

Maternal Perception of Fetal Activity and Late Stillbirth Risk: Findings from the Auckland Stillbirth Study

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ABSTRACT: **Background:** Maternal perception of decreased fetal movements has been associated with adverse pregnancy outcomes, including stillbirth. Little is known about other aspects of perceived fetal activity. The objective of this study was to explore the relationship between maternal perception of fetal activity and late stillbirth (≥ 28 wk gestation) risk. **Methods:** Participants were women with a singleton, late stillbirth without congenital abnormality, born between July 2006 and June 2009 in Auckland, New Zealand. Two control women with ongoing pregnancies were randomly selected at the same gestation at which the stillbirth occurred. Detailed demographic and fetal movement data were collected by way of interview in the first few weeks after the stillbirth, or at the equivalent gestation for control women. **Results:** A total of 155/215 (72%) women who experienced a stillbirth and 310/429 (72%) control group women consented to participate in the study. Maternal perception of increased strength and frequency of fetal movements, fetal hiccups, and frequent vigorous fetal activity were all associated with a reduced risk of late stillbirth. In contrast, perception of decreased strength of fetal movement was associated with a more than twofold increased risk of late stillbirth (aOR: 2.37; 95% CI: 1.29–4.35). A single episode of vigorous fetal activity was associated with an almost sevenfold increase in late stillbirth risk (aOR: 6.81; 95% CI: 3.01–15.41) compared with no unusually vigorous activity. **Conclusions:** Our study suggests that maternal perception of increasing fetal activity throughout the last 3 months of pregnancy is a sign of fetal well-being, whereas perception of reduced fetal movements is associated with increased risk of late stillbirth. (BIRTH 38:4 December 2011)

Key words: fetal movements, hiccups, stillbirth

Fetal activity is a reflection of a normally functioning central nervous system, and regular fetal movements have long been considered an indicator of fetal

well-being (1). The first description of decreased fetal movements preceding fetal death was by Sadovsky and Yaffe in 1973 (2). Since that time many papers have

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reported an association between reduced fetal movements and adverse pregnancy outcomes, specifically fetal growth restriction (3,4); preterm birth (5); and stillbirth (5,6). Some studies have suggested that maternal perception of fetal movements is too subjective, with only a minority of movements that are detected by a Doppler device being perceived by women (7). However, several other studies have reported a good correlation between objective recordings and maternal perception of fetal movement, in particular when movements involve the fetal trunk and lower limbs (8,9). Maternal perception of fetal movements has been shown to be affected by several factors, including body mass index, placental location, maternal position, and psychological factors (10–12).

Currently no consensus exists about what constitutes normal fetal movements in late pregnancy, with considerable variation in the number of daily fetal movements felt by women (11,13). It is also unclear whether a substantive change in perception of fetal movement occurs as pregnancy progresses. Some studies have reported a maximum frequency of fetal movements between 29 and 38 weeks, with a small reduction at term (2,14,15), and yet other studies have shown no overall reduction in fetal movements with advancing gestation (16–18). Consequently, sources of information available to women and health professionals are contradictory about the significance of a decrease in fetal movements in late pregnancy, with some consumer sources and professional texts suggesting that it is normal for fetal movements to decrease at term (19). In addition, no research has been published exploring other aspects of perceived fetal activity, such as sudden vigorous activity or fetal hiccups, and their relationship to stillbirth risk.

The primary aim of the Auckland Stillbirth Study was to identify potentially modifiable risk factors for late (≥ 28 wk) stillbirth. This paper explores the relationship between late stillbirth risk and aspects of maternal perception of fetal activity, specifically changes in strength and frequency of movement, unusually vigorous activity, and fetal hiccups. We hypothesized that women who experienced a late stillbirth would perceive a decrease in the frequency and intensity of fetal movements compared with control women at the same gestation.

Methods

All women with a singleton pregnancy who experienced a stillbirth at or after 28 weeks gestation between July 2006 and June 2009 in the greater Auckland region were eligible to participate in the study. Women with babies who died because of a congenital abnormality were excluded. Two randomly selected control women with an ongoing pregnancy were matched to each study par-

ticipant by gestation at which the stillbirth occurred. Data were obtained through interviewer administered questionnaires and from clinical data extraction. Interviews took place in the first few weeks after the stillbirth, or for control women at the equivalent gestation of pregnancy at which the stillbirth occurred. Demographic data and information on other potential confounding factors were also collected during the interview. Further details of methods and participant characteristics have been described previously (20,21).

The study was approved by the Northern “X” Regional Ethics Committee.

