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Aboriginal *Wingadhan Birrang* (woman's journey) of smoking cessation during pregnancy as they participate in the *ICAN QUIT in pregnancy* pilot step-wedge trial

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ABSTRACT

Background: Addressing smoking cessation during pregnancy among Aboriginal women is a national priority under the Closing the Gap campaign. There is a need to measure and report interventions to support Aboriginal women during pregnancy.
Aim: To quantitatively assess women's smoking experiences over a 12 week ICAN QUIT in Pregnancy program.
Methods: Aboriginal women and/or women expecting an Aboriginal baby reported their smoking experiences through repeated cross-sectional survey at baseline, four weeks, and 12 weeks. Self-reported nicotine dependence measures (heaviness of smoking index, strength of urges and frequency of urges to smoke), intentions to quit smoking, quit attempts, use of nicotine replacement therapy were gathered as well as a carbon-monoxide measure at each time point.
Results: Expectant mothers (n = 22) of Aboriginal babies participated from six Aboriginal Community Controlled Health Services between November 2016 and July 2017. At 12 weeks women reported (n = 17) low heaviness of smoking index 1.21 with high strength of urges 2.64 and frequency of urges 3.00; 12/13 (92%) reported likely/very likely to quit smoking, made a mean 1.67 number of quit attempts, three women (13.6%) quit smoking (validated); 5/16 (31%) reported using nicotine replacement therapy.
Discussion: Participating women made multiple quit attempts demonstrating motivation to quit smoking. Smoking cessation interventions should be tailored to address high strength and frequency of nicotine dependence despite low consumption.
Conclusion: Prolonged smoking cessation support is recommended to address physical, behavioural and psychological aspect of smoking. Cessation support should address previous quitting experiences to assess smoking dependence and tailoring of support.
Trial registration: Australian and New Zealand Clinicial Trials Registry (Ref #ACTRN12616001603404).

Statement of significance

Problem or issue
Limited quantitative evidence is available on Aboriginal[1] women's smoking and quitting experiences during pregnancy. Often this is captured qualitatively and retrospectively.

What is already known
Aboriginal women experience multiple barriers to quitting during pregnancy. Qualitative data has reported crucial knowledge on cultural influences, social context, barriers to cessation, and the journey of smoking and becoming pregnant.

What this paper adds
This paper traces 20 Aboriginal women and 2 mothers of Aboriginal babies who are current smokers and pregnant across five different Aboriginal communities in three states.

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[1] The term 'Aboriginal' will be used in this paper to refer to both Aboriginal and Torres Strait Islander peoples, but with recognition and respect to the autonomy of the two peoples.

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Offering important, real time data collection on Aboriginal women's experiences that is not often captured in outcome-based reporting.

1. Introduction

Urgent calls have been made to address the health disparities between Aboriginal and non-Aboriginal Australians[1]. Supporting Aboriginal women to quit smoking during pregnancy is the most significant, potentially-modifiable, risk modifier for adverse infant and maternal health, and is likely to enhance Aboriginal health outcomes[2,3]. Aboriginal pregnant mothers are over three times more likely to smoke during the first 20 weeks of pregnancy than non-Aboriginal counterparts (45% vs 13% age standardized)[4]. The prevalence of Aboriginal mothers smoking during pregnancy has declined by 5.4%, however from 2007 to 2014 the gap between Aboriginal and non-Aboriginal women smoking in pregnancy has widened (RR 4.3 to 4.8)[4].

Smoking during pregnancy among Aboriginal women is linked to colonisation and the introduction of tobacco[5], social environments and acceptability[6], and high levels of stress and trauma[7]. Aboriginal communities have reported a desire to offer tailored programs for Aboriginal women during pregnancy[8].

Smoking cessation interventions reduce the number of babies born with low birth weight (RR 0.83, 95% CI 0.73 to 0.95)[9]. Effective smoking cessation interventions during pregnancy in the general pregnant population include: psychosocial interventions and nicotine replacement therapy (NRT)[10,11]. Effective strategies for reducing smoking during pregnancy among Aboriginal woman have not been demonstrated. One randomised controlled trial conducted in Queensland and Western Australia in 2005–2009 reported non-significant higher quit rates[12].

Previous qualitative research has reported crucial information to understand the context of maternal smoking among Aboriginal women including: knowledge, cultural influences[13], social contexts[6], barriers to cessation[14], and the journey of smoking and becoming pregnant[15].

