

Characteristics of Congenital Syphilis at the Neonatal Center of Excellence Unit, University Teaching Hospital -Children's Division, Lusaka, Zambia-Retrospective Pilot Study.

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ABSTRACT

Background

The global incidence of congenital syphilis is increasing, particularly in developing countries, resulting in significant fetal and neonatal morbidity and mortality. Understanding the determinants contributing to this rise is essential for formulating effective preventive interventions.

Subject and methods

This pilot study examines retrospective cross-sectional data from a 12-month period, sourced from the ward register at the Neonatal Centre of Excellence, University Teaching Hospital–Children's Division in Lusaka, Zambia. The prevalence and characteristics of congenital syphilis in 758 hospitalized neonates were studied using percentages, Chi-square tests, and binary logistic regression models. The findings were presented as p-values, odds ratios, and 95% confidence intervals.

Results

The prevalence of congenital syphilis was 6% (45 out of 753). In descending order of strength of association, the RPR positive neonates were more likely ($p < 0.05$) to have Fathers who were HIV positive (Chi= 22.871, OR 3.0 [1.12, 7.90]); delivered outside health facilities (Chi =7.885, OR 2.4 [95% CI 0.89, 6.50]); Mothers who were HIV positive (Chi=5.098, OR 1.8 [0.38, 8.59]); present with hypoxia (Chi=4.895, OR 2.5 [95%CI 1.08, 5.55]); delayed first breastfeed (Chi=4.892, OR 2.2 [1.08, 4.39]) and present later at an average chronological age of 20.4days (sd 8.89) compared to their non-Syphilis infected counterparts.

Conclusion

The prevalence of neonatal congenital syphilis remains notably elevated. To mitigate fetal and neonatal morbidity and mortality associated with congenital syphilis, healthcare institutions ought to formulate and advocate for antenatal care initiatives that encompass the involvement of fathers alongside their pregnant partners, in addition to implementing dual rapid diagnostic assessments for both HIV and syphilis. Neonates

who present late, particularly those with a concerning medical history, signs of hypoxia, and an initial breastfeeding delay, should be managed with a heightened level of clinical suspicion and without delay.

Keywords: Neonatal Congenital Syphilis, HIV, Paternal participation.

BACKGROUND

The global estimated prevalence of congenital syphilis among newborns was 0.52% (2022), with significant variations across different countries. The World Health Organization has estimated that 62% of the global burden of congenital syphilis is concentrated in the African region, where the coverage of syphilis screening during pregnancy is the lowest at 47% (as of 2016)¹.

Despite the ambitious target established by the World Health Organization (WHO) in 2007, which aimed for a reduction to fewer than 50 cases per 100,000 live births, the global prevalence of Congenital Syphilis has escalated over the past decade, reflecting an approximate increase of 60% from 1990 to 2020, particularly in low- and middle-income nations. The incidence of Syphilis disproportionately affects populations with limited access to healthcare services, resulting in significant disparities that are influenced by geographic location, race, and ethnicity^{2,3}. Recent epidemiological data indicate an incidence rate of 473 occurrences per 100,000 live births, culminating in an aggregate figure of 661,000 instances of congenital syphilis^{4,5}.

To reduce congenital syphilis to 50/100,000 live births, the World Health Organization (2007) mandates countries to ensure 95% of pregnant women receive antenatal care, preferably before 20 weeks, that 95% of those attending antenatal care get screened and tested for syphilis, and that 95% of pregnant women diagnosed with syphilis receive Benzathine Penicillin treatment. Without treatment, 50–90% of pregnant women with syphilis will pass the infection to their fetus, leading to negative pregnancy or birth results like stillbirths, premature or low birthweight births, early neonatal fatalities, and congenital infections^{4,5,6}.

