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CLINICAL ARTICLE

Obstetrics

Join point trends of instrumental vaginal deliveries and cesarean sections at the Lagos University Teaching Hospital, Lagos, Nigeria (2002–2017)

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Abstract

Objective: To determine the trends of instrumental vaginal delivery (IVD) and cesarean section (CS) at the Lagos University Teaching Hospital (LUTH), Nigeria, over 16 years, from 2002 to 2017.

Methods: A retrospective cross-sectional study. The case records of all women who had IVD and CS during the study period were reviewed. The trends in the IVD and CS rates were evaluated using join point regression modeling. The average annual percent change (AAPC) and annual percent change (APC) with associated 95% confidence interval of segmental trends were calculated.

Results: The overall IVD rate was 1.36%. Vacuum delivery rate was higher than forceps (0.79% vs 0.57%). The CS rate was 44.9 per 100 deliveries; the rate increased by about 3.7% per annum. CS rates were 7.1–89.9 times the IVD rates within the study period. The number of IVDs performed in the hospital declined by about 83.02%, from 53 cases in 2002 to nine cases in 2017. Forceps delivery declined at a faster rate than vacuum delivery between 2002 and 2017 (AAPC for forceps: −12.6% [−17.5 to −7.5], $P < 0.001$ vs AAPC for vacuum: −6.2% [−14.3 to 2.7], $P = 0.200$). The commonest indication for IVD was prolonged second stage of labor (47/162, 29.01%) and shortening of the second stage of labor for maternal conditions (47/162, 29.01%).

Conclusion: IVD rates are low and declining at LUTH. There is need to train accoucheurs on the safe use of IVDs to potentially reduce the CS rate.

KEYWORDS
cesarean delivery, forceps, operative delivery, operative vaginal delivery, vacuum, ventouse

1 | INTRODUCTION

Instrumental vaginal delivery (IVD) is indicated to shorten the second stage of labor for maternal benefits, in cases of fetal distress or non-reassuring fetal heart rate tracing, in delivery of the fetal aftercoming head in breech presentation, or when there is cord prolapse in the second stage of labor.[1–4] IVD is a recommended intervention for reducing cesarean section (CS) rates, with the advantage of minimizing the maternal and fetal risks associated with CS. Compared with second stage CS, IVD is associated with less risk of postpartum hemorrhage (PPH), postoperative infection, and venous thromboembolism, quicker postoperative maternal recovery, shorter hospital stay, and reduced likelihood of babies being admitted into the neonatal intensive care unit (NICU), thereby reducing the cost of obstetric

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care. Women are also more likely to have a spontaneous vaginal birth in their subsequent confinement after IVD than after CS.[5–7]

Despite the advantages of IVD over CS, global rates of CS are increasing while IVD rates are declining worldwide.[8] The global decline in IVD rates, especially in developing countries, has mainly been attributed to lack of requisite skills and equipment, and fear of litigation and complications.[5,9] Knowledge of the current IVD rate is crucial to provide evidence for the formulation of policies that will enhance training and improved use of IVD. This is especially important in our setting, where women have a high aversion for CS and would rather patronize unskilled and traditional birth attendants in order to achieve vaginal delivery.[6] We therefore evaluated the trends of IVD and CS over a 16-year period, from 2002 to 2017, at the Lagos University Teaching Hospital (LUTH), Lagos, one of the foremost and the largest tertiary hospitals in Nigeria, using join point regression modeling. To the best of our knowledge, this is the first study to utilize join point regression modeling to assess the trends in IVD in Nigeria.

2 | MATERIALS AND METHODS

2.1 | Study design, study area, and study period

We conducted a retrospective trends analysis and comparative cross-sectional study of IVDs and CS at LUTH, Lagos, Nigeria, between 1st January 2002 and 31st December 2017. LUTH is the largest tertiary hospital in Nigeria, with over 1000 beds. The hospital provides specialized healthcare services, including obstetric care, to a population of over 25 million in Lagos State and neighboring States.