Qualitative research has been used to understand the reasons for continued smoking during pregnancy with pregnant Aboriginal women reporting that advice from health providers was inconsistent[14], and women requested a better understanding of the quitting process and more effective support for self-efficacy[16]. This information, while important, lacks contextual understanding of smoking during pregnancy due to a lack of quantitative data. Large epidemiological studies on smoking in the Aboriginal community setting have not reported smoking during pregnancy[17] and Governmental reports only state rates of smoking during pregnancy[18]. Quantitative data can assist in reporting the journey of quitting that, to date, has only been reported qualitatively in this setting.

Reporting in Aboriginal health is frequently limited to measuring and monitoring[19] health deficits. It is important to incorporate Indigenous quantitative research methodologies[20] in health research reporting. Indigenous quantitative methodology reframes the questions being asked and the focus of the reporting. This paper, written by an Aboriginal woman aims to privilege the experiences of Aboriginal women through repeated quantitative data collection to tell the journey undertaken by Aboriginal women to quit smoking during pregnancy. This descriptive study aims to report a current gap in knowledge for consideration when developing culturally responsive interventions to support smoking cessation during pregnancy for Aboriginal women. Such journeys to date have only been reported qualitatively and retrospectively. To our knowledge no quantitative studies have reported these experiences, to date quantitative data in this setting is only reported in an end outcome measure only. This creates significant barriers in understanding how to tailor support specifically to Aboriginal women during pregnancy.

This study was part of the *ICAN QUIT in Pregnancy* cluster step-wedge pilot study, aimed at enhancing health provider provision of cessation support to Aboriginal women attending Aboriginal Community Controlled Health Services (ACCHS) through webinar training and NRT to support cessation. The study protocol[21], development process[8,22] theoretical framework[23] and feasibility and acceptability of the intervention[24] are reported elsewhere. Details of the intervention and implementation of the step-wedge is described in Supplementary file 1.

2. Participants, ethics and methods

2.1. Setting and participants

This study was conducted at six urban and regional ACCHS: four in New South Wales, one in Queensland and one in South Australia.

Women were eligible if they were 28 weeks gestation or earlier, Aboriginal and/or Torres Strait Islander or expectant mothers of Aboriginal and/or Torres Strait Islander babies, aged 16 years or older, and smoked tobacco at any level of consumption (including those that only smoked occasionally), and were able to give informed consent. It was emphasised to the women that wanting to quit was not an eligibility criteria. Women were recruited between November 2016 and July 2017 with final follow up completed by September 2017.

2.2. Data collection

Women were asked to complete surveys at three times points: baseline (on recruitment), 4 weeks and 12 week follow up (Study protocol is available open access for further details on data collection[21]). Data was collected using either a paper copy of the survey or a computer tablet using the Qualtrics secure survey application. At each time-point the women were asked to complete the following: Smoking characteristics survey and exhaled breath carbon monoxide reading.

Smoking characteristics survey incorporated demographic questions and smoking characteristics. Demographic characteristics included: age, Aboriginal and/or Torres Strait Islander status, partner status, and number of children. Smoking characteristics included: current smoking status, nicotine dependence levels, quit attempts, and attitudes to smoking and quitting.

Current smoking status was assessed with: "*Which of the following statements best describes your cigarette smoking now? I'm not smoking at all (1) I'm smoking about the same as before (2) I've cut down (3) I'm smoking more than before (4).*

Nicotine dependence levels were measured using:

1) **Heaviness of smoking index (HSI)**: compromised of two questions - (i) the number of cigarettes typically smoked per day (scored in four groups: 1–10, 11–20, 21–30, 31+); and (ii) the time taken between waking and having their first cigarette (scored in four groups: less than/equal to 5, 6–30, 31–60, and 61 + min). Participants received a score between 0 and 6, classified into three groups: low addiction (scores between 0 and 2); moderate addiction (scores between 3 and 4) and high addiction (scores between 5 and 6).

2) **Strength of urges to smoke (SUTS)** was measured with one question: "*How much of the time have you felt the urge to smoke*

in the last 24 h?" Not at all (0) A little of the time (1) Some of the time (2) A lot of the time (3) Almost all the time (4) All the time (5). Participants received a score between 0 and 5 depending on their answer, with the higher score indicating higher strength and frequency of urges. These were categorized as being low (0–2) and high (3+).

