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Tobacco endgame and priority populations: a scoping review

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ABSTRACT

Aim To summarise the research literature on the impacts or perceptions of policies to end tobacco use at a population level (ie, tobacco endgame policies) among people from eight priority population groups (experiencing mental illness, substance use disorders, HIV, homelessness, unemployment or low incomes, who identify as lesbian, gay, bisexual, transgender, queer or intersex (LGBTQI+) or who have experienced incarceration).

Methods Guided by JBI Scoping Review Methodology, we searched six databases for original research examining the impacts or perceptions of 12 tobacco endgame policies among eight priority populations published since 2000. We report the results according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist.

Results Of the 18 included studies, one described perceptions of five endgame policies among people on low incomes in Aotearoa (New Zealand), and 17 focused on the effectiveness or impacts of a very low nicotine content (VLNC) cigarette standard among people experiencing mental illness (n=14), substance use disorders (n=8), low incomes (n=6), unemployment (n=1) or who identify as LGBTQI+ (n=1) in the USA. These studies provide evidence that VLNC cigarettes can reduce tobacco smoking, cigarette cravings, nicotine withdrawal and nicotine dependence among these populations.

Conclusions Most of the tobacco endgame literature related to these priority populations focuses on VLNC cigarettes. Identified research gaps include the effectiveness of endgame policies for reducing smoking, impacts (both expected and unexpected) and policy perceptions among these priority populations.

INTRODUCTION

Tobacco smoking prevalence has declined substantially in high-income countries. Nonetheless, smoking remains a leading cause of premature mortality and morbidity.¹ Policy options that could rapidly and permanently reduce smoking to very low levels (referred to as 'tobacco endgame' policies) are increasingly topical.^{2,3} Tobacco endgame policies go beyond the usual suite of tobacco demand reduction approaches (eg, mass media campaigns, tobacco advertising bans, smoke-free policies), and aim to substantially reduce the addictiveness, consumer appeal, availability or affordability of tobacco products.³ Examples of tobacco endgame policies include making cigarettes minimally or non-addictive by mandating a very low nicotine

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Eighteen of 49 evidence syntheses of tobacco endgame policies included at least one mention of the equity impact of the policy, with most concluding that endgame policies are likely to result in greater health benefits for priority populations compared with the general population, but few of the syntheses substantively addressed equity impacts.

WHAT THIS STUDY ADDS

⇒ Eighteen empirical studies examined tobacco endgame policies among eight selected priority population groups, with 17 focused on a very low nicotine content (VLNC) cigarette standard. These studies provide evidence that VLNC cigarettes can reduce tobacco smoking, cigarette cravings, nicotine withdrawal and nicotine dependence among these populations.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This evidence supports implementing a VLNC standard. However, there are significant research gaps for likely effectiveness and acceptability of most tobacco endgame policies among these priority populations that should be prioritised to inform policymaking.

content (VLNC) standard,⁴ drastically reducing the number of retailers that can sell tobacco⁵ or completely phasing out commercial tobacco retailing,⁶ a regulated market model⁷ or other not-for-profit supply models,⁸ state takeover of tobacco companies,³ ending tobacco sales for everyone born after a certain year (the tobacco-free generation model),⁹ a quota or sinking lid on the amount of tobacco allowed to be sold,¹⁰ performance-based regulation of tobacco manufacturers that requires them to meet targeted reductions in cigarette sales,¹¹ substantial increases in tobacco taxation,¹² requiring a licence to purchase tobacco,¹³ requiring a prescription from a medical practitioner to purchase tobacco,³ redesigning cigarette contents to make them less appealing or palatable³ or replacing tobacco products with lower risk alternatives such as nicotine vaping products (e-cigarettes).¹⁴

People from priority populations experience a disproportionate share of the smoking-related disease burden. Hence, tobacco endgame policies will need to consider how these policies impact priority populations who have the highest smoking



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prevalence,^{15 16} if they are to reduce rather than exacerbate health inequalities and to achieve maximum impact. Examples of priority populations include people experiencing mental illness, substance use disorders, homelessness, unemployment, or low incomes, who live with HIV, who identify as lesbian, gay, bisexual, transgender, queer or intersex (LGBTQI+) or who have experienced incarceration.¹⁶ For example, in Australia, 11.6% of adults in the general population smoke daily,¹⁷ compared with 24% of people living with a mental illness,¹⁸ 77% of people who experience homelessness,¹⁹ 75% of people entering prison²⁰ and 84% of people enrolled in substance use treatment.²¹ Not only do priority populations experience disproportionate rates of tobacco-related illness compared with the general population,²² their tobacco-related expenditure often exacerbates financial stress,²³ perpetuating cycles of poverty and disadvantage.²⁴ Tobacco control policies with demonstrated effectiveness in reducing tobacco prevalence among the general population are often efficacious for some priority populations.^{25 26} However, they have not resulted in sufficient reductions in smoking prevalence to meaningfully reduce existing health inequities.²⁷ As endgame policies aim to substantially reduce the addictiveness, accessibility and affordability of tobacco products,³ they may be of particular benefit to priority populations who typically find it more difficult to successfully quit smoking,^{28–30} often due to higher levels of nicotine dependence,²⁸ and who are more likely to live in neighbourhoods with easier access to tobacco retailers,²⁸ and/or are more sensitive to price changes compared with the general population.^{31 32}

This scoping review aimed to identify and synthesise the research literature on tobacco endgame policies among eight priority populations: people experiencing mental illness, substance use disorders, HIV, homelessness, unemployment, low income, who identify as LGBTQI+ or who have experienced incarceration. Although this list is not exhaustive of all populations with higher than average smoking prevalence, it covers those with the highest smoking prevalence.¹⁶ We did not examine the existing research on tobacco endgame policies with a focus on people from diverse races and/or ethnicities, such as Indigenous peoples or African American people. Tobacco smoking among these diverse populations is influenced by specific additional complex social and cultural factors that need to be considered, such as traditional cultural use of tobacco among some Indigenous populations and the impacts of racism and colonisation. As such, we believe that a separate review that includes a specific

focus on such cultural and social factors is warranted. We are unaware of any comprehensive evidence syntheses of tobacco endgame policies focused on priority populations.

METHODS

Guided by the JBI (formerly Joanna Briggs Institute) Methodology for Scoping Reviews,³³ and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist³⁴ (see online supplemental table 1), we identified and summarised literature describing research on tobacco endgame policies among eight priority populations. The protocol was pre-registered in Open Science Framework.³⁵

Review questions

We addressed the following questions related to tobacco endgame policies and priority populations:

1. Which policies and populations have been evaluated?
2. Which research methods and study designs have been used?
3. What is the effectiveness of these policies for reducing smoking prevalence?
4. How strong is the evidence of effectiveness?
5. Are there differences in the effectiveness between populations?
6. What are the features of the policies with demonstrated effectiveness?
7. What are the likely advantages and disadvantages of these policies?
8. How are these policies perceived?

