Original Article

Association of long and short interpregnancy intervals with maternal outcomes

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Abstract

Background: Interpregnancy interval (IPI) is spacing between live birth and beginning a new pregnancy. Both long and short IPIs have been associated with adverse maternal outcomes. There is paucity in the Indian literature regarding the impact of IPI on maternal outcomes. **Materials and Methodology:** The cross-sectional study was conducted in the Department of Obstetrics and Gynecology, King George's Medical University, Lucknow, from July 2019 to June 2020. Women with previous abortions, previous stillbirth, nulliparity, or multiple pregnancies were excluded. A pre-structured pro forma was used for demographic details. IPI was categorized as <6 months, 6 to <24 months, 24 to <60 months, and 60 months. Maternal outcomes were studied, and odds ratios were calculated. **Results:** There were 6984 deliveries in the period. A total of 4812 women were enrolled after following the inclusion and exclusion criteria. Of 4812 women, 142 (2.9%) had IPI <6 months, 3336/4812 women (69.3%) had IPI 6 to <24 months, 1144/4812 women (23.7%) had IPI 24 to <60 months, and 3.9% women (190/4812) had IPI ≥60 months. High risk of fetal malposition (OR 3.84), fetal growth restriction (OR 2.06), and hypertension (OR 1.86) were seen in women with short IPI <6 months. Women with longer IPI (≥ 60 months) had higher chances of preterm labor (OR 3.82), oligoamnios (OR 2.54), gestational diabetes (OR 2.19), and anemia (OR 1.45) **Conclusion:** Three-fourths of women had IPI less than 24 months recommended as minimum interval by WHO. Efforts are needed to increase awareness and availability of contraceptive choices for postpartum women to ensure adequate spacing.

Keywords: Birth spacing, contraception, interpregnancy interval, maternal outcomes

Background

India is the second most populous country in the world, and the increasing population has put immense pressure on existing infrastructure. Although the government has implemented national programs to increase contraceptives usage to space childbirths, there is still a gap in knowledge, attitude, and practice. As per NFHS-4, there is an 18–20% unmet need for family spacing.[1] The short intervals between subsequent pregnancies may jeopardize the mother's health, so practicing birth spacing is very important. Among the various intervals between pregnancies studied, the interpregnancy interval (IPI) is defined as spacing between live birth and beginning a new pregnancy. It is also referred to as birth to pregnancy interval. The World Health Organization now recommends that the gap between a woman's previous live birth and her subsequent conception (IPI) should be a minimum of 2 years.[2]

IPI influences pregnancy outcomes as reported in the literature through several theories. According to the maternal depletion hypothesis, maternal nutrients (particularly folate) are not replenished sufficiently between closely spaced pregnancies, particularly among breast-feeding mothers, leading to adverse

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pregnancy outcomes. A large prospective cohort study from the Netherlands reported a negative association between short IPI and fetal growth. Among them, those women who did not use folic acid supplements were at greater risk of fetal growth restriction after a short IPI.[3]A continuum of an infectious process extending from birth to subsequent pregnancy may contribute to adverse pregnancy outcomes in women with short IPI.[4] Other factors like cervical insufficiency, competition between siblings for maternal resources, and suboptimal strength of uterine scar from previous cesarean delivery are also proposed as a link between short IPI and poor obstetric and perinatal outcomes.

The physiologic regression hypothesis explains the association between long IPI and adverse pregnancy outcomes. After a longer interval after one pregnancy, a woman behaves like a primigravida. Longer interpregnancy intervals have also been associated with increased risk of preeclampsia, especially when longer than 10 years.[5]

A shorter IPI may reflect differences in socioeconomic class, lifestyle, access, and acceptance to contraception affecting feto-maternal outcomes. Short intervals can be avoided through the postpartum provision of contraception. However, avoidance of long IPI is not much controllable since it is guided by factors such as subfertility, availability of a partner, financial or occupational issues, and illnesses. Thus, the critical question lies whether such modification improves the outcome of the subsequent pregnancy or not. In a systematic review published in 2015 on the impact of IPI on maternal outcomes where IPI <12 months was studied, the evidence for maternal outcomes was found to be insufficient to warrant definitive conclusions. The authors suggested future high-quality studies in low-income nations.[6] Very little data on the impact of IPI on Asian ethnicity have been studied as yet. So, this study was planned to study the demographic factors with different interpregnancy intervals and the association of interpregnancy intervals with the maternal outcome in a large tertiary center in one of the most populous states of our country. Since a large sector of our population resides in rural areas and reaches out to primary physicians at the first point, the need to understand the impact of interpregnancy interval is very necessary. Primary care physicians can play an important role in advocating the importance of adequate intervals between consecutive pregnancies.

