Original Article

Severe maternal morbidity and breastfeeding outcomes in the early post-natal period: a prospective cohort study from one English maternity unit

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Abstract

Previous research has identified potential issues of establishing and maintaining breastfeeding among women who experience severe maternal morbidity associated with pregnancy and birth, but evidence in the UK maternity population was scarce. We explored the association between severe maternal morbidity and breastfeeding outcomes (uptake and prevalence of partial and exclusive breastfeeding) at 6 to 8 weeks post-partum in a UK sample. Data on breastfeeding outcomes were obtained from a large cohort study of women who gave birth in one maternity unit in England to assess the impact of women's experiences of severe maternal morbidity (defined as major obstetric haemorrhage, severe hypertensive disorder or high dependency unit/intensive care unit admission) on their post-natal health and other important outcomes including infant feeding. Results indicated that among women who responded ($n = 1824$, response rate = 53%), there were no statistically significant differences in breastfeeding outcomes between women who did or did not experience severe morbidity, except for women with severe hypertensive disorder who were less likely to breastfeed either partially or exclusively at 6 to 8 weeks post-partum. Rather, breastfeeding outcomes were related to multi-dimensional factors including sociodemographic (age, ethnicity, living arrangement), other pregnancy outcomes (neonatal intensive care unit admission, mode of birth, women's perceived control during birth) and post-natal psychological factors (depressive symptoms). Women who experience severe maternal morbidity can be reassured that establishing successful breastfeeding can be achieved. More studies are required to understand what support is best for women who have complex health/social needs to establish breastfeeding.

Keywords: epidemiology, breastfeeding, breastfeeding initiation, post-natal care, post-partum, pregnancy outcomes.

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Introduction

A large body of epidemiological evidence has shown that more health benefits arise from breastfeeding than from formula feeding for both mother and baby (Dyson *et al.* 2008; Feldens *et al.* 2012; de Jager *et al.* 2013). For the baby, the potential benefits include a reduction of the rate of infant mortality, preventable infections and unnecessary paediatric admissions in

infancy (Victora *et al.* 1989; Kramer *et al.* 2001; Guilbert *et al.* 2007; Ip *et al.* 2007; Hetzner *et al.* 2009), a reduction of the risk of obesity and type II diabetes and the improvement of general well-being in childhood (Mayer *et al.* 1988; Virtanen *et al.* 1991; Karjalainen *et al.* 1994). For the mother, the benefits include a lower risk of developing epithelial ovarian cancer (Gwinn *et al.* 1990; Danforth *et al.* 2007; Jordan *et al.* 2010, 2012) and breast cancer (United Kingdom

National Case-Control Study Group 1993; Ip *et al.* 2007) compared with those who do not breastfeed.

Given the strong evidence regarding the benefits of breastfeeding, the World Health Organization (WHO), in the global strategy on infant and young child feeding, recommends exclusive breastfeeding from birth of the baby to 6 months of age (World Health Organization 2002). This guideline was adopted by the Department of Health in England (Department of Health 2003a,b) and promotion of exclusive breastfeeding is one of the health policy priorities across countries in the United Kingdom (Department of Health 2002, 2004a,b; NICE 2008; Department of Health Social Services and Public Safety 2013). Despite this policy position, the United Kingdom has had one of the lowest exclusive breastfeeding rates and has ranked second lowest among 32 countries in the WHO European Region for the rate of at least partially breastfed children aged 6 months (Dyson *et al.* 2006; Agboado *et al.* 2010; Cattaneo *et al.* 2010). The most recent UK-wide infant feeding survey indicated that the initial breastfeeding rate across the UK was 81% in 2010; the rate included all babies whose mothers put them to the breast, even if this was on one occasion only, as well as babies given expressed breast milk (Health and Social Care Information Centre 2012). Prevalence of exclusive breastfeeding – defined as ‘the proportion of all babies who have only ever been given breast milk up to specific ages and who have never been fed formula, solid foods, or any other liquids’ (p. 14) – was 69% at birth. The rate had fallen to less than half of all mothers (46%) at 1 week and further decreased to around a quarter (23%) by 6 weeks and to 1% by 6 months (Health and Social Care Information Centre 2012).

A number of previous studies in the United Kingdom and other countries have reported that sociodemographic characteristics of mothers are associated with breastfeeding practice. Women who are younger, white, unmarried, have given birth to their first baby, have fewer qualifications and live in more deprived areas are less likely to initiate breastfeeding and more likely to only maintain a short duration of exclusive breastfeeding (Dennis 2002; O’Brien *et al.* 2008, 2009; Bonet *et al.* 2013). Studies have also shown a potential negative impact of a psychologically traumatic birth on mothers’ breastfeeding experiences; e.g. traumatic birth can lead to distressing impediments that reduce women’s breastfeeding attempts (Beck & Watson 2008) as well as a potential negative correlation between psychological factors such as depressive symptoms and exclusive breastfeeding (de Jager *et al.* 2013).

Few studies have examined the impact of women’s experiences of severe maternal morbidity on breastfeeding outcomes. One recent study in Australia identified the potential issues of a delay in establishing breastfeeding among women who experienced severe maternal morbidity because of the separation from their babies as a result of their admission to the intensive care unit (ICU)/high dependency unit (HDU) or because of special care required for their babies (Thompson *et al.* 2010). Given the increase in the overall rate of severe maternal morbidity in many developed countries (CMACE 2011; Callaghan *et al.* 2012), further study is necessary to examine the link between maternal morbidity and breastfeeding outcomes to provide appropriate support for women following the experience, both for those who planned to breastfeed and for women who may consider that

Key messages

- Little is known regarding the association between women’s experiences of severe maternal morbidity, including major obstetric haemorrhage, severe hypertensive disorder or high dependency unit/intensive care unit admission and breastfeeding outcomes.
- In a sample of women who gave birth in one maternity unit in England, there was no evidence to support an association with severe maternal morbidity except for women with severe hypertensive disorders who were less likely to breastfeed either partially or exclusively at 6 to 8 weeks post-partum.
- Women who experience severe maternal morbidity can be reassured that establishing successful breastfeeding can be achieved with appropriate care and support.

breastfeeding could be problematic following an adverse event.

The purpose of the present study is to describe the prevalence of breastfeeding and explore its association with maternal morbidity. It also explores the factors associated with any (at least partially breastfeeding) or exclusive breastfeeding at 6 to 8 weeks post-partum when routine post-natal care ends.

Materials and methods

Data were obtained from a large cohort study conducted in an inner city maternity unit in England that assessed the impact of severe maternal morbidity on women's post-natal health and well-being, which included breastfeeding as one of the predefined secondary outcomes of interest. Primary outcomes were post-traumatic stress disorder (PTSD) symptoms and the findings were presented elsewhere (Furuta *et al.* 2014). Other secondary outcomes included depression, general health status and the use of health services during the 6 to 8-week post-partum period. Women who gave birth under the care of the unit (which included obstetric-led care, a midwifery-led birth centre or offered women planned the home birth) between June and December 2010 were invited to participate. The criterion for inclusion was birth after 24 weeks of gestation, including women who planned to give birth at the unit but had an unplanned home birth. Exclusion criteria were women unable to read or understand English, women under 16 years old and those who experienced a stillbirth or neonatal death. Full ethics approval was obtained from the National Health Service Research Ethics Committee (REC 10/H0772/15) and the study site.

Study variables

Breastfeeding outcomes

Breastfeeding outcomes were measured by a set of questions validated adapted from the hospital-to-home post-natal study (Bick *et al.* 2011). Women were first asked if they had breastfed their babies at any time since they were born. If their answer was yes,

they were then asked, 'Are you still breastfeeding your baby?' There were three answer options: 'no, stopped', 'yes, breast plus formula milk' and 'yes, only breast milk'. To examine factors associated with exclusive breastfeeding at 6 to 8 weeks post-partum, we created a binary outcome, 'exclusive breast milk: yes or no', by combining the groups of women who never breastfed, who stopped breastfeeding and those were currently feeding their babies breast milk and formula at 6 to 8 weeks post-partum. We also created a binary outcome, 'any breast milk: yes or no', to explore the factor related to at least partially breastfeeding (including exclusive or partial breastfeeding). For this outcome, 'only breast milk' and 'breast plus formula milk' were combined to be 'yes', while never breastfed or stopped breastfeeding were considered to be 'no'.