Inclusion/exclusion criteria

We included studies that presented original research published between January 2000 (to focus on relatively recent findings and there was limited mention of the tobacco endgame prior to this date) and 20 October 2021, published in English, related to any of the target populations that reported research about at least one tobacco endgame policy listed in table 1. These policies were examined in a previous review of tobacco endgame evidence syntheses,³⁶ and included policies that would end tobacco retail sales or make tobacco products non-addictive; these policies are inherently considered to be endgame policies. We also considered conventional policies that could be endgame policies if implemented at sufficient intensity (eg, product standards for palatability or toxicity, retailing restrictions, action against the

Table 1 Summary of tobacco endgame policies

Policy category	Policy
Product focused	1. Mandate very low nicotine content (VLNC) for smoked tobacco products to make them non-addictive or minimally addictive. 2. Set product standards for nicotine products that make combustible tobacco products unappealing or removed from the market for exceeding toxicity thresholds. 3. Move consumers from combustible tobacco products to non-smoked reduced risk nicotine products (eg, e-cigarettes, heated tobacco products, smokeless tobacco products).
User focused	4. Require consumers to obtain a purchaser's licence or medical prescription to purchase tobacco. 5. Restrict tobacco sales by year born (tobacco-free generation).
Market/supply focused	6. End commercial retail sale of combustible tobacco (abolition). 7. Set a regularly reducing quota on the volume of tobacco products manufactured or imported into a country ('sinking lid'). 8. Actions that reduce the commercial viability of tobacco companies, such as a 'corporate death penalty', or criminal charges (eg, 'corporate manslaughter'), requiring compensation for full impacts of tobacco use, or limiting profitability. 9. Increases in tobacco tax that make tobacco products generally unaffordable. 10. Restrictions on tobacco retailer density/location/type/licensing that substantially reduce tobacco availability.
Institutional structure focused	11. Transfer management of tobacco supply to an agency with a mandate to phase out tobacco sales, for example, regulated market model, non-profit agency. 12. Performance-based regulation whereby tobacco companies are required to meet smoking prevalence targets or be fined; or manufacturers pay a levy based on sales volume similar to 'polluter pays' schemes.

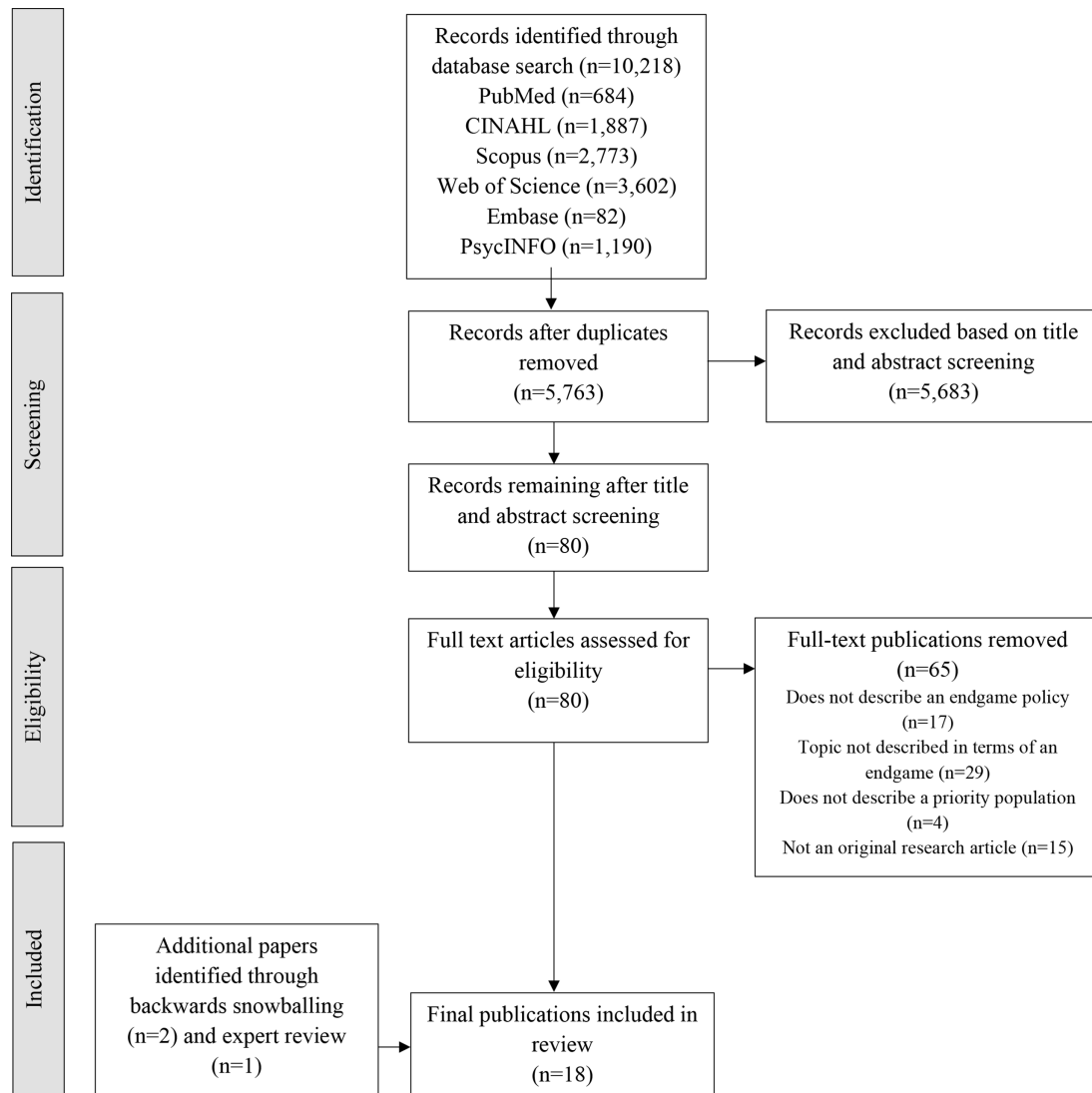


Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

tobacco industry, moving consumers to reduced risk products or tobacco tax increases), if the publication explicitly discussed the policy as one that could achieve a tobacco endgame.

Search strategy

We used a five-step search strategy. First, author LF confirmed no similar reviews had already been conducted by searching JBI Evidence Synthesis, Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Evidence for Policy and Practice Information (EPPI) and Epistemonikos in December 2020. Next, authors LF and CP conducted a pilot search of PubMed in collaboration with a research librarian in October 2021 to develop a search strategy (see online supplemental table 2). Third, author CP searched six databases (PubMed, CINAHL, PsycINFO, Scopus, EMBASE and Web of Science) using the search terms on 20 October 2021. Next, author CP searched the reference lists of included articles for additional relevant records not captured in database searches.

Evidence selection

Figure 1 details the search and retrieval process. First, each article's title and abstract was independently screened against

inclusion criteria by two reviewers (LF, MHO). The full text of all articles not excluded at this stage was then independently screened by two of four reviewers (LF, MHO, CP, DE). Conflicts were resolved through discussion with the senior author (CG), who also checked all included articles to ensure they met inclusion criteria. All screening was conducted using Rayyan review management software.³⁷ Finally, author CP sent the final list of included papers to the author team and additional topic experts to ascertain if any relevant articles were missing.

