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Rates and predictors of caesarean section for first and second births: a prospective cohort of Australian women

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Running Title: Caesarean births in Australia

Abstract

Objective To determine rates of vaginal delivery, emergency caesarean section, and elective caesarean section for first and second births in Australia, and to identify maternal predictors of caesarean section.

Methods Data were from the Australian Longitudinal Study on Women's Health. A total of 5275 women aged 18-38 years, who had given birth to their first child between 1996 and 2012 were included; 75.0% (n=3956) had delivered a second child. Mode of delivery for first and second singleton birth(s) was obtained from longitudinal survey data. Socio-demographic, lifestyle, anthropometric and medical history variables were tested as predictors of mode of delivery for first and second births using multinomial logistic regression.

Results Caesarean sections accounted for 29.1% (n=1535) of first births, consisting of 18.2% emergency and 10.9% elective caesareans. Mode of delivery for first and second births was consistent for 85.5% of women (n=3383) who delivered both children either vaginally or via caesarean section. Higher maternal age and body mass index, short-stature, anxiety and having private health insurance were predictive of caesarean section for first births. Vaginal birth after caesarean section was more common in women who were older, short-statured, or had been overweight or obese for both children, compared to women who had two vaginal deliveries.

Conclusions for Practice Rates of caesarean section in Australia are high. Renewed efforts are needed to reduce the number of unnecessary caesarean births, with particular caution applied to first births. Interventions could focus on elective caesareans for women with private health insurance or a history of anxiety.

Keywords Birth, caesarean, delivery, elective, emergency, labour, vaginal

Significance

What is already known on this subject?

Rates of caesarean section in Australia and internationally are high; much higher than should be medically indicated. Caesarean section carries risks for mother and child, and increases healthcare costs of birth dramatically.

What this study adds?

Strength to the argument that we have an important evidence-practice gap in obstetrics that requires review, at the individual, clinician, and national health policy levels. From our extensive list of maternal predictors of caesarean section, private health insurance and a diagnosis of anxiety were predictors of elective, but not emergency, caesarean section.

Introduction

There is no question that having access to caesarean section when needed can help reduce maternal and fetal morbidity and mortality related to a range of obstetric complications.

Historically, the World Health Organization (WHO) recommended that caesarean sections should not account for more than 10-15% of all births.(1) WHO have recently revised their position to state *“Every effort should be made to provide caesarean sections to women in need, rather than striving to achieve a specific rate”*.(2) In spite of abandoning the rate recommendation, there is good evidence from a WHO systematic review of ecological studies that a caesarean section rate of up to 10-15% at the population level achieves the desired reduction in maternal, neonatal and infant mortality.(2, 3) One further ecological study with data for 172 countries was published after the WHO systematic review. Molina *et al.* (2016) suggest the lowest rate of maternal and neonatal mortality is at 19 caesarean deliveries per 100 livebirths.(4)

International rates of caesarean section have continued to increase over time.(5, 6) China now has the highest rate of caesarean section at 46% in 2007-2008.(7) In the United States and Australia, one third of all deliveries are via caesarean section; (8, 9) this figure is slightly lower in the United Kingdom at 26%. Further work is required to understand the effects of caesarean section rates on outcomes other than mortality, including maternal and perinatal morbidity, paediatric outcomes, and psychological or social well-being.(2) Another consideration is cost. Caesarean sections cost more at both the individual and national level.(10) Under universal healthcare cover in Canada, it costs at least 45% more for a caesarean section compared to vaginal delivery (11) and in China the cost per birth is double.(12)

With the goal of reducing the number of unnecessary caesarean sections at the population level and to help clinicians make informed decisions at the patient level, we need to understand who has a caesarean section and why? Population-based data may also assist

in guiding policies around government subsidies for caesarean births. Despite a deluge of literature describing rates and predictors of caesarean sections there are limited opportunities to follow the same woman longitudinally throughout her reproductive years, linking data for first and subsequent births. Hence, our study specifically aimed to determine the rates of vaginal delivery, emergency (unplanned) caesarean section, and elective (planned) caesarean section for first and second births in Australian women, and to identify the multivariable maternal predictors of caesarean section for first and second births.

