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Trends in obstetric anal sphincter injuries and associated risk factors for vaginal singleton term births in New South Wales 2001-2009.

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Trends in OASIS and associated risk factors.

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ABSTRACT

Background: Changes in clinical practice and in the characteristics of child-bearing women have the potential to influence the rate of obstetric anal sphincter injuries (OASIS). To date, little investigation has been undertaken to assess the effect of risk factor trends for the Australian population on OASIS rates.

Aims: To ascertain the OASIS rates among singleton vaginal births ≥37 weeks gestation in NSW, 2001 to 2009; determine risk factor effect sizes and trends; and compare predicted with observed OASIS rates.

Methods: Using two linked population-based datasets, risk factors for OASIS were determined by logistic regression. Contingency tables and predictive modelling were used to determine trends and predicted rates of OASIS respectively.

Results: The OASIS rate increased from 2.2% in 2001 to 2.9% in 2009. Highest risks were for forceps deliveries without episiotomy (primiparas aOR 6.10, multiparas aOR 6.15), followed by multiparas with no previous vaginal birth (aOR 5.61). High birthweight, vacuum delivery and Asian country of birth posed risks for all women. The greatest risk factor trends were increases in Asian country of birth and vacuum delivery, while the greatest trend among protective factors was an increase in maternal age ≥35 years for primiparas. Predicted OASIS rates were lower than observed rates.

Conclusion: In an environment of changing demographic and clinical risk factors, the OASIS rate has increased. This increase is only minimally explained by the identified risk factors, and may be related to other unmeasured risk factors or a possible increase in clinical ascertainment and/or documentation of OASIS.

Keywords (from MeSH)

perineum, term birth, lacerations, logistic models, risk factors

INTRODUCTION

Obstetric anal sphincter injuries (OASIS) are relatively rare but distressing outcomes of vaginal births, with recent Australian and New Zealand rates estimated at approximately 2.9%[1]. OASIS occur when a laceration extends to the anal sphincter and disrupts the anal sphincter musculature (third degree tear)[2], or into the anal mucosa (fourth degree tear)[2]. In addition to the potential longer term physical and psychological ramifications (pain, faecal incontinence, sexual dysfunction and lifestyle alteration), OASIS can result in increased duration of hospitalisation or readmission for repair.

A number of demographic and clinical risk factors are associated with OASIS, with recognised risks including primiparity, instrumental births, Asian ethnicity and large birthweight[3-4]. Association with episiotomy is more complex, varying by type and across different subgroups[4-6]; while other factors such as epidurals and maternal supine position at birth have been demonstrated to be risk factors in some studies, but not all[4, 7].

The importance of OASIS as a gauge of care is reflected in the recommendation for inclusion as one of fifty-five national indicators of quality and safety of clinical care for Australia[8], as already exists in Europe[9]. The incidence of OASIS varies between countries[9], between states in Australia[10], and between hospitals[1]. With changes in obstetric practices and in the demographic profile of child-bearing women in Australia, including increased use of vacuum extraction, advancing maternal age and an increasingly multiculturally diverse population, it is important to monitor trends in OASIS. To date, there has been little investigation into the trends of risk factors for OASIS for the Australian population, and how any changes may affect OASIS rates.

AIM

The aims of this study were to 1) compare the OASIS rates of singleton vaginal births ≥37 weeks gestation in NSW for 2001 to 2009; 2) determine the risk factor effect sizes and their trends; and 3) compare a predicted OASIS rate with the observed.

METHODS

The study population consisted of all singleton births ≥ 37 weeks in NSW hospitals between 2001 and 2009.