Materials and Methodology

The study was conducted in the Department of Obstetrics and Gynecology, for 1 year from July 2019 to June 2020. Ethical approval was taken from the institute's ethical committee. It was a cross-sectional study in which all the women with previous live birth and who delivered in the hospital were enrolled in the postpartum ward. Women with prior abortions, previous stillbirth, nulliparous women, or multiple pregnancies were excluded. Written informed consent was taken at the time of enrolment. Women who declined to participate were excluded from the study. A pre-structured pro forma was used, and demographic details of the women, including age, area of residence, literacy, and occupation, were noted. The primary variable was IPIs, defined as spacing between live birth and the beginning of a new pregnancy. The IPI was measured in months. In this study, the IPI was categorized as below 6 months, 6 to <24 months, 24 to <60 months, and more than or equal to 60 months. As per WHO norms, the minimum interval recommended following a live birth is 24 months; hence, 24 to <60 months was taken as reference interval and maternal outcomes compared with reference interval.

Maternal outcomes included were the presence of hypertensive disorder of pregnancy,[7] gestational diabetes mellitus (GDM),[8] anemia,[9] fetal growth restriction, amniotic fluid disorders, congenital anomalies, placental abnormalities, preterm labor, operative intervention, and postpartum hemorrhage. In addition, labor complications including labor dystocia and mode of delivery were noted.

Statistical analysis

The descriptive statistic and frequency distribution (wherever applicable) were performed on all the variables used in the analysis. In addition, the Chi-square test of association and correlation was calculated between the outcome variable and covariates. Finally, the odds ratio of maternal complications was calculated based on the reference interval. The statistical analysis was performed using SPSS software version 21.

Results

There were a total of 6984 deliveries in the period. (This period included the COVID-19 pandemic period from March 22, 2020, to July 2020 when there was a complete lockdown in the area and the number of deliveries was reduced.) Of them, 4812 women were enrolled after following the inclusion and exclusion criteria. The various demographic parameters of the women enrolled were studied. IPI was calculated as the number of months from the last delivery of live birth to the beginning of the present pregnancy. The IPI months calculated were <6 months, 6 to <24 months, 24 to <60 months, and ≥60 months. Of 4812 women, 142 women (2.9%) had IPI < 6 months. The majority of women, i.e., 3336 of 4812 women (69.3%), had IPI from 6 to <24 months, followed by 1144 of 4812 women (23.7%) who had IPI 24 to <60 months. A small percentage of women, 3.9%, i.e., 190 of 4812 women enrolled in the study, had a long IPI ≥60 months. The demographic profile of women enrolled in the study is shown in Table 1.

There is a statistically significant difference in age distribution in women with different IPIs. Three-fourths of young women (age <20 years) had IPI <24 months. Among women >35 years of age, IPI was >24 months in 35% of women ($P = 0.004$). Primipara women have shorter IPI than those with increased parity ($P < 0.05$). There was no difference in IPI with regard to women's education ($P = 0.068$); however,

