Using a Cigarette Purchase Task to Assess Demand for Tobacco and Nicotine-containing Electronic Cigarettes for New Zealand European and Māori/ Pacific Island Smokers

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Can nicotine-containing electronic cigarettes (NECs) help to reducing smoking prevalence for Māori and Pacific Island persons in New Zealand? We compared simulated demand for tobacco cigarettes, reactions to first-time use of NECs, and the impact of NEC availability on tobacco demand for New Zealand European and Māori/Pacific Island smokers. New Zealand smokers (N=357; 30.1% Māori/Pacific ethnicity and 69.9% NZ European/ Other) completed questionnaires and of these 210 consented to attend a session in which they sampled an NEC and completed simulated demand tasks. Māori/Pacific smokers were significantly more price sensitive than NZ European/Other smokers. NECs were partially substitutable for tobacco cigarettes for both New Zealand European and Māori/Pacific smokers, but were rated as more satisfying by Māori/Pacific smokers. Tobacco excise tax increases may be beneficial for discouraging smoking, particularly for Māori/ Pacific male smokers, and the availability of NECs at a lower price than tobacco cigarettes may enhance the effects of price increases. NECs may be an attractive vehicle for nicotine replacement therapy and may reduce ethnic disparities in smoking prevalence in New Zealand.

Keywords: simulated demand, electronic cigarettes, subjective effects, nicotine replacement therapy, ethnicity, Māori

Smoking is a major contributor to health inequalities between ethnic groups in New Zealand with consistently poor outcomes for Māori and Pacific Island people (Blakely, Ajwani, Robson, Tobias, & Bonne, 2004; Howden-Chapman & Tobias, 2000; Wamala, Blakely, & Atkinson, 2006). Smoking prevalence among Māori (37.1%) and Pacific Island groups (23.3%) is elevated compared to New Zealanders of European descent (13.6%) (Ministry of Health, 2010, 2014a, 2014b). This increased prevalence hinders Māori and Pacific development aspirations and opportunities through premature death, smoking-related illness and the erosion of economic, social and cultural wellbeing (Māori Affairs Committee, 2010). Māori women have the highest smoking prevalence at 42% compared to Māori men at 34% (Ministry of Health, 2015). Achieving reductions in smoking prevalence among Māori and Pacific peoples, specifically for women, is of vital importance to reduce health inequalities and achieve the national public health goal of a smokefree society (Edwards et al., 2009; Ministry of Health, 2004). Increasing the price of tobacco via excise tax is an integral part of New Zealand's comprehensive tobacco control program and is considered one of the most effective single tobacco control measures worldwide (Chaloupka, Yurekli, & Fong, 2012; Gallet & List, 2003; IARC Working Group, 2011). It is important to consider whether this strategy can help reduce inequalities in smoking prevalence.

Considerable research has used econometric methods to assess how responsive the consumption of cigarettes is to changes in price at a population level (Chaloupka & Warner, 2000; Chaloupka et al., 2012; IARC Working Group, 2011). Meta-analyses of these studies estimate that the average price elasticity of demand for cigarettes is around -0.4, which indicates that a 10% increase in the price of cigarettes would reduce consumption by 4% (Chaloupka & Warner, 2000; Chaloupka et al., 2012; Gallet & List, 2003; IARC Working Group, 2011). Data from New Zealand are consistent with this result, with price elasticity estimates for tobacco from 0.43 - 0.45 (O'Dea, Thomson, Edwards, & Gifford, 2007; Thomson, O'Dea, Wilson, Reid, & Howden-Chapman, 2000). However, it is also important to consider whether responsiveness to price varies across ethnic groups in New Zealand, which cannot be achieved using population-based data. Individual-level data provides a way to compare responsiveness to price across different groups, by administering surveys before and after tobacco excise tax increases.

