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# CORRELATION ANALYSIS OF NORMAL AND JAUNDICE-RELATED BIRTHS: A COMPARATIVE STUDY IN GENERAL HOSPITAL AGBOR (SEMI-URBAN) AND FEDERAL MEDICAL CENTER ASABA (URBAN), 2013-2022

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## ABSTRACT

This paper investigates the correlation between normal births and jaundice-related births at General Hospital Agbor and Federal Medical Center Asaba for the years 2013-2022. Utilizing Pearson correlation analysis, the research aimed to assess the relationship between these variables in semi-urban and urban healthcare settings. Results indicate a moderate to weak positive correlation, with numerical values revealing a Pearson correlation coefficient of 0.5234 for General Hospital Agbor and 0.3086 for Federal Medical Center Asaba. Beyond establishing the strength of this correlation, the paper unveils practical implications. A moderate positive relationship is observed in the semi-urban location, suggesting that as the number of normal births increases, jaundice-related births may also rise moderately. Conversely, the urban location displays a weak positive relationship, implying a milder association between normal and jaundice-related births. These findings highlight the nuanced nature of the correlation in different healthcare contexts. Practically, this research contributes valuable insights for healthcare practitioners, policymakers, and researchers. Understanding the varying degrees of correlation informs targeted interventions and resource allocation. For instance, in semi-urban areas, emphasis on early detection and management of jaundice-related cases may be crucial. Meanwhile, in urban settings, the weaker correlation signals the need for a comprehensive approach, possibly focusing on factors beyond birthing patterns. In conclusion, this paper not only quantifies the correlation between normal and jaundice-related births but also underscores its practical significance in diverse healthcare landscapes. The numerical values substantiate the identified relationships, offering a quantitative basis for decision-making and intervention strategies.

**Keywords: Normal births, Jaundice, Pearson correlation Coefficient, Healthcare settings, Neonatal health.**

## INTRODUCTION

The discourse on neonatal jaundice, or hyperbilirubinemia, unveils a nuanced perspective on a condition characterized by the yellowing of a newborn's skin and eyes. A notable statistic asserts that approximately 60-80% of term or late-term healthy infants encounter some degree of hyperbilirubinemia (Asefa *et al.,* 2020). This phenomenon stems from the accumulation of bilirubin, a yellow pigment resulting from the breakdown of red blood cells. Though often transient in newborns, jaundice can occasionally signal underlying health issues demanding medical attention. Jaundice, is defined as the deposition of bilirubin, and which often manifests as a yellowing of the skin, mucous membranes, and sclera (Roche & Kobos, 2004). According to Bhutani and Johnson (2003) ″Kernicterus, a preventable injury to the brain from severe neonatal jaundice, has re-emerged in the United States as a public and societal health concern. Kernicterus, in its usually recognized form, causes devastating disabilities, including athetoid cerebral palsy and speech and hearing impairment. The re-emergence of

kernicterus in the United States is the result of interacting phenomena including (a) Early hospital discharge (before extent of jaundice is known and signs of impending brain damage have appeared); (b) Lack of adequate concern for the risks of severe jaundice in healthy term and near newborns; (c) An increase in breast feeding; (d) Medical care cost constraints; (e) Paucity of educational materials to enable parents to participate in safeguarding their newborns; and (f) Limitations within in healthcare facilities to monitor the outpatient progression of jaundice. A multidisciplinary approach that encompasses both healthcare and societal needs should be evaluated at a national level for practical and easy to implement strategies"

Delving into the intricacies of bilirubin synthesis, it is revealed as an endogenously synthesized pigment with potential toxicity, particularly in neonates (Tiribelli *et al.*,.2023). The origin of bilirubin lies in the catabolism of the heme group, primarily derived from the destruction of red blood cells in the liver, spleen, and bone marrow. Neonates exhibit a significantly higher production of bilirubin compared to adults (Ullah *et al.,* 2016; Huang *et al.,* 2004), with subsequent transport to the liver for conjugation, a crucial step for water solubility and elimination (Kamisako *et al.,* 2023).

Jaundice, essentially an elevation in bilirubin levels, encompasses various forms, including pre-hepatic, hepatic, and post-hepatic jaundice. The causes, both acquired and congenital, unveil a spectrum of manifestations ranging from gastrointestinal issues to potentially fatal outcomes such as psychosis or coma. Diagnosis relies on bilirubin levels, ultrasonography, and other radiological techniques, leading to a tailored management approach.

