



# PARENTAL SMOKING DURING PREGNANCY

## Findings from the Growing Up in New Zealand Cohort

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## Preface

This document is the final output of the Smoking in Pregnancy project completed by the National Institute for Health Innovation (NIHI). It provides an analysis of the Growing Up in New Zealand antenatal (Wave 1) data. NIHI identifies key findings and conclusions.

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## Executive Summary

The aim of this research was to investigate patterns of exposure to tobacco smoke in pregnancy among a representative sample of New Zealand women.

We analysed data from the antenatal period (first wave) of the Growing Up in New Zealand (GUINZ).

We found that 20% of mothers reporting smoking before pregnancy and 9.9% of mothers continued during pregnancy. This was more pronounced in younger women ( $p < .0001$ ), with lower education achievement ( $p < .001$ ) and of Māori ethnic group ( $p < .001$ ). Similarly, being Māori ( $p < .0001$ ) and to a lesser degree having lower education achievement ( $p < .0029$ ) were also significantly associated with smoking during an unplanned compared to a planned pregnancy. Multiparous mothers were also more likely to be smokers than primiparas (11%: 95% CI 10.0-12.1 vs 8.3%: CI 7.2-9.4). Exposure to cigarette smoke from someone smoking in the same room as them was far more common for younger women (OR 3.2: 95% CI 1.6-6.4) and Maori women (OR 1.9: 95% CI 1.4-2.5). However, the opposite was the case for women with planned pregnancies, where exposure to someone else's smoking was reported by only 3% (95% CI 2.4 -3.6) compared with unplanned pregnancies (13.4%: 95% CI 12.0-14.8). For planned pregnancies, someone else smoking in the same room at the mother was substantively less.

The findings clearly suggest that there are differences in a range of contextual and behavioural factors related to smoking before and during pregnancy. The role of low educational achievement, being young, Maori and multiparous all featured in continuing to smoke. Understanding what other factors both contribute and influence these different populations to continue smoking is needed.

## Recommendations

The findings from this research has identified that further understanding is needed. We recommend the following points be explored:

1. Firstly, an in-depth investigation into the factors that influence Maori women whom continue to smoke during pregnancy, particularly multiparous mothers, needs to be explored. Understanding what, if any, differences exist across the age groups will also be important.

Lakes District Health have identified that they have a population that appears to have entrenched smoking behaviours irrespective of the implementation of a range of interventions to support cessation. It is proposed that Lakes District Health is an ideal location to develop and implement a Kaupapa Research approach to exploring the contributing factors that are influencing this continued smoking behaviour. The learnings would form a key part to understanding the drivers of continued smoking behaviour and therefore form new knowledge to inform the development of additional interventions, particularly for Maori.

2. Secondly, the exploration of the other factors that may contribute to continued smoking during pregnancy such as partner smoking status, being single, changes in partner state, or depression may also help build a better picture on what barriers women and families are facing. The GUiNZ study offers an ideal opportunity to broaden the variables of analyses and examine what and if other factors have an influence on smoking behaviour.

In addition, as the GUiNZ data is a rich source of ongoing information we also recommend that Wave two of the GUiNZ data is analysed to explore, for example, if smoking rates increase since the child is born. Evidence suggests that smoking restarts post-partum irrespective of the quit success during pregnancy.<sup>1</sup> Understanding the context with which this occurs can provide insights into the development of strategies to support women (and their whanau) to remain quit.

## 1. Introduction

Tobacco smoke exposure in pregnancy (maternal smoking and second-hand smoke exposure) is one of the single most important preventable risks for maternal, fetal and infant health.<sup>2-4</sup> In this paper we present new data on tobacco smoke exposure in pregnancy for New Zealand women.

### 1.1 Maternal Smoking during Pregnancy

Smoking prevalence in the general population in developed countries has declined more rapidly in recent years compared to developing countries,<sup>5</sup> however, globally 22% of the world's adult population are estimated to be current smokers (36% men and 8% women).<sup>6</sup> Prevalence of exposure to SHS is equally concerning: the 2008–2010 Global Adult Tobacco Survey found that almost one half of reproductive-aged women (15–49 years) (470 million people) from 14 low and middle economy countries were exposed to SHS in their homes.<sup>7</sup> Similar to the international picture, the numbers reported as current smokers is declining in New Zealand from 25% in 1996/97 to 18% 2012/13.<sup>8</sup> However, the rates of decline are different amongst different populations, with Māori, Pacific Peoples and Asian groups changing little over the same period. In an analysis of smoking prevalence at registration and discharge from a lead maternity care from 2008 - 2010<sup>9</sup>, and in a MoH report on maternity care, 18.7 women were still smoking, and this was significantly higher for sub groups such as Maori, young women, living in most deprived areas and being multiparous (20.4%).<sup>10</sup>

