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Title:
The impact of first birth obstetric anal sphincter injury on the subsequent birth: a population-based linkage study

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ABSTRACT

Background

With rising obstetric anal sphincter injury (OASI) rates, the number of women at risk of OASI recurrence is in turn increasing. Decisions regarding mode of subsequent birth following an OASI are complex, and depend on a variety of factors. We sought to identify the risk factors for OASI recurrence from first and subsequent births, and to investigate the effect of OASI birth factors on planned caesarean for the second birth.

Methods

Using two linked population datasets from New South Wales, Australia, we selected women giving birth between 2001 and 2011 with a first birth OASI and a subsequent birth. Multivariable logistic regression was used to identify the association of first and second birth factors with OASI recurrence, and to determine which factors were associated with a planned pre-labour caesarean at the second birth.

Results

Of 6,380 women with a first birth OASI who proceeded to a subsequent birth, 75.4% had a vaginal second birth, 19.4% a pre-labour caesarean, and 5.2% an intrapartum caesarean. The OASI recurrence rate of 5.7% was significantly higher than the first birth OASI rate of 4.5% ($p<0.01$). Following adjustment for first and second birth factors, risk factors for recurrence included diabetes at first birth (adjusted odds ratio (aOR) 1.82), and birthweight at second birth ≥4.0kg (aOR 2.34); second birth at 37-38 weeks was associated with decreased odds of OASI (aOR 0.56). First birth factors associated with planned caesarean at second birth included epidural, spinal or general anaesthetic (aOR 1.88); birthweight ≥4.0kg (aOR 1.68); while factors associated with decreased likelihood included Asian country of birth (aOR 0.73), and maternal age< 25 years (aOR 0.81).

Conclusions

Compared with previous reports, the low OASI recurrence rate (approximately one in twenty) potentially indicates that appropriate decisions are being made about subsequent mode of delivery following first birth OASI. This assertion is supported by evidence of different risk profiles for women who have planned caesareans compared with planned vaginal births.

KEYWORDS

obstetric anal sphincter injury, recurrence, population, third/fourth degree tear

BACKGROUND

Obstetric anal sphincter injuries (OASIs) are recognised as a serious complication of vaginal births, and can result in long term problems including anal incontinence, ongoing perineal pain, dyspareunia and complex psychological issues [1-4]. A recent meta analysis of published risk factors reported primiparity, increased birthweight, median episiotomy and instrumental birth as being associated with OASI [5].

Within the last twenty years reported rates of OASI have varied considerably, from less than 0.6% in Finland [6] to a primiparous rate of 16% within a large US hospital [7]. Despite this variation, there is agreement that OASI rates are rising [6, 8-10]. For example, among primiparous women in Australia the rate has increased from 4.1% in 2001 to 5.3% in 2009 [8], with population studies from Scandinavia revealing rate increases of approximately 400% over the past four decades [6]. With a higher proportion of women experiencing a first OASI, the number at risk of a recurrence in a subsequent birth has in turn increased. The reported recurrence rates vary from 2.0% [11] to 13.4% [12], depending on population and study design. Investigation into recurrence risk has generally focussed on factors around the birth subsequent to the OASI, with similar risk factors reported as those for a first OASI [7, 11-18]. To our knowledge, no association between first OASI birth factors and risk of recurrence has been reported.

Not surprisingly, there is general agreement that women feel apprehensive about subsequent births, with some women wishing to delay a further pregnancy [1, 4, 19]. The risk of recurrence is a major factor in planning the mode of a subsequent birth. In some populations women with a prior OASI are reported to be more likely to have a caesarean for the next birth;[13, 20] however a Swedish study reported that very few caesarean sections were performed for this indication [18].

In recognition of the complexities in counselling a woman approaching a second birth following an OASI at her first, we undertook a large population-based study to determine risk factors from first and second births for OASI recurrence. In addition, we examined the effect of first birth factors on planning for either caesarean or vaginal second birth.

METHODS

Population

The study population consisted of women who sustained an OASI at first birth and proceeded to a subsequent second birth in New South Wales (NSW) between 2001 and 2011. NSW is the most populous state in Australia, and with over 95,000 births occurring in 2011, it contributes to approximately one third of all Australian births [21]. Where a multiple pregnancy occurred, data pertaining to the first born infant were used for analysis.