Data were sourced from two linked population-based data collections; the NSW Perinatal Data Collection (PDC) and the NSW Admitted Patients Data Collection (APDC). The former is a statutory collection and primary information source about pregnancy and outcomes for all births in NSW ≥ 20 weeks gestation or ≥ 400 grams birthweight. It includes births in public and private hospitals. Data are recorded by the attending midwife or doctor and include maternal, demographic, medical and obstetric information as well as details regarding labour, birth and infant condition. The APDC is a census of discharges from all NSW public and private hospitals and day procedure centres. In addition to demographic and administrative data, information regarding diagnoses and procedures is coded according to the most recent International Classification of Diseases, Australian Modification (ICD-10-AM)[11] and the Australian Classification of Health Interventions (ACHI)[12]. Probabilistic linkage of these two datasets was undertaken by NSW Centre for Health Record Linkage (CHeReL), with the linkage rate of PDC to APDC previously demonstrated at over 98%[13]. De-identified data were then provided to the researchers. Ethics approval was obtained from the NSW Population and Health Services Research Ethics Committee.

The primary outcome of interest was the incidence of third or fourth degrees tear at birth, referred to as OASIS (obstetric anal sphincter injuries) and identified by the APDC. An occurrence of OASI was ascertained by either ICD-10-AM diagnostic coding 'O70.2' (third degree perineal laceration during delivery) or 'O70.3' (fourth degree perineal laceration during delivery), or by ACHI procedural coding '16573-00' (suture of third or fourth degree tear of perineum). This combination from the APDC has been reported as the most reliable indicator for OASIS identification (sensitivity=94.2; PPV=99.7) for NSW population health data[14].

Data regarding the recognised risk factors for OASIS[2-3, 6, 15-17] were obtained from the PDC and/or APDC utilising the most reliable source according to local validation studies[14, 18-20]. Maternal age and country of birth, infant sex and weight, gestation, mode of delivery, regional analgaesia/anaesthesia, parity and year were identified from the PDC alone; induction/augmentation, hypertension and episiotomy as reported by either the PDC or APDC; and payment status (private or public) and diabetes were identified by the APDC alone.

Investigation of risk factor trends and effect sizes, as well as predictive modelling, were undertaken. Of the 543,062 records indicating vaginal birth, those with missing or invalid values for parity (n=743), weight (n=141), maternal age (n=85), country of birth (n=6,653), payment status (n=6,601) and infant sex (n=163) were excluded, leaving 528,846 (97.4%) complete records available for analysis.

Analyses

Contingency tables were constructed for all risk factors. The risk of OASIS differed significantly across different strata of parity for maternal age, episiotomy, mode of delivery, infant weight, analgaesia/anaesthesia and payment status. The analysis was consequently stratified by parity for calculation of crude odds ratios (cORs) with their associated 95% confidence intervals (CIs). Adjusted odds ratios (aORs) and CIs were determined by logistic regression for primiparas and for multiparas by entering those variables with univariate $p<0.25$, including the interaction term for mode of delivery with episiotomy. All predictors were modelled as categorical variables with the exception of birthweight which was modelled as a continuous variable. Trends for the categorical variables were examined using the two-sided Cochrane-Armitage test, with relative and absolute changes over time calculated.

In order to investigate whether any change in the OASIS rate over time was due to the identified maternal and birth characteristics, predictive models for both primiparas and multiparas were built using data from 2001. Explanatory variables with cORs of $p<0.25$ and significant interactions were entered. Backwards elimination resulted in acceptable models for prediction, with diagnostics demonstrating c-statistics of 0.72 (primiparas) and 0.77 (multiparas). Data from subsequent years were then entered into these models; prediction could thus be determined adjusting for any changes in the prevalence of risk factors. If predicted OASIS rates were similar to the observed, this would suggest that any change in observed OASIS rate was attributable to the identified maternal and birth characteristics within the model. All analyses were carried out using SAS, version 9.2 (SAS Institute, Cary NC, USA).