2.2 | Data collection, sample size and sampling frame

The case notes of all women who had IVDs and CS during the study period (2002–2017) were retrieved from the hospital's medical records department, and relevant information was extracted from the case notes and recorded. Aggregate information on annual number of IVDs, annual number of forceps and vacuum deliveries, annual live births, and annual CS from 2002 to 2017 were obtained from the hospital's labor ward records. As all the cases within the study period were reviewed, sample size calculation and sampling were not done.

2.3 | Statistical analysis

The annual incidence rates of IVD and CS were calculated as a percentage of the annual total births. The trends in the IVD and CS rates were evaluated using join point regression modeling, version 4.8.0.1 (National Cancer Institute, Bethesda, Maryland, United States of America). The rates were assumed as count data and were modeled using the Poisson regression model. In all, 4499 Monte Carlo permutation tests were performed for the trends and a maximum of four join points were utilized. The average annual percent change (AAPC) and annual percent change (APC) with associated 95% confidence interval of segmental trends were then calculated. For negative or positive values of APC, the trends were described as decreased or

TABLE 1 Baseline characteristics of women who had instrumental vaginal delivery (IVD) at Lagos University Teaching Hospital (LUTH) (2002–2017).

Characteristics	Frequency ($n=162$)	Percentage (%)
Total number of women		
2007–2012	126	77.78
2013–2017	36	22.28
Age (years)		
<25	21	12.96
25–34	124	76.54
≥35	17	10.49
Mean age ± SD (years)	28.88 ± 4.82	
Parity		
0	106	65.43
1–4	56	34.57
Median parity (IQR)	0 (0–1)	
Gestational age (weeks)		
<37	28	17.50
≥37	132	82.50
Median GA (IQR)	38 (37–40)	
Booking status		
Unbooked	55	33.95
Booked	107	66.05
Indication for IVD		
Shortening of second stage of labor	47	29.01
Prolonged second stage	47	29.01
Maternal exhaustion in second stage	34	20.99
Fetal distress in second stage	14	8.64
Fetal malposition	13	8.02
Retained second twin	7	4.32
Indication for shortening of second stage ($n=47$)		
Eclampsia	19	40.43
Abruptio placentae	6	12.77
Cord prolapse	6	12.77
Sickle cell anemia	4	8.51
Cardiac disease	1	2.13
Not indicated	11	23.40
Cadre of accoucheur		
Consultant	20	12.35
Senior registrar/senior resident	134	82.72
Registrar/junior resident	8	4.94

Abbreviation: IQR, interquartile range.

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increased trends, respectively, while values between −0.5 and +0.5 with non-significant *P*-value were described as stable trends.

Descriptive statistics of the sociodemographic and obstetric characteristics of women who had IVD from 2002 to 2017 were conducted using Stata version 16 (StataCorp, College Station, TX, USA) statistical software. Categorical variables were presented as frequencies and percentages while continuous variables were presented as medians with interquartile range (if skewed) and means and standard deviation (if normally distributed). Two-tailed test of hypothesis was assumed, and the statistically significant level was set at *P*-value <0.05.

2.4 | Ethical considerations

Ethical clearance for this study was obtained from LUTH's Human Research and Ethics Committee (ethics number: ADM/DSCST/HREC/APP/5575). As this was a retrospective study utilizing anonymous aggregated data, with no perceived ethical harm to study participants, informed consent from the study participants was waived.

3 | RESULTS

3.1 | Baseline characteristics of the women who had IVD at LUTH (2002–2017)

The mean age and median parity of women who had IVD at the hospital during the study period were 28.88 ± 4.8 years and 0 (0–1), respectively. About two-thirds of the women (107, 66.05%) were booked. The two leading indications for IVD were shortening of the second stage of labor on account of maternal conditions (47, 29.01%) and prolonged second stage of labor (47, 29.01%). More than four-fifths (134, 82.72%) of the IVD procedures were performed by senior registrars/senior resident doctors (Table 1).