Severe maternal morbidity

Although there is no universally accepted definition of severe maternal morbidity (Ronsmans 2001a,b), we defined it as (1) major obstetric haemorrhage; (2) severe hypertensive disorder; and/or (3) admission to a HDU or ICU after delivery following literature review on severe maternal morbidity in population-based studies in the United Kingdom and other high-income countries (Waterstone *et al.* 2001; Penney & Brace 2007; Penney *et al.* 2007; Zwart *et al.* 2008; Lennox & Marr 2010, 2011; Lennox 2011). The first two conditions are considered disease-based severe maternal morbidity while the last one is management-based severe maternal morbidity. There was a considerable overlap between disease-based and management-based severe maternal morbidity, as almost all severe maternal complications after giving birth at the study site would have been managed in HDU (ICU only if ventilation was required). However, it was necessary to include both disease-based and management-based severe maternal morbidity because HDU/ICU admission could depend on the availability of beds in these units (Say *et al.* 2004; Vais & Bewley 2006); this might lead to the underestimation of the cases. HDU/ICU admission also allowed less frequent types of severe maternal morbidity to be identified. Women who had at least one

condition of severe maternal morbidity as mentioned earlier (i.e. major obstetric haemorrhage, severe hypertensive disorder or HDU/ICU admission) were considered to have experienced severe maternal morbidity, while the remaining women were considered not to have experienced severe maternal morbidity. Categorical variables (ordinal) were created according to the severity of obstetric haemorrhage and hypertensive disorder. Table 1 presents definitions of severe maternal morbidity used in this study.

Other variables

As potential factors associated with breastfeeding outcomes, we included sociodemographic characteristics [maternal age, parity, ethnicity based on the classification of the Office for National Statistics (2011), educational qualification, index of multiple deprivation (IMD) (Department for Communities and Local Government 2011)] and pre-existing health conditions [body mass index (BMI) and self-reported mental health history identified prior to birth] as

Table 1. Definitions of severe and mild maternal morbidity

	Severe maternal morbidity	Mild maternal morbidity	None
Obstetric haemorrhage	Major obstetric haemorrhage: Estimated blood loss volume ≥ 1500 mL (either vaginal or Caesarean section related) or transfused four or more units of blood during labour, birth or immediately after birth (Waterstone <i>et al.</i> 2001)	Mild obstetric haemorrhage: Estimated blood loss volume ≥ 500 mL but <1500 mL or one to three units of transfused blood	No obstetric haemorrhage: Estimated blood loss volume <500 mL and no blood transfusion
Hypertensive disorder	Eclampsia: Convulsive condition associated with pre-eclampsia (Royal College of Obstetricians and Gynaecologists 2006) Severe pre-eclampsia: Pre-eclampsia with an existence of blood pressure of 160/110 mmHg (NICE 2010) HELLP syndrome: Haemolysis [abnormal peripheral blood smear or raised total bilirubin concentration ($>20.5 \mu\text{mol L}^{-1}$)], raised liver enzyme activity [raised aspartate aminotransferase ($>70 \text{ U L}^{-1}$)] or raised γ -glutamyltransferase ($>70 \text{ U L}^{-1}$) and low platelets ($<100 \times 10^9 \text{ L}^{-1}$) (Waterstone <i>et al.</i> 2001)	Pre-eclampsia: New hypertension (a diastolic blood pressure of 90 mmHg or a systolic blood pressure >140 mmHg) and new onset proteinuria (as shown by 1+ or more, on dipstick testing, a protein/creatinine ratio of 30 mg mmol^{-1} or more on random sample or a urine protein excretion of 0.3 g or more per 24 h) at or after 20 weeks of pregnancy (Guy's & St. Thomas' NHS Foundation 2009) Hypertension: Hypertension at or after 20 weeks gestation in a women with a diastolic blood pressure of 90 mmHg or a systolic blood pressure >140 mmHg or more (Guy's & St Thomas' NHS Foundation 2009)	No hypertensive disorder: None of conditions with severe/mild hypertensive disorder mentioned here
Intensive care unit (ICU)/high dependency unit (HDU) admission	ICU/HDU admission: ICU/HDU admission after giving birth. Admission for one of the above conditions or for any other reason	Not applicable	No ICU/HDU admission

HELLP syndrome, a syndrome involving haemolysis, elevated liver enzymes low platelets.

potential confounders. A woman's self-reported mental health history was treated as a binary variable, namely 'yes' if the woman had at least one mental health problem at the time of her maternity booking for the index pregnancy – i.e. a history of schizophrenia, bipolar affective disorder, depression or any other psychotic illness; history of post-partum psychotic illness (for multiparous women); history of inpatient or outpatient treatment by a psychiatrist or mental health team; 'felt down, depressed or hopeless' and/or 'little interest or pleasure in doing things' during pregnancy (in the past month); family history of severe mental illness in the post-natal period; or family history of bipolar affective disorder (manic depression) – or 'no' if the woman did not report any of the conditions mentioned earlier.

Variables related to pregnancy outcomes were also included [mode of birth, place of birth, neonatal outcomes (gestational age at birth, infant birth weight, infant Apgar score at 1 and 5 min and neonatal intensive care unit (NICU) admission)] and women's perceived control during labour and birth using the labour agency scale (LAS; Hodnett & Simmons-Tropea 1987). As for psychosocial factors during the post-natal period, several validated self-report measures were included; perceived social support was measured at 6 to 8 post-partum with the social support scale (Baker & Taylor 1997; O'Connor *et al.* 1998, 1999a,b) and depressive symptoms were measured with the Edinburgh postnatal depression scale (EPDS) (Cox *et al.* 1987). PTSD symptoms associated with the index birth were measured using the impact of event scale (IES) (Horowitz *et al.* 1979) and general health status of the women after giving birth was measured with the short-form 12 (SF-12), which produced two summary scores: a physical component score and a mental component score (Ware *et al.* 1996; Jenkinson *et al.* 1997). The number of home visits by midwives and health visitors during the post-natal period were also collected.

Data collection

Eligible women were provided with the study information package, which contained an invitation letter with a study opt-out sheet and a research information

leaflet, by midwives before discharge from the hospital or at home following birth (if they gave birth at home). Women who did not wish to take part were asked to return the opt-out sheet before receiving a questionnaire. All women were informed that they could withdraw from the study at any time. Following cognitive testing of the questionnaire (Willis 2005) with a small number of post-natal women ($n = 4$), a follow-up questionnaire was posted to women at 6 to 8 weeks after the birth to obtain information on post-natal outcomes. One reminder was sent 2 weeks after the first mailing.

Information on baseline characteristics, pregnancy, birth and neonatal outcomes of all eligible women who did not opt out were extracted from the electronic inpatient maternity records (data sets did not include any personally identifiable data except for a study ID). Data from the maternity records were then merged with data from the post-natal questionnaire. Following this, all identifiable data on women who did not return the post-natal questionnaire or did not provide consent for researchers to access their maternity records were removed. This data set was only used to compare baseline characteristics of respondents and non-respondents. A separate data set was then created that only included data from women who gave consent for their maternity records to be accessed, which was used for the main analysis. Details of data collection are outlined elsewhere (Furuta *et al.* 2012).

The sample size was calculated prior to the study to ensure a sufficient sample to provide 80% power to detect a significant (at the 5% level) difference in PTSD symptoms (our main outcome of interest) among women who did or did not experience severe morbidity. Czarnocka & Slade (2000) found that approximately 2% of women from two hospitals in Sheffield, England, had clinically significant levels of PTSD symptoms as measured by the IES (≥ 20 on both intrusion and avoidance subscales) at 6 weeks post-partum. Engelhard *et al.* (2002) found that 28% of women had PTSD symptoms (using a self-reported measurement, the PTSD symptom scale) within 2 years following births complicated by severe pre-eclampsia. The estimate of the incidence of severe maternal morbidity was based on the findings of

Waterstone *et al.* (2001), who found that 1.2% of women in their sample from England experienced severe maternal morbidity (defined as eclampsia, severe pre-eclampsia, HELLP syndrome (a syndrome involving haemolysis, elevated liver enzymes low platelets), severe haemorrhage, severe sepsis and uterine rupture). Based on these findings, a sample size of 1585 was required. As PTSD symptoms are relatively rare, we assumed that there was a sufficiently large sample size for other outcomes, including breastfeeding outcomes for the current study.

