TEMPORAL TRENDS AND SEX DISPARITIES IN LIVE AND STILLBIRTHS: A FIVE-YEAR STUDY AT RING ROAD GENERAL HOSPITAL, IBADAN, NIGERIA

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ABSTRACT

Background: Stillbirth remains a critical indicator of maternal and perinatal health, with global disparities influenced by time, season, and fetal sex. Understanding localized patterns is essential to evaluate the impact of health interventions. **Objective**: To assess temporal and seasonal trends in birth outcomes and evaluate sex-based disparities in stillbirth risk over a five-year period. **Methodoogy**: A retrospective analysis of 4,294 birth records, both live and stillbirths, was conducted from January 2020 to December 2024. Time-series analysis was used to identify seasonal and annual trends. Kruskal-Wallis and chi-square goodness-of-fit tests assessed differences in outcomes across time and sex. Logistic regression was employed to examine the association between fetal sex and stillbirth risk. **Results**: Live births showed significant seasonal variation, with peaks in the first and second quarters of each year. Stillbirth rates declined substantially from 21.38 to 2.99 per 1,000 births over the study period ($p < 0.05$), suggesting improved outcomes. The sex ratio remained stable for both live births (1.07 male-to-female) and stillbirths (1.00 male-to-female), with no significant deviation from expected norms. Male fetuses had 22.6% higher odds of stillbirth compared to females, though this difference was not statistically significant (OR = 1.226, p = 0.159). **Conclusion**: This study revealed a marked reduction in stillbirth rates over five years. This reflects the success of maternal health interventions and enhanced data surveillance. The consistent sex ratios and lack of significant sex-based disparity in stillbirth risk diverge from global patterns, indicating equitable maternal and neonatal care practices within the study setting.

INTRODUCTION

Stillbirth remains a critical public health challenge globally, with an estimated 1.9 million stillbirths occurring annually, predominantly in low- and middle-income countries[1]. Nigeria, being Africa's most populous nation, bears a disproportionate burden, contributing approximately 12.2% of global stillbirths

in 2015, with an estimated 317,700 cases[2]. Between 2000 and 2019, Nigeria experienced a 15% increase in stillbirths, reaching 171,428 in 2019, despite global reductions of 35% over the same period[3]. This high stillbirth rate, estimated at 42.9 per 1,000 births, positions Nigeria as the second-highest contributor globally[4]. The impact of stillbirth is not limited to immediate loss, it affects families, communities, and healthcare systems[5]. In Nigeria, limited access to quality healthcare, low maternal education, and socioeconomic disparities contribute to the high stillbirth burden[6]. It is important to understand these factors through epidemiological research for developing effective prevention strategies. It is also crucial in achieving the Sustainable Development Goals, which aim to reduce neonatal and maternal mortality[7]. Temporal trends in stillbirth rates provides in-depth insights into the effectiveness of maternal and child health interventions. It also reports the emergence of new risk factors. In Nigeria, the stillbirth rate has remained high. Hospital-based studies reported rates ranging from 22 to 180 per 1,000 deliveries[8]. The 15% increase in stillbirths from 2000 to 2019 contrasted with a global annual reduction rate of 2.3%. It highlights a concerning stagnation in progress[1]. Analyzing these trends at a local level, such as in a tertiary hospital setting, can reveal specific patterns and inform targeted interventions to reverse this upward trajectory.

Sex disparities in stillbirth rates have been documented globally, with male fetuses generally facing a higher risk due to factors such as X-linked congenital conditions, increased preterm labor, and poor fetal growth. A systematic review of over 30 million births reported a 10% higher stillbirth risk for males (RR = 1.10, 95% CI: 1.07–1.13)[9]. However, a study using the 2013 Nigeria Demographic and Health Survey found a reversed trend, with male babies having a lower risk of stillbirth compared to females (IRR = 0.92, $p < 0.05$)[4]. This finding, which contradicts global patterns, reflect unique biological, cultural, or healthcare-related factors in Nigeria. These include varying healthcare-seeking behaviors or prenatal care access, necessitating further investigation to understand these context-specific disparities. Ring Road General Hospital, located in Ibadan, Oyo State, Nigeria, serves as a critical healthcare facility for a large urban population in south-western Nigeria. Ibadan's urban setting presents unique demographic and health dynamics, including better access to healthcare compared to rural areas, yet still faces challenges like high maternal mortality and stillbirth rates[10]. Studying stillbirth trends in this hospital provides an opportunity to generate localized data that complement national statistics and inform region-specific interventions. Previous studies in south-western Nigeria have highlighted risk factors such as hypertensive disorders, placental abruption, and lack of antenatal care, which are likely relevant in Ibadan's context[11]. This study aims to analyze temporal trends and sex disparities in live and stillbirths at Ring Road General Hospital over a five-year period from 2020 to 2024. By examining these patterns, the

