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Increased Difficulties in Maternal Perception of Decreased Fetal Movement in Cases of Severe Fetal Growth Restriction: A Population-Based Study in Japan

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Fetal growth restriction (FGR) is defined as fetuses who have failed to achieve a normal weight for gestational age. FGR is associated with adverse perinatal outcomes, including stillbirth. Pregnant women often perceive decreased fetal movements before intrauterine fetal death. Previous reports on the association between fetal movements and FGR have mainly targeted livebirths, with few focusing on stillbirths. Studying stillbirths, not livebirths, may help improve perinatal adverse outcomes. This study evaluated the association between FGR leading to stillbirth and maternal perception of decreased fetal movement. This was a population-based study reviewing all stillbirths in Shiga Prefecture, Japan for 10 years. We analyzed 219 stillbirth cases, those with versus without FGR. We then compared maternal visits to healthcare providers due to perception of decreased fetal movement between these two groups. There were 82 stillbirths with FGR, and the remaining 137 stillbirth were without FGR. Women with FGR, compared with those without, were significantly less often to visit the outpatient department due to decreased fetal movement (30%; 25/82 vs. 46%; 63/137: P = 0.034). Pregnant women have more difficulty perceiving decreased fetal movements in cases with severe FGR than in those without FGR. Healthcare providers, including midwives, may need to closely monitor FGR pregnancy in addition to instructing pregnant women to be aware of decreased fetal movement.

Keywords: fetal growth restriction; fetal movement; population-based study; stillbirth
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Introduction

Fetal growth restriction (FGR) is defined as fetuses who have failed to achieve a normal weight for gestational age due to several factors, and the etiology can be broadly categorized into maternal, fetal, and placental (American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics and the Society forMaternal-FetalMedicin 2019). FGR has been reported to be associated with adverse perinatal outcomes, including stillbirth (Reddy et al. 2009; Bukowski 2010; Serena et al. 2013). Strict management of FGR may be important for preventing stillbirth (Serena et al. 2013).

The maternal assessment of fetal movements (FMs) is the oldest and most widely employed method of evaluating the fetal well-being (Frøen 2004). Decreased fetal movement (DFM) as well as FGR is also associated with adverse perinatal outcomes, including stillbirth (McCarthy et al. 2016). Maternal perception of DFM is a frequent concern, often resulting in unscheduled visits to the outpatient department (OPD) among our regional stillbirth cases (Koshida et al. 2015). We previously revealed that delayed maternal visit after perceiving DFM was frequently observed in intrauterine fetal death (IUFD) (Koshida et al. 2017). Pregnant women need to be aware of DFM to prevent stillbirths.

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There have been several reports on the association between FGR and maternal perception of DFM, with the conclusions proving quite controversial. Some of them report that maternal perception of DFM is more apparent in cases of FGR (Heazell and Frøen 2008; Saastad et al. 2011), whereas other reports hold that fetal movement is gradually reduced as gestation progresses and the fetal weight increases (Koshida et al. 2019). However, most of these reports mainly targeted relatively healthy FGR cases that led to livebirth, and the association between stillbirth with severe FGR and the maternal perception of DFM remains unclear. Therefore, we evaluated the association between IUFD with FGR at the OPD and the maternal perception of DFM for 10 years in Shiga Prefecture, Japan.

Materials and Methods

Data collection

This study was a population-based survey of stillbirth of Shiga Prefecture, Japan. There are approximately 13,000 births per year in Shiga. Two-thirds of them are delivered in 30 primary obstetric clinics, while the remaining cases are delivered at 11 general hospitals or 4 tertiary perinatal centers; all of these cases were evaluated in this survey.

First, we directly investigated all of stillbirth certificates with permission of the Japanese Ministry of Health, Labour and Welfare. Second, we prepared and sent a questionnaire to each facility that had submitted a stillbirth certificate. A peer-review team involving experienced obstetricians and neonatologists then retrospectively reviewed the questionnaires returned from the facilities.