3) **Frequency of urges to smoke (FUTS)** was assessed with one question asking *"In general how strong are your urges to smoke (in the last 24 h)*?" Participants received a score between 0 and 5 depending on their answer, with the higher score indicating higher frequency of urges. These were categorized as being low (0–2) and high (3+).

Quit attempts were measured with "*how many quit attempts have you had in the last 4 weeks that lasted more than 24 h*?" and "*what is the longest time you managed to stay off the smokes completely in the past 4 weeks*?". A variable was created describing whether participants had made at least one quit attempt that lasted more than 24 h in the past 4 weeks (yes vs. no).

Prescription and use of NRT was measured with questions such as "*Have you used NRT to help you quit or reduce smoking in the past 4 weeks*?" and "*did you use the NRT as prescribed to you*?" with an option here to select "*I was not prescribed NRT*". The women were also asked about use of other cessation aids such as e-cigarettes, hypnosis, acupuncture, counselling, Quitline and others.

Attitudes to smoking and quitting were measured using a 4 point Likert scale from very unlikely to very likely for 5 questions, including; *"How likely is it that in the next 3 months you will; quit smoking completely and permanently; reduce the number of cigarettes you smoke in a day; talk to a friend or family about quitting smoking; seek professional help to quit smoking; enroll in a smoking cessation program (if available at minimal cost)"*. Due to the small sample size the response options were dichotomised into very unlikely/unlikely vs. very likely/likely.

Exhaled breath carbon monoxide was performed at each study visit to validate smoking status with a Bedfont piCO Baby smokerlyzer. Smoking abstinence was defined as equal or less than 6 ppm[25].

Participating ACCHS staff were nominated to take on the role of Research Facilitator (RF) to recruit and follow up the women. Health services were reimbursed to cover the RFs time to conduct the research. Face to face support and training was offered to upskill staff in research implementation.

At recruitment Aboriginal women were given a unique code and any data collected from them was identified only with this code. All consent forms and identifying information on the women remained the property of the ACCHS and were not shared with the research team.

2.3. Reimbursements

Women received reimbursement of $20 for their time in the form of a shopping voucher for each study visit (maximum total $60). Women attending all three study visits were also entered into a draw for a baby pack valued at $50 per site.

2.4. Ethics approval

The study was approved by University of Newcastle Human Research Ethics Committee (HREC), Aboriginal Health & Medical Research Council HREC, South Australia Aboriginal HREC, Far North Queensland HREC.

2.5. Data analysis

Statistical analyses were conducted using SAS v9.4 (SAS Institute, Cary, North Carolina, USA). Although, pre vs. post comparisons of women's smoking outcomes were intended[21] these analyses were not conducted due to the smaller than expected sample size. Rather, a descriptive assessment of women's smoking behaviours over time was undertaken.

Smoking abstinence was defined as self-reported 7-day point prevalence and continuous abstinence and validated with expired CO measurement of < = 6 ppm. We used intention to treat (ITT) analysis so women lost to follow-up were considered as smoking.

3. Results

Women were recruited from 5 of the 6 ACCHS, n = 22 from a potential n = 36 eligible women. One of the partnering

Table 1
Participant pre and post intervention allocation at each time period and follow up data.

Participant code	Baseline	Four week follow-up	Twelve week follow-up
P03	Pre-intervention	.	Post-intervention
R01	Pre-intervention	Pre-intervention	Post-intervention
R04	Pre-intervention	Pre-intervention	Post-intervention
P02	Pre-intervention	Pre-intervention	Post-intervention
R03	Pre-intervention	Pre-intervention	Post-intervention
R02	Pre-intervention	Pre-intervention	Post-intervention
T01	Pre-intervention	Pre-intervention	Post-intervention
P01	Pre-intervention	Pre-intervention	Post-intervention
T02	Pre-intervention	Pre-intervention	Post-intervention
B01	Pre-intervention	Pre-intervention	Post-intervention
T03	Pre-intervention	Post-intervention	Post-intervention
W05	Post-intervention	.	.
W01	Post-intervention	.	.
W02	Post-intervention	.	Post-intervention
W03	Post-intervention	.	Post-intervention
R06	Post-intervention	.	Post-intervention
T04	Post-intervention	Post-intervention	.
P04	Post-intervention	Post-intervention	.
R07	Post-intervention	Post-intervention	.
W04	Post-intervention	Post-intervention	Post-intervention
T05	Post-intervention	Post-intervention	Post-intervention
R05	Post-intervention	Post-intervention	Post-intervention

sites reported a lack of eligible women during the study period. While this site still undertook the training component of the intervention, this site did not recruit any women to the study. In the other sites eleven women were recruited pre-intervention and eleven women post-intervention. The completion of survey at each time point were as follows: baseline n = 22 women, 4 weeks n = 16 and 12 weeks n = 17. Overall 5 women (23%) were lost to follow up. See Table 1 for listing of participants, intervention allocation and follow up completed.