Critical appraisal

Although assessments of included studies' methodological quality are not typically conducted for scoping reviews,³⁸ we used the Australian National Health and Medical Research Council (NHMRC) Evidence Hierarchy to broadly assess level of evidence each study contributes.³⁹ This hierarchy assigns a level of evidence according to the type of research question, acknowledging the importance of appropriate research design to address a research question, with levels ranked from level I (systematic review of randomised controlled trials (RCT)) to level IV (case series studies).³⁹

Table 2 Summary of included studies

Policy	Publications (n)	Study designs/methods	Study populations	Study countries	Research questions addressed
Mandating a very low nicotine content (VLNC) standard for smoked tobacco products.	17	<ul style="list-style-type: none"> ▶ Within-subjects experimental designs (n=7).^{41 42 44-49 51-58} ▶ Secondary analyses of data from RCTs or a randomised clinical trial (n=3). ▶ Secondary analyses of within-subjects experimental study data (n=2). ▶ Cross-sectional studies (n=2). ▶ Between-groups experimental study (n=1). ▶ RCT (n=1). ▶ Analysis of data from three randomised clinical trials (n=1). 	<ul style="list-style-type: none"> ▶ People experiencing mental illness (n=14).^{41 42 44-58} ▶ Affective disorder. ▶ Schizophrenia. ▶ Schizophrenia or schizoaffective disorder. ▶ Schizophrenia, schizoaffective disorder and/or bipolar disorder. ▶ Elevated depressive symptoms and/or psychiatric disorders other than schizophrenia or schizoaffective disorder. ▶ People experiencing substance use disorders (n=8). ▶ People with low incomes (n=6). ▶ People experiencing unemployment (n=1). ▶ People who identify as LGBTQ+ (n=1). 	▶ USA ^{41 42 44-58}	<ul style="list-style-type: none"> ▶ What are the effects of VLNC cigarette smoking, with and without 42 mg transdermal nicotine replacement patches, compared with usual brand cigarette smoking on tasks assessing key domains of cognitive functioning in people who smoke with schizophrenia and those without psychiatric illness?⁴⁴ ▶ What knowledge, attitudes and practices about cigarette smoking and cessation and VLNC cigarettes exist among patients attending an outpatient perinatal substance use treatment centre?⁵⁸ ▶ What are the potential effects of smoking menthol cigarettes on response to VLNC cigarettes?⁴⁵ ▶ How do young adults who smoke with additional vulnerabilities to smoking respond to VLNC cigarettes?⁴⁶ ▶ What is the impact of smoking VLNC cigarettes for 6 weeks on smoking topography characteristics and indicators of compensatory smoking among people with serious mental illness?⁴⁵ ▶ What are priority populations' perceptions about nicotine, low nicotine content (LNC) cigarettes, alternative nicotine delivery system (ANDS) products and medicinal nicotine, their perceptions of LNC cigarettes and ANDS products compared with conventional cigarettes, and their perceptions of medicinal nicotine compared with ANDS products?⁴⁷ ▶ Do cumulative vulnerabilities moderate response to VLNC cigarettes?⁵⁷ ▶ How do people with psychiatric disorders and other vulnerabilities to tobacco addiction respond to VLNC cigarettes?⁴⁸ ▶ What are the effects of VLNC cigarettes among people who are especially vulnerable to dependence to assess their potential as a less dependence-producing alternative to current commercial cigarettes?⁴⁹ ▶ Do VLNC cigarettes decrease smoking rates and dependence severity among people with psychiatric disorders or socioeconomic disadvantage?⁵⁰ ▶ Does smoking of cigarettes, after 6–12 hours' abstinence, transiently alter the expression of negative and/or positive symptoms in patients with schizophrenia who have a history of regular smoking?⁴¹ ▶ What are the effects of acute smoking of high nicotine and denicotinised cigarettes on positive and negative symptoms in people with schizophrenia?⁴⁹ ▶ What is the ability of VLNC cigarettes to attenuate acute tobacco withdrawal and craving severity in people receiving methadone or buprenorphine maintenance treatment for opioid use disorders versus people without substance use disorders?⁵¹ ▶ Do smoking topography characteristics of usual brand VLNC cigarettes differ in people with schizophrenia and people without psychiatric illness, and does nicotine replacement reverse any changes in topography produced by VLNC cigarettes?⁵² ▶ Does the use of VLNC by people with schizophrenia reduce cigarette consumption, cigarette craving and nicotine dependence compared with those using normal nicotine content cigarettes?⁵³ ▶ How does baseline depressive symptom severity moderate the effects of VLNC cigarettes?⁵⁶ ▶ What are the separate and combined effects of acute nicotine replacement and sensorimotor smoking replacement, in the form of VLNC cigarettes, on cigarette craving, withdrawal symptoms and usual brand smoking by people with schizophrenia and without schizophrenia?⁵⁴
Multiple policies (mandating a very low nicotine content standard for tobacco products; remove additives from tobacco; reduced risk products; tobacco tax increases; restrictions on the number of tobacco retailers).	1	▶ Qualitative. ⁴³	▶ People experiencing low incomes. ⁴³	▶ Aotearoa (New Zealand) ⁴³	▶ What are the perceptions of smoke-free policies and tobacco endgame measures among people experiencing low incomes? ⁴³

LGBTQ+, lesbian, gay, bisexual, transgender, queer or intersex; RCT, randomised controlled trial; VLNC, very low nicotine content.

Data extraction

Four reviewers (LF, MHO, CP, DE) independently extracted data from included articles using an online form created using Qualtrics.⁴⁰ Extracted data included article author(s) and affiliations, publication year, journal name, funding source, population, endgame policy, study design, methods, research question(s), relevant key findings and conclusions, and evidence gaps identified by the authors. Extracted data were reviewed by CP and CG to ensure consistency and accuracy.

RESULTS

Search results

From 5763 unique records identified in the initial database search, 15 remained after full text review. Two additional articles were identified from included article reference lists^{41 42} and one from review by tobacco endgame experts.⁴³ See figure 1.

Research question 1: which policies and populations have been evaluated?

Table 2 summarises included studies (including study designs, populations, countries and research questions) and online supplemental table 3 provides details of the characteristics of included studies. One study focused on perceptions of five endgame policies (mandating a VLNC standard for tobacco products, setting product standards (removing additives from tobacco), reduced risk products, tobacco tax increases and restrictions on the number of tobacco retailers) among people on a low income in Aotearoa (New Zealand),⁴³ while the remaining 17 studies described the impacts of mandating VLNC for smoked tobacco products to make them non-addictive or minimally addictive among participants based in the USA. The authors of 14 of these 17 studies are affiliated with the same research centre (the Center for Alcohol and Addiction Studies at Brown University in the USA).⁴⁴⁻⁵⁵

Research question 2: which research methods and study designs have been used?

Seven studies used within-subjects experimental designs,^{41 42 45 48 49 52 54} three involved secondary analysis of data from an RCT^{55 56} or randomised clinical trial,⁵⁷ two involved secondary analyses of within-subjects experimental study data,^{46 51} two were cross-sectional studies^{47 58} (with one of these involving analyses of data from one wave of a cohort study⁴⁷), one was a between-groups experimental study,⁴⁴ one was an RCT,⁵³ one study involved analyses of data from three randomised clinical trials⁵⁷ and one was a qualitative study.⁴³ Of the 11 publications describing analyses of data from non-randomised experimental studies,^{41 42 44–46 48 49 51 52 54} only three included concurrent control groups.^{44 52 54}

Research question 3: what is their effectiveness for reducing smoking prevalence?

