

Alcohol consumption in New Zealand women before and during pregnancy: findings from the *Growing Up in New Zealand* study

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ABSTRACT

AIM: To examine alcohol consumption before and during pregnancy in the mothers of a contemporary sample of New Zealand children.

METHOD: Analysis of data from the antenatal assessment of 6,822 women enrolled in the *Growing Up in New Zealand* study, using logistic regression models to examine associations between maternal alcohol use and maternal demographics, pregnancy planning and parity.

RESULTS: Seventy-one percent of women drank alcohol before becoming pregnant, 23% during and 13% after the first trimester. The odds of drinking alcohol before pregnancy were significantly higher for younger women who were European or Māori with an unplanned pregnancy and in their first pregnancy; during the first trimester, higher for women who were European or Māori with no secondary school qualification, in their first pregnancy, with an unplanned pregnancy; and in the second and third trimesters, higher for European or Māori women aged 30 and over, in their first pregnancy.

CONCLUSIONS: Drinking is common in New Zealand women before pregnancy, particularly among European and Māori women. Some women consume small amounts of alcohol and some engage in heavy drinking in pregnancy. Both are a risk for fetal harm. Population-wide and targeted measures are needed to reduce consumption overall and provide support to specific population groups.

Alcohol consumption is common in New Zealanders: 79% of individuals 15 years and over report drinking alcohol in the past 12 months.¹ Women's drinking patterns have increasingly become more like those of men, with drinking to intoxication, binge drinking and consumption of any amount across all ages common, particularly in young women.² In 2017, 75% of New Zealand women reported drinking alcohol in the past 12 months, compared with 84% of men.¹

It is now clear that consumption of any amount of alcohol at any stage of preg-

nancy may lead to fetal physical, cognitive and behavioural impairments collectively known as fetal alcohol spectrum disorder (FASD).^{3,4} Some 600–3,000 babies with FASD are thought to be born each year in New Zealand;⁵ approximately 1–5% of all live births in 2015.⁶ The impacts and costs of this preventable problem to individuals, families and society are significant: Easton et al estimated that the labour force productivity loss due to FASD-attributable morbidity and premature mortality translated to an aggregate loss in 2013 of \$NZ49–200 million, equivalent to 0.03% to 0.09% of annual gross domestic product.⁷ Dose and

timing of alcohol exposure are important in determining the extent and nature of the impairments.⁸ Heavy drinking—at least four or more standard drinks at a session during early pregnancy, when a woman may not yet be aware she is pregnant—is considered the most harmful pattern.^{9,10}

We aimed to identify the prevalence and predictors of alcohol consumption before and during pregnancy in a representative sample of New Zealand mothers.

Methods

We analysed data collected from pregnant women who enrolled into New Zealand's contemporary child cohort study, *Growing Up in New Zealand* (GUiNZ). Study design and methodology have been reported elsewhere.¹¹ In brief, all pregnant women residing in the geographical area defined by the contiguous Auckland, Counties-Manukau and Waikato District Health Board regions with an expected delivery date between 25 April 2009 and 25 March 2010 were eligible and invited to participate utilising a multi-modal recruitment strategy.¹² In total, 6,822 pregnant women enrolled, gave informed consent and completed a computer-assisted face-to-face antenatal interview. Instructions were given to interviewers about what constituted a standard drink (in New Zealand, a standard drink contains 10 grams of pure alcohol, equivalent to a small [100ml] glass of wine, a 330ml can of beer or a 30ml shot of spirits¹³) as well as standard show cards to make the meaning clear to participants, who were then asked: "On average how many drinks of alcohol—beer, wine, spirits, did you drink per week: 1) Before becoming pregnant or before you were aware you were pregnant?; 2) In the first three months of pregnancy?; and 3) After the first three months of pregnancy?" Response options for each of these items were: "I did not drink alcohol"; "less than 1 drink per week"; "1 drink per week"; "2 drinks per week"; "3 drinks per week"; "4–6 drinks per week"; "7–9 drinks per week"; "10–14 drinks per week"; "15–19 drinks per week"; "20–39 drinks per week"; and "40 or more drinks per week". Due to limited cell counts, "20–39 drinks per week"; and "40 or more

drinks per week" were combined to form the category "20 or more drinks per week".