RESULTS

A significant increase in OASIS rates for term vaginal singleton births occurred in NSW for both primiparous and multiparous women. From 2001 to 2009 the OASIS rate rose from 4.1% (n=964) to 5.3% (n=1,299) for primiparas ($p<0.0001$), and from 0.9% (n=307) to 1.2% (n=443) ($p<0.0001$) for multiparas. This represented an overall incidence for all vaginal singleton term births of 2.5% (n=13,455) during the nine year study period; 2.2% in 2001 and 2.9% in 2009. Over the same period the rate of second degree tears (ICD10-AM, O70.1) increased from 32.4% to 36.8% for primiparas ($p<0.0001$), and from 24.1% to 29.6% for multiparas ($p<0.0001$).

Compared with women who did not sustain an OASI, those with an OASI were more likely to be primiparous (75.5% vs 39.4%), born in an Asian country (21.8% vs 11.4%), be a public patient (76.9% vs 71.9%) and to give birth at ≥40 completed weeks gestation (64.3% vs 55.8%). Overall the incidence of OASIS was 4.8% among primiparous women, 0.9% among multiparous women with a previous vaginal birth, and 6.5% among multiparous women without a previous vaginal birth (Table 1). The highest OASIS incidences for primiparous women were among forceps delivery, birthweight ≥4,000g and Asian born; and for multiparous women forceps delivery, vacuum extraction, birthweight ≥4,500g and episiotomy.

Women with forceps delivery without episiotomy had the highest crude and adjusted risk of OASIS compared to non-instrumental birth and no episiotomy (Table 2). The risk was somewhat attenuated when episiotomy was performed. Multiparous women without a previous vaginal birth were also at increased risk of OASIS compared to multiparous women who had previously delivered vaginally. In a separate analysis investigating all vaginal births,

multiparous women without a previous vaginal birth remained at increased risk of OASIS when compared to primiparous women (aOR=1.25). Women born in an Asian country were also at increased risk of OASIS. Within the maternal age categories, the aORs for OASIS peaked at 30-34 years for primiparas, and 30-39 years for multiparas.

Of the significant predictors, vacuum extraction births with episiotomy and births to women born in an Asian country were among those with the largest relative increases over time, while the largest decreases were for post-term pregnancies among multiparous women and among those with maternal age of <20 years (Table 3).

Figure 1 shows the observed and predicted OASIS rates for 2001 to 2009 for primiparas and for multiparas as a percentage of total vaginal births. Differences between the observed and predicted trends strongly suggest that factors other than those entered in the model were driving most of the increase in OASIS. Amongst all vaginal births, only 15% of the increase was explained by factors within the model for primiparas, with none of the increase explained by these factors for multiparas.

DISCUSSION

Our study demonstrated increasing OASIS rates among singleton term births that were, for the most part, not explained by changes in the population of birthing women.

Our findings are consistent with other population data, with increasing OASIS rates reported in Scandinavian countries over approximately four decades from 0.5% – 1.6% to 4.2%[21]. More recently, Finnish data for primiparous women revealed an increase from 0.5% to 1.8%

over a similar time period to our data[22], while Canada reported a fairly steady rate from 3.7% to 3.9% amongst all vaginal births[23]. Australian national pooled data reports also indicate an increase in OASIS (1.1% in 2001, 1.7% in 2009), although the reporting of these data are such that overall rates are likely to be under-estimated.

Factors expected to affect OASIS rates and trends include changes in the prevalence of a risk factor, the population burden of a given risk factor, and its effect size. In addition, increases in the OASIS rate for vaginal births have occurred in an environment of increasing caesarean section rates (from 23.0% to 29.6% during the study period), potentially influencing the rates of risk factors for those women who did have a vaginal birth. Results from this study demonstrate that significant changes did occur in the prevalence of some risk factors, however these changes were competing in their effects. Changes in the NSW population potentially increasing OASIS likelihood (such as the increase in the proportion of women born in Asian countries, and the increase in regional analgaesia/anaesthesia for multiparas) were possibly offset by changes in other risk factors (such as the increase in infants born before 41 weeks gestation for multiparas). This 'cancelling out' of risk factor effects was reflected in the predicted rate of OASIS. Comparison with the observed rate suggests that factors outside those available in the population health datasets were responsible for much of the increase.

