An exploration of differences in infant feeding practices among women with and without diabetes in pregnancy: A mixed methods study

Short running title: Infant feeding practices following diabetes in pregnancy

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Novelty statement:

- Women who experience diabetes in pregnancy are less likely to fully breastfeed their infants than those who do not but the reasons for this are unclear.
- Our study identified that women with diabetes in pregnancy had 50% lower odds of fully breastfeeding at 3 months postpartum compared to women who did not have diabetes but who were matched for BMI, parity, mode of delivery and preterm delivery.
- Women who had experienced diabetes in pregnancy require additional breastfeeding support prior to giving birth and in early postpartum

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Abstract

Aims: 1) To determine the likelihood of full breastfeeding at 3 months postpartum in women with and without diabetes in pregnancy (DiP); 2) Explore associations between diabetes management practices and infant feeding practices in those who had DiP and 3) To examine women's experiences of feeding their infants after having DiP.

Methods: The quantitative study used data from Alberta Pregnancy Outcomes and Nutrition (APrON) cohort study. Participants who had DiP (n=62) were matched 1:3 to participants without DiP for pre-pregnancy BMI, parity, mode of delivery and preterm birth. Infant feeding questionnaires, prospective breastfeeding diaries, and medical chart data were analysed to determine likelihood of fully breastfeeding at 3 months postpartum. For the qualitative study, interviews were conducted with postpartum women who had DiP to explore experiences of infant feeding. Interviews were thematically analysed, and results were compared between women who were categorized as "Full breast Feeders" or "Mixed Feeders".

Results: The odds of fully breastfeeding were 50% lower in women with DiP than women without (OR: 0.50, 95% CI 0.25-0.99, p=0.04). Qualitative interviews identified that while all women showed resilience in the face of infant feeding challenges, those who were fully breast feeding reported seeking out external infant feeding supports e.g. classes or Doula's. Mixed Feeders perceived there was a lack of infant feeding information and support given to them prior to giving birth.

Conclusion**:** Women with diabetes in pregnancy may require additional prenatal and postnatal infant feeding support to be better prepared to overcome feeding challenges they may face.

Keywords: Breastfeeding, pregnancy, diabetes, gestational diabetes mellitus

Introduction

Experiencing diabetes in pregnancy (DiP) is a prevalent concern for women globally. DiP can include both pre-existing diabetes (Type 1 & Type 2 diabetes) or diabetes developed in pregnancy (gestational diabetes mellitus). It has been estimated that around 0.9% of pregnancies are complicated by pre-existing diabetes[1]. Furthermore, a 2013 study estimated that worldwide gestational diabetes mellitus (GDM) effects around 17% of pregnancies[2]. Within Canada rates of GDM have been on the rise; from 2004 to 2011 rates increased from 40.8 to 54.5 per every 1000 live births[3].

Breastfeeding has health benefits for mothers and infants[4-9] and maybe especially so for women who experience diabetes in pregnancy. For example for the mother, multiple clinical practice guidelines for the treatment of diabetes note that breastfeeding may improve glucose and lipid profiles following DiP[10-12], and longer breastfeeding duration is associated with a lower risk of obesity in the child[7] yet, women with DiP reported lower rates of initiation and shorter duration of breastfeeding than women without DiP[13-15].

Reasons for this are multifactorial. For example pathophysiologic mechanisms such as delayed lactogenesis and low milk supply have been associated with diabetes in pregnancy[16, 17] and insulin treatment[18]. In addition, caesarian-section, neonatal intensive care admission, and stress, anxiety and depression[19-21] among women with diabetes in pregnancy have been found to be negatively influence breastfeeding initiation and duration[22]. However, to date studies have not included diabetes management during pregnancy and healthcare delivery practices before, during and after pregnancy as factors that could impact infant feeding. There is some evidence to show that improved healthcare professional support for non-diabetic pregnant women can improve initiation and duration of breastfeeding[23, 24], however it is unclear how women with DiP consider the different factors that have influenced their infant feeding behaviours. Furthermore, studies in this area have used either quantitative or qualitative study designs. A mixed-methods approach can shed new light on how multiple factors interact to support or reduce breastfeeding behaviours in this vulnerable group of women. Better insight into how these factors are related could help to direct changes in clinical care that optimise infant feeding practices among women with DiP.

