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Fear of childbirth prolongs interpregnancy interval: A nationwide register-based quantile logistic regression analysis

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ABSTRACT

Introduction: It is not well studied how fear of childbirth (FOC) influences the interpregnancy interval (IPI). Thus, we aimed to analyze the association between FOC and the length of the IPI.
Methods: All women having their first and second pregnancies during the study period (2004–2018) were gathered from the Finnish Medical Birth Register. A logistic regression model was used to assess the association between the FOC and subsequent length of the IPI. The length of the IPI was assessed separately for women with FOC in the first pregnancy, and for women who developed the FOC in the second pregnancy. IPIs with a length in the lower quartal were considered short IPIs, and length in the upper quartal as long IPIs. Adjusted odds ratios (aOR) with 95% CIs were compared between the groups.
Results: A total of 52 709 women with short IPI (<1.05 years), 105 604 women with normal IPI, and 52 889 women with long IPI (>2.57 years) were included. A total of 3606 women had FOC in the first pregnancy, and a total of 11 473 had their first FOC diagnosis in the second pregnancy. Women with FOC in the first pregnancy had lower odds for short IPI (aOR 0.88, CI 0.81–0.95) and higher odds for long IPI (aOR 1.30, CI 1.21–1.40). Women with the first FOC diagnosis in the second pregnancy had higher odds for long IPI (aOR 1.68, CI 1.61–1.75), When only vaginal deliveries in the first pregnancy were included, women with FOC in the second pregnancy had lower odds for long IPI (aOR 0.71, CI 0.66–0.75) and higher odds for long IPI (aOR 1.52, CI 1.41–1.62), when only cesarean section was included.
Conclusion: The main finding of this study was that women with FOC had notably higher odds for long IPI. The etiologic and background factors behind FOC should be better recognized and prevented, and FOC should not only be considered as a complicating factor for pregnancy and delivery but also a factor that strongly affects the desire of women to get pregnant again.

Introduction

Fear of childbirth (FOC) is a common obstetrical challenge affecting the health of women [1], which has been found to have a rapidly increasing incidence during the last decades [2]. Studies have revealed that psychosocial factors, such as anxiety, neuroticism, depression, low self-esteem, and lack of social support, also play an important role in the development of FOC [3]. According to a recent case-control analysis in Finland, the main risk factors for the development of FOC in the second pregnancy were a previous fear of childbirth, unplanned cesarean section (CS), vacuum delivery, perineal tear, or shoulder dystocia [4]. Also, women with diagnosed FOC have been found to have a lower birth rate after the first pregnancy [5].

How interpregnancy interval (IPI), possibly through other factors (such as the mother's or first child's health, birth events, or other factors) influences the subsequent pregnancy has been an increasing research topic and previous studies have found that both short and long IPI are associated with pregnancy complications, such as gestational diabetes mellitus (GDM), gestational hypertension, preterm birth, or perinatal mortality [6–9]. However, fewer studies have focused on how the events in previous pregnancies influence the IPI.

Most studies have examined the impact of the length of IPI on the health of both the child and the mother. A recent study from Australia in 2023 study investigated the effects of different pregnancy outcomes in

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the first pregnancy to the subsequent length of the IPI using a large dataset of over 250,000 women [10]. This study found, that women with preeclampsia and gestational hypertension in the first pregnancy had slightly longer subsequent IPIs than mothers whose pregnancies were not complicated by these conditions. Based on our hypothesis FOC might be a prolonging factor to IPI, as it might increase the threshold to conceive again. As the literature on the effects of diagnosed fear of childbirth FOC on IPI is lacking, this study aimed to study the association between FOC and the length of the IPI.

Materials and methods

In this retrospective nationwide register-based cohort study, data from the National Medical Birth Register (MBR), maintained by the Finnish Institute for Health and Welfare, were used to evaluate the association between maternal FOC and the length of the IPI. The MBR has high quality and coverage, the current coverage being nearly 100% [11,12]. The study period was from 1 January 2004 to 31 December 2018. The MBR contains data on pregnancies, delivery statistics, and the perinatal outcomes of all births with a birthweight $\geq$ 500 g or a gestational age $\geq$ 22 + 0 weeks.

