Assessing predictors of respiratory tract infections in infants born to teenage mothers; secondary analysis of the Building Blocks trial data.

Running title: Infections in infants born to teenage mothers

Research methods

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Key messages

- Up to 77.5% of infants born to teenage mothers attend primary care for a RTI
- Up to 8.6% infants will have a hospital admission for RTI
- RTI hospitalisations are increased by being male, deprived and born in spring
- Infants with neonatal admissions have increased risk of RTI hospitalisation
- Infants who were not breastfeed had higher GP consultation rates for RTIs
- High RTI GP consulters were more likely to have a hospital admission for RTI

Abstract

Background

Respiratory tract infections (RTIs) are estimated to account for 60 percent of infant's primary care visits. There is limited research into risk factors for infant RTIs in those born to teenage mothers.

Aims

To identify risk factors for primary and secondary care RTI attendances, in infants of teenage mothers, and to identify risk factors associated with high primary care RTI consultations.

Method

Secondary analysis of a dataset from the Building Blocks trial of special home visiting support in England containing 1510 infants born to teenage mothers recruited to the study. Maternally reported and routinely collected data were examined. Multivariable logistic regression models were performed to determine independent predictors. Primary care data analysis also focused infant risk factors for RTI consultation.

Results

No independently predictive risk factors for infant RTI were identified in primary care. Lower maternal antenatal attendances (OR 0.96, 95% CI 0.92-0.99), infants born in autumn (versus spring) (0.54, 0.36-0.80), and NNU admissions (0.51, 0.30-0.89) had increased odds of attending A&E with an RTI. Male infants (1.52, 1.03-2.25), NNU admissions (3.21, 1.98-5.22), and birth season had increased odds of RTI-associated hospital admissions. High infant RTI primary care consulters were more likely to have a RTI-associated hospital admission (2.11, 1.17-3.81) and less likely to have breastfed (0.55, 0.38-0.78).

Conclusion

Risk factors previously found to increase risk of an RTI infant admission in the broader population have been identified here. This study is one of the first to identify modifiable risk factors of high primary care RTI consulters.

Keywords

Family Health
Infant Health
Nurse Practitioners

Pediatrics
Primary Health Care
Respiratory Tract Infections

Background

The United Kingdom has the highest teenage pregnancy rate in Western Europe; [1] with 19.7 live births per 1,000 adolescent females (aged 15-19). [2] Teenage pregnancy is associated with lower socio-economic status, inadequate prenatal care and mothers who are more likely to be unmarried, smoke and to bottle-feed their infants.[1,3,4] Furthermore, pregnancy in adolescents is linked to negative birth outcomes for infants, including: low birth weight, prematurity, being small for gestational age (birth weight below 10th percentile for that gestational age) in addition to increased risk of hospitalisation and mortality.[3,5-7,8] Such negative birth outcomes have further been linked to an increased risk of infant respiratory tract infections (RTI) in the general population. [5-7,9,10]

Several risk factors of infant RTIs have been previously identified but, the majority of the literature investigates mothers of any age. Breast-feeding, either exclusively or partially, has been shown to decrease the risk of RTI. [11-12] Quigley *et al.* undertook analysis of the UK Millennium cohort study, which collected data on 15,000 infants breast-feeding status and RTI history.[11] They found that exclusive breast-feeding can prevent up to 27% of hospitalisations due to lower RTI.[11]

Smoking, both first-hand during pregnancy and second-hand post-partum, increases the risk of RTIs. [9,14,15] Metzger *et al.* discovered that infants who were hospitalised with a RTI were 69% more likely to have a mother who smoked. [14] Other maternal factors that increase the risk of adverse birth outcomes include low socio-economic status and lack of paternal involvement. [10,16] Alongside negative birth outcomes, additional infant risk factors include: males, having an underlying medical condition such as a congenital deformity and a neonatal intensive care admission.[10,17,18]

Up to one quarter of GP and A&E consultations involve children.[18,19] Additionally, it is estimated that around 60 percent of infants under one visiting primary care, do so for respiratory conditions.[20] Yet, there is little literature investigating whether there are any underlying characteristics that lead to infants having high consultation rates in primary care for RTI.