Methods

Sample

Data were obtained from women born 1973-78 participating in the Australian Longitudinal Study on Women's Health (ALSWH), which is an ongoing, nationally representative prospective study. In 1996 women were randomly sampled via the Medicare database, with intentional oversampling of women in non-urban locations. Medicare is the universal healthcare system, which covers all citizens and permanent residents in Australia. Data were collected for the 1973-78 cohort via mailed, self-report surveys, at roughly three year intervals: in 1996 (when the women were aged 18-23 years), 2000 (22-27 years), 2003 (25-30 years), 2006 (28-33 years), 2009 (31-36 years) and 2012 (34-39 years). Further information on the establishment of ALSWH has been reported elsewhere (13, 14). Ethics approvals for the ALSWH were received from the University of Newcastle (H-076-0795) and University of Queensland (200400224) and all participants provided informed consent. To be eligible for the current analyses women had to have reported at any survey a singleton first birth, $\pm$ a singleton second birth, and to have completed a survey (up to three years) prior to the first birth.

Primary outcome: mode of delivery

At the 2006, 2009 and 2012 surveys women reported the dates of birth of all their children and for each child indicated whether they had experienced a series of events during childbirth. Mode of delivery was defined as: elective caesarean when women indicated they had received a 'caesarean section before going into labour'; emergency caesarean when they indicated a 'caesarean section after labour started'; and vaginal delivery when caesarean section had not been reported. Data were from the first available survey following the child's birth to minimise recall bias.

Explanatory variables

Eighteen potential predictors of mode of delivery for first births were considered, including a range of sociodemographic, lifestyle, anthropometric, and medical factors. Measures were self-reported in the survey immediately preceding the date of birth of the first child (mean 1.5 $\pm$ SD 0.9 years). For example, explanatory variables from Survey 2 in 2000 were used for a baby born in February 2002. Changes in body mass index (BMI) and in the diagnosis of diabetes, hypertension, anxiety, and depression were considered for those reporting a second birth (i.e. the data from two surveys were used to derive these variables).

Sociodemographic factors

Sociodemographic factors included maternal age, area of residence, relationship status, education, employment, monetary stress, and private health insurance. Area of residence was classified by ARIA+, a widely used measure of geographic remoteness, identifying locations as major cities, inner regional, outer regional, and remote.⁽¹⁵⁾ Relationships were defined as married, living in a *de facto* (cohabitating) relationship, and not partnered, including those separated, divorced or widowed. Highest educational level achieved was categorised as up to 11 years of school; 12 years of school, trade or apprenticeship; certificate or diploma; or a university degree. Employment was dichotomised as in paid work or not. Hours worked was categorised as none, part-time, full-time, or overtime. Monetary

stress was assessed by the question, 'Over the last 12 months, how stressed have you felt about money?' Stressed was defined as a response of 'very stressed' or 'extremely stressed'; not stressed about money was defined as 'not at all stressed', 'somewhat stressed', or 'moderately stressed'. Private health insurance status was reported as yes or no.

Lifestyle factors

Lifestyle factors included smoking status, usual alcohol intake, and level of exercise. Smoking status was defined as non-smoker, ex-smoker, or current smoker. Usual quantity and frequency of standard alcoholic drinks consumed were used to categorise alcohol intake as no alcohol, up to two drinks per day and less than seven drinks per week, or more. Total time spent walking briskly, in moderate leisure activity, and vigorous leisure activity was used to classify level of exercise as none or sedentary, low, moderate, or heavy.(16)

Anthropometry

Self-reported height was used to determine short-stature, defined as less than 157 centimeters. BMI was calculated using non-pregnant weight and height, and categorised as underweight ($<18.5 \text{ kg/m}^2$), healthy weight ($18.5\text{-}24.99 \text{ kg/m}^2$), overweight ($25\text{-}29.99 \text{ kg/m}^2$), or obese ($>30 \text{ kg/m}^2$), according to the WHO classifications.(17) There was a high level of missing BMI data (19%), because prior to Survey 4 in 2006 it was unclear whether women who were currently pregnant were reporting their pre-pregnancy weight or current weight while pregnant. Given this uncertainty weight data was set to missing for women who were currently pregnant at Surveys 1-3 (1996-2003). Statistical analyses were performed including the available BMI data and a sensitivity analysis was performed excluding BMI data.