Smoking during pregnancy is associated with a range of health risks for the baby and pregnancy including adverse fetal development,<sup>11,12</sup> birth complications<sup>13,14</sup>, antepartum haemorrhage<sup>15</sup> and pre-term delivery.<sup>16</sup> Smoking during pregnancy also has deleterious effects on children in the early neonatal and preschool periods with respiratory morbidity (such as asthma) being more common.<sup>17</sup> Harms have also been reported to continue through the child's life course into adulthood with some studies, reporting that adolescent experience of mental illness was associated with maternal smoking.<sup>18</sup> In a systematic review and meta-analysis, a positive association between maternal smoking during pregnancy with obesity and metabolic disorders in the adult offspring was found.<sup>19</sup> Another study found an association of increased cardiovascular disease risk in the adulthood offspring of women who smoked during pregnancy.<sup>4</sup> In a 2012 meta-analysis, the authors identified a 21% to 85% increase in incident asthma (strongest effect from prenatal maternal smoking on asthma in children aged  $\leq 2$  years, OR 1.85, 95% CI 1.35 - 2.53, 5 studies).<sup>20</sup>

There is also evidence of a dose response relationship. A UK study<sup>21</sup> reported that heavier maternal smoking during pregnancy (greater than 10 cigarettes per day) was associated with shorter stature and obesity in offspring compared to non-smokers (OR 2.76 (95% CI 1.21–6.33)), with the adjusted odds ratio for short stature in children higher if both parents were heavy smokers (OR 4.28 (1.27-13.37)). A Spanish study examined smoking through-out each trimester and found that women still smoking in the third trimester were at higher risk of giving birth to a baby under 3000g compared to their non-smoking counterparts (OR 5.94, CI 95%: 1.94\_18.16).<sup>22</sup> However, most studies used self-reported smoking status and consumption levels with different metrics, contributing to uncertainty and a range of findings across many similar studies. Nevertheless, the majority of these studies do observe a consistently increased risk of lower birth weight babies amongst maternal smokers.

## 1.2 Exposure to Second Hand Smoke

Exposure of non-smokers to second hand smoke (SHS) is also associated with harms.<sup>23</sup> Similarly, when non-smoking pregnant women are exposed to SHS there is evidence of harmful effects on fetal development and on the health of the child. A meta-analysis of studies of SHS during pregnancy and adverse birth outcomes in Chinese peoples by Li, Dai, Zhao, Yan<sup>24</sup> found increases in health related risks preterm and at birth that were similar as for those women who actively smoked. Another meta-analysis identified an association between maternal exposure to SHS and an increase risk of neural tube defects in offspring.<sup>25</sup> West et al. found an increased risk of cardiovascular disease amongst adult offspring amongst those exposed to SHS during pregnancy and infancy.<sup>26</sup> Other relationships are also evident, for example the relationship between SHS and childhood asthma is also widely recognised<sup>20</sup> as is low birth weight in offspring.<sup>27</sup>

Another report by the WHO examining the global burden of disease related to SHS estimated that of all deaths attributable to SHS, 28% occur in children, and 47% in women.<sup>28</sup>

The WHO 2012 report on Environmental Health Inequalities in Europe noted an inverse social gradient with higher exposure to SHS both in the home and at work for those socioeconomically disadvantaged and self-reporting a low social position.<sup>29</sup> A New York study identified women with lower educational achievement and from marginalised ethnicities as being more exposed to SHS when pregnant than their counterparts<sup>30</sup> and an Australian study reported being female, aged under 45 and low socioeconomic status were associated to higher exposure to SHS within the home.<sup>31</sup>

With regard to exposure to SHS in NZ, exposure to SHS amongst non-smokers is greatest amongst young children, Māori and low socioeconomic groups. Māori children are 2.6 times more likely to be exposed to SHS in the home and car compared to non-Māori children; children living in the most deprived neighbourhoods are 7.8 times more likely to be exposed to SHS in the home and 3.9 times more likely to be exposed to SHS in the car. Māori are more likely than non-Māori to be exposed for longer hours.<sup>32</sup> They are also more likely to be exposed in the home but likely to have a household smoking ban.<sup>33</sup> Pacific non-smokers are twice as likely as non-Pacific non-smokers to experience SHS exposure, particularly in their cars. Conversely, Asian children were the least likely of any ethnic group to be exposed to SHS either at home or in a car.<sup>33</sup>

Data on SHS exposure of pregnant women are limited. Given the rates of daily smoking amongst males aged 25-54 reported by Statistics NZ,<sup>34</sup> and the evidence of smoking in the home as shown in a variety of research studies,<sup>32,35,36</sup> it is highly likely that many non-smoking pregnant women are exposed to SHS. Exposure is likely to be disproportionately greater for Māori women due to higher Maori smoking, and similarly for those experiencing high levels of deprivation. Indeed, in a small study of Māori women who were pregnant smokers all the women also lived with smokers and smoking was the norm amongst their whanau, friends, and co-workers.<sup>37</sup> Participants remarked that this environment made being smoke-free a difficult concept to adopt.<sup>37</sup>

### **1.3 Growing Up in New Zealand Data**

The Growing Up in NZ (GUiNZ) cohort study offers a unique opportunity to capture and examine smoking behaviour and exposure to SHS over time. This paper focuses on the data reported at the first data collection point which ended in June 2010, that is during the antenatal period or before the child was born. The aim of this paper is to present in detail the patterns of pregnancy and exposure to tobacco smoke to better understand the profile of smokers and the at risk groups by examining the inter-relationships between smoking and other variables.