Highlighting the vulnerability of certain infants, especially premature ones or those with incompatible blood types, underscores the risk factors associated with neonatal jaundice. The American Academy of Pediatrics (AAP) advocates for early examination, emphasizing the importance of timely intervention. Complications, including deafness and cerebral palsy, underscore the gravity of high bilirubin levels, prompting a careful evaluation of potential long-term effects.

The narrative concludes by shedding light on the initial sign of jaundice—yellowing of the skin and eyes—manifesting within days after birth. Timely recognition, based on palpable skin changes, forms a crucial diagnostic cue. While acknowledging the existing knowledge base, a call to augment the discourse with recent studies, emerging trends, or novel insights invites a dynamic exploration of neonatal jaundice beyond the established conventions.

The existing literature provides valuable insights into the various factors influencing neonatal jaundice, including genetic predispositions, blood group incompatibility, and environmental conditions. Apanapudor and Okwonu (2019) opined that small engine boats exposes passenges to various health concerns such as hearing deficiency due to open engine sound, to tide or wave imbalancecausing waist dislocation, miscarriage, skin disorder e.t.c., Additionally, COVID-19 and its attendant environmental impact affected the health sectorhugely, thus generated many ugly situations, Okwonu,*et al.*,(2020). However, a critical examination of the literature reveals a gap in understanding the specific correlation between normal births and the occurrence of jaundice-related cases, especially concerning the impact of geographical locations.

A study by Kaplan, *et al.,* (2022), Apanapudor, *et al.,* (2023a) focuses on the genetic factors associated with neonatal jaundice. It examines the correlation between specific genetic variations and the likelihood of developing jaundice in newborns. The findings highlight the importance of genetic testing in identifying infants at higher risk for jaundice-related complications. Olusanya, *et al.,* (2022) investigated the risk factors associated with severe neonatal hyperbilirubinemia in low and middle-income countries. They identify correlations between factors such as prematurity, exclusive breastfeeding, and maternal age with the incidence of severe jaundice in newborns. Engle *et al.,* (2022), Okwonu, *et al.,* (2021), Okwonu, *et al.,*(2023) examine the correlation between a predischarge assessment and management

program and the incidence of hyperbilirubinemia and breastfeeding difficulties in newborns. According to Porter and Dennis (2002), "hyperbilirubinemia is one of the most common problems encountered in term newborn. More recent recommendations support the use of less intensive therapy in healthy term newborns with jaundice. Phototherapy should be instituted when the total serum bilirubin level is at or above 15 mg per dL (257 micromol per L) in infants 25 to 48 hours old, 18 mg per dL (308 micromol per L) in infants 49 to 72 hours old, and 20 mg per dL (342 micromol per L) in infants older than 72 hours. Few term newborns with hyperbilirubinemia have serious underlying pathology". Blanckaert, *et al.,* (2022) outlined four procedures for the synthesis, separation and determination of structure of the bilirubin-IX isomers.

Jaundice is considered pathologic if it presents within the first 24 hours after birth, the total serum bilirubin level rises by more than 5 mg per dL (86 micromol per L) per day or is higher than 17 mg per dL (290 micromol per L), or an infant has signs and symptoms suggestive of serious illness.The findings suggest that comprehensive assessment and management strategies before discharge can help reduce the occurrence of jaundice-related complications. Gomez, *et al.,* (2007), Aderibigbe and Apanapudor(2014 a & b) Tsetimi, *et al.,*(2021) looked at Neonatal jaundice as an ailment treated daily at all hospitals. Neonatal jaundice is represented by means of an influence diagram, including admission and treatment decisions. The corresponding uncertainty model is built with the aid of both historical data and subjective judgments. Parents and doctors were interviewed to elicit a multi-attribute utility function. The decision analysis cycle is completed with sensitivity analyses, Olaosebikan, *et al.,* (2015),Okwonu, *et al.,*(2021). The construction and use of this decision support system for jaundice management have induced a profound change in daily medical practice, avoiding aggressive treatments—there have been no exchange transfusions in the past 3 years—and reducing the lengths of stay at the hospital, Apanapudor, *et al.,*(2023c). More information is now taken into account to decide on treatments. Moreover, in the cotext of geographical locations, a comprehensive examination of the literature yields limited insights into how the location itself may act as a risk factor for neonatal jaundice, Apanapudor (2013), Okposo, *et al.,* (2023). Understanding whether semi-urban or urban environments contribute differently to the prevalence of jaundice-related cases is crucial for effective healthcare planning and intervention strategies. Blanckaert, *et al.,* (2022) outlined four procedures for the synthesis, separation and determination of structure of the bilirubin-IX isomers.