No studies measured impacts on smoking prevalence. Seven studies investigated the effectiveness of VLNC cigarettes for reducing smoking on an individual basis.^{49 50 52–56} No studies investigated the effectiveness of a VLNC policy in promoting smoking cessation beyond 12 weeks.⁵⁰ All found promising short-term (<12 weeks) results in reducing the overall number of cigarettes smoked,^{50 52 53 56} cigarette cravings,^{53 54} nicotine withdrawal,^{49 54} nicotine dependence^{50 56} and puffs per cigarette.^{49 52 55} Online supplemental table 3 provides the relevant figures for these findings when they are reported; some studies (eg, ref 49 50 52) performed analyses of variance and reported these results as figures only.

Three studies used within-subjects experimental designs.^{49 52 54} One compared four research cigarettes varying in nicotine content (0.4, 2.4, 5.2 or 15.8 mg/g) among people experiencing low incomes, substance use disorders or mental illness (affective disorders), finding that all cigarettes effectively reduced nicotine withdrawal with no significant differences in smoking topography (puff volume, puff duration, interpuff interval, maximal flow rate, puff number), suggesting minimal compensatory smoking.⁴⁹ The two other within-subjects studies compared VLNC cigarettes (≤ 0.05 mg nicotine), usual brand cigarettes, placebo nicotine patches and 42 mg patches using counterbalanced designs among people with schizophrenia versus controls without psychiatric illness.^{52 54} One found that people with schizophrenia and control group participants demonstrated a comparable significant net decrease in cigarettes smoked and total session volume when using VLNC as opposed to normal nicotine content cigarettes, suggesting that acute use of VLNC cigarettes does not increase intensity of smoking among people with schizophrenia.⁵² Similarly, the other found reduced cigarette craving, nicotine withdrawal symptoms, habit withdrawal symptoms and usual brand smoking among both people with schizophrenia and control group participants after smoking VLNC cigarettes.⁵⁴

Two publications that reported outcomes for effectiveness of the intervention were RCTs.^{50 53} The first randomised people experiencing mental illness (affective disorders), opioid use disorder or socioeconomic disadvantage to one of three study cigarettes (0.4 mg/g, 2.4 mg/g or 15.8 mg nicotine/g tobacco) weekly for 12 weeks; those smoking VLNC cigarettes (0.4 or 2.4 mg/g) significantly decreased mean total cigarettes smoked and nicotine dependence scores.⁵⁰ The second randomised people experiencing schizophrenia, schizoaffective disorder or bipolar disorder to either 0.4 mg/g (VLNC) or 15.8 mg/g cigarettes. Those in the VLNC condition smoked fewer cigarettes per day

and recorded lower breath carbon monoxide levels and cigarette craving scores.⁵³

A further two studies conducted secondary analyses of data from RCTs.^{55 56} In the first study, people experiencing schizophrenia, schizoaffective disorder and/or bipolar disorder were randomly assigned to use either VLNC (0.4 mg/g) or normal nicotine content (15.8 mg/g) research cigarettes for 6 weeks; those using VLNC cigarettes smoked significantly fewer puffs per cigarette and recorded significantly shorter interpuff intervals compared with control participants, suggesting that a nicotine reduction policy is unlikely to lead to compensatory puffing among this population.⁵⁵ In the second study, people experiencing elevated depressive symptoms were randomised to use either their usual brand cigarettes or one of six investigational cigarettes ('regular tar' cigarettes with 15.8, 5.2, 2.4, 1.3, 0.4 mg nicotine/g tobacco or 'high tar' cigarettes with 0.4 mg nicotine/g tobacco). Those who used VLNC cigarettes (2.4–0.4 mg/g) reported reduced cigarettes smoked per day, nicotine dependence and cigarette craving, and improvements or no change in their depression scale scores.⁵⁶

Moderators of response to or effects of VLNC cigarettes

Eight studies did not directly measure the effectiveness of VLNC cigarettes in reducing smoking among priority populations. Rather, these studies investigated moderators of responses to VLNC cigarettes (including age,⁴⁶ smoking menthol cigarettes⁴⁵ or cumulative vulnerabilities⁵⁷) or effects of smoking VLNC cigarettes (including cognitive effects,^{42 44} positive and/or negative symptoms of schizophrenia,^{41 42} addiction potential⁴⁸ and ability to attenuate acute tobacco withdrawal or craving severity⁵¹).

First, a secondary analysis of a within-subjects experiment among people experiencing affective disorder, opioid dependence or socioeconomic disadvantage found that young adults (aged 18–24 years) exhibited lower demand for reduced nicotine content cigarettes than older adults (aged ≥ 25 years), suggesting that VLNC cigarettes may decrease the addiction potential of tobacco smoking in young adult smokers more than older adult smokers.⁴⁶ Next, a study exploring the potential moderating effects of menthol status among people experiencing affective disorder, substance use disorder or socioeconomic disadvantage found menthol did not have a differential impact on response to VLNC cigarettes across measures of economic demand, cigarette withdrawal or craving, or smoking topography.⁴⁵ Third, a secondary analysis of data from three RCTs examining the role of cumulative vulnerabilities (rural residence, substance use disorder, affective disorder, low educational attainment, poverty, unemployment and/or physical disability) on response to cigarettes varying in nicotine content (0.4, 2.4 or 15.8 mg/g) found that total cigarettes per day increased as cumulative vulnerability increased, but decreased as nicotine content decreased.⁵⁷

Five studies examined the effects of VLNC cigarettes among priority populations. Two of these (one within-subjects⁴² and one between-groups experimental study⁴⁴) explored the impacts of VLNC cigarettes on cognition among people with schizophrenia, one also compared with a control group of people without schizophrenia.⁴⁴ One study found no effect,⁴² while the other found impaired cognitive functioning on domains of visual sustained attention, inhibitory control, processing speed and response variability among both participant groups, suggesting that reducing the nicotine content of cigarettes may impair cognitive functioning among people who smoke regardless of schizophrenia diagnosis.⁴⁴ One of these studies⁴² and a further within-subjects experimental study⁴¹ explored the impacts

of VLNC cigarettes on positive and/or negative symptoms of schizophrenia. Both studies found significantly lower negative symptom scores after smoking cigarettes moderately high⁴¹ or high⁴² in nicotine compared with denicotinised cigarettes. This suggests that smoking high nicotine content cigarettes reduces negative symptoms among people with schizophrenia. One within-subjects study among people experiencing affective disorders, opioid dependence or socioeconomic disadvantage found that participants chose a 0.4 mg/g dose cigarette significantly less than a 15.8 mg/g dose cigarette in concurrent choice testing and a cigarette purchasing task, suggesting that reducing the nicotine content of cigarettes may decrease their consumer appeal in these populations.⁴⁸ Finally, a secondary analysis of an RCT exploring responses to cigarettes varying in nicotine content (0.4, 2.4, 5.2 or 15.8 mg/g) found that tobacco withdrawal and craving did not differ significantly between people with opioid use disorders versus people without substance use disorders when smoking the VLNC cigarettes.⁵¹

Research question 4: how strong is the evidence of effectiveness?