Medical history

Women were asked to report how stressed they felt about their health, and diagnoses or treatment for depression, anxiety, diabetes and hypertension. Responses to 'Over the last 12 months, how stressed have you felt about your own health?' were grouped as stressed for those 'very stressed' or 'extremely stressed', and not stressed for those who responded 'not at all stressed', 'somewhat stressed', or 'moderately stressed'. Depression and anxiety were separately recorded from self-reported diagnosis or treatment for these conditions.

Women who reported being diagnosed or treated for gestational diabetes, insulin dependent (Type I) diabetes, or non-insulin dependent (Type II) diabetes were defined as having a diagnosis of diabetes. Similarly, those who reported hypertension, pre-existing or during pregnancy, were recorded as having a diagnosis of hypertension.

Statistical analysis

Rates of vaginal delivery, emergency caesarean section, and elective caesarean section for first and second births were calculated. Sociodemographic, lifestyle, anthropometric and medical history variables were tested as univariate predictors of mode of delivery for the first birth using chi-square tests. Multivariable (i.e. multiple explanatory variables) multinomial (i.e. three discrete outcomes) logistic regression was used to estimate the odds of having an emergency caesarean or an elective caesarean, compared to vaginal delivery as the reference, for first births. The final models only included explanatory variables where the p-value was less than 0.05, except for area of residence which was included to adjust for the overrepresentation of women from rural and remote areas.

For women who had two children, mode of delivery was classified as 1) vaginal for both births, 2) vaginal for the first birth and caesarean for the second birth, 3) caesarean for the first birth and vaginal for the second birth, or 4) caesarean for both births and a chi-square test was performed. Multivariable multinomial logistic regression was used to estimate the odds for each combination of delivery, relative to vaginal delivery for both births. Explanatory

variables for these models were generally measured before the first birth, except that changes in the diagnosis of diabetes, hypertension, anxiety, and depression were considered, and overweight (BMI of $\geq 25\text{kg/m}^2$) was classified as non-existent, existent for both children, or new for the second child. Statistical analyses were conducted using SAS version 9.3.

Results

This paper presents data from 5275 women aged 18-38 years who had given birth to their first child between 1996 and 2012. Vaginal deliveries accounted for 70.9% (n=3740) of singleton first births. Caesarean sections accounted for 29.1% (n=1535) of singleton first births, consisting of 18.2% (n=958) emergency caesareans and 10.9% (n=577) elective caesareans.

For women who had two singleton births (n=3956), 67.4% (n=2666) had vaginal deliveries for both, 6.7% (n=266) had a vaginal first birth and caesarean second birth, 7.8% (n=307) had caesarean first birth and vaginal second birth, and 18.1% (n=717) had a caesarean for both (chi-square $p < 0.001$). In total, caesarean sections accounted for 24.8% (n=983) of second births, consisting of 5.7% (n=227) emergency caesareans and 19.1% (n=577) elective caesareans. The mode of delivery for first and second births was consistent for 85.5% (n=3383) women delivering both children either vaginally or via caesarean section. Specifically, 90.9% (n=2666/2932) of women who had a vaginal delivery for their first birth also had a vaginal delivery for their second. Seventy percent (n=717/1024) of women who had a caesarean section for their first birth also had a caesarean section for their second.

Predictors of caesarean section for first births

Higher maternal age and holding private health insurance were each associated with having a caesarean section (Table 1), either emergency or elective. Women who had caesarean sections for their first births were also more likely to be short-statured, overweight, or obese.

Despite the low prevalence of diabetes, it was significantly associated with having a caesarean section.

Differences between the predictors of elective and emergency caesarean sections

Women living in major cities, married and more educated women, and those who were less stressed about money were more likely to have an elective caesarean, but not an emergency caesarean, compared to vaginal delivery (Table 1). Additionally, women who reported a diagnosis of anxiety or hypertension were also more likely to have an elective, but not emergency, caesarean section compared to a vaginal delivery. The only univariate predictor that was associated with emergency caesarean and not elective caesarean was hours worked. A higher proportion of women who had an emergency caesarean section reported working overtime, and correspondingly a lower proportion reported working part-time.

Multivariable multinomial models

The multivariable multinomial logistic regression model for emergency and elective caesareans versus vaginal delivery for first births is shown in Table 2. Women in their thirties had about twice the odds of having an emergency or elective caesarean, compared to younger women. Overweight ($\text{BMI} \geq 25\text{kg/m}^2$) and short-statured women were also more likely to have a caesarean section. Women with private health insurance and those diagnosed with anxiety had higher odds of an elective caesarean, but not an emergency caesarean.

