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Reaching the most vulnerable: A study of factors affecting enrolment in nurse-led home visiting in very remote communities of Australia's Northern Territory

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Abstract

Background This study reports preliminary findings of an evaluation of the implementation of maternal and early childhood sustained nurse home visiting (the MECSH program) by three Aboriginal Community Controlled Health Services (ACCHS) in very remote communities of Australia's Northern Territory (NT). MECSH was available to all women who were pregnant regardless of age and parity. There is a need to understand differences in access to the program among those eligible.

Methods A prospective evaluation cohort study gathered data for all women in three regions who were pregnant and eligible to be offered enrolment in MECSH over the period from 2019–2024. Using de-identified primary healthcare service records, demographic characteristics, perinatal risk factors and services used by women eligible to join the program are described. Differences in potential vulnerability to adverse birth and health outcomes are identified. Multivariable modified Poisson regression is used to identify characteristics of women that are associated with offer of enrolment.

Results In total, 1412 women were eligible to join MECSH from 2019–2024: of these, 45% were offered enrolment in the program, while 55% were not offered a place. There were differences in perinatal outcomes, psychosocial and behavioural risk factors and antenatal healthcare utilisation patterns within the cohort both by age and by enrolment in the program. Women offered MECSH were higher users of antenatal care than those not offered MECSH. Young women, women with other children, those with mental health concerns, who used drugs, had a chronic condition or who experienced domestic violence had somewhat increased likelihood of program offer.

Conclusions This study provides support for sustained nurse home visiting to be implemented at scale and made available regardless of age and parity. There is no evidence to justify focusing exclusively on teenage or first-time mothers at the expense of older and multiparous women, although there are likely to be significant differences in needs for support within the cohort. Assertive engagement of clients should identify those at risk of being missed

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through low use of antenatal services and should proactively consider both psychosocial needs and quality of family support in assessment of potential for benefit from the program.

Keywords Remote Aboriginal communities, Maternal and child healthcare, Sustained nurse home visiting, Aboriginal Community Controlled Health Services

Background

International evidence suggests that appropriately designed programs of sustained nurse-led home visiting can strengthen the capacity of at-risk mothers to care for their children with long-term benefits for both mother and child across the life course. Evidence for the effectiveness of programs implemented when integrated within community healthcare services is limited and provides little information on client engagement, recruitment and retention [1–3]. Growing interest in implementation of maternal and early childhood home visiting programs within healthcare systems at scale now extends to trials for Indigenous peoples in North America and Australia [4–6].

The context

Australia's Northern Territory (NT) spans a sparsely populated region with a population of 225,100 persons in 2024, of whom 30.8% were Aboriginal; approximately 75% of the NTs Aboriginal population lived in remote or very remote areas [7]. As part of policies towards self-determination, primary healthcare and other services are now increasingly provided by Aboriginal Community Controlled Organisations.

From 2017–2018, the Northern Territory Government (NTG) adopted policies that aimed to significantly increase support for families during pregnancy and the first years of life through an expansion of access to sustained nurse home visiting (SNHV) for Aboriginal mothers in very remote communities [8].

The program adopted for implementation was Maternal and Early Childhood Sustained Home Visiting program (MECSH). MECSH had been developed in metropolitan Sydney but had not been implemented in any remote regions with predominantly Aboriginal populations [9]. Four Aboriginal Community Controlled Health Services (ACCHS) responsible for providing primary healthcare in three very remote regions of the NT commenced implementation of MECSH in 2018/2019. Three ACCHS continued to implement the program until December 2024. Funding and coordination were provided by the NT Department of Health with implementation support by the program's developers at Translational Research and Social Impact (TReSI), Western Sydney University, which provided training and monitored elements of implementation. A team at the Menzies School of Health Research was commissioned by the Northern Territory Department of Health to undertake an evaluation.

Implementation took place in the East Arnhem and Katherine regions of the Northern Territory from 2018 to 2024. Clients of the health services were predominantly Aboriginal people resident in communities within their respective health service catchments, ranging in size from just over 2500 to as few as 100 residents, some living in one or more outstations serviced by a health clinic at a larger community nearby.

Initial expectations were that implementation would reach 40–50% of the eligible population of women giving birth. The program was progressively implemented in communities as recruitment and training of staff took place, so that by the end of 2020, almost all intended communities had allocated nurse positions.

Home visiting and modifiable risks in the NT

Programs of sustained home visiting target modifiable risks to healthy development from pregnancy through birth and early childhood: support during the prenatal period aims to reduce vulnerability to neurodevelopmental disorders and poorer health and development; postnatal support aims to strengthen parental responsiveness and to reduce risks of child maltreatment and its consequences for social-emotional and behavioural development [4]. Risks at each stage require appropriate strategies to strengthen parental capacity as well as to promote access to relevant services and supports [10].

Maternal, prenatal and infant risk profiles and childhood adversity

Improvements in birth outcomes, reductions in developmental vulnerabilities and reductions to the over-representation of Aboriginal children in the child protection system are priority target areas in national policies to “close the gap” in Aboriginal disadvantage [11]. Recent reports suggest that progress toward improvements in birth outcomes for NT Aboriginal infants and children have plateaued and indicators of child development and child protection involvement have declined [11–13]. Improvements in clinical maternal and child health care alone are not sufficient to change these outcomes [14–17]. Clinical care needs to be embedded in a framework of culturally safe, wrap-around care and augmented by early intervention to build parenting strengths of mothers through effective psycho-social support [17, 18].

NT research has found that the period of greatest vulnerability to child protection intervention for Aboriginal children was in the first two years, with the greatest

frequency of notifications in the first six months [19]. Maternal and perinatal factors associated with notification of Aboriginal children to child protection included, in order: maternal alcohol use; low birth weight; maternal smoking and attendance at fewer than seven antenatal visits; birth to a teenage mother had no association with likelihood of child protection involvement for Aboriginal infants [19]. However, maternal and perinatal risk factors only account for limited variance in child protection outcomes, suggesting that other factors associated with parent capability and family functioning may be important influences in risk of child protection involvement [20]. A study of profiles of early childhood adversity in a large NT cohort identified two clusters of primarily Aboriginal, remote-living children who experienced more frequent hospitalisation and increased notifications for neglect [21]. It concluded that for these groups, interventions such as sustained nurse home visiting may be more effective than single system responses that target narrowly defined categories of illness or indicators of neglect [21].