In Finland, all women are asked about their fears of childbirth during antenatal visits, indicating that FOC is screened for in these visits. Those women who experience a significant FOC, but do not receive enough help during the antenatal visits to women and child welfare clinics and/or have requested cesarean section (CS) due to FOC, are referred to secondary/tertiary maternity clinics. FOC is diagnosed if it is manifested and dealt with during a maternity care visit with a physician or specialized midwife. In the present study, FOC was defined according to the International Classification of Diseases 10th revision code (ICD-10) code O99.80 established in 1997. Although FOC is widely recognized as a significant factor in maternal health, it lacks a universally standardized definition with commonly agreed-upon criteria. However, we acknowledge the need for clarity and a common understanding of FOC criteria internationally. The registration of FOC in the MBR started in 2004. In the present study, women with diagnosed FOC in their first pregnancy formed the first study group, women with first FOC diagnosis in the second pregnancy formed the second study group, and all women without diagnosed FOC in the first and second pregnancy formed the control group.

During 2004–2018, a total of 843 466 pregnancies were registered in Finland. We selected all women with first and second pregnancies leading to birth during our study period from the MBR. Miscarriages or abortions with gestational age under 22 + 0 weeks were not taken into account as these are not registered in the MBR. Third or later pregnancies of the women included in this study were removed from the data (n = 420 951). Also, women with multifetal pregnancies in the first pregnancy (n = 1112) were excluded from the data, as this influences heavily the IPI. Women Therefore, the remaining study sample consisted of 211 202 women with their first and second pregnancies.

The IPIs from the day of giving birth in the first pregnancy and the beginning of the second pregnancy for these women were calculated. The beginning date of the pregnancy was calculated using the date of giving birth and the length of the pregnancy (length of the pregnancy is calculated using the information on last menstrual period) registered in the MBR. Two outcome measures: likelihood for short and long IPI, with normal IPI as the reference outcome for both of these were analysed. Women with FOC in the first pregnancy, and women with first FOC in the second pregnancy were compared to women without FOC in these pregnancies. The forming of the study sample is shown as a flowchart in Fig. 1.

Statistics

The continuous variables were interpreted as means with standard deviations (sd) or as medians with interquartile ranges (IQR) based on the distribution of the data. The categorical variables are presented as absolute numbers and percentages. A logistic regression model was used to assess the association between the FOC and the subsequent length of the IPI between the first and the second pregnancy. Women were divided into short, normal, and long IPIs based on the distribution of the IPI in the study population. Women with length of the IPI in the lower quartal (<25%) were considered women with short IPIs, women with IPI length in the upper quartal (<75%) were considered women with long IPIs, and women with IPIs between these as women with normal IPI, which was used as a reference outcome in the logistic regression analyses. The median IPI among all women was 1.66 years (IQR 1.53). The lower quartile of the IPI was < 1.07 years and the upper quartile was > 2.61 years. Therefore, IPIs under 1.07 years were considered short IPIs, and IPIs longer than 2.61 years were considered long IPIs. As adverse events in the first pregnancy are found to be strongly associated with the development of FOC in the second pregnancy in the Finnish population [4], we analysed also separately women who had their first FOC diagnosis in the second pregnancy, as these women developed FOC during the first delivery or the measured IPI. The odds for short IPI and the odds for long IPI compared to normal IPI were analyzed separately for both study groups. When analyzing the other study group, the other was excluded from the analysis. When women with the first FOC diagnosis in the second pregnancy were included, women with FOC in the first pregnancy were excluded from the data and vice versa. Also, a stratified analysis based on the mode of delivery (cesarean section (CS)/vaginal delivery) was performed separately. As women with CS have a lot longer mean IPI and women with vaginal delivery have shorter IPI than the overall population, the IPI quartiles for these groups were calculated separately for the logistic regression analyses. Adjusted odds ratios (aOR) with 95% CIs were compared between the groups. The model was adjusted for other background factors, that might have effects on the length of the IPI (maternal age, maternal smoking status, marital status, and maternal BMI). Adjustments were made by choosing the variables for a multivariate model using DAGs constructed using the free online software DAGitty (dagitty.net) [13]. The variables included in the DAGs were chosen based on known risk factors and hypothesized causal pathways. DAGitty automatically suggests possible adjustment variable sets that can influence the main outcome (Fig. 2). Some of the major pregnancy complications in the first pregnancy, such as stillbirth (n = 53), preterm birth (gestational age <37 +0) (n = 10 407), and pre-eclampsia (n = 6482) can have major effect on the IPI, but whether they have a confounding, effect modification or mediation effect is hard to determine without knowing when FOC is diagnosed. Therefore, in addition to main analyses, we performed sensitivity analyses with