Statistical analysis

Prevalence of breastfeeding and its association with women's experience of severity of maternal morbidity

Descriptive frequencies and 95% confidence intervals (CI) were initially calculated for breastfeeding outcomes at 6 to 8 weeks post-partum. The outcomes were then compared between groups of women with and without severe maternal morbidity (all severe maternal morbidity cases as well as specific conditions of severe maternal morbidity) using Pearson's chi-square tests or Fisher's exact tests as needed. Further analysis was conducted by developing a series of logistic regression models to examine the association between women's experience of severe maternal morbidity and breastfeeding outcomes while adjusting for women's baseline characteristics – maternal age at delivery, parity, ethnicity, educational qualification and living in more/less deprived areas, which were potential confounders identified in previous studies (Dennis 2002; O'Brien *et al.* 2008, 2009; Bonet *et al.* 2013).

Factors associated with 'any' or 'exclusive' breastfeeding

Bivariate analysis (binary logistic regression and cross-tabulation) was conducted to assess the relationship of variables of interest (women's baseline characteristics, pregnancy-related outcomes, post-natal health) to breastfeeding outcomes (at least partially breastfeeding and exclusive breastfeeding, respectively). Multiple logistic models were then developed to relate those factors that were approach-

ing statistical significance ($P \leq 0.1$) on bivariate binary logistic regression to breastfeeding outcomes. A backward stepwise model was chosen. Development of backward stepwise models begins with all the independent variables in the model; variables are then removed one at a time, the least significant first, until no more variables may be removed without significantly (at $P = 0.1$) affecting the model. This provides an equation estimating odds ratio while controlling other variables. For missing data, pairwise deletion was performed. No adjustments were made for multiple testing. Data analysis was undertaken using SPSS v.19.

Results

Of the potentially eligible women ($n = 3533$), questionnaires were sent to 3509 women at 6 to 8 weeks after giving birth after removing 24 women who opted out. Fifty-five women could not be reached by mail. A total of 1841 completed questionnaires were returned, although 17 had to be excluded because they were completed by women who had suffered a stillbirth or miscarriage ($n = 5$); most questions were not completed ($n = 2$) or consent to access clinical records was not provided ($n = 10$). The response rate was 53% ($n = 1824$), excluding the 55 women from the denominator (therefore, 52% of all eligible women). The majority of respondents (74.2%) completed the questionnaire at 6 to 8 weeks post-natal; 93% were completed within 10 weeks.

Details of sample characteristics are described elsewhere (Furuta *et al.* 2014). Respondents were older, more likely to be primiparous, of white ethnicity and living in less economically disadvantaged areas compared with non-responders. There were significantly more instrumental and fewer spontaneous vaginal births among respondents than non-respondents, although rates of Caesarean (CS) birth (either elective or emergency) were similar. There were no differences between respondents and non-respondents in severe maternal morbidity exposure (i.e. major obstetric haemorrhage) where data were available. Of the study respondents, 8.1% ($n = 147$) experienced severe maternal morbidity based on our definition of this (Table 2).

Breastfeeding outcomes

At 6–8 weeks post-partum, the majority of women (95%, $n = 1722$) reported having breastfed their baby

Table 2. Severe maternal morbidity

Severe maternal morbidity	Respondents (1824)
Major obstetric haemorrhage	73
Eclampsia	4
Severe pre-eclampsia	7
HELLP syndrome	1
Intensive care unit/high dependency unit admission	103
Total (all severe maternal morbidity cases)	147

HELLP syndrome, a syndrome involving haemolysis, elevated liver enzymes low platelets. Numbers does not add up to $n = 147$ because some women had more than one condition.

Table 3. Breastfeeding outcomes at 6–8-week post-partum

Breastfeeding	Frequency	Percentage	95% confidence interval (%)
Never breastfeeding since baby was born	91	5.0%	4.0 to 6.0
Stopped breastfeeding	193	10.6%	9.2 to 12.1
Breast milk plus formula	584	32.2%	30.1 to 34.3
Only breast milk (missing)	945 (11)	52.1% –	49.8 to 54.4 –
Total	1824		

Table 4. Breastfeeding outcomes according to severe maternal morbidity status

	Total N	Never n (%)	Stopped breastfeeding n (%)	Partially breastfeeding n (%)	Breastfeeding only n (%)	P
All SMM cases						
No	1677	80 (4.8%)	176 (10.6%)	533 (32.0%)	877 (52.6%)	0.33
Yes	147	11 (7.5%)	17 (11.6%)	51 (34.7%)	68 (46.3%)	
Obstetric haemorrhage						
None: EBL < 500 mL and no BT	1137	54 (4.8%)	127 (11.2%)	351 (31.1%)	598 (52.9%)	0.21
Mild: EBL 500–1500 mL or BT 1–3	606	29 (4.8%)	55 (9.1%)	213 (35.4%)	305 (50.7%)	
Major: EBL ≥ 1500 mL or BT 4+	73	6 (8.2%)	10 (13.7%)	18 (24.7%)	39 (53.4%)	
Hypertensive disorder						
No	1688	81 (4.8%)	174 (10.4%)	525 (31.3%)	897 (53.5%)	<0.001
Hypertension/PET	125	8 (6.4%)	16 (12.8%)	56 (44.8%)	45 (36.0%)	
Severe PET/eclampsia/HELLP syndrome	11	2 (18.2%)	3 (27.3%)	3 (27.3%)	3 (27.3%)	
HDU admission						
No	1721	86 (5.0%)	181 (10.6%)	544 (31.8%)	899 (52.6%)	0.43
Yes	103	5 (4.9%)	12 (11.7%)	40 (38.8%)	46 (44.7%)	

BT, blood transfusion; EBL, estimated blood loss; HDU, high dependency unit; HELLP syndrome, a syndrome involving haemolysis, elevated liver enzymes low platelets; PET, pre-eclampsia; SMM, severe maternal morbidity. Chi-square test for all SMM cases, obstetric haemorrhage and HDU admission; Fisher's exact test for hypertensive disorder.

at least once since the birth; 5% of women had never breastfed their babies. Some women (10.6%, $n = 193$), however, stopped breastfeeding at some point within 6–8 weeks post-partum. The proportion of women who were breastfeeding exclusively at 6–8 weeks post-partum was 52.1% ($n = 945$), while 32.2% ($n = 584$) of women were feeding breast and formula milk (Table 3).

Association between severe maternal morbidity and breastfeeding outcomes

Table 4 shows the summary of the results of bivariate analysis. Overall, there were no statistically significant differences in breastfeeding outcomes between women with and without severe maternal morbidity (defined as any of the three conditions: major obstetric haemorrhage, severe pre-eclampsia/eclampsia/HELLP syndrome or HDU/ICU admission). Differences in breastfeeding outcomes were examined further for each condition of severe maternal morbidity. There were no statistically significant differences between the three groups of obstetric haemorrhage (major obstetric haemorrhage, mild obstetric haemorrhage and no obstetric haemorrhage). Similarly, there was no statistical difference between women with and without HDU admission, although a smaller proportion of the HDU admissions were

Table 5. Association between severe maternal morbidity and breastfeeding outcomes

		Any breastfeeding (<i>n</i> = 1529)			Exclusive breastfeeding (<i>n</i> = 945)		
		ORs	(95% CI)	<i>P</i>	ORs	(95% CI)	<i>P</i>
Model 1	All SMM cases (unadjusted)						
	SMM vs. non-SMM	0.77	(0.50 to 1.19)	0.24	0.77	(0.55 to 1.09)	0.14
Model 2	All SMM cases (adjusted*)						
	SMM vs. non-SMM	0.71	(0.45 to 1.14)	0.15	0.77	(0.54 to 1.10)	0.16

CI, confidence interval; OR, odds ratio; SMM, severe maternal morbidity (defined as any of the three conditions: major obstetric haemorrhage, severe PET/eclampsia/HELLP syndrome or high dependency unit/intensive care unit admission). *Adjusted for age, parity, ethnicity, educational qualification and living in more/less deprived areas.

recorded for exclusively breastfeeding women. However, despite the small number of cases in the severe PET/eclampsia/HELLP syndrome group, there was an overall statistically significant difference in breastfeeding outcomes between the three groups (none, hypertension/PET and severe PET/eclampsia/HELLP). Exclusive breastfeeding at 6–8 weeks postpartum (*n* = 945) showed a decrease with increasing severity of hypertensive disorder (53.3%, 36.0% and 27.3% for these three groups). Consistently with that result, the proportion of women who had never breastfed their babies (*n* = 91) increased with increasing severity of hypertensive disorder (4.8%, 6.4% and 18.2%). Table 5 presents results for logistic regression analyses which found no statistically significant association between women's experiences of severe maternal morbidity and breastfeeding outcomes, while adjusting for women's baseline characteristics (maternal age at delivery, parity, ethnicity, educational qualification and living in more/less deprived areas).

