Success in Closing the Gap: favourable neonatal outcomes in a metropolitan Aboriginal Maternity Group Practice Program

Abstract

Objectives: To report differences in neonatal health outcomes for a community-based antenatal program, the Aboriginal Maternity Group Practice Program (AMGPP; the intervention group), compared with two matched control groups eligible for standard antenatal care.

Design: Non-randomised intervention study using data from the Western Australian Midwives Notification System. Regression models were used to report adjusted odds ratios (aORs) for defined neonatal health outcomes.

Setting: The AMGPP employed Aboriginal grandmothers, Aboriginal Health Officers, and midwives working in partnership with existing antenatal services to provide care for pregnant Aboriginal women residing in south metropolitan Perth.

Participants: 343 women (with 350 pregnancies) who participated in the AMGPP and gave birth between 1 July 2011 and 31 December 2012; historical and contemporary control groups of pregnant Aboriginal women (each including 350 pregnancies), frequency matched for maternal age and gravidity.

Main outcome measures: Preterm births, birthweight, neonatal resuscitation, neonatal hospital length of stay longer than 5 days.

Results: Babies born to AMGPP participants were significantly less likely to be born preterm (AMGPP, 9.1% v historical controls, 15.9% [aOR, 0.56; 95% CI, 0.35–0.92]; v contemporary controls, 15.3% [aOR, 0.75; 95% CI, 0.58–0.95]); to require resuscitation at birth (AMGPP, 17.8% v historical controls, 24.4% [aOR, 0.68; 95% CI, 0.47–0.98]; v contemporary controls, 31.2% [aOR, 0.71; 95% CI, 0.60–0.85]), or to have a hospital length of stay of more than 5 days (AMGPP, 4.0% v historical controls, 11.3% [aOR, 0.34; 95% CI, 0.18–0.64]; v contemporary controls, 11.6% [aOR, 0.56; 95% CI, 0.41–0.77]).

Conclusion: Participation in the AMGPP in south metropolitan Perth was associated with significantly improved neonatal health outcomes.

Australian Aboriginal women are at greater risk of complications during pregnancy and labour than non-Indigenous Australian women. There are for many reasons for this, including a higher prevalence of medical, lifestyle and socioeconomic risk factors, and lower antenatal care participation rates. Providing culturally competent services improves antenatal care uptake, but historically there has been a lack of such services in Western Australia.[1] Element Two of the National Partnership Agreement on Indigenous Early Childhood Development (IECD2), part of the Closing the Gap suite of health care reforms initiated in late 2008, aimed to improve the access of Aboriginal women (particularly teenagers) to antenatal care and other women's health care services.[2]

The Aboriginal Maternity Group Practice Program (AMGPP) was funded under this element, and commenced operating at various locations in the area of Perth served by the South Metropolitan Health Service (SMHS) in early to mid 2011. The SMHS spans the entire metropolitan area south of the Swan River (estimated population in 2012: 893 379, of whom 1.8% are Aboriginal residents)[3]; the remainder of metropolitan Perth is served by the North Metropolitan Health Service (NMHS). There are five health districts in the SMHS, each with its own hospital (four hospitals are public and one is private). The district hospitals provide antenatal care to local women, except for those at the greatest risk, who are referred to the sole public tertiary maternity hospital in Perth (King Edward Memorial Hospital [KEMH]; located in the NMHS). The criteria for referral differ between hospitals, but generally include type 1 diabetes, illicit substance use, and being younger than 16 years of age. During 2011, 369 children were born to local Aboriginal women in this area, equating to 3.1% of all births to SMHS residents and 21.4% of all births to Aboriginal women in WA.[4]

Before the AMGPP was introduced, local Aboriginal community members were concerned that some women were presenting late in pregnancy or giving birth at KEMH irrespective of their risk status. The AMGPP aimed to improve timely access to existing antenatal and maternity services in south metropolitan Perth, and to thereby increase the number of women giving birth safely in a local hospital. The program employed Aboriginal Health Officers (AHOs), Aboriginal grandmothers and midwives in each district to work with the existing services. The program model was culturally secure, with a focus on early access to antenatal care, employment of Aboriginal staff, and holistic care, including awareness of the social determinants of health (Box 1). Clients with low-risk pregnancies gave birth at the local district hospital, and higher-risk pregnancies were referred to KEMH, as per the standard SMHS policy.

