

Changes to smoking habits and addiction following tobacco excise tax increases: a comparison of Māori, Pacific and New Zealand European smokers

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New Zealand (NZ) has had a progressive tobacco control program since 1985 with the ultimate goal of achieving a smokefree population (<5% prevalence) by 2025. This reflects growing interest in an 'endgame' scenario with strategies targeted towards achieving near-zero smoking prevalence.¹ In recent years there has also been increasing emphasis on reducing inequalities in smoking-related health outcomes. Smoking is a major contributor to inequalities in health outcomes observed between ethnic groups in NZ, notably the consistently poor outcomes for Māori and Pacific Island people.²⁻⁴ Smoking prevalence among Māori (37.1%) and Pacific Island groups (23.3%) is higher than New Zealanders of European descent (NZ European) (13.6%).⁵⁻⁷

A range of strategies have been employed to achieve the dual health goals of reducing smoking prevalence and inequalities in smoking and smoking-related outcomes. These include smokefree environments, public health programs and an increasing range of cessation support.⁸ One strategy has been to increase the price of tobacco by raising the excise tax on tobacco products. International evidence suggests that excise tax is one of the most effective single tobacco control measures and has considerable support from cross-sectional population surveys and macroeconomic studies.⁹⁻¹⁴ Increasing tobacco excise tax is also seen as one way to target lower socioeconomic groups, who have been shown to be more price sensitive.¹⁵⁻¹⁷ Because Māori and

Abstract

Objective: To compare changes in smoking habit and psychological addiction in Māori/Pacific and NZ European smokers in response to two annual excise tax increases from 2012 to 2014.

Methods: Smokers from New Zealand cities completed questionnaires at three time points before and after two excise tax increases.

Results: There were no significant differences in cigarettes per day or psychological addiction at baseline, but a linear decline in both measures was observed in Māori/Pacific and NZ European smokers. Cigarettes per day reduced at a greater rate for Māori/Pacific than NZ European smokers but dependence did not.

Conclusion: Results indicated that Māori/Pacific smokers' demand for cigarettes may be more price sensitive than NZ European smokers.

Implications for Public Health: Tobacco excise tax may be particularly effective for Māori/Pacific smokers and may contribute to reductions in smoking-related health inequalities in NZ.

Key words: tobacco, tax, addiction, Māori, New Zealand

Pacific Island people are economically disadvantaged,¹⁸ excise taxes may be particularly effective in reducing smoking for these groups.

There were substantial increases in tobacco excise taxes in NZ in the 1980s, in 1991, 1998 and 2000; however there were no increases (in real terms) between 2000 and 2009. In April 2010, the NZ Government raised tobacco excise by 10% on factory-made (FM) cigarettes and by 24% on 'roll your own' (RYO) tobacco, followed by two annual 10% increases in 2011 and 2012. In October 2012, the Customs and Excise (Tobacco Products – Budget Measures) Amendment Act 2012 legislated for a further four 10% tax increases to come into effect on 1 January each year from 2013 to 2016.¹⁹ These efforts have provided opportunities to examine smoking-related responses to tax increases in terms of

rates of quitting altogether, quit attempts and cutting down on smoking.

After two tax increases in 2010 and 2011, considerable cross-sectional evidence suggests that smokers experienced increased pressure to quit. The volume of Quitline calls in May 2010, following the first excise tax increase, exceeded those in May 2008 and 2009²⁰ and both telephone and face-to-face surveys suggest that there was a significant increase in the number of smokers making quit attempts or smoking-related changes.^{21,22} Walton and colleagues²³ surveyed NZ smokers three months before and after the 2012 tax increase and found an increase in smoking-related behavioural change including quitting altogether, quit attempts and cutting down on smoking, although non-Māori smokers were less likely to report a change in smoking behaviour. Grace, Kivell

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and Laugesen²⁴ interviewed NZ smokers before and after the 2013 tax increase and found that participants reported a significant reduction in cigarettes per day and self-report measures of addiction.