Sensitivity analysis: missing BMI data

Due to the high levels of missing BMI data ($n=840$), the multivariable multinomial logistic regression models were repeated excluding BMI. The results for Table 2 were similar except that anxiety was no longer a significant predictor of elective caesarean section and women with diabetes had higher odds of an elective caesarean (OR 2.50; 95% CI 1.51-4.15).

Caesarean sections and second births

After the second birth one third (32.6%, n=1290) of all women had received one or more caesarean sections. Nine per cent (n=266) of women who had a vaginal delivery for their first birth had either an elective caesarean (n=173) or an emergency caesarean section (n=93) for their second birth. Table 3 uses vaginal deliveries for first and second births as the reference category. Overweight for both children was the only significant predictor of vaginal then caesarean delivery.

Thirty per cent (n=307) of women who had a caesarean section for their first birth then had a vaginal delivery for their second: of these, n=158 women had an emergency caesarean for their first birth and n=149 had an elective caesarean. Higher maternal age, short-stature, and being overweight for both children were the significant predictors of having a vaginal delivery after caesarean section relative to women who had two vaginal deliveries (Table 3). However, being overweight for both children was also associated with an increased odds of caesarean section after vaginal delivery and repeat caesarean section.

Of the 958 women who had an emergency caesarean section for their first birth, 83.5% had an elective caesarean (n=430) or an emergency caesarean section (n=370) for their second birth. Of the 577 women who had an elective caesarean section for their first birth, 74.2% had an elective caesarean (n=366) or an emergency caesarean section (n=62) for their second birth. The significant predictors of having two caesarean sections compared to two vaginal deliveries were higher maternal age, having private health insurance, short-stature, being overweight for both children, and having hypertension before the birth of their second child.

After excluding change in overweight (n=722) due to missing BMI data, women with existing diabetes or newly diagnosed diabetes had higher odds of two caesarean births: OR 1.84; 95% CI 1.02-3.30 and OR 1.74; 95% CI 1.12-2.72, respectively. Private health insurance was no longer a significant predictor of two caesarean births.

Discussion

Main findings

Caesarean sections accounted for 29% of first, singleton births in our population-based cohort of Australian women aged 18-38 years. After their second birth, one third of the same cohort of women reported having had a caesarean section for one or more births. These figures are in line with national perinatal statistics for the timeframe covered by this study, but have the advantage of being longitudinal, rather than cross-sectional. Rates of caesarean section in Australia have steadily increased from 19.5% in 1996(18) to 32% in 2012.(19) We have shown that mode of delivery for the first birth is strongly predictive of mode of delivery for the subsequent birth. Hence, efforts to reduce unnecessarily high caesarean rates should focus on facilitating vaginal deliveries for primiparous women, unless it is medically unsafe.

At the univariate level primiparous women living in major cities, who were married, more educated, and less stressed about money, and those who reported a diagnosis of anxiety or hypertension, were more likely to have an elective (planned) caesarean section compared to vaginal delivery, but not an emergency (unplanned) caesarean. At the multivariate level higher maternal age, higher BMI and short-stature were the common predictors of caesarean section (either emergency or elective) for first births. Interestingly, private health insurance and a diagnosis of anxiety increased the odds of an elective, but not emergency, caesarean section for first births in the adjusted model. These predictors of elective caesarean may highlight areas where alternatives could be both safer and more economical. For example, effective treatment of prenatal anxiety could assist women to opt for a vaginal rather than caesarean delivery. The role of private health insurance in the decision-making for caesarean section warrants further research.

Strengths and limitations

This study includes a large, broadly representative sample of Australian women, where data on mode of delivery and the maternal predictors have been measured prospectively and repeatedly over a 17-year period. This adds to the available literature on caesarean section, because it is difficult to collect or access data for the same woman over multiple pregnancies, hence studies tend to be cross-sectional or retrospective cohorts. Due to the timing of the ALSWH surveys, the predictor variables included in our analyses may have been reported up to three years prior to the first reported birth. While our list of maternal predictors can only go some way towards explaining why women might be receiving caesarean sections, it is among the most comprehensive of the currently published literature,(20) and has the advantage of covering first and second births sequentially, which has rarely been accomplished. We have taken a population-based approach and have not been able to determine what clinical factors may have been involved at the individual level.