Our study aimed to explore any differences in neonatal health outcomes that were associated with AMGPP participation.

Methods

Study design

The study was a non-randomised intervention, with the intervention

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1 Features of the Aboriginal Maternity Group Practice Program (AMGPP) in the South Metropolitan Health Service (SMHS), Perth, Western Australia

- All aspects of program planning, implementation and progression were guided by Aboriginal community members through district steering group meetings. These meetings were held quarterly, and were also attended by AMGPP staff, South Metropolitan Population Health Unit (SMPHU) contract management staff, maternity ward staff from each local district hospital and antenatal care providers.
- The Aboriginal Health Officer (AHO) was required to have the Certificate IV in Primary Health Care (or equivalent) as a condition of employment, and provided care coordination, including referrals to other health and social services providers.
- The Aboriginal grandmothers were respected women in the local community with good community networks. They identified pregnant women, assisted with access to services (including transport), provided support (including being present at appointments, if requested), and advised on cultural and health promotion matters.
- The AMGPP midwife delivered antenatal care in partnership with local antenatal care providers. Clinical staff provided clinical governance, working within existing hospital guidelines.
- Women were referred to the program by AMGPP staff, community members, general practitioners, hospital antenatal clinics, Medicare Locals and social services providers.
- A home-visiting service was available. Outreach clinics were provided in various locations, including women's refuges, Aboriginal community centres and mobile GP services.
- Aboriginal staff were trained to deliver culturally appropriate, brief interventions to assist with stopping smoking and alcohol use. Training was provided by the Drug and Alcohol Office (Strong Spirit, Strong Future), the Cancer Council WA (Fresh Start) and the SMPHU (Yarning It Up).
- The AMGPP staff delivered antenatal and sexual health education on an individual basis. Antenatal education included information about the stages of pregnancy, managing problems occurring during pregnancy, healthy lifestyle behaviours (nutrition; stopping smoking and alcohol use), mental health, available services, birth registration, breastfeeding, baby care, and the prevention of sudden infant death syndrome. Sexual health education included information about the symptoms of sexually transmitted infections, the importance of Pap smears, and contraception. Aboriginal staff received training in health promotion from the Aboriginal Maternal Services Support Unit (WA Department of Health). ◆

defined as participation in the AMGPP. The intervention group consisted of all Aboriginal women who gave birth while participating in the AMGPP between 1 July 2011 and 31 December 2012. These women received standard antenatal care and the additional services provided by the AMGPP (Box 1). The intervention group was compared with two control groups that were frequency matched on the basis of maternal age at the time of delivery (younger than 20 years or at least 20 years old) and gravidity (primigravida or multigravida). The historical control group consisted of Aboriginal women who resided in the SMHS and had given birth between 1 January 2009 and 30 June 2011; the contemporary control group consisted of Aboriginal women who resided in the NMHS and had given birth between 1 June 2011 and 31 December 2012. Women in the control groups were eligible to receive standard antenatal care. The outcome measures of the study were preterm delivery, low birthweight, neonatal resuscitation at birth, and the baby's hospital length of stay (LOS).

Data sources

Data from the WA Midwives Notification System (MNS) was analysed. The MNS is a statutory database that records all births in WA occurring at a gestational age of at least 20 weeks, or where the birthweight is at least 400 g. The available data included maternal demographics, pre-existing medical conditions, smoking status, pregnancy complications and neonatal characteristics. Pregnancy complications included threatened miscarriage before 20 weeks, threatened preterm labour, urinary tract infection, pre-eclampsia, antepartum haemorrhage (placenta praevia, placental abruption, and other), pre-labour rupture of membranes, gestational diabetes, and "other". Pre-existing medical conditions included asthma, diabetes, genital herpes, chronic hypertension, and "other". Gestational age at the first antenatal visit was the only antenatal care variable recorded by the MNS, and this information was recorded only from January 2010. As the MNS does not identify AMGPP clients, midwives from each of the districts provided client lists directly to the Data Linkage Branch of the WA Department of Health for linkage to the relevant MNS record; in this manner, all but one AMGPP client could be identified.