The overall impact of NZ tax policy on tobacco reduction, among other measures, appears to be effective, and many advocate more tax increases to encourage quitting.²¹ Although research on price sensitivity across ethnic groups is limited, some studies in the US have examined racial and ethnic differences in tobacco price sensitivity focusing specifically on Hispanic and African Americans compared to White Americans. These studies support the idea that Hispanic and African American smokers are more responsive to tax and price than White Americans.²⁵⁻²⁹ However it is unclear whether these findings can be generalised to minority groups in NZ. Furthermore, some authors argue that while mainstream public health

programs have the potential to improve average health outcomes, they do so at the expense of increasing health inequalities.³⁰

There is concerning evidence that smoking prevalence among Māori and Pacific Island groups remains high, despite intensive tobacco control strategies and a policy focus on reducing inequalities.^{7,18} Hill and colleagues³⁰ examined reductions in smoking prevalence between 1981 and 1996 and found that these were primarily driven by a decrease in smoking among high socioeconomic groups and the non-Māori and non-Pacific Island population. Similarly, Salmond et al.¹⁸ studied reductions in smoking prevalence between 1996 and 2006 and concluded that Māori continue to have an “exceedingly high prevalence of smoking despite a policy focus on reducing disparities in smoking” (p.668) and stated concerns that smoking prevalence in Pacific Island populations may not yet have reached

its peak based on modest increases over the decade.

These findings indicate that current tobacco control policies, including excise tax increases, may not motivate cessation in Māori and Pacific Island groups. However, smoking prevalence does not tell the whole story. Alternative responses to excise increases may include smoking fewer cigarettes per day, smoking closer to the filter, rolling thinner (roll-your-own) cigarettes, switching to cheaper brands or switching from roll-your-own to factory-made cigarettes.²¹ Although these responses may not be associated with the same health benefits as absolute cessation, some evidence suggests that reduction in smoking is associated with greater probability of future quitting³¹ and so these changes may still be considered favourable. Studies that compare these responses between different population groups report mixed results. Some have reported significantly greater reductions in cigarettes per day in Māori and Pacific Island groups following tax increases;²⁴ others have reported greater reductions in NZ European groups.²³ The latter pattern of results is especially concerning if, despite being a priority group for tobacco control, Māori are not benefited by excise tax increases.

It must be noted that the role of tobacco taxation on the above findings is unclear. Tax policy is generally seen as one of the more effective approaches for reducing tobacco consumption in lower socioeconomic groups; but other tobacco control measures are being applied simultaneously and the effects of these measures may not have been considered. For example, some authors suggest that public health promotion messages have their greatest initial impact on higher socioeconomic groups with greater educational attainment and access to resources,³² and thus Māori and Pacific Island people may have benefited less from such mainstream public health tobacco control interventions. This highlights the need to use targeted strategies for different population groups if NZ is to achieve the goal of Smokefree Aotearoa 2025.³⁰

As far as we are aware, there is no research that compares psychological measures of nicotine dependence and addiction in Māori/Pacific and NZ European smokers, or any research that evaluate changes in psychological dependence and addiction following excise tax increases. While there has been research investigating individual

Table 1: Demographic and smoking dependence information for Māori/Pacific and NZ European/Other groups.
Note: NCEA=National Certificate of Educational Achievement.

	Māori/Pacific		NZ European/Other	
Gender	%	n	%	n
Male	41	42	48	112
Female	59	61	52	122
Demographic	M	SD	M	SD
Age	36.37	12.32	36.97	13.89
Employment Status	%	n	%	n
Student	4.8	5	20.2	49
Unemployed	26.9	28	18.2	44
Employed	60.6	63	55.0	133
Education Attainment	%	n	%	n
No school qualifications	28.4	29	15.7	36
5th form School Cert/NCEA Level 1	11.8	12	8.7	20
6th form School Cert/NCEA Level 2	5.9	6	10.0	23
University Entrance (NCEA Level 3)	10.8	11	9.6	22
Post-secondary qualification	25.5	26	27.8	64
Undergraduate university degree	8.8	9	11.3	26
Postgraduate university degree	8.8	9	17.0	39
Income	%	n	%	n
<NZ\$20,000	23.8	24	31.1	73
NZ\$20,000 – NZ\$30,000	17.8	18	12.8	30
NZ\$30,000 – NZ\$40,000	12.9	13	8.5	20
NZ\$40,000 – NZ\$50,000	8.9	9	10.2	24
NZ\$50,000 – NZ\$60,000	12.9	13	9.8	23
NZ\$60,000 – NZ\$70,000	6.9	7	6.4	15
>=NZ\$70,000	16.8	17	21.3	50
Smoking Dependence	M	SD	M	SD
FTND	4.08	2.22	4.21	2.18
AUTOS	18.13	8.35	18.61	8.05
GNSBQ	16.63	7.85	17.15	7.86
Cigarettes/day	14.71	8.98	14.80	8.47
Changes in Smoking Behaviour	%	n	%	n
Quit by Wave 3	28.95	11	23.89	27
	M	SD	M	SD
Reduction by Wave 3	9.02	9.52	6.10	8.21

smokers' responses before and after a single tobacco excise increases in NZ,²⁰⁻²⁴ and two previous studies that compare these responses by ethnicity,^{23,24} our study is the first to compare Māori/Pacific and NZ European smokers at three time points before and after two annual tobacco excise increases. The goal of the present study was to evaluate how these groups of smokers responded – in terms of changes in smoking habit – to two successive 10% excise tax increases.

