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UNIVERSITY OF WOLLONGONG AUSTRALIA

Hard-core Smokers, the Hardening Hypothesis and Harm Reduction: Implications for Australian Tobacco Control Policy

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This thesis is presented as part of the requirement for the conferral of the Degree: Doctor of Philosophy (Psychology)

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Abstract

Background: The prevalence of cigarette smoking has decreased considerably in many developed countries over the past few decades. However, in Australia, the rate of the decrease has been slowing, and between 2013-2016, appeared to stall. This is important because cigarette smoking remains a major public health issue, and is – for example – the leading cause of cancer-related mortality in Australia.

The slowing decline in smoking prevalence has prompted calls to address the interrelated issues of hardening and hard-core smoking. The hardening hypothesis proposes that, as smoking rates decline, the remaining smokers will become hard-core (i.e., more resistant to quitting). This group of hard-core smokers may require more tailored approaches to cessation and/or product-based tobacco harm reduction (THR). Although hardening and hard-core smoking are often discussed and investigated, the literature is plagued by inconsistencies in how these terms are defined and operationalised. As a result, many aspects of the nature of hardening and hard-core smoking remain unclear.

Alternate nicotine delivery systems (ANDS), such as e-cigarettes, have been proposed as an option to achieve further reductions in smoking prevalence rates in Australia. This is because ANDS may support hard-core smokers to quit or (as a form of THR) transition smokers away from combustible cigarettes. The Australian regulatory environment for ANDS, together with a robust tobacco control environment, means that hard-core smoking and hardening research conducted in other countries may not be transferable to the Australian context. As such, there is a significant knowledge gap about the contemporary nature of hard-core smoking in Australia.

This thesis aims to examine the existence and nature of hardening and hard-core smoking in an Australian context. In doing so, this thesis will also address important theoretical issues relating to the definitions and operationalisations of these concepts. This includes the application of the Precaution Adoption Process Model as a theoretical framework to understand hard-core smoking. This thesis is comprised of three empirical studies and two policy focused commentary papers which address the gaps in the literature to account for: i) contemporary evidence supporting claims of hardening amongst Australian and international smokers (Paper1); ii) identification of the extent of hard-core smoking rates in Australia (Paper 2); iii) an understanding of the characteristics of hard-core smokers (Papers 2 and 3); iv) exploration of a stage-based behaviour change model that may account for smokers who do not want to change their smoking behaviour (Paper 3); v) a review of the status of smoke-free spaces in Australia as a key component of non-product-based THR (Paper 4); and v) a review of Australian tobacco dependence treatment policy (Paper 5).

Method: Paper 1 was a systematic review to identify and summarise studies on hard-core smoking and hardening to: i) determine the degree of variability in definitions of hard-core smoking and hardening; ii) assess the evidence for claims that smokers are becoming increasingly hardened; and iii) identify the determining characteristics of a hard-core smoker. We searched five electronic databases from 1970 to mid-April 2018 using the search term "smok* AND hard* AND (tobacco OR cigar* OR nicotin*)". We included studies if they included a definition of hard-core smokers and/or hardening and provided a prevalence rate for hard-core smokers or empirical evidence for hardening.

Paper 2 tested the hardening hypothesis by analysing the rates of hard-core smoking in the Australian smoking population between 2010 and 2016. Data were drawn from three waves of the National Drug Strategy Household Survey (NDSHS) in 2010, 2013 and 2016. Two different definitions were used to assess hard-core smoking to arrive at an upper and lower

rate. Logistic regression models assessed hard-core smoker characteristics for both definitions of hard-core smoking.

Paper 3 applied the Precaution Adoption Process Model (PAPM) to a community-based sample of smokers (n=336) to determine whether it provides a useful approach to identifying hard-core smokers. Australian smokers were recruited through social media and an online data collection agency.

Paper 4 and Paper 5 reviewed the status of smoke-free spaces and tobacco dependence treatment as key THR approaches in Australia and outlined the need for renewed focus on implementing comprehensive, robust and evidence-based tobacco control polices to reduce population level harm and drive cessation in the face of lobbying by industry for widespread availability of ANDS products.

Results: Paper 1 indicated there is considerable variability in how hard-core smoking is defined and operationalised in the literature. This variability was associated with inconsistencies in reported prevalence rates of hard-core smoking. The three empirical papers indicated there was little evidence of a crisis of hard-core smokers posing a credible threat to achieving further smoking prevalence reductions in Australia. Paper 1 suggested that hardening was not evident in the general smoking population, although there was evidence of softening occurring in smoking populations. In Paper 2, the most inclusive definition of hard-core smoking (i.e. a smoker with no plan to quit) showed a significant decline in hard-core smoking between 2010 and 2016 (5.49%–4.85%). The prevalence of hard-core smoking using the most stringent definition (i.e. a current daily smoker of at least 15 cigarettes per day, aged 26 years or over, with no intention to quit, a lifetime consumption of at least 100 cigarettes, and no quit attempt in the past 12 months) did not change significantly between 2010 and 2016. In Paper 3, 11.9% of smokers were in Stage 4 of the

PAPM – i.e. had decided not to quit. These smokers were more resistant to quitting and exhibited similar characteristics to hard-core smokers.

Conclusions: The present thesis demonstrates that the Australian smoking population is not hardening, nor are Australian smokers becoming increasingly hard-core. As such, further reductions in smoking prevalence are achievable by further strengthening and funding a comprehensive approach to tobacco control. This should include improvements in the delivery of tobacco dependence treatment (TDT) to improve quit outcomes amongst the majority of Australian smokers who are motivated to quit. ANDS may be of benefit to some smokers who have been unable to quit using evidence-based combination pharmacotherapy and behavioural support. However, they may create population level harm if they increase rates of youth smoking.

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To my supervisors: Thank you Chris and Peter for your unwavering support and guidance. Not only have you read more drafts than anyone should have to suffer, you have also had to deal with a mature age PhD student who is used to being a CEO and not an early career researcher. I have loved every minute of working with you both. You have taught me more than I can say thank you for. Your patience and feedback, together with the occasional pep talks, have enabled me to get this done.

To my husband Ian: Thank you for encouraging and supporting me in pursuing this dream. Your encouragement kept me going when I wasn't sure I had what it took. Thank you for being a sounding board for all my off the wall ideas. We make a great team.

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And last, but by no means least, to my reviewers and examiners: Thank you for taking the time to read my work. I am grateful to you for your time and expertise in helping me achieve this long-held dream.

Certification

I, Tanya Pauline Buchanan, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy (Psychology), in the School of Psychology, from the University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Tanya Pauline Buchanan

11 July 2021

Formatting Statement

This thesis is presented in compilation style format. Aside from the introduction (Chapter 1) and general discussion (Chapter 7), all the other chapters (Chapter 2, 3, 4, 5 and 6) are based on a manuscript that has been published in a peer reviewed journal.

The thesis chapters drawn from published papers are identical to the published manuscripts except for table numbers, changing “hardcore” to “hard-core” and inclusion of supplementary material from the published paper in the body of the thesis. Referencing style has also been consistently applied in this thesis with Vancouver style referencing used throughout. These changes have been made to ensure uniformity in formatting across the thesis.

List of Publications and Presentations

Publications/Manuscripts

First/Equal Author

1. **Buchanan, T**., Magee, C.A., See, H.V., Kelly, P.J. Tobacco harm reduction: are smokers becoming more hard-core? *J Public Health Pol* **41**, 286–302 (2020). https://doi.org/10.1057/s41271-020-00226-1
2. **Buchanan, T**., Magee, C.A, Igwe, E.O., Kelly, P.J. Is the Australian smoking population hardening? *Addictive* Behaviors 2021;**112** https://doi.org/10.1016/j.addbeh.2020.106575
3. **Buchanan, T**., Magee, C.A., & Kelly, P.J. (2020). Smokers who do not quit: Can the precaution adoption process model help identify hard-core smokers? *Journal of Smoking Cessation,* **15**(1), 6-13. https://doi.org/10.1017/jsc.2019.20
4. Brooks A, **Buchanan T**, Oakes W. Smoke-free environments: current status and remaining challenges in Australia. *Public Health Res Pract*. 2020;**30**(3):e3032022 https://doi.org/10.17061/phrp3032022
5. **Buchanan, T.,** White, S.L., Marshall, H., Kelly, P.J., Carson-Chahhoud, K.V., Magee, C.A. Time to Rethink Tobacco Dependence Treatment in Australia. *Australian and New Zealand Journal of Public Health.* https://doi.org/10.1111/1753-6405.13151

Affiliated paper

McDonald, C.F., Jones, S., Beckert, L., Bonevski, B.**, Buchanan, T.** et al. (2020) Electronic cigarettes: A position statement from the Thoracic Society of Australia and New Zealand. *Respirology.* **25**:1082–1089. https://doi.org/10.1111/resp.13904

Conference Presentations

1. **Buchanan, T.,** Magee, C.A., Phillipson, L. (October 2015). Unmotivated to Quit Smokers: Who are they and what do we know about them? Oral presentation at the Oceania Tobacco Control Conference 2015, Perth, Western Australia.
2. **Buchanan, T**., Igwe, E.O., Magee, C.A., Kelly, P.J. (November 2019). *Are Australian Smokers Hardening?.* Oral presentation at the 24th Congress of the Asia Pacific Society of Respirology 2019. Hanoi, Vietnam.

Statement of Contribution of Others

This statement verifies that the greater part of the work in the previously stated First/Equal Author Publications/Manuscripts are attributed to the candidate. Tanya Buchanan, under the guidance and supervision of her supervisors, took primary responsibility for the design of each study, data analysis, preparation of the first draft of each manuscript, and preparation of the papers for submission to relevant journals. Participant recruitment and data collection was completed exclusively by Tanya Buchanan for Study 1 (Chapter 2). Co-authors Peter Kelly and Christopher Magee contributed to the thesis as supervisors, providing guidance on the design of each study and editorial suggestions for every paper.

Co-author Hayley See, provided independent review and data extraction for studies included in the Systematic Review in Chapter 2. Co-author Ezinne Igwe provided statistical analysis support for Chapter 3. Co-authors Alecia Brooks and Wendy Oakes were equal co-contributors representing Cancer Council and Heart Foundation, respectively, for Chapter 5 which was an invited peer reviewed paper for a special tobacco control edition of the *Journal of Public Health Research and Practice*. Co-authors Sarah White, Kristin Carson-Chahhoud and Henry Marshall as tobacco control experts provided feedback and editorial suggestions for Chapter 6.

Tanya Buchanan had substantial authorial engagement with paper design, writing, drafting and preparation of “Electronic Cigarettes: A position statement from the Thoracic Society of Australia and New Zealand”.

