ORIGINAL ARTICLE

Does rural or urban residence make a difference to neonatal outcome in premature birth? A regional study in Australia

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Background: Patients living in rural areas may be at a disadvantage in accessing tertiary health care.
Aim: To test the hypothesis that very premature infants born to mothers residing in rural areas have poorer outcomes than those residing in urban areas in the state of New South Wales (NSW) and the Australian Capital Territory (ACT) despite a coordinated referral and transport system.
Methods: ''Rural'' or ''urban'' status was based on the location of maternal residence. Perinatal characteristics, major morbidity and case mix adjusted mortality were compared between 1879 rural and 6775 urban infants <32 weeks gestational age, born in 1992–2002 and admitted to all 10 neonatal intensive care units in NSW and ACT.
Results: Rural mothers were more likely to be teenaged, indigenous, and to have had a previous premature birth, prolonged ruptured membrane, and antenatal corticosteroid. Urban mothers were more likely to have had assisted conception and a caesarean section. More urban (93% *v* 83%) infants were born in a tertiary obstetric hospital. Infants of rural residence had a higher mortality (adjusted odds ratio (OR) 1.26, 95% confidence interval (CI) 1.07 to 1.48, p = 0.005). This trend was consistently seen in all subgroups and significantly for the tertiary hospital born population and the 30–31 weeks gestation subgroup. Regional birth data in this gestational age range also showed a higher stillbirth rate among rural infants (OR 1.20, 95% CI 1.09 to 1.32, p<0.001).
Conclusions: Premature births from rural mothers have a higher risk of stillbirth and mortality in neonatal intensive care than urban infants.

Across Australia, people living in rural and remote areas generally have a less favourable health outcome than those from metropolitan areas. Rural dwellers have a higher prevalence of health risk factors and a higher rate of hospital admission, ''avoidable'' deaths, and other adverse health outcomes.[1] Many factors contribute to this differential, including geographic isolation, socioeconomic disadvantage, a shortage of healthcare providers, greater exposure to injury risks, and the needs of the Aboriginal population.[2 3] In parts of rural Australia, it is not uncommon for homesteads to be more than 1000 km from townships that have the basic necessities such as groceries, banks, and medical care. The values, norms, and beliefs of the rural population may therefore differ from those of the urban resident, the former being less likely or able to seek medical care than the latter.[4]

In the state of New South Wales (NSW) and the Australian Capital Territory (ACT), tertiary perinatal care is confined to 10 hospitals, which, for logistic and human resource reasons, are all located within the Sydney Metropolitan area, in the coastal city of Newcastle (150 km north of Sydney), and in Canberra (300 km south of Sydney). The ACT lies entirely within NSW, and Canberra is its sole city and population centre (fig 1). The NSW population is 6.7 million, with 4.3 million residing in metropolitan Sydney. The population of the ACT is 340 000. There is, however, a well established antenatal referral system whereby high risk mothers are preferentially transferred to tertiary obstetric hospitals under the advice of a high risk fetomaternal consultative service. There is also a comprehensive neonatal transport service that provides state wide medical and nursing expertise for the postnatal transfer of critically ill newborn infants from rural hospitals to each of the 10 neonatal intensive care units (NICUs) in NSW and the ACT.

Although much effort has been put into providing rural high risk infants with equal access to tertiary perinatal care, it is not known if rural infants have comparable outcomes to their urban counterparts, and indeed, in a national survey, we found that district and regional obstetricians had an extremely pessimistic view of survival and outcome for very premature infants.[5]

The aim of our study was thus to compare the perinatal outcome of infants <32 weeks gestation admitted to tertiary NICUs, whose mothers' usual place of residence was located in rural regions of NSW and the ACT with infants of mothers whose usual place of residence was in designated urban areas. We hypothesised that very preterm infants born to mothers residing in rural areas had poorer outcomes than those born to mothers residing in urban areas despite having ready prenatal and postnatal access to tertiary NICUs and obstetric hospitals.