There is clearly a need to address the social and psychological vulnerabilities that influence maternal experience, psychological wellbeing and parenting and to reduce factors contributing to the prevalence of adverse experiences in early childhood. In the very remote communities of the present study, evidence suggests that there is need for implementation of a well-structured home visiting program that aims to improve psychosocial support and to build parenting strengths beginning in pregnancy and continuing through the first years of life.

MECSH: maternal and early childhood sustained home visiting

Although sharing common elements of theory and approach, MECSH differs from some other antenatal and postnatal home visiting programs in that it is not limited to teenage or first-time mothers but is open to women of any age and with other children. Further, it is designed to be embedded in primary healthcare service systems in socio-economically disadvantaged regions, with a focus on integration with existing care systems and promotion of access to additional tiers of services and supports [22].

In Australia, a first MECSH randomised trial was implemented in a disadvantaged area of Sydney, New South Wales [9, 23]. A subsequent trial of the program under the name “right@home” was implemented for women attending hospitals within the Victorian and Tasmanian health care systems from 2014 [20, 24, 25]. Recruitment and intake prior to randomisation were based on initial screening for emotional and psychosocial risks, risk behaviours and family circumstances with some variations between trials. Outcomes measured included birth outcomes, improved parenting and

improvements in the home environment and improvements in children’s development and learning. These studies have not directly investigated impacts of home visiting on child maltreatment and associated early childhood adversity.

Program design and recruitment to MECSH in the NT

In the NT, MECSH was delivered by three ACCHS responsible for provision of comprehensive primary healthcare in 19 very remote NT communities and associated homelands and outstations. The program was delivered in each community by a trained registered nurse, working together with a dedicated social care practitioner to provide social support to women and their families. The latter position was not consistently filled throughout the implementation period by all health services. For the NT, Aboriginal cultural advisors and community support workers were also included in MECSH teams. Recruitment of participants was undertaken in consultation with clinic maternity care providers (usually midwives but also GPs and remote area nurses). However, providers approached collaboration in different ways and there was considerable variability in practices to identify and engage women for offer of the program.

Scheduled MECSH nurse home visits were to commence during pregnancy and to continue until the child’s third birthday. Content of the program emphasised anticipatory guidance beginning with preparation for birth and parenthood, followed by parent education to build knowledge of child development, to encourage psychological stimulation of the child and to strengthen parental responsiveness to support children’s social- emotional and behavioural development [26]. The program engaged women about their goals and aspirations and their families about support for mother and child based on a model of parent-led family partnership [27]. In collaboration with other service providers, MECSH practitioners aimed to support access to additional health, allied and social services to meet both parents’ and children’s needs.

The program was designed to be offered at any time during pregnancy with scope to be offered to some women postnatally up to 8 weeks postpartum (Fig. 1). All women pregnant in any of the participating communities were eligible to join, although it was anticipated that resources would allow 40–50% of eligible women to be enrolled. Program design requirements specified that 100% of eligible women be assessed for entry to MECSH. However, this was not feasible and was not implemented.

To support caseload management, criteria were developed to prioritise women according to age, vulnerability, need and psychosocial risks in the familial environment, through a process involving review of clinical histories and assessment of family and household supports with interdisciplinary consultation as appropriate. These

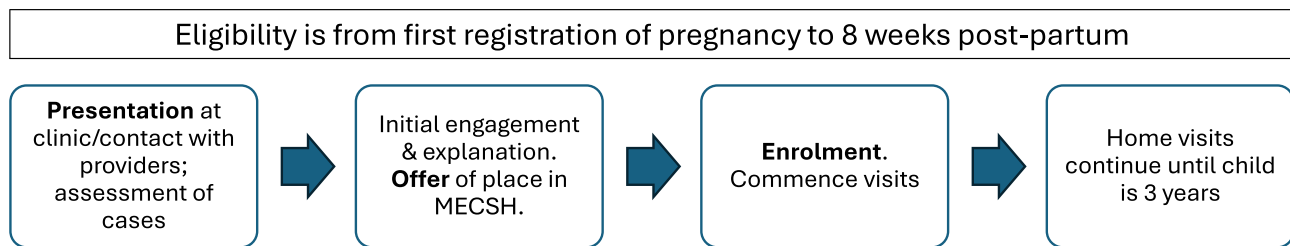


Fig. 1 Engagement and intake

criteria were not systematically implemented through formal screening procedures and relied on assessments by staff in each location according to their own understanding. Records of assessment were not maintained.

The evaluation was based on a prospective cohort study design in which data were gathered for the whole cohort of eligible women and followed up for the entire study period.

Unlike previous trials, this evaluation drew on routinely collected primary healthcare data that were provided in de-identified form by each of the participating ACCHS. These records were augmented by a suite of MECSH service items that were co-designed by the evaluators and MECSH practitioners at the beginning of the program.

In the absence of formal assessment for intake, for this study of client recruitment we used de-identified data from primary health care records to identify the population of women eligible to receive MECSH in the NT and to explore associations between women's characteristics, their use of antenatal health services and their enrolment in MECSH.

Over the evaluation period there was intensive engagement between evaluators, program managers, health practitioners including both Aboriginal and non-Aboriginal staff as well as semi-structured interviews with Aboriginal clients in communities. These methods support interpretation of findings of this quantitative investigation.

Aims

This study addresses the characteristics of the population identified as eligible to join the MECSH program in the NT from 2019 to 2024 and examines who had access to the program and why. It has the following specific aims:

- 1) To describe the socio-demographic characteristics and risk profile of the cohort of women eligible to receive the MECSH program in participating communities
- 2) To distinguish subgroups of eligible women: those who were offered the program; those who accepted enrolment in the program and those who were not offered the program

- 3) To investigate associations between women's characteristics, service use and risk profile and the likelihood of offer of a place and enrolment in the MECSH program.

Methods

We conducted a cohort study of prospectively collected, de-identified primary healthcare data to investigate the characteristics of women eligible to be offered MECSH and the various factors that could impact on their participation. In addition to extraction of quantitative data, semi-structured interviews were conducted with MECSH nurses and other health practitioners to explore factors influencing the delivery of the program and with Aboriginal parents in the implementing communities to understand their perceptions and experiences of the program. The methods for the parent and practitioner interviews are described elsewhere [28]. Results of this part of the investigation are provided to assist with interpretation of findings of this study but are not presented in detail here.