Key Abbreviations

ADA	Australian Data Archives
AIHW	Australian Institute of Health and Welfare
ANDS	Alternative Nicotine Delivery Systems
ANOVA	Analysis of Variance
BAT	British American Tobacco
CC	Combustible Cigarettes
COPD	Chronic Obstructive Pulmonary Disease
CPD	Cigarettes per Day
DB	Decisional Balance
e-cigarette	Electronic Cigarette
ENDS	Electronic Nicotine Delivery System
FCTC	Framework Convention on Tobacco Control
FTND	Fagerstrom Test for Nicotine Dependence
GATS	Global Adult Tobacco Survey
HCS	Hard-core Smokers
HNB	Heat Not Burn
HSI	Heaviness of Smoking Index
K10	Kessler 10
NDSHS	National Drug Strategy Household Survey
NRT	Nicotine Replacement Therapy
ORU	Online Research Unit
PAPM	Precaution Adoption Process Model
PBS	Pharmaceutical Benefits Scheme
PMI	Philip Morris International
RACGP	Royal Australian College of General Practitioners
RACP	Royal College of Physicians
RYO	Roll Your Own
SES	Socio-economic Indexes for Areas
SM	Survey Monkey
TDT	Tobacco Dependence Treatment

TGA	Therapeutic Goods Administration
THR	Tobacco Harm Reduction
TTFC	Time to First Cigarette
TTM	Transtheoretical Model
UK	United Kingdom
WHO	World Health Organisation

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Chapter 1. Introduction and Aims

1.1 Background: Smoking in Australia

Smoking has long been recognised as a major public health issue that greatly increases the risk of cancer, respiratory and cardiac disease, and early mortality.(1-3) Comprehensive tobacco control measures, which include smoking cessation, have been effective in reducing the rates of cigarette smoking in developed countries. For example, the prevalence of daily smoking in Australia more than halved from 24% in 1991 to 11% in 2019.(4) However, since 2010, the proportion of smokers in Australia who say they do not want to quit has remained stable at around 30%.(3) The prevalence of smoking in the overall population stabilised between 2013-2016 and, between 2016-2019, no prevalence reductions occurred in 40-50 year old smokers.(4, 5) As of March 2021, two targets established by the *National Tobacco Strategy 2012-2018*: i) an adult daily smoking rate of 10%; and ii) a halving of the Aboriginal and Torres Strait Islander daily smoking rate, have not been achieved.(6)

The above trends have led to suggestions that the Australian smoking population may be hardening, and that the remaining smokers may be highly resistant to quitting or hard-core. Harm reduction and pro-vaping advocates have created considerable debate in arguing that these trends are evidence that Australia must embrace product-based tobacco harm reduction (THR), usually in the form of electronic cigarettes (e-cigarettes) or other forms of alternative nicotine delivery systems (ANDS) to both mitigate the harms of continued tobacco smoking and to achieve further reductions in smoking prevalence rates.(7-9) In this thesis, the terms ANDS and ENDS (electronic nicotine delivery systems) are used interchangeably.

Although the terms ‘hard-core smoker’ and the ‘hardening hypothesis’ are widely utilised in the tobacco literature, they remain topics of considerable debate. As outlined in

more detail in the remainder of this introduction, this thesis aims to further investigate the nature and existence of hard-core smokers and the hardening hypothesis. While this thesis primarily focuses on an Australian context (e.g., in terms of sampling and policy context), the thesis has broader implications, as it addresses important theoretical issues relating to the definitions and operationalisations of the hard-core and hardening concepts, as well as policy implications relating to how to address hard-core smoking. In this thesis, a hard-core smoker is defined as a smoker who cannot and/or will not quit and who is likely to remain a smoker, although other definitions are also referred to and examined in the systematic review (Chapter 2).(10, 11) The hardening hypothesis states that as smoking prevalence rates decline, smokers who could quit will do so and the remaining smokers will be hard-core and increasingly unable to quit.(12)

Previous analysis of hard-core smoking in Australia examined data sets which pre-date the growth in popularity of ANDS. These studies found weak and mixed evidence for hardening amongst smokers with low socio-economic status (SES) and that rates of hard-core smoking in the general population were very low at around 2% prevalence.(13-15) The National Drug Strategy Household Survey (NDSHS) has been collecting data on ANDS use since 2013 with ANDS use increasing significantly each survey since 2013.(4) This is despite Australia having a regulatory framework that prohibits the use of ANDS without a valid medical prescription and which is amongst the most restrictive in the world. The Australian regulatory environment for ANDS and for the provision of cessation services within a comprehensive tobacco control framework means that hard-core smoking and hardening research conducted in other countries may not be relevant; this is especially true given that many other countries have very different regulatory and social norms with regards to smoking and vaping. As such, there is a significant knowledge gap about the contemporary nature of hard-core smoking in Australia.

This thesis aims to address this gap by investigating the existence and nature of hard-core smokers, focusing on an Australian policy context. This is especially relevant

given the active ANDS marketing and lobbying over a period in which the use of ANDS has increased significantly. (4) The objective of this thesis is to review claims that Australian smokers are hardening, and that product-based harm reduction is necessary to achieve further smoking prevalence reductions, because a significant proportion of existing smokers cannot and/or will not quit. This is important because, Australian tobacco control is premised on an evidence-based approach to reducing prevalence rates through a combination of policy and practices that work to reduce supply and demand and promote effective harm reduction.

In addition to addressing the public policy implications of hard-core smoking, as noted above, this thesis also addresses theoretical concepts that further our understanding of hard-core smokers. This has widespread implications in an Australian context, but also internationally. First, the literature on hard-core smokers is characterised by considerable inconsistencies in the definitions and operationalisations of this concept. The present thesis examines these inconsistencies and their implications.

Second, the academic literature also identifies some key characteristics of hard-core smokers, such as an increased likelihood to be male, from lower SES groups, lower levels of knowledge about the harms of smoking, higher rates of psychological distress and lower educational attainment. This thesis further investigates the characteristics of hard-core smokers who persist in smoking in the Australian environment, which is in the mature phase of the smoking epidemic.(1) For example, do hard-core smokers in Australia have lower levels of knowledge about smoking-related harms given the robust tobacco control environment? Understanding the characteristics of hard-core smokers is important because it can inform tobacco control initiatives targeted towards this group.

Finally, population level characteristics of hard-core smokers provide little insight into the psychological processes associated with hard-core smokers. There is limited data regarding hard-core smokers' beliefs about smoking and quitting, which is a research gap in the literature. Therefore, this thesis aims to address this gap by examining if there are

particular psychological processes associated with Australian hard-core smoking such as risk beliefs, pros and cons of smoking, differences in self-perceived health assessment and smoking-related behaviour, self-efficacy and influences of significant others.

Addressing the above issues ultimately has implications for endgame planning in countries such as Australia, which are in the more mature phases of tobacco control. The current daily smoking prevalence rate of 11% makes Australia one of the global leaders in tobacco control. The current tobacco use environment makes it feasible for Australia to start endgame planning.(16) The tobacco endgame has been described in various ways, however, is frequently accepted as achieving a daily smoking prevalence of less than 5%. (16, 17) Product-based, THR may be one of the strategies pursued in achieving an endgame. In pursuing product-based THR our approach should be proportionate to the problem it is seeking to resolve and must ensure that harm is indeed reduced. A necessary precondition of this is to understand the population of smokers who are unwilling or unable to quit. It is also vital to ensure that any product-based individually focussed THR does not increase harm at a population level by either: i) introducing new products to those who would not otherwise have smoked or used the reduced risk product; or ii) retaining smokers who would otherwise have quit all tobacco use had the reduced risk product not been available.

In summary, this thesis addresses the gaps in the literature regarding:

1) Contemporary evidence supporting claims of hardening amongst Australian and international smokers (Paper 1);

2) Identification of the extent of hard-core smoking rates in Australia (Paper 2);

3) Understanding of the characteristics of Australian hard-core smokers (Papers 2 and 3);

4) Investigating whether of a stage-based behaviour change model that can account for smokers who do not want to change their smoking behaviour (Paper 3); and

5) Harm reduction policy options such as smoke free spaces and tobacco dependence treatment (TDT) that reduce harm for hard-core smokers and the general population (Papers 4 and 5).

The remainder of this introduction:

1) Provides an overview of current smoking prevalence in Australia and the challenges of smoking cessation;

2) Introduces the concepts of the hard-core smoker and the hardening hypothesis;

3) Provides a brief description of ANDS products;

4) Discusses THR and the influence of the tobacco industry;

5) Presents the Precaution Adoption Process Model (PAPM) as a theoretical framework for understanding hard-core smokers; and

6) Presents the aims of the thesis and thesis structure.

1.2 Smoking in Australia

Australia is considered to be in the mature phase of the tobacco epidemic in which smoking has hit its highest rates and is now declining.(18) The success of Australian tobacco control has historically been built on a comprehensive approach that embraced activities to reduce supply and demand of combustible cigarettes such as taxation, restrictions on sales, places of use and prohibitions on marketing and promotional activity. These activities have been supported by cessation support and TDT as well as public education with a significant investment in public health marketing.

Despite significant success in more than halving smoking prevalence rates since 1991, smoking remains the leading cause of morbidity and mortality in Australia. For example, tobacco use contributes nearly a quarter of the burden of cancer in Australia, particularly lung cancer and chronic obstructive pulmonary disease which are leading causes of

mortality.(3) Smoking also accounted for 14% of the total fatal burden of disease in 2015, with approximately two-thirds of Australian smokers estimated to die prematurely as a result of their smoking.(1, 19) Smoking is responsible for 50% of all deaths in Aboriginal and Torres Strait Islander people over 45 years despite recent significant declines in smoking prevalence.(20)

The economic costs of tobacco smoking were estimated at $137 billion in 2015-16.(21) The costs of hospital care attributed to smoking in 2015-16 were $1.5 billion, whilst primary and specialists doctor consultations and treatment costs totalled $1.46 billion.(21) In 2015-16, the costs of smoking cessation medicine through the Pharmaceutical Benefits Scheme (PBS) totalled $451.1 million and $98.9 million was spent on over the counter Nicotine Replacement Therapy (NRT).(21)

A considerable body of research has identified risk factors for smoking. Smoking prevalence is 12% higher amongst individuals who are the most socio-economically disadvantaged.(22) Higher prevalence of smoking is also associated with lower educational attainment, non-heterosexuality, being male, living in remote areas, higher levels of mental illness and concurrent poly-drug use.(22, 23) Daily smoking prevalence rates for Aboriginal and Torres Strait Islander peoples aged over 18 has declined from 50% in 2004-5 to 40.2 % in 2018-19, but remains considerably higher than the rest of the population.(24)

1.2.1 How do Australian Smokers Quit?

The financial cost of smoking and the impact of smoking on their health are the primary reasons cited by smokers for making a quit attempt.(4) In 2019, 61% of smokers undertook some activity to quit smoking; 31% of smokers made an unsuccessful quit attempt, 21% made a quit attempt lasting 1 month or more, and 39% reduced their tobacco consumption.(4) More smokers were successful at making a quit attempt that lasted more than a month in 2019 than in 2016.(4) However, the proportion of ex-smokers did not change between 2016 and 2019 and the decrease in smoking prevalence rates appear to be the result of fewer young people starting to smoke rather than substantial cessation activity.(4)