METHODS

The study was a retrospective analysis of prospectively collected data testing an a priori hypothesis. All infants delivered <32 weeks gestational age and consecutively admitted to one of the 10 tertiary NICUs in NSW and the ACT during 1992 and 2002 were included in the study.

Abbreviations: ACT, the Australian Capital Territory; CI, confidence interval; NETS, neonatal and paediatric emergency transport service; NICU, neonatal intensive care unit; NSW, New South Wales; OR, odds ratio

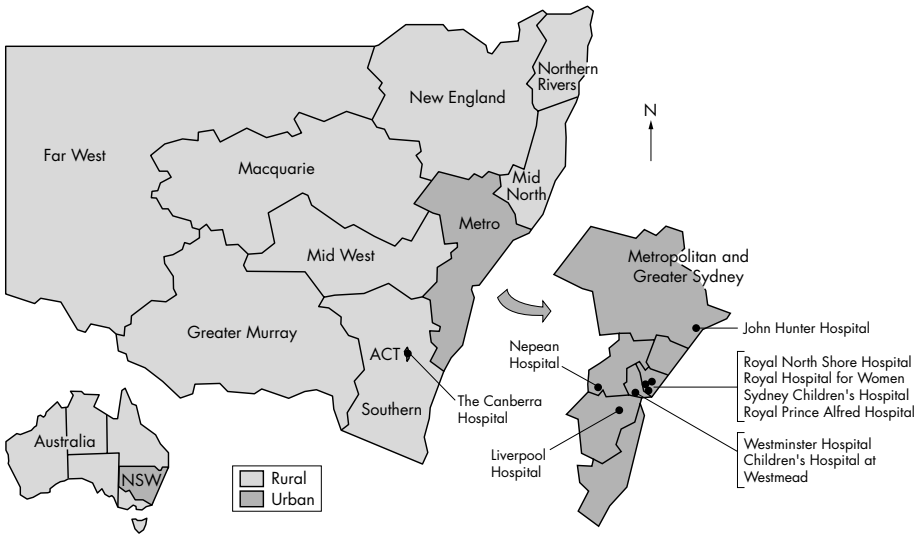

Figure 1 Location of the New South Wales (NSW) and Australian Capital Territory (ACT) neonatal intensive care units.

Geographically, the ACT lies within the state of NSW and the NICUs form part of the entire regional neonatal service network.

Data sources and patient population

NSW and the ACT have a combined total population of 7 005 400, and there were about 90 000 live births in the year 2003.[6] Although the tertiary perinatal hospitals are all clustered within urban health areas, a specialised neonatal and paediatric emergency transport service (NETS) team exists to transport infants born in non-tertiary hospitals to tertiary perinatal centres for specialised care. Each year the NETS team transfers about 700 newborn infants from non-tertiary centres to tertiary centres.[7] Furthermore, a team of on call obstetric consultant advisors coordinates the management of high risk mothers who may or may not be transferred to perinatal centres from non-tertiary rural and urban hospitals via the Perinatal Advice Line (PAL).

In Australia, it has been recommended by the National Health and Medical Research Council (NHMRC) that ''Wherever possible preterm birth at <33 weeks should occur in a perinatal centre that has the expertise to care for the woman and her preterm infant''.[8] In general, preterm infants <32 weeks who are born in non-tertiary hospitals are transferred to tertiary centres by the NETS team. There are three special care nurseries in urban NSW that provide nasal continuous positive airway pressure for full term or larger preterm infants, and there are no intermediate NICUs in NSW or the ACT that provide mechanical ventilation in newborns. Data from these or other special care nurseries were not included in this study.