Congenital syphilis is challenging to diagnose and frequently missed because it is asymptomatic in 60% - 90% of neonates at birth. If the exposed newborn is not treated, symptoms usually appear within weeks or months.^{7,8,9} In a South African (2023) study of children under the age of two, Kufa et al. found 1739 clinical alerts (198/100,000 live births) compared to 5160 laboratory alerts for congenital syphilis. Similarly, although clinical cases increased, laboratory diagnoses were stated to have decreased by 30% over the research period in South Africa¹⁰. This emphasizes the unreliability of clinical diagnosis, which is most likely because many individuals are asymptomatic, as well as the varied ways in which syphilis presents.

Confirmatory laboratory techniques utilized for the diagnosis of syphilis encompass darkfield microscopy, immunofluorescent antibody testing, immunohistochemical staining, silver staining, and nucleic acid amplification assays that directly identify *Treponema pallidum*. These methodologies are characterized by high costs and are predominantly inaccessible in resource-constrained environments. Consequently, serological testing serves as the foundational diagnostic approach in developing nations⁹.

Serological assessments for syphilis encompass both treponemal and non-treponemal methodologies. Treponemal assays identify antibodies that are directed against antigens associated with *T. pallidum*, whereas non-treponemal methodologies detect antibodies targeting biomarkers such as cardiolipin and lecithin, which are released in the context of host cellular damage. Among the treponemal tests are the *T. pallidum* hemagglutination assay (TPHA), *T. pallidum* particle agglutination (TPPA), fluorescent treponemal antibody absorption test (FTA-ABS), *T. pallidum* enzyme immunoassay (TP-EIA), and *T. pallidum* chemiluminescence assay (TP-CIA). It is noteworthy that these tests persistently yield positive results post-treatment in approximately 75-85% of affected individuals.⁹

Non-treponemal tests include the Venereal Disease Research Laboratory (VDRL) and Rapid Plasma Reagin (RPR) tests. These evaluations are employed to track disease progression and treatment response. A sufficient treatment response leads to a fourfold reduction in RPR titer or non-reactive status within a year. At times, these tests can stay reactive with low titers ("serofast") for several years. Seropositive pregnant women are deemed infected unless they can provide proof of sufficient treatment showing an appropriate serologic

response and stable low RPR titers ($RPR < 1:4$). Elevated or consistently high antibody levels could suggest reinfection. Non-treponemal tests are complicated by elevated false positive rates, particularly when connective tissue disorders, advanced age, lymphoma, and infections like Epstein–Barr virus, hepatitis, HIV, tuberculosis, malaria, and measles are present.⁹

Despite the existence of national policies that advocate for extensive antenatal services, which include implementation of antenatal testing, immediate on-site treatment, syphilis screening remains inconsistent across numerous countries^{6,9}. This inconsistency can primarily be attributed to financial constraints. Consequently, this study aims to assess the current prevalence of neonatal congenital syphilis and identify significant associated clinical and demographic characteristics that will assist in the prompt diagnosis and treatment of this condition.

MATERIALS AND METHODS

Study Design: This pilot study utilizes retrospective cross-sectional data from the Neonatal Centre of Excellence unit at the University Teaching Hospitals-Children Division in Lusaka, Zambia. A total of 758 neonates' data was collected during a ward audit in advance of the primary study focused on Meningitis in neonates hospitalized for sepsis in the unit.

Study setting

This pilot study was conducted at the Neonatal Centre of Excellence (NCOE), University Teaching Hospital-Children Division (UTH-Children-a National Referral centre). NCOE is a 23 cot level 2 Nursery catering for neonates admitted through the Emergency unit.

Data source and sampling method

The records of all neonates admitted consecutively from 27th February 2024 to 5th March 2025 were gathered from the ward register at the NCOE, UTH-Children. The dependent variable consisted of neonates (and their mothers) who tested positive for Syphilis using the RPR (Rapid Reagin Test). The independent variables included the HIV status of the neonates, birth weight, current weight, chronological age, gestational age, vital signs (admission heart rate, respiratory rate, body temperature, oxygen saturation), number of gestations, maternal HIV status, paternal HIV status, place of delivery, mode of delivery, maternal age, and parity.