The Building Blocks (BB) randomised controlled trial (RCT) evaluated the effectiveness of the Family Nurse Partnership (FNP) home visiting programme in England and was reported in 2016. The programme consisted of home visits from a specially trained Family Nurse during pregnancy and in the two years after birth, with the aim of improving outcomes for the health, wellbeing and social circumstances of teenage first-time mothers and their children.[21,22] BB found no evidence of a difference between the usual care and FNP group for the trials primary outcomes, which included emergency attendances and hospital admissions.[22]

While known risk factors for RTI in infancy include several that are also common in teenage mothers, it is important to determine any attributes that may additionally increase risk within this vulnerable population. Using the data collected from the BB trial, the primary objective of this study was to identify potential risk factors, both maternal and infant, for RTIs diagnosed in the first two years of life in primary care, Accident & Emergency (A&E) and inpatient hospital admissions in infants born to teenage mothers. Further exploration of the primary care data identified variation in the number of primary care RTI consultations hence, an exploratory analysis examined risk factors associated with high consultation rates for RTI in infants born to adolescent mothers.

Method

Study design and participants

This was a secondary analysis of data from the BB trial which recruited 1618 nulliparous women aged 19 or under and recruited by 24 weeks gestation from 18 sites across England.[21,22] Young maternal age was used as a programme proxy for a range of poor longer-term outcomes for both child and mother which is also associated with socioeconomic deprivation. A total of 1,510 children were born, with 1,505 included in analysis (5 stillbirths); these infants are the population under investigation in this study.

Data collection

Maternal self-report

A home-based structured interview prior to randomisation collected data on maternal baseline characteristics and follow-up data at 24 months post-partum.[22] At all other follow-up time-points (late pregnancy, 6, 12 and 18 months post-partum) telephone interviews were used. Self-report data from interviews addressed factors such as breast-feeding, smoking, alcohol use and employment status. Tobacco use was assessed at baseline and in late pregnancy through urine cotinine samples, to provide accurate smoking status.

Routinely collected data

Routinely collected data for both mother and infant were also retrieved. This included maternity records (pregnancy and birth details) collected by field-based researchers from maternity units, primary care data collected by field-based researchers or practice staff, and emergency attendances and hospital admissions provided by NHS Digital.

Primary care consultation data were collected for 925 infants (61.5%); each consultation was examined and those with a possible RTI diagnosis were recorded. For A&E attendances, diagnosis codes used to capture RTI attendances included those in the respiratory, ENT and infection categories. As these categories were broad, individual case codes were checked and those who undoubtedly did not attend with a RTI were excluded. For example consultations with coding relating to eyes, skin, nerve injury, wound closure or foreign body removal were excluded. Ear diagnoses were included for RTI, consistent with GP coding. Inpatient admissions were coded using the International Classification of Disease (ICD-10) codes.[22] Through use of clinical knowledge and prior research of RTI codes, ICD-10 codes allow a clear identification of infants who were admitted with a RTI. [24,25]

Statistical analysis

Infants were categorised as consulting with at least one RTI in primary care, A&E or being admitted to hospital with RTI, in the 24 months follow-up period. Baseline characteristics of those with and without primary care data collected were compared in order to assess bias in the sample. Potential predictors for infant RTIs were identified from the literature (Appendix 1) and were identified from maternal baseline, pregnancy and birth outcomes. Analysis was undertaken at a univariable level using a logistic regression model. Any predictors found significant at the 10% level were simultaneously entered in a multivariable logistic regression model, to identify those independently predictive of at least one RTI consultation. Backward stepwise elimination was applied and variables found no longer predictive of were removed and the goodness and strength of fit for the final models were determined by the Hosmer and Lemeshow (H-L) goodness of fit test and the Akaike Information Criterion (AIC). Multi-collinearity in each model between variables were assessed by detecting the tolerance and its reciprocal, the variance inflation factor (VIF). As a rule of thumb a VIF of 1 indicates no collinearity but a VIF greater than 4 (a tolerance of 0.2) might warrant further investigation and greater than 10 would indicate that multicollinearity is a problematic. The AUROC was also determined to examine the diagnostic value of the final model. Results were reported as odds ratios (ORs) alongside 95% confidence intervals (95% CI).