Recruitment of participants

In the NT, women were eligible to receive MECSH services from the start of pregnancy up to 8 weeks post-natal for term and well-infant births. Premature or sick infants were eligible to receive MECSH services up to 8 weeks post discharge from hospital. However, because discharge after birth was poorly documented in primary health care records and subject to delays in return to resident communities following birth in regional hospitals, we extended the period of eligibility for the cohort to 10 weeks after date of birth for all mothers.

For this study, eligibility for MECSH enrolment included any women who:

- were classified as resident in a MECSH implementing community during their period of eligibility and either of the following:
 - were pregnant on or after 1 January 2019 (start date of MECSH in the NT), or
 - had a date of birth recorded or linked child born on or after 4 November 2018 (8 weeks before MECSH start date).

Women were excluded if they appeared in the data extract but did not have any pregnancy-related services and were not linked to a child in the dataset, including women with a termination or first trimester miscarriage and no subsequent pregnancies. For the purpose of this investigation, only a woman's first eligible birth or, for women pregnant at time of data extraction, a woman's first eligible continuing pregnancy, was included for analysis.

Data sources and data collection

Participating ACCHS all use standalone versions of the clinical record system, Communicare. Using a purpose-designed script, each ACCHS provided de-identified extracts of demographic and clinical service data for all women potentially eligible to enrol in MECOSH and their children born during the study period. To protect individuals' confidentiality, information recorded in free text fields was excluded.

The dependent variable

The dependent variable, MECOSH enrolment, consisted of two mutually exclusive categories:

- *Eligible not offered*: all women in the cohort meeting inclusion criteria (hence eligible) but without any record of offer or acceptance of MECOSH
- *Eligible and offered*: women with any record indicating offer of enrolment in MECOSH

We further divided the 'Eligible and Offered' group into two subgroups for analysis:

- *Offered, not Enrolled*: women with a record of offer but no record indicating acceptance of the offer, and
- *Offered and Enrolled*: women with any record indicating acceptance of an offer of enrolment in the program.

The explanatory and controlled variables

For sociodemographic characteristics and risk profile, we selected variables that could potentially affect women's participation in MECOSH based on those commonly used in SNHV program intake criteria, and those found to be associated with adverse child development outcomes and potentially modifiable through SNHV programs [6, 15, 24, 29]. We derived the variables from the diverse data items available in the primary health care service datasets (Additional File, Supplementary Table 1).

- *Sociodemographic*: Maternal age at start of period of eligibility, number of previous births
- *Antenatal care*: Timing of first routine antenatal care check (not including care provided by MECOSH

in the antenatal period); total number of antenatal care checks (for women with completed pregnancies only)

- *Psychosocial and health risks*: Maternal emotional wellbeing screening; domestic and family violence (DFV); indication of maternal mental health concern; indication of maternal diagnosis of chronic condition; smoking, alcohol or other drug use during pregnancy
- *Birth outcomes*: Type of birth; birthweight, proportion low (less than 2500 grams) and high birth weight (more than 4000 grams) gestational age at birth, preterm birth (less than 37 weeks gestation).

Statistical analysis

Descriptive statistical analysis was conducted on explanatory, dependent and controlled variables. For univariate analysis, the Analysis of Variance (ANOVA), Kruskal-Wallis test and Chi-square tests were used to compare characteristics among categories of dependent variables. All factors yielding a p value < 0.15 , indicating at least marginal association, were tested by modified Poisson regression [30]. In multivariable analysis, we retained a number of control variables identified based on theoretical relevance and prior evidence regardless of the p -value at univariate analysis, including maternal age at start of eligibility and eligible pregnancy is woman's first birth. Modified Poisson regression was used to estimate prevalence ratios (PRs) with robust standard errors. Interaction terms between selected variables were evaluated individually by adding cross-product terms to the multivariable model. A two-tailed p -value of < 0.05 was considered to be significant. As the study used routinely collected administrative data, there were missing data for some variables included in the analyses. We reported the levels of missingness where appropriate and adopted complete case analysis in all regression analyses. All data analyses were performed using Stata release 17 (Stata Corp., 2021).

Ethics

The project was approved by the Northern Territory Government Department of Health and Menzies School of Health Research Human Research Ethics Committee (Approval number HREC 2020–3696) and the Charles Darwin University Human Research Ethics Committee (Approval number H20078).

Results

Characteristics and risk profile of women in the cohort

The cohort comprised 1412 women, of whom 191 were still pregnant with their eligible pregnancy and 1221 had a record of birth for their eligible pregnancy. Figure 2 outlines the cohort according to offer and enrolment as

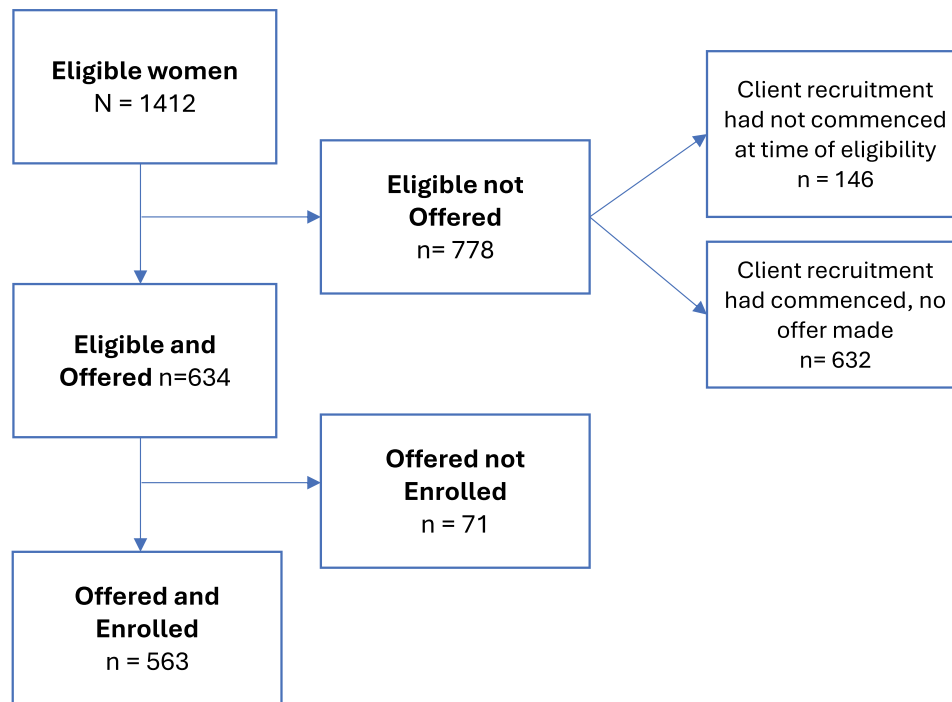


Fig. 2 Cohort description, January 2019–April 2024

groups for analysis. Due to the stepwise process of implementation in each community, of the 778 women who were not offered the program, 146 were eligible during a time when the program had not yet commenced (Fig. 2). Of the 1266 women eligible during a time when the nurse had commenced client recruitment, 634 (50%) were offered a place in the program and 563 (45%) had accepted an offer of enrolment.