Although the reporting of OASIS by the APDC is reliable[14], this reliability only reflects agreement between the clinical notes and the population datasets. Increased clinical awareness of major perineal trauma and thus greater ascertainment is possible over the study period. The Royal College of Obstetricians and Gynaecologists (RCOG) adopted a more detailed classification system for third degree perineal tearing in 2004[2]. In 2003 Andrews

published data that revealed many OASIS detected by endoanal ultrasound had not been diagnosed by doctors and midwives at birth[24]. It is possible that clinicians became more conscious of accurately diagnosing OASIS. Over the last decade there has also been a call for more transparency and improved reporting of adverse outcomes, with emphasis from 'blame and shame' to a culture of safety[25]. It is possible that clinicians may be more prepared to document poor outcomes than previously. More accurate OASIS diagnosis and better documentation may be contributing to the rise in OASIS that was observed in our study.

Results of analysis of the risk factors for the NSW population are consistent with many other studies, with the strongest risk factors being primiparity[3, 5, 16]; use of forceps or vacuum extraction[3, 5, 16]; large birthweight infant[3, 5]; and Asian ethnicity[3, 5, 15]. As ethnicity is not captured within the NSW population datasets, we have used country of birth to represent Asian background which is consistent with other studies [3, 15]. While multiparous women on the whole have a significantly decreased risk of OASIS, those with prior Caesarean section had increased OASIS risk compared to both primiparas and multiparas with previous vaginal births. A small number of studies have also investigated this association, with some demonstrating OASIS risk greater than that for primiparas[3], and others reporting similar risks[26-27].

Episiotomy has received much attention in the literature as a risk for OASIS. Apart from difficulty in comparing studies of different quality, design and population, comparison is further complicated by clinical variations within each study such as midline versus mediolateral episiotomy, and restrictive versus routine practices[4, 6]. While some population studies report episiotomy as a risk across the whole population[3], others demonstrate a more complex picture with differing risks depending on parity as well as mode of delivery[5, 28]. Our

analysis indicated that compared to women with non-instrumental delivery and no episiotomy, primiparous and multiparous women experiencing a forceps delivery had a lower risk of OASIS in the presence of episiotomy than without. In addition, the risk of OASIS for a non-instrumental delivery with episiotomy was greater for multiparas than primiparas. Whether episiotomy practice (eg by timing, type or extent) varies when performed on a primiparous compared to a multiparous woman is unknown, but if there is a difference this may contribute to the effect size.

Other factors that may influence OASIS incidence but are not reported in the population data include information regarding clinical management such as the birth attendant's level of experience[9]; 'hands poised' or 'hands on' method of perineal management; prolonged protracted valsalva style pushing[29]; the application of hot packs to the perineum during second stage[30]; antenatal perineal massage for primiparous women[4]; and maternal positions for birth[7]. In addition to these practices, persistent occipito-posterior fetal positions and shoulder dystocia have been found to increase the risk[4], but with sensitivities ranging from 20.7% to 44.0%[14], the accuracy of reporting of malposition and malpresentation by the APDC is too poor to analyse. It has also been hypothesised that increasing maternal weight may be influencing the OASIS rate, however this has not been supported by the literature to date[16], and is unavailable in the population data. Whether such factors are influencing the OASIS rate for the NSW population is unknown.

The strengths of this study include the use of linked whole population datasets, allowing access to a large number of the most reliably reported risk factors, as well as accurate trends for a relatively rare outcome.

CONCLUSION

In a complex environment of changing trends for risk factors, the OASIS rate has increased among vaginal births in NSW over the last decade. Using the known risk factors available in population health data, this rise is largely unexplained, and may be attributable to changes in the clinical diagnosis and medical recording of OASIS, or to other factors that are currently not recorded in these datasets. Further work is warranted to gain a greater understanding of the drivers of these increased rates and strategies that may reduce the number of women experiencing this distressing outcome.

