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Supplementary Material for

Is there unwarranted variation in obstetric practice in Australia? Obstetric intervention trends in Queensland hospitals

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File S1

Two datasets were used from the Maternity1000 linked administrative database (49), they include the Queensland Hospital Admitted Patient Data dataset and the Perinatal Data Collection dataset. The Queensland Hospital Admitted Patient Data dataset was used to the Hospital and Health Service variables. On this dataset, the baby is recorded as either being born in a public health facility; private facility or home. Home births were excluded from the analysis. If the baby was recorded as being born in a public health facility then the name of the hospital is also recorded. We used the names of the hospitals to create categories of Hospital and Health Service jurisdictions. If the birth was recorded as being in a private facility then they remained in this category for the analysis.

The Perinatal Data Collection dataset was used to create all other variables used in the analysis, including obstetric interventions, socioeconomic, demographic and health status variables. On the Perinatal Data Collection dataset, the birth delivery mode is recorded as either classical caesarean section or lower segment caesarean section (we recoded these variables to be merged into one category 'caesarean section'); vaginal non-instrumental; forceps and vacuum extractor, which we categorised as outcome variables in the analyses. The Perinatal Data Collection dataset also records the method in which the labour commenced (spontaneous/no labour due to caesarean section/induced). If a mother was recorded has her labour onset as being 'induced' they were recoded into an 'induction of labour' variable. It is recorded on the Perinatal Data Collection dataset if a woman experiences any damage to her perineum (1st degree laceration/2nd degree laceration/3rd degree laceration/4th degree laceration/episiotomy). We recoded the variable so for any mothers that were recorded as having an episiotomy into an 'episiotomy' variable. The Perinatal Data Collection dataset also records whether a mother received any form of analgesia (general anesthetic/spinal/epidural/combined spinal and epidural) during labour and birth. This variable only refers to epidural for the purpose of analgesia and not to facilitate a caesarean section. We recoded the variable so that it included any mothers that had either 'epidural' or 'combined spinal and epidural' into an 'epidural' category.

During pregnancy, it is recorded on the Perinatal Data Collection dataset if women have any pre-existing medical conditions as either a yes/no response. A pre-existing health condition is defined in the Perinatal Data Collection as either pre-existing maternal conditions; hypertension or diabetes; and other diseases, illnesses or conditions arising during the current pregnancy including anaemia that is not directly attributable to pregnancy but may significantly affect care during the current pregnancy and/or pregnancy outcome (48). We recoded the data so that all women who were recorded as 'yes', were categorised into a 'pre-existing health condition' variable. Pregnancy complications for the current pregnancy are also recorded as yes/no response on the Perinatal Data Collection dataset. A pregnancy complication is defined as complications of pregnancy arising up to the period immediately preceding labour and delivery that are directly attributable to the pregnancy and may significantly affect care during the current pregnancy and/or the outcome. This can include: Antepartum haemorrhage (Abruption, Placenta praevia, any other antepartum haemorrhage, or cause unknown) or gestational diabetes or hypertension (48). We recoded the data so that all women who recorded 'yes' were categorised into a 'pregnancy complication' variable.

Body Mass Index was calculated using the mothers' height and weight (weight (kg)/height (m2)), which are both recorded on the Perinatal Data Collection dataset. Maternal age was calculated based on the month and year of birth for the mother and the month and year she gave birth, which are both recorded on the Perinatal Data Collection dataset. If women reported 'yes' at their

antenatal appointment as being either Aboriginal and or Torres Strait Islander then they were recoded and categorized as 'Indigenous'. If they reported no, then they were categorized as no (non-indigenous). 0.01% of Indigenous status were missing and they were excluded from the analysis. We categorised mothers' socioeconomic status based on mothers' postcode of residence at the time of birth, which is recorded in the Perinatal Data Collection dataset (79). Socioeconomic status was mapped to the the Australian Bureau of Statistics Index of Relative Socioeconomic Disadvantage. We ranked the study population into five ordinal categories (IRSD 1-5), with IRSD1 representing mothers living in areas of greatest socioeconomic disadvantage and IRSD5 representing mothers living in areas of the least socioeconomic disadvantage (79). Rurality, which was also based on the mothers' postcode at birth, was used to map to the the Accessibility/Remoteness Index of Australia (ARIA+) (56). We recoded the variable containing the mothers' postcode into levels of rurality. Index scores were consolidated into the following ordinal categories: Major Cities; Inner Regional; Outer Regional; Remote; and Very Remote (56). Information on smoking status is collected at two time points during antenatal care, which is before 20 weeks gestation and after 20 weeks gestation. This is then recorded on the Perinatal Data Collection dataset. We recoded the data so that variable 'smoking before 20 weeks gestation' was used as a 'smoking' status variable in our analyses.

