THE NEW ZEALAND MEDICAL JOURNAL
Vol 117 No 1206 ISSN 1175 8716

Smoking among mothers of a Pacific Island birth cohort in New Zealand: associated factors

Sarnia Butler, Maynard Williams, Janis Paterson, Colin Tukuitonga

Abstract

Aims The present study investigated (among mothers of a Pacific Island birth cohort) the rates of smoking before, during, and after pregnancy as well as factors predictive of smoking during pregnancy.

Methods Data were gathered as part of the Pacific Islands Families (PIF) Study. In this study, mothers of a cohort of 1398 Pacific infants born in Middlemore Hospital, Auckland during 2000 were interviewed when their infants were 6 weeks old. Mothers were questioned about their maternal health, and lifestyle behaviours such as cigarette smoking. Additional data were obtained from hospital records. Analyses focused on 1365 biological mothers.

Results Overall, 339 (approximately one-quarter) of the mothers reported smoking during pregnancy. 331 (76.1%) of the 435 smokers (before pregnancy) continued to smoke during pregnancy, and eight mothers commenced smoking once pregnant. Smoking rates for each trimester were 23.7% in the first, 21.0% in the second, and 20.4% in the third trimester of pregnancy, respectively. Multivariate analyses showed that smoking was significantly associated with several factors, including indicators of disadvantage and degree of westernisation.

Conclusions Greater efforts are needed to reduce smoking during pregnancy among Pacific women. Findings can be used to inform public health policy and smoking cessation programmes for Pacific families.

Cigarette smoking has been linked to serious health problems including respiratory infections, asthma, cardiovascular disease, psychiatric disorders, cancer, and death.[1] For women, smoking carries the additional increased risk to reproductive health of reduced fertility, early menopause, ectopic pregnancy, osteoporosis, cervical cancer, infants of low birth weight, and stillbirth[2,3]—risks which many women are unaware of.[3]

Smoking during pregnancy has been linked to a high prevalence of delivery complications and morbidity for both mothers and infants,[1,4] with numerous adverse health consequences beyond birth for children including increased risk of sudden infant death syndrome,[5] respiratory illness,[6] and hospitalisation with infectious diseases.[7] Taken together, these studies reinforce the need to reduce tobacco use, particularly during pregnancy.

To better inform smoking cessation programmes, factors that characterise women who smoke during pregnancy need to be identified. Smoking during pregnancy has frequently been associated with markers of socioeconomic disadvantage such as unemployment,[2,8] low education,[2,9–11] low income,[12,13] single marital status,[8–10] rental housing tenure,[2] and younger maternal age.[9,10,14]

The American Academy of Pediatrics Committee on Substance Abuse has suggested that there is a need for information regarding tobacco use by different ethnic groups to guide understanding of different smoking patterns, to aid in the development of culturally appropriate interventions, and to evaluate their efficacy.[1]

While not specific to pregnancy, data from the 1996 New Zealand Census indicated that the prevalence of smoking for women is cause for concern with approximately 25% of European, 27% of Pacific, and 50% of Maori women aged 15–49 years reporting to be smokers.[15]

As little is known about smoking behaviour during pregnancy among Pacific women in New Zealand, the aim of the present study was to investigate the rates of smoking before, during, and after pregnancy—and to identify factors predictive of smoking during pregnancy among mothers of a birth cohort of Pacific infants.

Method

Data were collected as part of the Pacific Islands Families (PIF) Study, a longitudinal investigation of a cohort of 1398 infants (11 pairs of twins) born at Middlemore Hospital, South Auckland, New Zealand during the year 2000. Middlemore Hospital was chosen as the site for recruitment of the cohort as it has the largest number of Pacific births in New Zealand and is representative of the major Pacific ethnicities.

It was estimated that a cohort of 1000 would provide sufficient statistical power to detect moderate to large differences after stratification for major Pacific ethnic groups and other key variables. Eligibility criteria included having at least one parent who self-identified as being of Pacific ethnicity and a New Zealand permanent resident. Thus, non-Pacific mothers were eligible for the study in cases where the infant's father was of Pacific descent. Detailed information about the cohort and procedures is described elsewhere.[16]

Approximately 6 weeks after the birth of their child, Pacific interviewers, who were fluent in English and a Pacific language, visited the mothers in their homes. Of the 1376 mothers, 1365 were biological and 11 were foster or adoptive mothers. Eligibility criteria were confirmed and informed consent was gained for participation in an interview and access to their Middlemore Hospital discharge record.

