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Maternal obesity adversely affects early breastfeeding in a multicultural, multi-socioeconomic Melbourne community

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TITLE PAGE

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Running title: Maternal obesity adversely affects early breastfeeding.

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Short Running Title: Maternal obesity adversely affects breastfeeding

Keywords: Body mass index, maternal obesity, breastfeeding, ethnicity, severe obesity.

ABSTRACT

Background: Maternal breastfeeding support and maternal obesity are concerns effectively addressed at the community level. International, national and regional surveys have established that elevated maternal body mass index (BMI) is a risk factor for early cessation of breastfeeding. However, the extent of these concerns in the local community is often an unknown and related to variables such as socioeconomic status, education, culture and ethnicity.

Aims: We believed that a survey of post-natal breastfeeding and BMI status would provide a valuable insight into developing targeted local health initiatives.

Materials and Methods: In 2014 we teamed up with the Whittlesea Maternal and Child Health Service to complete a questionnaire of mothers and babies attending the 8-weeks infant review. Data included: infant and maternal weight, medical conditions, breastfeeding experience and satisfaction, prime language, education level, support.

Results: Maternal obesity at 8 weeks postpartum was high at 28.9 %, with 63.6% of mothers being overweight or obese. Obesity was associated with a lack of higher education ($p<0.05$) and with English as the prime language ($p<0.05$). Breastfeeding initiation was high across all BMI categories at 98.3%. By 8-weeks, 32.2% of mothers had ceased breastfeeding. Breastfeeding continuation at 8-weeks was negatively correlated with elevated BMI ($p<0.01$). Breastfeeding cessation in mothers with elevated BMI correlated with psychosocial concerns ($p<0.05$) and lack of previous breastfeeding experience ($p<0.01$).

Conclusion: Elevated maternal BMI is prevalent in our community and significantly impacts the success of breastfeeding in the early post-natal period. The survey data has allowed targeted health responses to be developed.

INTRODUCTION

Breastfeeding has multiple benefits. For the infant, breast milk provides nutritional requirements and has protective immunological and anti-inflammatory properties for both mothers and children. Breastfeeding has positive psycho-social effects such as enhanced mother child bonding and reduction in the risk of postpartum depression[1]. In later childhood life, a reduction in risk occurs for asthma, obesity, type 1 and 2 diabetes and leukemia. Breastfeeding for mothers has been associated with reduced risk of type 2 diabetes, breast, and ovarian cancer[2].

Obesity in women is a significant health concern. Obesity increases the relative risk of diabetes and coronary artery disease in women, increases the risk of low back pain and knee osteoarthritis and increases the risk of multiple cancers and is associated with depression[3]. In Victoria, normal weight mothers comprise 49.9%, overweight 27.2%, obese 17.1%, morbid obese 2.5 % and super obese (BMI > 50) 0.3 % of the population[4]. High maternal BMI, in particular obesity, has negative outcomes such as higher rates of lower uterine segment caesarean section (LUSCS), gestational diabetes and hypertension and is associated with decreased intention, initiation and duration of breastfeeding[3].

Despite international[5,6], Australian national[7] and Australian state-based studies[8,9] showing that elevated BMI is associated with early breastfeeding cessation, there have been few studies at the local community level - which is where both obesity and breastfeeding concerns are best managed. One such study done in two Sydney local health districts reported that the intention for exclusive breastfeeding (EBF) was high at 92%. Of those surveyed, 22.2% of mothers were overweight and 14.7 % were obese. At 1 to 4 weeks EBF amongst overweight and obese mothers had dropped to 21.6% and 11.6% respectively. General factors associated with early cessation of breastfeeding included: partner violence, assisted delivery, low socio-economic status, pre-existing health concerns, a lack of partner support[10].

The Northern Hospital (TNH) is situated in an outer suburb of Melbourne characterised by young families - many of lower socio-economic status with diverse multi-cultural backgrounds. Ante-natal and post-natal clinic data suggested that maternal obesity is common in our community as is early breastfeeding cessation. We believed that a survey of post-natal breastfeeding and BMI status would provide valuable insight for future local initiatives to improve breastfeeding and manage maternal obesity. Consequently, we teamed up with the Whittlesea Maternal and Child Health Service (MCHS) to complete a questionnaire of mothers and babies attending the 8-weeks infant review with the aim of investigating the influence of maternal BMI on infant breastfeeding initiation and duration in the early postnatal period.