Statistical analysis

The data was manually cleaned, processed, checked for completeness and entered into Microsoft Excel. It was then exported into SPSS version 26 for analysis. Data on 5 babies with missing Syphilis status were removed leaving a total of 753 for analysis. After categorizing and defining the variables, a descriptive analysis was carried out for each of the independent variables and presented with numbers, frequencies and percentages. Chi test and Binary logistic regression analysis were used to assess the characteristics of neonates who were diagnosed with congenital syphilis. Multicollinearity and fitness of the regression model were checked. Factors with p-values < 0.1 were included in the regression model. Odds ratio (OR), with a 95% confidence interval (CI) were computed. For all, statistical significance was declared at p-value < 0.05 . The reporting in this study were guided by the STROBE guidelines for observational studies.¹¹

Ethics

The Institutional Review Board of the University of Zambia (UNZABREC) approved the main study (parent to this Pilot study) investigating Neonatal Meningitis among babies admitted with sepsis, with reference number 5664-2024. All study documents were secured under a locked cabinet. In order to protect the privacy and confidentiality of the participants, no personal identification such as name was collected.

Results

The following are the results obtained from the study.

Participants

The study targeted pregnant women giving birth at WNH-UTH and all 5 first level Hospitals in Lusaka district.

Characteristics of participants in the study

Univariate analysis revealed that forty-five (6.0%) out of the 753 recruited neonates were diagnosed with congenital syphilis based on their laboratory RPR positive tests results, Table 1. Of note, none of the babies that presented before 72hours of life was diagnosed with congenital syphilis. 751 (99.7%) out of the 753 mothers attended ANC clinics. There were a varied amount of missing records of the variables in the ward register.

Table 1: Clinical characteristics of newborns in the study, n=753

	Frequency	Percent
Syphilis status		
Positive	45	6.0
Negative	708	94.0
Baby's HIV status		
Positive	31	4.1
Negative	670	89.0
Unknown	52	6.9
Chronological age of baby at presentation		
Early (0-7days)	139	18.5
Late (≥ 7)	582	77.3
Missing	32	4.2
Sex		
Male	411	54.6
Female	341	45.3
Undetermined	1	0.1
Birthweight status		
Low Birthweight	128	17.0
Normal Birthweight	579	76.9
High Birthweight	14	1.9
Missing	76	10.1
Gestation		
Preterm	113	15.0
Term	560	74.4
Missing	80	10.6
Number of Gestation		
Multiple	22	2.9
Singleton	731	97.1
Antenatal Care		
No	13	1.7
Yes	740	98.3
Place of Delivery		
Outside Health Facility	47	6.2
Health Facility	706	93.8
Mode of Delivery		
Cesarean section	156	20.7
Vaginal	597	79.3

Mother's HIV status		
Positive	90	12.0
Negative	643	85.4
Unknown	20	2.7
Father's HIV status		
Positive	55	7.3
Negative	582	77.3
Unknown	103	13.7
Missing	13	1.7
Parity		
1	255	21.9
2-4	409	35.1
≥5	66	5.7
Missing	23	3.1
Place of Delivery		
Outside Health Facility	47	6.2
Private Health Facility	40	5.3
Lower Level Hospital	488	64.4
Tertiary Hospital	13	1.7
National Referral Centre (UTH)	164	21.6
Missing	1	0.8

Characteristics of Neonatal Congenital Syphilis

Bivariate analysis was done to investigate the relationships between the independent variables and neonatal congenital syphilis, Table 2. Two, out of those born outside health facility-one was born on the road to the hospital and the other was born on the farm.