Participant characteristics and risk profile of the cohort of 1412 women according to age group are presented in Table 1. Results for all explanatory and controlled factors including confidence intervals are available in Supplementary Table 2 (Additional file 1). The mean age of women in the cohort was 26.1 years (standard deviation (SD) 6.4) at time of eligibility for MECOSH, 19.8% aged less than 20 years and 10.1% aged 35 years and older. More than half of women had at least one other child (53.8%) with a median of 2 children. The proportion of women with no previous births (46.2%) was significantly different by age group (Table 1, $p < 0.0005$), highest for teenage women (83.6%) and lowest for women 35 years or older (19.0%).

Most women (87.6%) presented for at least one antenatal care visit, attending a median of 9 visits during their eligible pregnancy (Table 1). There was significant variation in the pattern of attendance for antenatal care between age groups ($p = 0.003$). Women aged 35 years or older had the highest proportion with no antenatal care visits (20.9%), the lowest proportion with 7 or more visits (59.3%), but nevertheless had the highest median number

of visits. This suggests that there is a substantial number of older women receiving well above the recommended 7 visits. Teenage women had the highest proportion attending for at least seven visits (73.6%) but had their first visit later than older women. Mean gestation at first antenatal care visit was 13.6 weeks with no significant difference by maternal age. While the majority of women (60.4%) presented before 14 weeks gestation a substantial group of women (9.3%) presented for their first antenatal care visit at 28 weeks or later.

A substantial proportion of women in the cohort smoked (61.5%), drank alcohol (31.8%), and used drugs (15.6%) during pregnancy (Table 1). Alcohol use was highest for women over 34 years (38.4%) and lowest (22.9%) for teenage women ($p = 0.001$). There was near-significant difference by age in the proportion of women disclosing domestic and family violence ($p = 0.060$). One quarter of women had a record of a chronic condition and 28.2% of women had a mental health concern recorded, with no statistically significant variation by maternal age.

Differences in birth weight or in the proportion born with low birth weight by maternal age groups were not statistically significant (Table 2). Differences in mean gestational age at birth between age groups were statistically significant ($p = 0.001$) and in proportions of women giving birth pre-term: 18.4% overall, highest for women aged 35 years and older (26.0%) and lowest for teenage women (14.2%; $p = 0.035$).

Table 1 Sociodemographic characteristics and antenatal care attendance by age for the eligible cohort

Factors	All eligible women	Age group by age at start of period of eligibility			p value
		< 20 years	20–34 years	≥ 35 years	
Number of women (%)	1412	280 (19.8%)	990 (70.1%)	142 (10.1%)	
Parity					
No previous births (%)	46.2%	83.6%	39.5%	19%	< 0.0005
Number of previous births, median (range)	2 (0–9)	1 (0–3)	2 (0–8)	4 (0–9)	< 0.0005
Antenatal care attendance^a					
Any antenatal care visits	87.6%	93.7%	86.8%	80.1%	0.001
Number of antenatal care visits, median (range)	9 (0–38)	9 (0–33)	8 (0–38)	10 (0–26)	0.025
0 visits	12.4%	6.3%	13.2%	20.9%	0.003
1–4 visits	14.7%	11.3%	15.7%	14.0%	
5–6 visits	8.4%	8.8%	8.5%	5.8%	
7 or more visits	64.5%	73.6%	62.5%	59.3%	
Gestation at first visit, mean (SD) weeks	13.6 (13.1–14.1)	14.2 (13.1–15.3)	13.4 (12.8–14.0)	13.5 (11.5–15.4)	0.479
First antenatal care visit in first trimester (%)	60.4%	55.4%	61.0%	67.4%	0.112
First antenatal care visit in third trimester (%)	9.3%	8.9%	9.0%	12.0%	0.649
Psychosocial and health risks					
At risk on emotional wellbeing screen ^b	29.1%	30%	29.9%	16.4%	0.079
Mental health concern	28.2%	30.1%	27.4%	29.9%	0.595
Domestic and family violence disclosure	25.3%	30.5%	24.4%	21.2%	0.060
Chronic condition	24.8%	22.2%	25.3%	27.0%	0.480
Smoking during pregnancy ^c	61.5%	61.5%	66.9%	61.5%	0.207
Alcohol use during pregnancy ^d	31.8%	22.9%	33.5%	38.4%	0.001
Other drug use in pregnancy ^e	15.6%	15.5%	15.6%	15.7%	0.999

^a Excludes 191 women still pregnant with MECOSH eligible pregnancy at time of data extract ($N = 1221$); ^b Proportion of women with emotional wellbeing screen recorded ($n = 960$); ^c Proportion of women with record of inquiry about smoking in pregnancy ($n = 1312$); ^d Proportion of women with record of inquiry about alcohol use in pregnancy ($n = 1306$); ^e Proportion of women with record of inquiry about drug use in pregnancy ($n = 1278$). SD: Standard deviation

Table 2 Birth characteristics by age of the eligible cohort of women

Birth characteristics	All eligible women (n = 1221)	Age group by age at start of period of eligibility			p value
		< 20 years	20–34 years	≥ 35 years	
Birth type					
Normal vaginal	50.7%	55.2%	49.8%	48.3%	0.007
Complicated vaginal	12.7%	16.7%	12.5%	6.0%	
Caesarean	31.0%	25.1%	31.9%	37.1%	
Unknown	5.6%	2.9%	5.9%	8.6%	
Birth weight, mean (SD), grams	3007.1 (2965.3–3049.0)	3057.9 (2973.4–3142.4)	2993.0 (2941.5–3044.5)	3002.6 (2871.0–3134.2)	0.479
Low birth weight	18.3%	13.9%	19.7%	17.0%	0.136
Gestational age at birth, mean (SD) weeks	37.7 (37.5–37.9)	38.4 (38.1–38.7)	37.6 (37.4–37.8)	37.1 (36.4–37.9)	0.001
Preterm birth	18.4%	14.2%	18.6%	26.0%	0.035

Enrolment in MECOSH

Comparison of women who were eligible but not offered with those who were offered revealed some significant differences in demographic characteristics, healthcare attendance and psychosocial risks (Table 3).