Pregnant mothers also provided detailed information about their self-identified ethnic identity. We used Statistics New Zealand's priority coding criteria for self-identified ethnicity and coded responses into six Level 1 categories: Māori; Pacific; Asian; Middle Eastern, Latin American and African (MELAA); Other; and European (Statistics New Zealand, 2005).¹⁴ The categories of MELAA and Other were combined due to small numbers. Socio-economic deprivation was measured using the 2006 New Zealand Deprivation Index (NZDep2006), an area-level (neighbourhood) index constructed from nine Census 2006 variables (means-tested benefits, household income, home ownership, single-parent family, employment, qualifications, household overcrowding, access to a telephone, and access to a car).¹⁵ Summary deprivation scores were grouped into quintiles, 1 being the least deprived and 5 the most deprived neighbourhoods. Data on age, highest level of education attained, parity and planning of pregnancy were also collected. We calculated descriptive statistics and their 95% confidence intervals (95%CI). Logistic regression models were used to examine associations between maternal alcohol use and variables that described maternal demographics, pregnancy planning and parity, using SAS version 9.3 (SAS Institute Inc., 2011). The correlation between SES and education was 0.31, indicating mild correlation, so both variables were retained in the same model without affecting the standard errors. Adjusted odds ratios (OR) and their 95% CIs were calculated. A p-value of 0.05 was used as the cut-off for determining statistical significance. Ethics approval for the GUiNZ study was granted by the Ministry of Health Northern Y Regional Ethics Committee.

Results

Participant characteristics

Table 1 shows the participant's sociodemographic characteristics. Only one in twenty were under the age of 20 and 40% of pregnancies were unplanned.

Table 1: Participant sociodemographic characteristics.

Maternal characteristic	N	%
Total	6,822	100
Age group (n=6,812)		
19 or less	328	4.8
20–29	2,661	39.0
30–39	3,533	52.0
40 or older	290	4.2
Missing data	10	
Ethnicity (Level 1 prioritised, n=6,807)		
Māori	943	13.8
Pacific	999	14.7
Asian	1,009	14.8
MELAA & Other	167	2.4
European	3,689	54.3
Missing data	15	
Household deprivation (NZDep06, n=6,806)		
5 (most deprived)	1,879	27.6
4	1,423	20.9
3	1,169	17.2
2	1,235	18.1
1 (least deprived)	1,100	16.2
Missing data	16	
Highest education (n=6,802)		
No secondary school qualification	489	7.2
Secondary school/NCEA 1–4	1,625	23.9
Diploma/trade cert/NCEA 5–6	2,077	30.5
Bachelor's degree	1,542	22.7
Higher degree	1,069	15.7
Missing data	20	
Parity (n=6,815)		
First-born	2,852	41.8
Subsequent	3,963	58.2
Missing data	7	
Planned or unplanned pregnancy (n=6,791)		
Planned	4,091	60.2
Unplanned	2,700	39.8
Missing data	31	

Alcohol use before and during pregnancy

Table 2 shows that 71% of women reported drinking before pregnancy (including before becoming aware of pregnancy), 23% during and 13% after the first trimester, with 29% reporting four or more drinks on average per week before pregnancy, 7% during and 1% after the first trimester.

Before pregnancy (including before becoming aware of being pregnant): The odds of drinking any alcohol before pregnancy were almost double for women aged 19 years of under (aOR 1.8, 95%CI 1.2–2.8) compared with women ≥ 40 years old; low for women of Pacific (aOR 0.3, 0.2–0.3), Asian (aOR 0.1, 0.1–0.1) or MELAA/Other (aOR 0.2, 0.1–0.2) compared with European

Table 2: Mothers' average weekly alcohol consumption before and during pregnancy.¹

Average weekly maternal alcohol consumption	Before pregnancy (or awareness of pregnancy) (N=6,805)		During the first 3 months (N=6,804)		After the first 3 months (N=6,810)	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Did not drink	1,982	29.1 (28.0–30.2)	5,266	77.4 (76.4–78.4)	5,898	86.6 (85.8–87.4)
Less than 1 drink	1,238	18.2 (17.3–19.1)	613	9.0 (8.3–9.7)	635	9.3 (8.6–10.0)
1–3 drinks	1,602	23.5 (22.5–24.5)	472	6.9 (6.3–7.5)	220	3.2 (2.8–3.7)
4–19 drinks	1,831	26.9 (25.9–28.0)	399	5.9 (5.3–6.4)	47	0.7 (0.5–0.9)
20 or more drinks	152	2.2 (1.9–2.6)	54	0.8 (0.6–1.0)	10	0.1 (0.1–0.2)
Any drinking	4,823	70.9 (69.8–72.0)	1,538	22.6 (21.6–23.6)	912	13.4 (12.6–14.2)