Additionally, infants who had a high rate of primary care consultations for RTI in the first two years of life were identified using the sample median of 3.8 RTI consultation as a cut off. Similar cut-offs were found from the literature with varying averages between 2.0 to 5.6 consultations per year. [26-28] Thus, infants with four or more RTI consultations over the two years were deemed 'high consulters' and associated risk factors explored using similar methods as before. Further, the association between primary care consulters (high/low) and secondary care consultations (maternal antenatal and A&E attendances, and inpatient admissions) were assessed.

Analysis was undertaken using SPSS software version 20 and Stata verison 16.[29]

Results

Primary care attendances

1,505 infants were born to mothers recruited to the BB trial. Data related to primary care consultations for RTIs were available for 925 infants (61.5%). No imbalances were identified when comparing maternal characteristics for those with/without data available therefore no bias between the groups was identified (Appendix 2). Ten infants had been withdrawn by their mother from the trial or had left the practice before trial completion (and had incomplete follow-up), of these 6 were re-included in analysis as they attended with a RTI before withdrawing. A high proportion of children (716 (77.5%)) consulted with primary care at least once with an RTI but no risk factors were found to be associated with consulting with an RTI.

Accident and Emergency attendances

Accident and Emergency (A&E) data were obtained for 1,500 infants (five not matched by NHS Digital) and complete outcome data available for 1,462 infants who were included in the analyses. Withdrawals had occurred in 38 infants and of these, five had attended with an RTI and were included in the analysis. A total of 1,467 infants were included for this analysis and 306 (20.8%) infants attended A&E with at least one RTI over the two-year period. From the univariable analysis, A&E attendance with an RTI was significantly associated with mothers who consumed alcohol after discovering they were pregnant and who had lower rates of antenatal checkups, and infants' season of birth, and those with a lower rate of neonatal unit (NNU) admissions (table 1). At the multivariable level antenatal attendances (OR 0.96, 95% CI 0.92 to 0.99), birth season of autumn versus spring (0.54, 0.36 to 0.80) and NNU admissions (0.51, 0.30 to 0.89) remained significantly associated (table 2). There was no evidence of multi-collinearity found between any of the variables in the model (VIF=1.01).

The final model demonstrated a moderate diagnostic value (AUROC 0.60 (95% 0.56 to 0.63).

Inpatient admissions

Of the 1,505 live births, inpatient data were obtained for 1,500 infants (five not matched from NHS Digital). Complete data was available for 1,462 infants. There were 38 withdrawals, one infant had suffered a RTI before withdrawing and was included in the main analysis. Therefore, 1,463 infants were included in analysis of RTI for inpatient admissions. A total of 126 infants (8.6%) had at least one RTI hospital admission. At univariable level, children with at least one hospital admission for an RTI were significantly associated with several maternal (age of mother, deprivation at recruitment and reporting of burden at baseline) and child (birth weight, birth season, male sex, NNU admission, and congenital deformity) characteristics and features (Table 1). At a multivariable level, maternal age and birthweight were no longer predictive of an RTI admission and were subsequently omitted to result in a model with improved fit (higher H-L and lower AIC test statistic). The final model suggested that male gender (OR 1.52, 95% CI 1.03 to 2.25), NNU admissions (3.21, 1.98 to 5.22) and birth season (Spring births have higher odds of admissions compared to autumn (0.55. 0.33 to 0.94) and winter (0.47, 0.26 to 0.83) births) independently predicted children experiencing at least one hospital admission (table 2). In addition there was no evidence of multi-collinearity found between any of the variables in the model (VIF=1.02).The model demonstrated a moderate diagnostic value (AUROC 0.68 (95% 0.63 to 0.73).

High versus low Primary care RTI consulters.

