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Hospital admissions and gestational age at birth: 18 years of follow-up in Western Australia

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Abstract

Background: Infants born moderate to late preterm are twice as likely to be rehospitalised within the first few weeks following discharge from the birth admission. It is not understood how rehospitalisation risk changes with age, or how risks have changed over time.

Methods: A retrospective birth cohort study of all live, singleton births in Western Australia 1st January 1980-31st December 2010, without congenital anomalies, followed to 18 years of age.

Rehospitalisation rates for gestational age categories (<28, 28-31, 32-33, 34-36, 37-38, ≥42 weeks [wk]) were compared to term births (39-41wk) using negative binomial regression. To assess whether rehospitalisation risk changed with age or over time, analyses were conducted for different age intervals and for 5-year birth cohorts.

Results: Rehospitalisation rates were higher up to 18 years for all preterm and early term categories including early term (37-38wk) (130.2/1000 person-years at risk [pyr]; 95%CI 129.1,131.4); late preterm (34-36wk) (164.2/1000 pyr; 161.1,167.4), and post-term (≥42wk) (115.3/1000 pyr; 111.7,119.0) compared to term births (109.1/1000 pyr; 108.5,109.7). The effect of gestational age on rehospitalisation was highest during the first year of life and declined by adolescence (e.g. 34-36wk: rate ratio=2.10 (2.04,2.15) for 29d-1y; 1.14 (1.11,1.18) for 12-18y). The risk of rehospitalisation up to 1 year of age has declined since 1980, except for those born <32 weeks.

Conclusions: Rehospitalisation risk is greater for singleton children born at all gestational ages compared to those born full term. This effect of gestational age on rehospitalisation is highest in the first year post discharge, but has almost disappeared by adolescence.

Introduction

Infants born preterm are at increased risk of subsequent morbidity and mortality¹ and preterm birth is a major predictor for hospital admission following birth.²⁻⁴ Approximately 3-5% of moderate to late preterm births are readmitted to hospital in the first few weeks after discharge from

the birth admission, approximately twice that seen for term births.⁵⁻¹¹ In addition, the morbidity and mortality risks associated with post-term birth (≥ 42 weeks) are thought to be greater than previously appreciated.^{12, 13}

It is not clear at what age the risk of hospitalisation associated with gestational age is greatest, or whether the risk ameliorates with time. Few studies have examined patterns of rehospitalisation over a longer time period, and those that have tend to report cumulative risk from birth to the end of their follow-up period. For example, three studies of very preterm births (<33 weeks) reported just under half were readmitted in the first year of life.¹⁴⁻¹⁶ A European study found that 40% of births <32 weeks were re-hospitalised during the first year of life, and 20% during the second year of life,¹⁷ suggesting that the risk declines with age. The UK Millenium Cohort study found the odds of >3 admissions in births <32 weeks gestation, up to 9 months (m) of age and 9m-5y, was 13.7 and 6 times higher than in term births, respectively.¹⁸

There is also very little information as to whether the risk of hospitalisation has changed over time with changes in clinical practice. A study in France found that 1 year re-hospitalisation rates remained stable between 1997 and 2002 for very preterm births (≤ 33 weeks),¹⁹ however, there is no information regarding changes over a longer period.

Evidence-based information as to whether the adverse effects of preterm birth persist throughout childhood and into adolescence would give clinicians and parents a clearer picture of the long-term consequences preterm birth. The aim of the current study was thus to examine hospitalisation rates following discharge from the birth admission and up to 18 years of age according to gestational age at birth using population based data from Western Australia (WA). The following research questions were addressed:

1. What is the risk of hospital readmission up to 18 years of age for extremely preterm, very preterm, moderate preterm, late preterm and post-term births compared to term births?

2. What is the risk of any hospital readmission for gestational age categories in the neonatal period (28 days), post-neonatal period (29 days - 1 year), infancy (1-5 years), childhood (5-12 years) and adolescence (12-18 years)?
3. Have hospital admission rates in children born preterm and post-term changed over time?