Factors associated with breastfeeding outcomes

We developed a series of logistic regression models to examine factors associated with the prevalence of any breastfeeding and exclusive breastfeeding at 6–8 weeks postpartum.

Bivariate analysis

Sociodemographic characteristics

Unadjusted odds of any breastfeeding (at least partially breastfeeding) were significantly higher for women with older age, black or Asian women com-

pared with white women, with an educational degree or living with their husband/partner, although it was not associated with IMD. The results for exclusive breastfeeding were similar except for IMD with those living in less deprived areas as they were more likely to breastfeed exclusively. The detailed results are presented in Table 6.

Pre-existing health condition

There were no associations between any breastfeeding outcomes and either BMI or self-reported mental history. However, women with higher BMI were less likely to breastfeed exclusively [e.g. BMI ≥ 30 vs. 18.5–24.9: unadjusted odds ratio (OR) = 0.51, 95% CI = 0.38 to 0.70, $P < 0.001$].

Pregnancy outcomes

Odds of any breastfeeding were higher for women who gave birth in the alongside midwifery-led care unit compared with women who gave birth at in the obstetric-led unit (unadjusted OR = 1.66, 95% CI = 1.16 to 2.40, $P = 0.006$), and lower for women who had emergency CS compared with women who had spontaneous vaginal birth (unadjusted OR = 0.69, 95% CI = 0.50 to 0.96, $P = 0.025$). Similarly, odds of exclusive breastfeeding were lower among women who had CS, either an emergency (unadjusted OR = 0.72, 95% CI = 0.57 to 0.92, $P = 0.008$) or elective procedure (unadjusted OR = 0.51, 95% CI = 0.37 to 0.72, $P < 0.001$) compared with women who had spontaneous vaginal birth, and higher among those who gave birth in the alongside midwifery-led unit (unadjusted OR = 1.46,

Table 6. Unadjusted bivariate logistic regression

	N	Any breastfeeding (<i>n</i> = 1529)			Exclusive breastfeeding (<i>n</i> = 945)		
		ORs	95% CI	<i>P</i>	ORs	95% CI	<i>P</i>
Age at delivery				Overall < 0.001			Overall < 0.001
≤19	21	0.75	0.29 to 1.93	0.54	1.25	0.47 to 3.33	0.66
20–24	142	1	–	–	1	–	–
25–29	328	2.48	1.58 to 3.95	<0.001	2.77	1.81 to 4.25	<0.001
30–34	717	3.02	1.99 to 4.58	<0.001	3.65	2.45 to 5.42	<0.001
35–39	491	2.93	1.89 to 4.56	<0.001	2.58	1.72 to 3.88	<0.001
40+	125	2.25	1.25 to 4.05	0.007	1.99	1.20 to 3.32	0.08
Parity							
Primiparous	1184	1	–	–	1	–	–
Multiparous	640	0.94	0.72 to 1.22	0.62	0.88	0.72 to 1.06	0.19
Ethnicity				Overall < 0.001			Overall < 0.001
White	1103	1	–	–	1	–	–
Black (Black African/Caribbean etc.)	432	2.03	1.43 to 2.87	<0.001	0.47	0.37 to 0.59	<0.001
Asian (Indian/Pakistani/Chinese etc.)	158	1.77	1.06 to 2.96	0.03	0.53	0.38 to 0.74	<0.001
Mixed/multiple	131	1.34	0.81 to 2.24	0.26	1.15	0.79 to 1.67	0.46
Highest education qualification				Overall < 0.001			Overall < 0.001
None	84	1	–	–	1	–	–
GCSE level	204	1.05	0.61 to 1.79	0.82	1.57	0.88 to 2.80	0.13
A Level	271	1.96	1.14 to 3.38	0.15	2.95	1.69 to 5.14	<0.001
Degree	1221	4.16	2.55 to 6.78	<0.001	4.52	2.70 to 7.57	<0.001
Index of multiple deprivation				Overall = 0.58			Overall = 0.02
Most	520	1	–	–	1	–	–
Second	822	1.04	0.77 to 1.41	0.80	1.41	1.13 to 1.76	0.003
Third	291	0.98	0.66 to 1.44	0.91	1.45	1.09 to 1.94	0.011
Fourth	125	1.66	0.89 to 3.09	0.11	1.49	1.01 to 2.21	0.046
Least	47	0.94	0.42 to 2.09	0.88	1.23	0.67 to 2.23	0.51
Living arrangement				Overall < 0.001			Overall < 0.001
Single (no any adult)	138	1	–	–	1	–	–
With husband/partner	1476	2.07	1.36 to 3.15	0.001	2.46	1.70 to 3.55	<0.001
With parents/sisters/brothers	136	0.77	0.45 to 1.33	0.35	1.00	0.60 to 1.66	1.00
With other adults	52	1.19	0.55 to 2.59	0.65	1.81	0.95 to 3.47	0.07
Body mass index before current pregnancy				Overall < 0.34			Overall < 0.001
<18.5	47	0.84	0.39 to 1.83	0.66	0.86	0.48 to 1.54	0.60
18.5–24.9	1129	1	–	–	1	–	–
25.0–29.9	401	0.90	0.65 to 1.23	0.49	0.63	0.50 to 0.79	<0.001
≥30.0	200	0.70	0.48 to 1.03	0.07	0.51	0.38 to 0.70	<0.001
Mental health prior to birth							
No	1712	1	–	–	1	–	–
Yes	48	0.55	0.28 to 1.07	0.08	0.90	0.51 to 1.60	0.72
Place of birth				Overall = 0.02			Overall < 0.001
Obstetric unit	1388	1	–	–	1	–	–
Alongside midwifery unit	348	1.66	1.16 to 2.40	0.006	1.46	1.15 to 1.86	0.002
Planned home birth	51	2.37	0.84 to 6.64	0.10	4.66	2.25 to 9.67	<0.001
BBA	37	1.03	0.42 to 2.50	0.95	1.02	0.52 to 1.98	0.95
Mode of birth				Overall = 0.07			Overall < 0.001
Spontaneous vaginal births	1002	1	–	–	1	–	–
Breech/instrument	300	0.73	0.52 to 1.04	0.08	0.79	0.61 to 1.02	0.07
Elective CS	164	0.70	0.46 to 1.09	0.11	0.51	0.37 to 0.72	<0.001
Emergency CS	358	0.69	0.50 to 0.96	0.025	0.72	0.57 to 0.92	0.008
All severe maternal morbidity cases							
No	1677	1	–	–	1	–	–
Yes	147	0.77	0.50 to 1.19	0.24	0.77	0.55 to 1.09	0.14

Table 6. Continued

	N	Any breastfeeding (<i>n</i> = 1529)			Exclusive breastfeeding (<i>n</i> = 945)		
		ORs	95% CI	<i>P</i>	ORs	95% CI	<i>P</i>
Babies' birthweight				Overall = 0.39			Overall = 0.001
<2500 g	116	1	–	–	1		
≥2500, <3500 g	941	1.17	0.71 to 1.94	0.54	1.50	1.01 to 2.23	0.044
≥3500, <4500 g	730	1.36	0.81 to 2.28	0.25	1.95	1.31 to 2.92	0.001
≥4500 g	31	0.77	0.30 to 2.03	0.60	0.93	0.41 to 2.11	0.87
Gestational age at birth				Overall = 0.62			Overall < 0.001
<37	145	1	–	–	1	–	–
≥37, <42	1558	1.24	0.79 to 1.93	0.35	1.68	1.19 to 2.39	0.004
≥42	121	1.12	0.59 to 2.13	0.73	2.85	1.72 to 4.72	<0.001
Apgar at 1 min							
Discrete: unit = 1 Apgar score	1815	1.02	0.93 to 1.13	0.64	1.01	0.94 to 1.8	0.84
Apgar at 5 min							
Discrete: unit = 1 Apgar score	1818	1.00	0.85 to 1.18	1.00	1.01	0.90 to 1.14	0.84
Neonatal intensive care unit admission							
No	1735	1			1		
Yes	88	0.47	0.29 to 0.76	0.002	0.47	0.30 to 0.73	0.001
Perceived control during labour/birth							
Continuous: unit = 1 score on labour agency scale	1739	1.02	1.01 to 1.03	0.003	1.01	1.00 to 1.02	0.005
Perceived social support							
Continuous: unit = 1 score on SSS	1725	1.02	1.00 to 1.04	0.08	1.02	1.00 to 1.04	0.015
Post-traumatic stress symptoms							
Continuous: unit = 1 score on impact of event scale total	1765	0.99	0.99 to 1.00	0.22	0.99	0.98 to 1.00	0.001
Depression symptoms							
Continuous: unit = 1 score on Edinburgh postnatal depression scale	1785	0.99	0.97 to 1.01	0.39	0.96	0.94 to 0.98	<0.001
General physical health							
Continuous: unit = 1 score on PHC-12	1704	1.00	0.99 to 1.02	0.67	1.02	1.01 to 1.03	0.001
General mental health							
Continuous: unit = 1 score on MHC-12	1704	1.01	1.00 to 1.03	0.09	1.02	1.01 to 1.03	0.001
Home visit by midwives							
Continuous: unit = 1 visit	1812	1.09	0.99 to 1.19	0.07	1.08	1.01 to 1.16	0.019
Home visit by health visitors							
Continuous: unit = 1 visit	1785	0.93	0.80 to 1.08	0.36	0.84	0.74 to 0.94	0.003