The present study used a mixed methods approach. We carried out a quantitative study which aimed 1) to determine the likelihood of fully breastfeeding at 3 months postpartum in women with and without DiP; and 2) to explore the associations between diabetes management practices and breastfeeding practices in those who had DiP. We subsequently carried out a qualitative study to examine women's perceptions of their experience of feeding their infants after having DiP.

Methods

Study design: This mixed methods study examined infant feeding practices in women who experienced DiP. The quantitative study used data from the Alberta Pregnancy Outcomes and Nutrition (APrON) cohort[25] and included women who experienced DiP and a comparable group who did not. In the qualitative study, interviews were conducted with postpartum women who had recently experienced DiP. Studies were approved by Ethics Review Boards at the University of Alberta (PRO2954) and the University of Calgary (REB14-1702_REN6).

Quantitative Study

Study Population: The APrON study is a prospective cohort of 2189 pregnant women and their children[25, 26] recruited from Calgary and Edmonton, Alberta, Canada between 2009 and 2012. Women attended up to three study visits during pregnancy (one in each trimester) and at ~12 weeks postpartum. Women with complete data for DiP (Type 1 diabetes, Type 2 diabetes, or gestational diabetes) and breastfeeding status at 3 months postpartum (n=92) were matched 1:3 with women with breastfeeding status but without diabetes (n=276) on the following characteristics: pre-pregnancy BMI category (normal weight / overweight / obese); parity (nulliparous / multiparous); pre-term birth (yes / no); and mode of delivery (caesarean-section /vaginal). If information on one characteristic was missing, the match was made using the remaining three. For the power calculation we assumed that the true difference in the proportions of full breastfeeding between the two groups of women would be 0.2. In the whole APrON

cohort, the proportion of full breastfeeding at 3-month postpartum was 0.57. So a conservative power was based on assumed full breastfeeding proportions of 0.4 (DIP group) and 0.6 (non-DIP group). The study power under this sample size, study design and full breastfeeding proportions was 0.945.

Primary Exposure: Diabetes in pregnancy, the primary exposure of interest, was confirmed by linking maternal personal healthcare numbers with laboratory glucose tests completed in the 9 months prior to delivery. Information about diabetes treatment was collected through a similar linking process with an electronic clinical charting system specific for women with DiP. Women who reported using any insulin were classified as using insulin, while those who did not use insulin were classified as treated with diet therapy.

Outcomes: The primary outcome was whether the mother had been fully breast feeding her infant at 3 months postpartum. We defined 'fully breastfeeding' from the perspective of the mother in line with the WHO definition[27] i.e. mother had not provided any other food or liquid other than breastmilk to her infant since birth. This information was collected by questionnaire, along with information about women's use of formula and complementary weaning foods. Specifically, women were asked 'Since the birth of your baby have you ever fed breastmilk' with the possible responses of 'Yes and I continue to do so'; 'Yes but I have stopped' or 'No I never did'. The same was asked about infant formula. Introduction of complimentary feeding (any food or drink other than breastmilk or infant formula) to the infant was assessed using a short food frequency questionnaire. Women who were feeding breastmilk to their infant also completed a 3-day infant feeding diary in which they reported the number of times/day (from breast or bottle) their infant was fed, the duration (mins) of each feeding episode, and what and how their infant was fed each time (at breast/breastmilk in a bottle/formula).

Other maternal characteristics that might confound the association of full breastfeeding status at 3 months and diabetes status were also considered, including maternal age, ethnicity (white/non-white), income (<$100,000 Cdn/≥$100,000 Cdn), marital status,

gestational weight gain relative to Institute of Medicine (IOM) Guidelines[28], intentions to breastfeed[29], diet therapy (yes/no), insulin use (yes/no), induction of labour (yes/no), neonatal intensive care unit admission (NICU: yes/no). Attitude towards breastfeeding was assessed using the IOWA Infant Feeding Attitudes Scale[29] collected in the 3rd trimester of pregnancy. The scale consists of 17-items assessed on a 5-point Likert scale from 'strongly disagree' to 'strongly agree', responses are coded 1-5 and summed to produce an overall score between 17-85 with a higher score indicating more favorable attitudes towards breastfeeding. Previous research has shown that when assessed during pregnancy women who score >65 are more likely to exclusively breastfeed and for longer than those who score <65[30]. Furthermore the score has been shown to be highly correlated with intentions to breastfeed, therefore we refer to this score as intention to breastfeed'[31].