Quitting “cold turkey” – i.e., without behavioural support or pharmacotherapy – is the dominant mode of quitting for Australian smokers, reported by 23% of smokers. Despite this, it has been argued that the quitting process is overly medicalised in the literature, leading many smokers to believe that it is difficult to quit and that they require pharmaceutical support to do so successfully.(25) This concern seems unfounded as most smokers made a quit attempt in 2019, but less than 1 in 5 smokers who attempted to quit used NRT and only 1 in 10 sought assistance from their doctor.(4)

E-cigarettes have recently emerged as a potential smoking cessation approach. Between 2016 and 2019 around one third of e-cigarette users cited cessation from combustible cigarettes (CCs) as the reason they used e-cigarettes.(4) E-cigarette users also said they used them to try to cut down consumption of CCs (22%) and to stay off CCs (17.8%).(4) The rates of dual use of cigarettes and e-cigarettes are not reported. In 2019, the prevalence rate of current use of e-cigarettes was low at 2.5% overall and 9.7% amongst smokers.(4) Current patterns of use of e-cigarettes in Australia are suggestive of dual use of CCs and e-cigarettes, substitution of CCs with e-cigarettes and use by non-smokers.(26) The pattern of use does not suggest they are being used in any concerted way to achieve smoking cessation.(26)

1.3 Hard-core Smokers and the Hardening Hypothesis

This thesis investigates the interrelated concepts of hard-core smoking and the hardening hypothesis. These concepts may have important implications for guiding Australian tobacco control policy and are discussed in further detail below. The idea of the smoker who refuses to quit was identified in the work of McKennell and Thomas in 1967 with the introduction of the concept of consonant and dissonant smokers.(27) The dissonant smoker experiences cognitive dissonance between their smoking and the knowledge that smoking is unhealthy and as such responds affirmatively to the question “would you like to give up smoking if you could do so easily?”. By contrast, consonant smokers respond

negatively to the question regarding cessation and hold more positive attitudes with respect to their smoking.

Complicating the challenge of learning about smokers who are not motivated to change their smoking behaviour is the lack of research on unmotivated to quit smokers, the self-selection of such smokers out of research programs and the wide variation in the definition of unmotivated. The definition of 'unmotivated' in the literature varies widely from smokers who are 'not ready to quit in the next month to the next six months' to 'not ready to quit immediately' and to those who say they 'never wish to quit'.(28)

The term 'hard-core' was first used in relation to smokers in the 1970s, and became increasingly used in cessation literature to refer to smokers who could not and/or would not quit smoking.(29) Despite the term 'hard-core smoker' being increasingly used, there remains substantial variation in how it is defined and operationalised. Despite this variation, hard-core smoking could have important implications for tobacco control, since it provides a potential explanation for stalling declines in smoking prevalence rates in developed countries. Understanding the size and characteristics of this group of smokers could be vital to enabling effective policy and clinical interventions that will achieve an end to the smoking epidemic.

The hardening hypothesis argues that as smoking prevalence rates decline, smokers who could quit will do so; this leaves a group of inveterate or hard-core smokers who are unable and/or unwilling to quit.(12) In other words, those smokers most able to quit will do so first, leaving remaining smokers who struggle to quit behind. It is proposed that hardening occurs when smoking prevalence rates decline and the remaining smokers increasingly show traits of hard-core smokers. Eventually, according to the hypothesis, the only smokers who remain will be hard-core smokers who will be highly resistant to quitting. It has been suggested that the hardening hypothesis is probably only relevant in countries such as Australia which are in the mature stage of the tobacco epidemic.(1, 30) This is because smoking rates have already peaked, with the remaining smokers unevenly distributed across

a scale of disadvantage and in populations where rates of smoking have remained stubbornly high.

One of the challenges in this area of research is the considerable variation in how hard-core smoking is defined and operationalised. Warner's definition of a hard core smoker as "a daily, long-term smoker who is unable or unwilling to quit and who is likely to remain so even when possessing extensive knowledge about the hazards of smoking and when confronting substantial social disapprobation of smoking" is narratively specific but challenging to assess empirically.(11) Other definitions of hard-core smoking are more simplistic and are operationalised by a single item reflecting unwillingness to quit smoking. Thus, a key aim of this thesis is to review the literature on hard-core smoking and hardening to assess claims of hardening amongst smokers in Australia and internationally, determine whether there were similar characteristics amongst hard-core smokers and, importantly, to determine the degree of variability in hard-core smoker definitions. This variability is important because, if widely varying definitions and operationalisations of the definitions of hard-core smoking are being utilised, then this could either under- or over-estimate hard-core smoking rates, resulting in ineffective or even harmful strategies for public health.

1.4 ANDS Products in Australia

ANDS are also referred to as electronic nicotine delivery devices (ENDS). E-cigarettes or vapes, which vaporise nicotine liquid, are one form of ANDS, as are heat not burn (HNB) products. The common denominator amongst these products is the lack of combustion that occurs with CCs.

E-cigarettes use a battery to heat a nicotine liquid, which also contains either propylene glycol or vegetable glycerine and a range of flavourings to produce an aerosol. HNB products use a battery system to heat tobacco rather than nicotine liquid. HNB products include Philip Morris International's (PMI) IQOS product and British American Tobacco's (BAT) Glo product. All the major tobacco companies now have a stake in the ANDS market.

E-cigarette devices range from those that mimic the design of cigarettes, to modular tank systems, through to everyday items such as pens and USB sticks. E-cigarettes that do not contain nicotine may be sold in some Australian jurisdictions; however, the sale and purchase of nicotine-containing e-cigarettes without a valid medical prescription is illegal in all Australian States and Territories. HNB products are illegal in Australia and cannot be accessed even with a medical prescription.

1.5 Theoretical Stage Models of Smoking Cessation

This thesis utilises the Precaution Adoption Process Model (PAPM) as a theoretical framework to investigate hard-core smokers. PAPM is a stage-based model, with some similarities to the widely used and cited Trans-theoretical Model (TTM). This section begins by providing a brief overview of the TTM and how it has been applied in smoking cessation literature. The PAPM is then discussed within the context of hard-core smoking.

1.5.1 The Trans-theoretical Model

The TTM (also known as the stages of change model) was developed in the early 1980s and is the dominant theoretical model in smoking cessation research and clinical practice.(31) The TTM is based on a series of stages which allow for relapse through the stages as follows:

- pre-contemplation – no intention to change behaviour in the next six months;
- contemplation – the individual is considering changing behaviour within the next 6 months;
- preparation – the individual is planning to change in the immediate future, usually within a month and has tried to change in the past year;
- action – the individual is engaged in behaviour change; and
- maintenance – the changed behaviour is maintained for more than six months.

The TTM also incorporates a number of key constructs from other change theories, in particular:

- decisional balance – the individual's weighting of the pros and cons associated with smoking. In the early stages, the pros of smoking outweigh the cons, however, this changes as individuals move through the stages;
- self-efficacy – as individuals progress through the stages, self-efficacy is increased whilst temptation to relapse is decreased; and
- processes of change – which support progress through the stages and range from awareness raising in the early stages through to behavioural processes, which are more effective in the later stages.(32)

According to the TTM, hard-core smokers are in the pre-contemplation stage because they have no intention of quitting in the next six months. However, a key limitation of the TTM is that the pre-contemplation stage is not a single stage. Rather, researchers have identified subgroups in the pre-contemplation stage, suggesting the existence of pseudo-stages.(33-38) Three different subgroups of smokers have been identified in the pre-contemplation stage: i) immotives; ii) disengaged; and iii) progressing.(33, 34) Immotive smokers have low motivation to quit, and express high temptation to smoke. The progressing group are ambivalent about the pros and cons of smoking, but still express high levels of temptation to smoke. Disengaged smokers are not engaged with their smoking behaviour, nor are the pros nor cons of smoking perceived as important. Such different groups within the pre-contemplation stage suggest that it lacks the specificity to adequately deal with smokers not yet, or not ever, seeking to quit. As such, the TTM may have limited utility in understanding hard-core smokers.

1.5.2 The Precaution Adoption Process Model

In contrast to the TTM, the PAPM may provide a more useful framework for investigating hard-core smokers. While sharing some similarities with the TTM, the PAPM differs by specifying different stages for those who have not engaged with the quit message (Stage 2), those who are deciding about whether they might quit (Stage 3) and those who have made a

conscious decision not to quit (Stage 4). As such, the PAPM provides tobacco control researchers with the potential to better understand smokers who are unwilling or unable to quit.

Weinstein and Sandman acknowledge the similarities of the PAPM to the TTM but note "One value of the PAPM is its recognition of important differences among people who are not acting and not even thinking about acting".(39) Progression through the seven stages of the PAPM is determined by "psychological processes within the individual", rather than external factors or time constraints.(39) Table 1.1 details the PAPM stages and characteristics, and identifies where the TTM stages align with the PAPM stages.

Table 1.1 Summary of the PAPM stages, in comparison to the TTM (40, 41)

PAPM Stages	**PAPM Stages characterised by:**	**Corresponding TTM Stages**	**TTM Stages are characterised by:**
Stage 1: Lack of knowledge	Ignorance regarding the issue	Pre-contemplation	No intent to change behaviour in the next 6 months
Stage 2: Aware but unengaged	Knowledge of the issue but not personally engaged: never thought of changing behaviour	Pre-contemplation	No intent to change behaviour in the next 6 months
Stage 3: Engaged and making decision	Undecided but thinking about taking action	Contemplation	Intending to change behaviour within the next 6 months
Stage 4: Decides not to act	The severity of the risk, precaution effectiveness, cost, likelihood and susceptibility threshold is not met for the individual and they move out of the cycle to inaction	Pre-contemplation	No intent to change behaviour in the next 6 months
Stage 5: Decides to act	The severity of the risk, precaution effectiveness, cost, likelihood and susceptibility threshold is met and an intention to act is formed.	Preparation	Intending to change behaviour within the next month
Stage 6: Action	Behaviour change is implemented	Action	Behaviour change has been implemented in the previous 6 months
Stage 7: Maintenance	Behaviour change is maintained over time	Maintenance	Behaviour change is maintained over time

The PAPM was initially applied to home radon testing.(42, 43) Since then, it has been used in behaviour change research for a range of interventions.(44-60) Only a small number of studies have applied the PAPM to smoking cessation and none have looked at using the model for addressing hard-core smoking.(59, 60) By utilising the PAPM, this thesis has the potential to further our understanding of hard-core smokers. As outlined in the next section, individually focussed, product-based tobacco harm reduction, which remains a contentious area in tobacco control, has been proposed as a means of supporting hard-core smokers to reduce their risk by transitioning away from CCs to less harmful nicotine products.(61)

1.6 Tobacco Harm Reduction (THR)

THR refers to a range of strategies to mitigate the health risks associated with smoking but which may still involve use of nicotine.(62) Whilst most THR focus on product-based alternatives to combustible cigarettes, the provision of smoke-free spaces as a means of protecting non-smokers from exposure to smoke is also an effective form of THR.(63) Product-based THR has been suggested as way of providing smokers who cannot, or will not, quit with an alternative to cessation.(61, 64) Product-based THR is not a new concept, but it remains a contentious one. In this section, we briefly set out the place of THR in tobacco control and provide a brief overview of its contested history due to tobacco industry interference and political lobbying.