Procedure

No validated tools for the collection of data relating to maternal perception of fetal activity have been published. Questions were therefore developed for this study to explore a range of factors relating to maternal awareness of fetal activity. Patterns of fetal movement (during the last 2 wk before fetal death or before the interview for control women) were determined by asking participants to describe their baby’s movements, in particular whether any change in frequency or strength had occurred. The response was written down during the interview.

At completion of the study, these data were then coded separately by two researchers according to whether women perceived the strength and frequency of fetal movements to have “increased,” “decreased,” “stayed the same,” or “unsure.” The researchers were blinded as to whether the response was from a study or control woman. Coding was then compared for consistency; there was a difference in coding in 17 responses; for these responses, discussion was held with a third researcher and a consensus was agreed on. The normal pattern of maternal perception of fetal movements in late pregnancy is not well defined; therefore, “stayed the same” was used as the reference group in analysis.

Participants were also asked: “During the last two weeks (before fetal death or interview), did you notice any time that your baby was more vigorous than usual?” They were also asked: “During the last two weeks, did you feel your baby having hiccups (short jerking movements occurring at regular intervals, for a period of time)?”

In addition, presentation to a maternity assessment unit or to a maternity careprovider, because of a concern about decreased fetal movements, was ascertained from participants’ clinical records.

Data Analysis

All statistical analyses were performed using SAS version 9.1 (22). Standard conditional regressions

were used for matched case-control studies using the “proc logistic” procedure, with the “strata” statement to control for matching. A multivariable regression model was developed to include maternal variables reported to be associated with increased risk of late stillbirth or perception of fetal movements, based on previous literature (age, body mass index, ethnicity, parity, smoking, and socioeconomic status). The study was powered to detect an odds ratio (OR) of 2 with 80 percent power and significance level of 0.05, with a prevalence of the risk factor of 20 percent or more in the control population. Statistical significance in multivariable analysis was defined at the 5 percent level. ORs and adjusted ORs (aOR) with 95 percent confidence intervals (CIs) were used to estimate risk.

Results

Of the 215 eligible stillbirths identified during the study period, 155 (72%) consented to participate, as did 72 percent (310/429) of the eligible control women. The median gestation at diagnosis of fetal death was 261 days, with 57 percent occurring at or after 37 weeks gestation. Baseline characteristics of the study population have been described elsewhere (20).

Overall, 66 (42.6%) women who experienced a late stillbirth presented to health care services with decreased fetal movements at some time in their pregnancy, in contrast to only 28 (9.0%) control women. However, of those women who presented with decreased movements,

only 15 (9.7% of all study participants) presented before diagnosis of fetal death; of the remaining 51 participants, fetal death was diagnosed at time of presentation.

During the last 2 weeks of pregnancy (before fetal death or before the interview for control women), an association was found between maternal perception of decreased frequency of fetal movements and late stillbirth risk (aOR: 2.37; 95% CI: 1.29–4.35) (Table 1). In addition, an overall increase in frequency or strength of fetal movement, compared with no change, was inversely associated with late stillbirth risk (aOR: 0.24; 95% CI: 0.12–0.50 and aOR: 0.18; 95% CI: 0.09–0.36), respectively. Women who perceived unusually vigorous movements more than once also had a trend toward a reduced risk of late stillbirth (aOR: 0.58; 95% CI: 0.33–1.03). In contrast, women who perceived their baby to have had a single episode of movement that was more vigorous than usual were almost seven times more likely to experience a late stillbirth. Women who did not perceive their baby to have had hiccups during the last 2 weeks had a more than threefold increased risk of late stillbirth (aOR: 3.52; 95% CI: 2.18–5.68) compared with those women who noticed their baby having hiccups.

As the evidence is unclear about what is considered a normal pattern of fetal movements at term, interaction analysis was performed between perception of fetal activity and gestational age (preterm: 28–36 wk and 6 days' gestation; term: \geq 37 wk gestation). No interaction was found for fetal hiccups or episodes of unusually vigorous movements and gestational age, but an interaction was seen for perception of strength of fetal movement

Table 1. Maternal Perception of Fetal Movements During the Last 2 Weeks of Pregnancy