Table 2: Crosstabulation of independent variables with neonatal congenital syphilis in the study

	Chi	p-value	Syphilis		Total
			Yes (%)	No (%)	
Chronolog Age of Neonate	Chi=3.125	p-value =0.077			
Early (0-7days)	OR =2.491 (95%CI 0.88, 7.08)		4 (2.9)	135 (97.1)	139
Late (>7days)			40 (6.9)	542 (93.1)	582
Total			44 (6.1)	677 (93.9)	721
Oxygen saturation at adm	Chi= 4.895	p.value= 0.027			
Low (<94%)			8 (12.5)	56 (87.5)	64
Normal (94-100%)			34 (5.5)	583 (94.5)	617
Total			42 (6.2)	639 (93.8)	681
Time of initiating BF	Chi=4.892	p.value=0.027			
Delayed (>1hour)			26 (8.1)	294 (91.9)	320
Early (≤1hour)			12 (3.9)	295 (96.1)	307
Total			38 (6.1)	589 (93.9)	627
Maternal HIV status	Chi =	21.891			

	p<0.001			
Positive		15 (16.7)	75 (83.3)	90
Negative		28 (4.4)	615 (95.6)	643
Unknown		2 (10.0)	18 (90.0)	20
		45 (6.0)	708 (94.0)	753
Paternal HIV status				
Positive	Chi=22.871 p<0.001	11(20.0)	44 (80.0)	55
Negative		25 (4.3)	557 (95.7)	582
Unknown		8 (7.8)	95 (92.2)	103
		44 (5.9)	696 (94.1)	740
Place of Delivery	Chi=7.885 p=0.019			
Outside Health Facility		7 (14.9)	40 (85.1)	47
Lower Level Hospitals		26 (4.9)	502 (95.1)	528
Tertiary Hospitals		12 (6.8)	165 (93.2)	177
		45 (6.0)	707 (94.0)	752

In Table 3, the significant characteristics of RPR positive neonates were delivery outside health facility, HIV positive Mother and Father, delayed initiation of breastfeeding, hypoxia and they tend to present in the hospital in the 3rd week of life. Though not statistically significant, the RPR positive neonates were also more likely to be small for gestational age at birth, delivered by cesarean section, HIV positive, failing to thrive, referred from outside tertiary hospitals and present with lower vitals (temperature, respiratory rate and heart rate), but higher random blood sugar level than the uninfected. RPR positive babies were more likely to present with non-neurological symptoms, be of male sex, preterm, of young, multiparous mothers with poor antenatal care.

Characteristics	Sample size	OR (95% CI)	Means (sd)		Diff, t (95% CI)
			RPR pos	RPR neg	
Place of Delivery	752				
Outside Health Facility		2.4 (0.89, 6.50)			
Lower Level Hospitals		0.7 (0.35,1.44)			
Tertiary Hospitals		Ref			
Maternal HIV status	753				
Positive		1.8 (0.38, 8.59)			
Negative		0.4 (0.09, 1.85)			
Unknown		Ref			
Paternal HIV status	740				
Positive	p=0.029	3.0 (1.12, 7.90)			
Negative		0.5 (0.23, 1.22)			
Unknown		Ref			
TOIBF (hours)	627				
Delayed		2.2 (1.08, 4.39)			
Timely					
Neonatal O2 sat (%)	681				
Hypoxic		2.5 (1.08, 5.55)	96.0 (5.08)	96.7 (3.02)	0.8 (-2.26, 0.94)
Normal					
Chronological age of Neonate (days)	721	p=0.006	20.4 (8.89)	16.0 (10.35)	4.38 (1.24, 7.52)

Geospatial Mapping of the Distribution of Syphilis in Lusaka Province

Geospatial mapping of the distribution of Syphilis in Lusaka Province, revealed that the majority of the Syphilis cases seen at UTH-Children were coming from Matero, followed by Kanyama and the Munali, all of which are primarily classified as low-cost and informal residential areas in Lusaka. They are characterized by high population density, urban poor with unplanned informal residential areas, health challenges amongst other problems, Figure 1.

