Preventive health risks in pregnancy: Cross-sectional prevalence survey in three regions of New South Wales, South Australia and Tasmania

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Abstract

Objective: To examine the proportion of pregnant people meeting preventive health guideline recommendations in three regions of New South Wales, South Australia and Tasmania.

Methods: Cross-sectional surveys of pregnant people attending public maternity services were conducted between November 2021 and April 2022. Participants were asked about their preventive health risks during pregnancy, including tobacco smoking, e-cigarette use, alcohol consumption, gestational weight gain, dietary intake and physical activity.

Results: In total, 1064 surveys were completed. Smoking during pregnancy was reported by 10.5% of participants in New South Wales, 7.8% in South Australia and 18.0% in Tasmania. Most participants (95.2%-96.1%) reported that they did not currently consume alcohol. In each region, the majority of participants were currently gaining gestational weight outside recommended ranges (65.0%-70.2%) and not meeting minimum recommendations regarding intake of core food groups (except for fruit) and physical activity (65.2%-75.6%).

Conclusions: This study demonstrates a need for greater access to evidence-based interventions to support people reduce their preventive health risks in pregnancy and in turn achieve positive outcomes for themselves and their babies.

Implications for Public Health: The findings can inform region-based needs and prioritisation of support for addressing preventive health risks in pregnancy.

Key words: pregnancy, smoking, alcohol, weight, prevalence

Introduction

he World Health Organization (WHO) promotes pregnancy as a critical time for people to achieve positive health and wellbeing outcomes for themselves and their babies.¹ In many countries, including Australia, tobacco smoking, e-cigarette use, alcohol consumption, gestational weight gain (GWG), poor dietary intake and physical inactivity have been identified as priority preventive health risks to be addressed to achieve this.² Such health risks are associated with pregnancy complications and adverse

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perinatal outcomes (e.g. small or large for gestational age, preeclampsia and preterm birth), which can track into childhood and adolescence (e.g. respiratory conditions and cognitive impairment).³ For the pregnant person, future infertility, overweight and obesity and the development of chronic diseases are also associated with one or more of these health risks.⁴

In Australia, guidelines from health authorities exist to reduce the harms associated with these preventive health risks. Such guidelines recommend that people should not consume alcohol,⁵ smoke cigarettes or use e-cigarettes^{6,7} at any time during pregnancy. The United States Institute of Medicine's (IOM) weight gain in pregnancy guidelines,⁸ which have been adopted in Australia,⁷ recommend that people gain weight within defined ranges based on their pre-pregnancy body mass index (BMI). The Australian guide to healthy eating⁹ recommends that pregnant people consume a varied diet from five food groups each day. Lastly, the Australian guidelines for physical activity during pregnancy¹⁰ recommend that people should aim to be active on most, if not all, days of the week.

The prevalence of such risks in Australian pregnant people have been estimated using a variety of data collection methods, including medical record data, cross-sectional surveys and cohort studies. The National Perinatal Data Collection (NPDC), which collates medical record data for all notified births in Australia, is the largest data source reporting such estimates. The 2021 NPDC, which included data on over 311,000 pregnant people, reported prevalence estimates of 8.7% for tobacco smoking (individual state and territory range: 4.8%-20.5%), 2.7% for alcohol consumption up to 20 weeks gestation (0.5%-5.9%) and 0.7% after 20 weeks (0.2%-1.6%).¹¹ The data collection methods and measures used in the NPDC, however, differed across states, restricting interpretation. The NPDC also does not include prevalence estimates for the other preventive health risks.

Cross-sectional and cohort studies provide further information on the prevalence of preventive health risks in Australian pregnant people. A systematic review of 16 Australian studies reported a pooled prevalence estimate of 48% (95% CI: 38%-57%) for alcohol consumption at any time during pregnancy.¹² There was, however, considerable variability in measures used, again restricting interpretation of the results, and comparison between the regions in which studies were conducted. Further, when comparing the review's pooled estimate to the 2021 NPDC data¹¹ there are considerable differences in reported rates. In contrast, the 2022-2023 National Drug Strategy Household Survey (NDSHS) and the 2021 NPDC reported similar rates of tobacco smoking during pregnancy (7.6% and 8.7%, respectively).^{11,13} The only Australian study to date that has reported on e-cigarette use in pregnancy found that in a sample of 4024 people in one regional area of New South Wales (NSW) in 2021-2022, 1.2% were current users.¹⁴