Mothers participated in 1-hour interviews in their preferred language concerning the health and development of the child and family functioning. As part of this interview, mothers approximated how many cigarettes they had smoked per day before pregnancy and during the three trimesters of pregnancy. Current smoking behaviour was measured by the number of cigarettes smoked yesterday (the day before the interview).

Data collected on a number of sociodemographic and pregnancy-related factors were double-entered into the statistical software package SPSS (version 11.5.1). Univariate and multivariate logistic regression procedures were employed to examine association between these factors and risk of smoking during pregnancy. Responses based on the first-born twin for twin pairs were utilised in all analyses.

Variables examined included age, whether born in New Zealand, marital status, ethnicity (self-identified), education, English fluency (self-categorised), years in New Zealand, household income, housing tenure, parity, other smokers in the home, whether pregnancy was planned, and attendance at antenatal classes.

Cultural alignment was measured with an adaptation of the short version of the General Ethnicity Questionnaire[17] which categorises a person's alignment as either 'high' or 'low' towards mainstream New Zealand way of life and customs in addition to being either 'high' or 'low' towards the Pacific way of life and customs.

In the analyses, mothers were considered employed if they reported being in any paid employment (part, full, or self employment).

Results

Ninety-six percent (N=1590) of potentially eligible mothers of Pacific infants who had been born between 15 March 2000 and 17 December 2000, gave consent to be visited in their homes when the infant was 6 weeks old. Of the 1477 mothers contacted and who met the eligibility criteria, 1376 (93.2%) agreed to participate in the study. A more conservative recruitment rate of 87.1% would include mothers who consented to contact and were (a) confirmed eligible, or (b) of indeterminable eligibility due to inability to trace.

Of the 1365 biological mothers in the present study (1.7% gave birth to twins; n=23), 47.3% self-identified their major ethnic group as Samoan, 16.7% as Cook Island Maori, 4.3% as Niuean, 21.0% as Tongan, 3.4% as Other Pacific (includes mothers identifying equally with two or more Pacific groups, equally with Pacific and Non-Pacific groups or with Pacific groups other than Tongan, Samoan, Cook Island Maori, or Niuean), and 7.3% as Non-Pacific. The mean (SD) age of mothers was 27.8 (6.1) years; 80.4% were living together in married or defacto partnerships, 33.0% of mothers were New Zealand born, and 27.5% had post-school qualifications.

Table 1 gives the number and proportion of women who smoked before pregnancy, during each of the three trimesters of pregnancy, at any time during pregnancy, and yesterday (current smokers). Of the 435 smokers before pregnancy, 331 (76.1%) continued to smoke during pregnancy. McNemar Chi-squared tests ($p<0.001$) showed a significant reduction in the number of smokers from before pregnancy to the period during pregnancy. Eight mothers who reported not smoking before pregnancy commenced smoking during their pregnancies.

Table 1. Numbers (N) of Pacific mothers smoking before, during, and after pregnancy (N=1364)

Time period	n	%
Smoked before pregnancy	435	31.9
Smoked during the first trimester	323	23.7
Smoked during the second trimester	287	21.0
Smoked during the third trimester	278	20.4
Smoked at any time during pregnancy	339	24.9
Smoked yesterday	342	25.1

Table 2 shows the number of cigarettes consumed daily before and during the three trimesters of pregnancy. Selecting those mothers who smoked both before pregnancy and during the first trimester, and grouping cigarette doses into light (1–9) and moderate/heavy (10 or more), McNemar Chi-squared tests ($p<0.001$) showed that there was a significant reduction in the percentage of moderate/heavy smokers once pregnant.

Similarly, tests comparing the third and first trimesters revealed a significant ($p<0.001$) reduction in proportion of moderate/heavy smokers from the first to the third trimester. Thus, the majority of moderate/heavy smokers continued to reduce their daily cigarette intake throughout pregnancy.