Index of Relative Socioeconomic Disadvantage (IRSD) scores, one of the Australian Bureau of Statistics' Socio-Economic Indexes for Areas (SEIFA), are routinely linked with MNS records using geocodes based on the latitude and longitude of the client's address. In our study, population-level socioeconomic status was determined by the IRSD reported in the 2006 census at the collection district level (about 225 households), the smallest geographic unit of analysis available for the 2006 census.[5] The IRSD was reported in quintiles that compared the raw score with other IRSD scores in WA, with the first quintile including the most disadvantaged 20% of collection districts in WA.

Services provided by AMGPP staff were reported biannually as part of Closing the Gap IECD2 funding requirements. However, reporting practices varied across the five program districts and during the course of the study, so that program service data must be interpreted with caution.

Data analysis

Baseline demographic, pre-existing medical and pregnancy characteristics for the intervention group were compared with those for each of

the control groups. Health outcomes for the intervention group were compared with each control group, and reported as proportions and adjusted odds ratios (aORs). aORs with 95% confidence intervals were calculated using binomial logistic regression for the four dependent binary variables: birth before 37 weeks (preterm delivery, yes/no), birthweight under 2500 g (yes/no), neonatal resuscitation (yes/no), and baby LOS (> 5 days or ≤ 5 days). Covariates included in the regression models were: the continuous variable, maternal age; the two categorical variables, IRSD quintile and parity (nulliparous, 1–4, or more than 4 previous pregnancies of at least 20 weeks' gestation); and the five binary variables, previous caesarean delivery, caesarean delivery this pregnancy, one or more pregnancy complications, one or more pre-existing medical conditions and smoking during pregnancy. Covariates were retained in the final models only if they were independently associated with the neonatal outcome of interest.

Comparisons were made using Pearson or linear-by-linear χ^2 analyses (categorical variables) or Mann–Whitney U tests (continuous variables), with $P < 0.05$ defined as statistically significant.

Ethics approvals

Ethics approvals were obtained from the WA Aboriginal Health Ethics Committee (reference 493) and the SMHS Human Research Ethics Committee (reference 13/53). The WA Department of Health Human Research Ethics Committee provided approval for linkage to and analysis of statutory data (reference 2013/76).

Results

During the study period, there were 350 pregnancies and 353 babies born to 343 women in the AMGPP participant group, representing 58.2% of all pregnancies (350 of 601) and 66.0% of teenage pregnancies (99 of 150) in locally resident Aboriginal women. There were 350 pregnancies and 353 babies born in each of the two control groups.

Program participants

The mean age of AMGPP participants was 23.8 years, and 52.5% of the women resided in areas included in the most disadvantaged IRSD quintile (Box 2). Almost half of the women (44.6%) smoked during pregnancy. The most commonly recorded pre-existing medical conditions were "other" and asthma, occurring in 51.4% (180 of 350) and 13.1% (46 of 350) of pregnancies, respectively. The most common pregnancy complications were "other" and urinary tract infection, occurring in 14.9% (52 of 350) and 8.3% (29 of 350) of pregnancies, respectively.