Methods

Data

The study was a retrospective birth cohort study of all live, singleton births in WA between 1st January 1980 and 31st December 2010, surviving to hospital discharge and with no record of a congenital anomaly. Children were followed from discharge after birth admission to age 18 years, 31st December 2010 if aged <18 years, or until death. With 2.52 million residents, WA represents just 11% of the Australian population.²⁰ More than two-thirds (78%) of the WA population live in the capital city, Perth, which is similar to the relative distributions seen for Victoria (76% Melbourne) and South Australia (77% Adelaide) but greater than that seen for other States (range 48% - 64%). Ethical approval was obtained from the WA Department of Health Human Research Ethics Committee (2011/64).

The population in this study was identified from administrative data routinely collected on the WA population. Birth records from the Midwives Notification System of Western Australia were used to identify all infants born at least at 20 weeks gestation or weighing at least 400gm at birth in WA between 1st January 1980 and 31st December 2010. Birth records were linked to the Hospital Morbidity Data System (HMDS) of WA and also with statutory death notifications and the Australian Register of Developmental Anomalies to identify and exclude those born with a developmental anomaly.

The birth records provided information on mothers' demographic characteristics as well as pregnancy, delivery and neonatal characteristics, including gestational age. Information is recorded

by midwives or clinical practitioners attending the birth. Gestational age is reported as the number of completed weeks of pregnancy and is determined by early ultrasound and the first day of last menstrual period. The hospital data provided demographic and clinical information on all hospital admissions in WA for the infants included in this study. This information included the recording of diagnoses using the International Classification of Diseases (ICD). Hospital admissions that were serial transfers (the patient moved between hospitals successively without returning home), a nested transfer (the patient moves to another hospital during a stay in hospital) or an overlapping transfer (admission date prior to separation date on previous record) were considered a single event.

The de-identified data from the four databases were linked and extracted by the Data Linkage Branch (DLB) of the WA Department of Health. The DLB links records between numerous datasets held by the State and Federal governments using probabilistic matching.^{21, 22} Evaluation of the data linkage system has shown that matching procedures are 99.89% accurate.²²

Gestational age at birth was categorised according to current recommendations.^{23, 24} Extremely preterm birth was defined as <28 weeks gestation, very preterm as 28-31 weeks, moderate preterm as 32-33 weeks, late preterm as 34-36 weeks, early term as 37-38 weeks, term as 39-41 weeks and post-term as ≥ 42 weeks. The birth admission was defined according to code V30-V39 (ICD9) or Z38 (ICD10) or admission date on the date of birth.

Statistical methods

Analyses were undertaken using Stata v13.1. Analyses were conducted using gestational age as a categorical variable with term births (39-41 weeks) as the reference category. Rates of hospital admission were calculated as the number of admissions following the birth hospitalisation divided by total person years at risk (calculated as time out of hospital and before death) and expressed per 1000 person years at risk (pyr) with 95% confidence intervals (CI) that take into account multiple admissions per person (obtained using the “cluster” option in Stata’s “strate” command). The number of individuals with any admission per 100 births was also calculated.

Time to event analysis was used to produce the Nelson Aalen cumulative hazard estimate (the total hazard experienced up to time t^{25}) by gestational age group (representing the expected number of hospitalisations by a given age). In order to compare admission rates between gestational age groups (relative to term births), incidence rate ratios (IRR) and their 95% CIs were derived from multivariable negative binomial regression (NBR) models. Analyses were adjusted for year of birth and performed for both sexes combined (adjusted for sex) and separately for males and females. The likelihood ratio test was used to formally examine interactions between gender and gestational age.

To assess whether rehospitalisation risk changed with age, analyses were conducted for different age intervals consisting of the neonatal period (28 days), post-neonatal period (29 days-1 year), infancy (1-5 years), childhood (5-12 years), and adolescence (12-18 years). Age intervals were calculated according to the date they became that age, e.g. 29 days-1 year was 29 days of age up to the date they turned 1y, and 1-5 years was the day after turning one year to the date they turned five.

To examine whether rehospitalisation risk changed over time, analyses of admissions up to one year of age were conducted for 5-year birth cohorts (1980-84, 1985-89, 1990-94, 1995-99, 2000-04 and 2005-10). Admissions to one year were chosen to maximise the proportion of the sample with complete follow-up.