<i>Perceived Fetal Activity</i>	<i>Study Women (n = 155) No. (%)</i>	<i>Control Women (n = 310) No. (%)</i>	<i>Univariable OR (95% CI)</i>	<i>Adjusted OR* (95% CI)</i>
Frequency of fetal movement				
Increased	13 (8.4)	88 (28.4)	0.25 (0.13–0.50)	0.24 (0.12–0.50)
Same	76 (49.0)	135 (43.6)	Reference	Reference
Decreased	45 (29.0)	36 (11.6)	2.16 (1.24–3.77)	2.37 (1.29–4.35)
Unsure	21 (13.6)	51 (16.5)	0.65 (0.31–1.34)	0.76 (0.35–1.66)
Strength of fetal movement				
Increased	16 (10.3)	124 (40.0)	0.18 (0.09–0.34)	0.18 (0.09–0.36)
Same	76 (49.0)	112 (36.1)	Reference	Reference
Decreased	30 (19.4)	21 (6.8)	1.67 (0.88–3.15)	1.88 (0.93–3.79)
Unsure	33 (21.3)	53 (17.1)	1.05 (0.56–1.95)	1.03 (0.53–2.00)
Vigorous movement†				
None	97 (63.0)	202 (65.4)	Reference	Reference
Once	32 (20.8)	16 (5.2)	4.51 (2.23–9.10)	6.81 (3.01–15.41)
More than once	25 (16.2)	91 (29.5)	0.55 (0.33–0.93)	0.58 (0.33–1.03)
Hiccups‡				
Yes	52 (33.6)	199 (64.4)	Reference	Reference
None	98 (63.2)	100 (32.4)	3.53 (2.31–5.40)	3.52 (2.18–5.68)
Unsure	5 (3.2)	10 (3.2)	2.04 (0.66–6.32)	2.23 (0.68–7.29)

*Adjusted for maternal age, body mass index, parity, ethnicity, social deprivation, and smoking; †missing data: 1 study woman and 1 control woman; ‡missing data: 1 control woman.

Table 2. Maternal Perception of Fetal Movements During the Last 2 Weeks of Pregnancy Stratified by Gestation

Perceived Fetal Activity	Preterm: < 37 Weeks' Gestation			Term: ≥ 37 Weeks' Gestation		
	Study Women	Control Women	Adjusted OR (95% CI)	Study Women	Control Women	Adjusted OR (95% CI)
	(n = 66) No. (%)	(n = 132) No. (%)		(n = 89) No. (%)	(n = 178) No. (%)	
Frequency of fetal movements—last 2 wk						
Increased	5 (7.6)	45 (34.1)	0.10 (0.03–0.37)	8 (9.0)	43 (24.2)	0.31 (0.11–0.83)
Same	33 (50.0)	59 (44.7)	Reference	43 (48.3)	76 (42.7)	Reference
Decreased	20 (30.3)	6 (4.6)	8.00 (2.14–29.91)	25 (28.1)	30 (16.9)	1.52 (0.73–3.19)
Unsure	8 (12.1)	22 (16.7)	0.36 (0.08–1.55)	13 (14.6)	29 (16.3)	0.85 (0.30–2.41)
Strength of fetal movements—last 2 wk						
Increased	3 (4.6)	60 (45.5)	0.04 (0.01–0.21)	13 (14.6)	64 (36.0)	0.35 (0.16–0.78)
Same	34 (51.5)	40 (31.8)	Reference	42 (47.2)	70 (39.3)	Reference
Decreased	16 (24.2)	4 (3.0)	3.73 (0.82–17.03)	14 (15.7)	17 (9.6)	1.56 (0.65–3.78)
Unsure	13 (19.7)	26 (19.7)	0.43 (0.14–1.31)	20 (22.5)	27 (15.2)	1.78 (0.68–4.71)

($p = 0.03$) and a marginally significant interaction for perception of frequency of fetal movements ($p = 0.07$). Further analysis was therefore performed for strength and frequency of movement, stratified by gestational age (Table 2).

An inverse relationship between increased frequency and strength of fetal movements was found in both gestational periods, with the strongest association in the preterm period. In preterm stillbirths (28–36 wk and 6 days' gestation), a perception of decreased frequency of fetal movement, compared with fetal movements remaining the same, was strongly associated with an increased risk of late stillbirth (aOR: 8.00; 95% CI: 2.14–29.91), whereas such an association was not seen at term. No statistically significant association was seen between decreased strength of fetal movement and stillbirth risk in either gestational period.

Discussion

Maternal perception of an overall increase in fetal activity appears to be reassuring at any gestational age after 28 weeks gestation. We report that a maternal perception of increased fetal movements over the last 2 weeks, compared with no change in perception of fetal movements, was associated with a significantly reduced risk of late stillbirth. Our findings do not imply that there should be concern if women do not feel an increase in the strength and frequency of fetal movements in the third trimester because it was most common among control women for the perception of the frequency of movements to stay the same (43%), and over one-third felt that the strength of movements stayed the same. Furthermore, no evidence is available to support the use of antenatal testing for

women who do not feel an increase in fetal movements in the last 3 months of pregnancy.

