample that is basic. High and low pH levels can indicate problems with a person's kidneys; such environment could help kidney stones to develop. Of the 14(3.5%) pregnant women tested positive for glucose, 0.3% was HIV positive, the presence of glucose in urine samples implies too much level of sugar in the blood which can subsequently lead to diabetes. According to Shomon [21], diabetes in pregnancy can have serious repercussions for both mothers and neonates, one of such repercussions is stillbirth. 85(21 3%) of the pregnant women were positive to protein, out of which 2 (0.5%) showed positivity to HIV infection. When protein is present in urine, it means the kidney when filtering the blood or waste allowed protein to slip through. In people with HIV, protein in the urine may be due to HIV itself or as a result of other common diseases including hypertension and diabetes. This result is in agreement with Michael [22] who observed that HIV positive individuals have a significantly higher risk of having small quantities of protein in their urine.

11(2.8%) and 8 (2%) of the pregnant women were tested positive to ketone and nitrite respectively, but there was no positivity to HIV infection in women tested positive to these urinary parameters. The presence of nitrites in urine is an indicator of bacterial infection in the urinary tract. Ketones are produced in excess in disorders of carbohydrate metabolism, especially Type 1 diabetes mellitus, these ketoacids and their salts spill into the urine, causing ketonuria. This result is in agreement with Helen, et al. [9] who found out that 22% of women have urinary ketones at either 16 or 28 weeks' gestation.

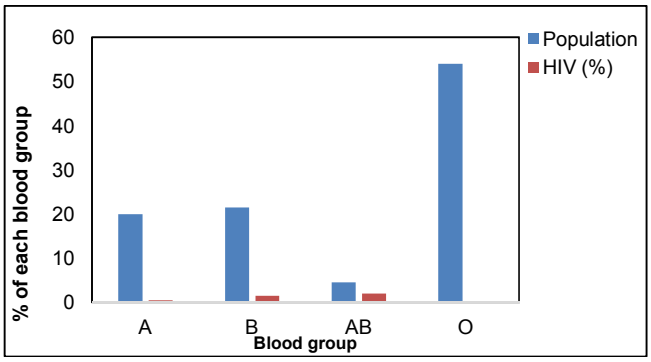

Fig. 3. Prevalence of HIV among the different blood groups

Table 4. Prevalence of HIV infection and some urinary parameters

Urinary parameters		Total	(%)	HIV +	(%)
Glucose	+	14.0	3.5	1.0	0.3
	-	386.0	96.5	16.0	4.0
Protein	+	85.0	21.3	2.0	0.5
	-	315.0	78.8	15.0	3.8
Ketone	+	11.0	2.8	0.0	0.0
	-	389.0	97.3	17.0	4.3
Nitrite	+	8.0	2.0	0.0	0.0
	-	392.0	98.0	17.0	4.3

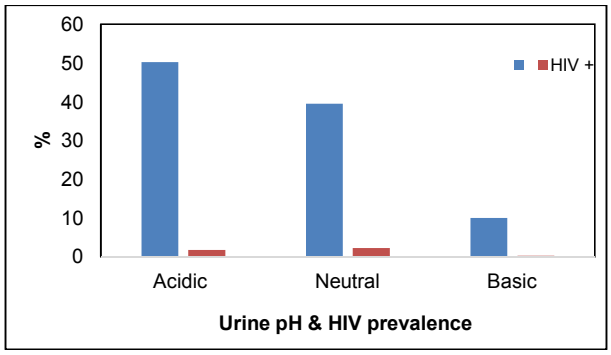

Fig. 4. Relationship between urine PH level and HIV prevalence

4. CONCLUSION

One of the hematological parameters (PCV) showed that 196(49%) of the 400 pregnant women were anemic; also, the anemic pregnant women had the highest prevalence of HIV infection. Anemia may be a complication of infection with the human immunodeficiency virus (HIV). Hence, there might be a relationship between some hematological and urinary parameters with HIV status among the pregnant women, further studies will involve carrying out metabolomics study to ascertain the real relationship.

Urinary parameters such as glucose, protein, ketone and nitrites were detected in the urine samples of the pregnant women; there was also the positivity of human immunodeficiency virus (HIV) among the pregnant women who had abnormal urinalysis result. This implies that some of the pregnant women are prone to urinary tract infections and kidney disease or damage.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical approval of the study was obtained from the chief medical director (CMD) of Ekiti- State Primary Health Care Development Agency, Ikere–Ekiti, Ekiti State, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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