Notes: 1. Relates to the questions “On average how many drinks of alcohol—beer, wine, spirits did you drink per week *before becoming pregnant or before you were aware you were pregnant?*”; “On average how many drinks of alcohol—beer, wine, spirits did you drink per week *in the first 3 months of pregnancy?*”; “On average how many drinks of alcohol—beer, wine, spirits did you drink per week *after the first 3 months of pregnancy?*”

women; and lower for women living in the most (0.7, 0.6–0.9) versus the least deprived quintile of households (Table 3). Women expecting their first child had 60% greater odds of drinking than those with second or subsequent pregnancies (75.3% versus 67.7%, aOR 1.6, 95%CI 1.4–1.9).

First trimester: Demographic variables independently associated with drinking any alcohol in the first trimester were ethnicity ($p < 0.0001$) education ($p = 0.025$), parity ($p = 0.001$) and planned or unplanned pregnancy ($p < 0.0001$) (Table 4). The odds of drinking any alcohol during the first trimester of pregnancy were highest for women of Māori ethnicity (aOR 1.3, 1.1–1.5) and far lower for women of Pacific (aOR 0.5, 0.4–0.67), Asian (aOR 0.2, 0.1–0.3) or MELAA/Other (aOR 0.3, 0.2–0.6) ethnicity compared with European ethnicity; and greatest for women with no secondary school education qualifications (aOR 1.4; 95%CI 1.1–1.9). A significantly greater proportion of women expecting their first child drank alcohol during the first trimester (75.9%) than women in their second or subsequent

pregnancies (24.1%) (aOR 1.2, 95%CI 1.1–1.4). Mothers with unplanned pregnancies were twice as likely (aOR 2.2, 95%CI 1.9–2.5) as those who had a planned pregnancy to report alcohol consumption in the first trimester but there was no difference after the first trimester (Table 4).

Second and third trimesters: In contrast to the first trimester, the odds of drinking any alcohol after the first trimester of pregnancy were lowest for younger women ≤ 19 years old (0.5, 0.3–0.9) and 20–29 years old (0.5, 0.3–0.6) compared with women ≥ 40 years old; and lowest for women of Pacific (aOR 0.2, 0.1–0.3), Asian (aOR 0.1, 0.1–0.2) or MELAA/Other ethnicity (aOR 0.4, 0.3–0.8) compared with European ethnicity. Māori women were as likely to be drinking at this time of pregnancy as European women. Unlike the first trimester, a significantly lower proportion of primiparous (11.4%) than multiparous women drank alcohol (14.8%) (aOR 0.8, 0.7–0.9) with no difference in women who had planned or unplanned pregnancies.

Table 3: Mothers’ average weekly alcohol consumption by demographic characteristics—before pregnancy (N=6,805).¹