3.2 | Operative delivery rates at LUTH (2002–2017)

Over the 16-year study period, 315 IVDs were performed at LUTH out of 23 229 deliveries, giving an IVD rate of 1.36%. The overall vacuum delivery and forceps delivery rates were 0.79% (183/23 229) and 0.57% (132/23 229), respectively. Of the 315 IVDs, vacuum delivery constituted 58.1% of IVDs ($n = 183/315$), while forceps delivery was performed in 41.9% of IVDs (132/315). The hospital performed 10 423 CSs over the study period, giving a CS rate of 44.9% (Table 2).

3.3 | Trends in annual CS rates at LUTH (2002–2017)

The number of CSs performed increased steadily from 374 in 2002 to peak at 1052 in 2010. Afterwards, CS performed declined to 510 in 2017 (Figure 1a; Table 2).

The overall join point trend of CS rates showed that, on average, there was an increase of about 3.7% per annum from 2002 to

TABLE 2 Trends in total deliveries, instrumental vaginal delivery (IVD), and cesarean section (CS) at Lagos University Teaching Hospital (LUTH) (2002–2017).

Year	Total delivery	Total forceps delivery	Forceps rate (%)	Total vacuum delivery	Vacuum rate (%)	Total IVD	IVD rate (%)	Total CS	CS rate (%)	CS rate/ IVD rate
2002	1224	37	3.19	16	1.38	53	4.57	374	32.27	7.06
2003	1635	22	1.41	23	1.47	45	2.88	579	37.12	12.87
2004	1121	7	0.65	22	2.06	29	2.71	348	32.52	12.00
2005	1109	1	0.11	15	1.61	16	1.72	345	37.10	21.56
2006	1618	5	0.34	13	0.88	18	1.21	629	42.36	34.94
2007	1905	6	0.39	14	0.91	20	1.31	700	45.72	35.00
2008	1809	11	0.63	11	0.63	22	1.25	852	48.57	38.73
2009	1978	4	0.20	12	0.61	16	0.81	925	46.93	57.81
2010	1828	6	0.28	14	0.66	20	0.94	1052	49.39	52.60
2011	2075	9	0.44	11	0.54	20	0.97	1004	48.93	50.20
2012	1871	9	0.48	11	0.59	20	1.07	900	48.21	45.00
2013	1654	6	0.37	4	0.25	10	0.62	899	55.67	89.90
2014	695	0	0.00	0	0.00	0	0.00	367	52.43	-
2015	836	3	0.36	4	0.48	7	0.84	476	57.14	68.00
2016	870	3	0.35	7	0.83	10	1.18	472	55.79	47.20
2017	1001	3	0.29	6	0.59	9	0.88	510	49.85	56.67
Total	23 229	132	0.57	183	0.79	315	1.36	10 432	44.91	33.12