Harm reduction has an entrenched place in public health with initiatives such as methadone clinics, low alcohol drinks, needle exchange programs and ready access to condoms, celebrated as successfully replacing risky behaviours with less risky ones. These activities protect the health of the individual and reduce harmful impacts on society at large. Harm reduction is recognised as a legitimate public health activity and is one of the three pillars of harm minimisation, upon which the current Australian *National Drug Strategy* and the previous *National Tobacco Strategy 2012-18* were premised.(6, 65) The other two pillars being demand reduction and supply reduction. As at July 2021, Australia has been without a

current National Tobacco Strategy since 2018. A draft Strategy for public consultation has been in development but has not been released for public consultation.

Harm reduction aims to reduce the adverse health, social and economic impacts of drug use for the user, their families and friends, and the community. Harm reduction is also enshrined in Article 1 of the World Health Organisation's (WHO) Framework Convention on Tobacco Control (FCTC) which defines tobacco control as "a range of supply, demand and harm reduction strategies that aim to improve the health of a population by eliminating or reducing their consumption of tobacco products and exposure to tobacco smoke".(66)

THR can be directed at a population level through activities such as the provision of smoke-free spaces, preventing uptake of smoking by young people, and requirements for reduced ignition propensity cigarettes to reduce fires.(63) However, THR can also focus on individual smokers by providing alternative nicotine products to transition smokers from CCs, with their well-established harms, onto less harmful nicotine products, such as NRT or other ANDS. This type of harm reduction is product-based THR.

1.6.1 The Tobacco Industry and THR

THR recognises that the ideal outcome is abstinence from tobacco use, either because one never started to smoke or via cessation, but it also accepts the premise that complete elimination of the use of tobacco products in the population is unlikely due to the existence of smokers who cannot or will not quit. Although THR is entrenched in current health policy, it has a contested history in tobacco control due to the interference of the tobacco industry and the failure of industry developed 'potentially reduced exposure products' (PREPs) to actually reduce harm. PREPs have a track record of boosting the industry's bottom line rather than any actual harm reduction.(67) As a signatory to the WHO's FCTC, Australia is obligated to protect public health policies from the vested commercial interests of the tobacco industry.(66) This, however, has not stopped the industry from endeavouring to sway public policy.(68, 69) The tobacco industry's playbook is well-established: invest in research that proves the industry's point, create or support "grass-

roots" organisations to act as front groups and allies, lobby politicians for legislative change, and employ marketing designed to influence social and cultural norms.(70)

Internationally, the tobacco industry has invested in research to support ANDS for harm reduction. A 2019 systematic review of financial conflicts of interest for tobacco, vaping and the pharmaceutical industries and THR included 826 articles published between 1992-2016. Only 39.4% of the articles were empirical studies. The review noted that any industry sponsorship increased support of THR, but that support was 95% for the e-cigarette industry, 88% for the tobacco industry and 72% for the pharmaceutical industry with tobacco industry funded empirical harm reduction research 100% supportive of harm reduction.(71) By contrast, where no funding was declared, support for THR was 49.2% noting that it is likely that not all sources of industry funding are declared, particularly in opinion pieces and letters.(71)

In 2017, PMI established and funded, to the amount of US$80 million over 12 years, the Foundation for a Smoke-Free World which aims to promote harm reduction through smoke-free alternatives to combustible cigarettes. The Foundation has established research centres of excellence for tobacco harm reduction internationally, some of which have overt funding ties to the tobacco industry and/or promote industry claims.(72) The Foundation also provides funding to apparently grass-roots organisations, which promote and lobby for ANDS use for harm reduction. This includes the International Network of Nicotine Consumer Organisations of which the now defunct New Nicotine Alliance Australia was a founding member.(72)

PMI has also appropriated smoke-free terminology (from tobacco control) with the launch of an "unsmoke" campaign which promotes ANDS use in Australia, despite the product not being legally available without prescription.(28) During the 2020 Senate Inquiry into Tobacco Harm Reduction, PMI ran a series of partner content articles in the Australian Newspaper promoting the "science" of smoke-free and in doing so raised questions from tobacco control advocates about whether such actions were a breach of the *Tobacco*

Advertising Prohibition Act 1992*.* Tobacco companies have responded to the various State and Federal government inquiries into e-cigarettes. In 2017, during the public hearings of the Inquiry into the *Use and marketing of electronic cigarettes and personal vaporisers in Australia*, health agencies were dismayed to find themselves asked to present evidence in the same session as the tobacco industry and other vested interest industry organisations. The Australian Medical Association, Thoracic Society of Australia and New Zealand, and Public Health Association of Australia all objected "in the strongest terms [to] the involvement of the tobacco industry in these proceedings".(73) Despite independent reports from Australian scientific agencies and, most recently, a Department of Health funded research program on e-cigarettes which urges policy caution with regard to e-cigarettes, lobbying by pro-vaping and tobacco industry groups has continued to attempt to exert political influence.(26, 68, 74, 75)

1.7 Thesis Aims

As outlined above, Australia's low daily smoking prevalence places it in an enviable position that would allow for planning for elimination of tobacco use. However, a number of challenges to achieving the tobacco endgame have been identified including the need to support smokers who can't and/or won't quit. If Australia is to effectively plan for an endgame, it is vital that evidence drives policy rather than the rhetoric and profit drive of the tobacco industry and other vested commercial interests. Therefore, this thesis aims to:

1. Identify whether the smoking population is hardening in Australia and overseas;

2. Assess whether hardening is occurring amongst Australian smokers during a period in which e-cigarette/ANDS use and advocacy has significantly increased;

3. Examine how hard-core smoking is defined and operationalised, and investigate how this influences variability in the scale and nature of hard-core smoking;

4. Estimate the proportion of Australian smokers who could be classified as hard-core;

5. Investigate the characteristics and risk exempting beliefs of Australian hard-core smokers;

6. Determine whether PAPM might be a useful theoretical framework for clinicians to identify hard-core smokers; and

7. Drawing on evidence for aims 1-6, consider policy responses to harm reduction, focussing on the population level THR approach of smoke-free spaces and tobacco dependence treatment in Australian tobacco control policy.

1.8 Outline of Thesis

This thesis is presented in compilation style. Aside from the introduction (Chapter 1) and general discussion (Chapter 7), all the other chapters (Chapter 2, 3 4, 5, and 6) are based on a published manuscripts in peer reviewed journals.

Chapter 2 (aims 1 and 3) contains the published manuscript of a systematic review of the literature on hard-core smokers and hardening. We used the findings from the systematic review to develop two measures of hard-core smoking in Australia that would provide upper and lower prevalence rates.

Chapter 3 (aims 1, 2, 4, and 5) presents a published manuscript examining the extent of hard-core smoking and evidence of hardening occurring in Australia through statistical analysis of the NDSHS results for 2010, 2013 and 2016.

Population level data sets do not provide sufficient psychological measures to clearly articulate hard-core smoker characteristics and so we conducted a community-based survey via social media and with panel participants to further identify hard-core smoker characteristics in Australia. This survey also enabled us to deploy the PAPM as a theoretical framework to determine whether it may be of assistance in clinical use to identify hard-core smokers. Chapter 4 (aims 5 and 6) contains the analysis of a community sample of smokers and uses the PAPM to identify specific traits of hard-core smokers (see Appendix 1 for the survey questions).

Chapter 5 (aim 7) recognises that smoke-free spaces is a population level THR measure and assesses the status of smoke-free spaces in Australia. Chapter 6 (aim 7) discusses Australian tobacco dependence treatment policy in Australia. Chapter 6 is informed by the peer reviewed publication on e-cigarettes.

Finally, Chapter 7 is a general discussion including a summary of findings, the implications of this thesis and a discussion on its limitations and recommendations for future research. If we are to adjust our public health and tobacco control policy to account for hard-core smokers and to incorporate product-based individually focused harm reduction, then it is vital that Australian policy makers are able to quantify the size and scope of the issues, have a baseline assessment of how many hard-core smokers there are, and whether they pose a credible threat to achieving further prevalence reductions. With this information, an improved understanding of the THR needs of the smoking population may be incorporated into an Australian tobacco control strategy and interventions which are proportionate to the problem and which address both population harms as well as individual harms can be developed.

Chapter 2.Tobacco Harm Reduction: Are Smokers Becoming More Hard-core? (Paper 1)

This chapter has been published in the Journal of Public Health Policy. The chapter is identical to the published manuscript except for table numbers, changing “hardcore” to “hard-core” and inclusion of supplementary material in the published paper and references, which have been altered to ensure uniformity in formatting across the thesis.

Buchanan, T., Magee, C.A., See, H.V., Kelly, P.J. Tobacco harm reduction: are smokers becoming more hard-core? *J Public Health Pol* **41**, 286–302 (2020). https://doi.org/10.1057/s41271-020-00226-1

Abstract

We undertook a systematic review to identify and summarise studies on hard-core smoking and hardening to: determine the degree of variability in definitions of hard-core smoking and hardening; assess the evidence for claims that smokers are becoming increasingly hardened within the context of harm reduction as a policy initiative; and identify the determining characteristics of a hard-core smoker. We searched five electronic databases from 1970 to mid-April 2018 using the search term “smok* AND hard* AND (tobacco **OR** cigar* OR nicotin*)”. We included studies if they included a definition of hard-core smokers and/or hardening, and provided a prevalence rate for hard-core smokers or empirical evidence for hardening. Definitions of hard-core smoker varied substantially across studies. Hardening was not evident in the general smoking population and we found mounting evidence of softening occurring in smoking populations. These results indicate that hardening of smokers is not occurring and that calls for policy interventions on this basis should be challenged.

2.1 Introduction

Tobacco harm reduction strategies aim to enable entrenched smokers to transition to less hazardous nicotine delivery systems.(76) Tobacco harm reduction is a public health priority given that up to two-thirds of smokers will die from their cigarette use.(1) However, reduced risk tobacco products (such as filters and low tar) have failed to reduce harm to smokers, and harm reduction has become a contentious issue in tobacco control.