Demographic characteristics		Average weekly alcohol consumption										Consumed alcohol ²	
		Did not drink (N=1,982)		Less than 1 drink (N=1,238)		1-3 drinks (N=1,602)		4-19 drinks (N=1,831)		20 or more drinks (N=152)			
		N	% (95% CI)	N	% (95% CI)	n	% (95% CI)	N	% (95% CI)	N	% (95% CI)	Adjusted odds ratio (95% CI)	p-value
Age group	19 or less	61	18.6 (14.4–22.8)	61	18.6 (14.4–22.8)	51	15.5 (11.6–19.5)	127	38.7 (33.4–44.0)	28	8.5 (5.5–11.6)	1.8 (1.2–2.8)	0.0003
	20–29	902	33.9 (32.1–35.7)	505	19.0 (17.5–20.5)	520	19.5 (18.0–21.0)	655	24.6 (23.0–26.3)	79	3.0 (2.3–3.6)	1.1 (0.8–1.5)	
	30–39	930	26.3 (24.9–27.8)	623	17.6 (16.4–18.9)	958	27.1 (25.6–28.6)	980	27.7 (26.3–29.2)	42	1.2 (0.8–1.5)	1.4 (1.0–1.8)	
	40 or older	89	31.4 (26.0–36.9)	49	17.3 (12.9–21.7)	73	25.8 (20.7–30.9)	69	24.4 (19.4–29.4)	<10	-	1.0	
Ethnicity	Māori	200	21.2 (18.6–23.8)	183	19.4 (16.9–21.9)	170	18.0 (15.6–20.5)	319	33.8 (30.8–36.8)	71	7.5 (5.8–9.2)	0.8 (0.6–1.0)	<0.0001
	Pacific	479	47.9 (44.8–51.0)	137	13.7 (11.6–15.8)	155	15.5 (13.3–17.8)	199	19.9 (17.4–22.4)	29	2.9 (1.9–3.9)	0.3 (0.2–0.3)	
	Asian	648	64.6 (61.6–67.6)	205	20.4 (17.9–22.9)	101	10.1 (8.2–11.9)	45	4.5 (3.2–5.8)	<10	-	0.1 (0.1–0.1)	
	MELAA & Other	86	54.4 (46.7–62.2)	27	17.1 (11.2–23.0)	28	17.7 (11.8–23.7)	16	10.1 (5.4–14.8)	<10	-	0.2 (0.1–0.2)	
	European	568	15.4 (14.2–16.6)	681	18.5 (17.2–19.7)	1,145	31.0 (29.5–32.5)	1,248	33.8 (32.3–35.4)	47	1.3 (0.9–1.6)	1.0	
Household deprivation (NZDep06)	5 (most deprived)	711	37.8 (35.6–40.0)	324	17.2 (15.5–19.0)	315	16.8 (15.1–18.5)	439	23.4 (21.4–25.3)	90	4.8 (3.8–5.8)	0.7 (0.6–0.9)	0.010
	4	471	33.1 (30.7–35.5)	264	18.6 (16.5–20.6)	290	20.4 (18.3–22.5)	366	25.7 (23.4–28.0)	32	2.2 (1.5–3.0)	0.8 (0.7–1.0)	
	3	302	25.9 (23.3–28.4)	215	18.4 (16.2–20.6)	307	26.3 (23.8–28.8)	335	28.7 (26.1–31.3)	<10	-	0.9 (0.7–1.1)	
	2	281	22.8 (20.4–25.1)	226	18.3 (16.1–20.5)	359	29.1 (26.5–31.6)	356	28.8 (26.3–31.4)	13	1.1 (0.5–1.6)	0.9 (0.7–1.2)	
	1 (least deprived)	217	19.8 (17.4–22.1)	208	18.9 (16.6–21.3)	331	30.1 (27.4–32.9)	334	30.4 (27.7–33.1)	<10	-	1.0	
Highest education	No sec school qualification	132	27.0 (23.1–30.9)	73	14.9 (11.8–18.1)	67	13.7 (10.7–16.7)	177	36.2 (31.9–40.5)	40	8.2 (5.8–10.6)	0.9 (0.7–1.2)	0.013
	Sec school / NCEA 1–4	568	35.0 (32.6–37.3)	299	18.4 (16.5–20.3)	297	18.3 (16.4–20.2)	426	26.2 (24.1–28.4)	35	2.2 (1.4–2.9)	0.7 (0.6–0.9)	
	Diploma / Trade cert / NCEA 5–6	614	29.6 (27.6–31.5)	377	18.2 (16.5–19.8)	477	23.0 (21.2–24.8)	544	26.2 (24.3–28.1)	65	3.1 (2.4–3.9)	0.9 (0.7–1.1)	
	Bachelor’s degree	416	27.0 (24.8–29.3)	310	20.2 (18.2–22.2)	410	26.7 (24.4–28.9)	396	25.7 (23.6–27.9)	<10	-	1.0 (0.8–1.2)	
	Higher degree	248	23.3 (20.8–25.9)	178	16.7 (14.5–19.0)	348	32.7 (29.9–35.6)	285	26.8 (24.1–29.5)	<10	-	1.0	
Parity	First-born	705	24.7 (23.2–26.3)	464	16.3 (14.9–17.6)	692	24.3 (22.7–25.9)	903	31.7 (30.0–33.4)	85	3.0 (2.4–3.6)	1.6 (1.4–1.9)	<0.0001
	Subsequent	1,277	32.3 (30.8–33.7)	774	19.6 (18.3–20.8)	910	23.0 (21.7–24.3)	928	23.5 (22.1–24.8)	67	1.7 (1.3–2.1)	1.0	
Planned or unplanned pregnancy	Planned	1,147	28.1 (26.7–29.4)	755	18.5 (17.3–19.7)	1,114	27.2 (25.9–28.6)	1,041	25.5 (24.1–26.8)	32	0.8 (0.5–1.1)	1.0 (1.1–1.4)	0.006
	Unplanned	826	30.6 (28.9–32.4)	479	17.8 (16.3–19.2)	484	18.0 (16.5–19.4)	786	29.2 (27.4–30.9)	120	4.5 (3.7–5.2)	1.2	

Notes: 1. Relates to the question “On average how many drinks of alcohol—beer, wine, spirits did you drink per week before becoming pregnant or before you were aware you were pregnant?” 2. Outcome being modelled is ‘Consumed alcohol during pregnancy’, N=6,757.