Table 1: Demographic profile of women enrolled

Characteristics	Interpregnancy interval				*n*	*P*
	<6 months *n* (%)	6-<24 months *n* (%)	24-<60 months *n* (%)	≥60 months *n* (%)		
Total	142	3336	1144	190		
Age						
<20 years	2 (16.7)	7 (58.3)	2 (16.7)	1 (8.3)	12	0.004
20-35 years	128 (2.9)	3110 (69.9)	1042 (23.4)	168 (3.8)	4448	
>35 years	12 (3.4)	219 (62.2)	100 (28.4)	21 (6.0)	352	
Mean age (years)	29.1±5.2	28.9±4.3	29.1±4.7	31.0±4.9		
Place of residence						
Urban	78 (2.9)	1868 (70.6)	594 (22.4)	107 (4.0)	2647	0.119
Rural	64 (3.0)	1468 (67.8)	550 (25.4)	83 (3.8)	2165	
Parity						<0.05
1	16 (7.0)	176 (77.2)	19 (8.3)	17 (7.4)	228	
2	59 (2.7)	1469 (67.8)	569 (26.3)	70 (3.2)	2167	
3	45 (3.0)	1078 (72.2)	313 (21.0)	57 (3.8)	1493	
≥4	22 (2.4)	613 (66.3)	243 (26.3)	46 (5.0)	924	
Education						
<8th grade	96 (3.2)	2115 (70.5)	688 (22.9)	103 (3.4)	3002	0.068
9-12th grade	33 (2.3)	951 (67.2)	363 (25.7)	68 (4.8)	1415	
Graduate	12 (3.2)	261 (68.9)	89 (23.5)	17 (4.5)	379	
Postgraduate	1 (6.2)	9 (56.2)	4 (25.0)	2 (12.5)	16	
Husband's education						
<8th grade	79 (3.9)	1477 (72.2)	427 (20.9)	62 (3.0)	2045	<0.05
9-12th grade	41 (2.1)	1333 (67.6)	502 (25.5)	95 (4.8)	1971	
Graduate	20 (2.6)	507 (67.1)	199 (26.3)	30 (4.0)	756	
Postgraduate	2 (5.0)	19 (47.5)	16 (40.0)	3 (7.5)	40	
Socioeconomic scale						
Lower class	0 (0)	1 (33.3)	2 (66.7)	0 (0)	3	<0.05
Upper-lower class	106 (3.3)	2306 (70.7)	726 (22.3)	122 (3.7)	3260	
Lower-middle class	34 (2.2)	1016 (67.2)	395 (26.1)	67 (4.4)	1512	
Upper-middle class	2 (8.0)	7 (28.0)	15 (60.0)	1 (4.0)	25	
Upper class	0 (0)	6 (50.0)	6 (50.0)	0 (0)	12	
ANC visits						<0.05
≤4	97 (3.3)	1967 (68.6)	674 (23.5)	128 (4.4)	2866	
5-8	39 (2.5)	1124 (71.1)	376 (23.8)	41 (2.6)	1580	
≥8	6 (1.6)	245 (66.9)	94 (25.7)	21 (5.7)	366	

longer IPI was observed in women whose male partners were educated ($P < 0.05$). Women in the upper-middle or upper socioeconomic class had longer IPI ($P < 0.05$). Similarly, antenatal visits also had a statistically significant association with IPI; longer IPI was associated with more antenatal visits ($P < 0.05$). Mode of delivery was seen in different IPIs, and it was evident that though a similar number (55%) of women in IPI 6 to <24 months and reference interval had lower segment cesarean section (LSCS), more (60% vs. 40%) women with short IPI, i.e., less than 6 months, had LSCS ($P < 0.05$), as shown in Table 2.

The odd's ratio of obstetric complications with different pregnancy complications was calculated with reference intervals being 24 to <60 months, as shown in Table 3. Seven women in the study had labor dystocia. Two women had IPI ≥24 months, and the rest five women had IPI <24 months. Twenty-four women of 4812 (0.5%) had a postpartum hemorrhage, and two-thirds of them (16/24; 66.7%) had IPI <24 months as compared to six women with IPI from 24 to <60 months and two women with IPI ≥60 months ($P = 0.58$). Forty-four (0.9%) women had sepsis in the postpartum period, and among them, 31 women had IPI between 6 and <24 months ($P = 0.427$). In addition, there were 12 women (0.2%) with a congenital anomaly, and of them, 11 women had IPI <24 months ($P = 0.407$).

Discussion

Interpregnancy interval is representative of the attitude, awareness, and desire of couples to plan pregnancy. It was seen in this study that three-fourths (73%) of women had IPI less than 24 months, recommended as the minimum interval by WHO, and of them, 3% of women had a short IPI of less than 6 months. In a large study conducted by Agustin Conde–Agudelo *et al.*[10] from 1985 to 2004 in Latin America, 1,125,430 women were enrolled. It was seen that about 46.2% of women had IPI less than 24 months; among them, 3% had IPI less than 6 months. Twenty percent of women had IPI >60 months.[10] Similarly, Fredrik J de Weger conducted a retrospective cohort