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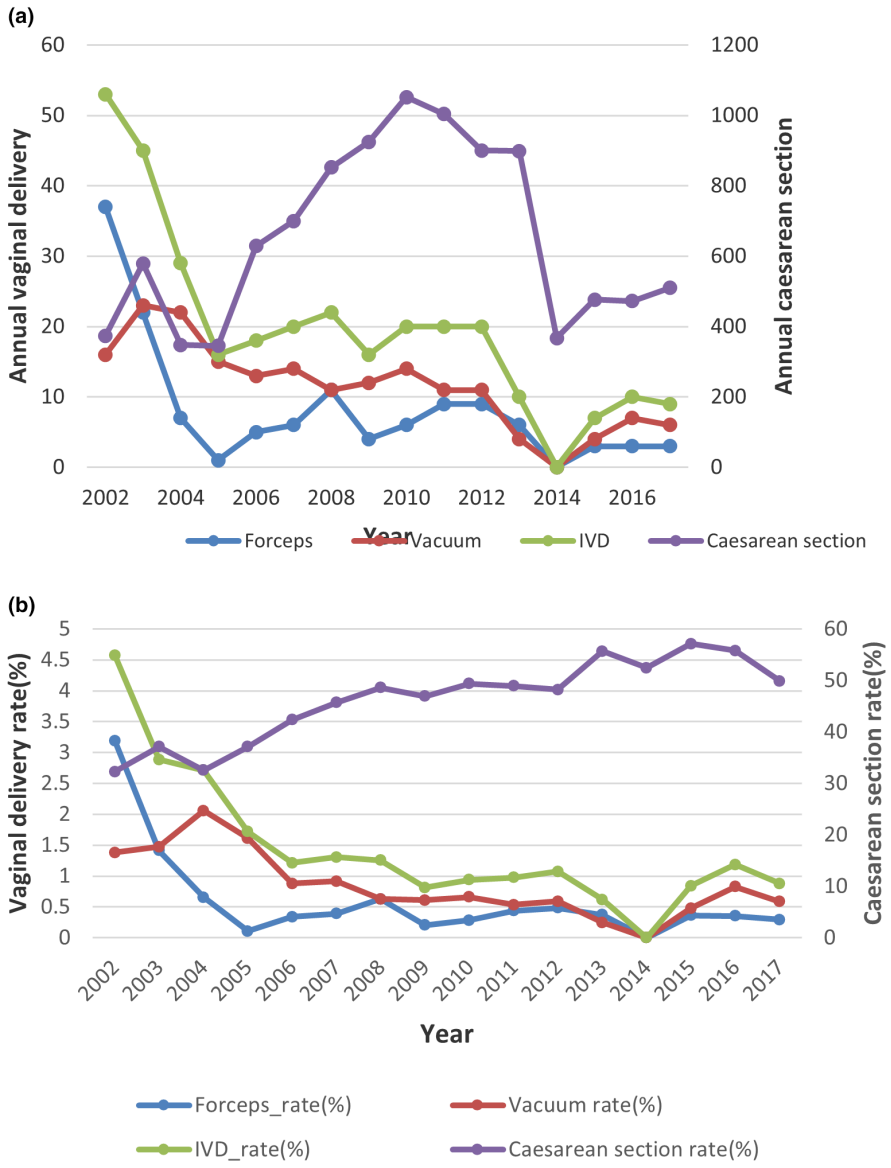


FIGURE 1 (a) Trends in the annual number of forceps, vacuum, instrumental vaginal delivery (IVD), and cesarean section (CS). (b) Trends in the forceps, vacuum, IVD, and CS rates at Lagos University Teaching Hospital (LUTH) (2002–2017).

2017 (Figures 1b and 2a; Table 2). However, segmental join point regression showed two trends: there was an initial steep increase in CS rates at about 7% per annum, from 32.27% in 2002 to 48.57% in 2008, and a subsequent non-statistically significant increase of about 1.6% per annum, from 2008 to 48.57% in 2017 (Figures 1b and 2a; Tables 2 and 3).

3.4 | Trends in annual IVD rates at LUTH (2002–2017)

The CS rate increased steadily while the IVD rate declined steadily. The CS rate was 7.1–89.9 times that of IVD (Table 2). The number of IVDs performed in the hospital declined by about 83.02%, from 53 cases in 2002 to nine cases in 2017 (Table 2; Figure 1a). The overall IVD rate declined by 9.0% per annum. Furthermore, the join point regression showed three trends in the IVD rates: the first was a dramatic decline in IVD rate by about 26% from 2002 to 2006. There was a subsequent non-statistically significant decline in IVD rate of 7.4% per annum from 2006 to 2014, while the third trend was a non-statistically significant increase in IVD rate of about 14.9% from 2014 to 2017 (Table 3; Figures 1b and 2b).