Data were obtained from the Neonatal Intensive Care Units (NICUS) Data Collection for all infants <32 weeks gestation born between 1 January 1992 and 31 December 2002 and admitted to a tertiary NICU in NSW and the ACT. The NICUS database is a collaborative effort of the 10 tertiary NICUs in NSW and the ACT. Canberra Hospital in the ACT and Liverpool Hospital in NSW joined the NICUS Data Collection in 1995. NICUS data are prospectively collected and collated within each NICU by designated clinical nurse specialists using standardised published definitions and compiled into a central database located at the NSW Pregnancy and Newborn Services Network. The accuracy of the NICUS Data Collection was validated in 1999.[9] NICUs database registration criteria include all infants admitted to a tertiary NICU during the neonatal period (first 28 days) who fulfil one or more of the following criteria: (*a*) born at <29 weeks gestation (1992–1993) or <32 weeks gestation (1994–2002); (*b*) birth weight <1000 g (1992–1993) or ⩽1500 g (1994–2002); (*c*) required assisted ventilation (intermittent mandatory ventilation or continuous positive airway pressure) for four hours or more starting during the neonatal period; (*d*) required major surgery, defined as opening of a body cavity. In the NICUS database, the clinical risk index for babies score[10] was collected from 1994 onwards. Information on total live births and stillbirths was obtained from the NSW Midwives Data Collection and the ACT Maternal-Perinatal Data Collection, as the NICUS database does not include infants who died before arrival at a tertiary NICU.[11]

The ''rural'' or ''urban'' status of the mother-infant dyad was based on the usual residence of the mother at the time of the infant's birth. NSW and the ACT were divided into 17 health areas classified as either rural or urban. A mother was classified as urban if her usual residence was located in the Sydney Metropolitan, Illawarra, Hunter, or ACT Health Areas as in the NSW health reports[1] corresponding closely to the accessibility-remoteness index of Australia category.[12]

Other than the NSW and the ACT NICU admission data, all birth data including live births and stillbirths for rural and urban residence in the same gestational age range 22–31 weeks was obtained from the NSW Midwives Data Collection (1992–2002) and the ACT Maternal-Perinatal Data Collection (1997–2002). These data were used solely for the analysis of stillbirth comparison between urban and rural residence. They were entered by midwives at the time of birth and could not be relied on for subsequent neonatal death in either the non-tertiary or tertiary hospital.

Statistical analysis

All analyses were performed using SPSS version 11.5.0 (SPSS, Chicago, Illinois, USA). The χ^2 test and *t* test were used where appropriate to determine the association between the clinical factors and the outcome. Mortality odds ratios were calculated by using a backward stepwise multiple logistic regression model[13 14] after adjusting for significant and clinically important baseline population characteristics (table 3). In this model, criteria for entry and removal were $p<0.05$ and $p>0.10$ respectively. The level of statistical significance for all analyses was set at $p<0.05$ using two tailed comparisons. The significance level was not changed when multiple comparisons were performed.[15]

Table 1 Comparison of perinatal characteristics of rural and urban mothers of infants <32 weeks gestation

Characteristic	Urban (n = 775)	Rural (n = 1879)	p Value
Maternal age (years)*	29.5 (5.8)	27.4 (6.0)	<0.001
Teenage mother (<20 years)	321 (4.7)	196 (10.4)	<0.001
Older mother (⩾35 years)	1430 (21.1)	254 (13.5)	<0.001
Aboriginal ethnicity	147 (2.2)	188 (10.0)	<0.001
Previous preterm birth	1014 (15.0)	325 (17.3)	0.018
Assisted conception	851 (12.6)	138 (7.3)	<0.001
Multiple pregnancy	1840 (27.2)	459 (24.4)	0.018
Ultrasound diagnosis IUGR	693 (10.2)	161 (8.6)	0.045
Antenatal corticosteroid in the last 7 days	5648 (83.4)	1616 (86.0)	0.008
PPROM >24 hours	1841 (27.2)	687 (36.6)	<0.001
Fetal distress	1264 (18.7)	352 (18.7)	NS
Caesarean delivery	3769 (55.6)	958 (51.0)	<0.001
Gestational age (weeks)*	28.4 (2.2)	28.4 (2.2)	NS
Birth weight centile*	47.9 (27.5)	48.1 (26.6)	NS
Small for gestation (<10th centile)	713 (10.5)	161(8.6)	0.019
Large for gestation (>90th centile)	389 (5.7)	93 (4.9)	NS
Appropriate for gestation	5673 (83.7)	1625 (86.5)	0.004
Male	3709 (54.7)	1021 (54.3)	NS
Non-tertiary obstetric hospital birth	509 (7.5)	328 (17.4)	<0.001
Congenital anomaly	541 (8.0)	140 (7.4)	NS
Major	359 (5.3)	94 (5.0)	NS
Minor	182 (2.7)	46 (2.4)	NS
CRIB score*†	3.8 (4.0)	3.9 (3.9)	NS
22–26 weeks	7.6 (4.6)	7.4 (4.5)	NS
27–29 weeks	3.3 (2.8)	3.3 (3.2)	NS
30–31 weeks	2.0 (2.4)	1.8 (2.4)	NS