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MATERIALS AND METHODS

Study population and data sources

In the state of Victoria, the MCHS offers free key age consultations with highly qualified maternal and child health nurses. At the 8-week consultation, a baby's growth, health and development is reviewed with a special focus on feeding, family relationships and wellbeing. As these criteria are complementary to our research interests, we developed a questionnaire, designed in a tick-box format, completed by the child health nurses after interviewing consenting mothers across the City of Whittlesea MCHS centres.

Physical Measurements

The weight, length and head circumference measurements of the baby and height and weight measurements of the mother were determined during the interview. To measure weight, head circumference and length the baby was laid down on the examination bench. Infant weights were determined with the Wedderburn Professional Baby Scale Model TIBD-590. Head circumference measurements were made with a disposable paper tape with 1mm increments. The length of a baby was measured using an infantometer with 1cm increments. The mother assisted by supporting the baby's head at the start of the measuring tool. Mothers height was measured on a wall fixed stadiometer and weight determined on the Wedderburn Digital personal Scale Model T1390.

Birth and discharge data for each child was obtained from the My Health, Learning and Development Record, an official record of a baby's milestones relating to health, learning, development and immunisations throughout their early years of their life.

Questionnaire

With regard to mothers, collected data included: smoking status, underlying medical condition, medications, number of previous children, breastfeeding experience, country of birth, language spoken at home (cultural proxy), level of education (social status proxy) and occupation.

With regard to breastfeeding, data included: level of satisfaction, whether the breastfeeding was exclusive, partial or ceased and if ceased the reasons for weaning.

Questions were also asked about social support including initial breastfeeding aims and partner / community support for breastfeeding. The data was collected over a seven-month period from 1 October 2013 to 30 May 2014.

BMI was calculated as weight (in kilograms) divided by height (in meters squared). The resultant BMI (kg/m^2) data was classified into 5 groups based on WHO classifications[11]: underweight <18.5 kg/m^2; normal weight range 18.5-24.99 kg/m^2; overweight >25 kg/m^2; obese >30 kg/m^2 and morbid obese >40 kg/m^2.

Statistical analyses

The data was collated and analysed using Microsoft Excel and NCSS 12 statistical programme (NCSS, UT, USA). Logistic regression was used to calculate Odds Ratio (OR) and OR 95 percent confidence intervals. Fisher's exact test was used to determine p values. Using logistic regression, relationships found to be statistically significant were tested for confounders including smoking, age, parity, LUSCS, university education, English language spoken at home and maternal height.

Ethical considerations

Official ethics approval was granted by the Northern Health Low Risk Ethics Committee (Approval Number: LR 32/13), the Department of Health, Victoria. Coupled with the questionnaire was a written consent form for the participants.

RESULTS

The results of this study are presented below and in Tables 1, 2 and 3 and in Figure 1.

307 questionnaires were returned. 6 questionnaires did not have a recorded weight and height measurements, but contained other relevant data such as maternal age, breastfeeding cessation, education.

Mean BMI was significantly lower for South Asian, Middle Eastern and Northern & South East Asian speaking mothers when compared to English language group (Figure 1).

There was no difference across the BMI categories for either birthweight, or weight at 8-weeks. There was no difference in the frequency of low birth weight (≤ 2500g) babies born across the BMI categories. However, babies born to obese mothers were significantly more likely to be macrosomic (≥ 4000g)[12]. Maternal age did not differ. Importantly, only 36.4% of mothers were normal weight at 8-weeks post-delivery with 28.9% being obese. Mean BMI for the cohort (n=297) was 27.8 with a standard deviation of 5.5 (Table 1).

Overall smoking rate was 6.9%. There was no difference in short stature and in being older (35 years or more) across BMI categories. There was no difference in the multigravida rates across BMI. Normal weight mothers were significantly less likely to have both obstetric complications (0.28 times) and a LUSCS (0.41 times) than obese mothers. Conversely, obese mothers were significantly less likely (0.45 times) to have a normal vaginal delivery (NVD). Morbid obese mothers were 5.73 times more likely to have had only a high school education and less likely to have had a university education (0.09 times) – both results statistically significant. Cultural and ethnic aspects were explored through the proxy of the prime language spoken at home. Overweight and obese mothers were 2.22 and 4.47 times respectively more likely to speak English at home – both results statistically significant. North and South East Asian languages (mainly Mandarin and Chinese dialects) were significantly less likely to be spoken by overweight or obese mothers. Although the percentage of overweight or obese mothers speaking South Asian languages (Indian subcontinent) was less than half of normal weight South Asian speaking mothers, this was not statistically significant. There were no differences across BMI categories for positive partner support, satisfaction with hospital breastfeeding support, or confidence in breastfeeding in public (Table 2).