Baseline characteristics

There were no significant differences between the AMGPP participant group and the control groups with respect to age, smoking status, parity or gravidity, body mass index (where data available), or multiple pregnancy (Box 2; multiple pregnancy data are not reported here because of MNS data-sharing agreement restrictions on the disclosure of data related to small numbers of individuals). Women in the contemporary control group were significantly less likely to reside in areas in the most disadvantaged IRSD quintile ($\chi^2 = 6.31$, $P = 0.01$). Women in the historical control group were significantly less likely to have a pre-existing medical condition ($\chi^2 = 10.57$, $P = 0.001$), although no significant differences were evident if the "other" diagnosis category was excluded from the analysis (AMGPP group, 50 of 350 (14.3%) v historical controls, 50 of 350 (14.3%): $\chi^2 = 0$, $P = 1.00$; v contemporary controls, 58 of 350 (16.6%): $\chi^2 = 0.70$, $P = 0.40$). The AMGPP participants were significantly less likely to have had a previous caesarean delivery (v historical controls, $\chi^2 = 6.29$, $P = 0.01$; v contemporary controls, $\chi^2 = 9.76$, $P = 0.002$).

Antenatal care and other services

Without adjusting for missing data, there were no significant differences in the proportions of women for whom an antenatal visit in the first trimester was recorded (AMGPP group, 102 of 337 (30.3%) v historical controls, 50 of 161 (31.1%): $\chi^2 = 0.03$, $P = 0.86$; v contemporary controls, 84 of 341 (24.6%): $\chi^2 = 2.71$, $P = 0.10$). For the AMGPP group, in addition to clinic-based antenatal visits, there were 294 outreach services by the AHO or an Aboriginal grandmother, with or without the midwife, during the study period. Individual brief smoking and alcohol interventions were delivered on 484 and 463 occasions, respectively. Program staff delivered a total of 62 antenatal education workshops, 1191 individual antenatal education services and 1155 individual sexual health education services.

Neonatal outcomes

The proportion of preterm births to AMGPP participants was significantly lower than in the two control groups (Box 3), and the program was associated with a significantly lower aOR for preterm birth (Box 4). Birthweight was correlated with gestational age ($r_s = 0.53$, $P < 0.001$), but significant differences between the groups in the proportions of low-birthweight babies were not found. The likelihood of neonatal resuscitation at birth or of having a hospital LOS of more than 5 days were significantly lower for babies of AMGPP participants (Box 4). There were significant differences between groups in the distribution of baby LOS (for the AMGPP, historical control and contemporary control groups, the respective means were 2.37 days, 3.01 days and 4.17 days; AMGPP v historical controls $P = 0.002$; v contemporary controls $P < 0.001$). The majority of AMGPP babies requiring a LOS of more than 5 days were born preterm (11 of 14 = 79%).

Discussion

Our study identified more favourable health outcomes for the babies of AMGPP participants than for babies of mothers in matched control groups, including significant reductions in the likelihood of preterm birth, neonatal resuscitation

2 Characteristics of Aboriginal Maternity Group Practice Program (AMGPP) participants and mothers in the two control groups

Characteristic	AMGPP participant group (350 pregnancies)	Historical control group (350 pregnancies)	Contemporary control group (350 pregnancies)
Maternal age, years (mean, range)	23.8 (15–44)	23.5 (14–42)	24.2 (13–44)
Gravidity (primigravida)	99 (28.3%)	99 (28.3%)	99 (28.3%)
Parity			
0 (nulliparous)	132 (37.7%)	127 (36.3%)	125 (35.7%)
1–4 births (multiparous)	188 (53.7%)	192 (54.9%)	209 (59.7%)
5 or more births (grand multiparous)	30 (8.6%)	31 (8.9%)	16 (4.6%)
Index of Relative Socioeconomic Disadvantage (IRSD) quintile			
1st (most disadvantaged 20%)	179/341 (52.5%)	174/330 (52.7%)	150/339 (44.2%)*
2nd	85/341 (24.9%)	94/330 (28.5%)	87/339 (25.7%)*
3rd	43/341 (12.6%)	33/330 (10.0%)	49/339 (14.5%)*
4th	21/341 (6.2%)	18/330 (5.5%)	37/339 (10.9%)*
5th (least disadvantaged 20%)	13/341 (3.8%)	11/330 (3.3%)	16/339 (4.7%)*
Body mass index			
Underweight (< 18.5 kg/m^2)	15/298 (5.0%)	na	4/136 (2.9%)
Normal weight (18.5–24.9 kg/m^2)	122/298 (40.9%)	na	64/136 (47.1%)
Overweight (25–29.9 kg/m^2)	72/298 (24.2%)	na	26/136 (19.1%)
Obese (≥ 30 kg/m^2)	89/298 (29.9%)	na	42/136 (30.9%)
Smoking status	156 (44.6%)	163/349 (46.7%)	160 (45.7%)
One or more pre-existing medical conditions	201 (57.4%)	158 (45.1%)*	185 (52.9%)
One or more complications during pregnancy	105 (30.0%)	127 (36.3%)	119 (34.0%)
Labour onset			
Spontaneous	248 (70.9%)	246 (70.3%)	212 (60.6%)†
Induced	77 (22.0%)	69 (19.7%)	90 (25.7%)†
No labour	25 (7.1%)	35 (10.0%)	48 (13.7%)†
Previous caesarean delivery	29 (8.3%)	50 (14.3%)*	56 (16.0%)*
Caesarean delivery this pregnancy			
Elective caesarean delivery	20 (5.7%)	27 (7.7%)	40 (11.4%)*
Non-elective caesarean delivery	46 (13.1%)	46 (13.1%)	61 (17.4%)