Values are number (%), with p values obtained by χ^2 test, unless stated otherwise.
*Values are mean (SD), with p values obtained by two independent samples *t* test.
†Data collected from 1994 (number (%) was 5795 (85.5) and 1609 (85.6) for urban and rural respectively).
CRIB, clinical risk index for babies; IUGR, intrauterine growth retardation; PPROM, prolonged premature rupture of membranes.

RESULTS

Maternal characteristics of NICU infants

A total of 8654 infants <32 weeks gestation were born between 1 January 1992 and 31 December 2002 and admitted to a tertiary NICU: 1879 (21.7%) infants were born to 1664 rural mothers and 6775 (78.3%) infants were born to 5880 urban mothers. When compared with their urban counterparts, rural mothers were more likely to be aboriginal (odds ratio (OR) 5.01, 95% confidence interval (CI) 3.99 to 6.30; p<0.001), teenaged (OR 2.34, 95% CI 1.94 to 2.83; p<0.001), to have had a previous preterm birth (OR 1.19, 95% CI 1.03 to 1.37; p = 0.018), or prolonged premature rupture of the membranes (OR 1.54, 95% CI 1.38 to 1.72; p<0.001). They were also more likely to have received antenatal corticosteroids (OR 1.23, 95% CI 1.06

Table 2 Comparison of major neonatal morbidity among infants <32 weeks gestation born to rural and urban resident mothers

Characteristic	Urban (n = 6775)	Rural (n = 1879)	p Value
Apgar score <7 at 5 min	1307 (19.4)	369 (19.8)	NS
Required mechanical ventilation	4864 (71.8)	1340 (71.3)	NS
Duration of ventilation (days)*	10.3 (16.1)	9.6 (18.9)	NS
Hyaline membrane disease	4470 (66.0)	1268 (67.5)	NS
Air leak requiring drainage	423 (6.2)	10 (0.5)	NS
CLD (respiratory support at 36 weeks gestation)	1152 (17.0)	328 (17.4)	NS
Postnatal steroids for CLD	958 (14.1)	317 (16.9)	0.034
Home oxygen	506 (7.5)	126 (6.7)	NS
Proven systemic infection	1720 (25.4)	472 (25.1)	NS
IVH grade 3 or 4†	408 (6.5)	134 (7.7)	NS
Parenchymal cyst or hydrocephalus at 6 week scan‡	201 (3.8)	68 (4.7)	NS
Necrotising enterocolitis	494 (7.3)	113 (6.0)	NS
ROP grade 3 or 4§	326 (6.6)	87 (6.5)	NS
PDA requiring treatment	1384 (20.4)	424 (22.3)	NS
Length of NICU stay (days)*	59.3 (37.3)	58.4 (37.9)	NS
Crude mortality [OR, 95% CI]	910 (13.4)	288 (15.3) [1.17, 1.01 to 1.35]	0.035
22–26 weeks	569/1519 (37.5)	169/409 (41.3) [1.18, 0.94 to 1.47]	NS
27–29 weeks	239/2514 (9.5)	77/724 (10.6) [1.13, 0.86 to 1.49]	NS
30–31 weeks	102/2742 (3.7)	42/746 (5.6) [1.54, 1.07 to 2.23]	0.021