Of the 925 infants whose primary care data was available, 10 mothers had either withdrawn or left their GP practice before the end of the two-year follow-up. Of the 10 withdrawals, seven were low consulters and three high consulters. The three high consulters were included in analysis (any future consultations would not change their status as a high consulter). The seven low consulters were excluded (future unrecorded consultations could change status). Of the 918 infants included in analysis, 291 (31.7%) had over four consultations for RTI and were classified as high consulters. The multivariable logistic regression model identified that mothers who had breastfed their child were significantly less likely to be a high consulter to primary care for a RTI (OR 0.55, 95% CI 0.38 to 0.78) (Table 3). Furthermore, an association was observed between high GP RTI consulters and infant inpatient admissions for RTI with high consulters being over twice as likely to have an inpatient admission for a RTI (OR 2.11, 95% CI 1.17 to 3.81) (Table 3).

Conclusion

Summary

This was a secondary analysis of a large cohort of families who had participated in a randomized controlled trial of a specialist home visiting service in England. No significant maternal or infant risk factors for presenting with an RTI in primary care were identified. Various risk factors were found to be independently predictive of attending secondary healthcare settings with an RTI. Increased odds of A&E attendances with an RTI was associated with fewer antenatal checkups, a neonatal unit (NNU) admission at birth and season of birth with autumn being significantly lower than spring. Increased risk of infant RTI hospitalisation was associated with male gender and NNU admission at birth. In addition, it was found that being born in autumn and winter significantly reduced RTI risk for inpatient admissions. Season of birth, male gender and deprivation have previously been linked to infant RTIs in the general population. Smoking and breast-feeding have previously been documented to be associated with infant RTIs yet these were not identified in this study, however, this could be due to the high levels of smoking and low levels of breastfeeding in our subset of mothers.[10,16-17]

When investigating high GP consulters (over four consultations in two years) for infant RTIs, never breastfeeding and high infant inpatient admissions for RTI were independently predictive of being a high consulter.

Strengths and limitations

This is one of the first large studies to investigate risk factors of RTI specifically in infants of teenage mothers. Collection of data from both primary and secondary healthcare will have captured a large proportion of infant infections with numerous data collection time points and sources for risk factors. Furthermore, for secondary care data only 3.4% of participants withdrew before the end of the trial, providing a large sample with complete follow-up data.

A limitation to this study lies in the coding of infections in A&E. In this setting coding was imprecise, hence, inclusion of respiratory conditions that were not infections was possible. This could explain the lack of significant anticipated risk factors for RTI presenting at A&E. Furthermore, the identification of such risk factors in the inpatient setting, where coding was more accurate, highlights that coding errors could have confounded the A&E results. This study recruited teenage mothers from 18 different areas in England. Coupled with the large sample size, this provides a high level of generalisability to teenage mothers. Participants were recruited from socially deprived areas and, it has been found that rates of teenage pregnancy are greatest in the most deprived areas.[30-31] Another limitation is the potential risk of a type 1 error (finding a significant result where one does not truly exist) given the number of risk factors in the models.

Comparison with existing literature

This study found that being male increased an infant's risk of being admitted to hospital for a RTI. Person *et al.* identified that male sex, alongside having a mother under 25, were risk factors for mortality due to infection, in both low and normal birth weight babies.[32] Another large cohort studies have found being male to be a risk factor for hospitalisation, but not specifically for RTIs.[33] However, this study was conducted over 15 years ago, hence, this research adds new and more relevant data.[33]

NNU admission following birth was found to increase the risk of an RTI hospitalisation 2.89 fold. Analysis of the English National Neonatal research database identified that the top two causes of admission are respiratory disease and infection.[34] Underlying respiratory conditions and NNU admissions have previously been linked to infection in infancy. [17,35-36] However, the majority of this evidence focused on preterm infants and as this study did not identify whether admitted infants were preterm or full-term, a clear conclusion cannot be drawn. An NNU admission however was found to protective for A&E attendances, this may be due to the fact that children who are known to the paediatric department, for example were in NNU after birth, often have an open door policy to the paediatric department and can therefore bypass A&E.