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FIGURE LEGENDS AND TABLES

Table 1 – OASIS rates for vaginal births by risk factor

Risk Factor	Number with OASIS (% within each category)		
	Primiparous (N=231,016)	Multiparous (N=315,830)	Total (N=528,846)
Parity			
primiparous	--	--	101,89 (4.8)
multiparous (previous vaginal birth)	--	--	2,660 (0.9)
multiparous (no previous vaginal birth)	--	--	606 (6.5)
Maternal age (yrs)			
<20	554 (2.8)	17 (0.4)	571 (2.4)
20-24	1,850 (4.0)	256 (0.7)	2,106 (2.5)
25-29	3,721 (5.4)	837 (1.0)	4,558 (3.0)
30-34	3,046 (5.4)	1,318 (1.2)	4,364 (2.6)
35-39	905 (4.8)	723 (1.2)	1,628 (2.0)
≥40	113 (4.1)	115 (1.0)	228 (1.6)
Country of Birth			
non Asian	7,898 (4.3)	2,625 (0.9)	10,523 (2.3)
Asian	2,291 (8.1)	641 (1.9)	2,932 (4.7)
Payment Status			
private	2,415 (3.7)	688 (0.8)	3,103 (2.1)
public	7,774 (5.3)	2,578 (1.1)	10,352 (2.7)
Diabetes†			
no	9,698 (4.7)	3,065 (1.0)	12,588 (2.5)
yes	491 (5.9)	201 (1.4)	692 (3.1)
Hypertension‡			
no	9,470 (4.8)	3,118 (1.0)	12,588 (2.5)
yes	719 (4.8)	148 (1.1)	867 (3.1)
Gestational age (completed weeks)			
37 completed weeks	329 (3.0)	101 (0.7)	430 (1.6)
38 completed weeks	967 (3.6)	342 (0.8)	1,309 (1.8)
39 completed weeks	2,284 (4.5)	784 (1.0)	3,068 (2.3)
40 completed weeks	3,692 (4.9)	1,222 (1.1)	4,914 (2.6)
≥41 completed weeks	2,917 (5.9)	817 (1.4)	3,734 (3.4)
Induction or augmentation§			
no	3,313 (4.1)	1,649 (1.1)	4,962 (2.1)
yes	6,876 (5.2)	1,617 (1.0)	8,493 (2.9)
Regional analgaesia/anaesthesia¥			
no	5,529 (4.2)	2,367 (0.9)	7,896 (2.0)
yes	4,660 (5.8)	899 (1.8)	5,559 (4.2)
Episiotomy			
no	6,267 (4.2)	2,607 (0.90)	8,874 (2.0)
yes	3,922 (6.3)	659 (2.6)	4,581 (5.2)
Episiotomy and mode of delivery			
no episiotomy non-instrumental	4,277 (3.4)	2,201 (0.8)	6,478 (1.6)
episiotomy non-instrumental	1,070 (4.2)	357 (1.8)	1,427 (3.2)
no episiotomy forceps	728 (16.8)	120 (7.1)	848 (14.1)
episiotomy forceps	1,633 (9.8)	156 (6.0)	1,789 (9.3)
no episiotomy vacuum	1,262 (6.5)	286 (3.1)	1,548 (5.4)
episiotomy vacuum	1,219 (6.2)	146 (3.9)	1,365 (5.9)
Birthweight (grams)			
<2,000	2 (1.0)	0 (0.0)	2 (0.5)
2,000 – 2,499	50 (1.3)	4 (0.1)	54 (0.7)
2,500 – 2,999	926 (2.7)	142 (0.4)	1,068 (1.5)