Values are number (%), with p values obtained by χ^2 test, unless stated otherwise. Odds ratio (OR), 95% confidence interval (CI) obtained by logistic regression model (urban group set as a referent).
*Values are mean (SD), with p values obtained by two independent samples *t* test.
†Number (%) examined was 6298 (92.9) and 1745 (92.9) for urban and rural respectively.
‡Number (%) examined was 5313 (78.4) and 1443 (76.8) for urban and rural respectively.
§Number (%) examined was 4968 (73.3) and 1335 (71.0) for urban and rural respectively.
CLD, chronic lung disease; IVH, intraventricular haemorrhage; NICU, neonatal intensive care unit; PDA patent ductus arteriosus; ROP, retinopathy of prematurity.

Table 3 Multivariate analysis of clinical features predictive of mortality among infants <32 weeks gestation born to rural and urban resident mothers

Factor	All sample (n = 8654)	Born in tertiary obstetric hospital (n = 7817)	Born in non-tertiary obstetric hospital (n = 837)
Rural *v* urban residence	1.256 (1.070 to 1.475)*	1.237 (1.037 to 1.477)*	1.239 (0.814 to 1.887)
22–26 weeks gestation	1.196 (0.939 to 1.523)	1.231 (0.951 to 1.594)	0.903 (0.451 to 1.806)
27–29 weeks gestation	1.207 (0.914 to 1.595)	1.120 (0.827 to 1.517)	1.977 (0.890 to 4.388)
30–31 weeks gestation	1.430 (0.974 to 2.099)	1.584 (1.032 to 2.430)*	0.913 (0.413 to 2.100)
No antenatal corticosteroid in the last 7 days	2.054 (1.736 to 2.431)*	2.019 (1.648 to 2.473)*	1.613 (1.053 to 2.468)*
Non-tertiary *v* tertiary obstetric hospital birth	1.204 (0.944 to 1.536)	–	–
Emergency caesarean delivery	1.087 (0.919 to 1.286)	1.052 (0.878 to 1.260)	1.345 (0.845 to 2.141)
Birth weight for gestation centile	0.987 (0.985 to 0.990)*	0.987 (0.985 to 0.990)*	0.985 (0.977 to 0.993)*
Gestational age	0.589 (0.570 to 0.608)*	0.589 (0.570 to 0.610)*	0.574 (0.518 to 0.637)*
Male sex	1.234 (1.076 to 1.417)*	1.173 (1.013 to 1.357)*	1.802 (1.176 to 2.762)*

Values are odds ratio (95% confidence interval) obtained by logistic regression model (urban group set as a referent).
*p<0.05.

to 1.42; p = 0.008) or to go into spontaneous labour (OR 1.19, 95% CI 1.07 to 1.33; p = 0.001).

Urban mothers were more likely to be older than 35 years (OR 1.71, 95% CI 1.48 to 1.98; p<0.001), to have had an assisted conception (OR 1.81, 95% CI 1.50 to 2.20; p<0.001), multiple pregnancies (OR 1.15, 95% CI 1.02 to 1.30; p = 0.018), antenatal diagnosis of intrauterine growth restriction (OR 1.22, 95% CI 1.01 to 1.46; p = 0.045), or a caesarean delivery (OR 1.21, 95% CI 1.09 to 1.34; p<0.001) (table 1).

NICU infant characteristics

Urban and rural infants were similar in gestation, birth weight, need for and duration of mechanical ventilation, and length of hospital stay. Rural infants were, however, more likely than their urban counterparts to be delivered in a non-tertiary obstetric hospital (OR 2.71, 95% CI 2.32 to 3.16; p<0.001) and thus to require postnatal transfer by the NETS team (OR 2.75, 95% CI 2.36 to 3.20; p<0.001) (table 1). CRIB score, as a measure of variability of case mix between the two infant groups, was comparable between rural and urban infants (mean (SD) 3.8 (4.0) *v* 3.9 (3.9), respectively; p = 0.503).