A very high percentage of mothers (98.3%) initiated breastfeeding. By 4 weeks, this rate had dropped to 71.1 % and by 8-weeks to 67.8 %. Obese mothers were 3.97 times more likely to have ceased breastfeeding compared to normal weight mothers ($p < 0.001$). Of those still breastfeeding, there was no difference in rates of EBF across BMI categories. However, for primigravida mothers, only those who were obese had a high probability of ceasing breastfeeding ($p=0.0281$). Multiple reasons were given for breastfeeding cessation. There was no difference across BMI categories for concerns relating to attachment, pain, infection or milk supply. However, psycho-social concerns were significantly more likely to be given by overweight and obese mothers (9.43 and 8.52 times respectively) as the reason for breastfeeding cessation. Psycho-social issues included: lack of convenience, family problems, lack of confidence of breastfeeding in front of others or in public, lack of partner support, lack of desire, return to work. Obese mothers were 6.5 times more likely to be prima-gravida and therefore not have had

previous breastfeeding experience. There was no difference in education level or English spoken as the prime language across BMI categories for those who ceased breastfeeding by 8-weeks (Table 3).

DISCUSSION

To our knowledge, this is a unique study providing insight into breastfeeding practice and maternal BMI in the early postnatal period within a single local government area of a large Australian city, with a population of 190,000. As such, the results provide an important comparison to national and international surveys.

Our study revealed unexpected results as well as findings consistent with published data. The percentage of obese mothers was high at 28.9 %, with 63.6% of mothers being overweight or obese. Morbid obesity was associated with a lack of higher education and obesity with English as the primary language. Initiation of breastfeeding was high across all BMI categories at 98.3%. By 8-weeks, 32.2% of mothers had ceased breastfeeding. Breastfeeding continuation at 8-weeks was negatively correlated with elevated BMI. Breastfeeding cessation in mothers with elevated BMI correlated with psycho-social concerns and lack of previous breastfeeding experience.

An alarming finding was the high rate of overweight and obesity amongst mothers of newborn infants when compared to international and Australian studies. International studies have reported rates of elevated BMI such as 30.7%[13], 32.6%[14] and 37%[15]. In Australia, reported rates of obesity and overweight have ranged from 11.7% and 6.3 %[8], 20% and 12.7 %[16] and 28.9% and 20%[7]. Our results (Figure 1 and Table 2) suggest that both education (proxy for social status) and ethnicity / culture (as represented by prime language) has a role to play in the elevation of BMI. University education was negatively correlated with obesity and conversely education only to high school was positively correlated. Speaking a North & SE Asian language was also negatively correlated with obesity. Maternal mean BMI was significantly lower for South Asian, Middle Eastern and Northern & SE Asian groups when compared to English speaking. Additionally, the distributions of maternal non-English speaking populations have more uniform BMI distributions with less outliers.

Elevated BMI is well recognised as a risk factor for birth. Due to the increased risk of complications during labour and delivery, the rate of NVD decreases with increasing BMI[17] and the rate of LUSCS increases[18]. Fetal macrosomia has been established as a major concern for obese women[19]. There also appears to be a dose dependent response between maternal obesity and fetal macrosomia[20]. Our study results were consistent with these findings. There was a positive correlation between obesity and both obstetric complications and LUSCS and a negative correlation with NVD (Table 2). While there was no overall difference in birth weight across BMI categories, our study did show a significant increase in babies over 4000g in birthweight being born to obese mothers (Table 1).