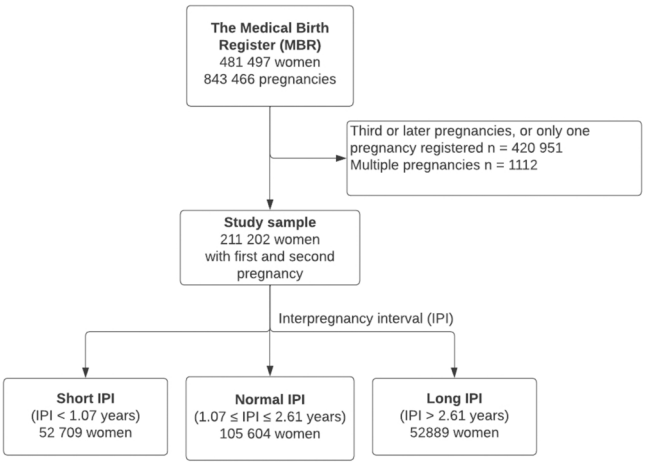

Fig. 1. Flowchart of the study population during the years 2004–2018 in Finland. Women were divided into short, normal, and long interpregnancy intervals (IPI) based on the distribution of the IPI variable.

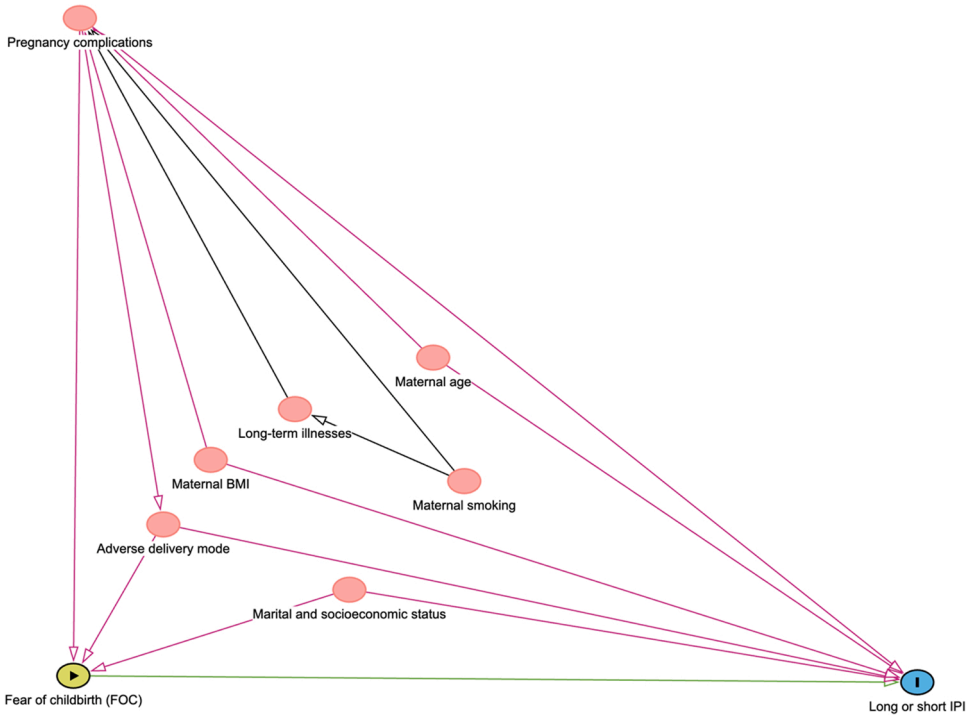

Fig. 2. DAG for the association between fear of childbirth (FOC) and long or short interpregnancy interval (IPI). FOC was the exposure variable and long or short IPI was the dependent variable.

women having these major pregnancy complications in the first pregnancy excluded. The results of this study are reported according to STROBE guidelines [14]. Statistical analysis was performed using R version 4.0.3.

Ethics

This study was conducted in accordance with the current Finnish regulations. The Ethical Committee of Tampere University Hospital waived the ethical committee evaluation of all retrospective studies utilizing routinely collected healthcare data and this decision is based on the law of medical research 488/1999 and the law of patient rights 785/1992. By the Finnish regulations (The law of secondary use of routinely collected healthcare data 552/2019), no informed written consent was required because of the retrospective register-based study design, and the patients were not contacted. Permission for the use of this data was granted by Findata after the evaluation of the study protocol (Permission number: THL/1756/14.02.00/2020).