Morbidity and mortality

There was no significant difference in major morbidity associated with high risk very preterm births between the two populations, including severe intraventricular haemorrhage (grade 3 or 4), retinopathy of prematurity (grade 3 or 4), proven necrotising enterocolitis, or respiratory support at 36 weeks gestation (chronic lung disease) (table 2).

Rural infants had a higher overall crude mortality (15.3% *v* 13.4%, OR 1.17, 95% CI 1.01 to 1.35; p = 0.035) than urban infants. This was evident among all gestation groups, and it reached significance in the 30–31 week gestation group (5.6% *v* 3.7%, OR 1.54, 95% CI 1.07 to 2.23; p = 0.021) (table 2).

Adjusted mortality showed significantly higher mortality for the rural group (adjusted OR 1.26, 95% CI 1.07 to 1.48; p = 0.005) (table 3). No antenatal corticosteroid, gestation, birth weight centile, and male sex were associated with a higher mortality irrespective of whether they were born in tertiary hospital or not. Including the teenage pregnancy and aboriginal background, both of which had strong association with rural residence, in the regression model did not change the results (data not shown). The increase in adjusted mortality is equivalent to one extra death in 44.1 NICU admissions.

When stratified by category of hospital of birth, there was a significantly higher mortality for the rural infants born in a tertiary centre compared with urban infants born in tertiary centres (n = 7817; adjusted OR 1.24, 95% CI 1.04 to 1.47). This trend was seen in all gestational group comparisons, and in the 30–31 week gestation group it reached statistical significance (table 3). The influence of non-tertiary hospital birth was further examined in the 837 infants. There was no significant difference in the time from birth to transfer to tertiary centre for rural infants born in non-tertiary centres who survived or died later in perinatal centres (mean (SD) 7.6 (2.8) *v* 7.5 (2.9) hours, respectively; p = 0.857). Rural infants born in non-tertiary hospital had higher mortality than their urban counterparts, but this did not reach statistical significance (adjusted OR 1.24, 95% CI 0.81 to 1.89; p = 0.317).

Regional stillbirth rates

To supplement the NICUS admission data analysis, stillbirth data in the same gestational age range 22–31 weeks was analysed from the NSW Midwives Data Collection (1992–2002) and the ACT Maternal-Perinatal Data Collection (1997–2002). Among a total of 14 707 births, there was a higher risk of stillbirth in the rural areas (20.6% *v* 17.8%; OR 1.20, 95% CI 1.09 to 1.32; p<0.001). Analysis by gestational age showed a significantly higher risk of stillbirth among rural residents of 22–26 weeks gestational age (table 4).

DISCUSSION

Our data on perinatal characteristics show that rural mothers of NICU infants were more likely to be teenaged, to have had previous preterm birth, and to be indigenous. Furthermore,

Table 4 Stillbirth rate for rural and urban mothers by gestational age

Stillbirth	Urban (n = 11177)	Rural (n = 3530)	p Value
22–26 weeks	1216/3148 (38.6)	451/1052 (42.9) [1.19, 1.03 to 1.38]	0.016
27–29 weeks	387/2938 (13.2)	141/914 (15.4) [1.20, 0.97 to 1.49]	0.094
30–31 weeks	260/3303 (7.9)	94/1016 (9.2) [1.19, 092 to 1.54]	0.181
Total	1991/11177 (17.8)	727/3530 (20.6) [1.20, 1.09 to 1.32]	<0.001

Values are number (%) and [odds ratio, 95% confidence interval], with the urban group set as a referent. p Values were obtained by the χ^2 test. The ACT data were available from 1997 to 2002.