Statistical Analyses**:** Differences in characteristics between women with and without DiP were compared using Chi-squared tests for categorical and two-sample t-tests for continuous variables. Proportions of full breastfeeding (yes/no) at 3 months were compared between women with and without DiP using a random effect logistic regression model and adjusted for ethnicity, where the adjustment of matching variables i.e. pre-pregnancy BMI, mode of delivery, parity, and pre-term birth, is through the use of the random effect. All analyses were conducted using STATA (version 13.1, College Station, TX: StataCorp LLC) and R (version 3.6.1) [32]

Qualitative Study

Setting and study participants: Women who had recently experienced DiP were recruited through medical clinics and support groups in Edmonton and Calgary, Alberta, Canada. Inclusion criteria were: diagnosis of DiP, ≤8 months postpartum, infant had no known anomalies that would prevent them from feeding by breast or bottle, fluent in written and spoken English, access to a computer and telephone, and > 18 years of age.

Potentially eligible women were informed of the study during pregnancy and if interested, provided their email address to be contacted again at ~ 3 months postpartum. Upon responding to the study team via email and requesting enrollment into the study, participants provided informed signed consent online via the Research Electronic Data Capture (REDCap) system[33].

In total, 57 women expressed interest in taking part in the study and 27 agreed to participate when contacted postpartum. Interviews were conducted between March and May of 2019; all were audio-recorded. Recordings from 24 interviews were analyzed as 1 participant could not be contacted and 2 interviews did not record properly.

Data collection: Participants completed a short online questionnaire reporting their demographic information prior to beginning their semi-structured interview. Interviews were then carried out over the telephone with a member of the study team at a date and time convenient to the participant. Interviews were recorded and followed a semi-structured question route (supplemental Table 1). During the interview, women were asked about their experiences with infant feeding, including their experiences with having DiP and about feeding their infant, perceptions about how having diabetes might have affected their infant feeding behaviours, and what supports, if any, they found useful to help them feed their babies the way that they wanted to.
Two members of the research team (DM and MJ) conducted the interviews with concurrent analysis. The researchers met regularly to discuss preliminary results and after 10 interviews, researchers added additional probes about women's experiences feeding their babies in hospital immediately after giving birth.
Participants were sent $15 (Cdn) gift card after completing their interview as remuneration for their time.

Data analysis:
Interviews were transcribed verbatim. Transcripts were read and re-read independently by the same two researchers who conducted the interviews. Each undertook initial, inductive coding of overarching themes and double coded a proportion of the transcripts

to confirm consistency. The two researchers discussed themes and sub-themes and agreed on a final coding frame (supplemental Table 2). Transcripts were separated into one of two groups of those who were Full Breast Feeders (FBF) or those who fed their infant using both breastmilk and infant formula (Mixed Feeders (MF)) according to participant's reported mode(s) of infant feeding. Similarities and differences in the interviews were then explored between these two groups.

Results

Quantitative Study Results

Confirmation of DiP using medical charts reduced the women with DiP from 92 to 62. Of the 30 participants removed, 16 did not provide a valid personal healthcare number and 14 had incorrectly self-identified as having gestational diabetes. The 62 participants with DiP were matched to 175 participants without diabetes, a comparison of their characteristics is included in Table 1. Most characteristics were similar between groups however, there were more women with DiP from a non-white ethnic background and women with DiP were more likely to have weight gain below national gestational weight gain guidelines. Intention to breastfeed scores were missing for many participants (50% without DiP and 29% with DiP). However, of those who did complete the questionnaire mean intention to breastfeed scores, were similar between the two groups but 75% of women without DiP had a score ≥65 compared to 61% of those with DiP.

At 3 months postpartum, 85 (49%) of women without DiP were fully breastfeeding compared with 18 (29%) women with DiP. Ethnicity was significantly associated with full breastfeeding; women identifying as white were more likely to fully breastfeed (OR: 2.66, 95% CI 1.19-5.90), adjusting for their DiP status, pre-pregnancy BMI, mode of delivery, parity, and pre-term birth status. The adjusted odds of full breastfeeding were 50% lower in women with DiP than women without DiP (OR: 0.50, 95% CI 0.25-0.99, p=0.04).