BBA, born before arrival; CI, confidence interval; CS, caesarean section; GCSE, General Certificate of Secondary Education; MHC-12, mental component summary of the 12-Item Short Form Health Survey (SF-12); OR, odds ratio; PHC-12, physical component summary of SF-12.

95% CI = 1.15 to 1.86, $P = 0.002$) or had a planned home birth (unadjusted OR = 4.66, 95% CI = 2.25 to 9.67, $P < 0.001$) compared with women who gave birth at in the obstetric-led unit.

Babies' birthweight (e.g. 3500–4500 g vs. <2500 g: unadjusted OR = 1.95, 95% CI = 1.31 to 2.92, $P < 0.001$), gestational age (e.g. ≥42 vs. <37 weeks: unadjusted OR = 2.85, 95% CI = 1.72 to 4.72, $P < 0.001$) and whether the baby was admitted to NICU (yes vs. no: unadjusted OR = 0.47, 95% CI = 0.30 to 0.73, $P = 0.001$) were also significantly

associated with exclusive breastfeeding, of which only NICU admission was associated with any breastfeeding outcomes (unadjusted OR = 0.47, 95% CI = 0.28 to 0.76, $P = 0.002$). Additionally, breastfeeding (both any and exclusive) had a statistically significant positive relationship with women's perceived control during labour and birth (measured with LAS). However, neither Apgar score at 1 or 5 min was significantly associated with exclusive breastfeeding. Women's experience of severe maternal morbidity was also not significantly related.

Post-natal factors

None of the post-natal factors selected in this study were statistically significantly associated with any breastfeeding. However, there was positive association between women's higher level of perceived social support and exclusive breastfeeding (OR = 1.015, 95% CI = 1.001 to 1.039, $P = 0.015$). In addition, women who had lower level of general health status (OR = 1.02, 95% CI = 1.01 to 1.03, $P < 0.001$ for both physical and mental) and higher level of PTSD symptoms (OR = 0.99, 95% CI = 0.98 to 0.996, $P < 0.001$) and depressive symptoms (OR = 0.96, 95% CI = 0.94 to 0.98, $P < 0.001$) were less likely to breastfeed exclusively. Exclusive breastfeeding also had positive association with the number of post-natal home visits by midwives but had negative association with the number of home visits by health visitors.

Multivariable logistic regression analysis

Based on bivariate analysis, a set of potential predictors ($P < 0.1$) that could be investigated in relation to the probability of any breastfeeding and exclusive breastfeeding were selected. For any breastfeeding, variables entered in the multivariable logistic regression were: age, ethnicity, education qualification, living arrangement, mental health history, place of birth, mode of birth, NICU admission and women's perceived control during labour and birth (measured with the LAS). For exclusive breastfeeding, variables entered in the multivariable logistic regression were: age, ethnicity, education qualification, IMD, living arrangement, BMI, place of birth, mode of birth, baby's birthweight, gestational age at delivery, NICU admission, women's perceived control during labour and birth (measured with the LAS), perceived level of social support during post-natal period (measured with social support scale) and post-natal PTSD symptoms (measured with IES), depressive symptoms (measured with EPDS) and general physical and mental health (measured with SF-12) as well as home visits by midwives and health visitors during post-natal period. By using the backward method for the model selection, we had the final outcome as shown in Table 7.

Factors associated with any breastfeeding after controlling for other factors entered in the model were ethnicity, education qualification, living arrangement, baby's NICU admission and women's perceived control during labour and birth. Women were more likely to breastfeed at least partially, if they were educated with a degree level (OR = 5.54, 95% CI = 2.84 to 10.80, $P < 0.001$) than those who had no education qualification, women in ethnic minority compared with white women (black: OR = 4.31, 95% CI = 2.68 to 6.92, $P < 0.000$; Asian: OR = 1.87, 95% CI = 1.05 to 3.33, $P = 0.03$; and mixed ethnicity: OR = 2.76, 95% CI = 1.38 to 5.51, $P = 0.004$). Statistical significance of living with husband/partner and any breastfeeding disappeared after controlling for other variables, but women who were living with parents/sisters/brothers were less likely to have at least partially breastfed compared with women living alone (OR = 0.49, 95% CI = 0.24 to 0.98, $P = 0.045$) as were women whose babies were admitted to NICU (OR = 0.51, 95% CI = 0.28 to 0.93, $P = 0.027$). Women's higher perceived control during labour and birth remained statistically significant.

Factors statistically significantly associated with exclusive breastfeeding were age, ethnicity, education, place of birth, mode of birth, NICU admission and depressive symptoms during the post-natal period. Exclusive breastfeeding was more likely to be practised among women who were older (e.g. women aged 30–34 vs. aged 20–24: OR = 2.96, 95% CI = 1.75 to 4.99, $P < 0.001$); women who left school with a higher level of qualification (OR = 2.96, 95% CI = 1.37 to 6.39, $P = 0.006$) or a degree (OR = 4.29, 95% CI = 2.05 to 9.00, $P < 0.001$) compared with women with no higher educational qualifications; and women who had planned home birth compared with women who gave birth in the obstetric-led unit (OR = 3.29, 95% CI = 1.38 to 7.87, $P = 0.007$). On the other hand, exclusive breastfeeding was less likely to be practised among black women (OR = 0.72, 95% CI = 0.53 to 0.97, $P = 0.03$) and Asian women (OR = 0.53, 95% CI = 0.36 to 0.78, $P = 0.001$) compared with white women; women who had instrumental birth (OR = 0.72, 95% CI = 0.52 to 1.00, $P = 0.05$), elective CS (OR = 0.57, 95% CI = 0.37 to 0.87, $P < 0.01$) and emergency CS (OR = 0.71, 95%

Table 7. Multivariable logistic regression: factors associated with breastfeeding outcomes

	N	Any breastfeeding (<i>n</i> = 1529)			Exclusive breastfeeding (<i>n</i> = 945)		
		ORs	95% CI	<i>P</i>	ORs	95% CI	<i>P</i>
Age at delivery							Overall = 0.001
≤19	21				2.37	0.66 to 8.43	0.18
20–24	142				1	–	–
25–29	328				2.62	1.52 to 4.50	0.001
30–34	717				2.96	1.75 to 4.99	<0.001
35–39	491				1.91	1.12 to 3.27	0.018
40+	125				2.05	1.07 to 3.90	0.30
Ethnicity				Overall = 0.001			Overall = 0.001
White	1103	1	–	–	1	–	–
Black	432	4.31	2.68 to 6.92	<0.001	0.72	0.53 to 0.97	0.03
Asian	158	1.87	1.05 to 3.33	0.03	0.53	0.36 to 0.78	0.001
Mixed/multiple	131	2.76	1.38 to 5.51	0.004	1.44	0.91 to 2.29	0.12
Highest education qualification				Overall = 0.001			Overall = 0.001
None	84	1	–	–	1	–	–
GCSE level	204	1.06	0.52 to 2.18	0.87	1.39	0.62 to 3.15	0.42
A Level	271	2.06	1.02 to 4.16	0.045	2.96	1.37 to 6.39	0.006
Degree	1221	5.54	2.84 to 10.80	<0.001	4.29	2.05 to 9.00	<0.001
Living arrangement				Overall = 0.001			
Single (no any adult)	138	1	–	–			
With husband/partner	1476	1.64	0.92 to 2.94	0.09			
With parents/sisters/brothers	136	0.49	0.24 to 0.98	0.045			
With other adults	52	1.29	0.45 to 3.71	0.64			
Place of birth							Overall = 0.057
Obstetric unit	1388				1		
Alongside midwifery unit	348				1.06	0.77 to 1.46	0.70
Planned home birth	51				3.29	1.38 to 7.87	0.007
BBA	37				1.30	0.61 to 2.78	0.49
Mode of birth							Overall = 0.023
Spontaneous vaginal births	1002				1		
Breech/instrument	300				0.72	0.52 to 1.00	0.05
Elective CS	164				0.57	0.37 to 0.87	0.009
Emergency CS	358				0.71	0.52 to 0.98	0.04
Neonatal intensive care unit admission							
No	1735	1			1		
Yes	88	0.51	0.28 to 0.93	0.027	0.53	0.30 to 0.92	0.02
Perceived control during labour/ birth							
Continuous: unit = 1 score on labour agency scale	1739	1.02	1.01 to 1.03	0.006			
Depression symptoms							
Continuous: unit = 1 score on Edinburgh postnatal depression scale	1785				0.96	0.94 to 0.98	<0.001