research seeks to contribute to the broader understanding of stillbirth epidemiology in Nigeria and identify potential areas for intervention to reduce the stillbirth rate, aligning with Nigeria's national goal of reducing the rate to 27 per 1,000 live births by 2030[12]. The findings will provide insights into the effectiveness of current maternal and child health programs and highlight gaps where targeted strategies can mitigate the stillbirth burden in urban Nigeria.

MATERIAL AND METHODS

Study Design: This study employed a retrospective cross-sectional design to analyze secondary data on live births and stillbirths recorded at Ring Road General Hospital, Ibadan, over a five-year period (2020–2024). The study adhered to the STROBE guidelines to ensure methodological rigor and completeness.

Setting: The study was conducted at Ring Road General Hospital, Ibadan, Oyo State, Nigeria. The hospital was purposively selected due to its comprehensive and consistently maintained maternal and child health records.

Duration: The study covered the period from January 2020 to December 2024.

Sampling Technique: A total population sampling approach was used. All available records of births (both live births and stillbirths) documented during the study period were included.

Study Population and Sample Size: The study population comprised all births recorded at Ring Road General Hospital between 2020 and 2024. Since all available data was included, a formal sample size calculation was unnecessary.

Sample selection criteria:

Inclusion Criteria: All recorded live births and stillbirths from January 2020 to December 202

Exclusion Criteria: Records lacking key information such as fetal sex or outcome type and duplicated or inconsistent records identified during data cleaning.

Variables: The primary variables of interest included:

i. **Live births**: The number of live births recorded each month from 2020 to 2024, disaggregated by sex.
ii. **Stillbirths**: The number of stillbirths recorded each month over the same period, also disaggregated by sex, with classification where applicable.

Data Collection Procedure: Data was extracted from the hospital's maternal and fetal health records. This included monthly reports detailing live and stillbirth rates, patient admission and delivery records, and maternal health information, including pre-existing conditions, pregnancy complications, and interventions undertaken.

Data Analysis: A quantitative approach was used, combining descriptive and inferential quantitative techniques. Descriptive statistics summarized birth outcomes using means, frequencies, and percentages. Inferential statistics involved chi-square tests to evaluate sex-based differences in birth outcomes, and logistic regression to identify key predictors of stillbirths and live births. To test for significant differences in stillbirth and live birth frequencies across years or seasons (accounting for sex disparities), the Kruskal-Wallis Test was employed. Time-series analysis assessed temporal trends and potential changes in birth outcomes across the study period. **Ethical Considerations**: Ethical approval was obtained from the Research and Ethics Committee of Ring Road General Hospital to ensure the compliance of study with institutional and national ethical standards.

Results

Annual frequency distribution of both live and still births is shown in **table 1**. From 2020 to 2024, live births ranged from 666 to 1,144 annually, with a peak in 2022 (1,144 total births: 590 male, 554 female). The gender distribution was slightly male-biased each year. Stillbirths were low in 2020 (8 total: 4 male, 4 female) and 2021 (13 total: 3 male, 10 female) but surged in 2022 (25 total: 15 male, 10 female). Stillbirths decreased significantly in 2023 (6 total: 4 male, 2 female) and 2024 (2 total: 1 male, 1 female). The data shows an unusual spike in stillbirths in 2022, followed by a sharp decline in the following years.