Table 4: Mothers’ average weekly alcohol consumption by demographic characteristics—first trimester (N=6,804).¹

Demographic characteristics		Average weekly alcohol consumption										Consumed alcohol ²	
		Did not drink (N=5,266)		Less than 1 drink (N=613)		1-3 drinks (N=472)		4-19 drinks (N=399)		20 or more drinks (N=54)			
		N	% (95% CI)	N	% (95% CI)	n	% (95% CI)	n	% (95% CI)	N	% (95% CI)	Adjusted odds ratio (95% CI)	p-value
Age group	19 or less	192	58.7 (53.4–64.1)	37	11.3 (7.9–14.7)	38	11.6 (8.1–15.1)	48	14.7 (10.8–18.5)	12	3.7 (1.6–5.7)	1.3 (0.9–1.9)	0.155
	20–29	2,052	77.1 (75.5–78.7)	205	7.7 (6.7–8.7)	184	6.9 (6.0–7.9)	194	7.3 (6.3–8.3)	25	0.9 (0.6–1.3)	1.0 (0.7–1.4)	
	30–39	2,799	79.2 (77.9–80.5)	346	9.8 (8.8–10.8)	231	6.5 (5.7–7.4)	142	4.0 (3.4–4.7)	16	0.5 (0.2–0.7)	1.1 (0.8–1.5)	
	40 or older	223	78.8 (74.0–83.6)	25	8.8 (5.5–12.1)	19	6.7 (3.8–9.6)	15	5.3 (2.7–7.9)	<10	-	1.0	
Ethnicity	Māori	589	62.1 (59.0–65.2)	99	10.4 (8.5–12.4)	102	10.8 (8.8–12.7)	131	13.8 (11.6–16.0)	27	2.8 (1.8–3.9)	1.3 (1.1–1.5)	<0.0001
	Pacific	812	81.4 (78.9–83.8)	42	4.2 (3.0–5.5)	68	6.8 (5.2–8.4)	63	6.3 (4.8–7.8)	13	1.3 (0.6–2.0)	0.5 (0.4–0.6)	
	Asian	936	93.3 (91.8–94.9)	41	4.1 (2.9–5.3)	22	2.2 (1.3–3.1)	<10	-	<10	-	0.2 (0.1–0.3)	
	MELAA & Other	142	89.9 (85.2–94.6)	<10	-	<10	-	<10	-	<10	-	0.3 (0.2–0.6)	
	European	2,780	75.5 (74.1–76.9)	425	11.5 (10.5–12.6)	269	7.3 (6.5–8.1)	198	5.4 (4.6–6.1)	12	0.3 (0.1–0.5)	1.0	
Household deprivation (NZDep06)	5 (most deprived)	1,407	74.7 (72.8–76.7)	145	7.7 (6.5–8.9)	133	7.1 (5.9–8.2)	159	8.4 (7.2–9.7)	39	2.1 (1.4–2.7)	1.1 (0.9–1.4)	0.807
	4	1,107	77.9 (75.7–80.1)	122	8.6 (7.1–10.0)	96	6.8 (5.5–8.1)	86	6.1 (4.8–7.3)	10	0.7 (0.3–1.1)	1.1 (0.9–1.3)	
	3	923	79.0 (76.7–81.4)	112	9.6 (7.9–11.3)	74	6.3 (4.9–7.7)	56	4.8 (3.6–6.0)	<10	-	1.0 (0.8–1.2)	
	2	963	78.2 (75.9–80.5)	113	9.2 (7.6–10.8)	102	8.3 (6.7–9.8)	52	4.2 (3.1–5.3)	<10	-	1.0 (0.8–1.3)	
	1 (least deprived)	866	78.8 (76.4–81.2)	119	10.8 (9.0–12.7)	67	6.1 (4.7–7.5)	46	4.2 (3.0–5.4)	<10	-	1.0	
Highest education	No sec school qualification	302	61.9 (57.6–66.2)	42	8.6 (6.1–11.1)	56	11.5 (8.6–14.3)	66	13.5 (10.5–16.6)	22	4.5 (2.7–6.3)	1.4 (1.1–1.9)	0.025
	Sec school / NCEA 1–4	1,249	76.9 (74.8–78.9)	137	8.4 (7.1–9.8)	122	7.5 (6.2–8.8)	105	6.5 (5.3–7.7)	12	0.7 (0.3–1.2)	1.0 (0.8–1.3)	
	Diploma / Trade cert / NCEA 5–6	1,602	77.1 (75.3–78.9)	173	8.3 (7.1–9.5)	134	6.4 (5.4–7.5)	151	7.3 (6.2–8.4)	18	0.9 (0.5–1.3)	1.0 (0.8–1.2)	
	Bachelor’s degree	1,250	81.3 (79.4–83.3)	146	9.5 (8.0–11.0)	92	6.0 (4.8–7.2)	47	3.1 (2.2–3.9)	<10	-	0.9 (0.8–1.2)	
	Higher degree	856	80.5 (78.1–82.9)	113	10.6 (8.8–12.5)	65	6.1 (4.7–7.6)	29	2.7 (1.7–3.7)	<10	-	1.0	
Parity	First-born	2,161	75.9 (74.4–77.5)	264	9.3 (8.2–10.3)	205	7.2 (6.3–8.2)	189	6.6 (5.7–7.6)	27	0.9 (0.6–1.3)	1.2 (1.1–1.4)	0.001
	Subsequent	3,105	78.4 (77.2–79.7)	349	8.8 (7.9–9.7)	267	6.7 (6.0–7.5)	210	5.3 (4.6–6.0)	27	0.7 (0.4–0.9)	1.0	
Planned or unplanned pregnancy	Planned	3,392	83.0 (81.8–84.1)	360	8.8 (7.9–9.7)	219	5.4 (4.7–6.0)	113	2.8 (2.3–3.3)	<10	-	1.0	<0.0001
	Unplanned	1,861	69.0 (67.3–70.8)	249	9.2 (8.1–10.3)	251	9.3 (8.2–10.4)	284	10.5 (9.4–11.7)	51	1.9 (1.4–2.4)	2.2 (1.9–2.5)	

