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Interpregnancy interval after a miscarriage and obstetric outcomes in the subsequent pregnancy in a low-income setting, Nigeria: A cohort study

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Abstract

Objectives: The aim of this study was to determine and compare the occurrence of adverse pregnancy outcomes in a cohort of pregnant women with interpregnancy interval of $<$ and $\geqslant$6 months (short and normal interpregnancy interval, respectively) following a spontaneous miscarriage in their last pregnancies.

Methods: This was a cohort study that involved pregnant women with a spontaneous pregnancy loss in their last pregnancies. They were recruited at a gestational age of 13–15 weeks and followed up to determine the obstetric and foetal outcomes of their pregnancies at four tertiary hospitals in Nigeria from July 2018 to September 2019. Data collected were analysed using SPSS version 26.0. A Chi-square and multivariate logistic regression analysis were done, and a p-value of less than 0.05 was assumed to be statistically significant.

Results: A total of 705 participants were studied, out of which 448 (63.5%) and 257 (36.5%) of the participants had short and normal interpregnancy interval after a spontaneous miscarriage. Over 80% of the participants had first-trimester pregnancy losses and were managed with manual vacuum aspiration in 73.3% of the cases. The majority, 87.5% for the normal interpregnancy interval cohort and 86.4% for the short interpregnancy interval cohort, had live births, while 8.5% and 10.1% of the women in the normal and short interpregnancy interval cohorts, respectively, had repeat miscarriages. There was no statistical difference in the occurrence of live births and repeat miscarriages between both cohorts ($p > 0.05$). There was no increased risk of occurrence of adverse foetomaternal outcomes in both groups ($p > 0.05$). Multivariate logistic regression analysis showed that there was no statistical difference in the occurrence adverse foetomaternal outcomes between the studied cohorts ($p > 0.05$).

Conclusion: There was no significant difference in the occurrence of adverse maternal and foetal outcomes in the cohorts of mothers with short and normal interpregnancy interval following miscarriages in their last previous pregnancies.

Keywords

Interpregnancy interval, miscarriage, obstetric outcome, early pregnancy loss, low-income setting, prospective cohort study

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Introduction

Grieving couples who have just experienced a miscarriage, especially for a planned pregnancy, are often eager to know the ideal time to undertake the next conception, without increased risk of a recurrent pregnancy loss and other obstetric complications. Early pregnancy loss complicates approximately 12%–15% of pregnancies, and studies have shown that previous miscarriages and interpregnancy interval (IPI) could affect the obstetric and perinatal outcomes of subsequent pregnancy.[1–4] These findings informed the World Health Organization's (WHO) recommendation, which encourages women who had experienced a previous miscarriage to wait for a minimum of 6 months before the next conception to achieve an optimal outcome and reduce obstetric complications, such as low birth weight babies, preterm delivery, premature rupture of foetal membrane, preeclampsia, stillbirth and operative delivery.[1,2,5–10] However, this duration may be a cause of concern or anxiety for grieving couples who have just experienced a pregnancy loss and want to know how soon they can attempt the next conception, especially those with poor obstetric history or who are elderly nulliparae.

Contrary to the findings of the research on which WHO based its recommendations regarding pregnancy spacing of ⩾6 months after a miscarriage, some researchers have reported that the risk of adverse obstetric outcome was less in women who conceived less than 6 months after a pregnancy loss.[3,4,11,12] There are also contemporary reports, indicating that the longer the waiting period, the higher the risk of a non-live birth in the next pregnancy.[4,13]

IPI is simply defined as the time interval between a live birth and the estimated time of conception of the subsequent pregnancy.[14] Also, defined as the spacing between a live birth and the beginning of the following pregnancy.[15] This interval is variously defined in studies as short or long. Some authors have defined short IPI as time interval that is shorter than 6 months, while long IPI was defined as time interval over 60 months between a live birth and the estimated time of conception of the subsequent pregnancy.[14,15]

It is noteworthy to observe that most of these studies were conducted in high-income countries with low fertility rates, good access to quality preconception, prenatal, intrapartum and postnatal care services, significant access and acceptance of family planning and where couples do not place an extremely high premium on childbirth and large family size.[16,17] Contrarily, the reverse is the case in most low- and middle-income countries (LMICs) like Nigeria, where a huge premium is placed on early childbearing and any delay in childbearing after marriage is unacceptable and considered as a reproductive failure by peers, family members and the society.[16,18] In such a setting, it is difficult for couples who have just experienced a miscarriage, to accept or adhere to long IPI before their next conception. Due to these pressing reasons, many couples and families in LMICs will want to know how soon they can safely attempt and achieve the next pregnancy.