BBA, born before arrival; CI, confidence interval; GCSE, General Certificate of Secondary Education; OR, odds ratio.

CI = 0.52 to 0.98, $P = 0.04$) compared with those who had spontaneous vaginal birth; women whose babies were admitted to NICU (OR = 0.53, 95% CI = 0.30 to 0.92, $P = 0.02$) and those who had depressive symptoms during post-natal period (OR = 0.96, 95% CI = 0.94 to 0.98, $P < 0.001$).

Discussion

In this study, the rate of exclusive breastfeeding at 6 to 8 weeks post-partum was 52%, similar to the findings of an Australian study (54%) which questioned women at 2 months post-partum (Henderson *et al.*

2003). The rate in the current study, however, was higher compared with the rates reported in the UK-wide infant feeding survey (Health and Social Care Information Centre 2012, Bolling *et al.* 2007), which were 21% and 23% at 6 weeks post-partum in 2005 and 2010, respectively. These differences can potentially be explained by the variations in the definitions used to measure the prevalence of exclusive breastfeeding. In the infant feeding survey, it was defined as 'the proportion of all babies who have only ever been given breast milk up to specific ages and who have never been fed solid foods, or any other liquids' (Health and Social Care Information Centre 2012, p. 14) while the rate in our study was the proportion of women who provided only breast milk to their babies at 6–8 weeks post-partum, without giving formula milk. This number in the current study would therefore include women who had fed formula milk in the past, such as until feeding on breast milk was established.

Our finding that severe maternal morbidity (overall, obstetric haemorrhage, ICU/HDU admission) was not significantly associated with breastfeeding outcomes at 6 to 8 weeks post-partum may be explained by the argument put forward by Thompson *et al.* (2010) in their study of Australian women's breastfeeding experiences following a significant primary post-partum haemorrhage. In their report, these researchers stated that 'even if full breastfeeding cannot be established immediately, there is the prospect of doing so later, and this offers potential for interventions to support and encourage women to continue breastfeeding following a significant PPH despite early difficulties' (p. 10). The only exception in the current study was hypertensive disorder, which showed a statistically significant difference in breastfeeding outcomes across the different levels of severity of hypertensive disorder groups. This result may be related to the babies' conditions, e.g. NICU admission, because babies are more likely to be premature in severe cases of maternal hypertensive disorders. This result may also reflect the fact that some women with hypertensive disorders in pregnancy probably received antihypertensive treatment during the post-natal period and these women might have been advised against breastfeeding by a clinician

following the National Institute for Health and Clinical Excellence clinical guidelines on hypertension in pregnancy (NICE 2010). The guidelines state that in the management of hypertensive disorders during pregnancy, for most drugs to date, 'there is insufficient evidence on the safety in babies receiving breast milk' (p. 32). However, with the very small number of cases of severe hypertensive disorder, controlling for other factors was not possible and there may be an issue of generalizability of findings. Further studies are required with larger samples.

Regardless of women's experiences of severe maternal morbidity, various factors were independently associated with breastfeeding practice at 6–8 weeks post-partum, the majority of which have been previously identified by other research to influence breastfeeding outcomes (Dennis 2002; Kelly *et al.* 2006; Health and Social Care Information Centre 2012). However, in our sample, factors associated with 'exclusive' breastfeeding were more multi-dimensional, compared with the one identified for 'any' breastfeeding practice, including factors related to pregnancy outcomes (mode of birth) and post-natal psychological condition (depressive symptoms). The finding that black and Asian women were more likely to have any breastfeeding was similar to previous UK studies (Kelly *et al.* 2006). There may also be underlying factors that were missing in our study that could explain these phenomena, such as employment status or access to health care support.

The findings that women's perceived control during labour and birth were positively associated with any breastfeeding supports a previous study, *a meta-ethnography of traumatic childbirth and its aftermath*, in which Beck (2011) demonstrated that some women who experienced a psychologically traumatic birth made a decision to stop breastfeeding. In one woman's words, 'I wanted to forget about it and the pain, so stopping breastfeeding would get me a bit closer to my "normal" self again' (Beck & Watson 2008, p. 234). Alternatively, the positive relationship between perceived control during labour and birth and any breastfeeding may reflect the fact that some women receive continuous support from caregivers from labour and birth to the post-natal period, including support for breastfeeding. It may also be that

higher levels of control may spill over into a sense of greater self-efficacy to breastfeeding. There could be various reasons, but the issue is that women's perceived control was assessed post-natally, therefore subjected to recall bias in which women who had difficulty breastfeeding might have been more likely to remember feelings of fear, helplessness and/or being uncared for during their labour and birth than women who had successfully established breastfeeding.

Similarly, while we have included a number of post-natal factors, there are issues related to a time sequence of events. For example, depressive symptoms were significantly associated with exclusive breastfeeding, but it was difficult from our study to provide information about whether depressive symptoms preceded the difficulty of establishing exclusive breastfeeding or vice versa. This was because, in our study, data on depressive symptoms and breastfeeding outcomes were collected simultaneously. However, in a sample of women who gave birth in Australian maternity units, Henderson *et al.* found that of the women who developed post-natal depression in the 6 months after birth, the majority (82%) stopped breastfeeding at a time after the onset of depression, and 11% stopped at the time they became depressed. Only 7% of women stopped before they developed symptoms of post-natal depression. This indicates that, in many cases, post-natal depression appeared to be a risk factor of difficulty of establishing exclusive breastfeeding.

Study limitations

In addition to the limitations described earlier, we asked women about the current breastfeeding practices at 6 to 8 weeks post-partum. It only provides a 'snapshot', which is not a good indicator of irregular feeding patterns or duration of breastfeeding (Health and Social Care Information Centre 2012). Study limitations also include the use of composite measures. For example, we constructed a composite measure of mental health history (which ranged from very severe and diagnosed pathology to 'feeling down in the last week') because of the low event rates for individual problems. This could have concealed

important differences in outcomes between different mental health problems and degrees of severity. In addition, the response rate was 53%, with lower response from more vulnerable groups (younger age, living in more deprived areas) in terms of socioeconomic status. Thus, there may be an underestimation of the issue of non-practice of breastfeeding. Another limitation is that breastfeeding was one of the secondary outcomes of the cohort study, which primarily looked at the impact of severe maternal morbidity on PTSD symptoms. Therefore, some variables previously identified as important predictors of breastfeeding (self-efficacy, employment status, maternal breastfeeding intentions; de Jager *et al.* 2013) were not available for analysis.

Nevertheless, in this prospective study, we had a relatively large sample size and severe maternal morbidity was identified from women's maternity records to minimize recall bias. With very few studies having examined the impact of severe maternal morbidity on breastfeeding outcomes to date, the results still provide important information on the link between severe maternal morbidity and breastfeeding outcomes in the early post-natal period, which currently has no evidence to support the relationship.