3.1. Demographics

Of the 22 women recruited, 20 women identified as Aboriginal and two women were expectant mothers of Aboriginal babies. Table 2 reports baseline demographics of all women. On average participants were 17 weeks pregnant (SD 6.62), with a mean age of 26 years old (SD 5.43).

Smoking characteristics including nicotine dependence are reported in Table 3. Quitting characteristics including; intentions to quit, quit attempts, validated abstinence and use of quitting aids are reported in Table 4.

3.2. Nicotine dependence

At baseline participating women smoked approximately 7 cigarettes per day (SD 4.66), had a low mean heaviness of smoking index score of 1.59 (SD 1.37), with a borderline low SUTS 2.95 (SD 1.53, Range 1–6), and high FUTS 3.00 (SD 1.16, range 1–5). At baseline over two thirds of participants reported having cut down smoking since becoming pregnant, with just under half of current smokers not smoking every day. (see Table 3)

At 4 weeks on average, women smoked approximately 6 cigarettes per day (SD 4.35), had a low mean heaviness of smoking index score of 1.27 (SD 1.16), with a borderline low SUTS of 2.93 (SD 1.10), and high FUTS of 3.07 (SD 1.28) with over one quarter of current smokers not smoking every day.

At 12 weeks on average, the women smoked approximately 5 cigarettes per day (SD 4.41), had a low mean heaviness of smoking index score of 1.21 (SD 0.89), a low mean SUTS of 2.64 (SD 0.93) and high FUTS of 3.00 (SD 0.96) with over one quarter of current smokers not smoking every day.

3.3. Intentions to quit smoking

At baseline all women indicated that they were likely or very likely to reduce the number of cigarettes they smoke per day. Seventeen women 17/22 (77%) reported that they were likely to quit smoking completely and permanently within three months. Thirteen women 13/22 (59%) reported that they were likely to enrol in a smoking cessation program.

For the women still smoking at the four-week point 12/15 (80%) indicated that they were likely to quit smoking completely and permanently, and 12/15 (80%) of women reported they would seek professional help to quit smoking. Just over half of participants who were still smoking (8/15; 53%) reported that they were likely to enrol in a smoking cessation program.

At 12 weeks 13/14 (93%) of women that were still smoking indicated that they were likely to quit smoking completely and permanently, and 9/14 (64%) of women who were still smoking reported that they were likely to enrol in a smoking cessation program.

3.4. Quit attempts

At baseline 17 of the 22 women (77%) had made a quit attempt in the past. Nine of the 22 women (53%) had made at least one quit attempt during pregnancy, with 9 women (53%) reporting the most recent quit attempting being now.

At four weeks 15 of the 16 women who responded were still smoking. Of the 15 women who were still smoking at 4 weeks 7 (47%) reported having made at least one quit attempt in the past four weeks that lasted more than 24 h, with 3 of these women (43%) making two or more quit attempts.

At 12 weeks 14 of the 17 women who responded were still smoking. Of the 14 women who were still smoking 9 (64%), reported having made a quit attempt in the past four weeks that lasted longer than 24 h. Of the women who made quit attempts 5/9 (56%) reported making at least two quit attempts, and 4/9 (44%) had sustained cessation for 3–13 days.

3.5. Validated abstinence

Overall, four women achieved validated abstinence of the 12 week period (18%- ITT analysis). One woman achieved validated

Table 2
Baseline characteristics of women participating in the study.

Variable	Category	Total (N = 22)
Are you Aboriginal and/or Torres Strait Islander	Not Aboriginal and/or Torres Strait Islander	2 (9%)
	Aboriginal and/or Torres Strait Islander	20 (91%)
Age category	16–24 years	9 (41%)
	25–34 years	11 (50%)
	35 to 45 years	2 (9%)
Education level	Primary or up to year 9	6 (27%)
	Year 10 to 11	9 (41%)
	Year 12	3 (14%)
	TAFE or trade certificate	3 (14%)
	Undergraduate	1 (4.5%)
Partner	No	7 (32%)
	Yes	15 (68%)
Number of children	None	5 (23%)
	1–2	10 (45%)
	3 or more	7 (32%)
Baby or child usually living in household	No	4 (18%)
	Yes	18 (82%)

Table 3
Smoking characteristics of women participating in the study.