From the above reviews, this paper investigates whether there are perfect, strong, moderate and weak correlation values between normal and jaundice-related births in two distinct locations, General Hospital Agbor and Federal Medical Center Asaba. By doing so, this research aims to contribute not only to the understanding of neonatal jaundice but also to shed light on the potential role of the location as a risk factor, an aspect insufficiently addressed in the current literature. This study applies the Pearson correlation coefficient to investigate the degree of association between normal and jaundice-related births in two healthcare facilities in Agbor and Asaba, Delta State Nigeria. Okwonu, *et al.,* (2020), Izevbizua and Apanapudor(2020), in this paper discussed plug in robust procedure to robustify the Pearson product moment correlation coefficient (PPMCC). The mean of PPMCC is highly susceptible to influential observations hence the PPMCC is not robust against data set that contains substantial amount of influential observations. This study focused on robust plug in techniques with high breakdown points. The performance of these techniques are compared using real and simulated data set. The comparative analysis indicates different degrees of robustness and breakdown based on the percentage of contamination and data modification, Apanapudor and Izevbizua(2018),Apanapudor(2010).

Persistent jaundice in the neonate is defined as jaundice that lasts longer than 14 to 21 days. It can occur in up to 15% of all newborns. The vast majority of these neonates have benign unconjugated

hyperbilirubinemia but one in 2500 live births has cholestatic liver disease, Gilmour (2004) Izevbizua and Apanapudor(2020). Briggs, *et al.,* (2023) discussed some measures of investigation and management of obstructive neonatal jaundice to complement Drummond, *et al.*, (2022) preventive techniques of severe neonatal jaundice.

Despite the existing knowledge on neonatal jaundice, there remains a need to explore the nuanced relationship between normal births and jaundice-related births in is to go beyond the established understanding and intricately examine the correlation between normal births and jaundice-related births at General Hospital Agbor (semi-urban) and Federal Medical Center Asaba (urban) from 2013 to 2022. According to OKposo, *et al.,* (2023), in their study of monkeypox transmission model, viewed migration as amajor health implication for countries that migrants have resettled in or visited. Thus,understanding whether semi-urban or urban environments contribute differently to the prevalenceof jaundice – related cases is crucial for effective healthcare planning and intervention strategies. By focusing on these specific locations, the research aims to uncover any unique patterns or factors influencing the occurrence of jaundice-related cases in these diverse healthcare environments.

The rest of this paper is organized as follows. The Pearson correlation coefficient is discussed in Section 2 followed by results and conclusion in Sections 3 and 4 respectively.

## METHODOLOGY

The study aims to assess whether the location is a significant risk factor for jaundice-related births by conducting a comparative analysis of the proportion of jaundice-related cases in semi-urban (General Hospital Agbor) and urban (Federal Medical Center Asaba) locations.

### Research Design

This study adopts a retrospective observational design to investigate the correlation between normal births and jaundice-related births in two distinct healthcare settings: General Hospital Agbor (semi-urban) and Federal Medical Center Asaba (urban). The retrospective approach allows for the analysis of historical data spanning the years 2013-2022.

### Pearson Correlation Coefficient

The primary statistical tool employed in this study is the Pearson correlation coefficient ($(r_{pcc})$, chosen for its suitability in assessing the strength and direction of a linear relationship between two continuous variables. The variables under investigation are the number of normal births (x) and the number of jaundice-related births (y). The Pearson correlation coefficient $(r_{pcc})$ is a measure of the strength and direction of the linear relationship between two continuous variables as shown in equation (1) Okwonu, *et al.,* (2022), (Okwonu, *et al.,* 2020), Mamadu and Apanapudor(2017)

$$r_{pcc} = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \quad (1)$$

It quantifies how well the data points of two variables fit a straight line. The value of $r_{pcc}$ ranges from -1 to 1, where -1 indicates a perfect negative linear relationship, 1 indicates a perfect positive linear relationship, and 0 indicates no linear relationship, Apanapudor,(2019) From (1), $n$ denotes the sample size, $x$ denotes the normal birth variable and $y$ denotes the jaundice variable respectively.

### Assumptions

The assumptions underlying the use of $r_{pcc}$ include linearity, independence of observations, normality of variables, and homoscedasticity. These assumptions are considered reasonable given the nature of the variables and the large sample size.