The existence of a cohort of smokers who either cannot or will not quit smoking (hard-core smokers) is a fundamental issue for tobacco harm reduction. In 2007, the Royal College of Physicians released a harm reduction report addressing smokers who are unable to quit. The report detailed three levels of tobacco harm reduction:

- maintain a focus on cessation only; often referred to as the "quit or die" approach,
- make nicotine containing products as available to adults as cigarettes, or
- make alternative products more available and affordable than cigarettes.(61)

In 2016, the College updated their harm reduction report to account for the dramatic rise of electronic or e-cigarettes and recommended that "in the interests of public health it is important to promote the use of e-cigarettes, NRT [nicotine replacement therapy] and other non-tobacco nicotine products as widely as possible as a substitute for smoking in the UK."(64) In contrast, the European Respiratory Society has argued the case against harm reduction asserting it is premised on the erroneous assumptions that smokers cannot or will not quit, alternative nicotine delivery systems are effective cessation aids, and smokers will switch to the alternative nicotine delivery system.(77)

Emergence of alternative nicotine delivery systems (ANDS) such as e-cigarettes and heat-not-burn products (for example, Philip Morris International's IQOS and British American Tobacco's glo) have breathed new life into the tobacco harm reduction debate. For example, between 2013 and 2016, smoking prevalence rates in Australia did not decline

significantly.(5) This resulted in claims that the Australian smoking population had 'hardened'; accompanying these claims were calls for widespread access to, and use of, e-cigarettes by smokers who could not or would not quit.(78, 79)

The concept of 'hard-core' smokers and the hardening hypothesis is particularly relevant for public health. In 2003, Warner and Burns defined a hard-core smoker as "a daily, long-term smoker who is unable or unwilling to quit and who is likely to remain so even when possessing extensive knowledge about the hazards of smoking and when confronting substantial social disapprobation of smoking".(11) The hardening hypothesis, has an intuitive appeal—as smoking prevalence rates decline, remaining smokers are increasingly hard-core because those who could quit easily will have done so.(12)

Existence of hard-core smokers is not evidence of hardening.(80) Rather, hardening is indicated by increases in the proportion of hard-core smokers amongst the smoking population over time, and is likely to be accompanied by reductions in support for tobacco control policies, increases in levels of psychological distress, and increasingly low levels of socioeconomic disadvantage amongst either hard-core smokers or the smoking cohort as a whole.

While many studies have examined hard-core smokers and the hardening hypothesis, existing literature is plagued by inconsistencies in the application of these concepts. For example, Darville and Hahn conducted a review of studies published between 1998 and 2012 that examined hard-core smokers.(81) The authors aimed to increase understanding of the characteristics of hard-core smoking to facilitate cessation treatment. They concluded that inconsistent definitions of hard-core smokers made determining prevalence rates challenging. Nonetheless, they found associations between early age of smoking onset and persistent smoking, and persistent smoking with increased dependence on nicotine. They also found that hard-core smokers were more likely to be socially marginalised, suffer medical and psychological illness, be from lower socio-economic groups, and have lower levels of education. As the review focussed on cessation, it

concluded that cessation treatment strategies must be expanded to address the needs of persistent smokers as well as ensuring that smoking is socially unacceptable and discouraged.

In this systematic review we aimed to identify and summarise studies on hard-core smoking and hardening to:

- determine the degree of variability in definitions of hard-core smoking and the impact of this variability on hard-core smoking prevalence rates,
- assess the evidence for claims that smokers are becoming increasingly hardened, and
- identify the determining characteristics of a hard-core smoker.

These are important considerations for harm reduction policy and interventions because different definitions and operationalisation of hard-core smoking could result in varied estimates of the extent of hard-core smokers or the introduction of ineffective, or even, harmful strategies.

2.2 Methods

2.2.1 Eligibility Criteria of Studies

We included studies if they included a definition of hard-core smokers or hardening, and provided either a prevalence rate for hard-core smokers or empirical evidence for hardening in the smoking population. We included only studies published in English in a peer reviewed journal between 1970 and April 2018 that addressed the adult population. We excluded studies that provided a commentary or a precis of existing research but lacked original empirical evidence.

2.2.2 Data Sources

One investigator searched five electronic databases (Web of Science, PubMed, PsycInfo, CINAHL, and Scopus) using the search term “smok* AND hard* AND (tobacco OR

cigar* OR nicotin*)". We set search dates between 1970, when the phrase hard-core smoker first appeared in the literature, and April 2018.

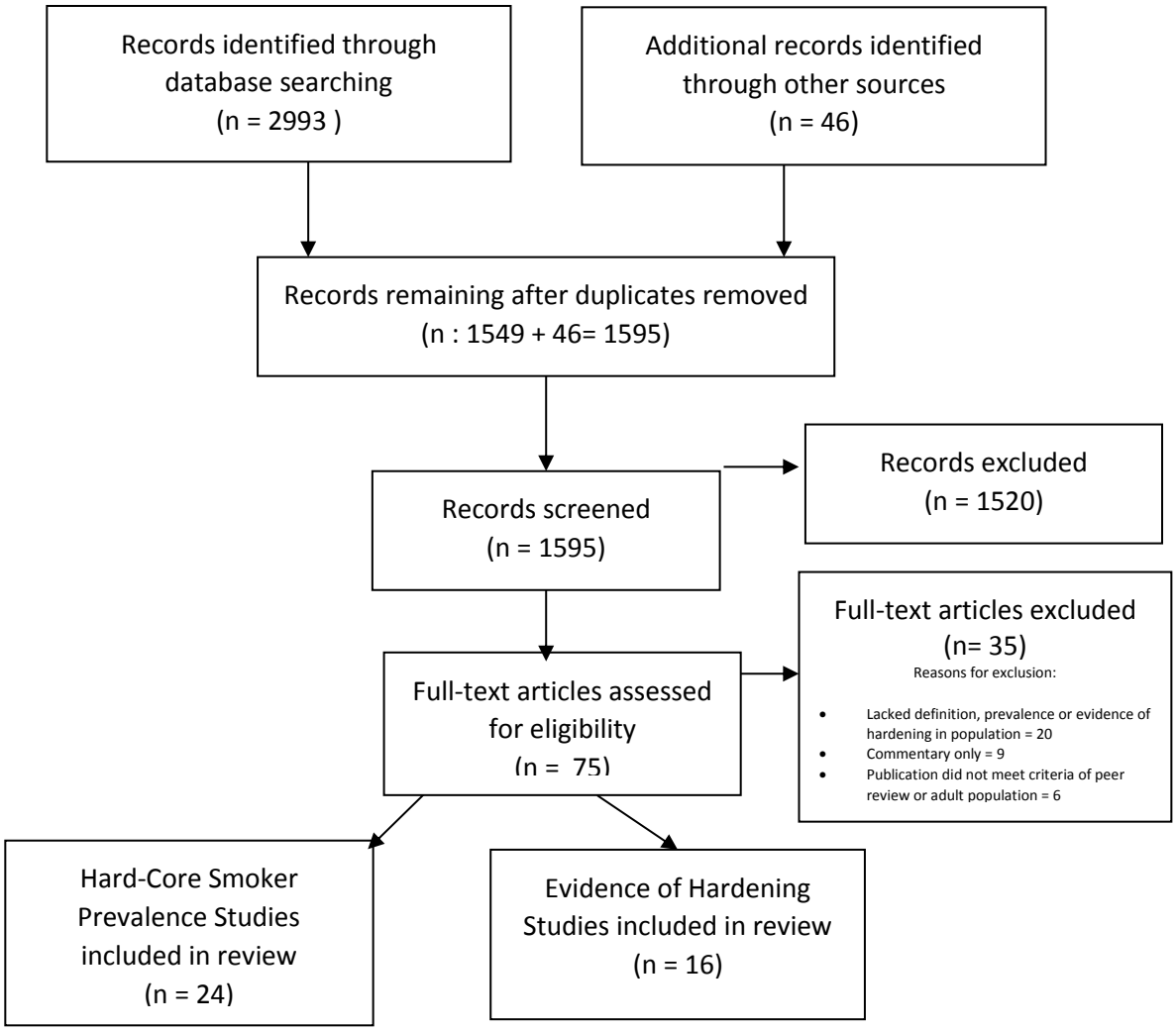
Results yielded 2993 studies. Removal of duplicates revealed 1549 unique studies. A single investigator (TB) reviewed reference lists of these studies and identified 46 more papers for inclusion in the screening process. This resulted in a total of 1595 papers. The PRISMA diagram (see Figure 1) details the identification, screening, and eligibility assessment for studies in this review.(82)

2.2.3 Study Selection, Data Extraction and Synthesis

A single investigator (TB) examined the titles and abstracts of the 1595 studies and excluded 1520 that did not define or discuss either hard-core smokers or the hardening hypothesis. Two reviewers (TB and HS) conducted study selection independently on the remaining 75 items. They used the study inclusion criteria and TB and HS were blinded to each other's comments. A third reviewer (CM) resolved any disagreements. There was a high degree of inter-rater agreement.

We extracted and recorded data on the extraction form for analysis, including sample size, study design, study setting, hard-core smoking definition, hard-core smoking prevalence, and study results. We selected 40 articles for inclusion in the systematic review: 24 that provided a prevalence rate for hard-core smokers and 16 that provided evidence about hardening in the smoking population.

Figure 2.1: PRISMA Diagram



2.3 Results

Twenty-four studies provided a prevalence rate for hard-core smokers. Variables used to define and operationalise hard-core smokers and the prevalence rates of each study are shown in Table 2.1. Definitions of a hard-core smoker vary widely. Twenty-four studies generated 33 definitions of hard-core smoker. Only three papers by two author groups used the same combination of variables to study hard-core smokers.(83-85) Thus, 24 studies generated 30 unique operational definitions of a hard-core smoker.

Table 2.1: Variables Used to Define Hard-core Smokers and Associated Prevalence Rates

Study	No of Def's	Min Age	Daily Smoker	Quit intent	Quit attempts	Smoking history	Dependence measures	Other	Country	HCS Prevalence*
Augustson & Marcus, 2004(83)	1	26	Y	Not in 6 months	No lifetime	=5yrs+	15+cpd		USA	13.7% national sample 8% California sample
Auguston & Marcus,2008 (84)	1	26	Y	Not in 6 months	No lifetime	=5yrs+	15+cpd		USA	11% female smokers
Azagba 2015 (86)	D1	-	Y	Not in 6 months	Not in 1yr	-	TTFC		Canada	19.7%
	D2	-	Y	Not in 6 months	Not in 1yr	-	15+cpd TTFC			14.3%
Bommelé et al 2016 (87)	D1	25	Y	Not in 6 months	Not in 1yr	-	15+cpd		Netherlands	40.8% in 2001-32.2% in 2012
	D2	25	Y	Not in 6 months	Not in 1yr	-	-			
Bowman et al 2012 (88)	1	-		Not in 6 months	Not in 1yr	-	15+cpd		Australia**	33.8% of sample only
Clare et al 2014 (14)	1	-	Y	no intent	Not in 1yr	-	15+cpd		Australia	11.9% in 2001 - 10.7% in 2010
Coady et al 2012 (89)	1	-	Y	-	-	100+ cigs	CPD rating		USA	Heavy smoking reduced from 7.8% in 2002 - 4.3% in 2008 of sample