Complete breastfeeding diaries were available for 78 women without DiP and 44 with DiP. Differences in proportions using expressed breastmilk, and daily frequency, and

duration, of feeding at breast between fully and non-fully breastfeeding women without and with DiP are shown in Table 2. A similar proportion of fully breastfeeding women reported expressing their breastmilk into a bottle to feed their infant, regardless of DiP status. Women who had DiP and were fully breastfeeding fed their infant at breast around once more per day than those who were fully breastfeeding without DiP, although this was not statistically significant (p=0.202). There were no differences between those without or with DiP in terms of the average minutes/day of feeding at breast. Unsurprisingly those who were not fully breastfeeding fed their infants less at breast that those who were fully breastfeeding, regardless of DiP status.

We compared available clinical characteristics in women with DiP between those who were fully breastfeeding and those who had introduced formula. There were no statistical differences in the proportions of women whose diabetes was treated using insulin or lifestyle therapy alone, had induced labour, caesarean-section or had babies admitted to the neonatal intensive care unit between the two groups of women. (Supplementary Table 3).

Qualitative Study Results

Participant Characteristics

The 24 participants in the Qualitative Study were between 25 and 43 years, primarily white, highly educated, married or living with a partner, and with a high household income (Table 3). Their age was similar to APrON participants (35.3 ± 4.4 years). In total 55% had developed GDM while others were diagnosed with diabetes prior to pregnancy. Two participants had a monogenic form of diabetes, one of whom was diagnosed in pregnancy. Women were between 3 and 6 months postpartum when interviewed. Three main themes were identified from the interviews: Preparing for Infant Feeding before Birth, Infant Feeding Experiences, and Healthcare Supports.

Theme: Preparing for Infant Feeding Before Birth

Most (67%) women either had no recollection of having discussed infant feeding with their healthcare providers before the birth of their infant or reported that the discussions

were general and brief. Women's experiences were similar in the FBF and MF groups. When asked "Do you feel that having DiP affected how you were recommended to feed your baby?" all women explicitly responded that they did not. Some women, however, noted that breastfeeding was generally encouraged, and the conversations revolved around ways that they could manage their blood sugar while breastfeeding if they had pre-existing diabetes (see Table 4: quote, P02_FBF).

Theme: Infant Feeding Experiences: Challenges

Women in FBF and MF groups expressed their strong intentions to breastfeed prior to giving birth. All described having experienced similar challenges while breastfeeding, such as exhaustion, poor latching, sore nipples, and a low milk supply (see Table 4: quotes P05_MF, P12_MF).

Most women did not believe that having DiP affected their ability to breastfeed. There were no clear differences in the reasons for pumping between FBF and MF groups. Although those in the MF group mentioned that pumping did not increase their milk supply and that they ultimately decided to give their infant formula (see Table 4: quote P12_ MF and P23_ FBF).

Theme: Infant Feeding Experiences: Women's Resilience

All women showed resilience to the challenges they faced when breastfeeding and women in both groups identified strategies to overcome breastfeeding challenges. Women in the FBF group resolved their challenges to carry on fully breastfeeding whereas women in the MF group described using infant formula to resolve the situation, despite wanting to continue to breastfeed (see Table 4: quote P06_MF and P09_ FBF).

Theme: Infant Feeding Experiences: Supports & Facilitators

Women in the FBF group often described how they sought out and sometimes paid for external supports, such as a doula or infant feeding classes. Most women in this group also had more than one child, which they attributed to helping them feel more confident in their approach to infant feeding and maintaining full breastfeeding. In contrast,

women in the MF group identified family members as their primary supports for infant feeding (see Table 4: quotes P27_ FBF, P04_ FBF, P23_ EFB, and P08_ MF).

Theme: Healthcare Supports

All women described having had some negative experiences with healthcare professionals related to feeding their infants. Women in the MF group often reported feeling pressure to breastfeed and feeling judged and guilty for not fully breastfeeding. They noted that information is lacking for those who cannot breastfeed and expressed the need for information and support that is non-judgemental and that recognizes that women may not be “choosing” to use a combination of breastmilk and formula to feed their infants. They also noted that infant feeding information and support should be available prior to delivery (see Table 4: quotes from P05_ MF). Women in the FBF group also highlighted a lack of individualized care and poor communication with health care providers regarding infant feeding. Some perceived that healthcare providers were “too busy” or “not listening” to them (see Table 4: quote P02_FBF).