With regard to GWG, Australian cross-sectional surveys using population-wide samples have been conducted in single regions within Queensland¹⁵ and NSW.¹⁶ The first study conducted in 2011 reported that of 664 participants, 64% had total weight gain outside recommended ranges (above: 38%, below: 26%).¹⁵ A marginally higher rate was reported in the second study conducted in 2018-2019 with 370 participants (70% with GWG outside of recommended ranges), with more people above the recommendations by end of pregnancy (above: 44%, below: 26%).¹⁶ Regarding intake of core food groups, a 2013 national cross-sectional survey of 857 pregnant people found that no participants met all food groups.¹⁷ The greatest

adherence was with consumption of fruit (56%) and dairy (29%), with minimum servings of the other food groups met by less than 10% of people. The Australian Bureau of Statistics Australian Health Survey conducted in 2011-2012 found that of 280 pregnant people, 30% met the physical activity guidelines, 54% were insufficiently active and 16% were inactive.¹⁸ A more recent survey of 780 pregnant people conducted between 2017-2019 in a single urban NSW hospital reported 7% adherence with the physical activity guidelines,¹⁹ however, pregnant people with certain medical or obstetric complications (e.g. preeclampsia) were excluded from the survey.

Given that prevalence data for preventive health risks in pregnancy exist at a national level only, or there are considerable inconsistencies in the measures used across regions, there has been limited ability to identify and act on regional differences. The aim of this study was to describe the proportion of people in three regions of NSW, South Australia (SA) and Tasmania not meeting preventive health guideline recommendations in pregnancy: tobacco smoking, e-cigarette use, alcohol consumption, GWG, dietary intakes of core food groups and physical activity.

Methods

This study is reported in accordance with the STrengthening the REporting of OBservational studies in Epidemiology (STROBE) guidelines.²⁰

Design and setting

A cross-sectional survey of pregnant people attending maternity services in a convenience sample of three regions located in NSW, SA and Tasmania. Two services were based in regional cities (4000 and 1600 births per year) and one in a capital city (5000). The survey was conducted between November 2021 and April 2022. For ease of reporting, each region is referred to by its state location.

Participants and recruitment

Pregnant people

Eligibility criteria included aged 18 years or older and 12-37 weeks gestation. Ineligibility criteria included given birth or unable to complete the survey unaided (e.g. insufficient English).

Recruitment procedure

Locally approved research processes were used to recruit people to the survey. In NSW, medical record and appointment data were used to generate a weekly random sample of approximately 80 eligible people (50% of total). Sampled people were sent an information statement in the mail outlining the purpose of the survey. Aboriginal and/or Torres Strait Islander people (hereby respectfully referred to as Aboriginal people) and people attending an Aboriginal Maternal Infant Health Service (AMIHS) were sent a text four days later providing choice of participation via telephone or online. Non-Aboriginal people were telephoned seven days later to invite participation, with the online option offered if participation via telephone was declined.

In SA and Tasmania, a research midwife approached people in antenatal waiting rooms to verbally inform them of the study and provide the information statement. People could complete an online consent to contact form accessible through a Quick Response code on the statement, which was provided to the study team. The same procedure used in NSW for recruitment of Aboriginal participants was used in SA and Tasmania. In all regions, the survey remained active for two weeks.

Data collection procedures

Survey questions were based on validated measures (alcohol consumption²¹ and physical activity²²) and previous surveys (smoking ²³, e-cigarette use²⁴ and GWG¹⁶). Both the telephone and online surveys were developed using REDCap and included identical questions. The online version of the survey was made accessible via text message or email using a unique survey link.

Measures

Participant characteristics

Participants were asked to report their Aboriginal origin; highest education level completed; employment status; marital status; pregnancy gestation; gravidity; number of foetuses; height and prepregnancy weight. Participant's age and allocated model of antenatal care were collected through medical records in NSW and selfreported in SA and Tasmania.

Tobacco smoking and e-cigarette use

Participants were asked to select from the following statements: I smoke every day, about the same as before I was pregnant; I smoke every day, but I've cut down since finding out I was pregnant; I smoke every once in a while; I don't smoke tobacco products now, but I used to; I have never smoked or smoked less than 100 cigarettes in my life.²³ Participants who indicated that they smoke every day or once in a while, were asked to report how many cigarettes per day on average (open-ended response), whether they had quit smoking for a period of at least 24 hours during their pregnancy (yes, no, don't know) and whether they had cut down on the number of cigarettes usually smoked since becoming pregnant (yes, no, don't know).