Initiation of breastfeeding is a key factor influencing success of breastfeeding in the postnatal period. A number of studies have found that obese mothers are less likely to initiate breastfeeding than those of normal weight. Internationally reported rates of breastfeeding initiation for obese mothers compared to normal weight mother have varied from 48% and 64%[21] to 80% and 88%[14]. Delayed lactogenesis amongst obese mothers has been suggested as one possible mechanism for decreased initiation[22]. Recent Australian and New Zealand studies have reported much higher overall breastfeeding initiation, most above 90% [23,10]. Our study found no difference with respect to BMI category with 98.3 % of mothers initiating breastfeeding. A possible reason for this high rate is education – as breastfeeding promotion is strongly advocated by antenatal clinics, labour and delivery wards. A unique feature of this study was that all maternal weights were measured at 8-weeks post-delivery, rather than the more common assessment of pre-pregnancy BMI.

Obesity prior to pregnancy, lower maternal education, anxiety during pregnancy and a desire to return to work have been associated with early cessation of breastfeeding[24]. Concerning EBF cessation, studies have concluded that obesity is implicated[21] with obese mothers feeling uncomfortable with public breastfeeding and believing their milk supply inadequate. EBF was more likely discontinued after 6 weeks for mothers with BMI above 25[25] with double the risk of early EBF cessation amongst primiparous mothers[15]. While psycho-social factors are important to breastfeeding success, they do not explain fully the early cessation of breastfeeding in obese women[26]. Contrary to all these findings, one study asserted that maternal BMI was not significantly associated with breastfeeding outcomes and that mother's plans for breastfeeding duration was the key to breastfeeding success and exclusivity[27].

Our study showed a highly significant, stepwise reduction in breastfeeding (full and partial) at 8-weeks across all BMI categories (Table 3). EBF for primiparous mothers was significantly reduced for the morbid obese group with no EBF at 8-weeks. There was a highly significant decrease in breastfeeding amongst mothers who had never breast fed before (including primiparous and multiparous mothers who had bottle fed previously). Psycho-social concerns were associated with breastfeeding cessation - as overweight and obese mothers gave a psycho-social reason for ceasing breastfeeding at 8-weeks significantly more so than normal weight mothers. Our study found no association across BMI categories for English language or education level and breastfeeding cessation, suggesting that breastfeeding cessation occurs across multicultural and socioeconomic divides. Breast attachment concerns, inadequate milk supply or pain / infection were not associated with breastfeeding cessation at 8-weeks.

As our study was questionnaire based, there are limitations. The data was collected in the course of visits to busy MCHS centres without rigorous checking as would be the case with a prospective study. Although physical measurements were recorded by a trained professional, the rest of the data was self-reported and therefore had an element of subjectivity. Potentially important data such as pre-pregnancy weight and specific details of obstetric complications were not able to be recorded, as the survey interview was intended to be spontaneous and confidential with mothers having no prior knowledge of the survey and not required to allow access to hospital

records. It was considered that asking mothers to report their BMI history would not be accurate. Non-probability, convenience sampling was used for this survey, which raises concerns representative data. Using local government data for 2014 births in Whittlesea[28] the sample size of 307 represented 17 % of the birth population. Given the consistency of some of the findings with other published surveys, as well as the strongly significant trends identified, we believe that the data is reliable in identifying key community concerns.

This study has allowed us to identify maternal post-natal concerns in our community and may have relevance to other multicultural, lower socioeconomic communities in Australia. Overweight and obesity amongst mothers in our community of childbearing age is unacceptably high, particularly so amongst English speaking mothers. Current hospital education and policies are working in relation to encouraging initiation of breastfeeding. We have identified that support of first-time breastfeeding mothers is important, as well as psycho-social support. To this end we have commenced a pilot study to assess if phone support via lactation consultants can improve breastfeeding success. Maternal obesity is a pre-pregnancy, pregnancy and post pregnancy concern. While pre-pregnancy initiatives are best handled at the primary health level, our survey results show that initiatives need to be developed both during pregnancy and post pregnancy, particularly with first time mothers so that obesity is lessened as a concern with subsequent pregnancies. To this end we have also commenced a multidisciplinary obesity, pregnancy and lifestyle clinic targeted at managing obesity during pregnancy.