Considering the difference in study populations, each with different cultures giving rise to the traditional recommendation to delay conception for ⩾6 months following a miscarriage, this study was underpinned. And also, due to the paucity of Nigerian studies examining the association between IPI after a prior miscarriage and adverse obstetric outcomes (maternal and foetal), the current study was designed to assess the impact of IPI <6 months versus IPI ⩾6 months on the obstetric outcome (live births, repeat miscarriages, placenta praevia, hypertensive disorders of pregnancy, preterm contractions and labour, premature rupture of membranes (PROM), intrauterine foetal deaths (IUFD) and intrauterine growth restriction (IUGR), mode/route of delivery, blood loss for vaginal and caesarean section deliveries, birth weight, need for resuscitation, admission into the newborn intensive care unit (NICU) and early neonatal deaths) in the next pregnancy following a miscarriage. This will help doctors, midwives, non-governmental organizations and governmental organization in establishing polices that will serve as bases for establishing patterns, and maternal and perinatal outcome recommendations regarding optimum interval of conception after miscarriages among parturients in the study area. In addition, it will provide non-existent local evidence that could guide health care providers in the study area during post-abortion care counsellors to assist couples to make informed decisions regarding their fertility needs and in planning future conception. Our evidence will also add to the global existing knowledge on the optimal IPI following a miscarriage in Nigeria. This study adhered to the STROBE guidelines for observational studies in the reporting of this study.[19]

Methods

Study design and setting

This was a cohort study conducted between 1 July 2018 and 30 September 2019 in four tertiary health facilities: Alex-Ekwueme Federal University Teaching Hospital in Abakaliki, Ebonyi State; University of Nigeria Teaching Hospital (UNTH) in Enugu, Enugu State; Enugu State University Teaching Hospital (ESUTH) in Enugu, Enugu State; and Stella Obasanjo Hospital (SOH) in Benin City, Edo State, which are all located in the southern region of the country. The south-south and southeast geopolitical zones are among the six geopolitical zones of Nigeria. There are 11 states in the two zones; Abia, Akwa Ibom, Anambra, Bayelsa, Delta, Ebonyi, Edo, Enugu, Imo and Rivers states. The two regions were created from the old eastern and western regions of Nigeria on 27 May 1967, by the regime of General Yakubu Gowon. Edo and Delta were created from the western region, while the rest were created from the eastern region of Nigeria. The region is one of the most densely populated places in

Nigeria. The region has three major vegetations; coastal south has mangrove swamps and tidal waterways, further north of the swamps is more of tropical rainforest and northernmost is the Guinea Savannah region. Most of the petroleum exploration in Nigeria occur in this region.

The total fertility rate (TFR) in Nigeria was 5.417 births per woman.[20] The obstetrics and gynaecology units of the above-named study sites were managed by consultant obstetricians and resident doctors assisted by midwives and nurses. All high-risk pregnancies and deliveries are supervised and conducted by senior resident doctors and/or consultant obstetricians, and attended by a neonatologist. The standard practice in the hospital is to admit all neonates with complications into the neonatal intensive care unit (NICU). Also, diagnostic protocols and treatment guidelines are similar in all four hospitals.

Participants

Participants were recruited at their antenatal booking visits at their earliest time of presentation up to a gestational age of 13 weeks.

Inclusion and exclusion criteria

All pregnant women with ongoing confirmed pregnancies (using ultrasound), previous spontaneous miscarriages antedating index pregnancy, confirmed singleton pregnancies and consenting parturients were eligible for recruitment for this study. The participants had ultrasound to confirm their pregnancies and if there is a disparity of more than 5 days, the ultrasound report of gestational age is accepted ahead of the calculated gestational age from the participant's last menstrual period (LMP). Women with induced abortion, no previous miscarriage(s), parturient with medical conditions antedating pregnancy like hypertensive disorders, pre-gestational diabetes, multiple pregnancy, previous caesarean sections, placenta praevia, abruption placenta, women scheduled for elective caesarean section, women who booked after 13 weeks' gestational age and women younger than 18 years of age were excluded.

Study sampling and selection of participants

Three states were randomly chosen among the 11 states in the south-south and southeast geopolitical zones. In the above-selected states, four centres (Alex-Ekwueme Federal University Teaching Hospital in Abakaliki, Ebonyi State; University of Nigeria Teaching Hospital (UNTH) in Enugu, Enugu State; Enugu State University Teaching Hospital (ESUTH) in Enugu, Enugu State and Stella Obasanjo Hospital (SOH) in Benin City, Edo State) with a high rate of maternal services were chosen purposively for this study. Pregnant women who met the inclusion criteria were consecutively recruited after informed written consent and were followed up during the antenatal period, intrapartum, postpartum until discharged home and for 6 weeks postpartum (during postnatal visits).