Method

Participants

Adult smokers (n=357) were recruited by newspaper, community and internet advertising from four major NZ cities: Auckland (n=72), Wellington (n=151), Christchurch (n=71) and Dunedin (n=63). Participants were required to be adult daily smokers, over 18 years old, who purchased their own tobacco and had no intention to quit. Pregnant or breastfeeding women were excluded. The mean age of the 357 participants included in the analysis was 36.95 (SD=13.39).

The study was approved by the University of Canterbury Human Ethics Committee and participants provided written consent.

Procedure

337 participants attended sessions at Wave 1 in November-December 2012 and 226 attended at Wave 2 in February-March 2013. All participants received an NZ\$15 shopping mall vouchers and a chance to win a NZ\$250 tablet computer for completing each interview. In each session participants completed several questionnaires that assessed demographic variables and measures of smoking dependence. In February-March 2014 (Wave 3), 152 participants were contacted by telephone or email and provided with a link to an online questionnaire.

Measures

Demographics and smoking habit

The demographic questionnaire included items relating to ethnicity, marital status, education, household income and occupation (employed/unemployed/student). Participants were also asked how many cigarettes per day they smoked.

Dependence measures

Three measures of dependence were

administered at Wave 1. The Fagerstrom Test of Nicotine Dependence (FTND)³³ assesses levels of physical nicotine dependence based on 6 items scored from 0-3 or 0-1. A FTND score is the sum of the six items and scores can be classified as mild [0-3], moderate [4-6] and severe [7-10]. Good test-retest and internal consistency have been demonstrated [$\alpha=0.64$].³⁴ The Glover-Nilsson Smoking Behaviour Questionnaire (GNSBQ)³⁵ assesses the behavioural dimension of smoking through patterns of use such as associating smoking with daily activities, as well as the cognitive, social and behavioural effects associated with tobacco dependence. It includes 18 items scored from 0 ("not at all") to 4 ("extremely so") and total scores range from 0-72. The GNSBQ has good internal consistency [$\alpha=0.82$] and test-retest reliability [$r=0.86$], and is significantly correlated with nicotine craving.³⁶ Finally, the Autonomy Over Smoking Scale (AUTOS)³⁷ has 12 items scored from 0 ("describes me not at all") to 3 ("describes me very well"). It has three subscales: Withdrawal Symptoms, Psychological Dependence, and Cue-Induced Craving. The AUTOS has excellent internal consistency both for total score [$\alpha=0.91-0.97$] and subscales [$\alpha=0.74-0.91$].³⁷

Statistical analysis

Demographic variables (gender, age, income, employment status, education attainment) and smoking information (FTND, AUTOS, GNSBQ, cigarettes per day) were compared between the Māori/Pacific and NZ European/Other groups using analysis of variance (ANOVA) or chi-square analysis as appropriate. To investigate changes in cigarettes per day at each wave, a mixed model analysis was conducted using IBM SPSS Statistics 22. Mixed model analysis was chosen over repeated measures ANOVA for their greater flexibility to model time effects and correlational patterns between time measurements for longitudinal data, and their ability to handle missing data more appropriately. Plausible covariance-structure models were fitted with and without inclusion of wave as a random effect. The best-fitting mixed model was selected by likelihood ratio comparison tests (Akaike's Information Criterion). The analysis was run with the repeated effect of wave and fixed effects of wave, ethnicity, gender, wave x ethnicity, wave x gender, ethnicity x gender, and wave x ethnicity x gender. Pairwise comparisons (Fisher LSD) were conducted to identify any significant differences within

each significant interaction. The relationship between wave and cigarettes per day was assessed by evaluating linear and quadratic effects for the main effect of wave.

Changes in dependence measures were assessed at Waves 1 and 2. A repeated-measures analysis of variance (RM-ANOVA) was conducted on addiction scores, with Wave, ethnicity and gender as factors. Separate analyses assessed changes in the total scores of the FTND, GNSBQ and AUTOS, and the three subscales of the AUTOS (Withdrawal Symptoms, Psychological Dependence and Cue-Induced Craving).