Because we only included original research studies in our review and excluded systematic reviews, none of the studies met criteria for level I of the hierarchy according to the NHMRC Evidence Hierarchy.³⁹ Five studies were assessed as contributing level II evidence (including one RCT,⁵³ one study involving analyses of data from three randomised clinical trials⁵⁷ and three studies involving secondary analysis of data from an RCT⁵⁵ or randomised clinical trial⁵⁷). Three experimental studies were assessed as level III-2 as they included concurrent controls,⁴⁴ 52–54 seven experimental design studies were assessed as level III-3 as they did not include controls⁴¹ 42 45 46 48 49 51 and two cross-sectional studies were assessed as level IV. One qualitative study⁴³ could not be assessed using this Evidence Hierarchy.

Research question 5: are there differences in the effectiveness between populations?

The seven studies examining the effectiveness of VLNC cigarettes for reducing smoking concluded that a VLNC policy would have beneficial impacts on smoking outcomes, specifically the overall number of cigarettes smoked,⁵⁰ 52–54 56 cigarette cravings,⁵³ 54 nicotine withdrawal,⁴⁹ 54 nicotine dependence⁵⁰ 56 and puffs per cigarette.⁴⁹ 55 These studies were conducted among people experiencing a mental illness,^{52–56} or a combination of people experiencing a mental illness, substance use disorder and/or socioeconomic disadvantage⁴⁹ 50 (neither study presented results stratified by population).

Research question 6: what are the features of the policies with demonstrated effectiveness?

Among the seven studies that found a VLNC standard was effective for reducing smoking among priority populations,⁴⁹ 50 52–56 four investigated VLNC cigarettes with ≤ 0.05 mg nicotine/g tobacco,^{52–55} compared with 'usual brand' cigarettes⁵² 53 or cigarettes with 15.8 mg nicotine/g tobacco.⁵³ 55 One study found that VLNCs with 0.4 mg or 2.4 mg nicotine/g tobacco were equally effective in reducing cigarettes per day compared with 15.8 mg nicotine/g tobacco.⁵⁰ In another study, the authors combined four VLNC conditions (regular tar cigarettes with 2.4 mg/g, 1.3 mg/g, 0.4 mg nicotine/g tobacco and high tar cigarettes with 0.4 mg nicotine/g tobacco), finding them more effective at reducing cigarettes smoked per day, nicotine dependence and cigarette craving than cigarettes with 15.8 mg nicotine/g tobacco.⁵⁶

Finally, one study compared four research cigarettes varying in nicotine content (0.4, 2.4, 5.2 or 15.8 mg/g) and found that all effectively reduced nicotine withdrawal with no significant differences in smoking topography, suggesting minimal compensatory smoking.⁴⁹ Dependence potential was lowest at the 0.4 mg/g dose.⁴⁹

Two studies highlighted benefits of supplementing VLNC cigarettes with nicotine replacement therapy (NRT) to overcome withdrawal symptoms. One found that functioning in domains of visual sustained attention, inhibitory control, processing speed and response variability was impaired among people with schizophrenia who received VLNC cigarettes and placebo patches relative to those who received VLNC cigarettes and 42 mg nicotine patches, suggesting that use of NRT while using VLNC may preserve cognitive functioning in this population.⁴⁴ A second study among this population found that total puff volume was reduced among those who used VLNC cigarettes and 42 mg nicotine patches versus VLNC cigarettes and placebo patches,⁵⁴ demonstrating that nicotine withdrawal symptoms from transitioning to VLNC cigarettes may be successfully mitigated through supplemental use of NRT.

Research question 7: what are the likely advantages and disadvantages of these policies?

The above sections highlight the advantages of VLNC cigarettes in reducing the number of cigarettes smoked,⁴⁹ 50 52–56 cigarette cravings,⁵³ 54 nicotine withdrawal⁴⁹ 54 and nicotine dependence⁵⁰ 56 among priority populations.

Four studies found potential disadvantages from VLNC cigarette use.⁴¹ 42 44 57 First, a study that explored whether cumulative vulnerabilities moderate response to reduced nicotine content cigarettes among several priority populations found some evidence of ongoing cravings for usual brand cigarettes even though total cigarettes per day decreased.⁵⁷ Above (see research question 3) we described findings from a study that found reduced cognitive functioning (attention, inhibitory control, processing speed and response time variability)⁴⁴ and two that found significantly lower negative symptom scores after smoking cigarettes moderately high⁴¹ or high⁴² in nicotine compared with denicotinised cigarettes among people with schizophrenia. However, supplemental use of NRT in conjunction with VLNC cigarettes has the potential to effectively mitigate these potential disadvantages.⁴⁴ 54

Research question 8: how are these policies perceived?

Two studies measured perceptions of VLNC cigarettes.⁴⁷ 58 The first study recruited 26 women who were substance dependent and either pregnant or <9 weeks post partum; 69% were interested in learning more about VLNC cigarettes, 68% perceived them as 'just as safe', 'safer' or 'much safer' for their baby compared with regular cigarettes (a further breakdown of figures for each response option was not provided) and 60% were likely to try them if they might be safer for their baby than regular cigarettes.⁵⁸ The second study recruited participants from multiple populations, including people who identified as lesbian or gay, from wave 4 (2016–2017) of the US-based adult Population Assessment of Tobacco Use and Health Study.⁴⁷ The authors reported a lower misperception about the addictiveness of VLNC versus normal nicotine content cigarettes among respondents who identified as lesbian or gay compared with those who identified as heterosexual.⁴⁷

Finally, one study explored perceptions of five endgame policies (mandating a VLNC standard for tobacco products,

setting product standards (removing additives from tobacco), reduced risk products, tobacco tax increases and restrictions on the number of tobacco retailers) among people receiving a low income in Aotearoa (New Zealand).⁴³ Many respondents supported these policies, but concerns were also raised. Some participants suggested the illicit tobacco market may grow in response to a VLNC policy, and others opposed the policy due to fears of nicotine deprivation and increased stress. In terms of mandated removal of additives to reduce the consumer appeal of cigarettes, some participants felt that nicotine cravings would over-ride a less appealing taste and may lead some to become accustomed to the new taste. Some participants raised potential health risks associated with using reduced risk products, with some viewing them potentially as equally risky as smoking, while others feared ongoing nicotine dependence. Next, most participants strongly opposed ongoing tobacco tax increases, perceiving that this policy 'ignored addiction, exacerbated financial hardship and stress, penalized children, and disproportionately affected people with low incomes or little agency'.⁴³ Finally, most participants believed that reducing the availability of tobacco through fewer retailers would not be effective as individuals would simply travel greater distances to purchase tobacco products, and a minority raised concerns about the impact of this policy on small businesses' viability.⁴³