Sample size calculation

The sample size used for this study was calculated using the formula $N = 1/(1–f) \times (2 \times (Z\alpha + Z\beta)^2 \times p \times (1–p)/(p_0–p_1)^2)$, where $p = p_0 + p_1/2$, p_0 is the proportion of the participants in the unexposed group who are expected to exhibit the outcome of interest, p_1 is the proportion of the participants in the exposed group who are expected to exhibit the outcome of interest, f is the proportion of the study subjects who are expected to leave the study for reasons other than the outcome under investigation.[21] The sample size calculation was based on a similar study by Bentolila et al.[22] in Beer-Sheva, Israel, where p_0 was 0.297, p_1 was 0.186, assumed f was 0.5 and $Z\alpha = 1.96$ for 95% confidence at a power of 90% ($Z\beta = 1.282$). The calculated sample size of 626 was enough for this cohort study, but a total of 705 participants were recruited for this study.

Outcome measures

The primary outcome measures were the rate of miscarriage, live birth, stillbirth, APGAR scores at birth, admission into the NICU and early neonatal death. Secondary outcomes were rates of caesarean section delivery, preterm delivery, low birth weight infants, PROM, IUGRs, preeclampsia, placenta praevia and placental abruption. Women were recruited blindly, that is, both the senior midwife recruiters and the doctors collecting the data did not know which category each mother will fall into. The cut-off length of the miscarriage to LMP interval used for statistical analysis was only known to the lead investigators.

Data collection

Data were collected by 16 trained research assistants, mostly junior medical doctors; four in each of the study facilities, using a pretested, specially designed pro forma. Data on socio-demographic characteristics were obtained from the participants and confirmed using the records on their medical files. These data were collected at contact, during follow-up in the antenatal clinics, during delivery/termination of pregnancy and at 6 weeks post-delivery. The phone contacts of these mothers were obtained and this helped in tracking the progress of their pregnancy outside that done in the antenatal clinics. Information obtained was the history of miscarriages antedating the current pregnancy, the number of previous miscarriages, gestational age at which miscarriage occurred, how it was managed, history of post-abortion complications, anaemia, antepartum haemorrhage, IPI, prenatal problems in the index pregnancy, duration of current pregnancy/gestational age at delivery and outcome of current

pregnancy; mode of delivery, intrapartum problems, estimated blood loss, birth weight and APGAR scores of the baby,[23] need for newborn resuscitation and admissions into the NICU, status of the baby (live birth, stillbirth, early neonatal deaths) and duration of hospital stay.

Definitions

Miscarriage was defined as the termination of a pregnancy before the age of viability (24 weeks gestation in the current study, based on the level of neonatal care facilities and savage rate in the study centres). IPI was defined as the time between the last miscarriage and the first day of the LMP of the index pregnancy. Short IPI in this study is defined here as time interval that is shorter than 6 months.

Statistical analysis

Data were entered in an Excel spreadsheet (Microsoft, Redmond, WA, USA), checked for double entry, cleaned and transferred to SPSS version 26.0 (IBM, Armonk, NY, USA) for statistical analyses. Descriptive statistics were used to assess baseline characteristics. Where appropriate, continuous variables were converted to clinically applicable categories. Frequencies were calculated for categorical variables and the Chi-square test (or Fisher's exact test) was used to test for associations. When both the Chi-square test and Fisher's exact tests were estimated, only the p-value of the Fisher's exact test was reported. Multivariable logistic regression analyses were performed to determine adjusted odds ratios for the primary obstetric outcomes. A p-value of less than 0.05 was used to define statistical significance at a 95% confidence interval (CI), and all tests were two-tailed.

Ethical considerations

The study was primarily approved by the Human Research and Ethics Committee (HREC) of Alex-Ekwueme Federal University Teaching Hospital, Abakaliki (FETHA/REC/VOL1/2019/540). Ethical approval was given by the Ethics Review committees of all the participating institutions. Signed written consents were obtained from all the participants for them to be interviewed and for their medical records to be used for this study. The data of parturient were made fully anonymous before they were entered into the database and analysed.

Results

At the commencement of the study, 720 participants who met the inclusion criteria were recruited. A total of 11 participants were lost to follow-up during the antenatal period, while 4 participants delivered in other health facilities with the outcomes of their pregnancy unknown and were subsequently excluded from the study. Only 705 participants with completed data were included in this study analysis. A total of 448 (63.5%) participants belonged to those with IPI of ⩾6 months, while 257 (36.5%) participants belonged to the IPI of <6 months group (short IPI). Details are shown in Figure 1. The mean age of the respondents was 28.23 ± 5.21 years. More than four-fifths of the respondents were aged 20–34 years, and most of the participants were married and had a secondary level of education and above. Over four-fifths of the women had first-trimester pregnancy losses. Other socio-demographic characteristics, number of previous miscarriages, gestational age at which they occurred and how the miscarriages were managed with associated complications are shown in Table 1.

There was no increased risk of placenta praevia (p = 0.538), hypertensive disorders of pregnancy (p = 0.111), preterm contractions and labour (p = 0.133), PROM (p = 0.500), IUFD (p = 0.130) and IUGR (p = 0.557) and other obstetric morbidities during pregnancy. Other details were shown in Table 2.