Those participants who indicated that they do not smoke tobacco products now but used to were asked when they stopped smoking (more than 12 months before pregnancy, less than 12 months but greater than six months before pregnancy, less than six months before pregnancy, during the first three months of pregnancy, between three and six months pregnant, between six and nine months pregnant).

Participants were asked whether they have ever used an e-cigarette or vaping device (yes, no, don't know). For those who answered yes, a further question of how often they currently use such devices was asked (daily or almost daily; less than daily, but at least once a week; less than weekly, but at least once a month; less often than once a month; not at all (I don't use one now)).²⁴

Alcohol consumption

Participants alcohol consumption was assessed using the validated three-item Alcohol Use Disorders Identification Test - Consumption (AUDIT-C) tool. Each AUDIT-C question has a choice of five answers, which are summed to provide a total score on a scale of 0 to 10.²⁵ Participants were asked how often do you have a drink containing alcohol (never, monthly or less, two to four times per month, two to three times per week, four plus times per week). For responses other than never, an additional two questions were asked: how many

standard drinks of alcohol do you drink on a typical day when you are drinking (one to two, three to four, five to six, seven to nine, 10 plus); and how often do you have five or more drinks on one occasion (never, less than monthly, monthly, weekly, daily or almost daily).

GWG against recommendations

Participants were asked to self-report their height, pre-pregnancy and current weight.

Dietary intake

Participants were asked to think about their dietary intake over the past seven-day period and report the average standardised number of servings consumed per day of vegetables, legumes, or beans; fruit; breads and cereals; meat and alternatives; and milk and alternatives.

Physical activity

Participants were asked how many days over the previous seven-day period they did vigorous and moderate physical activity. For participants who indicated they did such activities, additional openended questions of total duration were asked.

Statistical analyses

Statistical analyses were undertaken using SAS version 9.3. Condensed response categories were created for the participant's demographic and pregnancy characteristics. Participant's smoking status was categorised into current smoker (I smoke every day, about the same as before I was pregnant; I smoke every day, but I've cut down since finding out I was pregnant; I smoke every once in a while); recent guitter (I don't smoke tobacco products now, but I used to (and indicated that they guit during pregnancy to the when did you guit smoking question)); ex-smoker (I don't smoke tobacco products now, but I used to (and indicated that they guit prior to pregnancy to the when did you quit smoking question)); and non-smoker (I have never smoked or smoked less than 100 cigarettes in my life). When recent quitters and ex-smokers quit smoking were collapsed into four categories, more than 6 months before pregnancy, less than six months before pregnancy, first three months of pregnancy, after three months of pregnancy. Responses to whether participants had quit smoking for a period of at least 24 hours, cut down on the number of cigarettes smoked and ever used an e-cigarette or vaping device were dichotomised (yes/no) with don't know responses coded as no. Responses to the current use of e-cigarettes were dichotomised (yes/no) with responses of daily or almost daily; less than daily, but at least once a week; less than weekly, but at least once a month; less often than once a month categorised as yes and not at all (I don't use one now) categorised as no.

Total scores from the AUDIT-C were categorised according to Australian national guidelines²⁵: no risk (score: 0), low risk, ^{1,2} medium risk ^{3,4} and high risk (5+).

The United States Institute of Medicine (IOM) recommendations, which have been adopted in Australia, were used to calculate and assess GWG against recommendations. The IOM recommendations provide total and trimester-specific incremental weight gain recommendations for optimal healthy weight gain during pregnancy based on a person's pre-pregnancy BMI.⁸ Participant's pre-pregnancy BMI was calculated by dividing the participant's pre-pregnancy weight (in kgs) by the square of their height (in metres (m)). Pre-

pregnancy BMI was categorised according to the WHO defined categories⁸: underweight (less than 18.5 kg/m²), healthy weight (18.5 to 24.9 kg/m²), overweight (25 to 29.9 kg/m²) and obesity (30 kg/m² or more). The participant's GWG at their current gestation was determined by first subtracting pre-pregnancy weight from current weight (current GWG). To determine the recommended GWG range based on current gestation, the number of weeks gestation post the first trimester was calculated and multiplied by the IOMrecommended weekly weight gain ranges for the second and third trimesters based on their pre-pregnancy BMI (underweight: 0.44–0.58 kgs per week, healthy weight: 0.35-0.50 kgs per week, overweight: 0.23-0.33 kgs per week, obesity: 0.17-0.27 kgs per week) and then 0.5 to 2 kgs was added (as per the IOM guidelines, which recommend all people gain between 0.5 and 2 kgs in the first trimester). The current weight gain calculation was then compared to the recommended weight gain range calculation and categorised into one of three categories (lower, within or higher than recommendations). Participants who indicated a multiple pregnancy were excluded from this analysis due to different weight gain recommendations and unavailability of weekly weight gain ranges.⁷