The quality of self-reported longitudinal survey data is something that is routinely questioned. However, data linkage work within our own group has repeatedly demonstrated good agreement between the ALSWH self-reported data and more objective medical records for a large number of pregnancy and birth-related variables.(21, 22) Furthermore, in a UK population-based cohort study (Millennium Cohort) of 12,391 singleton infants, Quigley *et al.* (2007) demonstrated almost no (0.1%) discrepancies in the reliability of self-reported vaginal delivery compared to hospital records.(23) There was a higher rate of discrepancies in elective versus emergency caesarean sections at 10.7%. However, when they explored which factors were associated with disagreement between self-report and medical records more generally, there was no association with age at delivery, marital status, occupation, education or ward type.(23) First births were associated with slightly more disagreement (2.5% versus 1% for other births), as was ethnicity/speaking a language other than English at home.(23) Members of our group have also demonstrated that while attrition within the

1973-78 birth cohort is nonrandom and related to poorer health, the biases do not preclude meaningful longitudinal analyses.(24)

Interpretation

This paper provides a timely reminder for clinicians and health policy makers to review what has become a clear evidence-practice gap in obstetric care, within Australia and internationally. Caesarean section rates in Australia and other developed countries are generally two to three times higher than should be medically necessary. Our interpretation of these population-based data is that the focus should be on facilitating vaginal first births, unless it is unsafe to do so. This is because of the very strong correlation between mode of birth for first and second births, in combination with evidence from the literature that an elective recurrent caesarean section is safer for the baby than vaginal birth after caesarean. Specifically, Crowther *et. al.* (2012) have reported on a large number of health outcomes for women having a planned vaginal birth or elective repeat caesarean in a cohort of 2345 Australian women who had one prior caesarean.(25) They showed that elective recurrent caesarean section was associated with better fetal outcomes, including a lower risk of fetal death, liveborn infant death prior to discharge, and serious infant outcome (number needed to treat to benefit 66; 95% CI 40-200).(25)

Efforts to modify both patient preference and clinician behaviour are needed to lower the excessively higher rates of caesarean section, in Australia and internationally. Current practice is likely to reflect a combination of fear of litigation and claims of malpractice, clinician beliefs and experiences, patient preferences, and/or financial incentives, rather than best-practice medicine.(26, 27) At the population level, excesses in morbidity for mother and baby, in addition to high healthcare expenses are the likely result.

Private Health Insurance

Private health insurance in Australia is optional, because we also have universal health cover, known as Medicare. However, since 1997 the federal Government has introduced

strong tax-incentives to encourage higher income earners to take up private health insurance. Healthcare received in the private health system, including the management of labour and delivery, is subsidised by Medicare at 75% of the public fee included under the Medicare Benefits Schedule.(28) Using pre-post data, Einarsdottir *et. al.* (2012) identified an increase in the caesarean section rate with the national policy reforms implemented as part of the Australian Private Health Insurance Incentive in 1997–2000. A post-policy increase of 5% (rate difference) was observed for emergency caesarean sections and an increase of 10% was observed for elective caesarean sections, and length of stays in hospital increased for infants. These data highlight how private health insurance policy reforms may inadvertently increase demands and costs on public health resources, without improving the quality of healthcare delivered to patients. We also highlight that there is tax-payer burden from unnecessary caesarean sections, whether they are performed in the public or private sector in Australia, because the patient and/or private health insurer does not cover the full cost of the procedure and associated follow-up care.

Anxiety

Fear of childbirth is associated with anxiety (adjusted OR 4.8; 95% CI 4.1-5.7)(29) and it is the most common reason for women requesting an elective caesarean section.(30) In a study of Norwegian women with a fear of birth and concurrent request for a caesarean, counselling style was shown to predict a change in the request for caesarean section to giving birth vaginally.(31) Specifically, emphasis on the ability to overcome any emotional obstacle to vaginal birth ('coping attitude') reduced the desire for caesarean section compared to the 'autonomy attitude' where the counsellor communicated that vaginal birth was best for mother and baby but the ultimate choice of mode of birth was the woman's.(31) Providing women with clear information about the risks and benefits of having a caesarean section to facilitate informed consent for the procedure may not be sufficient to change patient preference. Clinicians may benefit from reflecting on their own motivations, beliefs and counselling strategies to best support women to feel confident to birth vaginally.