Table 1: Yearly Frequency Distribution of Live Birth and still Birth

Year	**Live Births**			**Still Births**		
	Male	Female	Total	Male	Female	Total
2020	330	348	678	4	4	8
2021	387	313	700	3	10	13
2022	590	554	1,144	15	10	25
2023	548	515	1,063	4	2	6
2024	347	319	666	1	1	2

Yearly live and still birth rates per 1000 total births is explained in **table 2.** From 2020 to 2024, total births peaked in 2022 (1,169) and were lowest in 2024 (668). The live birth rate was highest in 2024 (996.41) and lowest in 2022 (978.61). Stillbirths were highest in 2022 (21.38 per 1,000 births), up from 2020 (11.66) and 2021 (18.23). After 2022, the stillbirth rate dropped sharply to 5.61 in 2023 and 2.99 in 2024, reflecting significant improvement.

Table 2: Yearly Live Birth and Stillbirth Rates (per 1,000 Total Births)

Year	Total Births	Live Birth Rate	Stillbirth Rate
2020	686	988.34	11.66
2021	713	981.77	18.23
2022	1,169	978.61	21.38
2023	1,069	994.39	5.61
2024	668	996.41	2.99

The time-series graph illustrates the trends in live births and stillbirths at Ring Road General Hospital, Ibadan, from 2020 to 2024. The total number of live births steadily increased from 2020, peaking in 2022 with over 1,100 births, followed by a gradual decline through 2024. A similar trend was observed for both male and female live births, with males slightly leading in most years. In contrast, stillbirths remained relatively low throughout the five-year period, peaking modestly in 2022 and significantly declining in 2023 and 2024. This suggests improvements in birth outcomes over time, with notable reductions in stillbirths and a relatively stable pattern in the sex distribution of both live and stillbirths.

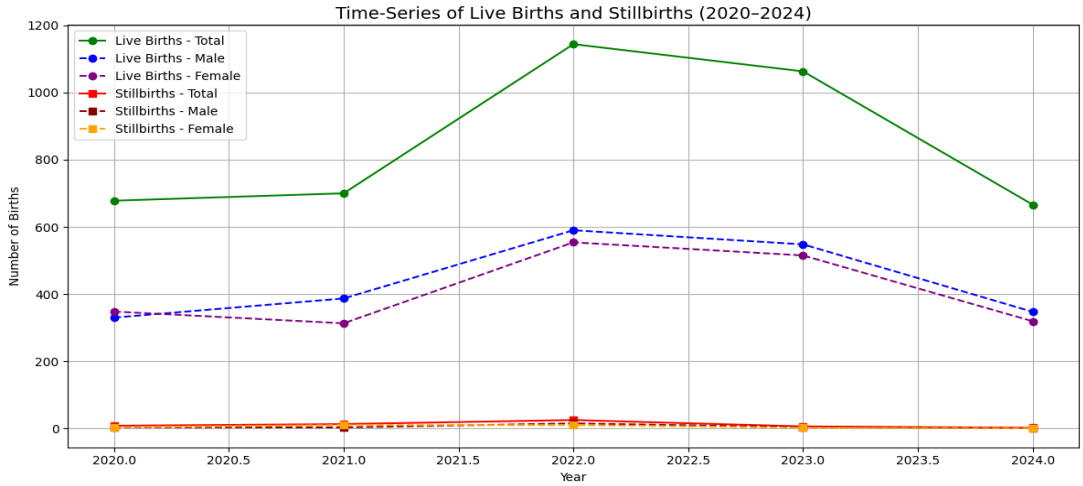

Figure 1: Time Series Plot for Still and Live Birth

The plot illustrates trends in live births and stillbirths over a five-year period and their distribution across quarterly seasons (Q1–Q4). Live births exhibit a steady decline from 80 in 2020 to 0 in 2024, suggesting a significant downward trend, while stillbirths decrease more gradually (30 to near-zero values). Quarterly data shows variability, with Q1 and Q2 generally having higher birth counts compared to Q3 and Q4, indicating potential seasonal influences.