Conclusion

Health benefits of breastfeeding for babies and mother are well established and promoting exclusive breastfeeding up to 6 months post-natal is an international and national priority. With the absence of evidence regarding the impact of severe maternal morbidity, which is increasing in many developed countries, we examined the relationship between severe maternal morbidity and breastfeeding at 6 to 8 weeks post-partum when routine post-natal care ends. From this study, there was no evidence to support the relationship. Rather, breastfeeding outcomes were related to multi-dimensional factors including sociodemographic (age, ethnicity, living arrangement), other pregnancy outcomes (NICU admission, mode of birth, women's perceived control during birth) and post-natal psychological factors (depressive symptoms). Women who experience severe maternal morbidity can be reassured that

establishing successful breastfeeding can be achieved. More studies are required to understand how to best support women to establish breastfeeding comprehensively by encouraging and proving them with appropriate care and education from pregnancy to post-natal.

Acknowledgements

The authors thank Mrs. Lynne Packanowski, Dr. Annette Briley and Ms. Mary Sheridan, Dr. Catherine Nelson-Piercy, Mr. Bolaji Coker and Mr. Waqas Shah, the midwives and midwifery managers in the study site for their help in data collection and creating a data set. The authors also thank Dr. Kirstie Coxon for her comments on the study.

Source of funding

No funding was received.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Contributions

MF developed the protocol with the support of DB and JS. All authors contributed to the development of analysis plan. MF collected data with support from DB and JS as well as midwives and IT managers at the study site. MF and DC conducted the main analyses. All authors checked the results. All authors contributed to the manuscript. All authors read and approved the final manuscript.

References

- Agboado G., Michel E., Jackson E. & Verma A. (2010) Factors associated with breastfeeding cessation in nursing mothers in a peer support programme in Eastern Lancashire. *BMC Pediatrics* **10**, 3.
- Baker D. & Taylor H. (1997) The relationship between condition-specific morbidity, social support and material deprivation in pregnancy and early motherhood. ALSPAC Survey Team. Avon Longitudinal Study of Pregnancy and Childhood. *Social Science & Medicine* **45**, 1325–1336.
- Beck C.T. (2011) A metaethnography of traumatic child-birth and its aftermath: amplifying causal looping. *Qualitative Health Research* **21**, 301–311.
- Beck C.T. & Watson S. (2008) Impact of birth trauma on breast-feeding – A tale of two pathways. *Nursing Research* **57**, 228–236.
- Bick D.E., Rose V., Weavers A., Wray J. & Beake S. (2011) Improving inpatient postnatal services: midwives views and perspectives of engagement in a quality improvement initiative. *BMC Health Services Research* **11**, 293.
- Bolling K., Grant C., Hamlyn B. & Thornton A. (2007) *Infant Feeding Survey 2005: A Survey Conducted on Behalf of the Information Centre for Health and Social Care and the UK Health Departments*. Health and Social Care Information Centre: London.
- Bonet M., Marchand L., Kaminski M., Fohran A., Betoko A., Charles M.A. *et al.* (2013) Breastfeeding duration, social and occupational characteristics of mothers in the French 'EDEN mother-child' cohort. *Maternal and Child Health Journal* **17**, 714–722.
- Callaghan W.M., Creanga A.A. & Kuklina E.V. (2012) Severe maternal morbidity among delivery and postpartum hospitalizations in the United States. *Obstetrics and Gynecology* **120**, 1029–1036.
- Cattaneo A., Burmaz T., Arendt M., Nilsson I., Mikiel-Kostyra K., Kondrate I. *et al.* (2010) Protection, promotion and support of breast-feeding in Europe: progress from 2002 to 2007. *Public Health Nutrition* **13**, 751–759.
- CMACE (2011) Saving mothers' lives: reviewing maternal deaths to make motherhood safer: 2006–2008. The eighth report on confidential enquiries into maternal deaths in the United Kingdom. *BJOG: An International Journal of Obstetrics & Gynaecology* **118** (Suppl. 1), 1–203.
- Cox J.L., Holden J.M. & Sagovsky R. (1987) Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. *The British Journal of Psychiatry: The Journal of Mental Science* **150**, 782–786.
- Czarnocka J. & Slade P. (2000) Prevalence and predictors of post-traumatic stress symptoms following childbirth. *British Journal of Clinical Psychology* **39**, 35–51.
- Danforth K.N., Tworoger S.S., Hecht J.L., Rosner B.A., Colditz G.A. & Hankinson S.E. (2007) Breastfeeding and risk of ovarian cancer in two prospective cohorts. *Cancer Causes and Control* **18**, 517–523.
- Dennis C.L. (2002) Breastfeeding initiation and duration: a 1990–2000 literature review. *Journal of Obstetric, Gynecologic, and Neonatal Nursing* **31**, 12–32.
- Department for Communities and Local Government (2011) *English Indices of Deprivation 2010* [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6871/1871208.pdf (Accessed 30 September 2011).

- Department of Health (2002) *Improvement, Expansion and Reform: The Next 3 Years. Priorities and Planning Framework 2003–2006*. Department of Health: London.
- Department of Health (2003a) *Infant Feeding Recommendation*. The Stationery Office: London.
- Department of Health (2003b) *Priorities and Planning Framework 2003–2006*. The Stationery Office: London.
- Department of Health (2004a) *Choosing Health: Making Healthier Choices*. Department of Health: London.
- Department of Health (2004b) *National Service Framework for Children, Young People and Maternity Services*. Department of Health: London.
- Department of Health Social Services and Public Safety (2013) *Breastfeeding – A Great Start. A Strategy for Northern Ireland 2013–2023* [Online]. Available at: <http://www.dhsspsni.gov.uk/breastfeeding-strategy-2013.pdf> (Accessed 26 July 2014).
- Dyson L., Renfrew M., McFadden A., McCormick F., Herbert G. & Thomas J. (2006) *Promotion of Breastfeeding Initiation and Duration: Evidence into Practice Briefing*. National Institute for Clinical Excellence: London.
- Dyson L., McCormick F. & Renfrew M.J. (2008) Interventions for promoting the initiation of breastfeeding. *Cochrane Database of Systematic Reviews* (2), CD001688.
- Engelhard I.M., Van Rij M., Boullart I., Ekhardt T.H., Spaanderman M.E., Van Den Hout M.A. *et al.* (2002) Posttraumatic stress disorder after pre-eclampsia: an exploratory study. *General Hospital Psychiatry* **24**, 260–264.
- Feldens C.A., Vitolo M.R., Rauber F., Cruz L.N. & Hilgert J.B. (2012) Risk factors for discontinuing breastfeeding in southern Brazil: a survival analysis. *Maternal and Child Health Journal* **16**, 1257–1265.
- Furuta M., Sandall J. & Bick D. (2012) A systematic review of the relationship between severe maternal morbidity and post-traumatic stress disorder. *BMC Pregnancy and Childbirth* **12**, 125.
- Furuta M., Sandall J., Cooper D. & Bick D. (2014) The relationship between severe maternal morbidity and psychological health symptoms at 6–8 weeks postpartum: a prospective cohort study in one English maternity unit. *BMC Pregnancy Childbirth* **14**, 133.
- Guilbert T.W., Stern D.A., Morgan W.J., Martinez F.D. & Wright A.L. (2007) Effect of breastfeeding on lung function in childhood and modulation by maternal asthma and atopy. *American Journal of Respiratory and Critical Care Medicine* **176**, 843–848.
- Guy's and St Thomas' NHS Foundation Trust (2009) *Trust Clinical Guidance: Hypertension and pre-eclampsia (Pet) – Diagnosis & management in pregnancy, labour & the puerperium*. Guy's and St Thomas' NHS Foundation Trust: London.
- Gwinn M.L., Lee N.C., Rhodes P.H., Layde P.M. & Rubin G.L. (1990) Pregnancy, breast feeding, and oral contraceptives and the risk of epithelial ovarian cancer. *Journal of Clinical Epidemiology* **43**, 559–568.
- Health and Social Care Information Centre (2012) *Infant Feeding Survey 2010* [Online]. Available at: <http://www.hscic.gov.uk/catalogue/PUB08694/Infant-Feeding-Survey-2010-Consolidated-Report.pdf> (Accessed 31 July 2012).
- Henderson J.J., Evans S.F., Straton J.A.Y., Priest S.R. & Hagan R. (2003) Impact of postnatal depression on breastfeeding duration. *Birth-Issues in Perinatal Care* **30**, 175–180.
- Hetzner N.M.P., Razza R.A., Malone L.M. & Brooks-Gunn J. (2009) Associations among feeding behaviors during infancy and child illness at two years. *Maternal and Child Health Journal* **13**, 795–805.
- Hodnett E.D. & Simmons-Tropea D.A. (1987) The labour agency scale: psychometric properties of an instrument measuring control during childbirth. *Research in Nursing & Health* **10**, 301–310.
- Horowitz M., Wilner N. & Alvarez W. (1979) Impact of event scale – measure of subject stress. *Psychosomatic Medicine* **41**, 209–218.
- Ip S., Chung M., Raman G., Chew P., Magula N., Devine D. *et al.* (2007) Breastfeeding and maternal and infant health outcomes in developed countries. *Evidence Report/Technology Assessment (Full Rep)* **153**, 1–186.
- de Jager E., Skouteris H., Broadbent J., Amir L. & Mellor K. (2013) Psychosocial correlates of exclusive breastfeeding: a systematic review. *Midwifery* **29**, 506–518.
- Jenkinson C., Layte R., Jenkinson D., Lawrence K., Petersen S., Paice C. *et al.* (1997) A shorter form health survey: can the SF-12 replicate results from the SF-36 in longitudinal studies? *Journal of Public Health Medicine* **19**, 179–186.
- Jordan S.J., Siskind V., C Green A., Whiteman D.C. & Webb P.M. (2010) Breastfeeding and risk of epithelial ovarian cancer. *Cancer Causes and Control* **21**, 109–116.
- Jordan S.J., Cushing-Haugen K.L., Wicklund K.G., Doherty J.A. & Rossing M.A. (2012) Breast-feeding and risk of epithelial ovarian cancer. *Cancer Causes and Control* **23**, 919–927.
- Karjalainen J., Martin J.M., Knip M., Ilonen J., Robinson B.H., Savilahti E. *et al.* (1994) A bovine albumin peptide as a possible trigger of insulin-dependent diabetes-mellitus. *Journal of Endocrinological Investigation* **17**, 565.
- Kelly Y.J., Watt R.G. & Nazroo J.Y. (2006) Racial/ethnic differences in breastfeeding initiation and continuation in the United Kingdom and comparison with findings in the United States. *Pediatrics* **118**, E1428–E1435.