na = not available. The denominator for the calculations is included where data for a variable were incomplete. * $P < 0.05$, † $P < 0.001$, each compared with AMGPP group. ◆

and a hospital LOS of more than 5 days. Notably, the proportion of preterm births to women in the program (9.1%) was similar to that reported for all births in WA during 2011 (8.6%, 2755 preterm births),[4] and lower than that for all births to Aboriginal women in the SMHS area (15.6%, 56 preterm births)[6] and in all of WA (14.4%, 251 preterm births).[4]

During 2008–2010, spontaneous preterm delivery was the most frequent contributor to Aboriginal neonatal mortality in WA (14 deaths in the first 28 days of life, 37.8% of neonatal deaths) and the second most frequent contributor to Aboriginal infant mortality (17 deaths during the first year of life, 27.9% of infant deaths).[7] Premature birth, regardless of birthweight, has been associated with hypertension and insulin resistance in Aboriginal children.[8] Reducing the likelihood of preterm birth is therefore likely to have long-term health benefits. Antenatal programs similar to the AMGPP in other states have found statistically significant reductions in the proportions of preterm births, but not of low-birthweight babies.[9,10] In our study, having one or more pregnancy complications (both control groups) and smoking during pregnancy (comparison with contemporary control group only) were also independent predictors of a preterm birth.

Extended LOS can reflect complications for the mother, the baby or for

3 Health outcomes for the babies of Aboriginal Maternity Group Practice Program (AMGPP) participants and of mothers in the two control groups

Health outcome	AMGPP participants (353 babies)	Historical control group (353 babies)	Contemporary control group (353 babies)
Preterm birth (< 37 weeks)	32 (9.1%)	56 (15.9%)*	54 (15.3%)*
Low birthweight (< 2500 g)	38 (10.8%)	51 (14.4%)	56 (15.9%)
Requiring resuscitation at birth	63 (17.8%)	86 (24.4%)*	110 (31.2%)†
Baby length of stay > 5 days	14 (4.0%)	40 (11.3%)†	41 (11.6%)†

* $P < 0.05$, † $P < 0.001$, each compared with the AMGPP group. ◆

both.[11] WA data show that gestational age is a better predictor of neonatal LOS than birthweight.[4] The LOS for AMGPP participants was significantly lower than in either control group, with potential impacts on hospital costs. The majority of AMGPP participants with a LOS greater than 5 days had delivered preterm babies (79%).

A significant proportion (58.2%) of locally resident Aboriginal women and an even greater proportion of Aboriginal teenagers (66.0%) who gave birth during the study period participated in the AMGPP. In 2008, 53.1% of locally residing Aboriginal women (179 women) gave birth at KEMH, compared with 36.8% (148 women) in 2013, with a commensurate increase in the proportion of pregnant Aboriginal women giving birth locally.[6] Moreover, the proportion of local women participating in the AMGPP continued to grow in 2014–2015 (data not shown).