Conclusion

This study adds to the available literature on caesarean section, because it is difficult to collect or access health and lifestyle information and birth outcome data for the same woman over multiple pregnancies. From the comprehensive list of maternal predictors of caesarean section explored in this study, private health insurance and diagnosis or treatment for anxiety were two factors predictive of elective, but not emergency, caesarean section. Private health insurance and maternal anxiety may be seen as key targets for strategies to reduce high rates of caesarean section, since the other predictors may be more indicative of medical necessity.

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Disclosure of interests

No conflicts of interest to declare, financial or otherwise.

Contribution to authorship

AH, JP, CC, and DL made substantial contributions to the conception and design of the study, interpretation of the data and have given approval for the final manuscript. JP conducted the statistical analysis. AH and JP drafted the manuscript.

Details of ethics approval

The ALSWH has been granted ethics clearance by the Universities of Newcastle and Queensland (Approvals: H0760795 and 2004000224; 26 July 1995).

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Table 1. Characteristics^a of women from the Australian Longitudinal Study on Women's Health who had caesarean section versus vaginal delivery for first singleton births (n=5275)

	Total N	Vaginal delivery n=3740 %	Emergency caesarean n=958 %	Emergency caesarean vs. vaginal P-value ^b	Elective caesarean n=577 %	Elective caesarean vs. vaginal P-value ^b
Maternal age (years)						
18-24	888	19.7	11.0	<.001	8.0	<.001
25-29	2052	39.8	38.9		33.1	
30-34	2014	35.8	41.1		48.7	
35-38	321	4.7	8.9		10.2	
Area of residence						
Major cities	2973	54.3	58.6	0.09	67.2	<.001
Inner regional	1368	27.1	25.2		19.8	
Outer regional	748	15.1	12.8		11.1	
Remote	176	3.5	3.4		1.9	
Relationship status						
Married	3054	56.9	58.9	0.26	62.9	0.02
De facto	1272	24.4	24.7		21.5	
Single ^c	944	18.7	16.4		15.6	
Education						
< 12 years	456	9.2	7.4	0.24	7.4	0.01
12 years or trade	1213	23.7	22.9		18.5	
Certificate or diploma	1141	21.6	21.4		22.2	
University	2463	45.5	48.3		51.8	
Employed						
Yes	4814	91.3	92.5	0.20	92.4	0.38
No	441	8.7	7.5		7.6	
Hours worked						
None	441	8.9	7.6	0.02	7.8	0.22
Part-time	945	19.2	15.8		16.6	
Full-time	1897	36.6	37.0		36.8	
Overtime	1886	35.3	39.6		38.9	
Stressed about money						
Yes	905	17.8	17.0	0.52	13.9	0.02
No	4343	82.2	83.0		86.1	
Private health insurance						
Yes	2833	50.8	55.7	0.01	69.5	<.001
No	2442	49.2	44.3		30.5	
Smoking status						
Non-smoker	4235	80.5	80.1	0.82	84.0	0.08
Ex-smoker	494	9.8	9.5		7.1	
Current smoker	513	9.8	10.4		8.9	
Drinks consumed before birth						
None	466	9.1	8.3	0.72	9.2	0.40
Up to 2/day and <7/week	2556	48.7	49.7		51.6	
More	2172	42.2	42.0		39.3	
Exercise level						
Sedentary	556	10.5	10.6	0.14	11.9	0.55
Low	1854	36.7	32.8		34.0	
Moderate	1174	22.2	24.5		22.2	
Heavy	1611	30.6	32.1		31.9	
Short stature (centimetres)						
<157	487	7.9	13.0	<.001	12.4	0.001
157 or more	4730	92.1	87.0		87.6	