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TABLE 1. INFANT WEIGHTS AND MATERNAL DATA VERSUS MATERNAL BMI

	Normal	Overweight	Obese	Morbid obese	Overweight vs normal (p value)	Total obese vs normal (p value)
Babies weight at birth (g)	3322 ± 513 (n = 106)	3411 ± 471 (n = 103)	3483 ± 549 (n = 75)	3304 ± 913 (n = 10)	(0.1900)	(0.0822)
Babies weight at 8-weeks (g)	5191 ± 655 (n = 97)	5290 ± 622 (n = 96)	5373 ± 724 (n = 58)	4961 ± 654 (n = 10)	(0.2792)	(0.2603)
Birth weight % ≤ 2500 (g)	5.6	5.8	2.7	10	(1.000)	(0.517)
Birth weight % ≥ 4000 (g)	7.4	12.6	18.7	30.0	OR 0.7 [0.27-1.81] (0.4813)	OR 0.37 [0.16-0.90] (0.0364)
Infant % weight gain Birth to 8-weeks BF	57.6 ± 2.3	57.2 ± 2.3	52.5 ± 3.6	--	(0.9032)	(0.2320)

(primigravida) ‡				
Mothers in Each Category (%) (n=297) †	36.4 (n = 108)	34.7 (n = 103)	25.6 (n = 76)	3.3 (n = 10)
Maternal Age (years, n=260)	32.4 ± 4.2	31.7 ± 4.5	31.8 ± 4.3	32.5 ± 5.4

†Mean BMI was 27.8 ± 5.5. Mass units are gram (g). ± refers to standard deviation. p values calculated using Students t Test and Fisher's-exact Test. OR = Odds Ratio [95% Confidence Interval]. BF = breastfeeding.

‡ Exclusive Breastfeeding + minimal top up with formula.

TABLE 2. CATEGORICAL DATA VERSUS MATERNAL BMI AT 8-weekS POST PARTUM

CATEGORY	Average Cohort Incidence (%)	Normal BMI (%)	Overweight BMI (%)	Obese BMI (%)	Morbid obese BMI (%)	Overweight vs Normal OR [95% CI]	Total Obese vs Normal OR [95% CI]

						(p value)	(p value)
Short Stature (< 1.6m)	26.7	27.1	24.3	27.6	40.0	0.86 [0.46-1.60] (0.7523)	1.07 [0.57-2.00] (0.8731)
Age 35 years and Older	26.4	28.0	23.7	26.8	37.5	0.79 [0.41-1.54] (0.6154)	0.99 [0.51-1.91] (0.8875)
NVD (no intervention)	47.3	57.5	60.2	40.0	20.0	1.12 [0.64-1.93] (0.7788)	0.45 [0.25-0.80] (0.0086)
LUSCS	33.0	28.3	28.2	41.3	70.0	0.99 [0.54-1.81] (1.0000)	0.41 [0.22-0.77] (0.0142)
Obstetric Complications	25.5	17.9	22.3	40.0	42.9	0.76 [0.39-1.50] (0.4911)	0.28 [0.14-0.56] (0.0042)
Smoking	6.9	4.0	6.3	11.3	11.1	1.63 [0.45-5.98] (0.5276)	3.07 [0.91-10.38] (0.0816)
High School Education	26.2	20.8	30.1	24.0	60.0	1.64 [0.88-3.09] (0.1523)	5.73 † [1.49-22.08] (0.0125)
TAFE	23.1	22.6	20.4	26.7	30.0	0.875 0.45-1.69] (0.7382)	1.27 [0.65-2.45] (0.5030)
University Education	50.7	56.6	49.5	49.3	10.0	0.75 [0.44-1.30] (0.3335)	0.09 † [0.01-0.70] (0.0062)
English Language	77.2	65.1	80.6	89.2	90.0	2.22 [1.18-4.18] (0.0133)	4.47 [2.01-9.93] (0.0001)
Nth & SE Asian Language	6.1	12.3	3.9	1.4	0	0.29 [0.09-0.92] (0.0405)	0.09 [0.01-0.67] (0.0038)
South Asian Language	6.8	11.3	4.9	4.1	0	0.40 [0.14-1.18] (0.1277)	0.29 [0.08-1.06] (0.0596)
Middle East Language	4.4	6.6	3.9	2.7	0	0.57 [0.16-2.01] (0.5382)	0.35 [0.07-1.71] (0.3029)
European Language	4.8	4.7	6.8	2.7	10	1.47 [0.45-4.80] (0.5650)	0.49 [0.09-2.61] (0.4668)
Previous Child	59.1	62.3	54.2	56.6	50.0	0.85	0.69