Results

There were 762 984 singleton births surviving to hospital discharge from 1st January 1980 to 31st December 2010, of which 723 953 had no congenital anomaly recorded. Of these, there were 1.52 million hospitalisations in 488 453 individuals. We excluded 2 154 individuals with missing information on gestational age. There were 97 births that were still in hospital on 31/12/2010, and therefore did not contribute to any time at risk of hospitalisation, giving a final sample of 721 702 individuals. Median follow-up time was 14.5 years (range 1 day to 18y). The total time at risk of

hospitalisation was 8 838 532.7 person-years while 5838.2 person-years were spent in hospital; the median time to first re-hospitalisation was 3.5 years (IQR 1.05-11.6 years).

The cohort included 1314 (0.2%) extremely preterm, 3629 (0.5%) very preterm, 4866 (0.7%) moderate preterm, 34 841 (4.8%) late preterm, 195 036 (27%) early term, 467 795 (64.8%) term and 14 221 (2%) post-term births (Table 1). Approximately 51% of the sample was male and 0.53% died following birth discharge with the highest proportion occurring in the extremely preterm group (2.4%). The proportion of infants born at 34-36 weeks and 37-38 weeks increased over time, whereas the proportion of infants born <34 weeks remained stable and the proportion born from 39 weeks onwards declined over time.

By age 18 years, 56% of the cohort had been re-admitted to hospital at least once following birth discharge, ranging from 55% of term births to 81% of extremely preterm births; percentages were generally higher in males than females across all gestational age categories (Table 2). There were 1 050 768 total admissions to hospital giving an incidence rate of 118.9 per 1000 pyr (95%CI 118.3,119.4). The re-hospitalisation rate increased from 109/1000 pyr for births at 39-41 weeks to 405/1000 pyr for those born extremely preterm. Those born post-term also had a higher rehospitalisation rate than term births at 115/1000 pyr. The re-hospitalisation rate was higher for males than females at all gestational ages.

In the first 28 days following birth discharge, 4.4% of births had been re-hospitalised at least once (Figure 1), 5.3% of males and 3.4% of females. The highest proportion with any admission occurred in moderate and late preterm births, 8.9% of each, compared to 3.7% of term births and 4.2% of post-term births. Only 2.3 and 4.0% of extremely and very preterm births, respectively, were re-hospitalised in the first 28 days after birth discharge but had the highest percentage of readmissions following the neonatal period. The percentage of readmissions peaked between 1-5 years for all gestational age groups, from 29.8% of term births to 62.9% of extremely preterm

births. Admissions declined in all gestational age groups after 5y and between 12-18 years rehospitalisations were similar across all gestational age groups.

Figure 2 shows cumulative hazard curves for re-hospitalisation by categories of gestational age showing that the risk of hospitalisation was higher in all gestational age groups compared to term births and that the hazard was greatest in the first few years of life and then plateaued. Those born extremely preterm had experienced two hospital admissions by 2 years of age and approximately six admissions by 18 years, whereas those born at term had experienced fewer than two hospitalisations by 18 years.

The association between gestational age and rehospitalisation (estimated by the IRR) was strongest up to 1 year of age and weakened thereafter (Table 3). Extremely preterm births had the highest risk, 8 times higher than term births by one year of age and 4 times higher between 1-5 years. Associations were stronger for females than males most notably in the post-neonatal period (29 days-1 year) and during infancy (1-5 years).

Results of the hospitalisation rates in the first year of life by gestational age for each birth cohort are presented in Table 4. Admission rates for term births declined from 0.79 per 1000 pyr (0.78,0.81) in 1980-85 cohort to 0.56 per 1000 pyr (0.55,0.57) in the 2005-2010 cohort. Admission rates for post-term births were 0.14 per 1000 pyr higher than term births in 1980-1985; however this difference no longer persisted after the mid-1990's. The difference in rates has also reduced for early term, late and moderate preterm births, but not for very or extremely preterm births, which remained 2.1 and 3.2 per 1000 pyr higher than for term births, respectively.

Discussion

In a population-based study of more than 700,000 births in Western Australia from 1980-2010 and followed to 18 years of age, children born preterm or post-term had higher rates of hospital admission following the post-birth hospitalisation discharge. The highest rates were found for

extremely preterm births, but rates were also significantly higher for other gestational age categories examined including early term births and post-term births. The effect of gestational age on rehospitalisation was highest during the first year after birth discharge, declined thereafter and had almost disappeared by adolescence. Patterns were similar for males and females, although the strength of the association between gestational age and rehospitalisation was stronger in females. The difference in admission rates up to one year of age between all gestational age categories and term births has narrowed since 1980, except for those born extremely or very preterm.