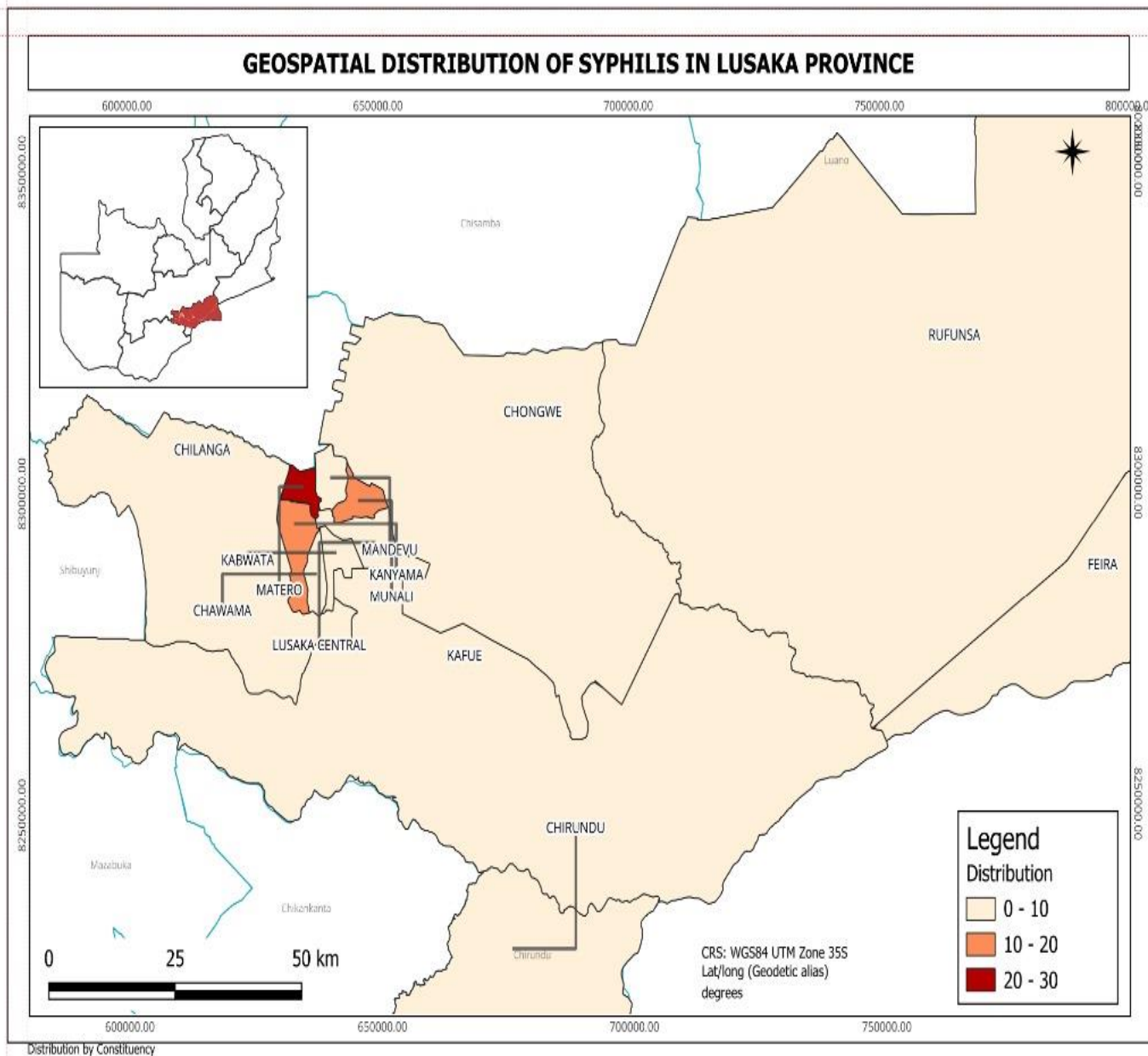


Figure 1: Geospatial distribution of syphilis in Lusaka Province

DISCUSSION

The research assessed the prevalence of congenital syphilis and examined its features in 753 consecutive admissions at the UTH-Children neonatal center of excellence unit, covering a retrospective period of 12 months.