There were 429 stillbirths after the 22nd gestational week in Shiga Prefecture from 2007 to 2016. We excluded the following 210 cases in this study (Fig. 1): questionnaires not returned (n = 64); inpatients (n = 64); multiple births (n = 47); unknown gestational week of IUFD (n = 17); lethal disorders (n = 12), including fetal hydrops (n = 7), trisomy-18 (n = 3) and Potter sequence (n = 2); IUFD before 22nd gestational week (n = 5) and traffic accident (n = 1). We analyzed a total of 219 cases divided into 2 groups according to the criteria of FGR by birthweight of infants: the FGR group and the Non-FGR group.

Definition of FGR

In the Japanese Obstetric Clinical Guideline, FGR is defined when the z-score of the estimated fetal weight measured by ultrasonography is less than −1.5 standard deviations (SD) from the fetal growth curve at a given gestational week. At the time of the visit to the OPD, the precise date of IUFD cannot be determined, so there is some discrepancy between the date of stillbirth and IUFD. Therefore, in the present study, we used the birthweight of the infant at stillbirth and the gestational week at which IUFD was confirmed to determine FGR. We did not employ the Japanese neonatal anthropometric charts used for "small for gestational age (SGA)", which is defined for cases falling under the 10th percentile of the chart at a given gestational week.

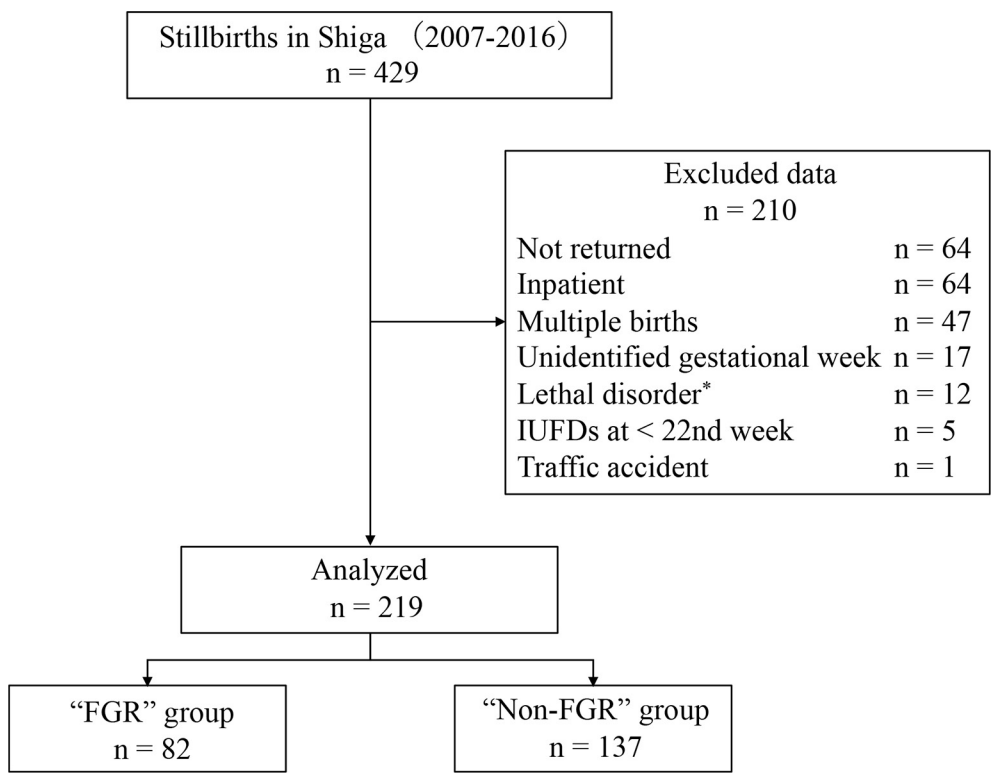

Fig. 1. The analyzed data regarding stillbirths in this study.
*The lethal disorder includes 3 cases of trisomy-18, 7 cases of hydrops and 2 cases of Potter sequence. IUFD, intrauterine fetal death; FGR, fetal growth restriction.

We considered it more appropriate to employ a fetal growth curve to evaluate whether or not fetuses should have been diagnosed with FGR before IUFD.

Situation and primary reason for visiting a healthcare provider

Regarding the visiting situation, we defined a scheduled visit as a pre-planned visit, meaning mainly pregnancy checkups. We also defined an unscheduled visit as an emergent visit, meaning a visit for any symptomatic reason, such as labor, genital bleeding, premature rupture of membrane, and maternal perception of DFM. We then divided the primary reason for the visit into two groups: maternal perception of DFM and others.