Several studies have reported a 2-3 fold increased risk of rehospitalisation for moderate to late preterm births within the first few weeks following birth.⁵⁻¹¹ Our study found a similar difference, with 9% of late (34-36 weeks) preterm and 10% of moderate (32-33 weeks) preterm births, compared to 3.7% of term (39-41 weeks) births, re-hospitalised within 28 days following discharge from the birth admission. Several large-scale studies in the USA have reported a rate between 3.5-4.8% for late preterm^{7, 8, 10, 26} compared to 1.5-3.5% of term births^{8, 10, 11} in the first 30 days. Outside of the USA, a study of approximately 8000 births in a Northern Taiwan medical centre reported that 4.4% of late preterm births compared to 2.3% of term births⁹ and in the UK 8.7% of infants born 35-37 weeks compared to 4.8% of infants born 38-40 weeks were readmitted within 28 days.²⁷

Few studies have investigated hospital readmission for early (37-38 weeks) or post (≥ 42 weeks) term births. Studies from the USA reported 2.1% and 1.7% of early term births were re-hospitalised in the neonatal period, a 20 and 40% increased risk, respectively, compared to term births.^{10, 11} In our study, 5% of early term births were re-hospitalised within 28 days, a higher rate than that reported from the USA, but representing an increased risk of 39% compared to term births which is similar to that found in previous studies. We found an increased risk of admission associated with post-term births, however the risk was small by comparison with preterm births, and the association had disappeared in recent birth cohorts, possibly due to the decline in post-term

births seen in recent years. We are not aware of a comparable study that has examined hospitalisation associated with post-term birth.

Beyond the neonatal period, our study found 32% of moderate and 23.6% of late preterm births were rehospitalised at least once by one year of age. This was higher than has been reported in the USA, with readmission between 15-182 days post discharge ranging from 5% to 9% for those born at 37 and 33 weeks.²⁸ Readmission up to one year of age occurred in approximately 15% of moderate to late preterm births in other large studies from the USA.^{2, 4} Additional studies from other countries are needed to provide a broader context for longer term readmission rates in moderate to late preterm births.

For very and extremely preterm births, long term rehospitalisation rates are considerably higher than for moderate and late preterm births. In France, 47% of children born extremely preterm (<29 weeks) were re-hospitalised by nine months.¹⁵ By one year, 40% of births <32 weeks in Austria¹⁷ and 42% born <33 weeks in Australia had been re-hospitalised.¹⁴ In Canada, 57% born 23-25 weeks and 49% born 26-28 weeks were re-hospitalised by 18 months.¹⁶ Our findings are consistent with these studies, finding 44% of very preterm and 54% of extremely preterm births were re-hospitalised between 29 days and 1 year.

There is also very little published data on whether the risk changes as the child ages. The UK Millenium Cohort study found the association for births <32 weeks gestation was weaker from 9 months to 5 year than up to 9 months.¹⁸ Our finding that risk of admission was highest up to one year and then declined and almost disappeared by adolescence support the hypothesis that the risk of rehospitalisation declines over time.

Our final objective was to examine whether hospitalisation risks associated with different gestational ages had changed over calendar time. We examined this by comparing the results for different 5-year birth cohorts finding that the rehospitalisation risk for each gestational age category relative to term births had declined over time, except for those born <32 weeks. This is a unique

finding of this study made possible by the long period of data available and it remains to be seen whether there are similar findings from other settings. To date, we are aware of only one previous study showing that one year re-hospitalisation rates in France remained stable between 1997 and 2002 for births ≤ 33 weeks.¹⁹

The main strength of this study is the availability of 30 years of linked demographic and hospital morbidity data on a large, stable population with low out-of-State migration.²⁹ The quality of administrative linked data in WA is generally good, with more than 98% of links made accurately and validation exercises undertaken to ensure the quality of routine collected data.^{21, 22} We examined rates across the full spectrum of gestational age using currently recommended preterm and post-term definitions. We assessed hospitalisation rates at different age intervals to determine at what point in childhood the risk of hospitalisation associated with preterm or post-term birth was greatest and whether the risks attenuated over time. By including birth year we were able to account for and examine changes across time. We controlled for the confounding effects of multiple births and congenital anomalies by restricting the analysis to singleton births without a record of a congenital anomaly. Rehospitalisation in the neonatal period for term births (3.7%) was comparable to that from a large US study using a similar population that excluded congenital anomalies (3.5%), but slightly higher than other US studies (1.5-2%); however, such studies may have examined healthier populations by excluding infants with an NICU admission¹⁰ or delivered by caesarean section.⁸ We did not examine factors such as obstetric decisions surrounding delivery timing, and acknowledge that factors other than gestational age itself may influence subsequent hospitalisation. As the primary research question was to report the association between gestational age and rehospitalisation over 18 years of follow-up this study did not examine the causes of hospital admission. The results from this study will inform future work that will focus on the main causes of admission at different ages associated with gestational age at birth.