- Kramer M.S., Barr R.G., Dagenais S., Yang H., Jones P., Ciofani L. et al. (2001) Pacifier use, early weaning, and cry/fuss behavior – a randomized controlled. *JAMA: The Journal of the American Medical Association* **286**, 322–326.
- Lennox C. (2011) Summary of Scottish confidential audit of severe maternal morbidity report 2008. In: *Saving Mothers' Lives: Reviewing Maternal Deaths to Make Motherhood Safer: 2006–2008: The Eighth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom* (ed. G. Lewis), pp. 196–198. CMAcE: London.
- Lennox C. & Marr L. (2010) *Scottish confidential audit of severe maternal morbidity: 6th annual report 2008*.
- Lennox C. & Marr L. (2011) *Scottish Confidential Audit of Severe Maternal Morbidity: 7th Annual Report 2009*. Healthcare Improvement Scotland: Scotland.
- Mayer E.J., Hamman R.F., Gay E.C., Lezotte D.C., Savitz D.A. & Klingensmith G.J. (1988) Reduced risk of iddm among breast-fed children – the Colorado IDDM registry. *Diabetes* **37**, 1625–1632.
- NICE (2008) Maternal and child nutrition. *Public Health Guidance* **11** Online. Available at: <http://guidance.nice.org.uk/PH11/Guidance/> (Accessed 22 July 2014).
- NICE (2010) *Hypertension in Pregnancy: The Management of Hypertensive Disorders During Pregnancy, Clinical Guideline 107*. National Institute for Health and Clinical Excellence: London.
- O'Brien M., Buikstra E. & Hegney D. (2008) The influence of psychological factors on breastfeeding duration. *Journal of Advanced Nursing* **63**, 397–408.
- O'Brien M., Buikstra E., Fallon T. & Hegney D. (2009) Exploring the influence of psychological factors on breastfeeding duration, phase 1: perceptions of mothers and clinicians. *Journal of Human Lactation* **25**, 55–63.
- O'Connor T.G., Hawkins N., Dunn J., Thorpe K., Golding J. & Team A.S. (1998) Family type and depression in pregnancy: factors mediating risk in a community sample. *Journal of Marriage and the Family* **60**, 757–770.
- O'Connor T.G., Pickering K., Dunn J., Golding J. & Team A.S. (1999a) Frequency and predictors of relationship dissolution in a community sample in England. *Journal of Family Psychology* **13**, 436–449.
- O'Connor T.G., Thorpe K., Dunn J., Golding J. & Team A.S. (1999b) Parental divorce and adjustment in adulthood: findings from a community sample. *Journal of Child Psychology and Psychiatry, and Allied Disciplines* **40**, 777–789.
- Office for National Statistics (2011) *Ethnic Group*. Available at: <http://www.ons.gov.uk/ons/guide-method/>
- measuring-equality/equality/ethnic-nat-identity-religion/ethnic-group/index.html (Accessed 15 March 2012).
- Penney G. & Brace V. (2007) Near miss audit in obstetrics. *Current Opinion in Obstetrics & Gynecology* **19**, 145–150.
- Penney G., Kernaghan D. & Brace V. (2007) Severe maternal morbidity – the Scottish experience 2003/05. In: *The Confidential Enquiry into Maternal and Child Health (CEMACH). Saving Mothers' Lives – 2003–2005. The 7th Report on Confidential Enquiries into Maternal Deaths in the United Kingdom* (ed. G. Lewis), pp. 248–253. CEMACH: London.
- Ronsmans C. (2001a) How can we monitor progress towards improved maternal health? In: *Safe Motherhood Strategies: A Review of the Evidence* (eds V. de Brouwere & W. van Lerberghe), pp. 313–338. ITG Press: Antwerp.
- Ronsmans C. (2001b) What is the evidence for the role of audits to improve the quality of obstetric care. In: *Safe Motherhood Strategies: A Review of the Evidence* (eds V. de Brouwere & W. van Lerberghe), pp. 203–223. ITG Press: Antwerp.
- Royal College of Obstetricians and Gynaecologists (RCOG) (2006) *The management of severe pre-eclampsia/eclampsia*. RCOG press: London.
- Say L., Pattinson R.C. & Gulmezoglu A.M. (2004) WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). *Reproductive Health* **1**, 3.
- Thompson J.F., Heal L.J., Roberts C.L. & Ellwood D.A. (2010) Women's breastfeeding experiences following a significant primary postpartum haemorrhage: a multicentre cohort study. *International breastfeeding journal* **5**, 5.
- United Kingdom National Case-Control Study Group (1993) Breastfeeding and risk of breast cancer in young women. *British Medical Journal* **307**, 17–20.
- Vais A. & Bewley S. (2006) Severe acute maternal morbidity. In: *A Textbook of Postpartum Hemorrhage. A Comprehensive Guide to Evaluation, Management and Surgical Intervention* (ed. C. B-Lynch), 1st edn, pp. 339–352. Sapiens: Kirkmahoe.
- Victora C.G., Smith P.G., Barros F.C., Vaughan J.P. & Fuchs S.C. (1989) Risk-factors for deaths due to respiratory-infections among Brazilian infants. *International Journal of Epidemiology* **18**, 918–925.
- Virtanen S.M., Rasanen L., Aro A., Lindstrom J., Sippola H., Lounamaa R. et al. (1991) Infant feeding in Finnish children <7 yr of age with newly diagnosed IDDM. *Diabetes Care* **14**, 415–417.
- Ware J. Jr, Kosinski M. & Keller S.D. (1996) A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. *Medical Care* **34**, 220–233.

- Waterstone M., Bewley S. & Wolfe C. (2001) Incidence and predictors of severe obstetric morbidity: case-control study. *British Medical Journal* **322**, 1089–1093.
- Willis G.B. (2005) *Cognitive Interviewing : A Tool for Improving Questionnaire Design*. Sage Publications: Thousand Oaks, CA; London.
- World Health Organization (2002) *Infant and Young Child Nutrition; Global Strategy for Infant and Young Child Feeding*. Executive Board paper 2002. Report No.:EB 109/12. Geneva.
- Zwart J.J., Richters J.M., Ory F., De Vries J.I.P., Bloemenkamp K.W.M. & Van Roosmalen J. (2008) Severe maternal morbidity during pregnancy, delivery and puerperium in the Netherlands: a nationwide population-based study of 371 000 pregnancies. *BJOG: An International Journal of Obstetrics & Gynaecology* **115**, 842–850.