Data sources and variables

Data sources consisted of two population-based previously validated data collections: the NSW Perinatal Data Collection (birth data) and the NSW Admitted Patients Data Collection (hospital data). The birth data are a legislated surveillance of demographic characteristics, pregnancy, and maternal and infant outcomes for all births in NSW ≥20 weeks gestation or ≥400g birthweight, with data recorded by the attending midwife or doctor. The hospital data collection is a census of all admissions to NSW hospitals, with diagnoses and procedures coded from clinical patient records according to the International Classification of Diseases, Australian Modification (ICD-10-AM) and the Australian Classification of Health Interventions (ACHI) [22, 23]. The NSW Centre for Health Record Linkage (CHeReL) undertook probabilistic longitudinal linkage of these two datasets using methods previously described [24], with de-identified data provided to researchers.

Obstetric anal sphincter injuries (OASIs) were identified from the hospital data by the ICD-10-AM diagnosis codes: ‘O70.2’ (third degree perineal laceration during delivery) or ‘O70.3’ (fourth degree perineal laceration during delivery), or by the ACHI procedure coding ‘16573-00’ (suture of third or fourth degree tear of the perineum) [22, 23]. With a sensitivity of 94.2 and a positive predictive value of 99.7, this combination of codes has been reported as the most reliable indicator for identifying OASIs for NSW population health data [25]. All OASI rates are reported among vaginal births.

Recognised risk factors for OASIs [5, 8, 16, 26-28] that were available in the population data were identified by the most reliable source as reported by previous validation studies [25, 29-31]. Birth data

were used to identify instrumental birth (forceps or vacuum), gestation, maternal age, infant sex and birthweight, epidural and/or spinal analgesia, induction or augmentation, and year of birth; while hypertension (pregnancy-induced or chronic), diabetes (gestational or diabetes mellitus) were identified exclusively from the hospital data. Asian ethnicity is a recognised risk factor for OASI [8]. As ethnicity is not available in the population data, country of birth as reported in the birth data was used to identify women of Asian background. Episiotomy was identified if reported by either birth or hospital data collections. Neither the birth nor hospital data specify the type of episiotomy, but typical Australian practice is to perform a mediolateral incision according to clinical perception of need.

Analyses

Firstly, we determined the first birth OASI rate among women having vaginal births who proceeded to a second birth. We then calculated the rates for second vaginal birth, intrapartum and pre-labour caesarean, and OASI recurrence. The OASI first birth rate and OASI recurrence rate were compared using McNemar's test of paired data.

Association of first and second birth factors with OASI recurrence.

Descriptive analysis was used to determine the distribution of birth factors from the first and second births among women with an OASI recurrence, and among those without. The crude odds ratios (cORs) were calculated. First birth risk factors that were considered included episiotomy, mode of birth, birthweight and analgesia/anaesthesia. As regional or general anaesthetic is recommended for OASI suturing to allow for repair without tension [32, 33], a combined analgesia/anaesthesia variable of epidural or spinal or general anaesthetic was created. In addition, diabetes and interpregnancy interval were included as they may influence healing after first OASI. Factors from the second birth were chosen for previously recognised association with OASI and included maternal age, hypertension, gestation, induction or augmentation, epidural analgesia, mode of birth, episiotomy, birthweight, infant sex and year of birth.

Factors with p values <0.25 for univariate association were entered into a multivariable logistic regression model. Backwards elimination with progressive removal of least significant variables was

undertaken with assessment by the log likelihood test, and checks undertaken to ensure that no removed variables introduced changes in odds ratios of >10%.

Association of first birth and second pregnancy factors with planned caesarean section for subsequent birth

Using information regarding labour onset, we categorised caesareans as pre-labour (recorded as 'no labour') or intrapartum (recorded as 'spontaneous labour' or 'induced'). Women who underwent a pre-labour caesarean were classified as 'planned caesarean'. Among the intrapartum caesarean group, some women may have been booked for a planned caesarean but commenced spontaneous labour prior to the planned date. These women were also classified as 'planned caesarean' if their medical record indicated that labour was not intended. Such indications included not having had an induction nor augmentation, and the reason for caesarean section not related to fetal distress nor failure to progress. All other women who laboured were classified as 'planned vaginal', including those from the intrapartum caesarean group who did have an induction or augmentation, or whose reason for caesarean was 'failure to progress' or 'fetal distress'.