What is already known on this topic

- People living in rural and remote areas may have a less favourable health outcome than those from metropolitan areas
- Mortality and morbidities for very premature babies born in tertiary centres are lower than for those born in non-tertiary centres

What this study adds

- Mothers of very premature NICU babies from rural residence are different from urban mothers in that they are significantly younger, more likely to be teenaged, of indigenous background, and had previous premature birth
- Despite the majority (83%) of NICU rural babies being born in tertiary centres, these rural inborn infants have a higher mortality than their metropolitan counterparts, suggesting that pre-existing factors are responsible. Stillbirth rates are also higher for rural births in this gestation range

they were more likely to have preterm prolonged premature rupture of membranes. All these characteristics are consistent with relative prenatal disadvantage and poorer perinatal outcome. These findings are in line with previous studies comparing rural and urban communities in Australia.[3] In contrast, the urban mothers were significantly older and more likely to have had an assisted conception and an antenatal diagnosis of intrauterine growth restriction.

We found that rural births within the less than 32 weeks gestation range in NSW and ACT had an overall increased mortality among NICU admissions. The adjusted mortality risk was 1.26, equivalent to one extra death in about 45 admissions. The trend of increased mortality was consistently seen in gestation subgroup analyses and tertiary or non-tertiary hospital birth comparisons. It reached statistical significance with those groups with large sample size such as the tertiary hospital inborn population or the 30–31 weeks gestation infants. Baldwin *et al*[16] found that the risk of perinatal complications was affected by the frequency with which a woman sought perinatal care and that inadequate prenatal care was significantly higher for rural than for urban mothers among American Indians/Alaskan Natives. In the state of NSW, Roberts and Algert[3] found an overall higher teenage pregnancy and smoking rate, with fewer antenatal visits and a higher stillbirth rate in the rural mothers. We found that rural births within the extremely premature gestation range in NSW and the ACT also had an increased risk of being stillborn.

There are limitations of our data. The two regional midwife data of NSW and the ACT were not linked to NICU data or the death registries for more detailed epidemiological analysis. The midwife data collection is entered at birth and is revised and completed at the time of maternal discharge. We analyse stillbirths only in midwife data as neonatal death may occur after transfer to NICU or during district nursery admission. These neonatal deaths would not have been updated in the midwife data and relied on for analysis. Although we had data on all births and NICU admissions, we could not capture all neonatal outcome reliably. Nonetheless, the stillbirth rate is consistent with the NICU mortality.

Furthermore, other data on how frequently or how appropriately each group of women accessed prenatal care during their pregnancies if available would have been most valuable. These underlying factors could partially explain the higher risk of stillbirths or NICU deaths found in our study. It has been widely reported that health outcomes favour patients treated in urban centres,[17–19] possibly because of easier access to support services (laboratory, radiology, and specialist facilities) and differing attitudes towards seeking health care. Staff competency in tertiary urban centres is maintained by higher patient throughput, ensuring that the necessary skills to treat acute problems are maintained with constant practice.[20–22] This distinction is true for newborn infants, who have a better outcome if they are born in tertiary rather than non-tertiary hospitals without NICU facilities.[23] Australia, as in other developed countries, has recommended, through the National Health and Medical Research Council (NHMRC), that ''Wherever possible preterm birth at <33 weeks should occur in a perinatal centre that has the expertise to care for the woman and her preterm infant''.[8] It was encouraging to find that 82.6% of rural infants were born in a tertiary obstetric hospital with NICU facilities, although the rate was lower than for infants of urban mothers (92.5%, $p<0.001$). The rate of antenatal corticosteroid use of 86% was also remarkably high for the infants of rural residence regardless of whether they were born in tertiary hospitals or not.

In summary, our study shows that infants of mothers who reside in rural areas have a higher risk of NICU mortality, implying that rural residents are still relatively disadvantaged compared with their urban counterparts in NSW and the ACT. Despite this, the short term neonatal morbidity rate in the survivors was comparable to that of urban infants. More information about the long term health of neonatal intensive care survivors for both rural and urban infants should be assessed.

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