After the data was cleaned and the variables were recoded, we merged the Queensland Hospital and Admitted Patient Data Collection dataset and the Perinatal Data Collection dataset into one dataset using the mother's unique identifier code and the birth episode. The PROC GENMOD procedure was used in SAS to undertake the multivariate regression analysis. We also included the LSMEANS statement in the models to produce adjusted mean percentages of obstetric interventions by Hospital and Health Service. A separate model was constructed for each of the outcome variables (cesarean section, Non-instrumental vaginal birth, forceps and vacuum, induction of labour, episiotomy and epidural). The confounding variables that were included into each analysis were rurality (remote and very remote); socioeconomic disadvantage (IRSD1); medical condition (yes); Smoking status before 20 weeks gestation (yes); Indigenous status (yes); BMI (>25); and age (>34). Due to their known statistical impact on outcomes in childbirth, this broad spectrum of maternal characteristics have been reported in the literature as important case-mix variables to adjust for when comparing variation in maternal health outcomes between hospitals (53, 54). In our analyses, we found that almost all of these variables had a significant effect on all of the outcomes of interest, and therefore they were kept in the final models.

The below table (Table S1, p. 3) reports the adjusted mean percentages of obstetric interventions by Hospital and Health Service and the effects of coefficient variables and their level of significance.

Table S1. Adjusted mean percentages of obstetric interventions by Hospital and Health service and coefficients

Note: **p sig at .05*; ***p sig at .01*; ****p sig at .001*

Hospital and Health Service	***Caesarean section***	***Instrumental vaginal birth***	***Non-instrumental vaginal birth***	***Induction of labour***	***Episiotomy***	***Epidural analgesia***
Private sector						
Private hospitals	45.8	12.8	41.4	27.8	7.68	19.23
Public Sector						
Metropolitan						
Townsville	31.6	9.4	59	23.9	7.56	12.38
Mater Hospitals	29.9	13.1	57	29	8.63	15.67
Metro South	30.9	7.9	61.2	25.2	4.90	15.23
Sunshine Coast	27.9	10.7	61.4	22.9	3.88	18.74
Metro North	27.8	10.7	61.5	18.1	7.14	16.30
Gold Coast	23.6	10.7	65.7	26.7	5.32	15.97
Variation in % points	8	5.2	8.7	11	4.8	6.36
Regional						
Cairns and Hinterland	30.7	10.6	58.7	21.2	5.37	15.34
Central QLD	29.9	7.3	62.8	20	6.12	11.38
Wide Bay	29.8	10.4	59.8	24.3	6.44	15.00
Darling downs	28.9	8.1	63	19.9	5.40	14.95
Mackay	28	12.8	59.8	24.9	6.77	15.18
West Moreton	26.5	7.8	65.7	23.1	5.28	13.40
Variation in % points	4.2	5.5	7	5	1.5	4
Rural and remote						
South West	36.2	10.3	53.9	16.97	5.47	8.98
North West	29.2	12.7	58.2	26.11	10.04	17.46
Central West	28.2	11.6	60.7	25.65	4.86	11.85
Torres and Cape	22.3	6.2	71.6	15.58	4.22	7.95
Variation in % points	13.9	6.5	17.7	10.6	5.8	9.5
Coefficients						
Rurality	-0.0016***	-0.0084***	0.0102***	0.0095***	-0.0054***	-0.0137***
IRSD	-0.0076***	-0.0056***	0.0019*	-0.0049***	-0.0045***	0.0108***
Indigenous	0.0034	-0.0306***	0.0271***	-0.0256***	-0.0187***	-0.0374***
Medical condition	0.0181***	0.0007	-0.0179***	0.0165***	0.0059***	0.0072**
Pregnancy complication	0.3414***	-0.0132***	-0.3283***	0.2159***	-0.0012***	0.0499***
Smoking	-0.0115**	0.0022***	-.0448***	-0.0061***	-0.0216***	-0.0247***
BMI	0.005***	-0.0002***	-0.0002***	0.0002**	0.0002***	0.00
Age	0.0089***	-0.0037***	-.0054***	-0.0033***	-0.0026***	-0.0052***