3.5 | Trends in annual forceps delivery rates at LUTH (2002–2017)

The number of forceps delivery declined by about 92%, from 37 cases in 2002 to three cases in 2017 (Table 2; Figure 1a). Join point regression showed that there was an overall dramatic decline in forceps delivery rate of about 12.6% per annum, from 3.19% in 2002 to 0.29% in 2017 (Tables 2 and 3; Figure 1b). Furthermore, the join point regression of forceps delivery rate showed two trends: the first was a huge decline of about 51.5% from 2002 to 2005, and the second was a non-statistically significant slight increase of 1.2% per annum from 2005 to2017 (Table 3; Figures 1b and 3a).

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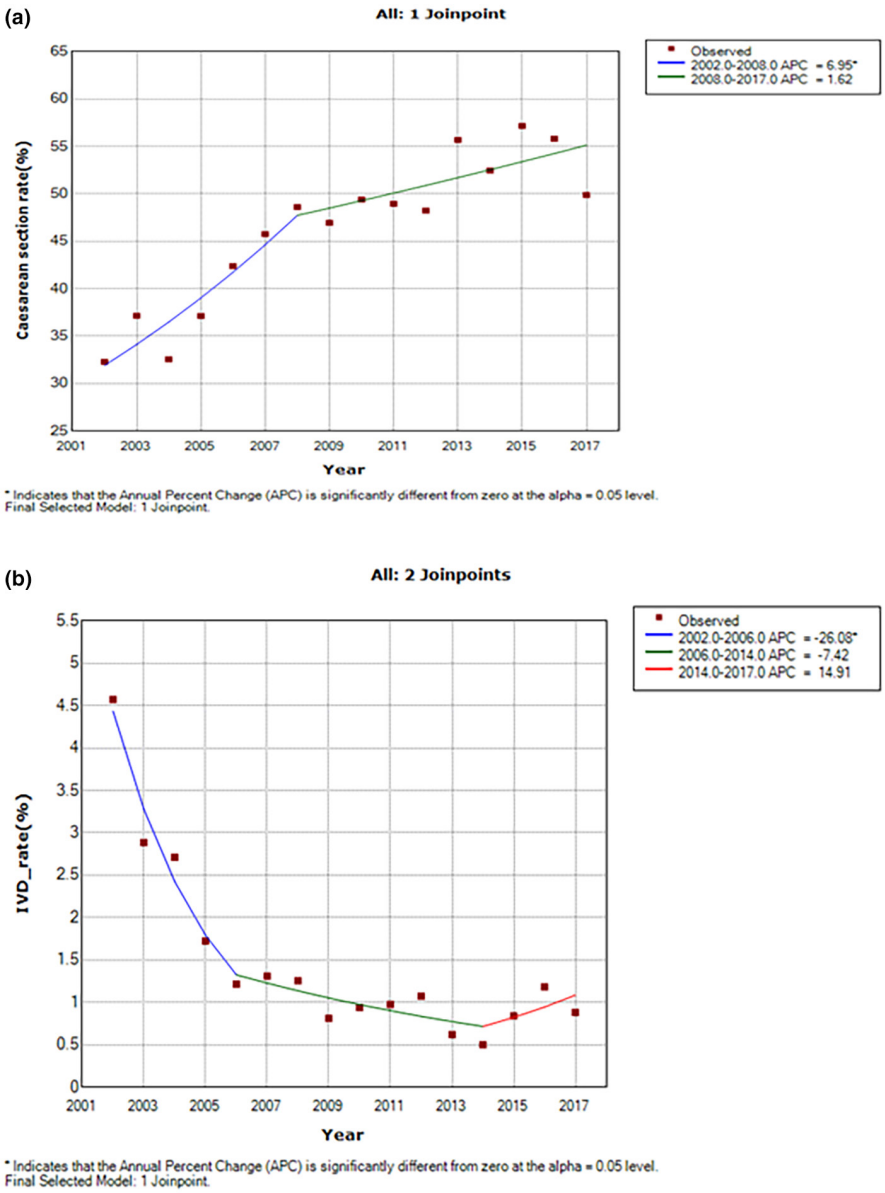


FIGURE 2 Join point regression analysis of the trends in cesarean section (CS) rates (a) and instrumental vaginal delivery (IVD) rates (b) at Lagos University Teaching Hospital (LUTH) (2002–2017). *, indicates that the annual percent change (APC) is significantly different from zero at the alpha = 0.05 level. Final selected model: 1 join point.