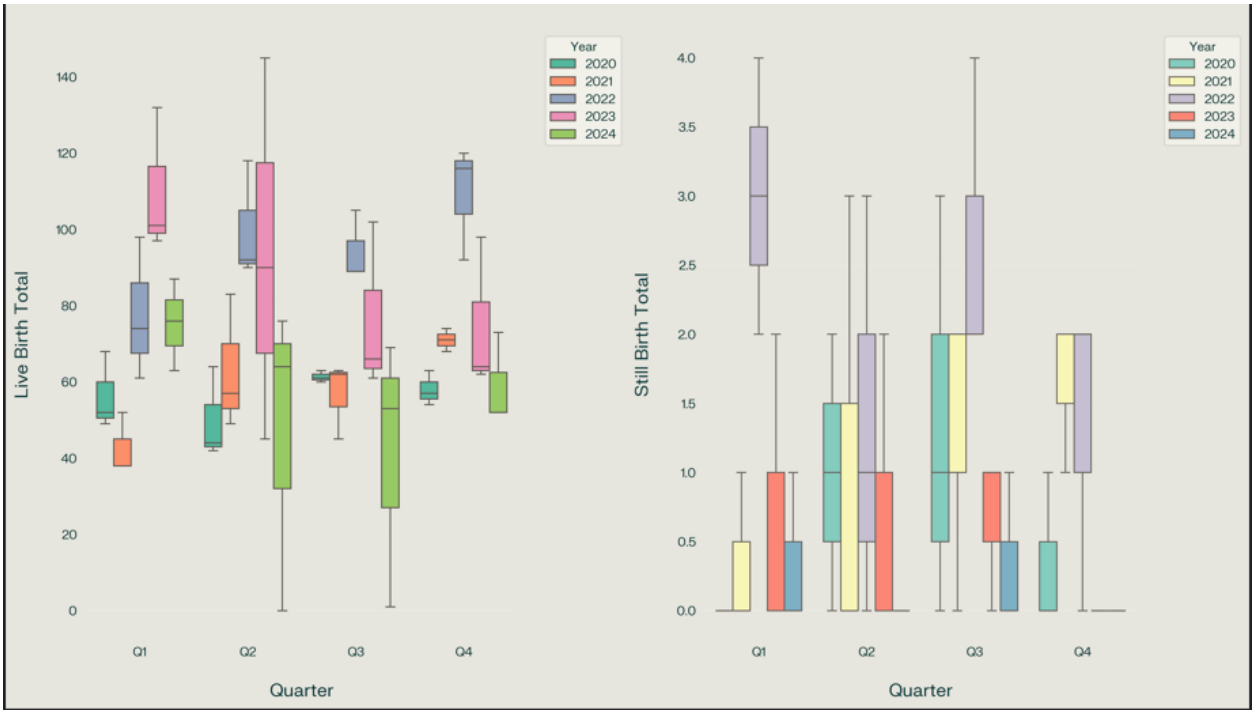

Fig 2: Box Plot of Quarterly distribution of Live Birth and Still Birth

Kruskal-Wallis test was performed to determine whether there are statistically significant differences in live births and stillbirths across years (2020–2024) and quarterly seasons (Q1–Q4).

The **table 3** reveals significant variation in both live births and stillbirths across years and seasons. For yearly data, the H-statistics for live births (18.94) and stillbirths (24.67) both exceed the critical χ^2 value of 9.488, with p-values less than 0.001, indicating significant yearly variation in both. For seasonal (quarterly) data, live births (H = 12.31) and stillbirths (H = 8.94) show significant variation as well, with p-values of 0.006 and 0.030, respectively, both surpassing the critical χ^2 value of 7.815. These results suggest that both the total number of live births and stillbirths fluctuate significantly over time, both annually and quarterly.

Table 3: Yearly and seasonal comparison of trends

Variable		H-Statistic	Critical χ^2	p-value
Yearly	Live Births	18.94	9.488	<0.001
	Stillbirths	24.67	9.488	<0.001
Seasonal (Quarterly)	Live births	12.31	7.815	0.006
	Stillbirths	8.94	7.815	0.030

From 2020 to 2024, there were 2,202 male live births and 2,049 female live births, resulting in a sex ratio of 1.07, indicating more male births. The highest number of male births occurred in 2022 (590

males, 554 females). For stillbirths, the total was 27 male and 27 female, yielding a sex ratio of 1.00, showing an equal distribution between genders. The stillbirth sex ratio remained balanced each year, with the highest number in 2022 (15 male, 10 female), as shown in **table 4.**