Notes: 1. Relates to the question “On average how many drinks of alcohol—beer, wine, spirits did you drink per week in the first 3 months of pregnancy?”
 2. Outcome being modelled is ‘Consumed alcohol during pregnancy’, N=6,756.

Table 5: Mothers’ average weekly alcohol consumption by demographic characteristics—2nd and 3rd trimesters (N=6,810).¹

Demographic characteristics		Average weekly alcohol consumption										Consumed alcohol ²	
		Did not drink (N=5,898)		Less than 1 drink (N=635)		1-3 drinks (N=220)		4-19 drinks (N=47)		20 or more drinks (N=10)			
		N	% (95% CI)	N	% (95% CI)	n	% (95% CI)	n	% (95% CI)	N	% (95% CI)	Adjusted odds ratio (95% CI)	p-value
Age group	19 or less	293	89.3 (86.0–92.7)	18	5.5 (3.0–8.0)	6	1.8 (0.4–3.3)	<10	-	<10	-	0.5 (0.3–0.9)	<0.0001
	20–29	2,432	91.4 (90.3–92.5)	156	5.9 (5.0–6.8)	48	1.8 (1.3–2.3)	22	0.8 (0.5–1.2)	<10	-	0.5 (0.3–0.6)	
	30–39	2,945	83.2 (82.0–84.5)	427	12.1 (11.0–13.1)	148	4.2 (3.5–4.8)	15	0.4 (0.2–0.6)	<10	-	0.8 (0.6–1.1)	
	40 or older	228	80.6 (76.0–85.2)	34	12.0 (8.2–15.8)	18	6.4 (3.5–9.2)	<10	-	<10	-	1.0	
Ethnicity	Māori	804	84.8 (82.5–87.1)	68	7.2 (5.5–8.8)	40	4.2 (2.9–5.5)	32	3.4 (2.2–4.5)	<10	-	0.9 (0.7–1.1)	<0.0001
	Pacific	958	95.9 (94.7–97.1)	17	1.7 (0.9–2.5)	12	1.2 (0.5–1.9)	<10	-	<10	-	0.2 (0.1–0.3)	
	Asian	976	97.4 (96.4–98.4)	21	2.1 (1.2–3.0)	<10	-	<10	-	<10	-	0.1 (0.1–0.2)	
	MELAA & Other	144	91.1 (86.7–95.6)	10	6.3 (2.5–10.1)	<10	-	<10	-	<10	-	0.4 (0.3–0.8)	
	European	3,004	81.4 (80.2–82.7)	519	14.1 (12.9–15.2)	159	4.3 (3.7–5.0)	<10	-	<10	-	1.0	
Household deprivation (NZDep06)	5 (most deprived)	1,682	89.3 (87.9–90.7)	110	5.8 (4.8–6.9)	49	2.6 (1.9–3.3)	34	1.8 (1.2–2.4)	<10	-	1.1 (0.9–1.5)	0.725
	4	1,263	88.8 (87.1–90.4)	109	7.7 (6.3–9.0)	41	2.9 (2.0–3.8)	<10	-	<10	-	1.0 (0.8–1.3)	
	3	997	85.4 (83.3–87.4)	132	11.3 (9.5–13.1)	37	3.2 (2.2–4.2)	<10	-	<10	-	1.1 (0.9–1.4)	
	2	1,044	84.5 (82.5–86.6)	139	11.3 (9.5–13.0)	50	4.0 (2.9–5.1)	<10	-	<10	-	1.0 (0.8–1.3)	
	1 (least deprived)	911	82.9 (80.7–85.1)	144	13.1 (11.1–15.1)	43	3.9 (2.8–5.1)	<10	-	<10	-	1.0	
Highest education	No sec school qualification	417	85.3 (82.1–88.4)	30	6.1 (4.0–8.3)	24	4.9 (3.0–6.8)	12	2.5 (1.1–3.8)	<10	-	1.0 (0.7–1.4)	0.022
	Sec school / NCEA 1–4	1,458	89.7 (88.2–91.1)	99	6.1 (4.9–7.3)	53	3.3 (2.4–4.1)	14	0.9 (0.4–1.3)	<10	-	0.7 (0.6–1.0)	
	Diploma / Trade cert / NCEA 5–6	1,837	88.3 (86.9–89.7)	171	8.2 (7.0–9.4)	51	2.5 (1.8–3.1)	20	1.0 (0.5–1.4)	<10	-	0.7 (0.6–0.9)	