Calculating the z-score

The z-score was calculated using the mean and SD of the estimated fetal weight at each gestational week from the fetal growth curve defined by the Japanese Society of Ultrasound in Medicine (Shinozuka 2002). The mean and SD for each gestational week and day were interpolated from the above values.

Perinatal factors influencing the visits for maternal perception of DFM

We conducted a multivariable logistic regression analysis to assess the association between unscheduled visits due to maternal perception of DFM and perinatal factors, including maternal age, sex of the fetus, parity, gestational week, and presence of FGR. Those explanatory variables were selected considering their clinical relevance and the independence of each factor.

Statistical analyses

To compare the FGR and Non-FGR groups, continuous variables were shown as the mean (SD) or n (%) and assessed using the Mann-Whitney U test or Student's *t*-test, depending on the results of the normality test. The frequency of other subjects and ratios are shown as n (%) and were assessed using a chi-squared test. The results of a multivariable logistic regression analysis were presented as the adjusted odds ratio with the 95% confidence interval (CI). P values under 0.05 were considered to indicate statistical significance. All statistical analyses were performed using the R application software program (ver. 4.0.2) (R Development Core Team 2020).

Ethical statement

This study was approved by the institutional review board of Shiga University of Medical Science (R 2017-151).

Results

Background of stillbirths

The background characteristics of the stillbirths in this study are shown in Table 1. A total of 219 of stillbirths were analyzed, and 82 (37%) were classified as the FGR group, with the remaining 137 (63%) classified as the Non-FGR group. There were no significant differences in parity, method of conception or sex of the fetus between the two groups. The average maternal age was 29.9 years old in the FGR group and 31.3 years old in the Non-FGR group (P = 0.049). The average number of gestational weeks was 29.5 weeks in the FGR group and 33.9 weeks in the Non-FGR group (P < 0.001). The average birthweight was 977 g in the FGR group and 2,077 g in the Non-FGR group (P < 0.001).

Visiting situation among IUFDs

The ratio of unscheduled visits was 46% in the FGR

Table 1. Background of stillbirth at the outpatient department.

Factors	FGR (n = 82)	Non-FGR (n = 137)	All (n = 219)	P value
Maternal age, years	29.9 ± 5.6	31.3 ± 5.0	30.8 ± 5.3	0.049
Parity				0.168
Primiparity	44 (54)	59 (43)	103 (47)	
Multiparity	38 (46)	78 (57)	116 (53)	
Method of conception				1.00
Fertilization	6 (7.3)	9 (6.6)	15 (6.8)	
Natural	76 (93)	128 (93)	204 (93)	
Sex of the fetus*				1.00
Male	40 (49)	68 (50)	108 (49)	
Female	40 (49)	68 (50)	108 (49)	
Gestational week	29.5 ± 5.6	33.9 ± 5.5	32.3 ± 5.9	< 0.001
Birth weight	977 ± 726	2,077 ± 898	1,666 ± 992	< 0.001

Data are shown as the mean ± SD or n (%).
*Two cases of FGR and one case of non-FGR were not identified.
FGR, fetal growth restriction.

group and 77% in the Non-FGR group (Table 2; P < 0.001). The most frequent reason for unscheduled visits was maternal perception of DFM in both groups. The ratio of cases in which maternal perception of DFM was the primary reason for the visit was 30% in the FGR group and 46% in the Non-FGR group (Table 2; P = 0.034).

Maternal perception of DFM and z-scores of birthweights

The average z-score was −0.94 ± 1.09 for the cases where maternal perception of DFM was the primary reason and −1.52 ± 1.77 for the cases where it was not (P = 0.033).

Perinatal factors associated with unscheduled visits due to maternal perception of DFM

A multivariable logistic regression analysis revealed the inverse correlation between unscheduled visits due to maternal perception of DFM and the presence of FGR (Table 3; adjusted odds ratio = 0.453, 95% confidence interval 0.242-0.849, P = 0.014). Other factors, such as the maternal age, sex of the fetus, parity and number of gestational weeks, showed no significant association with unscheduled visits due to maternal perception of DFM.