Two survey studies have compared how Māori, Pacific Island, and New Zealand European smokers respond to tobacco excise tax increases in New Zealand. Walton, Li, Newcombe, Tu, and Berentson-Shaw (2013) found that non-Māori were more likely than Māori to have made a smoking-related behavioural change (quit, tried to quit or cut down on smoking) and that men were more likely to have made a smoking related change than women following a 10% tobacco excise tax increase in 2012. However these differences were not statistically significant. Following a similar tax increase in 2013, Grace, Kivell, and Laugesen (2014) found that Māori and Pacific Island smokers reported significantly greater reductions in cigarettes per day compared to NZ European smokers. The same sample was

interviewed again in 2014 following an additional tax rise and Māori and Pacific Island smokers continued to report greater reductions (Tucker, Kivell, Laugesen, & Grace, 2016). Results also showed that Māori and Pacific Island males reported the greatest reductions in smoking than Māori and Pacific Island females and NZ European smokers. These results suggest that excise tax may be helpful in reducing tobacco-related harm for Māori and Pacific Island smokers in New Zealand and highlight the potential risk for Māori and Pacific Island females who have the highest smoking prevalence and may not benefit from excise tax increases as much as other groups. However, these studies only evaluated the effects of previous price increases. It is important to understand the effects of a wider range of potential price increases on smokers' demand for tobacco, as well as to identify additional policy measures that might help to reduce inequalities for Māori and Pacific Island persons, particularly females.

Simulated demand for cigarettes can be estimated using a Cigarette Purchase Task (CPT), which allows for relatively efficient data collection by asking individuals to estimate their daily cigarette consumption at a broader range of prices than could be assessed in the natural economy (MacKillop et al., 2012). It also produces multiple unique measures in addition to price elasticity, including maximum consumption, price of maximum expenditure, maximum amount spent per day and breakpoint (point at which the individual would quit smoking) which provide a richer understanding of how changes in price would influence the decision to smoke. A number of studies support the validity of using a CPT to derive indices of demand. Robust convergent and divergent validity have been demonstrated in adults (Few, Acker, Murphy, & MacKillop, 2012; Grace et al., 2014; MacKillop et al., 2008; Murphy, MacKillop, Tidey, Brazil, & Colby, 2011), and temporal stability has also been established over a one-week period (Few et al., 2012). Grace, Kivell, and Laugesen (2015a) assessed temporal stability over three months, before and after the 2013 New Zealand tax increase. They found that although the overall results were highly similar, demand after the tax increase was significantly lower for three prices that were immediately above the current market price, indicating that CPT responses are sensitive to tax increases. These studies suggest that the CPT may be a valid and reliable way to measure demand for cigarettes. (Grace et al., 2014) tested if CPT demand curves could predict changes in smoking habit following a tax increase. They anticipated that individual measures of demand derived from application of Hursh and Silberberg's (2008) exponential model would predict changes in smoking in response to price increases. Although results showed that smoking decreased for the sample overall after the tax increase, none of the measures derived from Hursh and Silberberg's model (including α, price elasticity) were significant predictors of changes in smoking. Grace et al. suggested that because α is based on fits to the full range of prices in the CPT, it may be a less effective predictor than an elasticity measure based on a more limited range near the market price. They showed that a measure of local elasticity, defined as the regression slope for simulated demand on five prices ranging from NZ$0.64 to NZ$0.85 per cigarette, predicted decreases in smoking after the tax increase. This suggests that demand curves and measures derived from the CPT may be used as individual difference variables to predict which smokers will benefit most from tobacco excise tax increases and inform how price could be used to reduce inequalities in smoking prevalence and smoking-related health outcomes.

It is also important to consider how demand for tobacco may change with the availability of alternative products. NECs are a nicotine replacement product that has been shown to be safer than tobacco cigarettes (Farsalinos & Polosa, 2014) and are favourably evaluated by smokers compared to traditional nicotine replacement products (Bullen et al., 2010; Steinberg et al., 2014) and more favourably by females than males (Grace, Kivell, & Laugesen, 2015b). Behavioural economic studies of NECs have been used to estimate cross-price elasticity (CPE): a measure of the relative change in demand for NECs when available at a constant price, given a change in price of regular cigarettes. CPE estimates for NECs are significantly positive, indicating that they are at least partially substitutable for regular cigarettes (Grace et al., 2015b; Quisenberry, Koffarnus, Hatz, Epstein, & Bickel, 2016). This suggests that NECs may be used alongside tobacco price policy as a means of reducing tobacco consumption. However, as NECs are a relatively recent development, their efficacy for smoking cessation and long-term risk profile are currently unclear. As a result, regulation has been undertaken with caution in a number of jurisdictions.