3,000 – 3,499	3,537 (4.0)	841 (0.7)	4,378 (2.2)
3,500 – 3,999	3,962 (5.9)	1,319 (1.2)	5,281 (2.9)
4,000 – 4,499	1,485 (8.9)	755 (1.9)	2,240 (3.9)
≥4,500	227 (12.3)	205 (3.0)	432 (5.0)
Sex of infant			
female	4,573 (4.3)	1,373 (0.9)	5,946 (2.3)
male	5,616 (5.3)	1,893 (1.2)	7,509 (2.8)

† Maternal diabetes mellitus or gestational diabetes

‡ Maternal hypertension or pregnancy-induced hypertension

§ Induction or augmentation by any means (includes oxytocic, ARM or prostaglandin)

¥ Epidural, caudal, spinal, pudendal and/or combination

Table 2 – Risk estimates of OASIS for primiparous and multiparous vaginal births

Risk Factor	Primiparous births (N=213,016)		Multiparous births (N=315,830)	
	Crude OR	Adjusted OR	Crude OR	Adjusted OR
Maternal age (yrs)				
<20	0.50 (0.46 – 0.55)	0.57 (0.52 – 0.63)	0.44 (0.27 – 0.71)	0.52 (0.32 - 0.84)
20-24	0.72 (0.68 – 0.77)	0.74 (0.70 – 0.79)	0.67 (0.58 – 0.77)	0.72 (0.62 – 0.82)
25-29	ref	ref	ref	ref
30-34	0.98 (0.94 – 1.03)	1.01 (0.96 – 1.07)	1.21 (1.11 – 1.32)	1.17 (1.07 – 1.28)
35-39	0.87 (0.80 – 0.93)	0.88 (0.81 – 0.95)	1.21 (1.09 – 1.33)	1.17 (1.05 – 1.29)
≥40	0.93 (0.87 - 0.99)	0.74 (0.61 – 0.90)	1.02 (0.84 – 1.24	0.99 (0.81 – 1.21)
Country of Birth				
Asian (ref non Asian)	1.96 (1.87 - 2.06)	2.03 (1.93 – 2.14)	2.09 (1.91 – 2.28)	2.19 (1.99 – 2.40)
Payment Status				
public (ref private)	1.45 (1.38 - 1.52)	1.85 (1.76 – 1.95)	1.33 (1.23 – 1.45)	1.80 (1.64 – 1.98)
Diabetes†				
yes	1.26 (1.15 - 1.38)	1.08 (0.98 – 1.19)	1.40 (1.21 - 1.61)	1.24 (1.07 - 1.44)
Hypertension‡				
yes	1.01 (0.93 - 1.09)	--	1.02 (0.87 - 1.21)	--
Gestational age				
37 completed weeks	0.59 (0.53 - 0.67)	0.96 (0.85 – 1.08)	0.60 (0.49 - 0.74)	1.04 (0.84 – 1.28)
38 completed weeks	0.71 (0.66 - 0.77)	0.93 (0.86 – 1.00)	0.69 (0.61 - 0.78)	0.93 (0.82 – 1.05)
39 completed weeks	0.91 (0.86 - 0.96)	1.02 (0.97 – 1.08)	0.88 (0.81 - 0.96)	1.00 (0.91 – 1.09)
40 completed weeks	ref	ref	ref	
≥41 completed weeks	1.21 (1.15 - 1.27)	1.01 (0.96 – 1.07)	1.28 (1.17 - 1.40)	1.13 (1.03 – 1.24)
Induction or augmentation§				
yes	1.29 (1.23 - 1.34)	1.01 (0.96 – 1.06)	0.94 (0.87 - 1.00)	0.82 (0.76 – 0.88)
Regional analgaesia/anaesthesia¥				
yes	1.43 (1.38 - 1.49)	0.91 (0.87 – 0.96)	1.97 (1.82 - 2.13)	1.25 (1.14 – 1.38)
Episiotomy and mode				
no episiotomy non-instrumental	ref	ref		ref
episiotomy non-instrumental	1.24 (1.16 – 1.33)	1.20 (1.12 – 1.29)	2.36 (2.11 – 2.64)	2.02 (1.79 – 2.27)
no episiotomy forceps	5.82 (5.34 – 6.33)	6.10 (5.56 – 6.70)	9.65 (7.98 – 11.64)	6.15 (4.98 – 7.58)
episiotomy forceps	3.13 (2.95 – 3.33)	3.00 (2.80 – 3.21)	8.06 (6.82 – 9.53)	3.38 (2.79 – 4.10)
no episiotomy vacuum	1.99 (1.86 – 2.12)	2.01 (1.88 – 2.15)	3.93 (3.49 – 4.48)	2.74 (2.39 – 3.14)
episiotomy vacuum	1.91 (1.79 – 2.04)	1.80 (1.70 – 1.93)	5.13 (4.32 – 6.08)	2.60 (2.16 – 3.13)
Birthweight				
per 200g increments	1.21 (1.20 – 1.22)	1.21 (1.19 – 1.22)	1.23 (1.22 – 1.25)	1.25 (1.23 – 1.27)
Sex of infant				
male (ref female)	1.24 (1.19 - 1.29)	1.08 (1.03 – 1.12)	1.33 (1.24 - 1.43)	1.13 (1.06 – 1.22)
Previous vaginal birth				
no (ref yes)	na	na	7.94 (7.25 – 8.70)	5.61 (5.05 – 6.23)