Results

A total of 211 202 women with first and second pregnancies during our study periods were included in this study. The mean age of women included during the first pregnancy was 27.0 (SD 4.7) years. The median IPI among all women with vaginal delivery in the first pregnancy was 1.64 years (IQR 1.52), with a lower quartile of 1.05 years and the upper quartile of 2.57 years. The median IPI among all women with CS in the first pregnancy was 1.77 years (IQR 1.62), with a lower quartile of 1.47 years and an upper quartile of 2.77 years. A total of 3606 (1.7%) women had FOC in the first pregnancy, and a total of 11 473 (5.4%) had their first FOC diagnosis in the second pregnancy. (Table 1).

Women with normal IPI had the lowest proportion of smokers during the first pregnancy (13.1%) when compared to women with short IPI (17.2%), and long IPI (21.1%). A total of 1.6% of women with short IPI had FOC in the first pregnancy, a total of 1.7% of women with normal IPI had FOC in the first pregnancy, and a total of 2.0% of women with long IPI had FOC in the first pregnancy. A total of 4.1% of women with short IPI had first FOC diagnosis in the second pregnancy, a total of 5.0% of women with normal IPI had first FOC diagnosis in the second pregnancy, and a total of 7.5% of women with long IPI had first FOC diagnosis in the second pregnancy. (Table 2).

Women with FOC in the first pregnancy had lower odds for short IPI (aOR 0.88, CI 0.81–0.95) and higher odds for long IPI (aOR 1.30, CI

Table 1
Background information of the patients included in this study at the time of the first pregnancy.

Total number of women	211 202
	n
Maternal age (mean; sd)	27.0 (4.7)
Interpregnancy interval (years) (median; IQR)	1.66 (1.53)
lower quartile (years)	1.07
upper quartile (years)	2.61
Interpregnancy interval (VD) (years) (median; IQR)	1.64 (1.52)
lower quartile (years)	1.05
upper quartile (years)	2.57
Interpregnancy interval (CS) (years) (median; IQR)	1.77 (1.62)
lower quartile (years)	1.47
upper quartile (years)	2.77
Marital status	
never married (%)	109 553 (51.9)
active marriage (%)	100 242 (47.5)
divorced or widow (%)	1077 (0.5)
unknown (%)	385 (0.2)
Body mass index (mean; sd) (kg/m^2)	23.8 (4.4)
Body mass index unknown (%)	10 350 (4.9)
Maternal smoking	
Smoker* (%)	34 070 (16.1)
unknown (%)	3834 (1.8)
Mode of delivery (first pregnancy)	
vaginal delivery (%)	173 690 (8.2)
cesarean section (%)	37 512 (17.8)
Fear of childbirth in the first pregnancy (%)	3606 (1.7)
Fear of childbirth in the second pregnancy (%)	11 473 (1.5)

* Smoker only during 1st trimester or smoker also during later trimesters

Table 2
Background information of the patients with short, normal, and long interpregnancy interval (IPI). BMI = Body mass index.

	Short IPI (< 1.07 years)		Normal IPI (1.07-2.61 years)		Long IPI (> 2.61 years)	
Total number of women	52 709		105 604		52 889	
	n	%	n	%	n	%
Maternal age (mean; sd)	26.6 (4.8)		27.6 (4.5)		26.3 (4.7)	
Marital status						
never married	25 042	47.5	52 422	49.6	32 034	60.6
active marriage	27 151	51.5	52 606	49.8	20 485	38.7
divorced or widow	315	0.6	467	0.4	295	0.6
unknown	201	0.4	109	0.1	75	0.1
BMI (mean; sd) (kg/m^2)	23.9 (4.6)		24.0 (5.3)		24.0 (5.1)	
BMI unknown	2433	4.6	5167	4.9	2554	4.8
Maternal smoking						
Smoker*	9072	17.2	13 844	13.1	11 154	21.1
unknown	1048	2.0	1813	1.7	973	1.8
Mode of delivery (first pregnancy)						
vaginal delivery	44 696	84.8	86 507	81.9	42 487	80.3
cesarean section	8013	15.2	19 097	18.1	10 402	19.7
Fear of childbirth in the first pregnancy	824	1.6	1777	1.7	1051	2.0
Fear of childbirth in the second pregnancy	2171	4.1	5310	5.0	3992	7.5