Smoking behaviours*		Baseline	4-weeks	12-weeks
Variable	Category	n = 22	N = 16	n = 17
Which of the following statements best describes your cigarette smoking now?	I'm not smoking at all	0	1 (6.3%)	3 (18%)
	I'm smoking about the same as before	7 (32%)	4 (25%)	2 (12%)
	I've cut down	15 (68%)	11 (69%)	11 (65%)
	I'm smoking more than before	0	0	1 (5.9%)
Number of cigarettes smoked per day	0		1 (6.3%)	3 (18%)
	1–4	9 (41%)	5 (31%)	3 (18%)
	5–9	5 (23%)	6 (38%)	8 (47%)
	10 to 14	5 (23%)	2 (13%)	2 (12%)
	15 or more	3 (14%)	2 (13%)	1 (5.9%)
How often do you smoke?	Every day	13 (59%)	11 (73%)	9 (64%)
	Most days	5 (23%)	1 (6.7%)	2 (14%)
	Occasionally, 3 times or less a week	4 (18%)	3 (20%)	3 (21%)
HSI classification	Low (0–2)	16 (73%)	12 (80%)	13 (93%)
	Moderate (3–4)	6 (27%)	3 (20%)	1 (7.1%)
	High (5–6)	0	0	0
Missing		0	1	3
SUTS classification	Low (0–2)	10 (45%)	6 (40%)	8 (57%)
	High (3+)	12 (55%)	9 (60%)	6 (43%)
Missing		0	1	3
FUTS classification	Low (0–2)	6 (27%)	6 (40%)	5 (36%)
	High (3+)	16 (73%)	9 (60%)	9 (64%)
Missing		0	1	3

* These outcomes were only collected for women who currently smoke.

abstinence at the four-week timepoint (4%- ITT analysis). By her 12 week follow up, she had relapsed. Three women achieved validated abstinence at the Twelve-week timepoint (13.6% - ITT analysis).

The woman who quit at four weeks reported having relapsed by 12 weeks. At 12 weeks this woman reported being prescribed NRT, reported using it 50–75% of the time, had made an additional 3 quit attempts lasting 1–2 days, and smoked less than 3 times per week.

3.6. Nrt

At baseline just under half (n = 10; 45%) of the women reported using some sort of smoking cessation aid to help them quit smoking in the past (it was not specified if this was related to pregnancy or not), with oral NRT being the most frequently reported quitting aid used 7/22 (32%) and 6/22 (27%) using patches.

At 4 weeks four of the 15 women (27%) currently smoking reported using NRT in the past 4 weeks.

At 12 weeks 1 of 3 women who had quit smoking (33%) and 4 of 14 women (29%) still smoking reported using NRT in the past four weeks. Data was missing for one woman.

Of all women at 12weeks 6 of 16 (37.5%) were not prescribed NRT; 4 of the 16 women (25%) indicated that they had used a quitting aid other than NRT in the past four weeks to help them quit or reduce smoking; with 2/4 (50%) being e-cigarettes, the other 2/4 (50%) women specifying 'other'.

3.7. Changes over time

The mean number of cigarettes smoked per day by participants slightly decreased over time (Table 5). The mean number of quit attempts remained relatively constant over time. However, due to the small numbers no statistical comparisons were made.

4. Discussion

This descriptive study reported the experiences of 22 pregnant Aboriginal women and/or women with Aboriginal babies who were current smokers and attending ACCHS. We found that most women had a low cigarette consumption rate and reported a low heaviness of smoking index score. The mean heaviness of smoking index scores seemed to decrease from baseline to week four follow-up and then remained relatively flat at the 12 week follow-up. However, on average, the strength of urges to smoke remained borderline low, with the frequency of urges to smoke remained high across the three time points. Most Aboriginal women in this study reported intentions to quit smoking, with all women intending to at least reduce consumption during pregnancy. Between the 4 and 12 week time points, 14 women made a total of 32 self-reported quit attempts. At 4 weeks one woman had quit smoking but reported relapse at 12 weeks follow up. Although relapsed the woman had accepted NRT and made 3 additional quit attempts that lasted a 1–2 days by 12 weeks. Three women quit smoking by 12 weeks which may reflect a need for prolonged smoking cessation support to enable successful quitting. Of the women continuing to smoke at each time point, we found 25%–41% who did not smoke every day. At the 4 and 12 week time points, uptake of NRT was over 25%, and two women reported using e-cigarettes as quitting aids at 12 weeks.