Adjusted for all factors in table and year

Comparison group (referent) is women without the risk factor unless otherwise stated

† Maternal diabetes mellitus or gestational diabetes

‡ Maternal hypertension or pregnancy-induced hypertension

§ Induction or augmentation by any means (includes oxytocic, ARM or prostaglandin)

¥ Epidural, caudal, spinal, pudendal and/or comb

Table 3 – Predictive factors demonstrating significant trends

(where Cochrane-Armitage 2-sided trend test p<0.01)†

Predictive Factor	% Rate of occurrence		Relative % change
	2001	2009	
Protective (in order of greatest protection)			
Maternal age <20 years	5.1	4.0	↓21.0%
Maternal age 20 – 24 years	17.1	15.2	↓11.0%
Maternal age ≥ 40 years (among primiparous)	1.2	1.5	↑25.2%
Maternal age 35 – 39 years (among primiparous)	7.8	9.9	↑27.1%
Regional analgaesia/anaesthesia (among primiparous)	36.2	40.3	↑11.3
Risk (in order of greatest risk)			
Forceps delivery without episiotomy	1.3	1.0	↓20.6
Vacuum delivery without episiotomy	4.8	5.7	↑19.3
Vacuum delivery with episiotomy	3.9	5.3	↑38.3
Asian	10.2	13.8	↑35.3
Non-instrumental delivery with episiotomy	9.4	7.9	↓16.0
Regional analgaesia/anaesthesia (among multiparous)	14.6	18.4	↑26.2
Diabetes (among multiparous)	3.8	4.3	↑12.4
Maternal age 35 – 39 years (among multiparous)	17.0	22.3	↑31.1
Gestational age ≥41 weeks (among multiparous)	20.8	15.7	↓24.5
Non-significant predictors			
Diabetes (among primiparous)	3.1	4.5	↑48.5
Induction/augmentation (among primiparous)	61.4	63.8	↑3.8
Maternal age 30 – 34 years (among primiparous)	24.1	26.8	↑10.9
Maternal age ≥ 40 years (among multiparous)	3.3	4.3	↑31.6

†Trends were not-significant for payment status, infant sex, previous vaginal birth, maternal age 30-34 years for multiparas, induction/augmentation for multiparas, and forceps deliveries with episiotomies.

Mean values for birthweight remained fairly constant across the years (3,474g in 2001, 3.464g in 2009)

Figure 1 – Observed and predicted rates of OASIS amongst all vaginal births