Results

Of the 337 participants that began the study, 67% responded at Wave 2 and 45% responded at Wave 3. There were no significant differences between those lost to follow-up and those who responded at each wave in terms of demographic variables (age, gender, income, educational attainment and occupational status), type of cigarette usually smoked (FM or RYO), cigarettes smoked per day, and dependence scores (FTND, GNSBQ and AUTOS).

Table 1 summarises the demographic and smoking information for the sample. No significant differences were found between Māori/Pacific and NZ European/Other smokers in terms of gender, age, or income. By contrast Māori/Pacific smokers were significantly less likely to be students [$\chi^2(3)=14.310, p < 0.005, \phi=0.203$] and had lower education attainment than NZ European/Other smokers [$t(330)=2.59, p < 0.005, \phi=0.189$]. There were no significant differences in smoking dependence between Māori/Pacific and NZ European/Other smokers for FTND ($t(344)=0.467, p=0.641$), AUTOS, ($t(343)=0.493, p=0.622$), and GNSBQ ($t(344)=0.569, p=0.570$) scores, or cigarettes per day ($t(311)=0.81, p=0.936$). There were no differences between the proportions of Māori/Pacific and NZ European/Other that smoked roll-your-own (RYO) versus factory-made (FM) cigarettes [$\chi^2(1)=0.843, p=0.358$]. Chi-square tests revealed no significant differences between the proportions of Māori/Pacific and NZ European/Other smokers who reported quitting at Wave 2 [$\chi^2(1)=0.988, p=0.320$] or Wave 3 [$\chi^2(1)=0.386, p=0.535$].

Figure 1 shows average cigarettes smoked per day reported by NZ European/Other (left panel) and Māori/Pacific (right panel)

participants at Waves 1, 2 and 3. For both groups, there was a reduction in cigarettes per day from Wave 1 to Wave 3, and the reduction appeared to be greater for Māori/Pacific smokers. Males reported smoking more cigarettes than females at Wave 1, especially for Māori/Pacific smokers, but by Wave 3 there appeared to be no difference between males and females.

These observations were confirmed with a mixed model analysis using a best-fitting covariance model (unstructured). There were significant effects of wave [$F(2,192.661)=63.318, p < 0.001$] and group x wave interaction [$F(2,192.661)=5.595, p < 0.005$]. Polynomial contrasts for wave confirmed a linear [$p < 0.05$] but not quadratic trend [$p = 0.91$], consistent with the decrease

in cigarettes per day for both groups. For the group x wave interaction, pairwise comparisons indicated that Māori/Pacific and NZ European/Other smokers reported similar cigarettes per day at Wave 1 [14.80 and 14.71, respectively] but Māori/Pacific smokers smoked fewer cigarettes per day than NZ European/Other at Wave 2 [10.14 and 11.63; $p < 0.05$] and Wave 3 [7.09 and 10.07; $p < 0.05$].

Figure 1: Mean change in cigarettes per day at Waves 1, 2 and 3 for NZ European (left panel) and Māori/Pacific (right panel) groups, plotted separately for males (unfilled diamonds) and females (filled diamonds).