	Total N	Vaginal delivery n=3740 %	Emergency caesarean n=958 %	Emergency caesarean vs. vaginal P-value ^b	Elective caesarean n=577 %	Elective caesarean vs. vaginal P-value ^b
Body mass index ^d (kg/m ²)						
Underweight (<18.5)	200	5.3	2.3	<.0001	3.5	<.0001
Healthy weight (18.5-24.99)	2821	65.7	60.1		56.5	
Overweight (25-29.99)	968	20.8	23.9		24.6	
Obese (≥30)	446	8.2	13.7		15.5	
Stressed about own health						
Very or extremely	327	6.1	6.4	0.76	6.6	0.65
Not	4948	93.9	93.6		93.4	
Diagnosed with depression ^e						
Yes	795	15.1	17.0	0.15	16.5	0.13
No	4211	84.9	83.0		83.5	
Diagnosed with anxiety ^e						
Yes	410	7.6	7.8	0.81	12.6	<.001
No	4586	92.4	92.2		87.4	
Diagnosed with diabetes						
Yes	105	1.5	2.5	0.05	4.2	<.001
No	5170	98.5	97.5		95.8	
Diagnosed with hypertension						
Yes	361	6.5	6.4	0.88	9.9	0.005
No	4914	93.5	93.6		90.1	

^a Data from up to three years before the birth.

^b Chi² tests comparing women who had emergency or elective caesarean versus vaginal delivery.

^c Includes separated, divorced, and widowed.

^d 16% missing data.

^e 5% missing data.

Table 2. Multivariable multinomial logistic regression model^a for elective or emergency caesarean section versus vaginal delivery for first singleton births in the Australian Longitudinal Study on Women's Health (N=5275)

	Emergency caesarean Odds ratio (95% CI)	Elective caesarean Odds ratio (95% CI)
Maternal age (years)		
18-24	reference	reference
25-29	1.48 (1.10-1.98)	1.30 (0.88-1.93)
30-34	1.77 (1.32-2.39)	1.77 (1.20-2.61)
35-38	2.86 (1.94-4.22)	2.40 (1.48-3.91)
Body mass index ^b (kg/m ²)		
Underweight (<18.5)	0.51 (0.31-0.84)	0.76 (0.45-1.31)
Healthy weight (18.5-24.99)	reference	reference
Overweight (25-29.99)	1.23 (1.01-1.49)	1.37 (1.09-1.74)
Obese (>30)	1.79 (1.39-2.30)	2.17 (1.62-2.91)
Short stature (centimetres)		
157 or more	reference	reference
<157	1.75 (1.35-2.26)	1.67 (1.22-2.28)
Diagnosed with anxiety		
No	reference	reference
Yes	0.86 (0.64-1.15)	1.39 (1.03-1.89)
Private health insurance		
No	reference	reference
Yes	1.02 (0.86-1.21)	1.68 (1.35-2.09)

^a Also adjusted for area of residence due to method of sampling.

^b 16% missing data.

Table 3. Multivariable multinomial logistic regression model^a for first and second singleton births (total N=3956) versus vaginal deliveries for both children (n=2666) in the Australian Longitudinal Study on Women's Health

	Vaginal / caesarean n=266 Odds ratio (95% CI)	Caesarean / vaginal n=307 Odds ratio (95% CI)	Caesarean / caesarean n=717 Odds ratio (95% CI)
Maternal age for first child (years)			
18-24	reference	reference	reference
25-29	0.97 (0.64-1.48)	1.43 (0.86-2.38)	1.41 (1.04-1.91)
30-34	0.99 (0.64-1.54)	3.16 (1.91-5.23)	1.47 (1.07-2.02)
35-38	0.98 (0.28-3.44)	6.43 (2.80-14.80)	2.57 (1.30-5.08)
Private health insurance			
No	reference	reference	reference
Yes	1.07 (0.79-1.45)	1.15 (0.87-1.52)	1.37 (1.12-1.66)
Short stature (centimetres)			
157 or more	reference	reference	reference
<157	1.20 (0.72-2.00)	2.14 (1.44-3.17)	1.68 (1.24-2.29)
Body mass index ^b (kg/m ²)			
Not overweight (< 25kg/m ²)	reference	reference	reference
Overweight for both children	1.44 (1.06-1.96)	1.42 (1.07-1.90)	1.50 (1.22-1.84)
Overweight for second child	0.65 (0.33-1.26)	1.22 (0.74-2.00)	1.39 (0.99-1.93)
Diagnosed with hypertension			
Not for either child	reference	reference	reference
Hypertension for both children	1.59 (0.96-2.64)	1.02 (0.60-1.76)	0.96 (0.65-1.42)
Hypertension for second child	1.28 (0.76-2.13)	1.49 (0.94-2.36)	1.64 (1.20-2.24)

^a Also adjusted for area of residence due to method of sampling.

^b 18% missing data.