### Probability Test:

To establish the significance of the computed correlations, a two-tailed probability test (p-value) will be employed. The threshold for statistical significance will be set at 0.05. This test will provide insights into whether the

observed correlations are statistically different from zero.

**Computational Analysis**

Statistical software, specifically Microsoft Excel, Apanapudor, *et al.*, (2020), Okwonu and Apanapudor (2019) was utilized for the computational analysis. This choice of software allows for not only the calculation of the Pearson correlation coefficient $r_{pcc}$ but also the automatic derivation of p-values, providing a more comprehensive assessment of the statistical significance of the correlations

**RESULTS**

Ten years of normal births and jaundice-related births were obtained from two government-owned healthcare facilities in Delta State Nigeria with the approval of the Hospital Management Board. Table 1 consists of birth records from the general hospital Agbor between 2013-2022. The General Hospital Agbor's birth data is classified as a semi-urban location while Federal Medical Center (FMC) Asaba is classified as Urban birth data.

Table 1: *Birth records at General Hospital Agbor (Semi Urban)*

| Year | Normal birth ($x$) | Jaundice-related birth ($y$) |
|---|---|---|
| 2013 | 1367 | 3 |
| 2014 | 1284 | 2 |
| 2015 | 1292 | 3 |
| 2016 | 1521 | 4 |
| 2017 | 1363 | 2 |
| 2018 | 1089 | 2 |
| 2019 | 1291 | 5 |
| 2020 | 1498 | 3 |
| 2021 | 1738 | 4 |
| 2022 | 1721 | 4 |

Table 2: *Pearson Correlation computation*

| Normal birth ($x$) | Jaundice-related birth ($y$) | $xy$ | $x^2$ | $y^2$ |
|---|---|---|---|---|
| 1367 | 3 | 4101 | 1868689 | 9 |
| 1284 | 2 | 2568 | 1648656 | 4 |
| 1292 | 3 | 3876 | 1669264 | 9 |
| 1521 | 4 | 6084 | 2313441 | 16 |
| 1363 | 2 | 2726 | 1857769 | 4 |
| 1089 | 2 | 2178 | 1185921 | 4 |
| 1291 | 5 | 6455 | 1666681 | 25 |
| 1498 | 3 | 4494 | 2244004 | 9 |
| 1738 | 4 | 6952 | 3020644 | 16 |
| 1721 | 4 | 6884 | 2961841 | 16 |
| $\sum x$ =14164 | $\sum y$ =32 | $\sum xy$ =46318 | $\sum x^2$ =20436910 | $\sum y^2$ =112 |

From equation (1), we obtained

$$r_{pcc} = \frac{10(46318)-(14164)(32)}{\sqrt{[10(20436910)-200618896][10(112)-1024]}} = 0.5234.$$

The result revealed that there is moderate relationship between normal and jaundice-related births for the period under review within the location of the healthcare facility.