Women offered were younger (mean 24.7 years) than those not offered (mean 25.8 years, $p = 0.001$), with a greater proportion of teenage women offered MECOSH ($p = 0.013$). The median number of other children was higher for women offered MECOSH compared to those not offered ($p = 0.001$), although the proportion pregnant with their first baby was not significantly different between the groups ($p = 0.092$). Women who were offered MECOSH were more likely to present for any antenatal care than women not offered (96.6% vs 83.8%, $p < 0.0005$), and to present before 14 weeks gestation for their first antenatal visit (62.2% vs 48.9%, $p < 0.0005$). Women not offered MECOSH presented later for antenatal care, with first visits occurring at nearly 13.5 weeks, compared to first visits at 12.5 weeks for women offered ($p = 0.043$). A greater proportion of women who were offered MECOSH had an indication in their clinical record of domestic and family violence (31.4% vs 21.7%), mental health concern (37.8% vs 23.1%), chronic condition (28.8% vs 18.3%) and drug use during pregnancy (20.7% vs 11.4%). There was

Table 3 Univariate analysis comparing characteristics and psychosocial and health risks of women according to whether they were offered enrolment in MECOSH

Factors	Whether offered MECOSH while eligible		
	Not offered (n = 632)	Offered (n = 634)	p value
Age at start of period of eligibility mean, (SD) years	25.8 (25.3–26.3)	24.7 (24.2–25.2)	0.001
20–34 years	74.4%	70.2%	0.013
< 20 years	17.3%	23.5%	
≥ 35 years	8.4%	6.3%	
No previous births	50.3%	45.6%	0.092
Number of previous births (median, range)	1, 0–9	2, 0–8	0.001
Antenatal care attendance^a			
Any antenatal care	83.8%	96.6%	< 0.0005
Number of antenatal care visits			
0 visits	16.2%	3.4%	< 0.0005
1–4 visits	20.5%	9.7%	
5–6 visits	10.2%	6.8%	
7 or more visits	53.2%	80.2%	
Gestation at first antenatal care visit, mean, (SD) weeks	13.5 (12.7–14.2)	12.5 (11.8–13.1)	0.043
First antenatal care visit in first trimester	48.9%	62.2%	< 0.0005
First antenatal care visit in third trimester	9.0%	7.1%	0.257
Psychosocial and health risks			
Smoking during pregnancy (n = 1075)	63.2%	67.0%	0.193
Alcohol use during pregnancy (n = 1189)	27.4%	31.3%	0.135
Other drug use in pregnancy (n = 1163)	11.4%	20.7%	< 0.0005
At risk emotional wellbeing screening score (n = 741)	15.1%	17.9%	0.313
Mental health concern	23.1%	37.8%	< 0.0005
Domestic and family violence disclosure	21.7%	31.4%	< 0.0005
Chronic condition (n = 1251)	18.3%	28.8%	< 0.0005

^a Excludes 191 women still pregnant with MECOSH eligible pregnancy at time of data extract (N = 1221)

no statistically significant association between MECOSH offer and smoking, alcohol use or at-risk emotional wellbeing screening scores.

Of women offered MECOSH, 71 did not accept the offer and commence enrolment. In comparison with those enrolled, this group was similar in age, parity, antenatal care attendance and most psychosocial and health risk factors to women enrolled in MECOSH (Additional File 1, Supplementary Table 3). An indication of mental health concern (26.8% vs 39.1%, $p = 0.043$) and chronic condition (18.1% vs 30.1%, $p = 0.039$) were the only significant differences.

Table 4 Multivariable analysis of associations between sociodemographic characteristics, health and psychosocial risks and offer to join MECOSH

	Whether offered MECOSH while eligible		
	Prevalence ratio	95% CI	P value
Age group at start of period of eligibility			
20–35 years	Reference		
< 20 years	1.18	1.04–1.34	0.010
> 35 years	0.84	0.66–1.06	0.136
Number of antenatal care visits for eligible birth			
0 visits	(null)		
1–4 visits	Reference		
5–6 visits	1.32	0.96–1.82	0.087
7 or more visits	2.41	1.92–3.02	< 0.0005
No previous births	1.02	0.87–1.20	0.780
Number of other births	1.07	1.01–1.12	0.014
Gestation at first antenatal care visit	1.01	1.00–1.02	0.001
Chronic condition	1.20	1.07–1.33	0.002
Other drug use in pregnancy	1.26	1.13–1.41	< 0.0005
Disclosed domestic and family violence	1.18	1.02–1.36	0.022
Mental health concern	1.20	1.06–1.36	0.004
Interaction term: having both mental health concern and disclosure of any domestic and family violence	0.82	0.66–1.36	0.079

Multivariable analysis confirmed the association with age (Table 4: PR = 1.18; $p = 0.010$) and with number of previous births (Table 4: PR = 1.02; $p = 0.014$). It confirmed the strength of the association of number of presentations for antenatal care with offer to join MECOSH: for 7 or more visits there was more than twice the likelihood of offer of a place in MECOSH (PR = 2.41; $p < 0.0005$).

Other factors associated with greater likelihood of being offered MECOSH were, in order of magnitude, other drug use in pregnancy (PR = 1.26; $p < 0.0005$), mental health concern (PR = 1.20; $p = 0.004$); having a chronic condition (PR = 1.20; $p = 0.002$); disclosed family violence (PR = 1.18; $p = 0.022$). Analysis of interaction between mental health concern and family violence suggests that having both conditions was associated with lesser likelihood of offer (PR = 0.82; $p = 0.079$).

Multivariable analysis of factors associated with enrolment in MECOSH found that only having a chronic condition and indication of a mental health concern remained significantly associated with increased likelihood of enrolment in MECOSH for women offered a place (Table 5). An interaction term including chronic condition and mental health concern did not improve the model.