In WA, infant rehospitalisation rates have declined over time, however, the gap in rehospitalisation rates between births <32 weeks and term births has not closed. Although this group are at greatest risk of rehospitalisation, they represent only 0.7% of births. The proportion born early term (37-38 weeks) has increased from 20% in the 1980s to 30% in the 2000s and findings from our data up to one year of age indicate they have an excess risk of rehospitalisation compared to term births. Our findings are in agreement with reports from other settings that, regardless of the reason for delivery, a large number of babies are born early term or late preterm for which there may be a substantial burden on health services.¹⁸ The increasing trend towards earlier delivery that has also been reported internationally,³⁰ is thought to be due to an increase in planned births through induction of labour or pre-labour caesarean sections,³¹ up to half of which are in low-risk women.³²

In conclusion, the risk of rehospitalisation is greater for singleton children born at all gestational ages compared to those born full term, particularly within the first year post discharge. This effect of gestational age on rehospitalisation is highest in the first year, but has almost disappeared by adolescence.

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Table 1: Characteristics of the study population

	Total	Gestational age (weeks)						
		<28	28-31	32-33	34-36	37-38	39-41	≥42
Total, n	721702	1314	3629	4866	34841	195036	467795	14221
Male, n (%) [*]	367386 (50.9)	665 (50.6)	1940 (53.5)	2603 (53.5)	18697 (53.7)	101159 (51.9)	235018 (50.2)	7304 (51.4)
Died, n (%) [*]	3824 (0.5)	32 (2.4)	65 (1.8)	55 (1.1)	322 (0.9)	931 (0.5)	2297 (0.5)	122 (0.9)
Birth cohort, n (%) [†]								
1980-84	100968	154 (0.2)	513 (0.5)	669 (0.7)	4456 (4.4)	20148 (20)	70673 (70)	4355 (4.3)
1985-89	112093	172 (0.2)	586 (0.5)	777 (0.7)	5017 (4.5)	25396 (22.7)	76892 (68.6)	3253 (2.9)
1990-94	115972	184 (0.2)	557 (0.5)	759 (0.7)	5492 (4.7)	28583 (24.6)	77470 (66.8)	2927 (2.5)
1995-99	115602	207 (0.2)	589 (0.5)	787 (0.7)	5647 (4.9)	32385 (28)	74441 (64.4)	1546 (1.3)
2000-04	113351	224 (0.2)	538 (0.5)	753 (0.7)	5784 (5.1)	35336 (31.2)	69704 (61.5)	1012 (0.9)
2005-2010	163716	373 (0.2)	846 (0.5)	1121 (0.7)	8445 (5.2)	53188 (32.5)	98615 (60.2)	1128 (0.7)

^{*}percentage of column total

[†] percentage of row total

Table 2: Hospitalisation patterns up to 18 years by gestational age categories, %