3.6 | Trends in annual vacuum delivery rates at LUTH (2002–2017)

The forceps delivery rate was about double the vacuum delivery rate in 2002 (3.19% vs 1.38%). Subsequently, the vacuum delivery rate was generally higher than the forceps delivery rate from 2003 to 2017 (Table 2; Figure 1a,b). The number of vacuum deliveries declined by about 73.9%, from 23 cases in 2003 to six cases in 2017 (Table 2; Figure 1a). Furthermore, the forceps delivery declined at a faster rate than vacuum delivery between 2002 and 2017 (AAPC for forceps: −12.6% [−17.5 to −7.5], $P < 0.001$ vs AAPC for vacuum: −6.2% [−14.3 to 2.7], $P = 0.200$) (Tables 2 and 3; Figures 1b and 3b).

The join point regression of the vacuum delivery rate showed two trends: the first was a dramatic decline of about 13% per annum from 2002 to 2013, while the second was a non-statistically significant increase of about 15.4% per annum from 2013 to 2017 (Table 3; Figures 1b and 3b).

4 | DISCUSSION

This study aimed to evaluate the trends in IVD and CS rates at a foremost tertiary health institution in Nigeria, over a 16-year period, from 2002 to 2017. Our study found an overall IVD rate of 1.4%, with overall forceps and vacuum delivery rates of 0.79% and 0.57%, respectively. Vacuum delivery constituted 58.1% of all IVDs performed, while forceps delivery was performed in 41.9% of IVD cases. The CS rate was 44.9 per 100 deliveries. Our study further showed that there was an average annual increase in CS rate of about 3.7% per annum between 2002 and 2017, while the overall IVD rate declined at 9.0% per annum. Forceps delivery declined at a faster rate than vacuum delivery between 2002 and 2017 (−12.6% vs −6.2% per annum). Senior registrars/senior resident doctors performed more than 80% of the IVDs, consultants performed 12%, while registrars/junior resident doctors performed only 5% of the IVDs, and midwives none.

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TABLE 3 Join point regression of the trends in cesarean section (CS) and instrumental vaginal delivery (IVD) at Lagos University Teaching Hospital (LUTH) (2002–2017).

Segmental trends/type of deliveries	Year	APC (95% CI)	AAPC (95% CI)	*P*-value
CS				
Trend 1	2002–2008	6.9* (3–11)		<0.001
Trend 2	2008–2017	1.6 (−0.2 to 3.4)		0.100
Overall trends	2002–2017	-	3.7* (2.0–5.4)	<0.001
IVD				
Trend 1	2002–2006	−26.1* (−34.8 to −16.2)		<0.001
Trend 2	2006–2014	−7.4 (−15.3 to 1.2)		0.100
Trend 3	2014–2017	14.9 (−19.7 to 64.3)		0.400
Overall trends	2002–2017	-	−9.0* (−15.8 to −1.5)	<0.001
Forceps delivery				
Trend 1	2002–2005	−51.5* (−61.8 to −38.3)		<0.001
Trend 2	2005–2017	1.2 (−4.1 to 6.8)		0.600
Overall trends	2002–2017		−12.6* (−17.5 to −7.5)	<0.001
Vacuum delivery				
Trend 1	2002–2013	−13.0* (−17.9 to −7.8)		<0.001
Trend 2	2013–2017	15.4 (−18.4 to 63.4)		0.400
Overall trends	2002–2017		−6.2 (−14.3 to 2.7)	0.200

Abbreviations: AAPC, average annual percent change; APC, annual percent change; CI, confidence interval.
*indicates statistical significance at *P*-value < 0.05.