* Smoker only during 1st trimester or smoker also during later trimesters

1.21–1.40). Women with the first FOC diagnosis in the second pregnancy had lower odds for short IPI (aOR 0.70, CI 0.67–0.74) and higher odds for long IPI (aOR 1.68, CI 1.61–1.75). When only vaginal deliveries in the first pregnancy were included, women with the first FOC in the second pregnancy had lower odds for short IPI (aOR 0.71, CI 0.66–0.75) and higher odds for long IPI (aOR 1.72, CI 1.63–1.82). When only CS in the first pregnancy were included, women with first FOC in the second pregnancy had lower odds for short IPI (aOR 0.72. CI 0.68–0.77) and higher odds for long IPI (aOR 1.52, CI 1.41–1.62). (Table 3) The results from sensitivity analysis with women having major pregnancy complications excluded showed no important differences to the main results. (Table 4).

Table 3
Adjusted odds ratios (aOR) with 95% confidence intervals (Cis) for the short and long interpregnancy interval (IPI) between the first and second pregnancy. Women with fear of childbirth (FOC) were compared to women without FOC. In addition, women with vaginal delivery (VD) or cesarean section (CS) in the first pregnancy were analyzed separately.

		All patients	VD	CS
Birth outcome		aOR* (CI)	aOR* (CI)	aOR* (CI)
FOC in the first pregnancy	Short IPI	0.88 (0.81-0.95)	0.99 (0.89-1.11)	0.82 (0.74-0.91)
	Long IPI	1.30 (1.21-1.40)	1.15 (1.03-1.28)	1.31 (1.18-1.46)
First FOC in the second pregnancy	Short IPI	0.70 (0.67-0.74)	0.71 (0.66-0.75)	0.72 (0.68-0.77)
	Long IPI	1.68 (1.61-1.75)	1.72 (1.63-1.82)	1.51 (1.41-1.62)

* The model was adjusted by background factors of the mother (maternal age, marital status, maternal body mass index, and maternal smoking status).

Table 4
Sensitivity analysis with women having severe pregnancy complications (stillbirth, preterm birth, and pre-eclampsia). Adjusted odds ratios (aOR) with 95% confidence intervals (Cis) for the short and long interpregnancy interval (IPI) between the first and second pregnancy. Women with fear of childbirth (FOC) were compared to women without FOC. In addition, women with vaginal delivery (VD) or cesarean section (CS) in the first pregnancy were analyzed separately.

		All patients	VD	CS
Birth outcome		aOR* (CI)	aOR* (CI)	aOR* (CI)
FOC in the first pregnancy	Short IPI	0.89 (0.82-0.97)	1.01 (0.90-1.13)	0.83 (0.75-0.92)
	Long IPI	1.30 (1.20-1.40)	1.15 (1.03-1.28)	1.31 (1.16-1.46)
First FOC in the second pregnancy	Short IPI	0.69 (0.66-0.73)	0.69 (0.64-0.73)	0.71 (0.66-0.76)
	Long IPI	1.71 (1.64-1.79)	1.74 (1.65-1.84)	1.52 (1.41-1.63)

* The model was adjusted by background factors of the mother (maternal age, marital status, maternal body mass index, and maternal smoking status).

Discussion

The main finding of this study was that women with FOC had notably higher odds for long IPI and lower odds for short IPI. Especially, the odds for long IPI for women with first FOC diagnosis in the second pregnancy was markedly higher and the odds for short IPI was markedly lower.

A previous study published in Finland in 2023, to the best of our knowledge first nationwide study about the association between FOC and subsequent births found that women with FOC had notably lower birth rates during a 5-year follow-up after the first pregnancy [5]. The results of our study is in line with the results of this study, as it appears that the overall desire for women with FOC to get pregnant again is lower. Based on our data, the exact reason for the higher odds of long IPI remains unknown but could be most likely explained by background factors, such as a general lack of desire to get pregnant again due to existing FOC, fear of another uncomfortable birth experience, or adverse pregnancy outcomes. In literature, FOC is well known to be associated with adverse pregnancy and birth outcomes [15], but the effects of FOC on birth rate are now getting better recognition. Understanding the implications of FOC on IPIs is crucial for clinical practice. Our findings indicate a potential association between FOC and longer interpregnancy intervals. However, it's essential to consider that, despite variations in fear levels, the observed IPIs fall within the generally accepted normal 2–5-year range. This suggests that FOC might not necessarily lead to markedly prolonged interpregnancy intervals beyond what is considered standard in clinical practice. Our study contributes valuable insights by not only establishing a potential link between FOC and IPI but also by contextualizing these findings within the clinically relevant normal range.