In New Zealand, e-cigarettes cannot currently be legally sold if they contain nicotine; however in March 2017 the Ministry of Health proposed legislative change in order to regulate NECs as consumer products (Ministry of Health, 2017). Though this legislation is unlikely to be enacted until at least 2018, it has the potential to complement current tobacco control strategies, including price policy, to reduce demand for tobacco cigarettes. In this study we planned to compare simulated demand curves and related measures such as cross-price elasticity for New Zealand European and Māori/ Pacific Island smokers using Grace et al.'s (2014) sample. Information regarding ethnic and gender group differences in demand curves could indicate whether price policy could affect smoking-related inequalities in New Zealand. In addition, we compared participants' reactions to first-time use of nicotine-containing electronic cigarettes (NECs) and their potential impact on tobacco demand.

METHOD

Participants

Adult smokers (N=357) were recruited by newspaper, community and internet advertising from four major New Zealand cities: Auckland (n=72), Wellington (n=151), Christchurch (n=71) and Dunedin (n=63). Participants were required to be daily smokers, over 18 years old, who purchased their own tobacco and had no intention to quit prior to 1 January 2013. Current or past users of NECs, current users of antismoking medication or non-cigarette tobacco, and pregnant/breastfeeding women were excluded. All participants were interviewed in November-December 2012 (Wave 1), and contacted and

attended a session in February-March 2013 (Wave 2). Excluded were those who could not be contacted or declined further participation (n=131). Also excluded were those who indicated that they had quit smoking by February-March 2013 (n=16), leaving a sample size of 210.

Of the sample, 30.1% reported Māori/Pacific ethnicity and 69.9% reported NZ European or other ethnicity. No significant differences were found between Māori/Pacific and NZ European/Other in terms of income, education, number of cigarettes smoked per day or other measures of smoking dependence. See Grace et al. (2014) and Tucker et al. (2016) for detailed demographic data.

All received a NZ$15 shopping voucher and a chance to win a NZ$250 tablet computer for each wave. The study was approved by the University of Canterbury and Victoria University of Wellington Human Ethics Committee, and participants provided written consent.

Procedure

Participants completed a pencil-and-paper questionnaire which involved questions about demographics, type of cigarette smoked (factory-made [FM] or roll-your-own [RYO]), packet of tobacco typically purchased (20, 25 or 30 cigarettes per pack for FM; or 30g, 40g or 50g for RYO) and several measures of addiction, and the Cigarette Purchase Task (CPT). Finally, participants were given the opportunity to sample an NEC.

Measures

Cigarette Purchase Task

The CPT is used to measure demand for tobacco over a range of prices. The CPT was adapted from that used by MacKillop et al. (2012) for prices that would be suitable for the New Zealand market. Two versions of the 64-item CPT were used depending on whether the participant indicated that they typically smoked factory-made (FM) or roll-your-own (RYO) tobacco.

For FM smokers, prices per cigarette ranged from NZ$0.00 to NZ$5.0 and for RYO smokers, prices were listed in terms of cost per pouch of 30g or 50g of tobacco. To generate prices comparable to those used for the FM CPT, prices for the latter were expressed relative to the current market price for cigs in Nov 2012 (NZ$0.70/cig) multiplied by the market price per package of 30 or 50g tobacco (NZ$30 and NZ$50 at the time) and rounded to whole dollar amounts. Thus minimum non-zero amount and maximum amount were NZ$2.00 and NZ$214.00 for 30g; NZ$4.00 and NZ$357.00 for 50g. The average current market price was at the same ordinal point among the prices in the scale as the NZ$0.70/cig on the FM CPT. This way the two questionnaires covered approximately two orders of magnitude, with current market price at the same position, and changes in price relative to current market price were constant across all versions. See Grace et al. (2014) for the instructions and a full description of the range of prices used.