						[0.49-1.49] (0.6699)	[0.39-1.23] (0.2432)
Satisfied with Hospital BF Support	83.9	91.0	79.3	70.3	50.0	0.43 [0.18-1.00] (0.0601)	0.44 0.17-1.13] (0.0967)
Confident to BF in Public	61.2	65.4	55.9	64.3	80.0	0.67 [0.38-1.17] (0.2045)	0.88 [0.48-1.58] (0.7622)
Positive Partner Support	98.6	96.2	100.0	100.0	100.0		

OR = Odds Ratio. 95% CI = .95 Confidence Intervals for OR. p values calculated using Fisher's- exact Test. LUSCS = Caesarean Section. TAFE = Technical & Further Education. NVD = Normal Vaginal Delivery (no intervention). Language – the primary language spoken at home. Nth & SE Asian - North and South East Asian languages (mainly Mandarin and Chinese dialects). South Asian – Indian Subcontinent languages. † Morbid Obese data only.

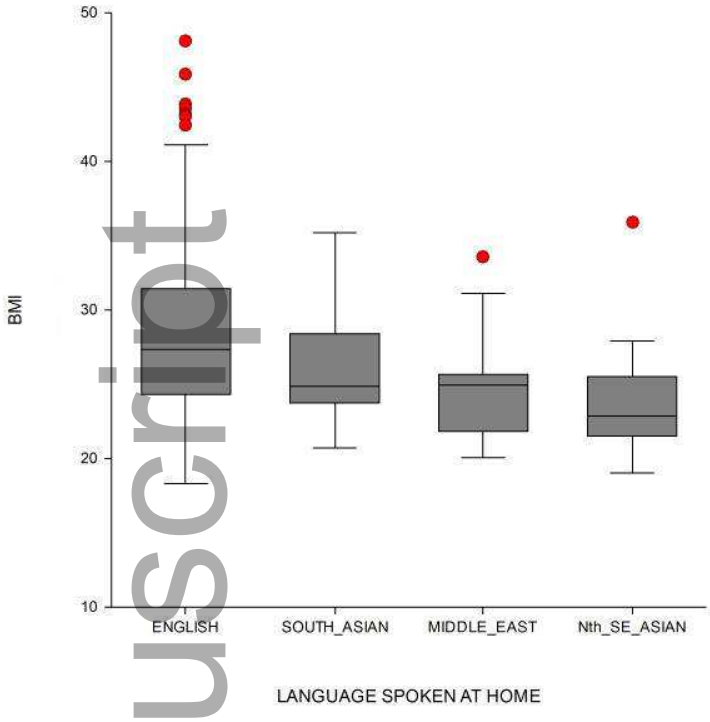
TABLE 3. BREASTFEEDING AND BREASTFEEDING CESSATION VERSUS MATERNAL BMI AT 8-WEEKS POST PARTUM

CATEGORY	Average Cohort Incidence (%)	Normal BMI (%)	Overweight BMI (%)	Obese BMI (%)	Morbid obese BMI (%)	Overweight vs Normal OR [95% CI] (p value)	Total Obese vs Normal OR [95% CI] (p value)
BF Initiation	98.3	99.3	99.7	99.3	100		
BF at 8-weeks (exclusive + partial)	67.8	78.3	70.9	54.7	25.0	1.48 [0.79-2.78] (0.2659)	3.97 [2.08-7.55] (0.000)
Exclusive BF (all gravida)	45.5	70.4	48.0	33.3	25.0	0.90 [0.45-1.78] (0.8609)	0.76 [0.34-1.67] (0.5426)
Exclusive BF (primigravida)	34.9	38.3	31.9	43.8	0	1.32 [0.68-2.58] (0.4983)	Morbid Only undefined (0.0281)
BF rate up to 4 weeks	71.1	85.0	73.1	65.6	75.0	0.48 [0.11-2.15] (0.4762)	0.37 [0.09-1.48] (0.2182)
BF Cessation Attachment Issues	29.4	34.8	34.8	22.9	37.5	0.80 [0.25-2.56] (0.77200	0.64 [0.22-1.93] (0.5693)
BF Cessation Pain / Infection	33.7	34.8	33.3	4.3	25	0.94 [0.30-2.95]	0.91 [0.31-2.64]