Table 5 Multivariable analysis of characteristics associated with enrolment in MECSH for all women offered a place

	Whether enrolled after being offered		
	Prevalence ratio	95% CI	p value
Age group at start of period of eligibility			
20–35 years	Reference		
< 20 years	0.950	0.878–1.028	0.205
> 35 years	0.947	0.838–1.071	0.386
No previous births	0.992	0.932–1.055	0.795
Chronic condition	1.070	1.013–1.131	0.016
Mental health concern	1.069	1.012–1.130	0.016

Discussion

Allowing for the gradual start-up of client recruitment over the first two years, the MECSH trial demonstrated the feasibility of implementation of the program at scale, with 50% of eligible women where the program was available offered MECSH and 89% of those women taking up the offer of enrolment. Therefore 45% of all women who were pregnant or less than 8 weeks postpartum at the time that recruitment commenced in their community were enrolled in MECSH. The demonstrated capacity of the program to reach this proportion of the population in very remote areas presents an important opportunity to contribute to improved maternal and child outcomes.

Vulnerability in the eligible population

The profile of perinatal outcomes and psychosocial risks in conjunction with high levels of health service engagement of women in the cohort are suggestive of opportunities to positively influence outcomes for births, child development and maternal wellbeing. Adverse birth outcomes are associated with higher likelihood of adverse neurodevelopmental outcomes and developmental delay and can thereby challenge parents' capacity to meet their children's needs [31].

For this cohort, the proportions of preterm births (18.4%) or infants born with low birth weight (18.3%) are comparable with proportions reported in NT remote dwelling populations [12]. There were significant differences in the proportions of women by age group who experienced adverse birth outcomes. However, in contrast with some previous studies of Aboriginal mothers and babies in northern NT, in this cohort teenage women experienced the lowest proportions of low birth weight and preterm births, compared with older age groups [15].

High proportions of women had records of psychosocial, behavioural and health risks, such as smoking (61.5%), alcohol use (31.8%), other drug use (15.6%) in pregnancy and experience of domestic violence (25.3%) along with mental health concerns (28.2%), emotional wellbeing risk (29.1%) and diagnosed chronic

conditions (24.8%). Only drug use, mental health concerns and chronic conditions appeared to influence offer of MECSH. The areas of parenting strength and positive support received from families may be central to child outcomes but are harder to assess with available data. MECSH personnel are almost certainly taking these factors into account at time of intake, but without recording details. Overall, variation within the cohort suggests that women of different ages may have specific needs for education, care and support provided through maternity care services and by MECSH.

Attendance at antenatal care

The pattern of women's usage of antenatal care differed significantly by age group. Although antenatal care was attended at least once by 87.6% of eligible women, there was variation between the three age groups. Of women aged over 34 years 20% received no antenatal visits while others received many more than the recommended seven visits. As a result, the highest median attendance among the three age groups was for older women. High service users across all ages may have very high healthcare needs. By contrast, only 6.3% of teenage women did not attend for any antenatal care and over three quarters attended 7 or more times. Teenage women may be more reticent initially to present for antenatal care but then engage more often through a combination of proactive contact by maternity care providers, their own help-seeking once pregnancy is disclosed and encouragement by older women and young women's receptiveness to their advice and support [32, 33]. Further investigation of patterns of antenatal service use and their association with later outcomes is planned.

Factors associated with offer of MECSH

Most women offered MECSH were contacted after presentation for antenatal care at a clinic, accounting for the strength of association between any presentation for antenatal care and both offered and enrolled groups. The significant association of MECSH offer with the number of antenatal attendances indicates not only that being known to the maternal care providers but also that repeated contact with antenatal services influenced whether a woman was offered MECSH.

Participants offered MECSH were younger than those not offered, but not significantly different in terms of the proportion of first-time mothers. The increased odds of MECSH offer for teenage women and young women with other children suggest that MECSH nurses have prioritised younger eligible women needing to care for their other young children. This is consistent with what nurses interviewed said about their concern for mothers who appeared to lack support. However, it may also suggest

that pregnant women with young children were more likely to seek out and accept support.

While women with psychosocial risks (mental health problems, drug use, domestic violence) and women with higher health needs (chronic illness) were more likely to be offered MECSH (Table 4), of all the factors considered, frequent antenatal care attendance had the strongest association with likelihood of being *offered* MECSH. The further multivariable analysis of factors contributing to likelihood of *enrolment* in MECSH, that is, of acceptance of offer (Table 5) suggests that women with psychosocial risks (mental health concerns) and women with higher health needs (chronic illness) were more likely to be enrolled. These women were not explicitly targeted within recruitment protocols but in the course of their antenatal attendance may have been ready to accept additional support from MECSH based in part on these other needs. Overall, the program appears to attract an already high health service utilising population.

Differences in levels of health service use may reflect a range of factors. Women without pre-existing conditions that bring them into frequent contact the health service may be less likely to be engaged by providers when they become pregnant. Individual interviews indicated that some women were reluctant to disclose their pregnancy and to contact providers until late. In individual cases, this was for personal reasons: worries associated with a previous birth experience or outcome; concern about the response of a partner, or uncertainty about the partner's commitment, and other concerns relating to personal circumstances. Perceptions of the care provided by the community health service appeared to have influenced readiness to engage antenatally in individual cases [28]. However, it is not possible to quantify these effects on participation overall.

Currently available health records do not adequately capture patterns of client mobility. However, interviews with both practitioners and clients suggest that movement between communities contributed to some women being missed for offer and enrolment into MECSH. Individual interviews described situations in which some women who were absent from community when learning of their pregnancy missed appointments and were not engaged by the MECSH providers. According to nurses' accounts, engagement to join the program often required multiple visits before there was agreement to accept an offer. They suggested that, despite considerable effort to make contact, client mobility was likely to be associated both with lower levels of antenatal and general clinic attendance and therefore with lower chances of offer and enrolment in MECSH. Analysis of a range of sources of qualitative and quantitative data is needed to more fully understand the reasons for low service use and its

association with lower likelihood of being engaged to join the home visiting program.

To maximise opportunities to participate in the home visiting program, additional strategies may be needed to identify and engage those women who for various reasons are low service users or present late for antenatal care. Community level promotion of the program – targeting potentially eligible women, partners and the 'grandparent' generation - might increase chances of engagement of those at risk of falling through the net. Interdisciplinary support by all maternal care providers is needed to ensure that engagement of all women for assessment and offer commences as soon as a pregnancy is recorded to ensure that those women with lower healthcare needs but with other sources of psycho-social vulnerability are included.

Addressing low service use and late access to antenatal care was not adequately anticipated in implementation planning. Both quantitative and qualitative evidence suggest that participating organisations including both ACCHS and the MECSH developers did not sufficiently emphasise and support interdisciplinary collaboration between MECSH nurses, midwives and other providers in the phase of recruitment of women to join the program. This collaboration is needed to support assertive strategies for early engagement that can help to ensure that mobile women or those who less often come to the attention of providers through routine care can be contacted for assessment and offer.