Several analyses were conducted to characterise CPT demand curves. Measures were obtained directly from CPT responses and derived from fits of Koffarnus et al.'s (2015) exponentiated version of Hursh and Silberberg's (2008) demand model using Microsoft Excel Solver . The equation for the exponentiated model is:

$$Q = Q_0 * 10^{k(e^{-\alpha Q_0 C}-1)}$$

where Q is the demand at price C, Q_o is maximum consumption (i.e. demand when cigarettes are free), k is a constant representing the span of the data in $\log_{10}$ units and α is elasticity, a fitted parameter which determines how quickly demand falls with increases in price (higher values of α indicate that demand falls more rapidly with price). Here, we determined k by subtracting the $\log_{10}$-transformed average consumption at the highest price from $\log_{10}$-transformed average consumption at the lowest price (giving k=1.31). Essential Value (EV) is a definition of value based on sensitivity to price and is inversely proportional to α (Hursh & Roma, 2016). The formula for EV is:

$$EV = 1/(100 * a * k^{1.5})$$

EV is linearly related to normalised P_{max}, the price at which consumption is maximum. P_{max} can be obtained from the observed data or calculated using the formula (Hursh & Roma, 2016):

$$P_{max} = m/(Q_o * k^{1.5}), \text{ where}$$
$$m = 0.084k + 0.65$$

Omax is the level of response output at P_{max}, that is the maximum amount of money spent per day. O_{max} can be derived from normalised P_{max} or obtained from the observed data.

NEC sampling and questions

The experimenter explained how the NEC (Safe Cigarette brand) produced a vapour containing nicotine when inhaled and could be puffed similarly to a regular cigarette. The NEC had tobacco extract flavour (no actual tobacco) and was listed as 18 mg/mL nicotine content. On analysis, the Safe Cigarette yielded 13.95 mg/mL nicotine, and 200 hand-drawn puffs at 20 mg of nicotine per puff. After taking several puffs on the NEC, participants were asked to rate both their regular cigarette and the NEC for liking and satisfaction on a single-item 10-point Likert scale (1=don't like at all; 10=like very much). Participants then completed three questions about how many e-cigarettes and regular cigarettes they would purchase per day at different prices. The price of the e-cigarette was listed as NZ$0.25 per cigarette which consisted of 15 puffs of vapour. The price of regular cigarettes was listed as either NZ$0.35, NZ$0.70 or NZ$1.40 per cigarette. These prices were chosen to correspond approximately to 0.5x, 1x and 2x the market price of cigarettes in New Zealand at the time the study was conducted.

Results

Cigarette Purchase Task

Figure 1 shows demand for cigarettes (cigarettes/day) reported on the Cigarette Purchase Task (CPT) for Māori/Pacific (upper panel) and NZ European/Other (lower panel) groups, separately for males and females. For both groups, results were characteristic of demand curves for inelastic commodities with cigarette consumption mostly high and decreasing sharply at relatively high prices, though males appear to report greater demand at all prices. The exponentiated model (Koffarnus et al., 2015) provided an adequate description of the average data, accounting for 66% of the variance. Stein et al.'s (2015) algorithm was used to identify nonsystematic data. 14 cases did not meet the trend criterion, 4 cases did not meet the bounce criterion and 2

cases did not meet the reversal criterion. These cases were excluded from demand curve analyses.