Group	N	N admitted at least once (%)	PYR	Total no. of admissions	Incidence rate* (95% CI)
All	721702	403887 (56)	8838533	1050768	118.9 (118.3,119.4)
≥42 weeks	14221	8767 (61.6)	220942	25472	115.3 (111.7,119.0)
39-41 weeks	467795	256935 (54.9)	5885025	642192	109.1 (108.5,109.7)
37-38 weeks	195036	108956 (55.9)	2202264	286782	130.2 (129.1,131.4)
34-36 weeks	34841	22121 (63.5)	413284	67880	164.2 (161.1,167.4)
32-33 weeks	4866	3334 (68.5)	58962	11164	189.3 (180.1,199.1)
28-31 weeks	3629	2711 (74.7)	43707	11459	262.2 (249.2,276.0)
< 28 weeks	1314	1063 (80.9)	14349	5819	405.3 (374.4,439.9)
Male	367386	220862 (60.1)	4500030	594280	132.1 (131.3,132.9)
≥42 weeks	7304	4766 (65.3)	113559	14250	125.5 (120.2,131.0)
39-41 weeks	235018	138862 (59.1)	2956502	358933	121.4 (120.5,122.3)
37-38 weeks	101159	60777 (60.1)	1145303	165278	144.3 (142.6,146.0)
34-36 weeks	18697	12520 (67)	222419	39497	177.6 (173.2,182.2)
32-33 weeks	2603	1866 (71.7)	31645	6555	207.1 (193.7,221.8)
28-31 weeks	1940	1527 (78.7)	23390	6682	285.7 (268.1,304.7)
< 28 weeks	665	544 (81.8)	7212	3085	427.7 (379.4,483.8)
Female	354316	183025 (51.7)	4338503	456488	105.2 (104.5,106.0)
≥42 weeks	6917	4001 (57.8)	107384	11222	104.5 (99.9,109.4)
39-41 weeks	232777	118073 (50.7)	2928523	283259	96.7 (95.9,97.6)
37-38 weeks	93877	48179 (51.3)	1056961	121504	115.0 (113.4,116.6)
34-36 weeks	16144	9601 (59.5)	190865	28383	148.7 (144.4,153.2)
32-33 weeks	2263	1468 (64.9)	27318	4609	168.7 (156.8,181.8)
28-31 weeks	1689	1184 (70.1)	20317	4777	235.1 (216.5,255.7)
< 28 weeks	649	519 (80)	7137	2734	383.1 (345.7,425.4)

*per 1000 person-years at risk

PYR=person years at risk

95% CI=confidence interval

Table 3. Incidence rate ratios (95%CI) for admission to hospital by preterm birth and age intervals

		Incidence rate ratio (95%CI)		
		All*	Males†	Females†
0-28d	≥42 weeks	1.09 (1.01,1.19)	1.07 (0.96,1.18)	1.13 (0.99,1.30)
	37-38 weeks	1.39 (1.35,1.42)	1.33 (1.29,1.37)	1.48 (1.42,1.55)
	34-36 weeks	2.62 (2.52,2.72)	2.29 (2.18,2.41)	3.20 (3.00,3.41)
	32-33 weeks	2.89 (2.61,3.20)	2.38 (2.08,2.73)	3.82 (3.26,4.48)
	28-31 weeks	1.11 (0.92,1.33)	0.98 (0.77,1.23)	1.37 (1.02,1.84)
	<28 weeks	0.63 (0.42,0.93)	0.26 (0.12,0.55)	1.31 (0.82,2.10)
29d-1y	≥42 weeks	1.16 (1.10,1.21)	1.16 (1.09,1.24)	1.15 (1.07,1.23)
	37-38 weeks	1.33 (1.31,1.35)	1.31 (1.29,1.34)	1.34 (1.31,1.37)
	34-36 weeks	2.10 (2.04,2.15)	2.02 (1.95,2.09)	2.20 (2.11,2.30)
	32-33 weeks	2.98 (2.79,3.18)	2.88 (2.65,3.13)	3.12 (2.81,3.45)
	28-31 weeks	5.10 (4.75,5.46)	4.89 (4.47,5.35)	5.37 (4.81,6.00)
	<28 weeks	7.77 (6.95,8.68)	6.62 (5.71,7.68)	9.06 (7.65,10.72)
1-5y	≥42 weeks	1.08 (1.05,1.12)	1.08 (1.03,1.12)	1.09 (1.04,1.15)
	37-38 weeks	1.18 (1.17,1.19)	1.18 (1.16,1.19)	1.18 (1.16,1.20)
	34-36 weeks	1.49 (1.46,1.52)	1.44 (1.41,1.48)	1.55 (1.50,1.60)
	32-33 weeks	1.76 (1.68,1.86)	1.75 (1.64,1.87)	1.78 (1.64,1.93)
	28-31 weeks	2.54 (2.40,2.69)	2.45 (2.28,2.63)	2.67 (2.44,2.92)
	<28 weeks	4.43 (4.05,4.84)	3.95 (3.51,4.45)	4.98 (4.35,5.71)
5-12y	≥42 weeks	1.05 (1.01,1.09)	1.05 (1.01,1.10)	1.05 (0.99,1.11)
	37-38 weeks	1.13 (1.11,1.14)	1.13 (1.11,1.15)	1.13 (1.11,1.15)
	34-36 weeks	1.33 (1.30,1.36)	1.30 (1.26,1.34)	1.37 (1.32,1.42)
	32-33 weeks	1.38 (1.30,1.47)	1.33 (1.23,1.45)	1.44 (1.31,1.59)
	28-31 weeks	1.89 (1.76,2.02)	1.82 (1.66,1.99)	1.97 (1.77,2.19)
	<28 weeks	2.94 (2.63,3.29)	2.99 (2.58,3.46)	2.89 (2.44,3.42)
12-18y	≥42 weeks	1.03 (1.00,1.07)	1.01 (0.96,1.06)	1.06 (1.00,1.11)
	37-38 weeks	1.08 (1.06,1.10)	1.05 (1.03,1.07)	1.12 (1.09,1.14)
	34-36 weeks	1.14 (1.11,1.18)	1.10 (1.05,1.14)	1.19 (1.14,1.25)