Conclusions

The evidence presented here concerning risks and vulnerabilities suggests that there are both need and capacity to benefit from antenatal and postnatal home visiting for the population of mothers in three remote regions of the NT regardless of age and parity. Based on this assessment of maternal and perinatal risks and needs for psychosocial support there is no evidence to justify an exclusive focus on teenage or first-time mothers at the expense of older and multiparous women. Rather, there are arguments for inclusion of women with previous births. Concerning the program's focus on behavioural change, teenage women manifest levels of risk behaviours such as smoking and use of other drugs that are similar to, albeit at lower levels, women of other ages. Given the commonality of these patterns across age groups, it may be important to intervene early with young women to prevent establishment of enduring patterns for all subsequent births.

Lower risk teenage women and women in older age groups are likely to include those with high levels of family support and families that function relatively without stress due to violence and alcohol misuse. Initial assessment should consider both family risk factors and quality

of support as well those psychological and behavioural risk factors affecting individual parents and occur as early as possible during the engagement of clients. Information available through primary health care data only provides indirect indication of family risks and strengths (associated with alcohol and drug use, family violence). Engagement of clients for intake should entail active assessment of both individual vulnerability as well as family risks and strengths.

In conclusion, sustaining a wide intake of 50% or more of all eligible women has substantial prospects for whole of population impacts, depending on resources available and on the quality and effectiveness of the home visiting intervention. However, the breadth of a population approach has implications for home visiting program design and practice. Close examination of the eligible cohort has described different needs that are likely to require differentiated strategies for engagement and recruitment and for targeted support both prenatally and postnatally. Women with older children are likely to have a range of parenting concerns and social care needs in addition to those of caring for the newborn, that are not faced by first time mothers. These needs may compete with some of the educational priorities of parent education and infant care that are the central focus of engagement of first-time mothers. The latter may have higher needs for information, reassurance and support for parenting that provide the focus for their engagement within the program.

Further investigation of outcomes for women with differing needs within the model of care is planned. This will aim to identify which characteristics of parents and families are associated with program participation and positive outcomes for child development and child safety in order to inform the process of assessment and intake.

Limitations

This is a study based on characteristics of participation in healthcare including antenatal care for women eligible to participate in the MECOSH program using de-identified primary healthcare data. It is not a study of MECOSH service activity. Primary healthcare data are of variable quality and completeness for some variables in this analysis, do not include care that may have been accessed from services other than the three participating ACCHS and do not record some variables of interest such as mobility of residence. Administrative data provide insight into patterns of service use that shape offer and acceptance of offer of the home visiting program. This needs to be augmented by further qualitative investigation of parents' and practitioners' accounts of their engagement in recruitment and delivery of the program.

Abbreviations

ACCCHS	Aboriginal Community Controlled Health Service
ANOVA	Analysis of variance
DFV	Domestic and family violence
MECOSH	Maternal Early Childhood Sustained Home-visiting
Miwatj	Miwatj Health Aboriginal Corporation
NT	Northern Territory
NTG	Northern Territory Government
SNHV	Sustained nurse-led home visiting

Supplementary information

The online version contains supplementary material available at <https://doi.org/10.1186/s40748-025-00245-4>.

Supplementary Material 1

Acknowledgements

We thank the boards and staff from Miwatj Health Aboriginal Corporation, Katherine West Health Board and Sunrise Health Service who contributed extensively to evaluation project governance and supported development of data extracts. We thank Professor John Condon and Christel van den Boogaard for their contributions to data preparation and preliminary analyses and Ass. Prof. Kayli Wild and Alexandra Gregory for qualitative data gathering.

Author contributions

G.R. was responsible for funding acquisition and project oversight. G.R. and D.A. conceptualised the study and wrote the main manuscript text. J.-Y.S. was responsible for data management and conducted all analyses. K.T. and K.B. contributed to interpretation of findings. All authors reviewed the manuscript.

Funding

The NT MECOSH evaluation was commissioned by the Northern Territory Government (Contract number D18-0358).

Data availability

The datasets generated and/or analysed during the current study are not publicly available because of the sensitivity of the data, ethical restrictions on their use and data sovereignty considerations involved in working with First Nations people in the Northern Territory. Participating Aboriginal Community Controlled Health Services are custodians of the data used in this study and made available the confidential, de-identified data on behalf of their health service users under strict terms and conditions. Any request for access to data would require approval of the ethics committee and all data custodians. For inquiries, contact Gary Robinson, gary.robinson@menzies.edu.au.

Declarations

Ethics approval and consent to participate

The project was approved by the Northern Territory Government NT Health and Menzies School of Health Research Human Research Ethics Committee (Approval number HREC 2020–3696) and the Charles Darwin University Human Research Ethics Committee (Approval number H20078).

Consent for publication

Not applicable.

Author backgrounds

GR, DA & J-YS are members of a team commissioned to undertake an evaluation of the MECOSH program in the NT; KT is a clinician and coordinator of the home visiting program in one of the participating health services; KB is an Aboriginal obstetrician with extensive experience in research in pregnancy and maternal healthcare among the study populations.

Competing interests

The authors declare no competing interests

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Received: 26 June 2025 / Accepted: 9 December 2025