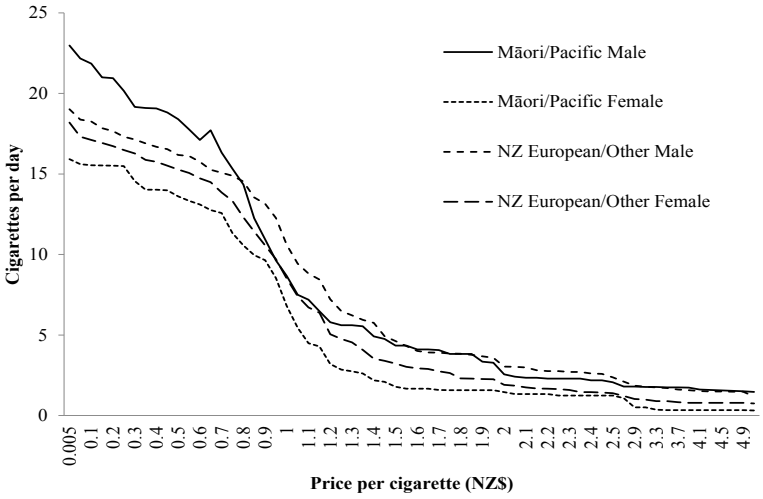

Figure 1. Mean predicted cigarettes per day using the CPT plotted separately for Māori/Pacific males (solid line) and females (dotted line) and NZ/European/Other male (small dashed line) and females (large dashed line).

At prices lower than the current market price in November 2012 (NZ$0.725/cigarette), the increased demand by males appeared greater for Māori/Pacific males than NZ European/Other males. This was confirmed by a repeated-measures ANOVA which found a significant main effect of price [$F(1,63) = 418.25$, $p<.001$, $\varphi = .559$] and significant interactions between price and ethnicity [$F(1,63) = 1.42$, $p<.05$, $\varphi = .004$], price and gender [$F(1,63) = 1.94$, $p<.001$, $\varphi = .006$], and price, ethnicity and gender [$F(1,63) = 2.02$, $p<.001$, $\varphi = .006$]. Post hoc analyses [Tukey HSD; *ps*>.05] revealed that there were no significant male-female differences for NZ European/Other smokers. However Māori/Pacific males reported that they would smoke more cigarettes per day than Māori/Pacific females at the lowest price NZ$0.00 [$p$=.017].

Average measures of demand derived from fits of Koffarnus et al.'s (2015) demand model to CPT data from individual smokers are shown in Table 1. Univariate ANOVAs were conducted on the derived measures. A significant main effect of gender [$F(1, 333) = 7.048$, $p < .01$, $\varphi = .021$] was found for Q_o; males estimated that they would smoke significantly more cigarettes per day than females if cigarettes were free [*Ms* = 19.75 and 17.32 respectively]. There was also a significant gender x ethnicity interaction for Q_o [$F(1, 331) = 4.452$, $p < .05$, $\varphi = .013$]. Post-hoc testing (Tukey HSD) indicated that Māori/Pacific males predicted that they would smoke more cigarettes per day if they were free [M = 22.97] than Māori/Pacific females [M = 15.91, $p<.05$]; while there were no significant gender differences in Q_o in the NZ European/Other group [*Ms* = 18.84 and 18.04 respectively]. A significant main effect of gender was found for observed O_{max} [$F = (1, 310) = 7.987$, $p=.005$, $\varphi = .025$]; males reporting a higher estimated maximum expenditure per day [M = NZ$18.57] than females [$M$ = NZ$14.43]. There were no significant differences in EV, normalised O_{max}, normalised P_{max}, or breakpoint [*ps*>.05].

Table 1. Mean scores for measures of demand derived from the CPT.

	Māori/Pacific M (SD)		NZ European/Other M (SD)	
	Male	Female	Male	Female
EV	0.47 (0.51)	0.36 (0.37)	0.53 (0.79)	0.42 (0.41)
Observed Q_0	22.97 a (13.57)	15.91 c (9.33)	18.84 b (13.42)	18.04 b (12.27)
Observed O_{max}	20.37 a (19.97)	13.21 c (7.98)	18.07 a (16.95)	15.08 c (12.21)
Normalised O_{max}	10.86 (11.71)	8.16 (8.50)	12.20 (18.05)	9.58 (9.34)
Normalised P_{max}	1.69 (1.49)	1.77 (1.93)	2.16 (2.07)	1.91 (1.89)
Breakpoint	1.25 (0.70)	1.43 (0.73)	1.46 (0.72)	1.48 (0.68)

Note. Subscripts indicate significantly higher (a) and lower (c) means at $p<.05$ according to Tukey HSD.