Additionally, this study identified that being born in the autumn and winter reduced an infant's risk of RTI admission. This is contradictory to previous research.[37,38] Previous studies have found that infant RTIs and hospitalisations are greater in those born just before or during the respiratory syncytial virus season (November-March).[37,38]However, these studies coded by birth month in comparison to this study coding by season and they focused on the first year of life (BB collected data for two years) thus, these differences may have impacted our results.[37,38]

Regarding high infant primary care consultations, previous research has mainly focused on average number of consultations for infants but in infants born to mothers of any age and background. [26] There is very little previous data regarding high and low primary care consultations for infants born to teenage mothers. It is known that infants of teenage mothers are at greater risk of hospital admissions and childhood accidents, yet there is little data that investigates the impact on primary care. [39,40] Furthermore, there are no previous studies that have investigated underlying risk factors for high primary care consulters in infants of teenage mothers.

Implications for research and/or practice

Levels of teenage pregnancy in the UK are high and often have adverse outcomes for the child including high hospital admissions. This study identified risk factors for infant hospital admissions for RTI alongside risk factors for high primary care consultation rates for RTI. If any of these risk factors are potentially modifiable this could improve child health and reduce healthcare usage by this population. This study highlights that being male and having a NNU admission following births puts infants of teenage mothers at higher risk of being admitted to hospital in the first two years of life for an RTI. Furthermore, infants who have a higher number of primary care consultations are also at greater risk of a hospital admission. Further investigation into reasons why this occurs, for example, lack of GP trust in mothers, whether children were genuinely ill etc. could be beneficial, and highlight a way to reduce hospital admissions in this subset.

Studies focusing on RTIs in infants of teenage mothers are limited and further investigations need to be conducted in this subset in order to identify other risk factors for infant RTIs. The limitation of using routinely collected data to identify patients with acute infection is that there will be proportion of patients missed or incorrectly included in the analysis. Continuing to understand how acute infections are coded and encouraging the improvement is key for future studies. This study is one of the first of its kind focusing on infants of teenage mothers and it identifies risk factors that if appropriately identified and supported could reduce the number of primary care consultations and hospital admissions for RTI in infants born to teenage mothers.

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Ethical approval

Approved by Wales NHS Research Ethics Committee (09/MRE09/08)

Competing interests

The authors have declared no competing interests.

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Table 1: Univariable risk factors for primary care consultations, A&E attendance, and inpatient admissions for RTIs