In 2011, birth rates were six times higher for WA Aboriginal teenagers than for non-Aboriginal teenagers.[4] Compared with adult women, teenagers are more likely to experience complications during pregnancy, such as urinary tract infections and hypertension, and their babies are more likely to be of low birthweight or stillborn.[12] Improving antenatal care uptake in this demographic was a major objective of the IECD2 program, and the AMGPP appeared to reach this risk group.

There were limited data in the MNS on the provision of antenatal care during the study period.[13] However, separate qualitative data collected as part of an evaluation of the program have shown the positive impact of the Aboriginal staff on ensuring early and continued engagement of pregnant women with the AMGPP.[13] Further, the 6-monthly district reports provided data about the outreach services, brief interventions and antenatal education delivered by the program staff.

Selection bias was potentially a limitation of the study design,[14] as women presenting for care possibly had different risk profiles to those who did not. In this study, the risk of selection bias was reduced (although

4 Multivariate models of neonatal health outcomes for Aboriginal Maternity Group Practice Program (AMGPP) participants compared with mothers in the two control groups

Health outcome Predictive factor	Historical control group aOR (95% CI)	 *P*	Contemporary control group aOR (95% CI)	 *P*
Preterm birth				
AMGPP	0.56 (0.35–0.92)	0.02	0.75 (0.58–0.95)	0.02
Pregnancy complications	6.24 (3.79–10.25)	< 0.001	3.69 (2.29–5.93)	< 0.001
Smoking		*	2.95 (1.79–4.84)	< 0.001
Low birthweight				
AMGPP	0.79 (0.49–1.30)	0.36	0.83 (0.66–1.07)	0.14
Pregnancy complications	8.41 (4.95–14.27)	< 0.001	5.70 (3.52–9.23)	< 0.001
Smoking	2.94 (1.77–4.87)	< 0.001	3.33 (2.03–5.47)	< 0.001
Previous caesarean delivery		*	2.05 (1.10–3.81)	0.02
Requiring resuscitation at birth				
AMGPP	0.68 (0.47–0.98)	0.04	0.71 (0.60-0.85)	< 0.001
Caesarean delivery this pregnancy	2.06 (1.36–3.12)	< 0.001	2.12 (1.45-3.10)	< 0.001
Baby length of stay > 5 days				
AMGPP	0.34 (0.18–0.64)	0.001	0.56 (0.41–0.77)	< 0.001
Pregnancy complications	2.53 (1.44–4.47)	0.001	2.79 (1.58–4.93)	< 0.001
Smoking		*	2.38 (1.32–4.30)	0.004

aOR = adjusted odds ratio. * Not significant, and therefore not included in the final models for the comparison with the historical control group. ◆

not eliminated) by the involvement of the Aboriginal grandmothers, who brought women into the program through their community networks.[13] Almost two-thirds of teenage pregnancies were managed by the AMGPP, suggesting that high-risk females were making use of antenatal health care. In addition, no significant differences between AMGPP participants and controls were detected with respect to maternal age, body mass index (when data were available), smoking status, parity or multiple pregnancy. In fact, some baseline characteristics of the contemporary control group suggested that it was a lower-risk group than the AMGPP participants; a greater proportion of the contemporary control group lived in socioeconomically less disadvantaged areas and this group included a lower proportion of grand multiparas. However, it is possible that the groups differed in ways that could not be quantified with the MNS data, such as the frequency of substance misuse. Further, the nature of the program, with AMGPP staff working alongside various hospital- and community-based antenatal services, meant that complete data on antenatal care provision were not always available, and this limits the conclusions that can be made about the direct effect of AMGPP participation on neonatal outcomes.