Availability of NECs

When demand for tobacco cigarettes was averaged over the three prices, the availability of NECs produced a 19% decrease in demand for tobacco cigarettes for Māori/Pacific smokers and a 26% decrease for NZ European smokers. A repeated measures ANOVA was conducted on tobacco cigarette demand with NEC availability and price as within-subjects factors and ethnicity as a between-groups factor. There was no difference found for demand between Māori/Pacific and NZ European/Other smokers [$F(1,127) = 0.6628$, p=.417]. A repeated measures ANOVA was also conducted on NEC demand when tobacco cigarettes were concurrently available at NZ$0.35, NZ$0.70 and NZ$1.40 and, again, no significant differences between Māori/Pacific and NZ European/Other [$F(1, 205) = 0.7335$, p=.393].

CPEs were calculated for individual participants as the regression slopes of (log) NEC demand on (log) cigarette price. There were no significant differences in the CPEs for Māori/Pacific smokers and NZ European/Other smokers [*Ms* = .11 and .19 respectively, $t(205) = .9155$, p=.36]. The average CPE for NZ European/Other smokers was significantly greater than zero [$t(146) = 3.922$, $p<.001$] but the average CPE for Māori/Pacific was not [$t(146) = 1.481$, p=.14]. CPE was not significantly correlated with any other derived demand measures.

NEC Ratings

Figure 3 shows the average satisfaction ratings for regular cigarettes and NECs by ethnicity. A repeated-measures ANOVA was carried out with cigarette type (own-brand/NEC), gender and ethnicity as within- and between-group factors. Significant main effects were found for gender [$F(1,328) = 6.696$, $p<.05$, $\varphi = .020$] and cigarette type [$F = (1,338) = 21.127$, $p<.001$, $\varphi = .060$]. The gender x cigarette type [$F(1,328) = 6.187$, $p<.05$, $\varphi = .019$] and ethnicity x cigarette type interactions were both significant [$F(1,328) = 6.967$, $p<.005$,

φ = .021] but there was no significant gender x ethnicity x cigarette type interaction, indicating that the effects of gender and ethnicity were independent of one another. NEC ratings were significantly greater for Māori/Pacific [*M*=6.96] than for NZ European/Other smokers [*M*=5.93] [Tukey HSD, $p<.005$] while there was no difference in own-brand cigarette ratings [*Ms* = 7.35 and 7.59, $p=.821$]. The Māori/Pacific group satisfaction ratings for NECs were 94.7% as high as those for regular cigarettes, whereas the NZ European/Other group satisfaction ratings were 78.1% as high for NECs as regular cigarettes.

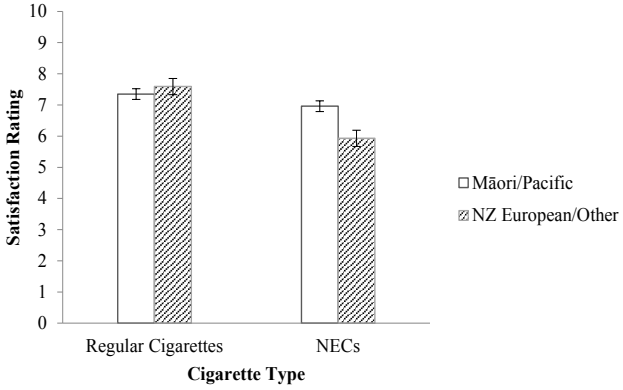

Figure 3. Average Satisfaction Ratings for Regular Cigarettes and E-Cigarettes, shown separately for Māori/Pacific (unfilled bars) and NZ European/Other (filled bars). Error bars indicate ±1 SE.

Discussion

To our knowledge this is the first study to compare simulated demand generated using a Cigarette Purchase Task by ethnicity and gender. We aimed to compare demand for cigarettes and NECs, ratings of NECs, and cross-price elasticity of NECs for Māori/Pacific and NZ European/Other males and females using a simulated demand procedure.