## 2 Methods

The methodology of GUiNZ is reported elsewhere<sup>38</sup> however in brief, GUiNZ is a longitudinal study that has recruited and collected information from pregnant mothers and their partners from before children are born and aims to continue to collect information until the child turns five. All participants had an expected delivery date between 25<sup>th</sup> April 2009 and 25<sup>th</sup> March 2010. In total, 6,822 pregnant women enrolled and completed a computer-assisted face-to-face antenatal interview. The cohort is comparable to the most recent New Zealand national birth statistics with regard to maternal age, ethnicity, parity, and socioeconomic indicators.<sup>39</sup>

### 2.1 Measurements

#### *Smoking*

There were three points of focus with regard to smoking questions within the GUiNZ survey. Two were specific for the mother and one for the partner. For the purposes of this paper we only looked at the questions for the Mother. These are:

1. About own smoking status.
  - a. Did you smoke regularly – that is, every day – before you were aware you were pregnant? [Yes; no; don't know]
  - b. How many cigarettes did you smoke per day, on average, before this pregnancy?
  - c. Are you currently smoking? [Yes; no; don't know]
  - d. How many cigarettes do you smoke per day, on average?
2. Exposure to SHS.
  - a. Does anyone currently regularly smoke in the same room as you? [Yes; no' don't know]
  - b. How often? [Rarely (less than once a week); occasionally (a few times a week); often (almost or every day of the week); don't know]

#### *Ethnicity*

Ethnicity was self-prioritised and coded into six Level 1 categories in line with Statistics New Zealand's coding criteria: European; Māori; Pacific Peoples; Asian; Middle Eastern, Latin American and African (MELAA); and Other.<sup>40</sup> For the purpose of presenting smoking data, we combined the categories of MELAA and Other due to small numbers.

#### *Social-economic position*

Socio-economic deprivation was measured using the 2006 New Zealand Deprivation Index (NZDep2006), and 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).<sup>41,42</sup> We aggregated summary deprivation scores as quintiles, with '1' representing the least deprived neighbourhoods and '5' the most deprived neighbourhoods. Highest educational qualification was coded as: no qualifications; secondary school completion; diploma/trade certification; bachelors' degree; or higher degree.

## **2.2 Statistical Analyses**

All statistical analyses used SAS version 9.3 (SAS Institute, Cary, Indiana,). We used descriptive statistics to examine associations between mothers' smoking with demographics, pregnancy period (before or during), planned/unplanned pregnancy, and parity. Where multiple regression modelling was used, variables were entered only if they were significant covariates in univariate analyses. Where response numbers are too small ( $n < 10$ ), they have not been presented.

### 3. Results

In total, 1946 mothers reporting smoking either before or during pregnancy - 20.4% (n=1,387) smoked before pregnancy and 9.9% (n=559) said they smoked during pregnancy. Table 1 presents the demographics of these mothers by smoking before and during pregnancy. In univariate analyses, being younger, Māori or Pacific, more deprived, and less educated were all associated with being a smoker, both before and during pregnancy.

**Table 1. Mothers smoking pre- and during pregnancy by demographic characteristics**

		MOTHERS SMOKING							
		Before pregnancy <sup>1</sup>				During pregnancy <sup>2</sup>			
		n (N=6,807)	% (95% CI)	Odds ratio (95% CI)	p-value	n (N=5,664)	% (95% CI)	Odds ratio (95% CI)	p-value
<b>TOTAL</b>		1,387	20.4 (19.4 - 21.3)	-	-	559	9.9 (9.1 - 10.6)	-	-
<b>Age group</b>	19 or less	190	57.9 (52.6 - 63.3)	4.4 (2.8 - 6.9)	<0.0001	85	31.1 (25.6 - 36.6)	1.7 (0.9 - 2.9)	<0.0001
	20 – 29	758	28.5 (26.8 - 30.2)	2.4 (1.6 - 3.5)		299	13.6 (12.2 - 15.1)	1.4 (0.9 - 2.3)	
	30 – 39	405	11.5 (10.4 - 12.5)	1.2 (0.8 - 1.7)		162	5.4 (4.6 - 6.2)	0.9 (0.5 - 1.4)	
	40 or older	34	12.1 (8.3 - 15.9)	1		13	6.4 (3.0 - 9.7)	1	
<b>Ethnicity</b>	Māori	444	46.8 (43.7 - 50.0)	2.2 (1.8 - 2.6)	<0.0001	236	31.6 (28.3 - 34.9)	3.1 (2.5 - 3.9)	<0.0001
	Pacific	316	31.7 (28.8 - 34.6)	1.1 (0.9 - 1.3)		98	13.5 (11.0 - 16.0)	1.0 (0.7 - 1.3)	
	Asian	35	3.5 (2.4 - 4.6)	0.2 (0.1 - 0.3)		-	-	-	
	MELAA & Other	18	11.5 (6.5 - 16.4)	0.6 (0.3 - 1.0)		-	-	-	
	NZ European	572	15.5 (14.3 - 16.7)	1		220	6.8 (5.9 - 7.7)	1	
<b>NZDep2006</b>	1 (least deprived)	106	9.7 (7.9 - 11.4)	1	<0.0001	31	3.3 (2.2 - 4.5)	1	<0.0001
	2	175	14.2 (12.2 - 16.1)	1.4 (1.1 - 1.9)		66	6.1 (4.7 - 7.5)	1.8 (1.1 - 2.7)	
	3	182	15.6 (13.5 - 17.7)	1.4 (1.0 - 1.8)		64	6.3 (4.8 - 7.8)	1.6 (1.0 - 2.5)	
	4	284	20.0 (17.9 - 22.0)	1.4 (1.1 - 1.9)		112	9.6 (7.9 - 11.2)	1.9 (1.3 - 3.0)	
	5 (most deprived)	640	34.0 (31.8 - 36.1)	2.0 (1.6 - 2.6)		286	19.5 (17.5 - 21.6)	2.9 (1.9 - 4.4)	
<b>Highest education</b>	No sec school qualification	284	58.0 (53.6 - 62.3)	1	<0.0001	143	40.6 (35.5 - 45.8)	1	<0.0001
	Sec school / NCEA 1-4	423	26.0 (23.9 - 28.2)	0.4 (0.3 - 0.5)		158	11.9 (10.2 - 13.7)	0.3 (0.2 - 0.4)	
	Diploma / Trade cert / NCEA 5-6	532	25.6 (23.7 - 27.5)	0.4 (0.4 - 0.6)		222	12.9 (11.3 - 14.5)	0.4 (0.3 - 0.5)	
	Bachelor's degree	101	6.6 (5.3 - 7.8)	0.1 (0.1 - 0.2)		21	1.6 (0.9 - 2.3)	0.1 (0.0 - 0.1)	
	Higher degree	41	3.9 (2.7 - 5.0)	0.1 (0.1 - 0.1)		13	1.4 (0.6 - 2.1)	0.1 (0.0 - 0.1)	