Theme: Healthcare Support: Support from a Lactation Consultant

Positive comments almost exclusively came from women who had received support from a lactation consultant. Positive care was described as being informative, person centered, non-judgemental, and readily available and women in the FBF and MF group both described positive healthcare support similarly (see Table 4: quote P07_MF).

Discussion

Clinical practice guidelines for treatment of diabetes highly recommend that women who experience DiP breastfeed their infants to optimize their and their infant’s health [10-12]. However, within our study, DiP is associated with lower rates of full breastfeeding. The quantitative results demonstrated that the odds of full breastfeeding at 3 months postpartum were 50% lower in women with DiP than without DiP in spite of them sharing similar physical and delivery characteristics.

Several studies have examined breastfeeding initiation rates among women who experience DiP[13-15], though few extend observations to longer term breastfeeding

duration and exclusivity. Our study suggests that the lower rates of full breastfeeding noted early after birth continue after the mother may have had a chance to establish breastfeeding once at home. However, we were unable to identify any differences in diabetes management practices associated with likelihood of full breastfeeding.

Women with and without DiP reported similar intentions to breastfeed prior to giving birth; this sentiment was mirrored in the qualitative interviews where most women expressed that their preference had been to fully breastfeed. Also, from the qualitative data we learnt that many of those in the FBF group sought support from external sources prior to giving birth. FBF reported hiring doula's, particularly those who are also lactation consultants, to help prepare them for breastfeeding. Emerging literature suggests that involving doulas in the early postpartum period is associated with an increase in breastfeeding initiation[34, 35], although the impact on sustainability is not clear[35]. Women in our qualitative study also noted that prenatal and breastfeeding classes were useful "external" supports and that "knowing what to expect" helped make them feel more prepared. It is important to note however, that "external" supports are often paid services, which would limit family's accessibility to them, and could undermine full breastfeeding among women with lower socioeconomic status.

Women in the qualitative study did not recall having conversations about breastfeeding with their health care providers prior to giving birth, and those who did reported that breastfeeding was generally encouraged, but further discussion on the topic was vague. Our findings align with several others in the literature. Heidari et al. (2016) interviewed nursing mothers, key family members and personnel who provide breastfeeding counselling services. Study participants suggested that breastfeeding supports were lacking during pregnancy[36]. In a similar study of women who breastfed, Doughty et al. (2018) reported that women felt they were not provided with enough information during the prenatal period about what to expect from breastfeeding, what could go wrong and how to handle problems[37]. While these studies were not specific to women who had DiP, their findings suggest that lack of consistent support for infant feeding and breastfeeding prior to birth may be a gap in the prenatal care.

Our quantitative study indicated that women with DiP fed at breast around once per day more frequently than those without DiP, although not statistically significant, possibly

due to limited numbers of participants in this sub-group analysis. We also showed that the total average daily time spent feeding their infant at breast was similar between women who were fully breastfeeding, regardless of their DiP status. The number of breastfeeds/24hrs were slightly lower in both groups of women compared to other research[38]. It is possible that a slightly higher frequency of daily breastfeeds seen in women with DiP was an attempt to increase milk supply as delayed lactogenesis and low milk supply have been shown to be more likely in women with DiP[16-18]. Poor milk supply was a particular challenge discussed by women in the qualitative study. Health information routinely collected by Statistics Canada (2013) cited that 'not enough milk' was the most common reason mothers stopped breastfeeding before 6 months[39]. Despite the challenges that women within the qualitative study reported, they also all described strategies they used to address these challenges. These included using "pumping" to stimulate milk production and creating a milk reserve for "top-up" feeds. Such efforts reinforce the fact that that women were motivated to breast feed and demonstrated resilience when faced with challenges.