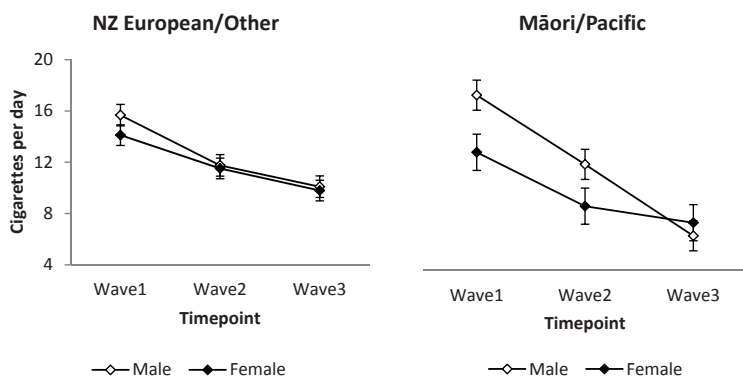
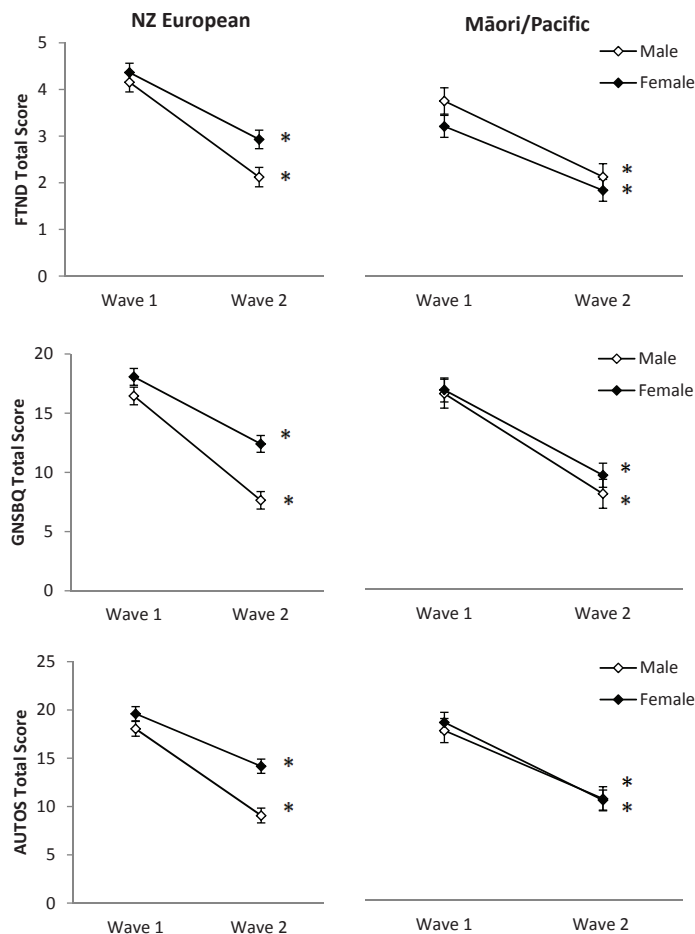


Figure 2: Mean change in total scores for Fagerstrom Test of Nicotine Dependence (FTND) (top), Glover-Nilsson Smoking Behaviour Questionnaire (GNSBQ) (middle) and Autonomy Over Smoking Scale (AUTOS) (bottom) at Waves 1 and 2 for NZ European (left) and Māori/Pacific (right), plotted separately for males (unfilled diamonds) and females (filled diamonds). Significant reductions at Wave 2 are indicated by an asterisk (*).



The gender x wave interaction was also significant [$F(2, 192.661)=4.850, p < 0.01$]. Pairwise comparisons confirmed that males smoked more than females at Wave 1 [16.05 and 13.74; $p < 0.01$]. Finally, the three-way interaction between group, gender and wave was significant [$F(2, 192.661)=3.451, p < 0.05$]. Māori/Pacific males smoked more than females at Wave 1 [17.26 and 12.93; $p < 0.013$], but there were no other significant differences.

Pooled across groups, these results show that smokers reported a 37.1% reduction in cigarettes smoked per day from Wave 1 (14.76) to Wave 3 (9.29). The reduction was greater for Māori/Pacific (52%) than NZ European/Other smokers (24%), with Māori/Pacific males reporting the largest decrease overall (68%) compared to Māori/Pacific females (40%), NZ European/Other males (34%) and NZ European/Other females (16%).

Figure 2 shows mean total scores for the FTND, GNSBQ and AUTOS at Waves 1 and 2. Overall, dependence scores decreased. Repeated-measures AVOVAs with Wave as a within-subjects factor and gender and ethnicity as between-groups factors confirmed significant decreases in FTND [$F(1,315)=119.5798, p < 0.001, \eta^2=0.275$], GNSBQ [$F(1,315)=131.648, p < 0.001, \eta^2=0.293$] and AUTOS [$F(1,314)=124.438, p < 0.001, \eta^2=0.28$] scores. The effect of gender was significant for overall GNSBQ scores [$F(1,317)=5.9232, p < 0.05, \eta^2=0.018$], indicating that females had higher levels of behavioural dependence, and a significant ethnicity x gender interaction confirmed that Māori/Pacific females had lower FTND scores than NZ European/Other females [$F(1,315)=4.4192, p < 0.05, \eta^2=0.036$]. No other main effects or interactions were significant [$ps < 0.05$].