Published online: 02 February 2026

References

- Gomby DS. The promise and limitations of home visiting: implementing effective programs. *Child Abuse Negl.* 2007 Aug;31(8):793–99.
- Olds DL. Prenatal and infancy home visiting by nurses: from Randomized trials to community replication. *Prev Sci.* 2002 Sep;3(3):153–72.
- Hernández D, Topping A, Hutchinson CL, Martin A, Brooks-Gunn J, Petitclerc A. Client attrition in the Nurse-family Partnership®: revisiting metrics of impact in a home visitation program in the United States. *Health Soc Care Community.* 2019;27(4):e483–93.
- Dodge KA, Goodman WB, Murphy R, O'Donnell K, Sato J. Toward population impact from home visiting. *Zero Three.* 2013, Jan, 1;33(3):17–23. PubMed PMID: 23526864. PMCID: PMC3606025. Epub 2013 Mar 26.
- Bleiwiss-Sande R, Sama-Miller E, Chavez C, Coughlin R, Mraz Esposito A. Assessing effectiveness of early childhood home visiting models implemented with tribal populations. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families U.S. Department of Health and Human Services; 2022.
- Nguyen H, Zarnowiecki D, Segal L, Gent D, Silver B, Boffa J. Feasibility of implementing infant home visiting in a central Australian Aboriginal community. *Prev Sci.* 2018, Oct;19(7):966–76. PubMed PMID: 30054778. PMCID: PMC6182376.
- Department of Treasury and finance. Northern Territory economy: population: northern Territory Government. 2025. [14 February 2025]. Available from <https://nteconomy.nt.gov.au/population>
- Northern Territory Government. Starting early for a better future: early childhood development in the Northern Territory 2018–2028. Northern Territory Government; 2018.
- Kemp L, Harris E, McMahon C, Matthey S, Vimpani G, Anderson T, et al. Child and family outcomes of a long-term nurse home visitation programme: a randomised controlled trial. *Arch Dis Child.* 2011;96(6):533–40.
- Kemp L, Harris E, McMahon C, Matthey S, Vimpani G, Anderson T, et al. Benefits of psychosocial intervention and continuity of care by child and family health nurses in the pre- and postnatal period: process evaluation. *J Adv Nurs.* 2013;69(8):1850–61.
- Productivity Commission. Closing the gap annual data compilation report July 2024. 2024. Canberra.
- Li L, O'Neil L. Northern Territory midwives collection mothers and babies 2020. *NT Health*; 2023.
- Brown K, Cotaru C, Binks M. A retrospective, longitudinal cohort study of trends and risk factors for preterm birth in the Northern Territory, Australia. *BMC Pregnancy Childbirth.* 2024 Jan 5;24(1):33.
- Kildea S, Gao Y, Rolfe M, Josif CM, Bar-Zeev SJ, Steenkamp M, et al. Remote links: redesigning maternity care for Aboriginal women from remote communities in Northern Australia - a comparative cohort study. *Midwifery.* 2016 Mar;34:47–57.
- Kildea SV, Gao Y, Rolfe M, Boyle J, Tracy S, Barclay LM. Risk factors for preterm, low birthweight and small for gestational age births among Aboriginal women from remote communities in Northern Australia. *Women Birth.* 2017, Oct;30(5):398–405. PubMed PMID: 28377142. Epub 20170401.
- Gao Y, Gold L, Josif C, Bar-Zeev S, Steenkamp M, Barclay L, et al. A cost-consequences analysis of a Midwifery group practice for Aboriginal mothers and infants in the top end of the Northern Territory, Australia. *Midwifery.* 2014 Apr;30(4):447–55.
- Kildea S, Gao Y, Hickey S, Nelson C, Kruske S, Carson A, et al. Effect of a birthing on country service redesign on maternal and neonatal health outcomes for first Nations Australians: a prospective, non-randomised, interventional trial. *The Lancet Global Health.* 2021;9(5):e651–9.
- Benzies KM, Magill-Evans JE, Hayden KA, Ballantyne M. Key components of early intervention programs for preterm infants and their parents: a systematic review and meta-analysis. *BMC Pregnancy Childbirth.* 2013 Jan 31;13(1):S10.
- He V, Guthridge S, Leckning B. From birth to five: a multiagency data-linkage study to inform a public health response to child protection in the Northern Territory. Darwin: Menzies School of Health Research; 2019.
- Goldfeld S, Bryson H, Mensah F, Price A, Gold L, Orsini F, et al. Nurse home visiting to improve child and maternal outcomes: 5-year follow-up of an Australian randomised controlled trial. *PLoS One.* 2022;17(11):e0277773.
- Roper L, He VY, Perez-Concha O, Guthridge S. Complex early childhood experiences: characteristics of Northern Territory children across health, education and child protection data. *PLoS One.* 2023;18(1):e0280648.
- Kemp L, Harris E. The challenges of establishing and researching a sustained nurse home visiting programme within the universal child and family health service system. *J Res Nurs.* 2012;17(2):127–38.
- Kemp L, Harris E, McMahon C, Matthey S, Vimpani G, Anderson T, et al. Miller early childhood sustained home-visiting (MECSH) trial: design, method and sample description. *BMC Public Health.* 2008 Dec 29;8(1):424.
- Goldfeld S, Price A, Bryson H, Bruce T, Mensah F, Orsini F, et al. 'Right@home': a randomised controlled trial of sustained nurse home visiting from pregnancy to child age 2 years, versus usual care, to improve parent care, parent responsiveness and the home learning environment at 2 years. *BMJ Open.* 2017, Mar, 20;7(3):e013307. PubMed PMID: 28320789. PMCID: PMC5372045. Epub 2017/03/23. eng.
- Goldfeld S, Price A, Smith C, Bruce T, Bryson H, Mensah F, et al. Nurse home visiting for families experiencing adversity: a Randomized control trial. *Pediatrics.* 2019;143(1).
- Kemp L, Harris E, McMahon C, Matthey S, Vimpani G, Anderson T, et al. Maternal Early Childhood Sustained Home-visiting (MECSH) Program Manual. In: Centre for health Equity training research and evaluation, part of the Centre for primary health Care and Equity, faculty of medicine. 2nd. Sydney: University of NSW; 2012.
- Davis H, Day C. Working in Partnership with parents. 2nd. London: Pearson; 2010.
- Gregory A, Wild K, Aquino D, Robinson G. 'They got my back': thematic analysis of relationship building in nurse home visiting in Aboriginal communities. *Australian J Rural Health.* 2024;32(6):1227–38.
- Steenkamp M, Rumbold AR, Kildea S, Bar-Zeev SJ, Kruske S, Dunbar T, et al. Measuring what matters in delivering services to remote-dwelling Indigenous mothers and infants in the Northern Territory, Australia. *Australian J Rural Health.* 2012;20(4):228–37.
- Zou G. A modified Poisson regression approach to prospective studies with binary data. *Am J Epidemiol.* 2004;159(7):702–06.
- Shaw RJ, Givrad S, Poe C, Loi EC, Hoge MK, Neurodevelopmental SM. Mental health, and parenting issues in preterm infants. *Children.* 2023;10(9):1565. PubMed PMID: doi: <https://doi.org/10.3390/children10091565>.
- Seear KH, Spry EP, Carlin E, Atkinson DN, Marley JV. Aboriginal women's experiences of strengths and challenges of antenatal care in the Kimberley: a qualitative study. *Women Birth.* 2021 Nov;34(6):570–77.
- Reibel T, Morrison L, Griffin D, Chapman L, Woods H. Young Aboriginal women's voices on pregnancy care: factors encouraging antenatal engagement. *Women Birth.* 2015 Mar;28(1):47–53.

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