32-33 weeks	1.21 (1.12,1.31)	1.21 (1.09,1.34)	1.21 (1.08,1.35)
28-31 weeks	1.37 (1.26,1.50)	1.35 (1.20,1.52)	1.39 (1.23,1.58)
<28 weeks	1.47 (1.27,1.71)	1.44 (1.17,1.78)	1.51 (1.22,1.87)

Reference category for gestational age is 39-41 weeks (IRR=1)

*adjusted for sex and year of birth

† adjusted for year of birth.

CI=confidence interval

P-values for likelihood ratio test of interaction between sex and gestational age categories: 0-28d

P<0.001; 29d-1y P=0.009; 1-5y P=0.006; 5-12y P=0.347; 12-18y P=0.006

Table 4. Risk of hospitalisation up to 1 year of age for preterm birth by birth cohort adjusted for sex

Cohort	Incidence (95%CI)*	Rate difference (95%CI) per 1000 pyr †					
	39-41 weeks	≥42 weeks	37-38 weeks	34-36 weeks	32-33 weeks	29-31 weeks	<28 weeks
1980-1984	0.79 (0.78,0.81)	0.14 (0.07,0.21)	0.25 (0.21,0.29)	1.02 (0.91,1.13)	1.38 (1.05,1.70)	2.12 (1.65,2.60)	3.32 (2.13,4.52)
1985-1989	0.69 (0.68,0.70)	0.15 (0.08,0.22)	0.26 (0.23,0.29)	0.91 (0.82,1.00)	1.47 (1.17,1.77)	2.48 (2.00,2.95)	3.20 (2.12,4.28)
1990-1994	0.56 (0.55,0.57)	0.10 (0.04,0.16)	0.23 (0.20,0.25)	0.77 (0.70,0.85)	1.11 (0.87,1.35)	2.01 (1.60,2.42)	3.84 (2.71,4.97)
1995-1999	0.66 (0.64,0.67)	0.01 (0.00,0.07)	0.24 (0.21,0.27)	0.74 (0.67,0.82)	1.30 (1.03,1.57)	2.22 (1.78,2.65)	4.17 (3.00,5.34)
2000-2004	0.67 (0.66,0.68)	0.08 (0.03,0.20)	0.20 (0.18,0.23)	0.64 (0.56,0.71)	1.08 (0.83,1.33)	2.03 (1.60,2.46)	3.29 (2.35,4.23)
2005-2010	0.56 (0.55,0.57)	0.01 (0.00,0.11)	0.15 (0.13,0.17)	0.60 (0.54,0.66)	1.06 (0.85,1.26)	2.11 (1.76,2.46)	3.23 (2.51,3.95)

*Baseline incidence rate per 1000 person-years for term births (39-41 weeks)

† from baseline rate in the 39-41 week group

Figure legends

Figure 1 Any admission per 100 births (95%CI) by gestational age categories over time

Figure 2 Cumulative hazard for hospitalisation by gestational age (expected number of hospitalisations by age)

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Supplementary figures

Figure S1 Cumulative hazard for hospitalisation by gestational age (expected number of hospitalisations by age) for males

Figure S2 Cumulative hazard for hospitalisation by gestational age (expected number of hospitalisations by age) for females

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