Reported average servings of food groups consumed per day were dichotomised (yes/no) according to whether the participant met the Australian Dietary Guidelines minimum recommendations⁹: vegetables, legumes and beans (5 serves); fruit (2 serves); breads and cereals (8.5 serves); meats and alternatives (3.5 serves); milk and alternatives (2.5 serves). A variable 'meeting minimum recommended physical activity per week' was created based on the Australian guidelines for physical activity during pregnancy¹⁰ recommendation of at least 2.5 to 5 hours of moderate activity, or 1.25 to 2.5 hours of vigorous activity, or a combination of both. The median total minutes of activity were calculated with responses greater than 960 minutes per day considered outliers and removed.²²

Descriptive statistics were used to describe participants' demographic and pregnancy characteristics and the prevalence of each of the risk factors. To determine sample representativeness, chi-squared tests were used to examine differences (p<0.05) between survey samples and available state-based maternal population demographics reported in the 2020 Australian mothers and babies report²⁶ (mother's age, Aboriginal origin, gravidity and number of foetuses). Chi-squared and ANOVA tests were used to examine differences (p<0.05) between regions for demographic and pregnancy characteristics.

Results

Participation

In NSW, 1864 potential participants were randomly sampled during the study period. In SA and Tasmania, 413 and 155 potential participants provided consent to be contacted, respectively, during the study period. Of these, 1566 (84.0%) in NSW, 355 (86.0%) in SA and 124 (80.0%) in Tasmania were able to be contacted within the two-week period and 1395 (74.8%) in NSW, 307 (86.5%) in SA and 113 (91.1%) in Tasmania were deemed eligible to participate. Of these, 749 (53.7%) in NSW, 234 (76.2%) in SA and 84 (74.3%) in Tasmania consented to participate at the time of the survey and 748 (53.6%) in

NSW, 232 (75.6%) in SA and 84 (74.3%) in Tasmania completed the survey.

Characteristics of participants

See Table 1 for characteristics of participants in each of the three regions. There was a statistically significant difference between the survey sample and state-based maternal population demographics for participant age in NSW (survey sample mean: 30.6; state mean: 31.1; diff: -0.5; 95% Cl: -0.9, -0.1; p<0.01) and SA (survey sample mean: 32.0; state mean: 30.7; diff: 1.3; 95% Cl: 0.7, 1.9; p<0.01). There were significant differences at a p-value of <0.05 in the age, education, pregnancy risk level as determined by allocated model of antenatal care and pre-pregnancy BMI categories between survey participants in each region.

Tobacco smoking and e-cigarette use

As shown in Table 2, a higher proportion of participants were current smokers and recent quitters in Tasmania (8.4%, 9.6%) than NSW (5.2%, 5.2%) and SA (2.2%, 5.6%). Less than 20% of participants reported ever using an e-cigarette (NSW:16.9%, SA:15.2%, Tasmania:19.3%), with lower prevalence of current use in NSW (0.7%).

Alcohol consumption

Most participants reported that they did not consume alcohol at the time of the survey (NSW: 95.2%, SA: 96.1%, Tasmania: 95.2%).

GWG against recommendations

As shown in Table 3, for approximately two-thirds of participants in each region, GWG was not within IOM recommendations for their gestation. Twenty-four percent (NSW) to 36.8% (Tasmania) reported GWG lower than recommendations and 33.3% (Tasmania) to 41.0% (NSW) higher.

Dietary intake

For all regions, fruit had the highest reported adherence (NSW: 63.0%, SA: 59.8%, Tasmania: 56.1%), followed by milk and alternatives (NSW: 28.4%, SA: 25.1%, Tasmania: 41.5%) and vegetables (NSW: 10.2%, SA: 12.0%, Tasmania: 12.4%).