Notes: 1. Relates to question: "Did you smoke regularly – that is every day – before you were aware you were pregnant?"

2. Relates to question: "Are you currently smoking?" NB: These results relate to mothers who were interviewed during pregnancy - mothers who were interviewed post-partum were excluded from these analyses.

Of the women who reported they were currently smoking (n=533), 40.1% (n=222) reported that they smoked 4 or less cigarettes per day, 31.1% (n= 172) smoked between 5 and 9 per day and 28.8% smoked 10 or more per day. Given the small numbers in each subgroup, we used regression analyses to investigate differences between smoking 9 or less and 10 and above (Table 2). The findings show that when other factors were controlled for, older women (aged 30-39 years; OR 0.7: 95% CI: 0.2-2.6; (p 0.0004)) and being Maori (OR 1.2, 95% CI: 0.8-1.9 (p<0.0001)) were associated with smoking 10 or more cigarettes per day.

**Table 2: Average number of cigarettes smoked per day by demographic characteristics<sup>1</sup>**

		NUMBER OF CIGARETTES PER DAY					
		9 or less <sup>2</sup>		10 or more		Odds ratio (95% CI)	p-value <sup>3</sup>
		n (N=553)	% (95% CI)	n (N=553)	% (95% CI)		
<b>TOTAL</b>		394	71.2 (67.5 - 75.0)	159	28.8 (25.0 - 32.5)	-	-
<b>Age group</b>	19 or less	70	84.3 (76.5 - 92.2)	13	15.7 (7.8 - 23.5)	0.2 (0.0 - 0.7)	0.0004
	20 – 29	216	73.0 (67.9 - 78.0)	80	27.0 (22.0 - 32.1)	0.4 (0.1 - 1.5)	
	30 – 39	101	62.7 (55.2 - 70.2)	60	37.3 (29.8 - 44.8)	0.7 (0.2 - 2.6)	
	40 or older	-	-	-	-	1	
<b>Ethnicity</b>	Māori	151	64.8 (58.7 - 71.0)	82	35.2 (29.0 - 41.3)	1.2 (0.8 - 1.9)	<.0001
	Pacific	82	84.5 (77.3 - 91.8)	15	15.5 (8.2 - 22.7)	0.3 (0.2 - 0.7)	
	Asian	-	-	0	-	-	
	MELAA & Other	-	-	0	-	-	
	NZ European	156	71.6 (65.6 - 77.6)	62	28.4 (22.4 - 34.4)	1	
<b>NZDep2006</b>	1 (least deprived)	24	77.4 (62.7 - 92.2)	-	-	1	0.3737
	2	49	75.4 (64.9 - 85.9)	16	24.6 (14.1 - 35.1)	1.0 (0.4 - 2.9)	
	3	45	72.6 (61.4 - 83.7)	17	27.4 (16.3 - 38.6)	1.4 (0.5 - 3.9)	
	4	79	70.5 (62.1 - 79.0)	33	29.5 (21.0 - 37.9)	1.6 (0.6 - 4.2)	
	5 (most deprived)	197	69.6 (64.2 - 75.0)	86	30.4 (25.0 - 35.8)	1.9 (0.7 - 4.9)	
<b>Highest education</b>	No sec school qualification	86	61.0 (52.9 - 69.1)	55	39.0 (30.9 - 47.1)	1	0.0002
	Sec school / NCEA 1-4	133	84.2 (78.5 - 89.9)	25	15.8 (10.1 - 21.5)	0.3 (0.2 - 0.5)	
	Diploma / Trade cert / NCEA 5-6	149	68.0 (61.8 - 74.2)	70	32.0 (25.8 - 38.2)	0.6 (0.3 - 0.9)	
	Bachelor's degree	13	65.0 (44.0 - 86.0)	-	-	-	
	Higher degree	11	84.6 (64.9 - 100.0)	-	-	-	

These results relate to: 1. The question: 'How many cigarettes do you smoke per day, on average?'; Mothers who indicated that they were currently smoking; and, Mothers who were interviewed during pregnancy -others who were interviewed post-partum were excluded from these analyses. 2. As this question was only asked of mothers' who indicated that they currently smoke, '9 or less' includes those who responded 'zero'. 3. Outcome being modelled is '10 or more'.