The distribution of first birth factors potentially influential in decision-making for mode of second birth were compared between the 'planned vaginal' group and the 'planned caesarean' group. These included country of birth, maternal age, morbidity (diabetes or hypertension), gestation, induction/augmentation, analgesia/anaesthesia, instrumental birth, episiotomy, and birthweight, as well as interpregnancy interval. Multivariable logistic regression was then used to ascertain adjusted odds ratios (aOR) for factors that may be predictive of planned caesarean.

Ethics approval

Ethics approval was obtained from the NSW Population and Health Services Research Ethics Committee.

RESULTS

Among 141,894 primiparous women in NSW 2001-2011 with a vaginal first birth and a subsequent second birth, 6,380 (4.5%) sustained an OASI. Of these women, 4,808 (75.4%) proceeded to a

second vaginal birth, 1,238 (19.4%) to a pre-labour caesarean section, and 334 (5.2%) to an intrapartum caesarean. The OASI recurrence rate at second birth was 5.7% which was significantly higher than the first birth OASI rate ($p<0.01$) (Figure 1).

Association of first and second birth factors with OASI recurrence.

Recurrence was investigated among the 4,808 women with a vaginal second birth following an OASI at first birth. Following exclusion of records with missing data, 4,773 (99.3%) records were available for analysis. After adjustment, the only factor from the first birth associated with OASI recurrence was diabetes (aOR 1.82 95%CI 1.08, 3.07). Gestation at second birth of 37-38 weeks (compared with 39-40 weeks) was associated with a decreased odds of second OASI (aOR 0.56, 95% CI 0.37, 0.84), while birthweight ≥ 4.0 kg increased the likelihood of recurrence when compared with birthweights of 3.0-<3.5 kg (aOR 2.34 95% CI 1.67, 3.28) (Table 1). While instrumental birth overall showed no association with recurrence, a sensitivity analysis indicated that forceps at the second birth carried an association with OASI recurrence compared with a non-instrumental birth (aOR 2.17, 95% CI 1.01, 4.64) while vacuum extraction did not (aOR 1.06 95% CI 0.61, 1.81). However, these results were based on very few births, with only 64 women having a forceps birth (of which 8 sustained an OASI).

Association of first birth with planned caesarean section for subsequent birth

Among the 6,380 women who had an OASI at their first birth, 1,447 (22.7%) were planned for a caesarean for their subsequent birth. Among those planned for a vaginal birth, 125 (2.5%) had a caesarean section. After exclusion of records with missing data, 6,337 (99.3%) records were available for analysis. Following adjustment, the following first birth factors remained predictive of a planned Caesarean: non-Asian country of birth; maternal age ≥ 25 years; gestation <37 weeks; epidural, spinal or general anaesthetic; instrumental birth; birthweight ≥4.0kg; year of birth 2007-2011; and interpregnancy ≥3.0 years (Table 2).

DISCUSSION

Among women with a first and a second birth, we found a first birth vaginal OASI rate of 4.5% and an OASI recurrence rate of 5.7%. This recurrence rate sits within the range of 2.0% to 13.4% found in other studies [7, 11-18, 34-37]; with the majority, but not all [14, 15], reporting increased risk for

recurrence. Large population based cohort studies similar to ours demonstrate increases from first to second birth of 2.4% to 5.2% [13], 4.6% to 7.1% [16] and 1.9% to 3.7% [17]; and although the relative increases in risk are larger than that for our population, they are from lower first birth OASI rates.

Recurrence rates for other maternal conditions show higher relative increases in risk from one pregnancy to the next, for example, increase in postpartum haemorrhage rates from 5.8% at first birth to 14.8% at the second [38], pre-eclampsia rates from 4.1% to 14.7% [39], and breech presentations from 4.2% to 9.9% [40]. The lower relative increase for OASI recurrence rate compared to other conditions may be explained by altered management following a first birth with OASI. Given that 25% of births subsequent to a first birth OASI were by caesarean section, the pool of women at high risk for subsequent perineal trauma may have been reduced, with an unequal distribution of potential risk factors among women progressing to a second vaginal versus caesarean birth.