The qualitative findings showed that mixed feeders highlighted that there was a lack of information available to women who could not breastfeed and described feeling pressure and/or guilt about not breastfeeding. These findings are mirrored in a number of other studies[40, 41]. On the other hand positive aspects of health care was described by some women in our study as being informative, person centered, and easily available. Additional research is needed to understand and facilitate effective implementation and integration of these principles throughout the healthcare system

We identified that ethnicity was an important predictor of full breastfeeding with white women more likely to be fully breastfeeding compared to non-white women, controlling for DiP status. Previous findings in relation to ethnicity and breastfeeding in other cohort studies are inconsistent. In the UK, the Millennium Cohort study found that white women were less likely to initiate and continue breastfeeding compared to non-white women[42]. Whereas, an analysis of the National Health and Nutrition Examination Survey (NHANES) noted that Mexican-American women were more likely to breastfeed relative to white women, but African-American were less likely to breastfeed relative to white women[43]. Due to the limited numbers in this study we were unable to examine the

complexity of this association further. Studies with more ethnically diverse populations are required.

Finally, it is of concern that in addition to only 30% of women with DiP fully breastfeeding only 49% of women without DiP in this cohort were fully breastfeeding at 3 months postpartum. The rate of full breastfeeding noted in the comparison group is slightly less than the 54% noted in a previous report women in the whole APrON cohort[44] and lower that the population rate of 53% reported in the Canadian Community Health Survey 2009/2010[45]. It is possible that the factors chosen for matching, such as pre-pregnancy BMI, mode of delivery, and pre-term birth status, is associated with breastfeeding rates in the comparison group. Half of the women in the quantitative study had overweight or obesity pre-pregnancy. A recent systematic review of the literature showed that women who had overweight or obesity were more likely to experience physical challenges with breastfeeding including low milk supply, and difficulties latching, as well as having lower rates of initiation and duration of breastfeeding[46]

Strengths and limitations

Research exploring infant feeding practices among women with DiP is limited. The mixed methods design of this study is a strength as we begin to link information about having had DiP with mothers' experiences with infant feeding. Within the quantitative study, women with DiP were well matched to those in the comparison group, which helped to isolate effects of having DiP from important confounders including pre-pregnancy BMI, preterm status, parity and mode of delivery. In the quantitative study we had only 6 women with pre-existing diabetes, therefore we did not have enough power to investigate breast feeding between types of diabetes, this would be an important step for future research. Generally, women in this study were highly educated, have a high family income, and most of them are living with a partner or spouse; they also live in Canada where maternity leaves of up to 1 year are common; Thus, the findings reported for this well-resourced group may not be directly applicable to groups of lower socio-economic status. Although the quantitative study was constrained by the sample size, the differences in the proportions of full breastfeeding between the 2 exposure

groups were clear and lend additional support to those studies noting differences in infant feeding practices among women with DiP.

For the qualitative study recruiting women in early postpartum from an expression of interest they gave during pregnancy may have impacted on the number of participants actually recruited. Whilst 57 women expressed interest in taking part in the qualitative study while they were pregnant, only 27 responded to our recruitment email sent in early postpartum to follow-up this interest; This is possibly due to the challenges with having a newborn and not having time.

Conclusion:

The time during pregnancy could represent an opportunity to intervene by referring to lactation consultants, or breastfeeding classes, to support more women with DiP to breastfeed postpartum. Such additional supports both in hospital and at-home may empower women to initiate and maintain breastfeeding by feeling more able to overcome challenges they face. Future research should explore how healthcare providers and women understand, interpret, and use current infant feeding guidelines to identify how these supports can be optimized.

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Contribution Statement:

MJ, RB, LD, JY, and YY conceived of this project, designed the studies and obtained funding for this work. MJ and YY carried out analyses for the Quantitative portion of this study. MJ and DM collected and analyzed data for the Qualitative portion of this study. All authors provided a substantial contribution to drafting and revising this manuscript and contributed important intellectual content. All authors approved the final version of the manuscript. All authors accept responsibility for all aspects of this work. MJ is the guarantor of this work and along with RB and YY, has full access to the data analyzed and takes full responsibility for the integrity of the data and its analysis.