Tables 3 and 4 present the unadjusted findings for the number of cigarettes smoked by planned or unplanned pregnancy and by parity. Among women with unplanned pregnancies unplanned smoking 10 or more was more common (31.2%) than among women with planned pregnancies (20.7%) (Table 3) Table 4 shows that multiparous women were more likely to smoke 10 or more cigarettes (32.1%) than their primipara counterparts (22.6% (n=195)).

**Table 3: Number of cigarettes per day by planned / unplanned pregnancy<sup>1</sup>**

Maternal self-reported average daily cigarette consumption	Planned pregnancy		Unplanned pregnancy	
	n (N=135)	% (95% CI)	n (N=414)	% (95% CI)
9 or less	107	79.3 (72.4 - 86.1)	285	68.8 (64.4 - 73.3)
10 or more	28	20.7 (13.9 - 27.6)	129	31.2 (26.7 - 35.6)

- These results relate to:
  - The question: 'How many cigarettes do you smoke per day, on average?';
  - Mothers who indicated that they were currently smoking; and,
  - Mothers who were interviewed during pregnancy - mothers who were interviewed post-partum were excluded from these analyses.

**Table 4: Number of cigarettes per day by parity<sup>1</sup>**

Maternal self-reported average daily cigarette consumption	First pregnancy		Subsequent pregnancies	
	n (N=195)	% (95% CI)	n (N=358)	% (95% CI)
9 or less	151	77.4 (71.6 - 83.3)	243	67.9 (63.0 - 72.7)
10 or more	44	22.6 (16.7 - 28.4)	115	32.1 (27.3 - 37.0)

- These results relate to:
  - The question: 'How many cigarettes do you smoke per day, on average?';
  - Mothers who indicated that they were currently smoking; and,
  - Mothers who were interviewed during pregnancy - mothers who were interviewed post-partum were excluded from these analyses.

### 3.1 Planned versus Unplanned Pregnancy on continued smoking

Smoking before pregnancy was greater when that pregnancy was unplanned. This was more pronounced if you were younger ( $p < .0001$ ), had lower education achievement ( $p < .001$ ) and were Māori ( $p < .001$ ).

We also examined if there were differences in the same variables for those continuing to smoke while pregnant between planned or unplanned pregnancy. We used regression modelling to test for the influencing factors. After adjusting for all covariates in the regression analysis, being Māori ( $p < .0001$ ) and to a lesser degree having lower education achievement ( $p < .0029$ ) were also found to feature significantly in continuing to smoking during an unplanned pregnancy compared to planned, while age was less important ( $p < .015$ ) (Table 5)

**Table 5: Mothers Smoking during pregnancy by planned/unplanned pregnancy**

		DURING pregnancy <sup>1</sup>					Odds ratio (95% CI)	p-value <sup>2</sup>
		Planned		Unplanned				
		n (N=3,488)	% (95% CI)	n (N=2,156)	% (95% CI)			
<b>TOTAL</b>		135	3.9 (3.2 - 4.5)	420	19.5 (17.8 - 21.2)	-	-	
<b>Age group</b>	19 or less	8	9.4 (3.2 - 15.6)	77	90.6 (84.4 - 96.8)	2.6 (0.7 - 10.8)	0.0156	
	20 – 29	73	24.7 (19.8 - 29.6)	223	75.3 (70.4 - 80.2)	0.7 (0.2 - 2.4)		
	30 – 39	50	31.1 (23.9 - 38.2)	111	68.9 (61.8 - 76.1)	0.7 (0.2 - 2.4)		
	40 or older	4	30.8 (5.7 - 55.9)	9	69.2 (44.1 - 94.3)	1		
<b>Ethnicity</b>	Māori	30	12.8 (8.5 - 17.0)	205	87.2 (83.0 - 91.5)	3.4 (2.1 - 5.4)	<.0001	
	Pacific	26	26.8 (18.0 - 35.6)	71	73.2 (64.4 - 82.0)	1.3 (0.8 - 2.2)		
	Asian	0	-	-	-	-		
	MELAA & Other	-	-	0	-	-		
	NZ European	77	35.3 (29.0 - 41.7)	141	64.7 (58.3 - 71.0)	1		
<b>NZDep2006</b>	1 (least deprived)	10	32.3 (15.8 - 48.7)	21	67.7 (51.3 - 84.2)	1	0.1661	
	2	19	30.2 (18.8 - 41.5)	44	69.8 (58.5 - 81.2)	0.8 (0.3 - 2.0)		
	3	25	39.1 (27.1 - 51.0)	39	60.9 (49.0 - 72.9)	0.5 (0.2 - 1.3)		
	4	29	25.9 (17.8 - 34.0)	83	74.1 (66.0 - 82.2)	0.7 (0.3 - 1.8)		
	5 (most deprived)	52	18.2 (13.8 - 22.7)	233	81.8 (77.3 - 86.2)	1.1 (0.5 - 2.5)		
<b>Highest education</b>	No sec school qualification	23	16.2 (10.1 - 22.3)	119	83.8 (77.7 - 89.9)	1	0.0029	
	Sec school / NCEA 1-4	44	28.0 (21.0 - 35.1)	113	72.0 (64.9 - 79.0)	0.4 (0.3 - 0.8)		
	Diploma / Trade cert / NCEA 5-6	51	23.1 (17.5 - 28.6)	170	76.9 (71.4 - 82.5)	0.7 (0.4 - 1.2)		
	Bachelor's degree	10	50.0 (28.1 - 71.9)	10	50.0 (28.1 - 71.9)	0.2 (0.1 - 0.6)		
	Higher degree	-	-	7	-	-		