The decision around mode of delivery for second birth is challenging. Not only is risk of recurrence a consideration, but also whether a subsequent vaginal birth will worsen any symptoms or produce new problems, even in the absence of an OASI recurrence [41]. Our study has shown planned caesareans were more likely than planned vaginal births among women who were not Asian or were older than 25 years; if their first births were instrumental, or at gestation less than 37 weeks, or with regional or general anaesthetic; their first-born infants were greater than 4kg or born between 2007-2011 (compared with births which occurred 2001-2003); or had a longer interpregnancy interval. It is also likely that other factors associated with OASI but not available in routine population health data may have influenced decision-making, such as length of labour, infant position and shoulder dystocia.

The presence of ongoing symptoms following OASI are likely to have had an affect on decision-making as well. The results of a recent questionnaire completed by UK consultant obstetricians reported that they would be far more likely to advise women to have a caesarean section if they had ongoing symptoms (including incontinence of flatus or stool) following a first OASI than those without symptoms [42]. This is in agreement with the Royal College of Obstetricians and Gynaecologists Guideline [43]. Whether OASI recurrence is more likely among women with symptoms than those who are symptom free is not known, as most studies to date have not examined this association but have

focussed their outcomes on anal function and incontinence symptoms rather than recurrence per se [44]. While one small study concluded that 'antepartum assessment…did not prove useful in identifying women in whom a further third degree was likely to occur', it was based on only two cases of recurrence and is therefore not generalizable [45 p151]. With the relatively small increase between first occurrence and recurrence rates of 1.2% in the NSW population, women with predisposing risk factors for recurrence may in fact have delivered by caesarean at their subsequent birth. The lower recurrence rate reported in our population compared to other studies may relate to different decisions made about mode of delivery at second birth. As such the recurrence rate of 5.7% may not reflect the true risk of recurrence for all women who have had a first OASI.

First birth factors associated with recurrence have not previously been reported. Ours is the first study to report an effect of first birth diabetes on recurrence. Our finding of increased OASI recurrence risk with higher birthweight at the second birth is not surprising and is consistent with other studies [11, 13, 15-17, 36]. The only other factor we found to be associated with recurrence was gestation at second birth, with 37-38 weeks associated with reduced odds of an OASI recurrence. This may reflect pregnancies with other underlying complications. The apparently small number of predictive factors may also be related to the reduced population at risk of recurrence. Some women at increased risk of a recurrence will have delivered by caesarean section for their second birth, potentially resulting in a lower risk profile for those women who did proceed to a vaginal delivery. Women with large babies (≥4.0 kg) and inter-pregnancy intervals of 3 or more years were likely to have had a caesarean at second birth and it is therefore not surprising that these factors were not associated with recurrence among women with a second vaginal birth.

The results of this study demonstrate the complexity of counselling a woman approaching a second birth following a first birth OASI, when the option of a caesarean section may be being discussed. If a woman does progress to a second labour and vaginal birth, and requires oxytocin, an epidural, episiotomy or vacuum birth, the results from this large population study provide some reassurance that there is no increased risk for OASI recurrence. In addition, with only a small increase in OASI rates from one birth to the next and with a paucity of risk factors identified for recurrence, it appears that women who were at higher risk were appropriately being delivered by caesarean section.

Strengths and limitations of this study

Longitudinal linkage of these large population-based datasets allowed exploration of the association of first and second birth factors and obstetric interventions with a subsequent adverse outcome. Our data allowed us to identify consecutive births, and exclude the small number of women who birthed outside NSW for either their first or second birth. Records that were excluded due to missing data were small in number (less than 1%), and the variables we used for analysis have previously been validated as reliably and accurately reported [25, 29-31]. The analysis was limited by having no information available on the influence of symptoms, personal preference or other factors that may have affected clinical decision-making for the second birth mode. There is also possibility of increased vigilance in detection and reporting of a subsequent adverse outcome. We have demonstrated in another study that recorded history of postpartum haemorrhage was associated with an increased risk of reporting a recurrent event, however recurrence rates approximated the true recurrence [46].