4.1. Implications for public health

Although we did not require women enrolling in our study to be planning to quit, our study is consistent with previous research findings indicating that amongst Aboriginal pregnant women, motivation to quit is high[12,26] in the five Aboriginal communities involved. Women in our study made ongoing quit attempts over

Table 4
Quitting characteristics of women participating in the study.

Intentions to quit	Very unlikely/ unlikely	Very likely/ likely	Very unlikely/ unlikely	Very likely/ likely	Very unlikely/ unlikely	Very likely/ likely
Quit smoking completely and permanently	5 (23%)	17 (77%)	3 (20%)	12 (80%)	1 (7.1%)	13 (93%)
Reduce the number of cigarettes you smoke in a day	0 (0%)	22 (100%)	1 (6.7%)	14 (93%)	1 (7.1%)	13 (93%)
Talk to a friend or family about quitting smoking	2 (9.1%)	20 (91%)	2 (13%)	13 (87%)	1 (7.1%)	13 (93%)
Seek professional help to quit smoking	5 (23%)	17 (77%)	3 (20%)	12 (80%)	2 (14%)	12 (86%)
Enrol in a smoking cessation program	9 (41%)	13 (59%)	7 (47%)	8 (53%)	5 (36%)	9 (64%)

Of women reporting still smoking		N = 22	N = 15		N = 14	
			No attempt (n = 8)	Attempt made (n = 7)	No attempt (n = 3)	Attempt made (n = 9)
Number of quit attempts	0	5 (23%)	8 (100%)	0	3 (1005)	0
	1	5 (23%)	0	4 (57%)	0	4 (44%)
	2	8 (36%)	0	1 (14%)	0	2 (22%)
	3	3 (14%)	0	2 (29%)	0	2 (22%)
	4 or more	1 (4.5%)	0	0	0	1 (11%)
Missing		0	0		2	
What was the longest time you managed to stay off the smokes completely in the past 4 weeks?	Didn't manage to stay off the smokes for more than 24 h	2 (9.1%)	5 (63%)	3 (43%)	1 (33%)	1 (11%)
	1–2 days	3 (14%)	2 (25%)	3 (43%)	1 (33%)	4 (44%)
	3–13 days	3 (14%)	0	1 (14%)	0	4 (44%)
	Between 14 days to 1 month	7 (32%)	1 (13%)	0	1 (33%)	0
	3 months to a year	5 (23%)	0	0	0	0
	A year and over	2 (9.1%)	0	0	0	0
Missing		0	0		0	

Variable	Category	*Not reported at baseline*	No, not currently smoking (n = 1)	Yes, currently smoking (n = 15)	No, not currently smoking (n = 3)	Yes, currently smoking (n = 14)
Have you used NRT	No		0	11 (73%)	2 (67%)	10 (71%)
	Yes		1 (100%)	4 (27%)	1 (33%)	4 (29%)
Did you use the NRT - Nicotine Replacement therapy as prescribed to you?	I was not prescribed NRT		1 (100%)	9 (60%)	1 (50%)	6 (43%)
	I was prescribed NRT but did not take at all		0	2 (13%)	1 (50%)	4 (29%)
	I used NRT occasionally, 1-2 times a week		0	1 (6.7%)	0	2 (14%)
	I used NRT 3-4 times a week but not all doses		0	2 (13%)	0	1 (7.1%)
	I occasionally missed a dose		0	1 (6.7%)	0	1 (7.1%)
Missing			0	0	1	0
Use of quitting aids	No, I haven't used anything to help me quit or reduce smoking		1 (100%)	13 (87%)	2 (67%)	11 (79%)
	Yes, other		0	2 (13%)	0	3 (21%)
	No, other		0	0	1 (33%)	0

Table 5
Mean consumption and quit attempts over time.