1. Relates to question: "Are you currently smoking?" NB: These results relate to mothers who were interviewed during pregnancy - mothers who were interviewed post-partum were excluded from these analyses. 2. Outcome being modelled is 'Unplanned pregnancy'.

### 3.2 Parity and Smoking

While the survey did not capture if mothers smoked during earlier pregnancies, Table 7 reports unadjusted smoking responses by parity status. There was little difference in smoking between the parity groups (first-born – 20.5%: 95% CI 19.0-22.0) v subsequent – 20.3%: 95% CI 19.0-21.5) or during pregnancy (first-born – 8.3%: 95% CI 7.2-9.4) v subsequent – 11%: 95% CI 10.0-12.1.

However, when independently controlling for age, ethnicity, deprivation and educational achievement; continuing to smoke during pregnancy was more likely in multiparous women who were Maori and Pacific (Table 6).

**Table 6: Mothers smoking during pregnancy by parity**

Demographic characteristics		DURING pregnancy <sup>1</sup>					p-value <sup>2</sup>
		First-born		Subsequent		Odds ratio (95% CI)	
		n (N=2,396)	% (95% CI)	n (N=3,268)	% (95% CI)		
<b>TOTAL</b>		198	8.3 (7.2 - 9.4)	361	11.0 (10.0 - 12.1)	-	-
<b>Age group</b>	19 or less	67	78.8 (70.1 - 87.5)	18	21.2 (12.5 - 29.9)	0.0 (0.0 - 0.1)	<.0001
	20 – 29	100	33.4 (28.1 - 38.8)	199	66.6 (61.2 - 71.9)	0.2 (0.0 - 0.6)	
	30 – 39	30	18.5 (12.5 - 24.5)	132	81.5 (75.5 - 87.5)	0.6 (0.1 - 2.3)	
	40 or older	-	-	12	92.3 (77.8 - 100.0)	1	
<b>Ethnicity</b>	Māori	77	32.6 (26.6 - 38.6)	159	67.4 (61.4 - 73.4)	1.9 (1.2 - 2.9)	<.0001
	Pacific	27	27.6 (18.7 - 36.4)	71	72.4 (63.6 - 81.3)	2.2 (1.3 - 3.9)	
	Asian	0	-	-	-	-	
	MELAA & Other	-	-	-	-	-	
	NZ European	92	41.8 (35.3 - 48.3)	128	58.2 (51.7 - 64.7)	1	
<b>NZDep2006</b>	1 (least deprived)	-	-	24	77.4 (62.7 - 92.1)	1	0.167
	2	25	37.9 (26.2 - 49.6)	41	62.1 (50.4 - 73.8)	0.5 (0.2 - 1.4)	
	3	24	37.5 (25.6 - 49.4)	40	62.5 (50.6 - 74.4)	0.9 (0.3 - 2.7)	
	4	46	41.1 (32.0 - 50.2)	66	58.9 (49.8 - 68.0)	0.4 (0.1 - 1.1)	
	5 (most deprived)	96	33.6 (28.1 - 39.0)	190	66.4 (61.0 - 71.9)	0.6 (0.2 - 1.5)	
<b>Highest education</b>	No sec school qualification	39	27.3 (20.0 - 34.6)	104	72.7 (65.4 - 80.0)	1	<.0001
	Sec school / NCEA 1-4	65	41.1 (33.5 - 48.8)	93	58.9 (51.2 - 66.5)	0.4 (0.2 - 0.6)	
	Diploma / Trade cert / NCEA 5-6	81	36.5 (30.2 - 42.8)	141	63.5 (57.2 - 69.8)	0.3 (0.2 - 0.5)	
	Bachelor's degree	-	-	16	76.2 (58.0 - 94.4)	0.3 (0.1 - 0.9)	
	Higher degree	-	-	-	-	-	

1. Relates to question: "Are you currently smoking?" NB: These results relate to mothers who were interviewed during pregnancy - mothers who were interviewed post-partum were excluded from these analyses.

2. Outcome being modelled is 'subsequent pregnancy'.

### 3.3 Exposure Second hand Smoke

Seven percent of the 5664 women reported being exposed to SHS from someone smoking in the same room.

For planned pregnancies, someone else smoking in the same room at the mother was substantively less (3%: 95% CI 2.4 -3.6) than for unplanned pregnancies (13.4%: 95% CI 12.0-14.8)). However, when parity was examined irrespective of planned or unplanned, that difference was not apparent, (primigravida mothers (8.1%, CI 7.0-9.1) versus multiparous mothers (6.2%, 95% CI 5.3-7.0)).