Table 2. Mean daily cigarette dose smoked by the sample of Pacific mothers before, during, and after pregnancy

Time period	Mean daily cigarette dose	N	%
Before pregnancy	1–9	225	51.7
	10–19	131	30.1
	20>	79	18.2
First trimester	1–9	189	58.5
	10–19	89	27.6
	20>	45	13.9
Second trimester	1–9	188	65.5
	10–19	65	22.6
	20>	34	11.8
Third trimester	1–9	194	69.8
	10–19	50	18.0
	20>	34	12.2
Yesterday	1–9	259	75.7
	10–19	64	18.7
	20>	19	5.6

Table 3 lists variables examined for potential association with smoking during pregnancy. For the categories within each variable the numbers and percentages of mothers who reported smoking are given along with their respective univariate odds ratio (95% CI) indicating likelihood of smoking during pregnancy.

Table 3: Numbers (row percentages) and Univariate Odds Ratios of smoking during pregnancy by selected variables (N=1365)

Variable	Category	Smoking during pregnancy		Univariate Odds Ratio (95% CI)	
		N	% within category		
Maternal variables					
Age	<20 years	49	(44.5)	7.00	(2.33–21.01)†
	20–29 years	188	(26.2)	3.10	(1.09–8.82)*
	30–39 years	98	(19.7)	2.14	(0.74–6.14)
	40> years	4	(10.3)	1.00	
NZ born	No	164	(18.0)	1.00	
	Yes	175	(38.8)	2.90	(2.25–3.73)‡
Marital status	Partnered	231	(21.0)	1.00	
	Non- partnered	108	(40.4)	2.55	(1.92–3.38)‡
Ethnicity	Samoan	116	(18.0)	1.00	
	Cook Island Maori	90	(39.6)	3.00	(2.15–4.18)‡
	Niuean	27	(45.8)	3.85	(2.22–6.67)‡
	Tongan	41	(14.3)	0.76	(0.52–1.12)
	Other Pacific[§]	22	(46.8)	4.01	(2.19–7.36)‡
	Non Pacific	43	(43.4)	3.50	(2.24–5.47)‡
Education (formal qualifications)	None	143	(26.9)	1.00	
	Secondary school	93	(20.3)	0.69	(0.52–0.93)*
	Post-school	103	(27.5)	1.03	(0.76–1.38)

English fluency	No	51	(9.8)	1.00	
	Yes	288	(34.1)	4.76	(3.46–6.57)‡
Cultural alignment	Low NZ high Pacific	47	(10.7)	1.00	
	High NZ low Pacific	161	(37.2)	4.96	(3.46–7.11)‡
	High NZ high Pacific	56	(24.1)	2.67	(1.74–4.09)‡
	Low NZ low Pacific	74	(30.0)	3.59	(2.39–5.39)‡
Years in NZ	0–5	24	(8.9)	1.00	(0.99–3.41)
	6–10	22	(15.2)	1.84	(2.96–7.15)‡
	>10	292	(30.9)	4.60	
Employed prior to pregnancy	Yes	180	(24.2)	1.00	(0.85–1.39)
	No	159	(25.7)	1.09	
Parity	1	87	(23.5)	1.00	
	2–4	202	(26.5)	1.18	(0.88–1.57)
	5>	47	(22.2)	0.93	(0.62–1.39)
Other variables					
Household income (annual)	>$40,000	36	(22.6)	1.00	(0.61–1.38)
	$20,001–40,000	149	(21.1)	0.91	(1.03–2.39)*
	$0–20,000	142	(31.4)	1.57	(0.55–2.49)
	Unknown	12	(25.5)	1.17	
Housing tenure	Owned or mortgaged	50	(20.3)	1.00	
	Private rental	93	(28.3)	1.55	(1.04–2.29)*
	State rental	113	(23.3)	1.19	(0.82–1.73)
	Other (eg, boarding)	83	(27.3)	1.47	(0.99–2.20)
Lived with other smokers during pregnancy	No	77	(11.7)	1.00	
	Yes	262	(37.1)	4.45	(3.35–5.90)‡
Pregnancy planned	Yes	90	(17.7)	1.00	
	No	249	(29.1)	1.91	(1.46–2.50)‡
Attended antenatal classes	Yes	16	(14.3)	1.00	
	No	323	(25.8)	2.09	(1.21–3.60)†

NZ=New Zealand; *p<0.05; †p<0.01; ‡p<0.001; §Includes mothers identifying equally with two or more Pacific Island groups, equally with Pacific Island and non-Pacific Island groups, or with Pacific Island groups other than Tongan, Samoan, Cook Island Maori, or Niuean.