	Primary care consultation			Accident and Emergency attendance			Hospital admissions		
Predictor	**No RTI n =207**	**RTI n =714**	**Unadjusted OR (95% CI)**	**No RTI n =1161**	**RTI n =306**	**Unadjusted OR (95% CI)**	**No RTI n =1,337**	**RTI n =126**	**Unadjusted OR (95% CI)**
BB Trial arm N(%)									
Usual Care	103 (49.8)	361 (50.6)	Ref	593 (51.1)	155 (50.7)	Ref	682 (51.0)	62 (49.2)	Ref
FNP	104 (50.2)	353 (49.4)	0.98 (0.71 to 1.32)	568 (48.9)	151 (49.3)	1.02 (0.79 to 1.31)	655 (49.0)	64 (50.8)	1.07 (0.75 to 1.55)
Missing	0	0		*0*	*0*		*0*	*0*	
Age at recruitment (years) Mean (SD)	18.01 (1.18)	17.85 (1.22)	0.89 (0.78 to 1.02)	17.82 (1.24)	17.89 (1.22)	1.05 (0.95 to 1.16)	17.62 (1.24)	17.85 (1.24)	0.86 (0.75 to 0.99)
Missing	*0*	*0*		*0*	*0*		*0*	*0*	
IMD deprivation quintile N(%)									
1 = least deprived	54 (26.2)	146 (20.6)	Ref	237 (20.6)	62 (20.4)	Ref	284 (21.4)	14 (11.3)	Ref
2	46 (22.3)	142 (19.9)	1.13 (0.72 to 1.79)	237 (20.6)	60 (19.7)	0.97 (0.65 to 1.44)	264 (19.9)	32 (25.8)	2.46 (1.28 to 4.71)
3	33 (16.0)	154 (21.8)	1.73 (1.06 to 2.81)	231 (20.1)	49 (16.1)	0.81 (0.53 to 1.23)	256 (19.3)	23 (18.5)	1.82 (0.92 to 3.62)
4	34 (16.5)	136 (19.2)	1.48 (0.91 to 2.41)	217 (18.9)	65 (21.4)	1.15 (0.77 to 1.70)	257 (19.4)	24 (19.4)	1.89 (0.96 to 3.74)
5 = most deprived	39 (18.9)	131 (18.5)	1.24 (0.77 to 2.00)	228 (19.8)	68 (22.4)	1.14 (0.77 to 1.68)	265 (20.0)	31 (25.0)	2.37 (1.24 to 4.56)
Missing	1	6		*11*	*2*		*11*	*2*	
NEET status* N(%)									
No	96 (52.5)	346 (55.7)	Ref	520 (52.7)	135 (50.4)	Ref	600 (52.2)	52 (51.5)	Ref
Yes	87 (47.5)	277 (44.3)	0.88 (0.64 to 1.23)	466 (47.3)	133 (49.6)	1.10 (0.84 to 1.44)	550 (47.8)	49 (48.5)	1.03 (0.68 to 1.54)
Missing	24	91		*175*	*38*		*3*	*0*	
Generalized self-efficacy scale (score 10 to 40)** Mean (SD)	29.92 (4.59)	30.14 (4.32)	1.01 (0.98 to 1.05)	29.97 (4.28)	30.24 (4.89)	1.01 (0.96 to 1.04)	30.01 (4.41)	30.35 (4.16)	1.02 (0.98 to 1.06)
Missing	8	11		*18*	*2*		*18*	*2*	
Adaptive functioning:									

Difficulty in at least 1 basic skill N(%)									
No	162 (78.3)	540 (75.7)	Ref	858 (74.0)	230 (75.4)	Ref	997 (74.7)	87 (69.0)	Ref
Yes	45 (21.7)	173 (24.3)	1.15 (0.80 to 1.67)	302 (26.0)	75 (24.6)	0.93 (0.69 to 1.24)	338 (25.3)	39 (31.0)	1.32 (0.89 to 1.97)
Missing	0	1		*1*	*1*		*2*	*0*	
3 or less life skills N(%)									
No	149 (72.3)	529 (74.4)	Ref	854 (73.9)	226 (73.9)	Ref	989 (74.2)	88 (69.8)	Ref
Yes	57 (27.7)	182 (52.6)	0.90 (0.64 to 1.27)	302 (26.1)	80 (26.1)	1.00 (0.75 to 1.33)	343(25.8)	38 (30.2)	1.25 (0.83 to 1.86)
Missing	1	3		*5*	*0*		*5*	*0*	
At least one life burden N(%)									
No	147 (71.0)	500 (70.7)	Ref	818 (71.0)	206 (67.5)	Ref	943 (71.1)	78 (61.9)	Ref
Yes	60 (29.0)	207 (29.3)	1.01 (0.72 to 1.43)	334 (29.0)	99 (32.5)	1.18 (0.90 to 1.54)	384 (28.9)	48 (38.1)	1.51 (1.03 to 2.21)
Missing	0	7		*9*	*1*		*10*	*0*	
Maternal smoking at baseline N(%)									
Non-smoker	78 (39.4)	282 (41.8)	Ref	477 (43.4)	117 (40.6)	Ref	547 (43.2)	47 (38.8)	Ref
Smoker	120 (60.6)	393 (58.2)	0.91 (0.66 to 1.25)	622 (56.6)	171 (59.4)	1.12 (0.86 to 1.46)	719 (56.8)	74 (61.2)	1.19 (0.81 to 1.75)
Missing	9	39		*62*	*18*		*71*	*5*	
Living with baby's father at baseline N(%)									
No	129 (73.3)	525 (77.9)	Ref	799 (75.0)	215 (78.2)	Ref	922 (75.3)	89 (78.1)	Ref
Yes	47 (26.7)	149 (22.1)	0.78 (0.53 to 1.14)	267 (25.0)	60 (21.8)	0.84 (0.61 to 1.15)	302 (24.7)	25 (21.9)	0.98 (0.92 to 1.05)
Missing	31	40		*95*	*31*		*113*	*12*	
Drunk alcohol before they knew they were pregnant? N(%)									
Yes	133 (67.5)	450 (66.0)	Ref	707 (64.7)	203 (68.4)	Ref	831 (65.6)	77 (64.2)	Ref
No	64 (32.5)	232 (34.0)	1.07 (0.76 to 1.50)	386 (35.3)	94 (31.6)	0.85 (0.64 to 1.12)	435 (34.4)	43 (35.8)	1.07 (0.72 to 1.58)