Physical activity

Approximately one-third of participants located in NSW (34.8%) and Tasmania (32.5%) met physical activity recommendations, and just under one-guarter in SA (24.4%).

Discussion

This cross-sectional study estimated the prevalence of priority preventive health risks in samples of pregnant people in three Australian regions. Across all regions, less than 10% of participants were current smokers and less than 5% consumed alcohol. GWG was outside recommended ranges for approximately two-thirds of participants, the majority did not meet the recommended intake of core food groups (except for fruit) and one-third or less met physical activity recommendations. This study demonstrates a need for greater access to evidence-based interventions for people to reduce their preventive

Table 1: Participant characteristics.					
	New South Wales (n=748)	South Australia (n=232)	Tasmania		
	% (n)	% (n)	(n==84) % (n)		
Weeks' gestation at time of survey			70 (II)		
Mean (SD)	24.5 (8.7)	27.0 (8.2)	28.3 (7.2)		
Range	13.0 - 40.0	10.0 - 39.0	13.0 - 40.0		
Age Mean (SD)	30.6 (4.9)	32.0 (4.7)	30.2 (5.1)		
Range	18.0 - 47.0	18.0 - 44.0	18.0 - 41.0		
Aboriginal origin Aboriginal, or Torres Strait Islander, or both	4.3% (32)	5.2% (12)	<5		
Not Aboriginal or Torres Strait Islander	95.7% (716)	94.8% (220)	97.6% (82)		
Highest education level completed	10.70/ (147)	10.00/ (44)	22 10/ (27)		
Completed high school of less	22 204 (249)	20.20% (44)	32.1% (27)		
Completed technical certificate of upforma	35.2% (248)	29.3% (00) 51.7% (120)	22 20% (29)		
	47.170 (552)	51.7% (120)	55.5% (20)		
Employment status Employed full time	46.1% (344)	43.1% (100)	30.1% (25)		
Employed part time or casual	33.2% (248)	37.5% (87)	41.0% (34)		
Home duties	7.9% (59)	6.9% (16)	13.3% (11)		
Student	1.7% (13)	2.6% (6)	<5		
Not employed	11.1% (83)	9.9% (23)	13.3% (11)		
Marital status Married or defacto relationship	92.0% (688)	92.2% (214)	86.9% (73)		
Other	8.0% (60)	7.8% (18)	13.1% (11)		
Gravidity			. ,		
One pregnancy	43.0% (322)	47.0% (109)	35.7% (30)		
Two or more pregnancies	57.0% (426)	53.0% (123)	64.3% (54)		
Number of foetuses	07.50/ (730)	07 00/ (177)	06 40/ (91)		
	97.5% (729)	97.8% (227)	90.4% (81)		
	2.5% (19)	2.2% (5)	<>		
Allocated model of antenatal care Low risk	69.4% (519)	50.2% (115)	60.7% (51)		
High risk	30.2% (226)	47.2% (108)	39.3% (33)		
Aboriginal service	<5	2.6% (6)	N/A		
Pre-pregnancy BMI category ^a Underweight	2.6% (18)	4.2% (9)	<5		
Healthy	49.1% (339)	48.4% (103)	31.0% (22)		
Overweight	25.9% (179)	25.4% (54)	22.5% (16)		
Obesity	22.4% (155)	22.1% (47)	46.5% (33)		

<5 is displayed in cells instead of % and n in instances where there were less than five participants to reduce risk of identification. ^aMissing data from pre-pregnancy BMI category due to participants not being able to report pre-pregnancy weight (NSW n=691, South Australia n= 213, Tasmania n=71).

health risks in pregnancy and in turn achieve positive outcomes for themselves and their babies. The prevalence data for each region, and overall, provides policymakers and maternity services information to prioritise the implementation of such interventions.

In comparing results for smoking during pregnancy to national data (NDSHS: 7.6%; NPDC: 8.7%^{11,13}), a similar prevalence was found for NSW (10.5%) and SA (7.8%) and higher for Tasmania (18.0%). Most current smokers reported making changes, confirming pregnancy as an opportune time to offer evidence-based interventions that support quitting. A 2017 systematic review of 102 randomised controlled trials found that psychosocial interventions increased the proportion of people who stopped smoking in late pregnancy (by 35%).²⁷ Improving access to such interventions is essential, especially in Tasmania, where almost double the proportion of people reported

smoking. There is also a need to monitor e-cigarette use to establish prevalence trends over time and for effective strategies and consistent clinical guideline recommendations to be developed so that people can be supported to not use e-cigarettes in pregnancy.