Figure 3 shows scores for each of the subscales of the AUTOS: withdrawal symptoms, psychological dependence and cue-induced craving. Figure 5 shows an overall decrease in subscale scores from Wave 1 to Wave 2, most consistently for cue-induced craving. Repeated-measures ANOVAs with Wave as a within-subjects factor

and gender and ethnicity as between groups factors confirmed a significant reduction in cue-induced craving [$F(1,199)=20.103$, $p<0.001$, $\eta^2=0.092$] but not psychological dependence or withdrawal symptoms [$ps<0.05$]. One significant interaction was found between wave, gender and ethnicity for withdrawal symptoms [$F(1,199)=4.1386$, $p<0.05$, $\eta^2=0.020$]. *Post hoc* analysis revealed a decrease in withdrawal symptoms from Wave 1 to Wave 2 for NZ European/Other males but no other differences. No other main effects or interactions effects were significant [$ps<0.05$].

Discussion

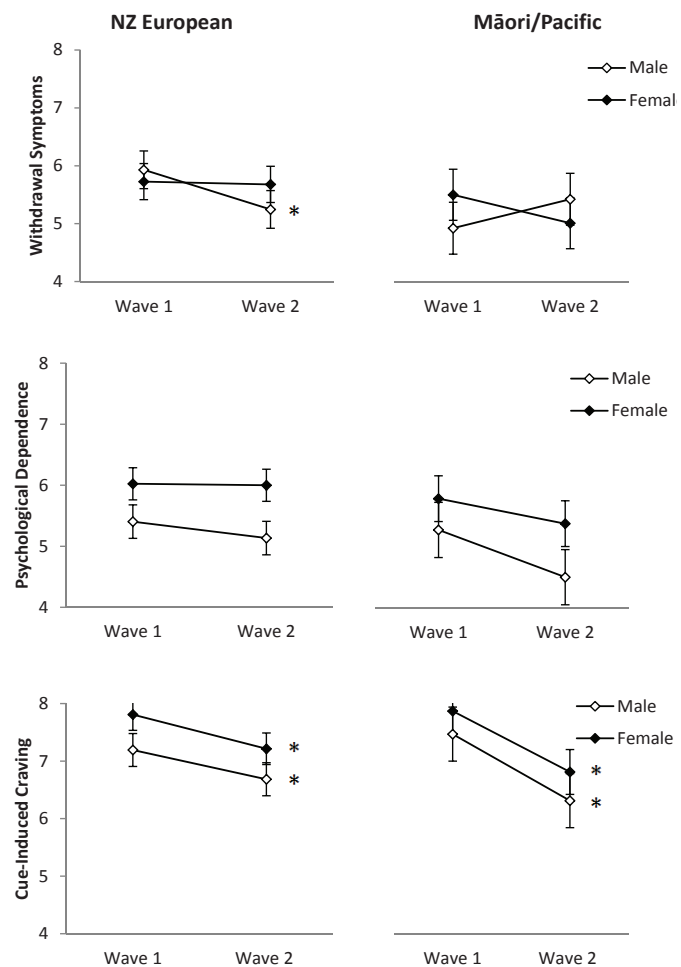
Our goal was to compare measures of smoking dependence and smoking behaviour for Māori/Pacific and NZ European/Other smokers, and to assess whether these groups differed in their response to a series of annual 10% tobacco excise tax increases. Results showed that Māori/Pacific and NZ European/Other smokers had similar levels of smoking behaviour and dependence at Wave 1, but their responses to the annual excise tax increases differed: Māori/Pacific smokers reported greater reductions by Waves 2 and 3 in the number of cigarettes they smoked per day than NZ European/Other smokers, with Māori/Pacific males showing the greatest reductions.

Psychological measures of dependence and addiction

Results showed that there were no significant differences in cigarettes per day or smoking dependence as measured by the FTND,³³ AUTOS³⁷ or GNSBQ³⁵ between Māori/Pacific and NZ European/Other smokers at baseline (before the first tax increase). Whereas previous research consistently shows elevated smoking prevalence in Māori and Pacific Islanders,⁵⁻⁷ to our knowledge there is no existing research that compares psychological measures of nicotine dependence and addiction between Māori/Pacific and NZ European/Other smokers. Our results suggest that, regardless of disparities in smoking prevalence by ethnicity, there were no differences in smoking dependence or the number of cigarettes smoked per day among Māori/Pacific and NZ European/Other smokers prior to the 2012-2014 excise tax increases.