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Table 1: Characteristics of women with and without diabetes in pregnancy from the Alberta Pregnancy Outcomes and Nutrition Study

Characteristic	Without Diabetes in Pregnancy (n=175)	With Diabetes in Pregnancy (n=62)
Age, years (mean (SD))	32.7 (4.8)	31.7 (4.4)
Breastfeeding intention score ‡ (mean (SD)	68.5 (7.2)	65.5 (8.8)
	n (%)	**n (%)**
Diabetes Type		
- Type 1	N/A	2 (3)
- Type 2		4 (7)
- GDM		56 (90)
Diabetes treatment		
- Insulin	N/A	28 (45)
- Diet/Lifestyle		25 (40)
- Missing		9 (5)
Ethnicity*		
- White	151 (86)	39 (63)
- Non-white	22 (13)	23 (37)
Missing	2 (1)	0 (0)
Education		
- < University	49 (28)	18 (29)
- ≥University	124 (71)	43 (69)
Missing	2 (1)	1 (2)
Income		
- < $100,000	78 (45)	27 (44)
- ≥$100,000	92 (53)	34 (55)
Missing	5 (3)	1 (2)
Marital status		
- Single	5 (3)	0(0)
- Married/cohabiting	169 (97)	62 (100)
Missing	1 (1)	0 (0)
Gestational Weight Gain relative to IOM Guidelines*†		
- Below	8 (5)	11 (18)
- Within	19 (11)	9 (15)
- Above	52 (30)	19 (31)
Missing	96 (55)	23 (37)
Pre-pregnancy BMI Category†		
- Normal	58 (33)	20 (32)
- Overweight	51 (29)	17 (27)
- Obese	41 (23)	14 (23)
Missing	25 (14)	11 (18)

Parity†		
- Nulliparous	82 (47)	28 (45)
- Primiparous/Multiparous	92 (53)	33 (53)
Missing	1 (1)	1 (2)
Pre-term birth†		
- No	158 (90)	55 (89)
- Yes	17 (10)	7 (11)
C-section†		
- No	133 (76)	45 (73)
- Yes	37 (21)	15 (24)
Missing	5 (3)	2 (3)

* P=<0.05; † Matched characteristic

‡ intention to breastfeed score was missing in 90 participants without DiP and 18 participants with DiP

Table 2: Differences in Breastmilk feeding between fully and not fully breastfeeding mothers, without and with DiP.

Characteristic	Without Diabetes in Pregnancy		With Diabetes in Pregnancy	
	Fully breastfeeding (n=44)	Not fully breastfeeding* (n=34)	Fully breastfeeding (n=16)	Not fully breastfeeding* (n=28)
	N (%)		N (%)	
Any feeding expressed breastmilk in a bottle	9 (21)	10 (30)	4 (25)	5 (18)
	Mean (SD)		Mean (SD)	
Average number of feeds at the breast per day	8 (2.5)	6 (2.5)	9 (2.8)	6 (3.6)
Average daily time spent feeding at the breast (mins/day)	136.7 (68)	116 (63)	137.5 (59)	117 (72)

*Diaries were only completed by women who indicated feeding breastmilk to their infants at 3 months postpartum and therefore data are not available for those who were fully formula feeding.

Table 3: Characteristics of participants who completed semi-structured interviews (N=24)

Participant Characteristics	N (%)
Type of diabetes	
- Type 1 Diabetes	8 (33)
- Type 2 Diabetes	1 (4)
- Monogenic form of diabetes	2 (8)
- GDM	13 (55)
Feeding practice	
- Full breastfeeding	15 (62)
- Mixed feeding	9 (38)
Ethnic origin	
- White/Caucasian	15 (62)
- Non-white/ Non-Caucasian	9 (38)
Born in Canada	
- No	7 (29)
- Yes	17 (71)
Highest level of education	
- Less than university level	3 (13)
- University level	21 (87)
Household income	
- < $100,000 CAD	9 (38)
- ≥ $100,000 CAD	14 (58)
- Declined to answer	1 (6)
Marital status	
- Married	6 (25)
- Common law	18 (75)
Parity	
- Primiparous	15 (62)
- Multiparous	9 (38)
Currently on maternity leave	
- No*	2 (12)
- Yes	22 (88)
Managed using insulin	
- No	9 (38)
- Yes	15 (62)
Managed using diet therapy	
- No	11 (46)
- Yes	13 (54)

*These women indicated that they were not in paid employment prior to becoming pregnant

Table 4. Supporting Quotations from Women in Each of the Feeing Groups who Participated in the Qualitative Study