Our study IVD rate is lower than the previous IVD rates of 4.52% and 4.9% from studies by Emuveyan and Agboghoroma and Ogedengbe and Odeneye, respectively, in the same hospital.[10,11] Our IVD rate falls within the range of reported IVD rates of 0.69%–3.7% in Nigeria, and 1%–4% in Africa.[3,12,13] Our study indicates a declining rate of IVD in our facility. IVD rates are similarly low and declining across other hospitals in Nigeria and sub-Saharan Africa (SSA).[9,12,13] Although there is a global decline in IVD rates, rates in high-income countries (HICs) are higher (5%–15%) than those in low- and middle-income countries (LMIC), owing to the availability of advanced emergency obstetric care, skilled personnel and equipment, and widespread use of epidural analgesia in HICs.[8,14–16]

Our join point regression modeling showed an increasing CS rate of 3.7% per annum. This corroborates the increasing CS rate of more than 50% in south-eastern Europe, China and North America, and up to 64% in Central Africa.[17,18] Dwindling competence for managing difficult vaginal deliveries and lack of skills for IVDs play major roles in the rising CS rates.[19] There is an urgent need for training and retraining of skilled birth attendants to improve their skills for conducting IVDs to stop the CS epidemic, even more so as IVD carries less risk of short- and long-term maternal and fetal complications compared with CS, when properly applied.[5–7,19]

As also reported in other studies,[2,4,12] the overall vacuum delivery rate in our study was higher than the forceps delivery rate. The preference for vacuum over forceps is because vacuum is easier to use, requiring less expertise and supervision, with fewer complications.[20,21] The higher vacuum delivery rates and the preponderance of IVDs performed by resident doctors in our study has been corroborated by other studies, which similarly found that resident doctors are more familiar with and proficient in the use of vacuum than forceps.[9,22] It is important that consultants train and supervise residents in the use of forceps. If residents are also proficient in conducting forceps deliveries, they will be able to conduct most of the deliveries that are amenable to forceps, thereby obviating the need for CS, and consequently reducing CS rates.[23] Training will also reduce the incidence of complications associated with IVD.[24] Very few IVDs in our study were performed by junior residents, and none by midwives. It is also beneficial to train junior doctors and midwives in the conduct of IVDs, especially vacuum, being a component of basic emergency obstetric and newborn care, and a useful midwifery skill that can reduce maternal and perinatal mortality and morbidity from delivery complications.[14]

The limitation of our study is that it was a single facility-based retrospective study, and therefore may not be generalizable to the entire country. Being a retrospective study, some variables that may be useful to further characterize and explain the trends may not be available. However, ours is the first study to utilize objective join point regression modeling to assess the trends in IVDs in Nigeria. As all deliveries were meticulously recorded in the labor ward and case records of the patients, we did not have challenges with missing data. The study was also conducted over a long period, of 16 years, over which the pattern of the trends and shift in