A multiple logistic regression analysis was undertaken to control for potential confounding effects. Five demographic variables (maternal age, education, ethnicity, marital status and household income) were initially forced into the model as control variables and then all remaining variables in Table 3 were then submitted to a forward stepwise procedure (p to enter=0.15 and p to remove =0.20).

Table 4 demonstrates that when adjusting for all other variables in the final model, factors which were significantly associated with smoking during pregnancy ($p<0.05$) were not being in a married or defacto relationship, being of Niuean, 'Other Pacific' or Non-Pacific ethnicity, being fluent in English and residing in New Zealand for more than 10 years, a parity of two or more children, not attending antenatal classes, and living with other smokers during pregnancy. Compared to no formal educational qualifications, having secondary school qualifications reduced likelihood of smoking during pregnancy ($p<0.05$).

Table 4. Adjusted odds of smoking during pregnancy for variables attaining significance[||] in a multiple logistic regression (n=1328)

Variable	Category	Adjusted odds ratio (95% CI)	
Maternal variables			
Social marital status	Partnered	1.00	
	Non-partnered	2.41	(1.56–3.71)‡
Ethnicity	Samoan	1.00	
	Cook Island Maori	1.45	(0.98–2.15)
	Niuean	1.95	(1.03–3.68)*
	Tongan	0.71	(0.46–1.11)
	Other Pacific[a]	2.59	(1.26–5.33)*
	Non Pacific	1.83	(1.08–3.09)*
Education (formal qualifications)	None	1.00	
	Secondary school	0.54	(0.37–0.77)†
	Post-school	0.71	(0.49–1.04)
English fluency	No	1.00	
	Yes	2.71	(1.78–4.11)‡
Years in NZ	0-5	1.00	
	6-10	1.88	(0.95–3.72)
	>10	2.76	(1.67–4.59)‡
Parity	1	1.00	
	2–4	1.67	(1.11–2.51)*
	5>	1.92	(1.06–3.46)*
Other variables			
Attended antenatal classes	Yes	1.00	(1.24–4.49)†
	No	2.36	
Lived with other smokers during pregnancy	No	1.00	
	Yes	4.56	(3.31–6.28)‡

*p<0.05; †p<0.01; ‡p<0.001; §Includes mothers identifying equally with two or more Pacific Island groups, equally with Pacific Island and non Pacific Island groups, or with Pacific Island groups other than Tongan, Samoan, Cook Island Maori, or Niuean; [||]Factors included in the final model but not reaching significance were maternal age and household income.

Discussion

The present study shows that smoking, particularly during pregnancy, continues to be a substantial public health problem requiring greater attention. 435 (31.9%) mothers reported smoking before pregnancy, 339 (24.9%) mothers reported smoking during pregnancy, and by 6-weeks post-birth, 342 (25.1%) mothers reported that they were current smokers. The proportion of pre-pregnancy smokers in the study was slightly higher than the 27% recorded nationally for Pacific women in the 1996 Census.[18]

In concordance with a recent New Zealand study,[13] and in contrast to others who reported 36%–46% of smokers ceased smoking during pregnancy,[10,19] less than a quarter of smoking women in our study stopped during their pregnancy and a small number even started smoking at this time.

The rate of smoking during pregnancy recorded in our study was higher than some recent international comparisions of 11%–16%,[14,19,20] but in line with those reporting the prevalence of maternal smoking to be in the 20%–30% range,[10,11] including New Zealand research conducted approximately 10 years ago in which 23.6% of Pacific mothers smoked during pregnancy compared with 33.2% for the whole

population sampled.[9] In addition, inspection of smoking rates by trimester show similarities to that reported in a 1997 Christchurch study.[21]

In the present study, 23.7% smoked in the first, 21.0% in the second, and 20.4% in the third trimester of pregnancy. Smoking rates for the Christchurch study were 26.8%, 25.0%, and 23.0% for the first, second and third trimesters, respectively.[21] While small fluctuations over time have been observed, the smoking rates during pregnancy have remained fairly stable at approximately 30% for 20 years.[22]

Heavy smoking has been classified as smoking over 10 cigarettes[3, 9] or in some studies, over 20 cigarettes daily.[12,19,20] Examination of cigarette consumption in the present study showed (overall) 48.3% of smokers consumed more than 10 cigarettes daily before pregnancy, signifying an almost even split between light smokers (1–9 cigarettes per day) and moderate-to-heavy smokers (10> cigarettes per day) among Pacific women.