DISCUSSION

We identified 18 relevant publications. One described perceptions of five endgame policies among people receiving low incomes,⁴³ and the remaining 17 publications focused on the impacts and perceptions of VLNC cigarettes among various priority populations. Our previous review of tobacco endgame evidence syntheses identified a similar disproportionate focus on syntheses describing a VLNC standard, with 53% of included syntheses describing this policy.³⁶ Although a VLNC standard has not yet been implemented in any country, the Aotearoa (New Zealand) government intends to implement this policy by 2025 as part of their Smokefree Aotearoa 2025 Action Plan,⁵⁹ and the US Food and Drug Administration has announced proposed rulemaking for a nicotine content standard for cigarettes.⁶⁰ This review found evidence that a VLNC standard is likely to be accepted by people from priority populations,^{47 58} and effective for reducing smoking.^{49 50 52–56} This is consistent with findings from our previous review,³⁶ which identified 26 evidence syntheses examining a VLNC standard; all of these syntheses concluded that the policy is likely to result in a notable reduction in cigarette smoking in the general population and among people experiencing mental illness,^{61–64} socioeconomic disadvantage,⁶⁴ pregnant women,⁶¹ women of childbearing age⁶⁵ and First Nations peoples.⁶⁶ Similarly, the evidence that VLNC cigarettes did not result in compensatory puffing among priority population groups reflects the findings of VLNC cigarette trials among general population samples.³⁶ The adverse impacts on cognitive functioning after switching to VLNC cigarettes among people with schizophrenia in one trial also found these impacts among people without schizophrenia,⁴⁴ reflecting prior research on nicotine withdrawal-associated cognitive impacts and highlighting consideration for dependence treatment to ameliorate these adverse impacts.⁶⁷

Research gaps and priorities

Although 17 of the 18 included studies only examined a VLNC policy, some research gaps on this topic remain: none included people experiencing HIV or homelessness, or people who have

experienced incarceration, and only one study included people who identify as LGBTQI+,⁴⁷ and one included people who have experienced unemployment.⁵⁷ Furthermore, although the included studies showed that use of VLNC cigarettes reduced smoking,^{49 50 52–56} cigarette cravings,^{53 54} nicotine withdrawal^{49 54} and nicotine dependence^{50 56} among priority populations, none examined the effectiveness of a VLNC standard in promoting smoking cessation beyond 12 weeks. Although substantial reduction in the amount smoked provides financial benefits and may produce some health benefits,⁶⁸ the greatest health benefit is from long-term cessation⁶⁸—the ultimate goal of a VLNC policy—highlighting an area worthy of future research.

Many of these studies also used experimental or cross-sectional designs, with no studies meeting criteria for level I and only five included studies assessed as contributing level II evidence according to the NHMRC Evidence Hierarchy,³⁹ emphasising a need for future research on this topic to employ more rigorous study designs whenever possible. Furthermore, as in VLNC cigarette trials with general population samples, participants in some studies may not have adhered to the protocols as they could easily access regular cigarettes, potentially affecting the results. As New Zealand implements a mandatory VLNC standard, evaluation studies should be designed to measure the policy's impact on both general and priority populations, including substitution with illicit tobacco, and duration of smoking VLNC cigarettes.

Research on how best to mitigate potential adverse impacts of tobacco endgame policies for priority populations is also needed. Two of the included studies highlighted a benefit of supplementing use of VLNC cigarettes with NRT. We recommend that future studies continue to investigate the moderating role of nicotine replacement, whether supplementing VLNC with NRT or other nicotine products may lead to continued smoking, and the relative effectiveness of various types of nicotine replacement products (eg, nicotine patches/gum/lozenges/mouth spray/inhalator, nicotine vaping products) in assisting with symptoms of nicotine withdrawal among people switching from conventional cigarettes to VLNC cigarettes. The two studies exploring perceptions of VLNC cigarettes were conducted among people with substance use disorders⁵⁸ and people who identified as lesbian or gay,⁴⁷ showing a need for future research exploring perceptions of VLNC cigarettes among other priority populations, especially people with mental illness considering that VLNC cigarettes may reduce cognitive functioning⁴⁴ or exacerbate negative symptoms of schizophrenia.^{41 42} Finally, all 17 VLNC-focused studies in this review were conducted in the USA, and authors of 14 of the 17 studies were affiliated with the same research centre (the Center for Alcohol and Addiction Studies at Brown University in the USA^{44–55}), demonstrating a limited geographic scope in research on this topic, and highlighting a need for other research groups to replicate these studies in other locations to reduce any risk of potential bias or non-generalisability in this body of evidence.

With almost all included studies focused on the impacts of a VLNC standard, future research is needed on the effectiveness, impacts (including unintended ones, such as increased illicit tobacco trade) and perceptions of all tobacco endgame policies (see table 1) among priority populations. This is particularly the case for policies that have already been implemented or are due to be implemented. These include product standards to reduce appeal or palatability (eg, New Zealand,⁵⁹ use of reduced risk products such as nicotine vaping products to promote smoking cessation (included in tobacco endgame policy documents in England,⁶⁹ Canada⁷⁰ and New Zealand⁵⁹), large tobacco tax increases, restrictions on the number of tobacco retailers (eg, Hungary and the Netherlands,⁷¹ New Zealand⁵⁹),

ending commercial tobacco sales (eg, US cities of Beverly Hills and Manhattan Beach,⁷² and Bhutan^{1 73 74}) and a tobacco-free generation law (eg, New Zealand,⁵⁹ Balanga City Council (Philippines)⁷⁵ and Brookline City Council (Massachusetts, USA)⁷⁶). Where policies have already been implemented, we recommend that research investigating the impacts and effectiveness of these policies employs robust and rigorous study designs, with concurrent control conditions (whenever possible).³⁹ For policies that have not yet been implemented, robust simulation modelling studies, experimental studies measuring consumer intentions and qualitative studies exploring perceptions of endgame policies (such as the one included in this review⁴³) are crucial to anticipate policy effectiveness (both when implemented alone and in combination with other policies) and impacts.

Strengths and limitations

Our review benefited from a comprehensive literature search, complemented with a review of the list of included articles by tobacco endgame research experts, that covered a broad range of tobacco endgame policies. However, it is possible that we missed relevant publications. We also relied on expert judgement as to which policies should be included as endgame policies. Finally, as this is a scoping review, we did not conduct a formal quality assessment of the literature, but our classification of included studies according to the NHMRC Hierarchy of Evidence³⁹ provides an indication of the strength of research evidence in this area.

CONCLUSION

Most of the tobacco endgame literature related to these priority populations focuses on VLNC cigarettes. These studies found that use of VLNC cigarettes can reduce tobacco smoking, cigarette cravings, nicotine withdrawal and nicotine dependence in the short run among various high priority populations. Supplemental use of NRT in conjunction with VLNC cigarettes has the potential to effectively mitigate any potential disadvantages associated with their use by people experiencing mental illness, such as reduced cognitive functioning or exacerbated negative symptoms of schizophrenia. Consistent with a previous review of evidence syntheses on tobacco endgame policies, we found the research on other endgame policies was more limited. Further high-quality research on the effectiveness, impacts (expected and unexpected, positive and negative) and perceptions of all tobacco endgame policies among priority populations is needed to assist policymaking.