Adjusting for age, ethnicity, deprivation and educational status, the younger the mother (19 years or less (OR 3.2: 95% CI 1.6-6.4; p<.0001), being Maori (OR 1.9: 95% CI: 1.4-2.5; p<.0001), mothers living in high deprivation (OR 3.495% CI: 2.0-5.7; p<.0001) and those



with low educational achievement ( $p < .0001$ ) were significant factors in mothers reporting having someone smoking in the same room as them (Table 7).

**Table 7: Exposure to second hand smoke by demographic characteristics**

Demographic characteristics		EXPOSURE TO SECOND-HAND SMOKE DURING PREGNANCY					
		Yes		No		Odds ratio (95% CI)	p-value <sup>2</sup>
		n	% (95% CI)	n	% (95% CI)		
<b>TOTAL</b>		394	7.0 (6.3 - 7.6)	5,270	93.0 (92.4 - 93.7)	-	-
<b>Age group</b>	19 or less	77	28.2 (22.9 - 33.5)	196	71.8 (66.5 - 77.1)	3.2 (1.6 - 6.4)	<0.0001
	20 – 29	228	10.4 (9.1 - 11.7)	1,967	89.6 (88.3 - 90.9)	1.6 (0.9 - 3.0)	
	30 – 39	79	2.6 (2.1 - 3.2)	2,913	97.4 (96.8 - 97.9)	0.6 (0.3 - 1.2)	
	40 or older	10	4.9 (1.9 - 7.9)	194	95.1 (92.1 - 98.1)	1	
<b>Ethnicity</b>	Māori	135	18.1 (15.3 - 20.8)	612	81.9 (79.2 - 84.7)	1.9 (1.4 - 2.5)	<0.0001
	Pacific	84	11.6 (9.2 - 13.9)	642	88.4 (86.1 - 90.8)	1.1 (0.8 - 1.5)	
	Asian	27	3.4 (2.1 - 4.6)	775	96.6 (95.4 - 97.9)	0.7 (0.5 - 1.1)	
	MELAA & Other	-	-	134	96.4 (93.3 - 99.5)	0.6 (0.3 - 1.6)	
	NZ European	142	4.4 (3.7 - 5.1)	3,100	95.6 (94.9 - 96.3)	1	
<b>NZDep2006</b>	1 (least deprived)	18	1.9 (1.0 - 2.8)	918	98.1 (97.2 - 99.0)	1	<0.0001
	2	38	3.5 (2.4 - 4.6)	1,042	96.5 (95.4 - 97.6)	1.6 (0.9 - 2.9)	
	3	49	4.9 (3.5 - 6.2)	960	95.1 (93.8 - 96.5)	1.8 (1.0 - 3.2)	
	4	78	6.7 (5.2 - 8.1)	1,094	93.3 (91.9 - 94.8)	2.0 (1.1 - 3.4)	
	5 (most deprived)	211	14.4 (12.6 - 16.2)	1,254	85.6 (83.8 - 87.4)	3.4 (2.0 - 5.7)	
<b>Highest education</b>	No sec school qualification	94	26.7 (22.1 - 31.3)	258	73.3 (68.7 - 77.9)	1	<0.0001
	Sec school / NCEA 1-4	113	8.5 (7.0 - 10.0)	1,213	91.5 (90.0 - 93.0)	0.4 (0.3 - 0.6)	
	Diploma / Trade cert / NCEA 5-6	144	8.4 (7.1 - 9.7)	1,573	91.6 (90.3 - 92.9)	0.5 (0.3 - 0.7)	
	Bachelor's degree	31	2.4 (1.5 - 3.2)	1,277	97.6 (96.8 - 98.5)	0.2 (0.1 - 0.3)	
	Higher degree	-	-	941	99.1 (98.4 - 99.7)	0.1 (0.0 - 0.2)	

These results relate to: 1. The question: 'Does anyone currently regularly smoke in the same room as you?'; Mothers who were interviewed during pregnancy - mothers who were interviewed post-partum were excluded from these analyses. 2. Outcome being modelled is 'Does anyone currently regularly smoke in the same room as you? - Yes''.

## 4 Discussion

Being younger, being less well educated and living in high deprivation continue to be highly related to smoking before and during pregnancy. These factors are similar to those reported in various international research,<sup>43,44,45</sup> and those reported in MoH maternity report<sup>10</sup> and a Midwifery research study,<sup>9</sup> both undertaken during a similar time period. Like other studies<sup>46</sup> multiparous women were also more likely to continue to smoke during pregnancy and smoke more per day than primipara women. While first time pregnancy appears to be a motivator for smoking cessation it does not seem to hold true for multiparous women. A finding also reported in other studies<sup>9</sup> and may be related to smoking behaviour such as being more dependent smokers but also contextual factors such as less social support, financial pressures and low self-confidence.<sup>47</sup> Understanding the contextual factors that contribute to their lower quit rates is important to explore especially as they are highly likely to be contributing to the wider family's (including older children) exposure to SHS as well as their unborn child.