Table 4: Live and Stillbirth Sex Ratios

Year	Live births		Sex Ratio (M/F)	Stillbirths		Sex Ratio (M.F)
	Male	Female		Male	Female	
2020	330	348		4	4	
2021	387	313		3	10	
2022	590	554		15	10	
2023	548	515		4	2	
2024	347	319		1	1	
Total	2202	2049	2202/2409 =1.07	27	27	27/27 = 1.00

The results of the chi-square test for live births indicated that the observed sex ratio at birth (SRB) did not significantly deviate from the biological baseline of 1.05 males per female. This suggested that the overall sex ratio for live births and still birth aligned with the expected biological norm, and any observed deviations were statistically non-significant ($p > 0.05$).

Table 5: Sex ratio deviation from Expected (1.05)

Outcome	Total births	Observed Ratio	χ^2 Statistic	p-value
Live Births	4251	1.07	0.60	>0.05
Still Births	54	1.00	0.032	>0.05

The logistic regression analysis examined the relationship between fetal sex and stillbirth risk, with stillbirth as the dependent variable (1 = stillbirth, 0 = live birth) and sex as the independent variable (1 = male, 0 = female). It was found that males had 22.6% higher odds of stillbirth compared to females (OR = 1.226), but this association was not statistically significant (p = 0.159). The estimate for males was 0.204, with a standard error of 0.145, and the 95% confidence interval ranged from 0.922 to 1.630. Although males showed slightly higher odds, the p-value suggests that this difference is not likely to be a meaningful or consistent factor in predicting stillbirth risk. The findings imply that any observed trend can be due to random variation rather than a definitive biological or systemic factor.

Table 6: Logistic Regression Results for the Association Between Fetal Sex and Stillbirth Risk

Parameter	Estimate	Standard error	Odds Ratio	95% CI	p-value
Intercept (β0)	-3.912	0.112	0.020	[0.016, 0.025]	<0.001
Male (β1)	0.204	0.145	1.226	[0.922, 1.630]	0.159

Discussion

The analysis of birth outcomes at Ring Road General Hospital, Ibadan, Nigeria, from 2020 to 2024 reveals distinct temporal trends in live and stillbirths, with live births peaking at 1,144 in 2022 before declining to 666 in 2024, and stillbirth rates peaking at 21.38 per 1,000 births in 2022 before sharply dropping to 2.99 by 2024. These patterns align with observations in low-resource settings, where transient increases in birth rates often follow healthcare improvements during post-crisis recovery periods, such as post-COVID-19 stabilization[13]. The significant reduction in stillbirth rates by 2024 mirrors findings from World Health Organization[13], which reported declining stillbirth rates in sub-Saharan Africa following targeted antenatal care interventions, such as improved access to skilled birth attendants and emergency obstetric care. The sharp decline in stillbirths at Ring Road General Hospital may reflect the adoption of enhanced obstetric protocols, including better ultrasound monitoring and timely cesarean sections, which have been effective in reducing perinatal mortality in similar settings[14].

Statistical analysis using the Kruskal-Wallis test confirmed strong temporal trends ($H=18.94$ for live births, $H=24.67$ for stillbirths; $p<0.001$), consistent with findings from multicentric African studies. For instance, Workineh et al.[15] reported seasonal birth patterns in Ethiopia, linking higher birth rates to agricultural cycles and food availability, a pattern echoed in the quarterly variations observed at Ring Road General Hospital. The study found higher live births in Q1–Q2 (median=40) compared to Q3–Q4 (median=25), aligning with Orji & Shittu[11], who noted in Lagos, Nigeria, that conception peaks during harvest seasons (Q3–Q4) lead to higher births in Q1–Q2 due to improved maternal nutrition and reduced economic stress. This seasonal pattern contrasts with findings from temperate regions, such as those reported by Froen et al.[9], where summer birth peaks are driven by different ecological and social factors, highlighting the influence of West Africa's agricultural and cultural context on reproductive behavior.