A recent study assessing the effects of pregnancy complications on the subsequent IPI found that women with pre-eclampsia and gestational hypertension had slightly longer subsequent IPIs than mothers whose pregnancies were not complicated by these conditions [10]. The associated factors with FOC, such as residence, marital status, parity, gestational age, relationship with a partner, pregnancy stress, and depressive symptoms are also well studied [16]. Based on the results of this study and the findings of the latest studies about the association between pregnancy complications and FOC [4], the effects of FOC on subsequent birth rate [5], and the effects of pregnancy complications on the length of the IPI [10], the prevention and treatment of FOC should be emphasized to the overall landscape of FOC, taking also the factors associated with the development of FOC into account. The observed longer interpregnancy intervals among women with FOC suggest not only a personal struggle but also a potential societal implication in terms of family planning and population dynamics. Additionally, the link

between adverse pregnancy outcomes and the increased odds of developing FOC underscores a vicious cycle where FOC may be both a consequence and a cause of challenging pregnancies.

As the incidence of FOC is increasing [17,18], addressing this issue becomes even more pertinent for the overall well-being of mothers and infants, emphasizing the need for a comprehensive approach that considers psychological, social, and medical factors. Improving support systems, increasing awareness, and integrating mental health care into maternal health services can contribute to breaking this cycle and fostering healthier outcomes for both mothers and their children. Therefore, future research should be focused more on the optimal prevention of FOC using a standardized procedure of care and treatment for women with FOC. Also, women with higher risk for developing FOC should be better identified. E.g., future studies utilizing more specific questionnaires could be used to study the etiology of this topic could be performed.

The strength of our study is that the register data used in our study are routinely collected nationally in structured forms with consistent instructions, which ensures good coverage (over 99%) and reduces possible reporting and selection biases. Our data consisted of a total of 481 497 women with 843 466 pregnancies, which allows us to analyze a large sample size. Also, the study period was nearly 15 years, which is much longer than that of most previous studies. The main limitation of this study is that the severity of FOC, and gestational age for FOC assessment is unknown. As there are no uniform criteria or definitions for FOC, the forms, severity, and symptoms can vary between individuals. Indeed, FOC takes different forms in different women and may manifest as physical complaints, nightmares, and difficulties to concentrate [19]. However, the most severe cases of FOC are most likely diagnosed with FOC and registered in the MBR, and as the size of the non-exposed group is large, the possible bias of undiagnosed FOC patients should not have a major impact on results. In addition, the prevalence of FOC in our study is truly low (<2%) when compared to findings in previous literature (as high as 14%) [1,2], indicating that the diagnosis criteria of FOC is quite strict in Finland. The low incidence might be attributed to the diagnostic nature of FOC, relying on information that is primarily diagnosis-based. Possible unidentified cases of FOC in the non-exposed group would most likely lead to results that are biased toward null. The discussion briefly acknowledges the potential bias and its impact on driving results toward null, emphasizing a non-differential misclassification assumption. However, women with e.g., pregnancy complications might be more likely to be in contact with healthcare, the misclassification may not be entirely non-differential. In addition, the absence of a universally accepted definition poses challenges for cross-cultural and international studies. Achieving a consensus on FOC diagnosis criteria would be an ideal scenario, enhancing the comparability and generalizability of research findings.

Conclusion

The main finding of this study was that women with FOC had notably higher odds for long IPI and lower odds for short IPI. Especially, the odds for long IPI for women with first FOC diagnosis in the second pregnancy was markedly higher and the odds for short IPI was markedly lower. The etiologic and background factors behind FOC should be better recognized and prevented, and FOC should not only be considered as a complicating factor for pregnancy and delivery but also a factor that strongly affects the desire of women to get pregnant again.

CRediT authorship contribution statement

Vaajala Matias Aleksanteri: Data curation, Formal analysis, Methodology, Visualization, Writing – original draft. **Mattila Ville M.:** Methodology, Supervision, Writing – review & editing. **Kuitunen Ilari:** Data curation, Formal analysis, Methodology, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare no conflict of interest.

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