The AMGPP endeavoured to deliver culturally competent and holistic antenatal care services for Aboriginal women in the south metropolitan region of Perth, and babies born to participants were at lower risk for several adverse health outcomes, including preterm birth. Given the association between preterm birth and infant mortality, as well as the impact of prematurity on chronic disease throughout life, programs providing access to culturally secure antenatal care for Aboriginal women may have long-term benefits for their children. The AMGPP enhanced existing maternal health services and enabled more Aboriginal women to give birth locally and safely. This model of care could be adapted for use in similar settings with the support of local Aboriginal communities.

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1 Reibel T, Walker R. Overview and summary report of antenatal services audit for Aboriginal women and assessment of Aboriginal content in health education in Western Australia. Perth: Telethon Institute for Child Health Research, 2009. http://www.healthnetworks.health.wa.gov.au/docs/Summary_Antenatal_Services_Project_June_2009.pdf (accessed May 2013).

2 Council of Australian Governments. Closing the Gap: National Partnership Agreement on indigenous early childhood development. Canberra: COAG, 2009. http://www.federalfinancialrelations.gov.au/content/npa/education/ctg-early-childhood/national_partnership.pdf (accessed Jun 2014).

3 Epidemiology Branch. Population data. Perth: Department of Health, Western Australia, 2013. http://www.public.health.wa.gov.au/2/1124/2/epidemiology_.pm (accessed Jul 2015).

4 Joyce A, Hutchinson M. Western Australia's mothers and babies 2011. Twenty-ninth annual report of the Western Australian Midwives Notification System (Statistical series number 98). Perth: Department of Health, Western Australia, 2014. http://www.health.wa.gov.au/publications/documents/perinatal/WA_Mothers_Babies_2011.pdf (accessed Jul 2014).

5 Pink B. Socio-Economic Indexes for Areas (SEIFA). Technical paper. Canberra: Australian Bureau of Statistics, 2006. (ABS Cat. No. 2039.0.55.001.) http://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001 (accessed May 2014).

6 Midwives Notification System [website]. Perth: Department of Health, Western Australia. http://www.health.wa.gov.au/healthdata/statewide/midwives.cfm (accessed Nov 2014).

7 Ballestas T. The 14th report of the Perinatal and Infant Mortality Committee of Western Australia for deaths in the triennium 2008-2010. Perth: Department of Health, Western Australia, 2014. http://www.health.wa.gov.au/publications/documents/perinatal/14th_Report_Perinatal_Infant_Mortality_Committee.pdf (accessed Oct 2014).

8 Hoy WE, Nicol JL. Birthweight and natural deaths in a remote Australian Aboriginal community. *Med J Aust* 2010; 192: 14-19. https://www.mja.com.au/journal/2010/192/1/birthweight-and-natural-deaths-remote-australian-aboriginal-community

9 Murphy E, Best E. The Aboriginal Maternal and Infant Health Service: a decade of achievement in the health of women and babies in NSW. *N S W Public Health Bull* 2012; 23: 68-72.

10 Panaretto K, Lee H, Mitchell M, et al. Risk factors for preterm, low birth weight and small for gestational age birth in urban Aboriginal and Torres Strait Islander women in Townsville. *Aust N Z J Public Health* 2006; 30: 163-170.

11 Roberts SA, Kruger GB. Reasons for increased postnatal length of stay and women's perceptions of length of stay. *Aust J Midwifery* 2001; 14: 12-15.

12 Lewis LN, Hickey M, Doherty DA, Skinner SR. How do pregnancy outcomes differ in teenage mothers? A Western Australian study. *Med J Aust* 2009; 190: 537-541. https://www.mja.com.au/journal/2009/190/10/how-do-pregnancy-outcomes-differ-teenage-mothers-western-australian-study

13 South Metropolitan Population Health Unit. Evaluation of the Aboriginal Maternity Group Practice Program in the South Metropolitan Health Service. Perth: Department of Health, Western Australia, 2015.

14 Herceg A. Improving health in Aboriginal and Torres Strait Islander mothers, babies and young children: a literature review. Canberra: Australian Government Department of Health and Ageing, 2005. http://www.health.gov.au/internet/main/publishing.nsf/Content/health-oatsih-pubs-hfllit.htm (accessed May 2013). ■