	Bachelor’s degree	1,303	84.8 (83.0–86.6)	174	11.3 (9.7–12.9)	59	3.8 (2.9–4.8)	<10	-	<10	-	0.9 (0.7–1.1)	
	Higher degree	871	81.9 (79.5–84.2)	160	15.0 (12.9–17.2)	33	3.1 (2.1–4.1)	<10	-	<10	-	1.0	
Parity	First-born	2,523	88.6 (87.4–89.7)	244	8.6 (7.5–9.6)	66	2.3 (1.8–2.9)	11	0.4 (0.2–0.6)	<10	-	0.8 (0.7–0.9)	0.005
	Subsequent	3,375	85.2 (84.1–86.3)	391	9.9 (8.9–10.8)	154	3.9 (3.3–4.5)	36	0.9 (0.6–1.2)	<10	-	1.0	
Planned or unplanned pregnancy	Planned	3,492	85.4 (84.3–86.5)	455	11.1 (10.2–12.1)	134	3.3 (2.7–3.8)	<10	-	<10	-	1.0	0.552
	Unplanned	2,389	88.5 (87.3–89.7)	176	6.5 (5.6–7.5)	86	3.2 (2.5–3.8)	38	1.4 (1.0–1.9)	10	0.4 (0.1–30.9)	1.1 (0.9–1.2)	

Notes: 1. Relates to the question “On average how many drinks of alcohol—beer, wine, spirits did you drink per week after the first 3 months of pregnancy?” 2. Outcome being modelled is ‘Consumed alcohol during pregnancy’, N=6,762.

Light and heavy drinking

A substantial proportion (38%) of the 2,840 women drinking smaller amounts (ie, <1 drink and 1–3 drinks per week) before becoming pregnant, continued to drink during the first trimester and a quarter (27%) persisted throughout their pregnancy. Of the 1,983 women drinking more heavily before pregnancy (four or more drinks per week), 23% continued drinking in the first trimester, and 3% in subsequent trimesters. Heavier drinking in the first trimester was highest among younger women, and significantly higher in Māori women, women who were the most deprived, without a secondary school education, in their first pregnancy and with an unplanned pregnancy (Table 4).

Discussion

In this study involving mothers of a representative group of New Zealand children, interviewed when they were pregnant, we found one-third (1,538, 32%) of the 4,823 women who reported drinking alcohol before pregnancy (or before awareness of pregnancy) continued to drink after becoming pregnant (or becoming aware of being pregnant) in the first trimester. Almost one in five (19%) continued to drink throughout the pregnancy. There was, however, a fall in consumption with the stage of pregnancy across all deprivation deciles and ethnic groups, suggesting the abstinence message is influencing the drinking behaviour of a wide cross-section of New Zealand women, albeit later in the pregnancy than is optimal.