Costa et al 2010 (90)	D1[I]	-		Not in 6 months	No lifetime	-	-		Canada	13.77%
	D2[II]	-		Not in 6 months	No lifetime	=5yrs+	-			10.56%
	D3[III]	-		-	-	-	HSI			9.60%
	D4[IV]	-		Not in 6 months	No lifetime	-	HSI			1.47%
	D5[V]	-		Not in 6 months	No lifetime	=5yrs+	HSI			1.41%
	D6[VI]	-		Not in 6 months	No lifetime	=5yrs+	HSI	Outcome expectations and social influences		0.03%
Docherty et al 2014 (91)	D1	26		no intent	-	-	-		UK	27.9%
	D2	26		-	-	-	TTFC			47.6%
	D3	26		no intent	-	-	TTFC			12.8%
Emery et al 2000 (10)	1	26	Y & non-daily	no intent	Not in 1yr	100+ cigs Smoking for 1yr+	15+cpd		USA	5.2%
Ferketich et al 2009 (85)	1	26	Y	Not in 6 months	No lifetime	=5yrs+	15+cpd		Italy	33.1%
Jarvis et al 2003(92)	1	-		no intent	Not in 1yr	=5yrs+	-	Less than 24hrs without smoking in past 5years	England	16%
Jena & Kishore	1	26	Y	no intent or not in 12	Not in 1yr		TTFC	Knowledge	India	28.7%

2012(93)				months						
Kaleta et al 2014 (94)	1	26	Y	no intent or not in 12 months	Not in 1yr	=5yrs+	15+cpd		Poland	Men= 41.6% Women =37.7%
Kang et al 2017 (95)	1	-		no intent or not in 12 months	Not in 1yr		15+cpd		South Korea	23.1% in 2007 23.0% in 2013
Kien et al 2017 (96)	1	25	Y	Not in 12 months	Not in 1yr	=5yrs+	15+cpd		Vietnam	2010: 9.5% (male population) 2015: 13.1% (male population)
Kishore et al 2013 (97)	1	-	Y	no intent or not in 12 months	Not in 1yr		TTFC	Knowledge	India Bangladesh Thailand	India: 28.7% Bangladesh: 18.3% Thailand: 29.7%
Ladwig et al 2005 (98)	1	-	Y	no intent	Not in 1yr			No attempt to reduce smoking No intent to change behaviour	Germany	22.6%
Leung et al 2016 (99)	1	-	Y	no intent	No lifetime	min 6yrs	11+ cpd		Hong Kong	2005: 22.5% 2008:28.3%
Lund et al	1	25	Y	Not in 6	Not in 1yr		-	Believed still	Norway	16% in 1997 -

2011(100)				months				smoking in 5 years		6% in 2009 of sample
MacIntosh & Coleman 2006 (101)	1	-	Y or most days	Not in four weeks & no desire to quit	Not in 1yr		-		England**	16.1% (sample)
Sorg et al 2011 (102)	1	26	Y or some days	no intent	Not in 1yr	100+ cigs	15+cpd		USA	7.8%
Walsh et al 2006 (103)	1	26	Y or some days	no intent	Not in 1yr	100+ cigs & Smoking for 1yr +	15+cpd		Australia**	5.5%
Yang et al 2016 (104)	1	26	Y	Not in 6 months	No lifetime	=5yrs+	TTFC		China**	32.9% (sample)

* Unless otherwise indicated, prevalence rate is the % of HCS in the smoking population

** Non-population level survey sources

i derived from Macintosh and Coleman 2006

ii derived from Jarivs et al 2003

iii derived from Fagerstrom et al 1996

iv derived from Emery et al 2000

v derived from Augustson and Marcus 2004

vi derived from Warner and Burns 2003

Variability appeared in every definitional item. Fifty-four percent of the studies included a minimum age of 25+ years to account for smokers who had recently started smoking and had not yet had an opportunity to fully form the habit or dependence. The remaining studies did not specify a minimum age for hard-core smokers and used the age data available from the data sets in use. Some data sets included smokers as young as 12 years.

Measures of smoking history varied; half of the definitions did not include any smoking history. The remainder measured a history of 5 years or more smoking (*n* = 10), a 6 year smoking history (*n* = 1), 100 cigarettes in a lifetime (*n* = 2), and 100 cigarettes and a smoking history of more than 1 year (*n* = 2).

Many of the prevalence papers equated intent to quit with the precontemplation stage of 6 months from the Transtheoretical Model (TTM). Fifteen definitions used a 6 month timeframe, 9 definitions used no intent to quit without a time frame, and 5 definitions used no intent in 12 months and/or no intent. Only three definitions included no measure of intent to quit. Intent to quit was the most frequently deployed item in assessing hard-core smokers.

Studies operationalised quit attempt history as either any previous quit attempt in the last 12 months or no lifetime quit attempt. Ten definitions used no lifetime quit attempt, 18 studies used no 12-month quit attempt, and 5 did not include previous quit attempts. Previous quit attempts were the second most frequently deployed item in assessing hard-core smokers.

We detail characteristics of hard-core smokers from studies in the general population in Table 2.2. This table excludes studies focussed on specific groups such as addiction treatment seekers. Regardless of varying definitions, hard-core smokers are more likely to be older, male, less exposed to smoking bans, and to have initiated smoking at a younger age.

Table 2.2: Characteristics of Hard-core Smokers from General Population Studies

Authors, year, and country	**Factors associated with hard-core smokers**							
	Gender	**Age**	**Employment**	**SES/income status**	**Educational attainment**	**Relationship status**	**Contact with smoking restrictions**	**Other**
Augustson and Marcus, 2004(83), US	↑ Male	↑ Older	↓ Employed	↓ Income	↓ Education	↓ Married	↓ contact	↓ Younger age started smoking ↑ Number cigarettes/day ↓ Seen health professional in past 12 months
Auguston and Marcus 2008 (84), US	-	-	-	-	-	-	-	-
Azagba 2015 (86), Canada	↑ Male	↑ Older	ns	-	↓ Education	↓ Married	-	-
Bommelé et al. 2016 (87), Netherlands	ns	↑ Older	↓ Employed	-	↓ Education	-	-	↑ Consumption of RYO
Clare et al. 2014 (14),	↑ Male	-	↑ Not in workforce	↓ SES	↓ Education	↑ Separated/	-	↑ Aboriginal or Torres Strait Islander

Authors, year, and country	Factors associated with hard-core smokers							
	Gender	**Age**	**Employment**	**SES/income status**	**Educational attainment**	**Relationship status**	**Contact with smoking restrictions**	**Other**
Australia						widowed		↑ Single parent ↑ Migrant ↑ Speaks 'other' language at home
Docherty et al. 2014 (91), UK	↑ Male	↑ Older	-	↓ SES	-	-	-	-
Emery et al. 2000 (10), US	↓ Female	↑ Older	↓ Employed	↓ Income	ns	↓ Married	↓ Contact	↑ Younger age started smoking ↓ Poorer health status ↓ Perceived health impact of smoking ↓ Family disapproval of smoking ↑ Non-Hispanic white

Authors, year, and country	Factors associated with hard-core smokers							
	Gender	**Age**	**Employment**	**SES/income status**	**Educational attainment**	**Relationship status**	**Contact with smoking restrictions**	**Other**
Ferketich et al. 2009 (85), Italy: female sample	-	-	ns	ns	ns	ns	↑ Smoking permitted at home	↓ Younger age started smoking ↑ Perceived stress
Ferketich et al. 2009 (85), Italy: male sample	-	-	↑ Lower employment 'class'	ns	ns	ns	ns	↓ Younger age
Jarvis et al. (92), England	ns	↑ Older	-	↑ Deprivation	-	-	-	↑ Younger age started smoking ↑ Number of cigarettes/day ↑ Have cigarette within 5 mins of waking
Jena and Kishore 2012 (93), India	↑ Male	↑ Older	↓ Self employed	-	ns	-	-	

Authors, year, and country	Factors associated with hard-core smokers							
	Gender	**Age**	**Employment**	**SES/income status**	**Educational attainment**	**Relationship status**	**Contact with smoking restrictions**	**Other**
Kaleta et al. 2014 (94), Poland female sample	-	↑ Older	ns	-	ns	-	↑ Smoking allowed in home	↑ Younger age started smoking ↑ Live in larger cities ↑ Awareness of health consequences
Kaleta et al. 2014 (94), Poland male sample		↑ Older	ns	-	ns	-	↑ Smoking allowed in home/no rules	↑ Younger age started smoking ↑ Awareness of health consequences
Kang et al. 2017 (95), South Korea	↑ Male	↑ Older	ns	ns	ns	ns	-	-
Kien et al. 2017 (96), Vietnam	Study limited to males only	↑ Older	↑ Self employed	↑ Low SES	↑ Lower education	ns	↑ Smoking allowed in home	↑ Urban area
Kishore et al. 2013 (97), India,	↑ Male (India)	↑ Older (India and Banglades	↑ Self employed	↑ Low SES (Bangladesh)	ns	-	-	-

Authors, year, and country	Factors associated with hard-core smokers							
	Gender	**Age**	**Employment**	**SES/income status**	**Educational attainment**	**Relationship status**	**Contact with smoking restrictions**	**Other**
Bangladesh, Thailand		h)	(India) ↑ 'other' employment (Thailand)					
Leung et al. 2016 (99), Hong Kong	ns	ns	-	-	-	ns		↑ Reasons for not giving up smoking—as a refreshment, social functions, 'killing' time
Lund et al. 2011 (100), Norway	↑ Male	↑ Older	-	-	↑ Lower education	-	-	-
MacIntosh and Coleman 2006 (101), England	↑ Male	ns	-	-	-	-	-	↑ Higher dependence
Sorg et al. 2011 (102), US	↑ Male	↑ Older	↓ Employed	↑ Lower income	↑ Lower education	↓ Married	-	↑ Live in rural areas ↑ Non-Hispanic white
Walsh et al. 2006 (103),	-	-	-	-	-	-		-

Authors, year, and country	Factors associated with hard-core smokers							
	Gender	**Age**	**Employment**	**SES/income status**	**Educational attainment**	**Relationship status**	**Contact with smoking restrictions**	**Other**
Australia								
Yang et al. 2016 (104), China	Study limited to males only	↓ Younger	↑ Farmer (vs other occupation)	ns	ns	-	-	↑ Higher smoking intensity ↑ Younger age started smoking ↓ Number of smokers around

↑ Covariate has a positive relationship with hard-core smoking; ↓ covariate has a negative relationship with hard-core smoking, - covariate not included/insufficient information to determine the nature of the relationship;

ns, Relationship not significant

Hard-core smoker prevalence ranged from 0.03 to 41.6% of smokers depending on the definition used. Thus, we did not conduct a meta-analysis due to lack of consistency in study methodologies, sample characteristics, recruitment, study time frames, variability of hard-core smoker definitions, and methods of reporting of prevalence rates.

Sixteen papers provided empirical evidence for, or against, hardening in the smoking population (Table 2.3) using various measures as evidence of hardening in the population. These included a wide range of factors as evidence including mental illness, cessation rates, quit attempts, dependence/consumption and motivation. More than two thirds of the studies (69%) assessed changes in the smoking population over several years. This is a major strength of the papers as hardening occurs in a population over time.