Theme	Women who using Mixed Feeding (MF), including infant formula	Women who were Fully breast Feeding (FBF)
Preparing for Infant Feeding Before Birth		P02_FBF: *"There was literally no discussion about breastfeeding. I think maybe except for the question, "Do you plan to breastfeed?" Which I think everyone asks when you're pregnant" … "Their focus is mostly on the blood sugar, because that's a big determinant if the baby's gonna be healthy and you know, strategies for when I was in labour and delivery to make sure that my blood sugar was still good then, and also after making sure I had the right basal rates and stuff like that after I gave birth, because obviously my insulin needs to go down a lot*".
Infant Feeding: Challenges	P05_MF:"*I was wanting to breastfeed, the entire time. And unfortunately, because of the challenge of me not feeling comfortable, I couldn't*."	*P24:FBF: "Because immediately after giving birth, for me, I was totally overwhelmed with a lot of different things. You're exhausted. At first, we did have latching problems. And she would latch, and then she would unlatch*

	P12_MF: "I would have loved to have been able to keep breastfeeding him. I think I would have loved him to figure out how to breastfeed. But he just could not figure it out. He couldn't figure out the latch. And so, he got more frustrated. And they would tell me, "Oh, just try for 10 minutes, and then just go to the bottle." 'Cause you don't want to frustrate him, 'cause then he won't eat from the bottle either". P12_ MF: *"Even when I was pumping, it was difficult to get a steady flow. So I don't think there has ever been a chance for him to suck hard enough to get that flow*. "	*and get really fussy. And it just really frustrating, and I couldn't understand why."* P23_ FBF: *"Then I would pump after the feed, and then whatever I pumped, I'd add as the top up for the next feed."*
Infant Feeding: Women's Resilience	P06_MF: *My nipples were broken and bloody and I think the recommendation was first to try to feed him on the breast for ten or 15 minutes each side. After that, he got a bottle, because he didn't drink. And then I should pump and this took already, I think, in total, more*	*P09_FBF: And I think it was hard because he had blood sugar issues, so I just had to feed him basically everything all the time. So because I was so fatigued, it was very difficult to keep up with the actual breastfeeding. But I did".*

	than one hour. And I should continue every two to three hours – ah, to repeat it. So that was not easy. My plan was to breastfeed him completely as in full breastfeed. But this did not work and yeah, I tried to increase milk supply. So at first I was a bit frustrated about the situation, but now its okay for me.	
Infant Feeding: Supports and Facilitators	*P08_MF: "I had a lot of family support, both on my partner's side and with my own family. Specifically my mother-in-law and my mother in trying to help me focus on breastfeeding as opposed to other responsibilities in my home. And so a lot of it was more emotional support, along with the physical support, which was helpful."*	*P27-FBF: "We had a doula. So we worked really closely with our doula – and you know, people talked a lot about how difficult nursing can be. And so she helped us prepare for some of the challenges that may arise. Just getting the first latch and getting a good latch. We talked about the fact that it was important to continue taking the pre-natal vitamin as long as I was nursing. And I didn't know how important it was to feed the baby right after delivery – like, within that one hour so that he could get tested for his sugars – I didn't know that. She was also –like she was also a lactation specialist. Yeah, so we*

		hired her to be there for the labour and the delivery. And then also, we hired her to do a specialized pre-natal classes before the baby came." *P04_FBF: "This is my second child. So he seemed to take to it pretty easily. I don't know if it was because maybe I was a little more confident in what I was doing"* *P23:FBF: "It might have been different if he was my first because I did have a little bit of experience with my daughter, so I knew a few things like to expect"*
Perceptions of Healthcare: Supports	*P05:_MF: "But really, they don't give you any options if you cannot breastfeed properly. It's having the information before babies arrive, information about the breastfeeding, but also giving that option – because they also make you feel bad when you cannot breastfeed. You are like, "Well, I'm a bad mom, because I don't know what to do if I cannot breastfeed."*	*P02_FBF: "They were just not empathetic. They were very strict with their exact rules and didn't really look at the individual. They just were like, "Well, this is what our rules say, so this is what you're gonna do."*

Perceptions of Healthcare: Support From a Lactation Consultant	P07_MF: *“Actually what happened is at the hospital I was practicing breastfeeding. I saw two lactation consultants and they gave me tricks and everything. I went to the community health centre to see a lactation consultant, to try to get more tricks to finally be able to breastfeed her. So I think I had real good support. I think that the visit from the nurse the day after I came back home was pretty helpful talking about everything. My baby’s two months old and that I can still go to the community health centre for the breastfeeding, all that kinda stuff – so I think the support was pretty good. I could just reach out whenever I needed, so it was pretty good.”*	