However, by the third trimester, a reduction in numbers of heavy smokers was observed with 30.2% of smokers consuming over 10 cigarettes daily. These figures are similar to those observed in the New Zealand Plunket National Child Health Study, where Pacific mothers were considered lighter smokers than other ethnic groups with only 36% of Pacific mothers smoking more than 10 cigarettes daily compared to 71% of Maori mothers.[9]

Overall, mothers reduced tobacco intake once pregnant. Whether this was due to a conscious decision to reduce harm to the foetus or for other reasons is not known. Other researchers have also found that mothers tend to reduce their cigarette intake once pregnant[12,23] but significant numbers of mothers subsequently relapse in the months following birth.[12] Nevertheless, unlike complete cessation, reducing cigarette smoking may not eliminate all risks to the infant.[24]

After controlling for confounding factors, two markers of socioeconomic disadvantage (non-partnered marital status and low education) were significantly associated with smoking during pregnancy. These findings provide some support for the suggestion that smoking is associated with socioeconomic determinants of health, that smokers are a high-risk group from multiple perspectives,[14] and that smoking may be a coping mechanism for stressful life circumstances.[10]

In line with earlier research,[8-10,14] not being partnered (not married or in a defacto relationship) increased the odds of being a maternal smoker compared to being partnered. As identified previously,[2,9,10] those with no formal educational qualifications were more likely to be smokers than those with secondary school qualifications. Low education may be a reflection of inferior knowledge regarding the deleterious consequences of smoking during pregnancy.[11]

In contrast to others,[8,12] multivariate analyses showed that household income and employment status did not exert any independent influence on smoking status. Similarly, no independent influence on smoking status was observed for maternal age. This finding differs to that frequently seen in other[9,10,14] but not all[8,11] previous research.

Ethnic group differences were found in the present study with Niuean, Other Pacific and Non-Pacific mothers being more likely to smoke than their Samoan counterparts. Indicators of greater exposure to Westernisation also predicted smoking status.

Mothers residing in New Zealand for more than 10 years were more likely to be smokers than newer migrants. Similarly, a larger proportion of mothers fluent in English smoked during pregnancy compared to mothers not fluent. An Australian study containing a high proportion of non-English speaking mothers, also observed differences between ethnic groups, and found those mothers from English speaking backgrounds were more likely to smoke than those from non-English backgrounds.[8]

In concordance with previous research,[2,9] higher parity increased likelihood of smoking. Smoking may be used to relieve stress associated with the demands of caring for more than one child, particularly for mothers with low psychosocial resources.[10] Alternatively, motivation to quit smoking in the most recent pregnancy may have been reduced if no obvious detrimental health outcomes were observed in previous pregnancies.

Non-attendance at antenatal classes was associated with a two-fold increase in odds of smoking during pregnancy. Antenatal class attendance in this cohort is low (8%) with a considerable proportion of first time mothers not attending.[25] Poor utilisation of antenatal classes may indicate a lack of awareness surrounding health issues, signifying the importance of reaching this group.

The behaviour of partners and other family members can influence the smoking behaviour of pregnant women,[2] with those living with smoking partners[13,23]or exposed to passive smoke by others at home or at work[10] being less likely to stop smoking. For mothers in this study, living with at least one other smoker more than quadrupled the likelihood of smoking during pregnancy. Thus, despite a lack of success with some interventions aimed at enhancing partner support to improve smoking cessation,[26] it is clear that the smokefree message needs to extend beyond childbearing women.

Interpretation of findings should be made recognising possible limitations. The measurement of smoking status was based on use during a specific timeframe, thus data regarding non-smokers may also include ex-smokers. It is not known whether characteristics of ex-smokers in the present study would differ markedly from non-smokers or whether this may have had any influence on the relationships observed between smoking status, sociodemographic factors, and other variables. The reliance on mothers' reports may have underestimated smoking behaviour so the possibility of reporting bias cannot be ruled out. However, studies (that have compared the use of self-report versus biomarkers of cigarette consumption) have shown self-reports to be an accurate measure of smoking status,[27,28] although, measures of dose may be under-reported.[28]

Furthermore, reporting bias in the present study is likely to be minimal given that smoking questions formed only a small part of the overall interview content and that interviewers were not health workers. Despite the possibility of some under-reporting of cigarette dose, our data provide an estimate of patterns of consumption throughout pregnancy that can be further explored in additional research.