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REFERENCES

- 1 Reitsma MB, Fullman N, Ng M, *et al*. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the global burden of disease study 2015. *Lancet* 2017;389:1885–906.
- 2 Malone R, McDaniel P, Smith E. It is time to plan the tobacco endgame. *BMJ* 2014;348:bmj.g1453.
- 3 McDaniel PA, Smith EA, Malone RE. The tobacco endgame: a qualitative review and synthesis. *Tob Control* 2016;25:594–604.
- 4 Benowitz NL, Henningfield JE. Reducing the nicotine content to make cigarettes less addictive. *Tob Control* 2013;22 Suppl 1:i14–7.
- 5 Marsh L, Doscher C, Cameron C, *et al*. How would the tobacco retail landscape change if tobacco was only sold through liquor stores, petrol stations or pharmacies? *Aust N Z J Public Health* 2020;44:34–9.
- 6 Smith EA, Malone RE. An argument for phasing out sales of cigarettes. *Tob Control* 2020;29:703–8.
- 7 Borland R. A strategy for controlling the marketing of tobacco products: a regulated market model. *Tob Control* 2003;12:374–82.
- 8 Callard C, Thompson D, Collishaw N. Transforming the tobacco market: why the supply of cigarettes should be transferred from for-profit corporations to non-profit enterprises with a public health mandate. *Tob Control* 2005;14:278–83.
- 9 Berrick AJ. The tobacco-free generation proposal. *Tob Control* 2013;22 Suppl 1:i22–6.
- 10 Thomson G, Wilson N, Blakely T, *et al*. Ending appreciable tobacco use in a nation: using a sinking lid on supply. *Tob Control* 2010;19:431–5.
- 11 Sugarman S. No more business as usual: enticing companies to sharply lower the public health costs of the products they sell. *Public Health* 2009;123:275–9.
- 12 Cobiac LJ, Ikeda T, Nghiem N, *et al*. Modelling the implications of regular increases in tobacco taxation in the tobacco endgame. *Tob Control* 2015;24:e154–60.
- 13 Chapman S. The case for a smoker's license. *PLOS Med* 2012;9:e1001342.
- 14 Rahman MA, Hann N, Wilson A, *et al*. E-cigarettes and smoking cessation: evidence from a systematic review and meta-analysis. *PLoS One* 2015;10:e0122544.
- 15 Malone RE. The race to a tobacco endgame. *Tob Control* 2016;25:607–8.
- 16 Bonevski B, Borland R, Paul CL, *et al*. No smoker left behind: it's time to tackle tobacco in Australian priority populations. *Med J Aust* 2017;207:141–2.
- 17 Australian Institute of Health and Welfare. Tobacco smoking. 2020. Available: <https://www.aihw.gov.au/reports/australias-health/tobacco-smoking>
- 18 Australian Institute of Health and Welfare. Alcohol, tobacco & other drugs in australia. 2020. Available: <https://www.aihw.gov.au/reports/alcohol/alcohol-tobacco-other-drugs-australia>
- 19 Mannan H. Gains in life expectancy in the Australian population due to reductions in smoking: comparisons between interventions targeting the population versus interventions in a specific high risk group. *BMC Public Health* 2020;20:1478.