Table 2: Maternal outcomes of women in relation to IPI

Characteristics	Interpregnancy interval				*P*
	<6 months	6-<24 months	24-<60 months	≥60 months	
Mode of delivery	142	3336	1144	190	
LSCS	84 (59.1)	1825 (54.7)	637 (55.6)	80 (42.1)	<0.05
VD	58 (40.8)	1511 (45.2)	507 (44.3)	110 (57.8)	

study among 263,142 Dutch women and observed that 49% of women had IPI <24 months; of them, 3.8% women had short IPI (<6 months).[11] Thus, the percentage of women with shorter IPI was considerably higher (almost twice) in the present study than in earlier studies, pointing toward significant gaps in contraceptive practice.

In our study, 70% of women belonged to the lower socioeconomic class, and among them, three-fourths of women had IPI less than 24 months; however, in the upper-middle class, IPI less than 24 months was seen in 36% of women. Similarly, a study conducted among 263,142 Dutch women also had 70% women who belonged to low socioeconomic class and 82% of women among them had IPI less than 24 months.[11] This study conducted in our hospital showed that 55% of women belonged to the urban area and about 45% belonged to the rural area. No significant difference was noted among women residents with different IPIs. (71% from rural areas and 74% from urban areas had IPI less than 24 months.) Hence, this study showed that younger women with less parity and poor socioeconomic classes had shorter IPI. The literary status of the husband was directly linked to the duration of IPI, making them an essential part of decision-making in planning families. Women with shorter IPI had fewer antenatal visits. It is similar to observations from studies in developing countries where women with short IPI were likely to be younger, came from rural areas, had low education levels, and had low socioeconomic status[10]; they also received poor antenatal care.[12]

Zhu *et al.*[13] did an extensive study on 173,205 nulliparous women in Utah. They observed a J-shaped association between IPI and several obstetric outcomes with odds at lowest at 18 to 23 months and increased with longer IPI, especially those over 60.[13] Similarly, in 2006, Conde-Agudelo and colleagues conducted an international systematic review and meta-analysis that included many of the above studies. They replicated the "J-shaped" relationship between IPIs and preterm birth. In this review, an IPI of 18 to 23 months consistently conferred the lowest risk of preterm birth.[14] Razzaque *et al.*,[15] in a cross-sectional study from Bangladesh in 11,122 women, found a threefold increase in preterm premature rupture of membranes (PPROM) in women with an IPI of 6–14 months compared with an IPI of 27–50 months.

This study found a high risk of fetal malposition (OR 3.84), twice the risk of fetal growth restriction in women with short IPI (<6 months). The risk of hypertension was also found twice in women with short IPI, i.e., <6 months. However, there was no difference in preterm birth or anemia with short IPI. Similarly, Razzaque *et al.*[15] found that preeclampsia and high blood pressure are significantly more likely for women with preceding interpregnancy intervals of less than 6 months or 75 months or more than those with intervals of 27–50 months. Higher rates of maternal anemia in pregnancy after short IPI were found to be a 30% increased risk when women conceived within 6 months after the index pregnancy (Conde-Agudelo 2000).[16] In two other studies from Bangladesh[15] and Singapore,[17] no significant association was found between interpregnancy interval and maternal anemia.

Women with longer IPI (>60 months) had three times the chances of preterm labor. Anemia was also more common in women with IPI >60 months. GDM was seen more often (OR = 2.19) in women with IPI longer than 60 months, probably due to their advanced age. In this study, it was seen that more number of women had LSCS than vaginal delivery in all the groups; however, it was significantly more in women with IPI <6 months. As a policy, women with short IPI (<6 months) are offered a cesarean section in this institute. In the rest of the groups as well, the trend corresponds with a high cesarean rate in the institute as women are referred to with medical and obstetrical complications warranting cesarean section.