CONCLUSION

We have demonstrated that for women who proceed to a subsequent vaginal birth the recurrence risk of OASI is approximately 1 in 20, and not markedly higher than the risk for an OASI at first birth. Significant risk factors for OASI recurrence included diabetes recorded at first birth and large infant birthweight at second birth. The profile for women having a planned caesarean section differed from those who planned to deliver vaginally, which likely influenced the OASI recurrence rate.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

AJA participated in study design, performed the statistical analysis, participated in interpretation, and drafted the manuscript. CLR contributed to study conception and design, statistical interpretation, and manuscript revision. JMM contributed to study conception, design and interpretation. JBF contributed to study conception and design, interpretation and manuscript revision. All authors read and approved the final manuscript.

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Table 1 - Factors associated with OASI recurrence at second vaginal birth, 2001–2011

		OASI at 2nd birth n=276 (5.7%)	No OASI at 2nd birth n=4532 (94.3%)	p	Cr ORs	Adj ORs
Country of birth	Asian	47 (17.2)	910 (20.2)	0.23	0.82 [0.60, 1.13]	NR
FIRST BIRTH FACTORS						
Diabetes		17 (6.2)	174 (3.8)	0.06	1.64 [0.98, 2.75]	1.82 (1.08, 3.07)
Epidural/spinal/general		109 (39.5)	1993 (44.0)	0.14	0.82 [0.64, 1.05]	NR
Birth mode	Instrumental	120 (43.5)	2007 (44.3)	0.79	0.97 (0.76, 1.24)	NE
Episiotomy		121 (43.8)	1939 (42.8)	0.73	1.04 [0.82, 1.33]	NE
Birthweight(kg)	<3.0	29 (10.5)	462 (10.2)	0.34	1.08 [0.70, 1.66]	NE
	3.0 - <3.5	95 (34.4)	1636 (36.1)		Reference	
	3.5 - <4.0	119 (43.1)	1749 (38.6)		1.17 [0.89, 1.55]	
	≥ 4.0	33 (12.0)	685 (15.1)		0.83 [0.55, 1.25]	
Inter pregnancy interval (years)	< 1	50 (18.1)	1020 (22.5)	0.39	0.76 [0.52, 1.13]	NE
	1-<2	126 (45.7)	1926 (42.5)		1.02 [0.74, 1.40]	
	2-<3	59 (21.4)	919 (20.3)		Reference	
	≥ 3	41 (14.9)	666 (14.7)		0.96 [0.64, 1.45]	
SECOND BIRTH FACTORS						
Mat age	<25	29 (10.5)	550 (12.1)	0.61	0.87 [0.58, 1.30]	NE
	25-34	189 (68.5)	3110 (68.6)		Reference	
	≥35	58 (21.0)	872 (19.2)		1.09 [0.81, 1.48]	
Hypertension	Yes	16 (5.8)	161 (3.6)	0.05	1.67 [0.99, 2.84]	NR
Gestation (wks)	<37	4 (1.5)	155 (3.4)	<0.01	0.36 [0.13, 0.99]	0.69 [0.23, 2.06]
	37-38	29 (10.5)	840 (18.5)		0.49 [0.33, 0.73]	0.56 [0.37, 0.84]
	39-40	197 (71.4)	2779 (61.3)		Reference	Reference
	≥41	46 (16.7)	757 (16.7)		0.86 [0.62, 1.19]	0.73 [0.52, 1.02]
Induction/Augmentation		143 (51.8)	2428 (53.6)	0.57	0.93 [0.73,1.19]	NE
Epidural		48 (17.4)	892 (19.7)	0.35	0.86 [0.62, 1.18]	NE
Birth mode	Instrumental	24 (8.7)	289 (6.4)	0.13	1.40 (0.91, 2.16)	NR
Episiotomy		68 (24.6)	1180 (26.0)	0.61	0.93 [0.70, 1.23]	NE
Infant sex	Male	158 (57.3)	2208 (48.7)	0.06	1.27 [1.00, 1.63]	NR
Birthweight(kg)	<3.0	14 (5.1)	543 (12.0)	<0.01	0.54 [0.30, 0.96]	0.62 [0.33, 1.15]
	3.0 - <3.5	80 (29.0)	1675 (37.0)		Reference	Reference
	3.5 - <4.0	107 (38.8)	1653 (36.5)		1.36 [1.01, 1.83]	1.33 [0.99, 1.80]
	≥ 4.0	75 (27.2)	658 (14.5)		2.39 [1.72, 3.31]	2.34 [1.67, 3.28]
Year of second birth	01-05	68 (24.6)	1098 (24.2)	0.24	Reference	NR
	06-08	87 (31.5)	1643 (36.3)		0.86 [0.62, 1.19]	
	09-11	121 (43.8)	1791 (39.5)		1.09 [0.80, 1.48]	