Discussion

Analyzing all stillbirths in Shiga, we revealed that fewer pregnant women with FGR perceived DFM than those without FGR. In addition, we also found that the lower the infant's weight for their gestational age, the less likely pregnant women were to perceive DFM.

We found that fewer pregnant women with FGR perceived DFM than those without FGR. Our results are not consistent with those of previous reports (Heazell et al. 2005; Heazell and Frøen 2008), which indicate more frequent maternal perception of DFM in pregnant women with FGR than in those without FGR. This discrepancy may be due to differences in study targets, as those previous reports mainly targeted relatively healthy FGR cases leading to livebirths, while the current study targeted severe FGR cases leading to IUFD. It is possible that FMs in severe FGR cases are relatively infrequent even before their condition worsens, so the changes in FMs are difficult for pregnant women to notice, resulting in fewer unscheduled visits

Table 2. Situation and primary reason for the visit to the healthcare provider.

	FGR (n = 82)	Non-FGR (n = 137)	P value
Visiting situation*			< 0.001
Scheduled visit	38 (46)	29 (21)	
Unscheduled visit	38 (46)	106 (77)	
Primary reason for the visit			0.034
DFM	25 (30)	63 (46)	
None or others	57 (70)	74 (54)	

Data are shown as n (%).
*A total of eight unidentified cases (six cases of FGR and two of non-FGR) were excluded.
FGR, fetal growth restriction; DFM, decreased fetal movement.

Table 3. Perinatal factors influencing visits for maternal perception of decreased fetal movement (DFM).

Perinatal factors	Adjusted OR	95% CI	P value
Maternal age	1.017	0.963-1.074	0.545
Parity			0.340
Primiparity	Ref	–	
Multiparity	0.759	0.430-1.338	
Sex of the fetus			0.610
Male	Ref	–	
Female	0.872	0.514-1.478	
Gestational week	0.973	0.925-1.024	0.291
Presence of FGR			0.014
Non-FGR	Ref	–	
FGR	0.453	0.242-0.849	

DFM, decreased fetal movement; FGR, fetal growth restriction; Ref, reference; CI, confidence interval; OR, odds ratio.

due to maternal perception of DFM. According to a previous report (Morita et al. 2020), fetuses with FGR showed relatively few FMs, even in the absence of hypoxia, which supports the above theory. Further studies of maternal perception of DFM related to FGR are needed.

We also found that the lower the infant's weight for their gestational age, the less likely pregnant women were to perceive DFM. This indicates that pregnant women have difficulty perceiving DFM when the fetal weight is relatively low for gestational age, such as in cases of FGR. A multivariable logistic regression analysis showed that FGR was the only factor associated with a reduced rate of unscheduled visits due to maternal perception of DFM, although gestational week was considered to be associated with perception of FMs. It may be insufficient to instruct pregnant women to monitor FMs in order to prevent stillbirth with FGR. As stillbirths include a large substantial proportion of FGR, the results of a meta-analysis (Bellussi et al. 2020) showing that instructing pregnant women to monitor FMs does not significantly prevent stillbirths seem acceptable. However, since instructing pregnant women to monitor FMs is reported to be extremely useful for the early diagnosis of FGR (Saastad et al. 2011), such instructions may decrease the incidence of IUFD with FGR. Instructing pregnant women to monitor FMs is thus not necessarily ineffective. To prevent further stillbirths, it would be important for healthcare providers, including midwives, to manage FGR pregnancies more carefully through frequent fetal heart rate monitoring (Minakami et al. 2014) and Doppler ultrasound velocimetry (Caradeux et al. 2018) in addition to simply having pregnant women be alert for DFM.

This study was limited by the inability to determine the accurate date of IUFD. It is impossible to determine at the OPD precisely when the IUFD occurred after the last visit. However, since the maximum interval between such visits is two weeks, and most cases of decreased FMs are observed within a few days at most, the effect on the results is likely marginal.

We have concluded that pregnant women have difficulty perceiving DFM of severe FGR compared to those without FGR. It may be necessary for healthcare providers, including midwives to closely monitor FGR pregnancies in addition to instructing pregnant women to be alert for DFM. Further studies on maternal perception of DFM related to FGR are needed.

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Conflict of Interest

The authors declare no conflict of interest.

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