In conclusion, for mothers of Pacific infants in New Zealand, the present study showed that:

- Smoking rates during pregnancy remain high (24.9%),
- Over three-quarters of smoking women continued to smoke once pregnant, and
- Several factors were associated with a greater likelihood of smoking during pregnancy.

Factors identified as associated with smoking during pregnancy can be used to better target mothers for smoking cessation programmes. As smoking has many adverse health effects, which are potentially dose-related and cumulative during pregnancy, stopping smoking as early as possible is desirable and to be encouraged.[29] For those mothers who are not motivated or unable to quit, education on ways to reduce possible harm to infants should be a priority.[30] Furthermore, studies suggest that good smoking hygiene, such as not smoking in the same room as the infant, require greater attention.[31,32]

The link between smoking and negative health consequences, including respiratory illness,[1] is widely accepted. Smoking is a preventative risk factor for serious illness and places a significant economic burden on society through additional healthcare expenditure.[4,33] Thus, greater emphasise should be placed on disease prevention to reduce the health, social, and economic burden caused by smoking.

Consideration of how to prevent women from taking up smoking is of extreme importance and is likely to require a multifaceted approach.[19,26] As conventional programmes may not appeal to or work for Pacific women, barriers to becoming smokefree warrant further in-depth investigation, and cessation programmes designed specifically for Pacific women are urgently needed.

Author information: Sarnia Butler, Research Fellow, Pacific Islands Families: First Two Years of Life Study, Auckland University of Technology, Auckland; Maynard Williams, Senior Research Fellow and Statistician, Auckland University of Technology, Auckland; Janis Paterson, Co-Director, Pacific Islands Families Study, Auckland University of Technology, Auckland; Colin Tukuitonga, Pacific Health Research Centre, Department of Maori & Pacific Island Health, University of Auckland (and former Co-Director, Pacific Islands Families: First Two Years of Life Study), Auckland

Acknowledgments: The Pacific Islands Families (PIF) Study is supported by grants awarded from the Foundation for Science, Research and Technology, the Health Research Council of New Zealand, and the Maurice and Phyllis Paykel Trust. The authors gratefully acknowledge the families who have participated in the study, the Pacific Peoples Advisory Board, and other members of the PIF research team.

Correspondence: Sarnia Butler, Faculty of Health Studies, Auckland University of Technology, Private Bag 92006, Auckland. Fax: (09) 917 9877; email: sarnia.butler@aut.ac.nz

References:

1. American Academy of Pediatrics Committee on Substance Abuse. Tobacco's toll: Implications for the pediatrician. Pediatrics. 2001;107:794–8.

2. Penn G, Owen L. Factors associated with continued smoking during pregnancy: analysis of socio-demographic, pregnancy and smoking-related factors. Drug and Alcohol Review. 2002;21:17–25.

3. Roth L, Taylor H. Risks of smoking to reproductive health: Assessment of women's knowledge. Am J Obstet Gynecol. 2001;184:934–9.

4. Miller D, Villa K, Hogue S, Sivapathasundaram D. Birth and first-year costs for mothers and infants attributable to maternal smoking. Nicotine Tob Res. 2001;3:25–35.

5. Mitchell EA, Scragg R, Stewart AW, et al. Results from the first year of the New Zealand cot death study. N Z Med J. 1991;104:71–6.

6. Fergusson D, Horwood L, Shannon F. Parental smoking and respiratory illness in infancy. Arch Dis Child. 1980;55:358–61.

7. Yuan W, Basso O, Sorensen H, Olsen J. Maternal prenatal lifestyle factors and infectious disease in early childhood: A follow-up study of hospitalisation within a Danish birth cohort. Pediatrics. 2001;107:357–62.

8. Bai J, Wong F, Gyaneshwar R, Stewart H. Profile of maternal smokers and their pregnancy outcomes in South Western Sydney. J Obstet Gynaecol Res. 2000;26:127–32.

9. Alison LH, Counsell AM, Geddis DC, Sanders DM. First report from the Plunket National Child Health Study: Smoking during pregnancy in New Zealand. Paediatr Perinat Epidemiol. 1993;7:318–33.

10. Dejin-Karlsson E, Hanson B, Ostergren P, et al. Psychosocial resources and persistent smoking in early pregnancy – a population study of women in their first pregnancy in Sweden. J Epidemiol Community Health. 1996;50:33–9.