Simulated demand curves showed similar trends for Māori/Pacific and NZ European/Other smokers in which demand for cigarettes decreased with price. However some differences were evident. Males demonstrated higher demand for cigarettes at prices lower than the average price per cigarettes at the time sampled (approximately NZD$0.725), greater maximum consumption and greater maximum expenditure than females. This is consistent with the differences observed in the measures of demand derived from fits of the Koffarnus et al. (2015) demand model to the CPT data. Furthermore, Māori/Pacific males showed greater maximum consumption at extremely low prices. These findings indicate that, for Māori/Pacific male smokers, smoking behaviour may be more limited by price and that if cigarettes were to become more affordable relative to income (as would be the case without repeated annual tobacco excise tax increases), Māori/Pacific males may be at risk of increasing their smoking behaviour. This finding is consistent with the survey-based data described in Tucker et al. (2016) which found that Māori/Pacific males reduced their smoking rate at a greater rate than Māori/Pacific females following two annual 10% tobacco excise tax increases. Both the survey-based data and simulated demand data suggest that Māori/Pacific males are more price sensitive than Māori/Pacific females and NZ European/Other smokers and sustaining tobacco excise tax increases may be an especially effective strategy for discouraging smoking for these individuals. This raises concern for Māori/Pacific females, who have elevated smoking prevalence, and suggests that other strategies may be required to help Māori/Pacific females reduce their smoking behaviour and ultimately quit smoking.

We found that the availability of e-cigarettes reduced demand for tobacco cigarettes for Māori/Pacific and NZ European/Other smokers. Māori/Pacific smokers responded more particularly favourably to e-cigarettes, however there were no differences in demand for tobacco cigarettes when NECs were concurrently available or cross-price elasticity, and there were no overall correlations between favourability ratings and demand or cross-price elasticity. Reasons for this discrepancy are unclear. While both self-reported subjective effects (e.g. liking, satisfaction, and craving reduction) and elasticity of demand may both be used to infer reinforcement effects, these data are often disparate and may not be correlated with one another or actual smoking behaviour (Shahan, Bickel, Madden, & Badger, 1999). We found no significant relationship between subjective ratings of NECs and cross-price elasticity in this study which suggests that these two measures of the reinforcing efficacy of NECs are independent of one another. While Māori/Pacific smokers responded particularly favourably to NECs, the results of this study suggest that this is unrelated to their simulated demand for NECs or the extent to which they may consider NECs an alternative to cigarettes.

It is important to interpret our results with caution considering the simplicity of the measures used. Though previous studies have successfully used single-item measures for overall satisfaction for other NRT products (Schneider et al., 2004), a single-item measure of satisfaction is likely to have lower reliability compared to multiple item measures. Additionally, while hypothetical purchase tasks for cigarettes and alcohol have been shown to correspond with actual behaviour change (Amlung, Acker, Stojek, Murphy, & MacKillop, 2012; Lagorio & Madden, 2005; MacKillop, Amlung, Acker, & Stojek, 2010; MacKillop, Miranda, et al., 2010; Mackillop et al., 2016; Madden et al., 2004; A. G. Wilson, Franck, Koffarnus, & Bickel, 2016), it is unclear whether CPE as measured using our cross-price task corresponds with the complexity of the actual decision to smoke and actual substitution behaviour. As such, participants may have under- or overestimated the extent to which they would purchase NECs if they were concurrently available with tobacco cigarettes which may explain why ethnic differences were found in satisfaction ratings but not CPE.

Another potential limitation is that participants were asked to rate satisfaction after their first exposure to NECs. It is also unknown whether

the high levels of NEC satisfaction, especially for Māori/Pacific smokers, would be maintained long-term. It has been suggested that smokers may have a 'honeymoon' period when they first use NECs and their satisfaction may reduce over time (Bullen et al., 2013). This may have impacted participants' responses to the demand questionnaires and inflated the simulated demand for NECs. However the modest estimated cross-price elasticity for NECs generated in this study appears credible and not over-inflated compared to previous behavioural economic studies (Johnson, Bickel, & Kirshenbaum, 2004; O'Connor et al., 2014; Shahan, Odum, & Bickel, 2000). More research is needed to determine whether the high satisfaction ratings and demand for NECs can develop into sustained satisfaction, habitual use and eventual cessation.