Variable	Baseline mean (STD)(n = 22)	Baseline median (IQ1, IQ3) (n = 22)	Four week follow-up mean (STD)(n = 16)	Four week follow-up median (IQ1, IQ3)(n = 16)	Twelve week follow-up mean (STD)(n = 17)	Twelve week follow-up median (IQ1, IQ3)(n = 17)
Number of cigarettes smoked per day	7.14 (4.66)	6.50 (3.00,10.00)	6.19 (4.35)	5.00 (4.00,9.00)	5.29 (4.41)	5.00 (3.00,6.00)
Number of quit attempts	1.59 (1.26)	2.00 (1.00,2.00)	0.80 (1.08)	0.00 (0.00,1.00)	1.67 (1.72)	1.00 (0.50,2.50)

the 12 week duration of the follow-up period. In the general population it has been reported that intention to quit influences quit attempts but not their success, and self-efficacy is an important predictor for success in quitting[27]. Enhancing self-efficacy and ownership of the quitting process has also been reported to be required in the Aboriginal community to support cessation[28] and should be incorporated in interventions designed specifically to address smoking during pregnancy with Aboriginal women[14]. The high number of quit attempts undertaken by Aboriginal women during pregnancy is encouraging and indicates the need for prolonged Health Professional support. In the general population, it has been reported that the true number of quit attempts before success in quitting is high, at 30 attempts[29]. These estimates are particularly relevant for smokers who experience difficulty quitting, which is pertinent for many Aboriginal people who smoke. Experiences of past quit attempts has been reported to be more useful in addressing smoking dependence than conventional dependence scores for Aboriginal people[17].

Factors associated with success in quitting smoking in pregnancy include: low cigarette consumption, high motivation and lower nicotine dependence[30], these were similarly important factors for the majority of Aboriginal women participating in our study. Women in our study that successfully quit smoking at 12 weeks reported a low heaviness of smoking index (the standard measure of dependence) but strength (SUTS) and frequency of urges to smoke (FUTS) were high at baseline. The HSI is reported to be an reliable measure in pregnancy[31] and time to first cigarette and cigarettes per day have been a predictor of quitting in pregnancy[32]. Aboriginal women's low nicotine dependence scores have been previously reported in pregnancy[33].

The high SUTS and FUTS suggests that even though cigarette consumption is low, the higher nicotine metabolism in pregnancy[34] and potential for compensatory smoking[35], and experiences of stress, may combine to cause high levels of nicotine craving and other withdrawal effects. Our study concurs with previous reports that nicotine dependence measures may be useful to assess physical nicotine dependence but further research is needed to understanding appropriate supports to address behavioural and psychological aspects of continued tobacco use among Aboriginal women[33].

Due to our small sample size it is difficult to draw any firm conclusions regarding the relationship between the various dependence measures and smoking cessation rates. The research findings reported here remain useful due to the limited data available on Aboriginal women's smoking characteristics during pregnancy. We recommend further research in this area to collect experiential data across time points to add to this current gap.

While further evidence is gathered, smoking cessation interventions for pregnant Aboriginal women could consider tailoring support to address low consumption but high dependence (SUTS and FUTS) and build on the experiences of quit attempts. Previous research with this population have found that social environment and influences of social networks and partners are influential predictors of antenatal smoking[7]. These factors should be incorporated in an assessment of behavioural and psychological aspects of smoking to support tailoring of culturally responsive interventions.

Over the last decade Aboriginal pregnancy women have been advised to "quit or reduce smoking during pregnancy" to improving health outcomes for them and their babies[3]. Research into maternal smoking since this report found that Aboriginal women are reducing smoking during pregnancy[13,14,26]. Advising women to cut down is still being promoted in 2018 clinical practice guidelines if mothers do not want to, or struggle to quit smoking[36]. Health providers in Aboriginal settings have reported advising Aboriginal mothers to reduce their cigarette consumption rather than quitting[14,26] which may influence women's intentions to reduce consumption rather than quit. Health Professionals have also reported a lack of confidence in advising Aboriginal mothers to quit smoking[37] which is likely to influence their advice to reduce rather than quit smoking completely. Aboriginal smokers who are advised to quit smoking by their Health Professionals are more likely to make a quit attempt than those who are not[38] highlighting a need to offer consistent messages to quit smoking during pregnancy. Reduction in cigarette consumption is no more effective in long term cessation than spontaneous quitting[39] and does not increase the birth weight of babies[40]. Health Professionals should not suggest reduction in consumption and educational resources should address the need to quit smoking completely to enhance maternal and infant health outcomes.