Missing	10	32		*68*	*9*		*71*	*6*	
Consumed alcohol after finding out they were pregnant? N(%)									
Yes	43 (21.8)	160 (23.5)	Ref	230 (21.0)	79 (26.6)	Ref	280 (22.1)	28 (23.3)	Ref
No	154 (78.2)	523 (76.5)	0.91 (0.62 to 1.34)	864 (79.0)	218 (73.4)	0.73 (0.55 to 0.99)	987 (77.9)	92 (76.7)	0.93 (0.60 to 1.45)
Missing	10	31		*67*	*9*		*70*	*6*	
Breast-feeding intention N(%)									
Breast or mixed	80 (52.6)	316 (53.8)	Ref	495 (53.8)	138 (58.0)	Ref	577 (54.5)	54 (55.1)	Ref
Bottle or undecided	72 (47.4)	271(46.2)	0.95 (0.67 to 1.36)	425 (46.2)	100 (42.0)	0.84 (0.63 to 1.13)	481(45.5)	44 (44.9)	0.98 (0.64 to 1.48)
Missing	55	127		*241*	*68*		*279*	*28*	
Ever breastfed baby N(%)									
Yes	67 (57.8)	274 (56.0)	Ref	436 (56.1)	103 (57.2)	Ref	481 (56.1)	47 (58.8)	Ref
No	49 (42.2)	215 (44.0)	1.07 (0.71 to 1.62)	333 (43.9)	77 (42.8)	0.96 (0.69 to 1.33)	377 (43.9)	33 (41.2)	0.90 (0.56 to 1.43)
Missing	91	225		*402*	*126*		*479*	*46*	
Antenatal attendances									
Mean (SD)	10.23 (3.85)	10.50 (3.75)	1.02 (0.98 to 1.06)	10.42 (3.59)	9.97 (4.36)	0.96 (0.93 to 0.99)	10.37 (3.74)	10.01 (3.67)	1.00 (0.96 to 1.04)
Missing	2	22		*27*	*8*		*34*	*1*	
Birth weight of baby (g)									
Mean (SD)	3180.7 (627.5)	3266.7 (566.1)	1.00 (1.00 to 1.001)	3227.0 (595.6)	3193.6 (546.4)	0.99 (0.99 to 1.00)	3236.18 (562.40)	3068.13 (754.03)	0.9995 (0.9993 to 0.9998)
Missing	0	0		*0*	*0*		*0*	*0*	
Birth season of the baby N(%)									
Spring	45 (21.7)	195 (27.4)	Ref	273 (23.7)	87 (28.4)	Ref	316 (23.8)	43 (34.1)	Ref
Summer	65 (31.4)	187 (26.3)	0.66 (0.43 to 1.02)	308 (26.8)	95 (31.0)	0.97 (0.69 to 1.35)	365 (27.5)	36 (28.6)	0.72 (0.45 to 1.16)
Autumn	58 (28.0)	180 (25.3)	0.72 (0.46 to 1.11)	318 (27.7)	55 (18.0)	0.54 (0.37 to 0.79)	346 (26.1)	27 (21.4)	0.57 (0.35 to 0.95)