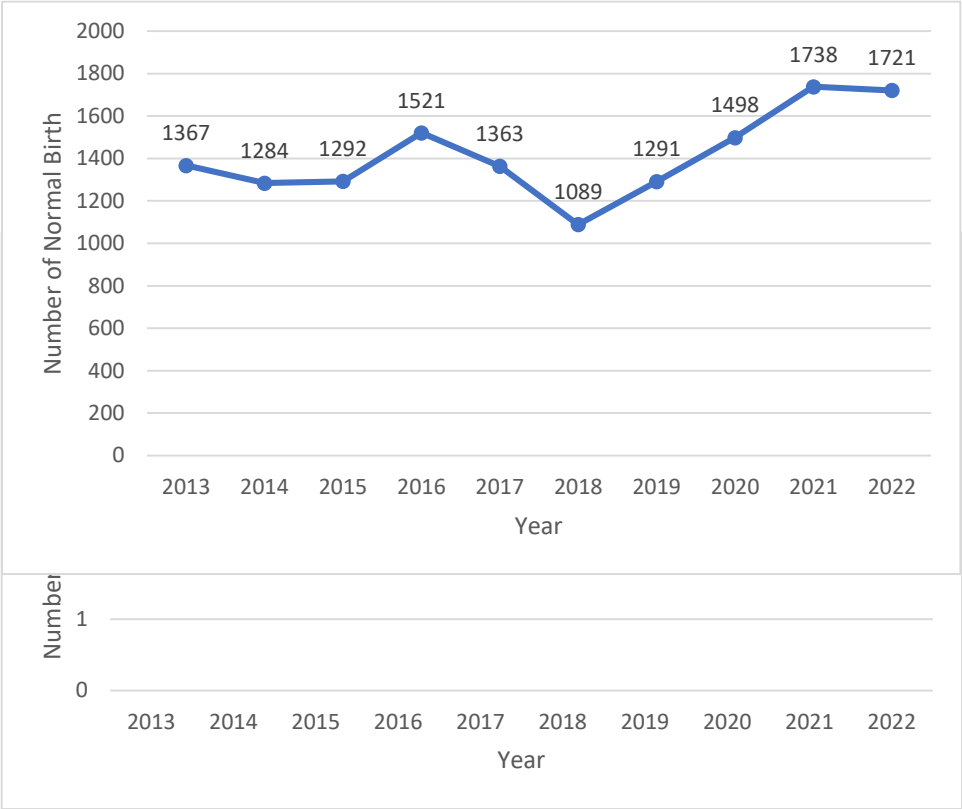


*Figure 1*. Number of Normal Birth and Jaundice-Related births at General Hospital Agbor (Semi Urban)

Table 3 :*Births record at Federal Medical Center (FMC) Asaba (Urban)*

| Year | Normal birth ($x$) | Jaundice-related birth ($y$) |
|---|---|---|
| 2013 | 1135 | 90 |
| 2014 | 858 | 57 |
| 2015 | 778 | 64 |
| 2016 | 742 | 57 |
| 2017 | 875 | 60 |
| 2018 | 729 | 64 |
| 2019 | 910 | 113 |
| 2020 | 684 | 92 |
| 2021 | 492 | 71 |
| 2022 | 661 | 70 |
| TOTAL | 7864 | 738 |

Table 4: *Pearson correlation computation for FMC Asaba (Urban)*

| Year | Normal birth ($x$) | Jaundice related birth ($y$) | $xy$ | $x^2$ | $y^2$ |
|---|---|---|---|---|---|
| 2013 | 1135 | 90 | 102150 | 1288225 | 8100 |
| 2022 | 858 | 57 | 48906 | 736164 | 3249 |
| 2023 | 778 | 64 | 49792 | 605284 | 4096 |
| 2023 | 742 | 57 | 42294 | 550564 | 3249 |
| 2023 | 875 | 60 | 52500 | 765625 | 3600 |
| 2018 | 729 | 64 | 46656 | 531441 | 4096 |
| 2019 | 910 | 113 | 102830 | 828100 | 12769 |
| 2020 | 684 | 92 | 62928 | 467856 | 8464 |
| 2021 | 492 | 71 | 34932 | 242064 | 5041 |
| 2022 | 661 | 70 | 46270 | 436921 | 4900 |
| | $\sum x$ =7864 | $\sum y$ =738 | $\sum xy$ =589258 | $\sum x^2$ =6452244 | $\sum y^2$ =57564 |

From equation (1), we obtained the following correlation value.

$$r_{pcc} = \frac{10(589258)-(7864)(738)}{\sqrt{[10(6452244)-61842496][10(57564)-544644}} = 0.3086.$$

The result demonstrated weak positive relationship between normal and jaundice-related births. This indicates that as normal birth increases, the jaundice related-births increase weakly.