Between 3.9% and 4.8% of participants were found to consume alcohol during pregnancy, which is marginally higher than the 2021 NPDC national (first 20 weeks: 2.7%, after 20 weeks: 0.7%),¹¹ but lower than the pooled prevalence of Australian cohort and cross-sectional studies (48%).¹² Such discrepancy may be explained by the differences in measurement and the contexts in which people were sampled. Accurate reporting of risk is critical for both practice and policy, as it enables pregnant people to access support, as well as providing clear understanding for policy and resource allocation considerations. A 2009 qualitative study of 26 Australian people found

Table 2: Prevalence estimate of tobacco smoking, e-cigarette use and alcohol consumption during pregnancy.						
	New South Wales	South Australia	Tasmania			
	% (n)	% (n)	% (n)			
Smoking	n=745	n=231	n=83			
Smoking status Current smoker	5.2% (39)	2.2% (5)	8.4% (7)			
Recent quitter (quit during pregnancy)	5.2% (39)	5.6% (13)	9.6% (8)			
Ex-smoker (quit before pregnancy)	13.4% (100)	13.0% (30)	16.9% (14)			
Non-smoker	76.1% (567)	79.2% (183)	65.1% (54)			
Current smokers Number of cigarettes smoked per day (mean (SD))	7 (5)	5 (6)	4 (2)			
Quit attempt made during pregnancy (for at least 24 hours)	51.3% (20)	<5	<5			
Cut down on number of cigarettes smoked during pregnancy	89.7% (35)	<5	71.4% (5)			
Ex-smokers and recent quitters - When quit smoking						
More than 6 months before pregnancy	59.7% (83)	51.2% (22)	59.1% (13)			
Less than 6 months before pregnancy	12.2% (17)	18.6% (8)	<5			
First 3 months of pregnancy	27.3% (38)	30.2% (13)	27.3% (6)			
After 3 months of pregnancy	<5	<5	<5			
E-cigarette use						
Ever used e-cigarette	16.9% (126)	15.2% (35)	19.3% (16)			
Current user of e-cigarettes	0.7% (5)	<5	<5			
Alcohol consumption	n=747	n=232	n=83			
Alcohol risk categories No risk (AUDIT-C score: 0)	95.2% (711)	96.1% (223)	95.2% (79)			
Low risk (AUDIT-C score: 1-2)	4.3% (32)	3.9% (9)	<5			
Medium risk (AUDIT-C score: 3-4)	<5	<5	<5			
High risk (AUDIT-C score: 5+)	<5	<5	<5			

SD = standard deviation.

<5 is displayed in cells instead of % and n in instances where there were less than five participants to reduce risk of identification.

Table 3: Prevalence estimate of GWG, dietary intake and physical activity during pregnancy.						
	New South Wales % (n)	South Australia % (n)	Tasmania % (n)			
Gestational weight gain	n=486	n=139	n=57			
Current tracking of GWG against IOM recommendations Lower	24.0% (117)	30.9% (43)	36.8% (21)			
Within	35.0% (170)	31.7% (44)	29.8% (17)			
Higher	41.0% (199)	37.4% (52)	33.3% (19)			
Dietary intake	n=741	n=229	n=83			
Meeting minimum recommended serves of each core food group Vegetables, legumes and beans	10.2% (75)	12.0% (27)	12.4% (10)			
Fruit	63.0% (467)	59.8% (137)	56.1% (46)			
Breads and cereals	0.7% (5)	<5	<5			
Meats and alternatives	4.2% (31)	4.5% (10)	<5			
Milk and alternatives	28.4% (210)	25.1% (57)	41.5% (34)			
Physical activity	n=734	n=227	n=83			
Meeting minimum recommended physical activity per week	34.8% (257)	24.4% (55)	32.5% (27)			
Total minutes of moderate and/or vigorous minutes per week Median (IQR)	70.0 (0.0 - 210.0)	0.0 (0.0 - 120.0)	40.0 (0.0 - 210.0)			

IQR = interquartile range.