When gender was included in the analysis, we found that overall females had consistently higher addiction levels based on the GNSBQ

Figure 3: Mean change in Autonomy Over Smoking (AUTOS) subscale scores: Withdrawal Symptoms (top), Psychological Dependence (middle) and Cue-Induced Craving (bottom) at Waves 1 and 2 for NZ European (left) and Māori/Pacific (right) groups, plotted separately for males (unfilled diamonds) and females (filled diamonds). Significant reductions at Wave 2 are indicated by an asterisk (*).



than males at all time points, while there were no significant gender differences using the FTND or the AUTOS. This indicates that behavioural components of smoking may be more important in female smoking habits than in male smoking habits, while physiological dependence appears to be equally important for males and females. This is partially consistent with a previous study that found that women had significantly higher GNSBQ scores than men while men had significantly higher FTND scores than women,³⁸ though we found no gender differences using the FTND. There is relatively little research investigating differential reinforcement of smoking behaviour in men and women, however a review of human and animal research suggested that nicotine self-administration and direct reinforcing effects of nicotine (through discriminative or interoceptive stimuli, i.e. physiological changes) appear to be reduced in females relative to males, while non-nicotine stimuli

associated with smoking appear to be more reinforcing and influential on smoking behaviour in females.³⁹ It was proposed that females may have reduced discrimination of the physiological (or interoceptive) effects of nicotine unless these effects are paired with contextual or environmental (or exteroceptive) cues; these cues are considered to be more reinforcing of smoking behaviour in women than the physiological effects themselves. This concept has received little research attention. However one recent study found that females showed greater physiological reactivity to nicotine yet reported lower subjective reactivity.⁴⁰ This supports the idea that women have reduced discrimination of the physiological effects of nicotine, however more research is required to understand the relative contributions of nicotine and non-nicotine reinforcers in smoking behaviour in men and women. When both ethnicity and gender included in our analyses it was observed that Māori/

Pacific females had significantly lower dependence based on the FTND than NZ European/Other females at Waves 1 and 2, while there were no significant differences in behavioural dependence based on the GNSBQ or cigarettes per day. This is particularly interesting given that smoking rates for Māori/Pacific females are one and a half times those of NZ European/Other females.⁵ It may indicate that behavioural, social or cultural influences are particularly important in maintaining smoking behaviour for Māori/Pacific females, while physiological nicotine dependence may have a relatively smaller contribution. This may be partially consistent with previous research that found female smoking rates among Māori were more influenced by changes in socioeconomic factors than males.⁴¹ Similarly, a literature review examined qualitative and quantitative descriptions of self-reported barriers to quitting smoking in Indigenous groups (not exclusively Māori) and suggested that smoking cessation may exclude an individual from fully participating in their culture or may challenge their family, personal or community relationships.⁴² This is similar to a qualitative review of Māori women's views on smoking cessation initiatives which identified that whānau (extended family) attitudes and behaviour toward smoking, such as friends and whānau members smoking at home, affected Māori women's smoking behaviour.⁴³ It appears that Māori/Pacific females may be particularly vulnerable to maintaining smoking behaviour given a combination of a) exposure to increased social acceptance of smoking and environmental smoking cues, and b) increased responsiveness to behavioural, social and cultural factors in maintaining smoking behaviour rather than physiological factors. These findings may indicate the importance of holistic smoking cessation interventions for females, particularly Māori/Pacific females that target the home and social environment as well as individual factors.

Changes to smoking behaviour following excise tax increase

There were no significant differences in the number of Māori/Pacific and NZ European/Other smokers who quit smoking at Wave 2 and Wave 3 (14%). However, there were significant differences in changes to smoking behaviour. Overall a linear decline in cigarettes per day was observed from Wave 1 to Wave 3 with a mean reduction of 7 in cigarettes per

day. Similarly, there was an overall trend in which psychological dependence decreased from Wave 1 to Wave 2.

There were no significant differences in cigarettes per day between Māori/Pacific smokers and NZ European/Other smokers at Wave 1; however Māori/Pacific smokers smoked significantly fewer cigarettes per day than NZ European/Other smokers at Waves 2 and 3. This suggests that Māori/Pacific smokers were more price sensitive when it came to price increases than NZ European/Other smokers. This effect appeared to be independent of income level, as both groups demonstrated comparable self-reported income. Additionally, while there were no significant gender differences in cigarettes per day at Waves 1, 2 and 3 for NZ European/Other smokers, Māori/Pacific males smoked significantly more cigarettes per day than Māori/Pacific females at Wave 1 but not at Waves 2 and 3. It is particularly interesting given that Māori/Pacific males did not show any significantly greater reductions in physical and psychological dependence than Māori/Pacific females or NZ European smokers which may suggest that price sensitivity contributes more to cigarette consumption in Māori/Pacific males above and beyond physical and psychological dependence.