Majority (87.5% for the ⩾6 months cohort and 86.4% for the <6 months cohorts) had live birth, p = 0.734. About 8.5% in the ⩾6 months cohort and 10.1% in the <6 months cohort had repeat miscarriage in the index pregnancy. Table 3 shows the association between IPI and obstetric outcomes in the subsequent pregnancy. It indicates that there was also no significant statistical difference in the mode/route of delivery (p = 0.568). The mean blood loss for vaginal delivery (p = 0.174) and caesarean section (p = 0.225), birth weight (p = 0.481), need for resuscitation (p = 0.555), admission into the newborn intensive care unit, NICU (p = 0.445) and early neonatal deaths (p = 0.199) were not statistically different. The mean duration of hospital admission, APGAR scores at the first and fifth minute, indications for NICU admission and causes of early neonatal deaths are shown in Table 3.

Multivariate logistic regression analysis (Table 4) demonstrated that there was no significant difference in the primary outcomes; repeat miscarriage (p = 0.667), stillbirth (p = 0.972), low APGAR scores at the fifth minute (p = 0.233) and neonatal death (p = 0.182) even after adjusting for maternal age, parity of the mothers, number of prior miscarriages, gestational age of the immediate last miscarriage and how the last miscarriage was managed.

Discussion

This study was designed to assess the impact of IPI <6 months (short IPI) versus IPI ⩾6 months on the obstetric outcome (live births, repeat miscarriages, placenta praevia, hypertensive disorders of pregnancy, preterm contractions and labour, PROM, IUFD and IUGR, mode/route of delivery, blood loss for vaginal and caesarean section deliveries, birth weight, need for resuscitation, admission into the newborn intensive care unit (NICU), and early neonatal deaths) in the next pregnancy following a miscarriage. The result showed that the two study cohorts had similar socio-demographic and obstetric characteristics, thus limiting potential bias which could arise from significant differences in