As has been described elsewhere, maternal perception of a decreased frequency of fetal movement was found to be associated with an increased risk of late stillbirth (3,23,24). Currently, no clear evidence exists to suggest that any objective limit of reduced fetal movements (such as number of kicks within a given time frame) is of greater value at predicting poor outcome than a more subjective overall maternal perception of reduction in movement (25).

Prior to term, women who had a perception of decreased frequency of fetal movements had a more than eightfold increased risk of stillbirth, whereas this association was not evident at term. Almost 17 percent of term control women perceived a reduction in frequency of fetal movements in the last 2 weeks (compared with < 5% before term). A large study investigating fetal activity in the third trimester also reported a reduction in frequency of fetal movement as pregnancy advanced, although because of a concurrent increase in duration of movement, no overall reduction in total fetal activity was reported (17). Our findings do not negate the importance of maternal awareness of fetal activity. Tveit et al showed that providing information to women to increase their awareness of fetal movements, and implementing consistent guidelines for the management of decreased fetal movements may be associated with a reduction in stillbirths (26).

Unusually Vigorous Movement

Research into the significance of unusually vigorous fetal movements has been minimal. It has been

suggested, in a single report, that a sudden increase in fetal movement can be associated with acute fetal distress and poor outcome (13); no studies have confirmed or refuted this speculation. We report an association between late stillbirth risk and maternal perception of a single episode of unusually vigorous movement. Our data suggest that a single episode of unusually vigorous movement is associated with a greater than sixfold increased risk of late stillbirth.

Repeated episodes of unusually vigorous fetal movements, on the other hand, may be reassuring. In a previous study that has reported about repeated excessive movements, no association was found with adverse outcomes (6). The clinical significance of the association between unusually vigorous movements and late stillbirth risk is difficult to gauge, however, as it is only in retrospect that the frequency of unusually vigorous movements can be determined.

Fetal Hiccups

A novel finding of this study was the protective association between maternal perception of fetal hiccups and late stillbirth risk. This study is the first to have investigated such a relationship. Fetal hiccups are easily felt by pregnant women and have been identified on ultrasound as abrupt episodes of fetal movements occurring regularly every 2 to 3 sec (27). Although the physiological mechanisms underlying fetal hiccups remain unclear, they have been reported to occur throughout pregnancy and are thought to be related either to the preparation for postnatal breathing, or to the development of suckling or gasping patterns (28), and as such are considered a sign of a normally functioning fetus. The few studies that have investigated the effect of fetal hiccups on fetal heart rate patterns support the suggestion that fetal hiccups are a normal aspect of fetal behavior, more commonly observed in the active fetal state (29–32). Fetal hiccups have also been associated with reactive non-stress tests (31). Further studies are needed, however, to determine the physiological significance of fetal hiccups and their association with fetal well-being.

Strengths and Limitations

This study is the first that has explored a relationship between a broad range of maternally perceived fetal activities and stillbirth risk. However, assessment of fetal activity by maternal perception is subject to several maternal physical and psychological factors (10–12). This study was able to control for some of these factors (such as maternal body weight), but not others (such as placental position). A limitation of this study is

the potential for recall bias because women who experienced a stillbirth may place different significance on the perception of their baby's movements before death compared with those who have a live ongoing pregnancy. This suggestion is particularly relevant to the perception of decreased movements, which have long been associated in the general population with poor outcome. Sadovsky et al have described a reduction in fetal movements before death (2); however, decreased fetal movements may also be a sign of actual rather than impending fetal death. Recall bias is less likely to be a factor in relation to unusually vigorous fetal activity and fetal hiccups because they have not been described previously in relation to stillbirth risk.

Conclusions

Our study suggests that a maternal perception of increasing fetal activity (in both frequency and strength) throughout the last 3 months of pregnancy is a sign of fetal well-being. The findings also confirm the association between maternal perception of decreased fetal movement and risk of late stillbirth. This finding is of particular significance between 28 and 36 weeks gestation, suggesting that raising maternal awareness of fetal movements may be of benefit from as early as 28 weeks gestation. The novel finding of a strong association between maternal perception of fetal hiccups and a reduced risk of late stillbirth is of interest; further research is required to confirm or refute this finding and to explore the physiological significance of fetal hiccups.

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