11. King G, Barry L, Carter D. Smoking prevalence among perinatal women: The role of socioeconomic status, race and ethnicity. Connecticut Medicine. 1993;57:721–8.

12. Najman J, Lanyon A, Andersen M, et al. Socioeconomic status and maternal cigarette smoking before, during and after pregnancy. Aust N Z J Public Health 1998;22:60–6.

13. McLeod D, Pullon S, Cookson T. Factors that influence changes in smoking behaviour during pregnancy. N Z Med J. 2003;116(1173): URL: http://www.nzma.org.nz/journal/116-1173/418

14. Stewart D, Streiner D. Cigarette smoking during pregnancy. Can J Psychiatry. 1995;40:603–7.

15. Borman B, Wilson N, Mailing C. Socio-demographic characteristics of New Zealand smokers: results from the 1996 census. N Z Med J 1999;112:460–3.

16. Paterson J, Tukuitonga CF, Abbott M, et al. The Pacific Islands Families Study:Technical Report Number 1. Auckland: Auckland University of Technology; 2002. Available online. URL: http://www.aut.ac.nz/research_showcase/research_activity_areas/pacific_islands_families/pdf/pif_technical_report2002.pdf Accessed November 2004.

17. Tsai JL, Ying Y, Lee PA. The meaning of "being Chinese" and "being American: Variation among Chinese American young adults. Journal of Cross-Cultural Psychology. 2000;31:302–22.

18. Statistics New Zealand. 1996 Census of Population and Dwelling: Pacific Islands people. Wellington: Statistics New Zealand; 1998.

19. Ebrahim S, Floyd R, Merritt R, et al. Trends in pregnancy-related smoking rates in the United States, 1987-1996. JAMA. 2000;283:361–6.

20. Von-Kries R, Toschke A, Koletzko B, Slikker W. Maternal smoking during pregnancy and childhood obesity. Am J Epidemiol. 2002;156:954–61.

21. Schluter PJ, Ford RPK, Ford CJ. A biochemical prevalence study of smoking in pregnancy for a cross-section of women in Christchurch, New Zealand. Aust N Z J Public Health. 2002;26:231–5.

22. Tappin DM, Ford RPK, Nelson KP, Wild CJ. Prevalence of smoking in early pregnancy by census area: measured by anonymous cotinine testing of residual antenatal blood samples. N Z Med J. 1996;109:101–3.

23. Hakansson A, Lendahls L, Petersson C. Which women stop smoking? A population-based study of 403 pregnant smokers. Acta Obstet Gynecol Scand. 1999;78:217–24.

24. Mitchell E, Thompson J, Robinson E, et al. Smoking, nicotine and tar and risk of small for gestational age babies. Acta Paediatr. 2002;91:323–8.

25. Low P. Attendance at antenatal care and antenatal classes by mothers of Pacific infants in South Auckland (thesis). Auckland: The University of Auckland; 2003.

26. Ministry of Health. Clearing the Smoke: A five-year plan for tobacco control in New Zealand (2004-2009).Wellington: Ministry of Health; 2004. Available online. URL: http://www.moh.govt.nz/moh.nsf/0/aafc588b348744b9cc256f39006eb29e?OpenDocument Accessed November 2004.

27. Etter J, Duc T, Perneger T. Saliva cotinine levels in smokers and nonsmokers. Am J Epidemiol. 2000;151:251–8.

28. Klebanoff M, Levine R, Clemens J, et al. Serum cotinine concentration and self-reported smoking during pregnancy. Am J Epidemiol. 1998;148:259–62.

29. Aaronson L, Macnee C. Tobacco, alcohol, and caffeine use during pregnancy. JOGNN. 1989;18:279–87.

30. Liston J. Breastfeeding and the use of recreational drugs – alcohol, nicotine and marijuana. Breastfeeding Review. 1998;6:27–30.

31. Joyce D, Chapman K, Balter M, Kesten S. Asthma and allergy avoidance knowledge and behavior in postpartum women. Ann Allergy Asthma Immunol. 1997;79:35–42.

32. Ponsonby A, Couper D, Dwyer T. Features of infant exposure to tobacco smoke in a cohort study in Tasmania. J Epidemiol Community Health. 1996;50:40–6.

33. Stoddard J, Gray B. Maternal smoking and medical expenditures for childhood respiratory illness. Am J Public Health. 1997;87:205–9.