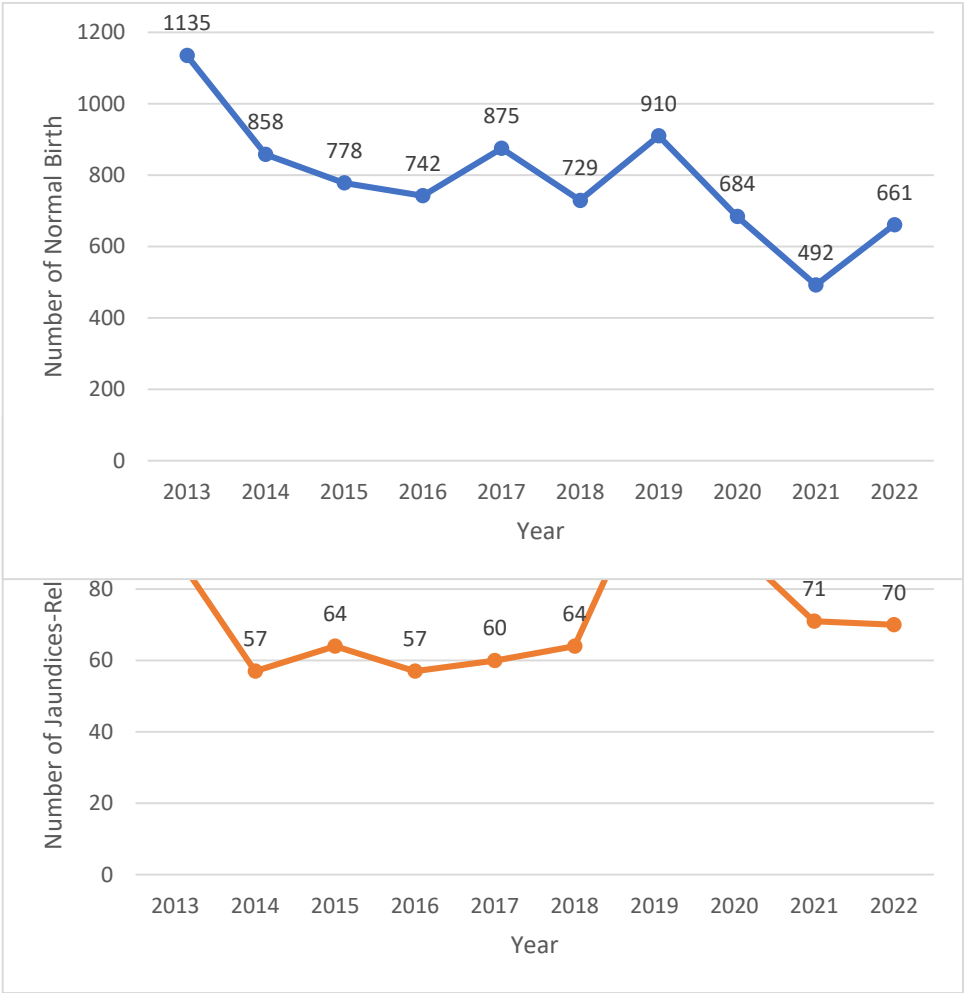

*Figure 2*. *Figure 1*. Number of Normal Birth and Jaundice-Related births at FMC Asaba (Urban)

**Computational Analysis**

The computational analysis using Microsoft Excel yielded the following results:
General Hospital Agbor (Semi-Urban):
$r_{pcc}$ = 0.5234, p<0.05
Federal Medical Center Asaba (Urban):
$r_{pcc}$ =0.3086, p<0.05
The computed p-values indicate that both correlations are statistically significant at the 0.05 level, providing evidence to reject the null hypothesis of no correlation. These results affirm the moderate positive relationship in General Hospital Agbor and the weak positive relationship in Federal Medical Center Asaba between normal and jaundice-related births.

The results obtained from the two locations indicate that there is a moderate to weak positive relationship between normal births and jaundice-related births. However, from Figure 1 we observed that jaundice-related cases are extremely small compared to Figure 2. Generally, different factors may play out in Figure 1 because the location semi urban while Figure 2 is Urban and state capital. It might also be possible that jaundice-related births are not reported after discharge from the hospital due to the increased use of traditional medicine to cure jaundice-related cases, cost implications, and long stays in hospital facilities. Therefore, Figure 2 may present more jaundice-related cases due to hospital admission than the data reported in Figure 1. In general, awareness may also be the reason for the weak positive relationship in the urban location than the semi-urban location in the study locations. We may infer also that educational exposure may be responsible for the urban location.

**CONCLUSION**

This study aimed to explore the correlation between normal births and jaundice-related births in two distinct healthcare settings, General Hospital Agbor and Federal Medical Center Asaba, over the period 2013-2022. The statistical analysis, conducted using Microsoft Excel, revealed moderate to weak positive correlations between normal and jaundice-related births in the respective locations. The computed p-values, <0.05, indicate the statistical significance of these correlations. This implies that the observed relationships are unlikely to have occurred by chance. However, it is crucial to interpret these findings within the context of the magnitudes of the correlations (0.5234 in General Hospital Agbor and 0.3086 in Federal Medical Center Asaba). This study investigated the comparative strength based on Pearson correlation coefficients using normal and jaundice-related birth data in semi-urban and urban locations in Delta State, Nigeria. The outcome demonstrated that there is moderate to weak positive correlation value for normal and jaundice related births in the two locations. Therefore, this study concludes that there is moderate positive relationship between normal birth and jaundice-related birth in a semi urban location and weak positive relationship between normal and jaundice related births in an urban location.

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