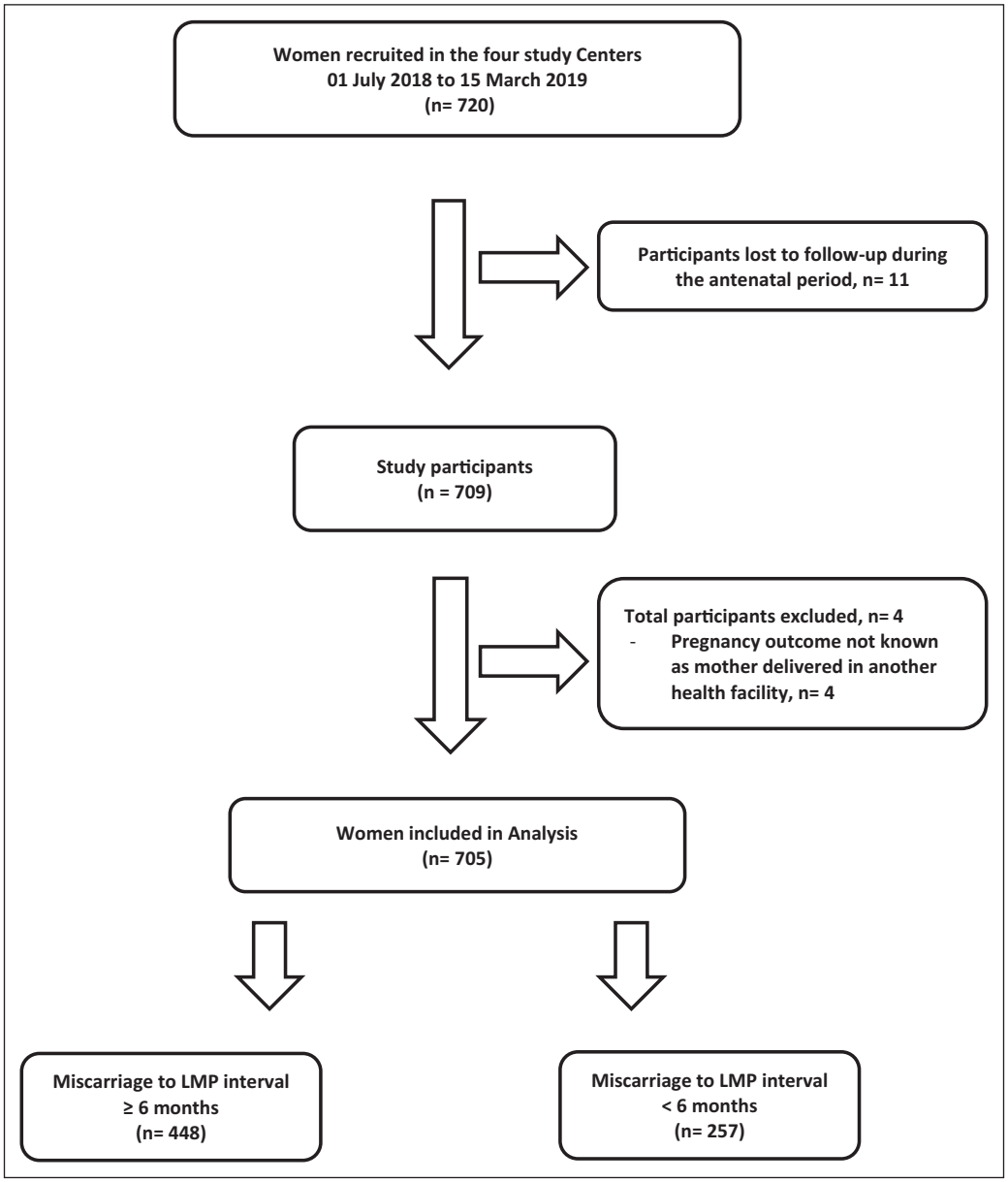

Figure 1. Selection and follow-up of study cohorts.
LMP: last menstrual period.

characteristics of the participants. It was also observed that over 80% of the participants had first-trimester pregnancy losses and these participants were managed with manual vacuum aspiration in 73.3% of the cases. The majority, 87.5% for the normal IPI cohort and 86.4% for the short IPI cohort had live births, while 8.5% and 10.1% of the women in the normal and short IPI cohorts, respectively, had repeat miscarriages. There was no observed statistical difference in the occurrence of live births and repeat miscarriages between both cohorts ($p > 0.05$). There was no increased risk of occurrence of adverse foetomaternal outcomes in both groups ($p > 0.05$). Multivariate logistic regression analysis showed that there was no statistical difference in the occurrence adverse foetomaternal outcomes between the studied cohorts.

This study corroborated the fact that majority (80%) of miscarriages occur during the first trimester as reported in several studies globally.[24–26] In contrast, a report on the occurrence of early pregnancy loss was reported only in 43% of the participants in a retrospective study of spontaneous first-trimester miscarriage rates per woman among parous women with one or more pregnancies of 24 weeks or more by Cohain et al.[27] in Jerusalem, Israel. They blamed the low reporting of first trimester miscarriages may have occurred due to underreporting, perhaps due to denial, forgetfulness, and/or miscarriage mistaken for delayed menstruation. Early pregnancy losses before pregnancies were clinically detectable and was identified to have occurred in 22% of the women studied by Wilcox et al.[24] in a US cohort study.

Table 1. Baseline socio-demographic characteristics of study participants.

Socio-demographic characteristics	Sub-category	Miscarriage to LMP interval ⩾6 months (n = 448)	Miscarriage to LMP interval <6 months (n = 257)	p
Mothers' age (years)	<20	2 (0.4%)	3 (1.2%)	0.309
	20–34	352 (78.6%)	209 (81.3%)	
	⩾35	94 (21.0%)	45 (17.5%)	
Marital status	Single	1 (0.2%)	2 (0.8%)	0.558
	Married	447 (99.8%)	255 (99.2%)	
Educational qualification	Primary education and below	37 (8.3%)	18 (7.0%)	0.565
	Secondary education and above	411 (91.7%)	239 (93.0%)	
Occupation	Not employed	98 (21.9%)	65 (25.3%)	0.309
	Employed	350 (78.1%)	192 (74.7%)	
Religion	Christianity	439 (98.0%)	246 (95.7%)	0.099
	Islam	9 (2.0%)	11 (4.3%)	
Parity	0	151 (33.7%)	81 (31.5%)	0.136
	1–4	274 (61.2%)	170 (66.1%)	
	⩾5	23 (5.1%)	6 (2.3%)	
No. of miscarriages in the past	1 miscarriage in the past	311 (69.4%)	188 (73.2%)	0.303
	⩾2 miscarriages in the past	137 (30.6%)	69 (26.8%)	
Gestational age of last miscarriage (weeks)	1–13	367 (81.9%)	215 (83.7%)	0.607
	⩾14	81 (18.1%)	42 (16.3%)	
How was the last miscarriage managed?	Expectant management	54 (12.1%)	25 (9.7%)	0.014
	Medical management with uterotonics	56 (12.5%)	53 (20.6%)	
	Manual vacuum aspiration (MVA)	338 (75.4%)	179 (69.7%)	
Post-abortal complication in previous miscarriages[a]	Haemorrhage	4 (0.9%)	1 (0.4%)	0.658
	Retained products of conception	3 (0.7%)	1 (0.4%)	1.000
	Cervical incompetence[b]	2 (0.4%)	1 (0.4%)	1.000
	Delayed fertility[c]	27 (6.0%)	6 (2.3%)	0.026
	Pyrexia	8 (1.8%)	4 (1.6%)	1.000
	Uterine synechiae	11 (2.5%)	3 (1.2%)	0.277

LMP: last menstrual period.
[a]More than one complication can apply in a respondent.
[b]Cervical incompetence was diagnosed in those with two more previous miscarriages before the index pregnancy.
[c]Delayed fertility is defined as being unable to conceive for 1 year after the last miscarriage despite desiring to conceive.