- 20 Australian Institute of Health and Welfare. The health of australia's prisoners 2018; 2019.
- 21 Guydish J, Passalacqua E, Pagano A, *et al.* An international systematic review of smoking prevalence in addiction treatment. *Addiction* 2016;111:220–30.
- 22 Australian bureau of statistics. *National Health Survey* 2018; Available: <https://www.abs.gov.au/statistics/health/health-conditions-and-risks/national-health-survey-first-results/2017-18>
- 23 Siahpush M, Borland R, Scollo M. Smoking and financial stress. *Tob Control* 2003;12:60–6.
- 24 Lawn S. Tobacco control policies, social inequality and mental health populations: time for a comprehensive treatment response. *Aust N Z J Psychiatry* 2008;42:353–6.
- 25 Hill S, Amos A, Clifford D, *et al.* Impact of tobacco control interventions on socioeconomic inequalities in smoking: review of the evidence. *Tob Control* 2014;23:e89–97.
- 26 Thomas S, Fayer D, Misso K, *et al.* Population tobacco control interventions and their effects on social inequalities in smoking: systematic review. *Tob Control* 2008;17:230–7.
- 27 Cook BL, Wayne GF, Kafali EN, *et al.* Trends in smoking among adults with mental illness and association between mental health treatment and smoking cessation. *JAMA* 2014;311:172–82.
- 28 Twyman L, Bonevski B, Paul C, *et al.* Perceived barriers to smoking cessation in selected vulnerable groups: a systematic review of the qualitative and quantitative literature. *BMJ Open* 2014;4:e006414.
- 29 Giskes K, van Lenthe FJ, Turrell G, *et al.* Smokers living in deprived areas are less likely to quit: a longitudinal follow-up. *Tob Control* 2006;15:485–8.
- 30 Kotz D, West R. Explaining the social gradient in smoking cessation: it's not in the trying, but in the succeeding. *Tob Control* 2009;18:43–6.
- 31 Chaloupka FJ, Yurekli A, Fong GT. Tobacco taxes as a tobacco control strategy. *Tob Control* 2012;21:172–80.
- 32 Guillaumier A, Bonevski B, Paul C, *et al.* Paying the price: a cross-sectional survey of Australian socioeconomically disadvantaged smokers' responses to hypothetical cigarette price rises. *Drug Alcohol Rev* 2014;33:177–85.
- 33 Peters M, Godfrey C, McInerney P, *et al.* Chapter 11: scoping reviews (2020 version). In: Aromataris E, Munn Z, eds. *JBI Manual for Evidence Synthesis*. JBI, 2020.
- 34 Tricco AC, Lillie E, Zarin W, *et al.* PRISMA extension for scoping reviews (PRISMA-scr): checklist and explanation. *Ann Intern Med* 2018;169:467–73.
- 35 Puljević C, Gartner C. Tobacco endgame strategies for priority populations: a scoping review. 2022. Available: osf.io/ezkcy
- 36 Puljević C, Morphet K, Hefler M, *et al.* Closing the gaps in tobacco endgame evidence: a scoping review. *Tob Control* 2022;31:365–75.
- 37 Ouzzani M, Hammady H, Fedorowicz Z, *et al.* Rayyan-a web and mobile App for systematic reviews. *Syst Rev* 2016;5:210.
- 38 Pham MT, Rajić A, Greig JD, *et al.* A scoping review of scoping reviews: advancing the approach and enhancing the consistency. *Res Synth Methods* 2014;5:371–85.
- 39 National Health and Medical Research Council. NHMRC levels of evidence and grades for recommendations for developers of guidelines. 2009. Available: [https://www.nhmrc.gov.au/sites/default/files/images/NHMRC%20Levels%20and%20Grades%20\(2009\).pdf](https://www.nhmrc.gov.au/sites/default/files/images/NHMRC%20Levels%20and%20Grades%20(2009).pdf)
- 40 Qualtrics. *Qualtrics*. Provo, Utah, USA, 2020.
- 41 Smith RC, Infante M, Ali A, *et al.* Effects of cigarette smoking on psychopathology scores in patients with schizophrenia: an experimental study. *Subst Abuse* 2001;22:175–86.
- 42 Smith RC, Singh A, Infante M, *et al.* Effects of cigarette smoking and nicotine nasal spray on psychiatric symptoms and cognition in schizophrenia. *Neuropsychopharmacology* 2002;27:479–97.
- 43 Barbalich I, Gartner C, Edwards R, *et al.* New Zealand smokers' perceptions of tobacco endgame measures: a qualitative analysis. *Nicotine Tob Res* 2022;24:93–9.
- 44 AhnAllen CG, Bidwell LC, Tidey JW. Cognitive effects of very low nicotine content cigarettes, with and without nicotine replacement, in smokers with schizophrenia and controls. *Nicotine Tob Res* 2015;17:510–4.
- 45 Davis DR, Miller ME, Streck JM, *et al.* Response to reduced nicotine content in vulnerable populations: effect of menthol status. *Tob Regul Sci* 2019;5:135–42.
- 46 Davis DR, Parker MA, Villanti AC, *et al.* Examining age as a potential moderator of response to reduced nicotine content cigarettes in vulnerable populations. *Nicotine Tob Res* 2019;21:549–55.
- 47 Denlinger-Apte RL, Pacek LR, Ross JC, *et al.* Risk perceptions of low nicotine cigarettes and alternative nicotine products across priority smoking populations. *Int J Environ Res Public Health* 2021;18:5311.
- 48 Higgins ST, Heil SH, Sigmon SC, *et al.* Addiction potential of cigarettes with reduced nicotine content in populations with psychiatric disorders and other vulnerabilities to tobacco addiction. *JAMA Psychiatry* 2017;74:1056–64.
- 49 Higgins ST, Heil SH, Sigmon SC, *et al.* Response to varying the nicotine content of cigarettes in vulnerable populations: an initial experimental examination of acute effects. *Psychopharmacology (Berl)* 2017;234:89–98.
- 50 Higgins ST, Tidey JW, Sigmon SC, *et al.* Changes in cigarette consumption with reduced nicotine content cigarettes among smokers with psychiatric conditions or socioeconomic disadvantage: 3 randomized clinical trials. *JAMA Netw Open* 2020;3:e2019311.
- 51 Streck JM, Sigmon SC, Priest J, *et al.* Investigating tobacco withdrawal in response to reduced nicotine cigarettes among smokers with opioid use disorder and other vulnerabilities. *Exp Clin Psychopharmacol* 2020;28:714–23.
- 52 Tidey JW, Cassidy RN, Miller ME. Smoking topography characteristics of very low nicotine content cigarettes, with and without nicotine replacement, in smokers with schizophrenia and controls. *Nicotine Tob Res* 2016;18:1807–12.
- 53 Tidey JW, Colby SM, Denlinger-Apte RL, *et al.* Effects of 6-week use of very low nicotine content cigarettes in smokers with serious mental illness. *Nicotine Tob Res* 2019;21:538–45.
- 54 Tidey JW, Rohsenow DJ, Kaplan GB, *et al.* Separate and combined effects of very low nicotine cigarettes and nicotine replacement in smokers with schizophrenia and controls. *Nicotine Tob Res* 2013;15:121–9.
- 55 Denlinger-Apte RL, Donny EC, Lindgren BR, *et al.* Smoking topography characteristics during a 6-week trial of very low nicotine content cigarettes in smokers with serious mental illness. *Nicotine Tob Res* 2020;22:1414–8.
- 56 Tidey JW, Pacek LR, Koopmeiners JS, *et al.* Effects of 6-week use of reduced-nicotine content cigarettes in smokers with and without elevated depressive symptoms. *Nicotine Tob Res* 2017;19:59–67.
- 57 Higgins ST, DeSarno M, Bunn JY, *et al.* Cumulative vulnerabilities as a potential moderator of response to reduced nicotine content cigarettes. *Prev Med* 2021;152:106714.
- 58 Andersen A, Chisolm MS, Kleykamp BA, *et al.* Reduced nicotine content cigarette knowledge, attitudes, and practices of patients at a perinatal substance abuse treatment center. *Addict Disord Their Treat* 2013;12:111–7.
- 59 Ministry of Health. *Smokefree aotearoa 2025*. 2020. Available: <https://www.health.govt.nz/our-work/preventative-health-wellness/tobacco-control/smokefree-aotearoa-2025>
- 60 Food and Drug Administration. *Tobacco product standard for nicotine level of combusted cigarettes: a proposed rule*. 2018. Available: <https://www.federalregister.gov/documents/2018/03/16/2018-05345/tobacco-product-standard-for-nicotine-level-of-combusted-cigarettes>
- 61 Ferris Wayne G, Donny E, Ribisl KM. A global nicotine reduction strategy: state of the science. In: *Report on the Scientific Basis of Tobacco Product Regulation: Seventh Report of a WHO Study Group*. Geneva: World Health Organization, WHO Study Group on Tobacco Product Regulation, 2019.
- 62 Gaalema DE, Miller ME, Tidey JW. Predicted impact of nicotine reduction on smokers with affective disorders. *Tob Regul Sci* 2015;1:154–65.
- 63 Tidey JW, Davis DR, Miller ME, *et al.* Modeling nicotine regulation: a review of studies in smokers with mental health conditions. *Prev Med* 2018;117:30–7.
- 64 Tidey JW, Muscat JE, Foulds J, *et al.* Reducing the nicotine content of cigarettes: effects in smokers with mental health conditions and socioeconomic disadvantages. *Nicotine Tob Res* 2019;21:526–8.
- 65 Kurti AN. Reducing tobacco use among women of childbearing age: contributions of tobacco regulatory science and tobacco control. *Exp Clin Psychopharmacol* 2020;28:501–16.
- 66 Johnston V, Westphal DW, Glover M, *et al.* Reducing smoking among indigenous populations: new evidence from a review of trials. *Nicotine Tob Res* 2013;15:1329–38.
- 67 Ashare RL, Falcone M, Lerman C. Cognitive function during nicotine withdrawal: implications for nicotine dependence treatment. *Neuropharmacology* 2014;76 Pt B:581–91.
- 68 Pisinger C, Godtfredsen NS. Is there a health benefit of reduced tobacco consumption? A systematic review. *Nicotine Tob Res* 2007;9:631–46.
- 69 Department of Health. *Towards a smokefree generation: A tobacco control plan for England*. 2017. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/630217/Towards_a_Smoke_free_Generation_-_A_Tobacco_Control_Plan_for_England_2017-2022_2_.pdf
- 70 Canada's tobacco strategy. 2020. Available: <https://www.canada.ca/en/health-canada/services/publications/healthy-living/canada-tobacco-strategy.html>
- 71 Kong AY, Henriksen L. Retail endgame strategies: reduce tobacco availability and visibility and promote health equity. *Tob Control* 2022;31:243–9.
- 72 McDaniel PA, Malone RE. Tobacco industry and public health responses to state and local efforts to end tobacco sales from 1969–2020. *PLoS One* 2020;15:e0233417.
- 73 Givel MS. History of bhutan's prohibition of cigarettes: implications for neo-prohibitionists and their critics. *Int J Drug Policy* 2011;22:306–10.
- 74 World Health Organization. *The big ban: bhutan's journey towards a tobacco-free society*; 2019. Available: <https://apps.who.int/iris/rest/bitstreams/1278727/retrieve>
- 75 de Leon K, Sarita JT. The philippines: pioneering the tobacco endgame. *Tob Control* 2020;
- 76 Cromar A. Tobacco-free generation: brookline passes new restriction aiming to phase out tobacco sales to young smokers. 2020. Available: <https://www.boston.com/news/local-news/2020/11/24/tobacco-free-generation-brookline/>