A planned pregnancy was positively associated with not smoking during pregnancy or if still smoking, a lower consumption of cigarettes (< 9 cigarettes/day). Arguably this may signal that women (and families) may have planned a wider "healthy" strategy which included smoking cessation when planning to start or add to their family. It is not known if these women (and families) also have greater and /or earlier interactions with health professionals and as such are exposed to early cessation advice, support and treatment. Until relatively recently, cutting down rather than quitting was the dominant message to pregnant smokers by health professionals reported in a recent systematic review<sup>48</sup> and reflects an earlier finding in NZ.<sup>49</sup> It is critical that a consistent message and a subsequent supportive environment is provided if changes to these rates are to happen. It will also be important to explore the next GUINZ data wave for smoking rates as international research has found that women often resume smoking in the days or weeks following the birth.<sup>9</sup>

While there is a high awareness of the harms of smoking on themselves and their unborn child the lived context of the pregnant women plays a large part in smoking cessation. While it is not possible to determine who actively cut down in this study, research suggests that adoption of a cutting down approach versus quitting is more common in women with low educational achievement, greater deprivation and being Maori ethnicity.<sup>48,50,51</sup>

### 4.1 Second Hand Smoke

Wider social contexts (friends, family, work) are important factors in supporting or impeding behavioural change activities.<sup>52</sup> While only 7% of our cohort reported another person smoking in the same room it was univariately correlated with being younger, most deprived, lower educational achievement and Maori; hence, understanding these contexts in more detail is important for intervention strategies to be successful. Exploration of the GUINZ partner responses and the other contextual details captured in GUINZ data is needed. This may help provide further insights into the factors and contexts for the women who continued to smoke (and those who don't). Also, more in-depth qualitative research with multiparous women who stopped smoking and those who did not is needed to explore their motivations and situational contexts. This may highlight where additional interventions could be focused and therefore reduce the burden of SHS on other children still living at home.<sup>53</sup>

### 4.2 Equity

Our findings also highlight that being Maori was a single constant consistently correlated to smoking before and during pregnancy or being exposed to SHS. The impact of high rates of smoking is evident for Maori health related outcomes across the life course from the new-

born through to adulthood.<sup>54</sup> Some research has found that Maori are reported to receive antenatal care later in their pregnancy.<sup>9</sup> Other factors influencing lower cessation rates are that more-dependent, and heavier smokers have a greater probability of continuing to smoke and age at smoking initiation.<sup>6</sup> In repeated smoking survey's, Maori youth report having their first cigarette significantly earlier than their Non-Maori counterparts and the prevalence of young Maori females (15-24 years) was significantly higher than for Non-Maori.<sup>55</sup> This may partly account for the low smoking cessation rate for Maori during pregnancy.<sup>37</sup>

Efforts to support young Maori and Pacific women at their first pregnancy to quit is pivotal, as both groups were positively associated with smoking during subsequent pregnancies. The ability to act on information given about smoking in pregnancy has been reported as low by Maori women.<sup>49,56</sup> This finding should clearly emphasise that the effectiveness of the current suite of interventions is suboptimal for pregnant Maori women regardless of parity and new strategies are needed to reduce significant life course harms.

### 4.3 Interventions

Indigenous research on interventions by Glover et al.<sup>57,58</sup> and Walker et al.<sup>36</sup> have set some of the ground work for successful intervention directions such as coaching and using incentives as motivators for change but more work is needed. There is a burgeoning literature on effectiveness of cessation activities but few on sub groups such as pregnant women or indigenous groups. However, two Cochrane reviews, one focused on pharmacological interventions<sup>59</sup> and the other focused on psychological interventions<sup>60</sup> have recently been published. Both report a mix of interventions was most effective with Chamberlain et al.<sup>60</sup> finding a significant effect for the use of incentives. Another Cochrane review examining interventions for indigenous populations was equivocal for effectiveness, and concluded that more rigorous trials are required to bridge the gap between tobacco related health disparities in Indigenous and non-Indigenous populations.<sup>61</sup> Other strategies that emerged showing some effectiveness focused on engaging with early in their antenatal care. This is especially relevant for Maori and Pacific women and their families. While NZ has a significant array of smoking cessation intervention programmes based on and contributing to, the evidence pool of effectiveness there are few that have a specific focus on pregnant women. Hapū Mama which is part of the Aukati Kaipapa programme designed to support mothers and their whanau/family to be smoke free and a mix of cessation services for pregnant women explicitly funded by the three metro Auckland DHBs, and their counterparts in Canterbury, Hawke's Bay and Southern District Health Board were the only ones found. Furthermore, while not specific to mothers, an earlier study of the awareness and perceived effectiveness of smoking cessation services for those living in high deprivation areas has been reported to be low.<sup>62</sup> This is important as our findings show that Maori, and deprivation were associated with smoking during pregnancy and the knowledge gap on how to quit is an important gap to address.

## 5 Conclusion

Reducing maternal tobacco smoke exposure has the potential to have a positive health effect that far exceeds the immediate health of both mother and infant. Effective interventions to support smoking cessation are supported by a large amount of research. However, there is a noticeable paucity of evidence on the effectiveness of these interventions for specific population groups such as pregnant women. While there is emerging evidence for effective strategies for pregnant women<sup>60</sup> overall for NZ, these groups have seen little fall in smoking prevalence in the last decade. If this continues smoking will become concentrated in communities already marginalised by their health, their ethnicity or their economic status, and health inequalities will become more entrenched.

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