Winter	39 (18.8)	149 (21.0)	0.88 (0.55 to 1.42)	251 (21.8)	69 (22.6)	0.86 (0.60 to 1.24)	299 (22.5)	20 (15.9)	0.49 (0.28 to 0.86)
Missing	0	3		*11*	*0*		*11*	*0*	
Sex of baby N(%)									
Female	97 (47.1)	341 (47.8)	Ref	571 (49.2)	140 (45.9)	Ref	660 (49.4)	50 (39.7)	Ref
Male	109 (52.9)	373 (52.2)	0.97 (0.71 to 1.33)	590 (50.8)	165 (54.1)	1.14 (0.89 to 1.47)	676 (50.6)	76 (60.3)	1.48 (1.02 to 2.15)
Missing	1	0		*0*	*1*		*1*	*0*	
Any NNU admission (direct or subsequent) N(%)									
No	19 (9.4)	66 (9.4)	Ref	1017 (89.0)	286 (94.4)	Ref	1205 (91.4)	95 (76.6)	Ref
Yes	183 (90.6)	639 (90.6)	0.99 (0.58 to 1.70)	126 (11.0)	17 (5.6)	0.48 (0.28 to 0.81)	113 (8.6)	29(23.4)	3.26 (2.06 to 5.15)
Missing	5	9		*18*	*3*		*19*	*2*	
Congenital deformity N(%)									
No	199 (96.6)	682 (95.5)	Ref	1114 (96.0)	298 (97.7)	Ref	1293 (96.8)	115 (91.3)	Ref
Yes	7 (3.4)	32 (4.5)	1.33 (0.58 to 3.07)	47 (4.0)	7 (2.3)	0.56 (0.25 to 1.24)	43 (3.2)	11 (8.7)	2.88 (1.44 to 5.73)
Missing	1	0		*0*	*1*		*1*	*0*	

***** Definition of NEET: Not in education, employment, or training (applicable to those only whose academic age is >16 at baseline interview)

**Higher score indicates higher level of self-efficacy

Table 2: Multivariable logistic regression model for Accident and Emergency attendances and hospital admissions for RTI

Predictor	**Accident and Emergency attendance**	**Inpatient admissions**
	Adjusted* OR (95% CI)	**Adjusted* OR (95% CI)**
Index of multiple deprivation quintile		Overall p-value=0.684
1 = least deprived		Reference
2		2.31 (1.19 to 4.51)
3		1.89 (0.94 to 3.80)
4		2.05 (1.02 to 4.11)
5 =most deprived		2.62 (1.34 to 5.11)
Adaptive functioning: At least one life burden (Reference=no life burdens)		1.44 (0.97 to 2.14)
Consumed alcohol after finding out they were pregnant?		
Yes	Reference	
No	0.74 (0.55 to 1.01)	
Number of antenatal attendances	0.96 (0.92 to 0.99)	
Birth season	Overall p-value =0.011	Overall p-value=0.036
Spring	Reference	Reference
Summer	0.91 (0.64 to 1.29)	0.70 (0.43 to 1.14)
Autumn	0.54 (0.36 to 0.80)	0.55 (0.33 to 0.94)
Winter	0.87 (0.60 to 1.27)	0.47 (0.26 to 0.83)
Sex of baby		
Female		Reference
Male		1.52 (1.03 to 2.25)
NNU admission		
No	Reference	Reference
Yes	0.51 (0.30 to 0.89)	3.21 (1.98 to 5.22)
Any congenital deformity		
No		Reference
Yes		2.13 (0.99 to 4.54)

*Adjusted for all other variables in the model

Table 3: Multivariable logistic regression model for high primary care consulters for RTI.

Predictor	Adjusted OR (95%CI)
Congenital deformity	1.70 (0.78 to 3.73)
Maternal Unplanned antenatal attendances	1.08 (0.97 to 1.19)
Maternal antenatal admissions	1.07 (0.93 to 1.24)
Infant RTI inpatient admission	2.11 (1.17 to 3.81)
Ever breastfeed infant	0.55 (0.38 to 0.78)