The *ICAN QUIT in Pregnancy* pilot guidelines follow the RACGP clinical guidelines, recommending use of oral NRT as first line and combination NRT if needed[41,42]. NRT is safer in pregnancy than continued smoking[43] and should be offered to Aboriginal women during each check-up when discussing smoking status, if they were unable to quit on their own. It appears that NRT use may support quit attempts but more data is needed to measure its effectiveness in this setting. Aboriginal smokers that are more disadvantaged may be less likely to have used NRT[44]. Issues such as cost and access can be addressed with long term implementation of interventions such as *ICAN QUIT in Pregnancy* and the recent recommendation that oral forms of NRT (preferred for pregnancy) are to be listed on the Pharmaceutical Benefits Scheme[45].

5. Strengths and limitations

To our knowledge, this is the first study to report Aboriginal women's journeys of quitting smoking during pregnancy through quantitative data and aims to support the knowledge already available through qualitative studies in this setting[6,13–15]. Research in this setting is challenging, (Aboriginal people make up only 3% of the population in Australia as well as pregnancy being time limited) reporting on smaller studies has limitations in findings but strength in exploring new areas for research. By conducting data collection and analysis at multiple time-points, this paper offers further insight to the journeys of pregnant mothers of Aboriginal babies who are current smokers. Due to the multiple additional barriers Aboriginal women face when trying to quit smoking during pregnancy there is a need to collect more data on women's smoking cessation journeys during pregnancy to better understand how to appropriately tailor interventions to enhance quitting in pregnancy.

This study was not powered to measure effectiveness of the intervention on smoking consumption or abstinence. The small sample size is a limitation that impacted the ability to conduct data analysis for pre and post intervention groups. All women completed baseline data, five women were lost to follow up and reducing the data to report. The Research Facilitators reported that services did not experience difficulties with women consenting to the research, but some services reported a lack of eligible pregnant women over the study period (primarily due to women reporting not smoking). As a pilot study these learnings will inform the implementation of a large randomised control trial (SISTAQUIT® — Supporting Indigenous Smokers To Assist Quitting), powered to measure efficacy for smoking cessation in pregnancy.

6. Conclusion

In this study 20 Aboriginal women and 2 mothers of Aboriginal babies from three Australian states participating in the *ICAN QUIT in Pregnancy* pilot study, made multiple quit attempts to stop smoking, and 13.6% achieve carbon monoxide validated abstinence at 12 weeks follow-up. Limited quantitative evidence on Aboriginal women's experiences of smoking and becoming pregnant are available. While a larger trial is underway (SISTAQUIT), reporting

these pilot results in detail is important given the urgent need to address smoking in pregnancy among Aboriginal women. Descriptive evidence suggests tailoring of support in this setting should be holistic and acknowledge physical, behavioural and psychological aspects of smoking in Aboriginal communities and not rely solely on nicotine dependence measures. Low cigarette consumption and high strength and frequency of urges to smoke could be addressed along-side an assessment of social networks, partners and stress. Health Providers are recommended to advise Aboriginal women to quit smoking completely during pregnancy and provide prolonged intensive smoking cessation support. Encouraging self-efficacy and ownership through building on previous quit attempts and experiences across the course of the pregnancy as abstinence may take several attempts to achieve.

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Author contributions

GG, conceived and designed the ICAN QUIT in Pregnancy study with guidance from YBZ, MB, and BB. MB led the data collection and analysis plan for the women's outcomes, and wrote the manuscript. MB and MG advised on Aboriginal community consultations and adherence to ethical guidelines to research with Aboriginal communities. JR advised on methodology and implementation of the research. AH performed the statistical analysis, and CO oversaw the analysis and advised on methodology. All authors advised on the research design and implementation. GG oversaw the entire study. All co-authors critically reviewed and approved the final manuscript.

Competing interests

YBZ has received funds in the past (2012–2015) from Novartis NCH who used to distribute NRT in Israel. She has not received any funding from pharmaceutical companies in Australia. All other authors declare no conflict of interest.

Ethics approval

The study was approved by University of Newcastle Human Research Ethics Committee (HREC) (REF #H-2015–0438), Aboriginal Health & Medical Research Council HREC (REF #1140/15), South Australia Aboriginal HREC (REF #04-16-652, Far North Queensland HREC (REF #16/QCH/34–1040).

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