<5 is displayed in cells instead of % and n in instances where there were less than five participants to reduce risk of identification.

that data collection methods other than face-to-face/phone (e.g. selfcompleted assessments) facilitate accurate self-report and hence are warranted for testing in the maternity service context.²⁸ Improved identification of risk would increase the likelihood that pregnant people have access to evidence-based interventions, such as psychosocial support delivered by healthcare professionals, which have been found to significantly increase the odds of achieving abstinence in pregnancy by more than two-fold.²⁹

(70%),¹⁶ however, such data are not directly comparable due to the differences in measurement timing. Like the previous national surveys, low levels of meeting healthy eating and physical activity recommendations were found in this study.^{17,18} Behavioural interventions supporting diet and/or physical activity provided as part of antenatal care and/or through specialist services (e.g. dietitians) have been shown to reduce GWG (-1.15 kgs; 95% Cl:-1.40–0.91).³⁰ Given that almost no people were found to be meeting such recommendations, there is a critical need to implement population-wide, evidence-based interventions for each of these preventive health risks in pregnancy.

Australian antenatal clinical guidelines⁷ recommend the routine implementation of interventions to reduce preventive risks in pregnancy. Specifically, the guidelines recommend that all people have their preventive health risks assessed, receive advice about the risks and discuss behaviour change, and be referred for further support where indicated. In each state, referrals can be made to free population-wide telephone counselling services, and specialist services, such as dietitians, drug and alcohol specialists and tobacco cessation counsellors, where available locally. Despite such guidelines, previous Australian studies have found their provision to be less than optimal.³¹ For example, a 2016 survey of 223 pregnant people found that only 62% were provided support for tobacco smoking, 36% GWG and 10% alcohol consumption in Australian maternity services.³¹ Implementation strategies, including educational meetings and reminders, have been shown to improve the provision of such care.³² Given the number of risks that could be targeted for service improvements, localised priority setting and planning is recommended.² The region-based prevalence data presented in this study, coupled with an understanding of the current local implementation of the clinical guideline recommendations, could assist policy makers and health services make decisions about where to allocate resources for greatest benefit.

This study needs to be considered in light of its strengths and limitations. First, the differences in recruitment procedures between regions may have led to differences in the people sampled to participate. However, the study samples were found to be representative in regard to maternal and pregnancy characteristics, including Aboriginal origin, gravidity, number of foetuses and age (for Tasmania). The study used validated tools for assessing alcohol consumption and physical activity; however, the use of self-report may have led to underreporting of risk due to recall or social desirability bias. $^{\ensuremath{^{33}}}$ The smaller sample sizes in SA and Tasmania, as well as the reduced sample for estimating GWG prevalence (due to participants not being able to report weights), are further limitations of the study. The small sample sizes also prohibited the examination of prevalence for priority populations, including Aboriginal and Torres Strait Islander people, which is an important consideration when examining prevalence estimates in pregnancy. It is unclear whether current GWG (at a mean week's gestation of 24.5-28.3) would have differed from total GWG for full term pregnancy and the small sample sizes precluded the ability to examine trends at various pregnancy

time points. Despite such limitations, this study provides a comprehensive overview of the current prevalence of preventive risks in pregnant people located in three separate regions and provides policymakers and maternity services with useful information to prioritise and target intervention support.

Conclusions

This study found that many people are not meeting Australian guideline recommendations for preventive health risks in pregnancy. People's access to evidence-based interventions as part of routine antenatal care provision and specialist referrals is crucial to reducing such risk. Findings from this research can be used by policymakers and maternity services to understand the need for interventions and prioritise support for implementation.

Ethics

The study was approved by the Hunter New England Human Research Ethics Committee (16/11/16/4.07), The University of Newcastle Human Research Ethics Committee (H-2017-0032) and the Aboriginal Health and Medical Research Council (1236/16). Site Specific Assessments were approved by the Women's and Children's Health Network, SA (2021/SSA00471), SA Aboriginal Research Ethics Committee (04-21-942) and Tasmanian Government Department of Health (SSA/THSLGH/220).

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Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Emma Doherty reports financial support was provided by The Australian Prevention Partnership Centre Grant (GNT 9100003). Sophie Dilworth reports financial support was provided by The Australian Prevention Partnership Centre Grant (GNT 9100003). Melanie Kingsland reports financial support was provided by The Australian Prevention Partnership Centre Grant (GNT 9100003). Melanie Kingsland reports financial support was provided by The Australian Prevention Partnership Centre Grant (GNT 9100003). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability statement

Data is available from the corresponding author upon reasonable request.

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