It must be noted that while are not aware of any previous research comparing simulated demand for cigarettes in Māori/Pacific and NZ European/Other smokers, research does suggest that lower income groups are more price sensitive (Wilson, 2007; Wilson & Thomson, 2005; Wilson et al., 2010). In our sample Māori/Pacific and NZ European/Other smokers reported similar income levels; however based on the 2013 Census (Statistics New Zealand, 2014) Māori and Pacific peoples median person incomes (NZ$22,500 and NZ$19,700 respectively) were 78.9% and 69.1% of the national median personal income (NZ$28,500). Given the lack of significant differences in income between Māori/Pacific and NZ European/Other smokers in our study, our sample may not be representative of the Māori/Pacific population in New Zealand and thus with a more representative sample we may have observed more price sensitivity in Māori/Pacific smokers. Our findings provide some preliminary support for the idea that Māori/Pacific males are more price sensitive than Māori/Pacific females and NZ European/Other smokers and that sustaining tobacco excise tax increases may be beneficial for discouraging smoking for this population.

The current status of NECs in New Zealand is that they cannot be legally sold if they contain nicotine, however in recent years a number of regulatory options have been explored. Wilson et al. (2015) list options ranging from fully liberalised access (free market), increased access as a quit aid or NRT product available in pharmacies, available upon prescription by a registered health professional, available upon prescription from a hospital only pharmacy, to full restraint (complete ban on importing and use). The authors also discuss supplementary policy measures including making it illegal to use NECs in smokefree environments, implementing quality standards, quality criteria for legal sales (age limits, regulated marketing) and price mechanisms to encourage switching. In March 2017 the Ministry of Health proposed legislative change in order to regulate NECs as consumer products but with similar restrictions to tobacco cigarettes including prohibition of sale to people under the age of 18 years, limits on advertising and vaping in public places, and requirements for product safety (Ministry of Health, 2017). This reflects a relatively liberal regulatory status but with consideration of some of the concerns raised by Wilson et al. (2015). The Ministry of Health (2017) proposal considers excise tax on nicotine e-liquid but acknowledges the complexity of this decision with regard to the unknown risk profile of NECs, the risk of discouraging switching to NECs from tobacco cigarettes, and the limited evidence on the responsiveness of NEC demand to price changes. With annual 10% tobacco excise tax increases scheduled until at least 2020 and the proposed changes to NEC regulation expected to take effect from 2018 at the earliest, it is important to consider whether these policies could reduce demand for tobacco in New Zealand.

Our findings have some implications for the proposed changes to regulation of NECs in New Zealand. Consistent with previous behavioural economic studies (Grace et al., 2015b; Quisenberry et al., 2016), our results support this policy, suggesting that NEC availability could reduce demand for tobacco cigarettes overall. In addition, NECs may be a particularly satisfactory delivery vehicle for NRT for Māori/Pacific smokers. The combination of increased price sensitivity and increased NEC favourability ratings suggests that if NECs become available with an appropriate price differential to regular cigarettes, price sensitive groups including Māori/Pacific male smokers may be encouraged to switch. This supports the idea of differential taxation for NECs relative to tobacco cigarettes (Chaloupka, Sweanor, & Warner, 2015; Grace et al., 2015b; Wilson et al., 2015). Although their combination with price policy may encourage NEC use for Māori/Pacific males, the similar sensory and behavioural aspects of NECs may encourage their use for Māori/Pacific females, who appear to be less physically dependent on nicotine but more responsive to behavioural, social and cultural cues (Tucker et al., 2016). As NECs become more available and accessible and as the Smokefree 2025 goal approaches, it will be important to determine whether the positive ratings do translate into increased likelihood of e-cigarette uptake, particularly for Māori/Pacific smokers, whose smoking prevalence remains disproportionately elevated despite comprehensive targeted and population-level tobacco control strategies. In this way, the availability of NECs as a consumer product in New Zealand may reduce ethnic disparities in NRT use and subsequently smoking prevalence.

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