						(1)	(1)
BF Cessation Supply	43.2	39.1	46.7	47.1	25.0	1.36 [0.45-4.10] (0.7802)	1.12 [0.40-3.15] (1)
BF Cessation Psycho-Social	23.2	4.3	30.0	28.6	25.0	9.43 [1.10-81.00] (0.0307)	8.52 [1.03-70.38] (0.0247)
BF Cessation † High School Education Only	43.8	34.8	46.7	45.7	50.0	1.64 [0.54-75.02] (0.4148)	1.63 [0.57-4.64] (0.4377)
BF Cessation † University Education	25.0	34.8	20.0	25.7	12.5	0.47 [0.14-1.62] (0.3711)	0.57 [0.19-1.73] (0.4751)
BF Cessation English Language	83.3	69.6	86.7	88.6	87.5	2.84 [0.73-11.27] (0.1766)	3.33 [0.92-12.05] (0.0925)
BF Cessation No Previous BF	43.9	31.8	34.5	55.9	87.5	1.13 [0.35-3.67] (1)	6.50 [2.00-21.10] (0.0014)

OR = Odds Ratio. 95% CI = .95 Confidence Intervals for OR. Significance (p values) calculated using Fisher's- exact Test. LUSCS = Caesarean Section. TAFE = Technical & Further Education. NVD= Normal Vaginal Delivery (no intervention). BF = Breastfeeding. † Morbid Obese data only. Language – the primary language spoken at home.

FIGURE 1. BOX PLOT FOR LANGUAGE SPOKEN AT HOME VS BMI



F-Test for variance was significant for South Asian (p = 0.03), North & South East (Nth_SE) Asian (p = 0.03) mothers compared to English speaking mothers. t-Test for means (assuming unequal variances) was significantly lower for South Asian (p = 0.03), Middle East (p = 0.02) and Nth & SE Asian (P = 0.00) mothers when compared to English speaking mothers. It should be noted that with regard to languages spoken at home, Table 2 and Figure 1 are examining the data in different ways. Table 2 compares the frequency of a category between elevated BMI and normal BMI. Figure 1 compares the distributions as a whole for variance and mean differences. The findings reported in Table 2 and Figure 1 with respect to language spoken at home are therefore complementary.

TABLE 1. Infant Weights and Maternal Data versus Maternal BMI.

	Normal	Overweight	Obese	Morbid obese	Overweight vs normal (p value)	Total obese vs normal (p Value)
Babies weight at birth (g)	3322 ± 513 (n= 106)	3411 ± 471 (n= 103)	3483 ± 549 (n= 75)	3304 ± 913 (n= 10)	(0.1900)	(0.0822)
Babies weight at 8-weeks (g)	5191 ± 655 (n= 97)	5290 ± 622 (n= 96)	5373 ± 724 (n= 58)	4961 ± 654 (n= 10)	(0.2792)	(0.2603)
Birth weight % ≤ 2500 (g)	5.6	5.8	2.7	10	(1.000)	(0.517)
Birth weight % ≥ 4000 (g)	7.4	12.6	18.7	30.0	OR 0.7 [0.27-1.81] (0.4813)	OR 0.37 [0.16-0.90] (0.0364)
% weight gain at 8-weeks BF (primigravida) ‡	57.6 ± 2.3	57.2 ± 2.3	52.5 ± 3.6	--	(0.9032)	(0.2320)

Mothers in Each Category (%) (n=297) †	36.4	34.7	25.6	3.3
Maternal Age (years, n=260)	32.4 ± 4.2	31.7 ± 4.5	31.8 ± 4.3	32.5 ± 5.4

†Mean BMI was 27.8 ± 5.5. Mass units are gram (g). ± refers to standard deviation. p values calculated using Students t Test and Fisher's- exact Test.

‡ Exclusive Breastfeeding + minimal top up with formula. BF=breastfeeding

TABLE 2 CATEGORICAL DATA VERSUS MATERNAL BMI AT 8-weeks POST PARTUM.