Table 2. Association between interpregnancy interval and complications of pregnancy beyond 20 weeks gestation in the subsequent pregnancy.

Complications during index pregnancy beyond 20 weeks' gestation (n = 641)[a]	Miscarriage to LMP interval ⩾6 months (n = 410)	Miscarriage to LMP interval <6 months (n = 231)	p
APH due to placenta praevia[b]	2 (0.5%)	0 (0.0%)	0.538
Threatened miscarriage	8 (2.0%)	7 (3.0%)	0.420
Required cervical cerclage for cervical incompetence	2 (0.5%)	1 (0.4%)	1.000
Hypertensive disorders of pregnancy	17 (4.1%)	4 (1.7%)	0.111
Preterm contractions and labour	19 (4.6%)	5 (2.2%)	0.133
Premature rupture of membranes (PROM)	16 (3.9%)	6 (2.6%)	0.500
Intrauterine foetal death (IUFD)	0 (0.0%)	2 (0.9%)	0.130
Intrauterine growth retardation	1 (0.2%)	2 (0.9%)	0.557

LMP: last menstrual period; APH: antepartum haemorrhage.
[a]More than one complication can apply.
[b]Hypertensive disorders of pregnancy = non-proteinuric (gestational) hypertension, preeclampsia, eclampsia.

Table 3. Association between interpregnancy interval and obstetric outcomes in the subsequent pregnancy.

Obstetric outcomes in the subsequent pregnancy	Sub-category	Miscarriage to LMP interval ⩾6 months (n = 448)	Miscarriage to LMP interval <6 months (n = 257)	p
Birth outcome of the subsequent pregnancy	Live birth	392 (87.5%)	222 (86.4%)	0.734
	Stillbirth	18 (4.0%)	9 (3.5%)	
	Miscarriage	38 (8.5%)	26 (10.1%)	
Gestational age at birth (N = 641)[a]	Preterm (GA <37 weeks)	333 (81.2%)	187 (81.0%)	1.000
	Term (GA ⩾37 weeks)	77 (18.8%)	44 (19.0%)	
Mode of delivery of index pregnancy (N = 641)[a]	Vaginal delivery	306 (74.6%)	177 (76.6%)	0.575
	Caesarean section	104 (25.4%)	54 (23.4%)	
Blood loss during delivery (N = 641)[a]	M ± SD (mL) for vaginal delivery	221.04 (±99.6)	192.50 (±111.8)	0.174
	M ± SD (mL) for caesarean section	402.14 (±140.8)	368.9 (±115.3)	0.225
Duration of admission for mother (N = 641)[a]	M ± SD (in days)	3.67 (±2.33)	3.42 (±2.30)	0.429
Birth weight, g (N = 641)[a]	<2500	53 (12.9%)	25 (10.8%)	0.481
	2500–3999	319 (77.8%)	189 (81.8%)	
	⩾4000	38 (9.3%)	17 (7.4%)	
Did baby need assistance to breath? (N = 614)[b]	Yes	55 (13.4%)	35 (15.2%)	0.543
	No	355 (86.6%)	196 (84.8%)	
APGAR scores at 1 min (N = 614)[b]	Low/abnormal (0–6)	57 (13.9)	39 (16.9)	0.310
	Moderate/normal (>6)	353 (86.1%)	192 (83.1%)	
APGAR scores at 5 min (N = 614)[b]	Low/abnormal (0–6)	25 (6.1%)	22 (9.5%)	0.110
	Moderate/normal (>6)	385 (93.9%)	209 (90.5%)	
Admission into NICU (N = 614)[b]	Admitted	67 (16.3%)	44 (19.0%)	0.385
	Not admitted	343 (83.7%)	187 (81.0%)	
Indication for admission into NICU (N = 614)[b]	Birth asphyxia	23 (5.6%)	19 (8.3%)	0.189
	Complication of prematurity	19 (4.6%)	11 (4.8%)	0.941
	Respiratory distress syndrome	17 (4.1%)	9 (3.9%)	0.877
	Congenital anomalies	0 (0.0%)	1 (0.4%)	0.182
	Foetal macrosomia	5 (1.2%)	0 (0.0%)	0.165*
	Hypoglycaemia	1 (0.2%)	2 (0.9%)	0.296*
	Phototherapy for neonatal jaundice	2 (0.5%)	2 (0.9%)	0.622*
Neonatal death (N = 614)[b]	Yes	18 (4.6%)	16 (7.2%)	0.169
	No	392 (95.6%)	215 (93.1%)	
Cause of death (N = 614)[b]	Birth asphyxia	9 (2.2%)	8 (3.5%)	0.337
	Severe prematurity	4 (1.0%)	5 (2.2%)	0.295*
	Respiratory distress syndrome	5 (1.2%)	2 (0.9%)	1.000*
	Congenital anomalies	0 (0.0%)	1 (0.4%)	0.360*

LMP: last menstrual period; GA: gestational age; SD: standard deviation; NICU: neonatal intensive care unit.
[a]N = 641, as miscarriage cases were deselected.
[b]N = 614, as women who had miscarriage and stillbirths were deselected.
*Fisher's exact test.