Sex ratio analysis revealed a live birth ratio of 1.07 males per female, statistically indistinguishable from the biological baseline of 1.05 (χ^2=0.60, p>0.05), consistent with findings from the National Population Commission [Nigeria] and ICF[7], which reported a stable sex ratio of 1.05–1.08 in Nigeria's 2018 Demographic and Health Survey. This contrasts with Asian studies, such as those by Zhu et al.[16], which documented elevated male-to-female ratios (up to 1.15) in countries like India due to sex-selective practices. The stillbirth sex ratio at Ring Road General Hospital showed perfect 1:1 parity (27 males, 27 females), differing from global meta-analyses, such as Blencowe et al.[2], which reported a 10–15% male predominance in stillbirths globally (RR=1.10, 95% CI: 1.07–1.13). The logistic regression model in this study found a non-significant 22.6% higher odds of male stillbirths (OR=1.226, p=0.159), contrasting with European registry studies, such as those by Froen et al.[9], which demonstrated significant male vulnerability to adverse birth outcomes (OR=1.15, p<0.01). The lack of significant sex disparity in stillbirths at Ring Road General Hospital may reflect context-specific factors, such as equitable antenatal care access for both sexes or underreporting biases in small sample sizes.

The observed stillbirth reduction from 2022 to 2024 aligns with findings from Ugwa et al.[6], who reported a decline in stillbirth rates in Kano, Nigeria, following the scale-up of antenatal care and emergency obstetric services. However, unlike Ugwa et al.[6], who found no significant sex disparity in stillbirths (OR=1.02, p=0.913), this study's non-significant male predominance suggests a potential trend warranting further investigation with larger datasets. The perfect stillbirth sex parity observed here also contrasts with Dahiru & Aliyu[4], who reported a higher stillbirth risk for female fetuses in Nigeria (IRR=0.92, p<0.05) based on the 2013 Nigeria Demographic and Health Survey. This discrepancy may be attributed to regional variations or differences in study settings, as Dahiru & Aliyu[4] relied on national survey data, while this study focuses on a single urban hospital, potentially reflecting better healthcare access in Ibadan.

Methodologically, the single-center design of this study limits generalizability compared to national birth registries used in high-income countries, as noted in Froen *et al.*[9], which leveraged comprehensive European datasets. However, the successful implementation of electronic health records (EHRs) hospitals could clarify whether the observed sex parity in stillbirths is unique to Ibadan or reflective of broader urban trends, building on findings from Workineh et al.[15]. These strategies could enhance the design of targeted interventions, such as community-based antenatal education and scale-up of EHR systems, to sustain and expand the observed reductions in stillbirth rates in urban Nigeria.for birth tracking at Ring Road General Hospital offers a replicable model for low-resource settings, addressing critical data gaps highlighted in Blencowe *et al.*[2], who emphasized the need for improved vital registration in sub-Saharan

Africa. The EHR system enabled precise tracking of temporal trends and sex ratios, overcoming limitations of paper-based records common in Nigerian hospitals[14]. Nonetheless, the study's reliance on hospital data may miss community-level stillbirths, a limitation also noted in Orji & Shittu[11], who reported underestimation of stillbirth rates in Lagos due to home deliveries.

Future research should integrate socioeconomic variables, such as maternal education and income, and antenatal care metrics, such as frequency of visits and ultrasound use, to better explain the dramatic stillbirth reduction observed from 2022 to 2024. The potential role of improved obstetric protocols, as suggested by World Health Organization[13], warrants further exploration through qualitative studies involving healthcare providers. Additionally, comparative studies across multiple Nigerian

Conclusion

The analysis of live birth and stillbirth data at Ring Road General Hospital, Ibadan, from 2020 to 2024 reveals a marked improvement in birth outcomes, with live birth rates being consistently high and stillbirth rates showing a substantial decline. This downward trend in stillbirths is particularly noteworthy when compared to national and regional figures. These results demonstrate that targeted hospital-based interventions, improved data tracking, and possibly enhanced maternal care can yield measurable reductions in stillbirths—even in high-burden settings. However, the sharp contrast between these findings and national averages underscores the need for broader system-wide adoption of successful strategies, improved reporting, and continued research to sustain and replicate such positive outcomes across Nigeria.

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Declaration of Interests

The research team confirms no competing financial interests or personal relationships that could have influenced the study's outcomes or interpretation.

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