In 2014, Ball *et al.*[18] did a retrospective cohort study in Australia where 40,441 women who delivered three live-born singleton neonates were enrolled. Within the mother, analysis of IPI was performed, and it failed to show any significant association between interpregnancy interval and preterm birth. This study questioned the causal effect of short IPI on adverse birth outcomes and pointed to the possibility of unmeasured confounding maternal risk factors.[18]

In 2017, 38,178 women with three or more deliveries in Canada were taken (Hanley GE *et al.*[19]). IPI was examined with reference as 18–23 months. It was seen that even while traditional design showed an increased risk of preterm birth in 0–5 months (OR 1.53, 1.35–1.73), the matched design using women as their controls showed a higher risk of GDM (adjusted OR 1.35, 95% CI 1.02–1.80) for 0–5 months and obesity and similar preterm birth rate.[19] Thus, these studies have refuted the evidence that short IPI can lead to preterm birth and the previous results could be due to many confounders like illiteracy and poor socioeconomic status. In contrast, a recent study in California by Liu *et al.*[20] analyzed the association between IPI and significant maternal morbidity across sequential pregnancy. It was found that short IPI (<6 months) had similar morbidity when compared

Table 3: Odds ratio of maternal complications in relation to IPI

IPI	Preterm		Malposition		APH		FGR		Oligo		GDM		Anemia		Hypertension		PPROM	
months	OR	95%CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<6	0.62	0.08-4.75	3.84*	1.44-10.26	0	0	2.06*	1.27-3.33	0.59	0.14-2.51	1.12	0.64-1.94	0.74	0.47-1.16	1.86*	1.21-2.85	1.10	0.55-2.17
6-<24	0.95	0.50-1.80	0.60	0.31-1.20	0.85	0.66-1.08	0.79	0.62-1.01	0.93	0.59-1.45	1.04	0.83-1.29	0.93	0.79-1.09	1.22*	1.01-1.49	0.98	0.75-1.29
24-<60	Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference		Reference	
≥60	3.82*	1.56-9.36	0.46	0.06-3.54	0.34*	0.15-0.79	1.19	0.72-1.97	2.54*	1.24-5.22	2.19*	1.47-3.29	1.45*	1.04-2.03	1.06	0.68-1.64	1.42	0.82-2.47

to women with an IPI of 18–23 months. However, women with longer IPI (24–59 months) and ≥60 months had higher morbidity in between mother and within mother comparison.[20] Similarly, higher severe maternal morbidity, more maternal sepsis, and need for ventilatory support were reported in women with IPI ≥60 months as per the retrospective study by Garg *et al*.[21] The study also found that women with short IPI (<6 months) had higher maternal morbidity in comparison with women with an IPI of 18–23 months.

To our knowledge, this is the first large study in India on around 5000 women to understand the effect of IPI on maternal outcomes. However, this study had its limitations. All the women were enrolled in the postpartum ward. Hence, the study did not include women who had life-threatening morbidity and mortality. This study was focused only on maternal outcomes with IPI, and perinatal outcomes were not studied. Moreover, since it is a hospital-based study conducted in a tertiary referral center, it does not truly reflect the actual effect of IPI on the population in the community. A further study is planned to study the relation of IPI with maternal and perinatal outcomes in health facilities at the community level.

India is a populous nation and has a huge unmet need for contraception. It was seen that the majority of women had short IPI that is less than 24 months, recommended as minimum interval by WHO. This study highlights the dismal family spacing attitude among couples. Various demographic factors like poor literacy status and lower socioeconomic class were directly associated with it. Short IPI was associated with fetal growth restriction (FGR) and malposition. Prolonged IPI ≥60 months was associated with preterm labor, oligohydramnios, and medical complications like anemia and gestational diabetes mellitus. Social interventions like improving education status and better contraceptive availability will promote optimal IPI, improving maternal outcomes. Further strengthening the awareness programs on contraception and encouraging couples to practice adequate spacing by primary physicians will help to achieve optimal maternal health. The findings of the study will enable the policymakers to further sensitize the healthcare workers at all levels to promote optimal interpregnancy interval as emphasized by WHO.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Ethical clearance and human rights

Ethical approval was obtained from the institute's ethical committee before the commencement of the study (96th ECM

II B-Thesis/73-763/Ethics/19 dated May 22, 2019). The work described has not been published before; and it is not under consideration for publication anywhere else. The publication has been approved by all co-authors. The publisher will not be held legally responsible should there be any claims for compensation. The manuscript has been read and approved by all the authors that the requirements for authorship as stated earlier in this document have been met.

Author contributions

SA, MC, and AA contributed to the conception, data collection, and manuscript drafting and revising it critically. NK, AP, and VD drafted the manuscript and revised it critically. SM did the statistical analysis and critical review.

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Conflicts of interest

There are no conflicts of interest.

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