CATEGORY	Average Cohort Incidence (%)	Normal BMI (%)	Overweight BMI (%)	Obese BMI (%)	Morbid obese BMI (%)	Overweight vs Normal OR [95% CI] (p value)	Total Obese vs Normal OR [95% CI] (p Value)
Short Stature (< 1.6m)	26.7	27.1	24.3	27.6	40.0	0.86 [0.46-1.60] (0.7523)	1.07 [0.57-2.00] (0.8731)
Age 35 years and Older	26.4	28.0	23.7	26.8	37.5	0.79 [0.41-1.54] (0.6154)	0.99 [0.51-1.91] (0.8875)

NVD (no intervention)	47.3	57.5	60.2	40.0	20.0	1.12 [0.64-1.93] (0.7788)	0.45 [0.25-0.80] (0.0086)
LUSCS	33.0	28.3	28.2	41.3	70.0	0.99 [0.54-1.81] (1.0000)	0.41 [0.22-0.77] (0.0142)
Obstetric Complications	25.5	17.9	22.3	40.0	42.9	0.76 [0.39-1.50] (0.4911)	0.28 [0.14-0.56] (0.0042)
Smoking	6.9	4.0	6.3	11.3	11.1	1.63 [0.45-5.98] (0.5276)	3.07 [0.91-10.38] (0.0816)
High School Education	26.2	20.8	30.1	24.0	60.0	1.64 [0.88-3.09] (0.1523)	5.73 † [1.49-22.08] (0.0125)
TAFE	23.1	22.6	20.4	26.7	30.0	0.875 0.45-1.69] (0.7382)	1.27 [0.65-2.45] (0.5030)
University Education	50.7	56.6	49.5	49.3	10.0	0.75 [0.44-1.30] (0.3335)	0.09 † [0.01-0.70] (0.0062)
English Language	77.2	65.1	80.6	89.2	90.0	2.22 [1.18-4.18] (0.0133)	4.47 [2.01-9.93] (0.0001)
Nth & SE Asian Language	6.1	12.3	3.9	1.4	0	0.29 [0.09-0.92]	0.09 [0.01-0.67]

						(0.0405)	(0.0038)
South Asian Language	6.8	11.3	4.9	4.1	0	0.40	0.29
						[0.14-1.18]	[0.08-1.06]
						(0.1277)	(0.0596)
Middle East Language	4.4	6.6	3.9	2.7	0	0.57	0.35
						[0.16-2.01]	[0.07-1.71]
						(0.5382)	(0.3029)
European Language	4.8	4.7	6.8	2.7	10	1.47	0.49
						[0.45-4.80]	[0.09-2.61]
						(0.5650)	(0.4668)
Previous Child	59.1	62.3	54.2	56.6	50.0	0.85	0.69
						[0.49-1.49]	[0.39-1.23]
						(0.6699)	(0.2432)
Satisfied with Hospital BF Support	83.9	91.0	79.3	70.3	50.0	0.43	0.44
						[0.18-1.00]	0.17-1.13]
						(0.0601)	(0.0967)
Confident to BF in Public	61.2	65.4	55.9	64.3	80.0	0.67	0.88
						[0.38-1.17]	[0.48-1.58]
						(0.2045)	(0.7622)
Positive Partner Support	98.6	96.2	100.0	100.0	100.0		

OR = Odds Ratio. 95% CI = .95 Confidence Intervals for OR. p values calculated using Fisher's- exact Test. LUSCS = Caesarean Section. TAFE = Technical & Further Education. NVD= Normal Vaginal Delivery (no intervention). Language – the primary language spoken at home. Nth & SE Asian - Northern and South East Asian languages (mainly Mandarin and Chinese dialects). South Asian – Indian Subcontinent languages. † Morbid Obese data only.

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BF Cessation Attachment	29.4	34.8	34.8	22.9	37.5	0.80 [0.25-2.56] (0.7720)	0.64 [0.22-1.93] (0.5693)
BF Cessation Pain / Infection	33.7	34.8	33.3	4.3	25	0.94 [0.30-2.95] (1)	0.91 [0.31-2.64] (1)
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BF Cessation English Language	83.3	69.6	86.7	88.6	87.5	2.84 [0.73-11.27]	3.33 [0.92-12.05]

						(0.1766)	(0.0925)
BF Cessation	43.9	31.8	34.5	55.9	87.5	1.13	6.50
No Previous BF						[0.35-3.67]	[2.00-21.10]
						(1)	(0.0014)

OR = Odds Ratio. 95% CI = .95 Confidence Intervals for OR. Significance (p values) calculated using Fisher's- exact Test. LUSCS = Caesarean Section. TAFE = Technical & Further Education. NVD= Normal Vaginal Delivery (no intervention). BF = Breastfeeding. † Morbid Obese data only. Language – the primary language spoken at home.

Figure 1. Box Plot for language spoken at home vs BMI.