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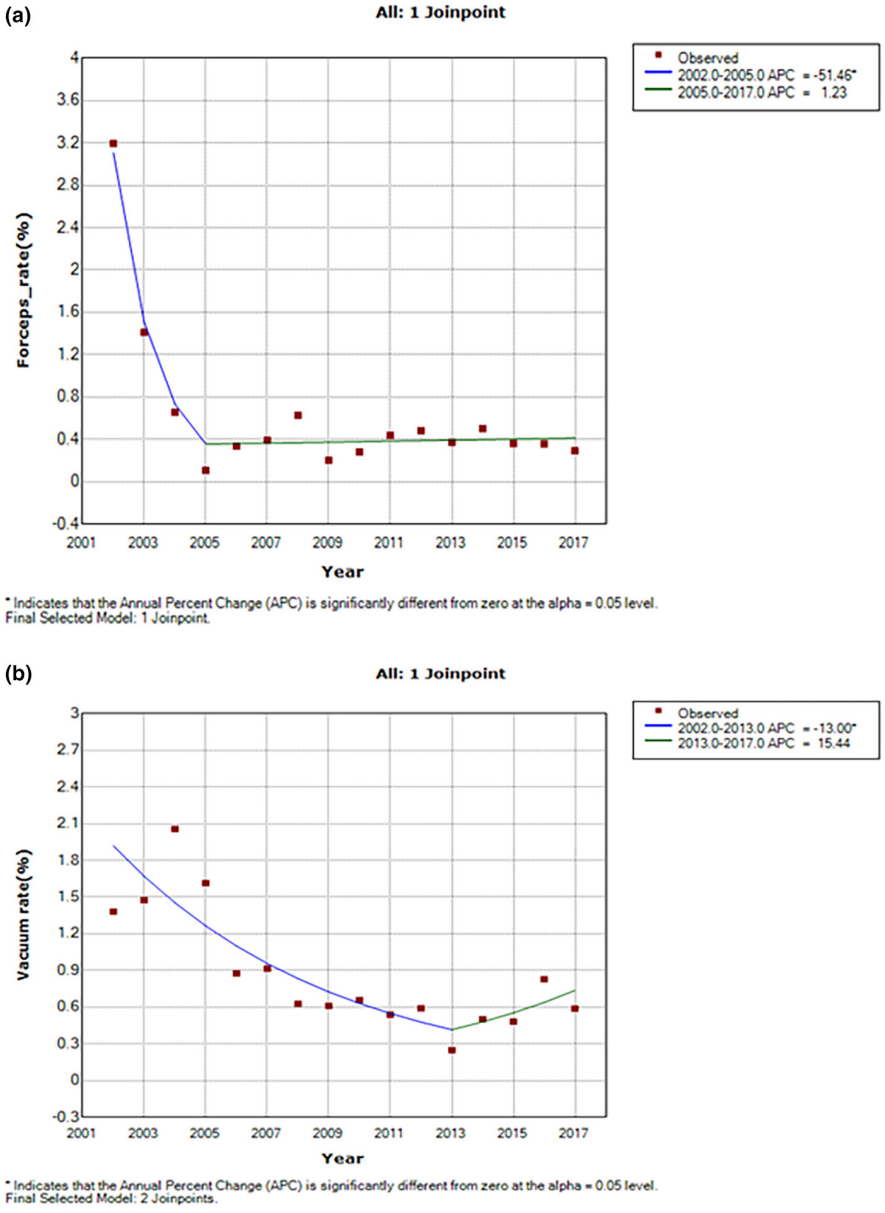


FIGURE 3 Join point regression analysis of the trends in forceps delivery rates (a) and vacuum delivery rates (b) at Lagos University Teaching Hospital (LUTH) (2002–2017). *, indicates that the annual percent change (APC) is significantly different from zero at the alpha = 0.05 level. Final selected model: (a) 1 join point; (b) 2 join points.

trends would have been generally established. The results generated from this study further provide important data upon which further larger-scale, highly powered multicenter/national studies can be conducted.

In conclusion, IVD rates are low and declining at LUTH, Lagos, a foremost teaching hospital in Nigeria. There is a need to train accoucheurs on the safe use of IVDs to potentially reduce the CS rate.

AUTHOR CONTRIBUTIONS

JAO, ZA, GO, OA: conception and protocol development. **ZA, OA**: data collection. **GO, ATA**: data analysis. **JAO, ZA, GO, OA, ATA, AEU**: data interpretation. **ZA, GO, OA, AEU**: initial draft of the manuscript. **JAO, ZA, GO, OA, ATA, AEU**: critical review of manuscript before publication.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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