Table 4. Association between interpregnancy interval and primary obstetric outcomes in the subsequent pregnancy.

Obstetric outcomes in the subsequent pregnancy	Miscarriage to LMP interval ⩾6 months AOR[a] (95% CI)	Miscarriage to LMP interval <6 months AOR[a] (95% CI)	p
Repeat miscarriage	1.000 (Reference)	1.222 (0.490–3.050)	0.667
Stillbirth	1.000 (Reference)	1.027 (0.236–4.472)	0.972
Low birth weight	1.000 (Reference)	0.544 (0.192–1.540)	0.251
Need assistance to breath	1.000 (Reference)	1.151 (0.503–2.635)	0.739
Low APGAR score at 5 min	1.000 (Reference)	3.338 (0.860–12.959)	0.082
Admission into NICU	1.000 (Reference)	1.439 (0.719–2.882)	0.304
Neonatal death	1.000 (Reference)	2.091 (0.675–6.483)	0.201

LMP: last menstrual period; AOR: adjusted odds ratio; NICU: neonatal intensive care unit.
[a]Adjusted for maternal age, parity of the mother, number of prior miscarriages, gestational age of last miscarriage and how the last miscarriage was managed.

Majority (73.3%) of the participants had manual vacuum aspiration in this study and this finding is much similar to the treatment method that was used among 3000 Finnish women that participated in a survey.[28] The continued prevalent use of the surgical approach for the evacuation of the uterus may not be unconnected to the possible occurrence of incomplete miscarriage and unplanned surgical evacuation which complicates the medical method in some patients.[29] Also, the poor awareness and utilization of standard treatment guidelines,[30] prevalence of supplier-induced demand,[31] poor counselling, restrictive abortion laws[32] and asymmetry of information[33] between the patients and their doctors especially in the study area may have played a significant role in making surgical method a preferred method by the health practitioners. This preponderance of treatment using surgical method was, however, different from findings in other studies[34,35] where medical management was applied and found to have comparable outcomes with the surgical methods, especially since the introduction of prostaglandins as an efficient method of medical evacuation. The convenience of medical method, reduction of occurrence of uterine synechiae, absence of use of anaesthesia and the resultant comparable outcomes with surgical methods made it an easier and convenient method of uterine evacuation recently.[36,37] The use of medical management also reduces drastically the need for specialized surgical skills and therefore encourages task shifting and task sharing, making it easy to use even in secondary[34] and primary health care facilities.[38]

Overall, there were no significant differences in adverse obstetric and perinatal risk to the mother and baby, between the two groups studied. This is corroborated by the study in Scotland, United Kingdom, where women who conceived within 6 months of an initial miscarriage had the best reproductive outcomes and lowest complication rates in the next pregnancy.[3] The current study showed that getting pregnant within 6 months of a miscarriage did not predispose parturient to a significantly higher risk of another miscarriage in the next pregnancy (8.5% in the ⩾6 months IPI cohort versus 10.1% in the <6 months IPI cohort), this finding was higher than 7.3% repeat miscarriage for IPI <3 months reported by Sundermann et al.[39] in Tennessee, United States. However, a systematic review and meta-analysis reported that the risk of a recurrent pregnancy loss was less in women who had post-abortion IPI <6 months.[40] This was contrary to the finding in Bangladesh, where short inter-outcome intervals after a spontaneous miscarriage were associated with a high risk of a similar outcome in the next conception.[41] However, the live birth outcome for both arms was similar (87.5% for ⩾6 months IPI cohort versus 86.4% for the <6 months IPI cohort). This outcome is primarily very important to women in the study area as most of them are interested in knowing from the doctor the safest time of getting pregnant after a pregnancy loss. This outcome was in tandem with 76.5% live birth reported by Wong et al.[4] However, Love et al.[3] in Scotland, reported a live birth outcome of 85.2% in women with IPI <6 months. These reports of higher live birth outcomes are consistent with the outcome of a systematic review and meta-analysis by Kangatharan et al.,[40] where the chance of having a live birth was 40% higher in women with IPI <6 months. Nigerians and Africans in general attach a lot of premium to childbirth in their families. Most of the women out of pressures from their relatives to get a child for them in the new family will most likely want to get pregnant within the window of short IPI to narrow the waiting time for a child to be born in their families.