This level of alcohol consumption is consistent with findings from cohort studies in Ireland, the UK and Australia¹⁶ and several earlier, smaller New Zealand studies. For example, 28% of 100 post-natal women delivering at Taranaki Base Hospital in 2009 reported consuming alcohol through their pregnancy.¹⁷ In a survey of 723 post-partum women across New Zealand in 2012, Mallard et al found 34% reported drinking at some time during their pregnancy, and 24% continued to drink following confirmation of pregnancy.¹⁸ The New Zealand Health Survey 2012/13 reported one in five women drank alcohol at some time during

their pregnancy, and while the majority either stopped before becoming pregnant or as soon as they learned of their pregnancy, a small proportion persisted.¹⁹ This is despite the first trimester being a critical period for fetal development, when drinking any amount of alcohol may result in harm to the developing fetus.²⁹

Our study has a number of strengths. First, it draws on the largest and most current dataset with information on maternal drinking behaviour collected during pregnancy in New Zealand, conferring sufficient power to allow reliable estimates of alcohol consumption for major ethnic groups for the first time. This, together with the robust sampling methodology of the GUiNZ study, means that it is a large representative sample of a major regional proportion of the New Zealand population. Second, the prospective collection of alcohol consumption in pregnancy prior to the birth of the children sets it apart from other cohort studies that have asked women to recall this information *after* birth. A further strength is the collection of information about alcohol consumption in both the first trimester and post-first trimester period. However, there are some limitations: there was no verification of self-reported alcohol consumption and a degree of social desirability bias is probable, whereby participants may have been reluctant to report their true alcohol use, particularly during pregnancy, leading to underestimation of consumption. Furthermore, because of the cross-sectional nature of this analysis it was not possible to investigate possible casual associations between exposure and outcomes. However, as data from subsequent waves of GUiNZ become available there will be an opportunity to examine the links between maternal alcohol consumption in pregnancy and subsequent child health and developmental outcomes.

The harmful effects of alcohol on the fetus have only recently been recognised as a major public health problem. The recent FASD Working Group's FASD Action Plan appropriately recommends a major shift in societal attitudes to alcohol use overall, and specifically in pregnancy.²¹ Our findings support the recommendation for

population strategies addressing alcohol marketing, labelling, pricing and availability; clear messages about alcohol and its harms in pregnancy, complemented by targeted messages to specific groups identified in this paper.^{2,21,22} The New Zealand Health Promotion Agency's "Don't know? Don't drink" campaign is an example of such a programme.²³ More consistent pregnancy planning, preparation and support are also needed. More than this, however, the evidence we present of high rates of unplanned pregnancies and high levels of alcohol consumption in younger, more deprived, less well-educated groups of women during the critical first trimester adds further weight to the case for a broader public health approach that addresses the structural determinants of health. Our finding that, in general, education was a stronger determinant than socio-economic deprivation in this study suggests that interventions seeking to lift educational attainment may be the priority.

Health professionals involved in maternal and reproductive health should be competent to provide evidence-based, unambiguous messages about the risks of alcohol in pregnancy. Such intervention may

not be as widespread as it should; in 2012/13 only 49% of pregnant women recalled being advised by their GP to have alcohol-free pregnancies.¹⁹ Research is needed to develop a better understanding of the reasons for unplanned pregnancy, about pregnancy preparation and health-related behaviours in general, from adolescence. More evidence is required about "what works" to support women to cease alcohol use when contemplating or first becoming aware of pregnancy. Finally, it will be important to establish the prevalence of FASD in New Zealand to be able to characterise those at greatest risk. Without such information, it will be difficult to plan early intervention support services for affected children and their families when it is most effective.

Conclusions

A significant proportion of New Zealand women across a range of social and ethnic groups drink alcohol before and during pregnancy, creating risk of fetal harm. Population-wide and targeted measures are urgently needed to reduce alcohol consumption of any amount during pregnancy.

Competing interests:

Dr Newcombe reports: a grant was received from the Health Promotion Agency (2015) for an application to the HPA Research Investment for Priorities in Alcohol. Project entitled: Alcohol use across the lifespan and trends in older adulthood. Andy Towers, Janie Sheridan, David Newcombe - \$120,000. Dr Morton reports grants from New Zealand Government during the conduct of the study.

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