Only one study concluded there was evidence of hardening in the general population.(105) However, this study had a number of methodological issues including use of ecological data, reliance on publications instead of raw data, and only one measure of hardening. There was some indication that hardening may be occurring in treatment seekers, women and low SES groups, but not in the general smoking population.(12, 13, 106) As detailed in Table 2.4, the greater weight of evidence pointed to softening in the smoking population. (87, 89, 100, 107-109)

Table 2.3: Studies Assessing Hardening

Study	Study Objective	Component constructs	Sample and Data source	Location
Edwards et al 2017 (110)	Assessed whether hardening was occurring using four hardening constructs from 2008-2014	a) motivation to quit, b) increased levels of addiction, c) increased levels of disadvantage d) reduced quit rates among continuing smokers	2008 n=422 current smokers 2010 n=451 current smokers 2012 n= 581 current smokers 2014 n=580 current smokers The Health and Lifestyle Survey (HLS)	NZ
Etter 2008(111)	Tested the hardening hypothesises	CPD, quit attempts and motivation to quit	Behavioural Risk Factor Surveillance System (BRFSS)	USA
Fagerstrom and Furberg 2008(105)	Examined correlation between FTND and smoking prevalence	FTND	15 studies from 13 countries	Various
Fernandez et al 2015 (112)	To test the hardening hypothesis	HSI compared with smoking prevalence	Pricing Policies and Control of Tobacco in Europe Project. 2882 male smokers 2254 female smokers	Europe
Fu et al 2009 (113)	To test the hardening hypothesis	Dependence using FTND compared with prevalence	Cross sectional survey (n=2522)	Spain
Gartner et al 2012 (13)	To examine if there has been an increased hardening	SES and levels of psychological distress amongst smokers 1997-2007	National Survey of Mental Health and Well Being 1997 (n=10641) and 2007 (n=8463) National Health Surveys	Australia

			2001 (n=17725), 2004-5 (n=19501) and 2007-8 (n=15779) National Drug Strategy Household Survey 2001(n=25263), 2004 (n=26730), 2007(n=21846) and 2010 (n=21846)	
Hughes 2011 (12)	Reviews existing studies. Proposes a definition of hardening and tests hardening	Decreased ability to quit due to increased nicotine dependence	Literature search	-
Ip et al 2012 (114)	To identify which components of the hard-core smoker definition are predictive of quitting and which combination of components is most predictive	Daily cigarette consumption Nicotine dependence Daily smoking History of long term smoking No quit intent No life time quit attempt	Ontario tobacco Survey 2005-8 with 1 year follow up (n=4130)	Ontario, Canada
Joly et al 2016 (115)	Compare successful quitting rates between hard-core smokers and other smokers	26yrs and over 15 + CPD No previous quit attempts	1296 smokers Recruited in cessation clinics 1999-2009	France
Kulik and Glantz 2016 (107)	Examined if hardening was occurring by analysis of quit rates	Quit rates over time	USA: Tobacco Use Supplement 1992/93 – 2010/11 Europe: Eurobarometer Surveys for 31 countries (2006, 2009 & 2012)	USA And Europe
Kulik and Glantz 2017	Analysis of hardening in smokers with psychological	Smokers with Kessler-6 score greater than or equal to 13	National Health Interview Survey 1997-2015	USA

(108)	distress			
Mathews et al 2010 (15)	To examine changes in prevalence of affective distress amongst smokers	Affective disorders and psychological distress in smokers over time	National Survey of Mental Health and Well Being 1997 and 2007	Australia
Pierce et al 1989 (116)	Uses the smoking continuum to identify if hard-core smokers are over-represented in some population groups	Smoking continuum	Adult Use of Tobacco Survey 1996	USA
Smith et al 2014 (106)	Studies changes in dependence	Nicotine Dependence Syndrome Scale Cigarette consumption SES	130637 smokers National Survey on Drug Use and Health 2002-12	USA
Szlko et al 2016 (109)	Examines changes in smokers' behaviour and health	Health status Nicotine dependence Quit attempts Cessation rates	Global Adult Tobacco Survey (GATS)-Brazil 2008 and 2013	Brazil
Warner and Burns 2003 (11)	Reviews the hard-core smokers and hardening concepts in the literature and examines the pros and cons of the hardening debate.	Daily, long term smoker unable or unwilling to quit and likely to remain so despite being knowledgeable about the hazards of smoking and confronting social disapprobation of smoking	Literature review	USA

Table 2.4: Studies Citing Evidence of Hardening or Softening

Study	Support for Hardening	Rationale
Augustson and Marcus, 2004 (83)	No	Compared the differences between a national and Californian sample, noting that California's hard-core smoking rate in an active tobacco control environment does not support the hardening hypothesis.
Azagba 2015 (86)	No	There were no increases in hard-core smokers over time.
Bommelé et al 2016 (87)	No: supports softening	The decrease in hard-core smoking suggests a 'softening' of the smoking population
Clare et al 2014 (14)	No	There was no increase in the proportion of hard-core smokers.
Coady et al 2012 (89)	No: supports softening	After a 27% decline in smoking prevalence, remaining smokers consumed fewer cigarettes and exhibited reduced levels of heavy smoking.
Edwards et al 2017 (110)	No	Smoking prevalence decreased over the period of study but there was no evidence based on multiple indicators of hardening as evidenced by decreased motivation to quit, increased addiction, increased levels of disadvantage, reduced quit rates or falling support for tobacco control policy.
Etter 2008(111)	No	In states where there was a higher smoking prevalence this was associated with higher rates of heavy smokers, lower quit rates and lower motivation to quit.
Fagerstrom and Furberg 2008 (105)	Yes	An inverse correlation between countries with low prevalence and higher FTND scores identified.
Fernandez et al 2015 (112)	No	The relationship between HSI and smoking prevalence were not significant but did occur in the opposite direction to that posited by the hardening hypothesis
Fu et al 2009 (113)	No	A decrease in smoking prevalence has not been accompanied by an increase in nicotine dependence.
Gartner et al 2012 (13)	Inconclusive	Smoking prevalence declined but there was no change in psychological distress.
Hughes 2011 (12)	Treatment seekers may be	Quit rates have not decreased over time. TTFC has not changed over time and CPD has declined over time.

	hardening	
Jarvis et al 2003(92)	No	Uses a comparator with California where robust tobacco control has reduced hard-core smoking rates and smoking prevalence.
Kulik and Glantz 2016 (107)	No: supports softening	For each 1% decline in prevalence, quit attempts increased in the USA and remained stable in Europe
Kulik and Glantz 2017 (108)	No: supports softening	Smokers with higher Kessler scores smoke more heavily than the general smoking population but prevalence rates are declining, albeit more slowly than in the general smoking population. There were significant increases in quit attempts and decreases in consumption over the period.
Leung et al 2016 (99)	No	The proportion of hard-core smokers remained stable over the study period which included the implementation of smokefree legislation and warning labels on cigarette packets.
Lund et al 2011(100)	No: supports softening	A downward trend in rates of hard-core smoking does not support hardening, where hardening is defined as increased inability or desire of remaining smokers to quit.
Mathews et al 2010 (15)	No	No increase in the prevalence of affective disorders in smokers over the period.
Smith et al 2014 (106)	Low SES and women may be hardening	Consumption and dependence both declined over the study period.
Szlko et al 2016 (109)	No: supports softening	As prevalence rates declined there was an increase in quit rates and quit attempts
Walsh et al 2006 (103)	No	The very low rate of hard-core smoking in the sample supports the claim that low smoking prevalence rates lead to a lower acceptability of smoking and reduced levels of hard-core smoking.
Warner and Burns 2003 (11)	Hardening is probably occurring in high risk populations	Hardening should be considered in specific groups such as the mentally ill. Little evidence of hardening in the general smoking population as cessation rates had not decreased.

2.4 Discussion

This systematic review reveals wide-ranging disparity in the application of the hard-core smoker concept making it difficult to accurately estimate the extent of this problem and compare results among studies. Variations in hard-core smoking operationalisation have persisted even as hard-core smokers have increasingly become a target population for harm reduction. This variability can be partly attributed to the number of studies using secondary data sources, thus relying on the measures already included in the study. While use of population data is a strength of studies included in this systematic review (for generalisability of results to the population), it is also a limitation; it contributes to different operationalisations and prevalence rates of hard-core smoking.

The variation makes it difficult to compare studies as they likely identify different sub-populations of smokers. Some studies operationalised hard-core smoking using a small set of criteria (such as relying only on a single measure of quit intent). This is problematic; these studies are likely to include a mix of different smokers, including hard-core smokers as well as those who are lacking self-efficacy or social encouragement to quit. These studies are likely to overestimate the prevalence of hard-core smokers. Costa et al., for example, found that the various operational definitions produced prevalence rates ranging from 13.77% (for a study that required only no intent to quit in the next 6 months and no ever quit attempt) to 0.03% (for a study using daily smoker with a 5 year smoking history, no intent to quit in the next 6 months, no ever quit attempt, high nicotine dependence, outcome expectations and social acceptance factors).(90) Despite the variation, most studies included these indicators: intention to quit; number of quit attempts; and, tobacco dependence. We discuss these indicators in more detail below.

While intent to quit is the most consistent criterion used to define hard-core smokers, many smokers do not plan quit attempts and spontaneous, poorly planned, or impromptu quit attempts can, and frequently do, occur. (117) Nearly half of the studies in the prevalence papers assessed intent to quit using the precontemplation stage of the TTM as no intent to

quit in the next 6 months. There is a substantial body of work critiquing arbitrary timeframes of TTM. Analysis of smokers in the precontemplation stage has identified subsets of smokers including hard-core and non-hard-core smokers.(34, 37, 118, 119) A lack of intent to quit may reflect a lack of self-efficacy, a lack of social norms directing attention to quitting, or other psycho-social factors. For lack of quit intent, it is important to understand why a smoker may not have any intent to quit. These reasons include high dependence or psychological factors such as the self-efficacy as well as the social and cultural norms of the smoker.

A lack of quit attempts is the second most consistently applied criterion used to define hard-core smokers. Whilst past quit attempts are a marker of future quit attempts, it is unclear whether no lifetime quit attempts is a useful measure of hard-core smoking. Very few smokers have never made a quit attempt.(120) Using 'no lifetime quit attempt' rules out a smoker who made a quit attempt early in their smoking life course but who subsequently went on to become hard-core. Smokers' definitions of quit attempts also vary. Most tobacco control studies define a serious quit attempt as lasting more than 24 h—a requirement that may rule out past quit attempts of shorter duration.(121) Hughes and Callas (2010) estimated that this definition missed approximately 20% of past quit attempts among then current smokers.(121)

Researchers used a range of nicotine dependence measures in the studies including, cigarettes per day (CPD), time to first cigarette (TTFC), Fagerstrom test for nicotine dependence (FTND), and the heaviness of smoking index (HSI). Half of the papers estimating the prevalence of hard-core smoking used CPD as a measure of dependence. With the exception of TTFC, all the measures of dependence include a measure of cigarette consumption.

There is considerable debate about the use of consumption as a proxy for measuring dependence.(89, 107) Emery defined hard-core smoking in relation to ≥ 15 CPD; however a more recent study (published after we completed our data synthesis) compared hard-core

smoking prevalence rates across 27 Global Adult Tobacco Survey (GATS) country studies using a consumption measure of 10 or fewer CPD.(10, 122) This reduction in CPD reflects that as tobacco control restrictions become increasingly stringent on where smoking can occur, opportunities to smoke are reduced and so too the average CPD.