This study also showed that there was no difference in the risk of hypertensive disorders of pregnancy, low birth weight, preterm labour, PROM, IUFD/stillbirth and IUGR, between the two groups. This finding was much the same as that by Kangatharan et al.,[40] except for preterm birth which they reported to be lower in women with IPI <6 months. However, in Scotland, Love et al.[3] reported that the risk of these low birth weight and preterm delivery was less in the parturient with IPI <6 months. These results were contrary to that by Conde-Agudelo et al.,[2] where these complications were more in those with IPI <6 months, except for preeclampsia and low birth weight that were not significantly different in both groups. Preterm birth was also found to have increased odds ratio in women with IPI <1 or >3 years after a live birth.[42] In Denmark, Hegelund et al.[43] found that preterm birth and small for gestational age babies were lowest in women with IPI between 18 and 23 months compared to those with short IPI; these findings were, however, comparable to the report by Zhang et al.[44] in China.

There was no difference in the mode of delivery by either caesarean section or vaginal birth between both arms. Also, blood loss for vaginal delivery and caesarean section was comparable with no higher risk of primary postpartum haemorrhage (PPH) in either group. In contrast, Love et al.[3] and El Behery et al.,[13] independently reported that the risk of having a caesarean section, after an IPI of <6 months, after a miscarriage was less. Furthermore, this study showed that there was no higher neonatal resuscitation for birth asphyxia, newborn intensive care unit admissions and early neonatal deaths. Correspondingly, Morgan-Ortiz et al.[45] reported that APGAR scores were similar between the similar cohorts, with no differences in the perinatal morbidity, akin Goldstein et al.[46] reported that neonatal outcomes for the two groups were similar, although neonates in the longer IPI conception arm were more likely to have low birth APGAR score <7 at 5 minutes, or admission to the neonatal intensive care unit. However, in a similar study by DaVanzo et al.,[47] which assessed late neonatal morbidity and mortality, it was found that post-miscarriage IPI of ⩽3 months was associated with significantly higher late neonatal mortality and IPI of 12–18 months was associated with a significantly lower unadjusted risk of post-neonatal mortality.

Finally, most women and at large their families in Nigeria and most low-income countries, place a high premium on

children. They are also eager to know the safest possible time for them to become pregnancy after a pregnancy loss. The implication of the results of this research is that with further research works on this research topic in a similar setting as in this study, our policies in the management of women after a miscarriage should be changed to reflect the findings of this research. By implication of this research, and with proper patient selection (depending on her pre-pregnancy morbid conditions), our women can also be counselled and encouraged to get pregnant within the short IPI timing and expect good foetomaternal outcomes.

Strengths /limitations of the study: Most of the aspects of the cohort study were conducted by the generation of primary data. The reliability of primary data collected from multiple centres and proper follow-up of the participants therefore gives this study an edge. This local study is one of the very few in Nigeria and other LMICs and will help in the development of policies that will guide health practitioners in counselling mothers who had a miscarriage and are eager to get pregnant as soon as feasible. This is even more important these days where women continue childbearing into their advanced ages with the attendant adverse events.[48] However, the sample size was relatively smaller and recall of events associated with the previous miscarriage was subjective and maybe a source of bias.

Conclusion

IPI <6 months following a miscarriage was not associated with increased maternal and perinatal complications. Therefore, women who suffered uncomplicated pregnancy losses and who desires future conception should not be deterred from doing so before 6 months.

We recommend that counselling women on the optimum IPI after a spontaneous miscarriage should be individualized with proper risk assessment instead.

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Author contributions

L.O.L., P.E., J.T.E. and C.A.I. designed the study, oversaw its conduct, data collection, data analysis, interpretation of results, drafted the original article and reviewed the final draft. F.N.I. and N.O.E. contributed to the design of the study, data collection and review of the article. C.I.U. and U.J.A. participated in the design of the study, analysis and interpretation of data and the review of the final manuscript. All the authors read and approved the final draft of the article.

Availability of data and materials

The datasets used and/or analysed during this study are available from the corresponding author on reasonable request.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Ethical approval and consent to participate

The study was approved primarily by the Human Research and Ethics Committee (HREC) of Alex-Ekwueme Federal University Teaching Hospital, Abakaliki (FETHA/REC/VOL1/2019/540). Ethical approval was granted by the Ethics Review Committee of all four participating health facilities; Alex-Ekwueme Federal University Teaching Hospital in Abakaliki, Ebonyi State; University of Nigeria Teaching Hospital (UNTH) in Enugu, Enugu State; Enugu State University Teaching Hospital (ESUTH) in Enugu, Enugu State; and Stella Obasanjo Hospital (SOH) in Benin City, Edo State. All four hospital research committees determined that the study did not constitute a human subject trial and therefore approved the protocol for the research.

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Informed consent

Written informed consents were obtained from all the parturients at the point of recruitment for them to be interviewed and for their medical records to be used for this study. Mothers younger than 18 years of age were excluded from the study.

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Supplemental material

Supplemental material for this article is available online.

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