This study recorded a neonatal congenital syphilis rate of 6%; a slightly higher rate of 6.4% was noted in 1982 (Ratman et al.)¹² in the same study site, while a rate of 8% was recorded in 2024 by Hamboote et al.¹³

neonates born at Misisi Mini Hospital and Chawama General Hospital in Lusaka. These figures exceed the 4% reported by Health RoZMo¹⁴ in 2021 among pregnant women in Zambia. The current rate of 6% may be an underestimation in the country, considering the significant rates of non-testing occurring in health facilities. The antenatal non-screening rate for syphilis in Zambia fell from 52% in 2020 to 28.5% in 2025, despite 96% of pregnant women having attended at least one antenatal clinic; among those who were tested, 10% returned positive results. Factors contributing to this high non-testing rate included health workers' perceptions of low risk and frequent shortages of test kits. The treatment rate for those who tested positive is also notably low¹⁵.

These Zambian figures are notably higher than the 0.198% rate reported in a 2023 survey conducted in South Africa¹⁶. In Uganda, a 3.8% (95% CI 3.1–4.6) incidence of congenital syphilis was identified among newborns in 2015, along with a maternal rate of 4.1% (95% CI 3.4–5.0)¹⁷. However, in Peru, a 2024 study by Carcamo et al documented a significantly higher congenital syphilis rate of 38% among 71 neonates, utilizing a case-control study approach on women hospitalized at the Instituto Nacional Materno Perinatal.¹⁸

The HIV-positive status of a father does not directly result in neonatal congenital syphilis, as the transmission of syphilis occurs from an infected mother to her fetus during gestation. Nonetheless, maternal co-infection with HIV and syphilis significantly elevates the risk of vertical transmission of both infections, thereby increasing the likelihood of congenital syphilis and other adverse health outcomes. This observation aligns with the findings of this current study, as well as those reported by Kufa et al.¹⁰ in South Africa, which indicate that pregnant women who are living with HIV and co-infected with syphilis have a higher probability of transmitting Syphilis to their unborn children compared to their counterparts who are solely HIV-positive. Furthermore, syphilis can facilitate the transmission of HIV, underscoring the necessity for routine syphilis screening among all pregnant women, particularly those who are HIV-positive, to prevent congenital syphilis and enhance overall maternal and infant health outcomes.¹⁰

The HIV status of both parents, especially that of the father (as shown in this current study), who might be a source of recurrent infection, serves as a critical determinant in the incidence of neonatal congenital syphilis. This finding highlights the importance of including male partner screening in antenatal care protocols. Numerous studies have indicated that solely focusing on the screening and treatment of pregnant mothers is inadequate for the prevention of mother-to-child transmission (PMTCT) of both HIV and syphilis. However, male partner participation in antenatal care remains relatively low, with reported engagement levels ranging from 32% to 64.5% in sub-Saharan Africa. This phenomenon presents a significant challenge attributed to various factors, including the prevailing belief that antenatal clinics primarily serve women, as well as issues related to ineffective communication and a lack of awareness within the community.^{19,20,21}

Giving birth outside of a healthcare facility raises the likelihood of missing antenatal care, which includes the screening and treatment of infected parents, leading to a greater risk of babies developing congenital syphilis. The precise rate of congenital syphilis in infants born outside medical facilities is not well-documented but is notably higher compared to those delivered in healthcare settings. The World Health Organization (WHO) has estimated that 21% of congenital syphilis cases arise from pregnant women who did not receive any antenatal care.^{1,6} In sub-Saharan Africa, where a significant number of births happen outside of healthcare establishments, the impact of negative pregnancy outcomes and congenital syphilis remains particularly severe. Mumba et al. (2025)²² reported that the rate of home births in Zambia fell from 49% in 1992 to 15% in 2018. In this recent study, 6.2% (47 out of 753) of infants were born outside of healthcare facilities, 14.9% of these (7 out of the 47) was notably linked to neonatal congenital syphilis and significantly higher than the 4.9-6.8% observed among those delivered within health facilities.