Adjusted for all variables with statistically significantly aORs presented in table
Comparison group (reference) is women without the risk factor unless otherwise stated
NE=Not entered in model
NR=Not retained in model

Table 2 - Association of first birth factors with planned caesarean section at second birth following OASI at first birth

		Planned CS n=1447 (22.7%)	Planned Vaginal n=4933 (77.3%)	p	crOR	aOR
Country of birth	Asian	202 (14.0)	979 (19.9)	<0.01	0.66 (0.56, 0.77)	0.73 (0.61, 0.87)
Age	<25	295 (20.4)	1196 (24.2)	<0.01	0.81 (0.70, 0.93)	0.81 (0.70, 0.94)
	25-34	1036 (71.6)	3394 (68.8)		ref	ref
	≥35	116 (8.0)	343 (7.0)		1.11 (0.89, 1.38)	1.00 (0.80, 1.27)
Diabetes		70 (4.9)	200 (4.1)	0.19	1.20 (0.91, 1.59)	NR
Hypertension		133 (9.2)	430 (8.7)	0.58	1.06 (0.86, 1.30)	NE
Gestation (weeks)	<37	34 (2.4)	84 (1.7)	<0.01	1.49 (0.99, 2.23)	1.72 (1.11, 2.67)
	37-38	160 (11.1)	621 (12.6)		0.95 (0.78, 1.15)	1.02 (0.84, 1.25)
	39-40	782 (54.0)	2870 (58.2)		ref	ref
	≥41	471 (32.6)	1357 (27.5)		1.27 (1.12, 1.45)	1.15 (1.00, 1.32)
Induction/augmentation		1064 (73.5)	3352 (68.0)	<0.01	1.31 (1.15, 1.49)	NR
Epidural/spinal or GA		915 (63.2)	2185 (44.3)	<0.01	2.16 (1.92, 2.44)	1.88 (1.65, 2.14)
Birth mode	Instrumental	815 (56.3)	2209 (44.8)	<0.01	1.59 (1.41, 1.79)	1.21 (1.06, 1.38)
Episiotomy		718 (49.6)	2121 (43.0)	<0.01	1.31 (1.16, 1.47)	NR
Birthweight (kg)	<3.0	130 (9.0)	504 (10.2)	<0.01	1.10 (0.88, 1.37)	1.09 (0.86, 1.38)
	3.0-<3.5	417 (28.8)	1772 (35.9)		ref	ref
	3.5-<4.0	562 (38.8)	1918 (38.9)		1.25 (1.08, 1.44)	1.16 (1.00, 1.34)
	≥4.0	337 (23.3)	739 (15.0)		1.94 (1.64, 2.29)	1.68 (1.41, 2.00)
Year of birth	01-03	451 (31.2)	1689 (34.2)	0.09	ref	ref
	04-06	543 (37.5)	1777 (36.0)		1.14 (0.99, 1.32)	1.15 (0.99, 1.32)
	07-11	453 (31.3)	1467 (29.7)		1.16 (1.00, 1.34)	1.24 (1.06, 1.45)
Interpregnancy interval	<1	291 (20.1)	1094 (22.2)	0.04	0.91 (0.76, 1.09)	0.89 (0.74, 1.08)
(years)	1-<2	601 (41.5)	2099 (42.6)		0.98 (0.84, 1.15)	0.96 (0.81, 1.13)
	2-<3	292 (20.2)	999 (20.3)		ref	ref
	≥3	263 (18.2)	740 (15.0)		1.22 (1.00, 1.47)	1.31 (1.08, 1.60)

Adjusted for all variables with statistically significantly aORs as presented in table
Comparison group (reference) is women without the risk factor unless otherwise stated
NE=Not entered in model
NR=Not retained in model

Figure 1 – OASI rates and mode of second birth among women with an OASI at first birth