Strengths and limitations

We already know that increasing excise tax on tobacco is a cost-effective and powerful smoking intervention. This study adds that two recent tobacco excise tax increases on 1 January 2012 and 2013 in NZ resulted in 14% of a sample of smokers quitting, a rate that was similar for Māori/Pacific and NZ European/Other smokers, and an average reduction in consumption of seven cigarettes per day. Few people quit following the tax increases (14%), perhaps reflecting the high tension to quit smoking alongside the chronic relapsing nature of nicotine addiction. However, cessation does not tell the whole story. Notably, Māori/Pacific smokers' consumption of cigarettes per day reduced at a greater rate than NZ European smokers following the two tobacco excise tax increases which may indicate that tax policy is particularly effective at reducing smoking in Māori/Pacific smokers. The data on the health benefits of reducing smoking is sparse and methodologically flawed with poor measurement of the duration of smoking reduction and short follow-up periods relative

to the delayed nature of health consequences of smoking.⁴⁴ The existing data suggests that there may be benefits to cardiovascular and respiratory health, but these are likely to be small relative to absolute cessation.^{31,44,45} However, evidence suggests that reduction in smoking is associated with greater probability of future quitting^{31,44,46} and may be considered a 'first step' towards smoking cessation.^{31,45} Given the greater reductions in consumption for Māori/Pacific smokers observed in this study, increases in tobacco excise tax may be beneficial for reducing inequalities in smoking and smoking-related outcomes in NZ, but changes in prevalence may take longer to be observed. To support this hypothesis, it would be necessary to follow individual smokers for longer periods following excise tax increases to evaluate whether those who reduce their consumption eventually go on to quit, and how long this may take. Additionally, as far as we are aware this study is the first to compare measures of physical and behavioural dependence in males and females, and Māori/Pacific and NZ European smokers in NZ. It provides some preliminary evidence for differential physical and behavioural dependence between males and females in NZ, including the particular importance of behavioural dependence in Māori/Pacific females.

While this research has some interesting findings, some limitations should be acknowledged. Māori and Pacific Island smokers were combined due to the relatively small sample and low numbers of Pacific Island participants. Although both groups have elevated smoking prevalence and low socioeconomic status,^{18,47,48} it must be considered that this may not reflect a homogenous group and results must be interpreted with caution. Particular caution should be taken when interpreting the results for Māori/Pacific females given the relatively high smoking prevalence for Māori females compared with relatively low smoking prevalence for Pacific females.^{47,48} Additionally, we found that Māori/Pacific and NZ European/Other smokers reported similar income levels. However based on the 2013 Census,⁴⁹ Māori and Pacific peoples median personal incomes (NZ\$22,500 and NZ\$19,700 respectively) were 78.9% and 69.1% of the national median personal income (NZ\$28,500), and these gaps had increased from 2006 to 2013. This suggests that our sample may not have been representative of the Māori/Pacific population in NZ. Had our sample been more representative, we

may have seen different price sensitivities by ethnicity in line with previous research showing that lower income groups are more price sensitive.¹⁵⁻¹⁷ We also used multiple statistical tests, which increases the chances of Type 1 error. Finally, NZ excise tax increases do not occur in isolation, but are part of a comprehensive tobacco control strategy. Our study does not account for the effects other policies or variables on demand or changes in smoking behaviour over this period.

To conclude, the present study compared measures of smoking dependence and smoking behaviour for Māori/Pacific and NZ European/Other smokers, and assessed whether these groups differed in their response to a series of annual 10% tobacco excise tax increases. The study provided some evidence for differential physical and behavioural dependence between males and females in NZ, including the particular importance of behavioural dependence in Māori/Pacific females. We also provided additional support for tobacco excise tax as an effective and powerful smoking intervention and provided some evidence for differential responses to this strategy across ethnic groups in NZ. Although this strategy is unlikely to combat inequalities in smoking and smoking-related outcomes alone, it may be considered to be a useful contributor as part of a comprehensive tobacco control strategy.

Implications for public health

Increasing tobacco excise tax appears to be particularly beneficial for reducing cigarette consumption in Māori/Pacific smokers, especially Māori/Pacific males. While reducing consumption has minimal direct health benefits, it is hypothesised that individuals who reduce their cigarette consumption may be more likely to quit smoking in the future. This suggests that tobacco excise taxes may contribute to a comprehensive tobacco control strategy aiming to reduce inequalities in smoking and smoking-related health outcomes for Māori and Pacific Island people in NZ.

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