In alignment with the findings of Oloya et al. (Uganda)¹⁷ and Carcamo et al. (Peru)¹⁸, this current study revealed that younger women had a higher likelihood of being infected with syphilis than their older counterparts. Nonetheless, while maternal age was a crucial element in the other two studies, it did not emerge as a significant factor in the current study.²³

Hypoxia may arise in newborns with congenital syphilis due to serious complications such as persistent pulmonary hypertension and hypoxic ischemic encephalopathy, resulting in acute respiratory failure, and hemodynamic instability (Aleem et al. 2020)²⁴, which can also delay the initiation of feeds in these infants.²⁵

In this current study, 12.5% of syphilis-infected infants were found to be hypoxic, and 8.1% had delayed first feeds, a hypoxic rate significantly lower than the 58% low Apgar scores and 49% resuscitation rates documented by Appalsamy et al.¹⁶ in a retrospective chart review involving 47 admitted symptomatic cases at Prince Mshiyeni Memorial Hospital, eThekweni, South Africa, from January 2018 to March 2021.

The majority of neonates with congenital syphilis show no symptoms at birth and generally manifest signs between 4 to 8 weeks of age (Taneja et al. 2018)²⁶, akin to this study's findings where the average age of infants with congenital syphilis at the time of presentation was 20.4 days.

In alignment with a mixed ecological study conducted in Brazil by Vital et al.²⁷, which identified the greatest prevalence of Congenital syphilis in regions with significant human traffic and a high density of healthcare facilities, this study revealed that Congenital Syphilis was predominantly located in the densely populated residential neighborhoods of Lusaka Province-Matero, followed by Kanyama and Munali, but unlike the Brazil study, with limited health facilities to cater for rapidly growing population.

Limitations of the study

The study's retrospective nature, along with the absence of complete data, restricted the extent of data analysis that could be conducted to gather more insights about the subject being examined.

Strength

The substantial sample size (753) is a significant strength of this research, enhancing the reliability of prevalence estimates and associations. The study addresses a major and rising public health concern, which is congenital syphilis-in a high -burden African setting. The paper notes a prevalence of 6% for congenital syphilis underscoring the urgency of the problem. This makes the work timely and policy-relevant. The mapping of cases across Lusaka adds a valuable epidemiological dimension, showing clustering in high density, low-income areas such as Matero and Kanyama.

CONCLUSION AND RECOMMENDATIONS

The frequency of neonatal congenital syphilis has remained steady over the years, but significantly elevated. To reduce fetal and neonatal morbidity and mortality associated with congenital syphilis, healthcare institutions should develop and advocate for antenatal care initiatives that include fathers as well as their pregnant partners, in addition to implementing dual rapid diagnostic testing for HIV and syphilis. Neonates who arrive late, especially those with a concerning medical history, signs of hypoxia, and an initial breastfeeding delay, should be treated with a high level of clinical suspicion and promptly.

Authors Contributions

Dr Ogah Adenike Oluwakemi: Corresponding Author; Conceptualization (lead), writing – original draft (lead), writing-review and editing (equal), formal analysis (lead). Mrs Kasemuka Kamusaki: Geospatial mapping Software (lead); Data curation (equal). Dr Edwin Kanombola Chembo: Data curation (lead). Dr James-Aaron Ogbole Ogah: Conceptualization (supporting), Writing – review and editing (equal).

Conflict of Interest

All the Authors declare 'No Conflict of Interest'.

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