A reduction in consumption does not, however, necessarily reflect a reduction in dependence as smokers can alter their smoking behaviour to manage nicotine consumption. As smoking is increasingly disapproved and CPD is a self-reported measure, smokers may under-report their CPD. If CPD is flawed then the HSI, a combination of TTFC and CPD, may also be a poor proxy for dependence.

The results of this systematic review indicate that rates of hard-core smoking are higher in certain populations, including low socio-economic groups, treatment seekers, and those with mental health conditions. This does not mean these populations are unable to quit. Indeed, between 2013 and 2016, it was the most disadvantaged smokers in Australia who recorded a statistically significant decline in smoking prevalence, which was not experienced in the population as a whole.(22)

Our results indicate no clear evidence of hardening; indeed, the evidence appears to favour softening. This is particularly apparent in more recent literature arguing that the concept of hardening should be rejected and that softening of populations is occurring.(122-127) These results have important implications for tobacco control. Proponents of harm reduction argue that providing safer alternatives to conventional cigarettes are essential. However, there is substantial evidence that ANDS are not safe and indeed, may act as a gateway to youth smoking.(128) As such, harm reduction must balance harm reduction to the individual smoker against the very possible harm caused by increasing smoking rates in young people and non-smokers. If we wish to use ANDS as a harm reduction tool then we need to ensure doing so occurs in such a way that harm is not introduced to the general population in which consumption is demonstrably declining.

Making ANDS as, or more, available than cigarettes risks introducing nicotine dependence to people who would otherwise not have developed an addiction. Authors of studies that detail the gateway effect of e-cigarettes leading to smoking suggest that making these products widely available could create harm.(129) For example, in the USA where vaping products are readily available, nearly a third of high school students vaped in 2019.(130) It is not credible to claim these adolescents required this product for harm reduction or cessation purposes.

Clearly, the quit or die approach for hard-core smokers is problematic. Thus, if we are serious about harm reduction, we must develop an alternative that is proportionate to the scale of the issue and which addresses the components of the hard-core smoker concept. Rates of hard-core smoking are very low; hard-core smokers do not represent the majority of smokers in robust tobacco control environments. At stake here are the two issues of unwilling to quit and unable to quit. These are two very different issues and require different interventions. The smoker who is unable but willing to quit needs treatment that effectively manages dependence on nicotine. These smokers may benefit from nicotine replacement therapies (NRT). Whether ANDS can be included in the suite of NRT offered is dependent on safety and efficacy.

By contrast, it is possible that smokers unwilling to give up will continue to smoke even if ANDS are widely available. It is also possible that these smokers will smoke using both mechanisms (dual use) and achieve no benefit of harm reduction. Where dual use allows a smoker to circumvent restrictions on smoking bans, this undermines the effectiveness of strategies such as smoke free spaces to reduce prevalence rates.

2.4.1 Strengths and Limitations of Review

Most of the studies in this review rely on data drawn from large, representative samples of smokers—a significant strength. The major challenge is the non-standard methods of operationalising the hard-core smoker construct. Similarly, evidence for

assessing hardening uses a range of measures. Deployment of proxies for assessing factors such as dependence is very high. Calls for standardisation of the hard-core smoker construct abound in the literature.

This review included only peer-reviewed journal articles. This is a limitation because it excluded program reports and grey literature such as the Monograph (131) and commentaries. The scope of the review was limited to English language studies, and although it included countries where English is not the primary language, the results could be different in economically disadvantaged countries with poorer tobacco control policies, and where the tobacco epidemic is yet to peak.

2.5 Conclusion

Whilst there are clearly smokers who meet the various definitions of hard-core smokers, they are small in number and appear to be softening. Individual smokers who struggle to quit require, and must receive, appropriate support. However, individual treatment approaches must not jeopardise the impact of comprehensive tobacco control interventions which appear to be lowering the ‘hardness’ of smokers. Policymakers should implement programs that drive further softening in the smoking population and support individual smokers, especially those from at risk groups, to quit.

Chapter 3. Is the Australian smoking population hardening? (Paper 2)

This chapter has been published in the journal *Addictive Behaviours*. This chapter is identical to the published manuscript except for table numbers, changing “hardcore” to “hard-core” and references, which have been altered to ensure uniformity in formatting across the thesis.

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Abstract

Background: The hardening hypothesis proposes that as smoking rates decline, the remaining smokers will become hard-core and resistant to quitting. This group of highly resistant quitters will potentially require more individualistic approaches to cessation and harm reduction. The harm reduction approach (specifically e-cigarettes) has been proposed as an option to address hardened Australian smokers. We tested the hardening hypothesis by analysing the rates of hard-core smoking in the Australian smoking population between 2010 and 2016.

Methods: Data were drawn from three waves of the National Drug Strategy Household Survey (NDSHS) in 2010, 2013 and 2016. Two different definitions were used to assess hard-core smoking to arrive at an upper and lower rate. Logistic regression models assessed hard-core smoker characteristics for both definitions of hard-core smoking.

Results: The most inclusive definition of hard-core smoking (i.e., a smoker with no plan to quit) showed a significant decline in hard-core smoking between 2010 and 2016 (5.49%–4.85%) In contrast, the prevalence of hard-core smoking using the most stringent definition (i.e., a current daily smoker of at least 15 cigarettes per day, aged 26 years or over, with no intention to quit, a lifetime consumption of at least 100 cigarettes, and no quit attempt in the past 12 months) did not change significantly between 2010 and 2016.

Conclusion: The observed trends in the prevalence of hard-core smokers (i.e., either stable or declining depending on the definition) suggest that the Australian smoking population is not hardening. These results do not support claims that remaining smokers are becoming hard-core.

3.1 Introduction

Smoking prevalence has declined dramatically in many developed countries over the past several decades. In countries where the tobacco epidemic is in its mature phase there is an increasing focus on hard-core smokers. The hardening hypothesis proposes that as smoking rates continue to decline at a population level, the remaining smokers are more resistant to quitting.(11) These remaining smokers are often referred to as hard-core smokers. While there is a relationship between hard-core smoking and hardening, the mere existence of hard-core smokers in a population does not, by itself, indicate hardening. Instead, hardening is proposed to occur when there is an increase in hard-core smoking prevalence rates coupled with a decline in overall smoking prevalence.(87) There are also other indicators of hardening in the smoking population, such as i) increasing levels of psychological distress ii) declining numbers of quit attempts iii) high levels of cigarette consumption iv) declining support for tobacco control policies and v) increased levels of socio-economic disadvantage amongst smokers.(110)

In Australia, results from the 2016 National Drug Strategy Household survey (NDSHS) show that the prevalence of smoking has continued to decline over the past two decades (e.g., falling from 23.20% in 2001 to 14.90% in 2016).(5) While this decline appears to be continuing, it may be slowing as reflected by the non-significant change in daily smoking prevalence between 2013 and 2016 (from 12.80% to 12.20%).(5) In addition, other trends between 2013 and 2016 collectively suggest hardening may be occurring in the Australian population. In particular, between 2013 and 2016, available data show that: i) the rate of weekly cigarette consumption did not significantly decrease, ii) the smoking prevalence rate was static, iii) 1 in 3 smokers stated that they intended to continue to smoke and iv) support for tobacco control policies declined slightly.(5)

Issues surrounding hard-core smoking and hardening are becoming increasingly relevant in the context of electronic cigarette use. Proponents of individually focussed tobacco harm reduction argue that the slowing decline in prevalence rates suggests a need

for greater access to e-cigarettes to address the needs of smokers who will not or cannot quit.(64) Australian data on e-cigarette use were first collected in the NDSHS in 2013. Between 2013 and 2016 there was a significant increase in e-cigarette use across all age groups with 30% of smokers having tried an e-cigarette and 50% of smokers aged under 25 having tried an e-cigarette.(5) The rapid rise in the popularity of e-cigarettes, coupled with the stall in prevalence and possible hardening of Australian smokers has fuelled claims that e-cigarettes should be made available as a harm reduction intervention for hard-core smokers. This type of claim was evident in the submissions made to the Australian Government's review of e-cigarettes during 2017. For example:

> *It appears with the stalling in our quit rates that we do indeed need something new, and we are getting down to a hard core of smokers that either gain so much benefit and enjoyment out of smoking or else are so deeply addicted that we do need this disruptive technology.(78)*
>
> *Adult smoking rates in Australia have stalled over the last 3 years. New and innovative solutions such as e-cigarettes are needed if Australia is to reach its target of 10% smoking by 2018.(132)*

One key challenge in the literature is that definitions of hard-core smoking vary considerably. For example, the least stringent definition operationalises hard-core smoking in relation to a single variable - no intent to quit.(91) Other definitions operationalise hard-core smoking in relation to multiple variables. Emery et al. for instance, define a hard-core smoker using six criteria.(10) The different definitions have led to variations in the prevalence estimates of hard-core smokers, and make it difficult to compare results between studies. The rates of hard-core smokers tend to be lower as more variables are included in the operationalisation of hard-core smoking. For example, Costa et al demonstrated that a measure of hard-core smoker based on two variables (no intent to quit and no life time quit attempts) estimated the prevalence of hard-core smoking nine times higher than a more comprehensive definition based on no intent to quit, no lifetime quit intent, 5 year smoking

history and heaviness of smoking index.(90) Likewise Docherty et al studied multiple definitions of hard-core smoker within the same sample; this included the less stringent definition (no intent to quit) which returned a prevalence rate of more than double the definition that required no intent to quit and a time to first cigarette of less than 30 minutes.(91) Given the lack of a single definition of hard-core smoking, in the present paper we investigate the extent of hard-core smoking in Australia using two definitions noted above: the least stringent definition utilised by Docherty et al that operationalises hard-core smoking as no quit intent, and Emery et al's more stringent definition.

It has been argued that hardening is most relevant in countries which are in the advanced stages of the tobacco epidemic.(30) This is because although these countries have experienced large declines in smoking prevalence rates, these declines may have been uneven across different segments of the population. In particular, despite comprehensive tobacco control efforts in the Australian context, smoking prevalence rates remain high in some disadvantaged populations, such as Aboriginal and Torres Strait Islanders, those from low socio-economic backgrounds, and people with higher levels of psychological distress.(133) It is important to note that Australian smokers face some of the most stringent restrictions that are actively designed to make smoking socially unacceptable. They are also subject to substantial public health campaigns extolling the health impacts of smoking. Because of these factors, the Australian environment should reflect a softening (rather than hardening) in which smokers become more receptive to quitting.(124)

Previous work examining the prevalence of hard-core smoking rates in Australia utilised national level survey data up to 2010.(13-15) These studies indicate some weak mixed evidence for hardening amongst low socio-economic smokers, but nonetheless the rates of hard-core smoking were very low at around 2.00% prevalence.(14) The first Australian research on hardening in the Australian context published since the 2016 National Drug Strategy Household Survey (NDSHS) was conducted in the state of Victoria and sought to determine if there was an increase in hardening in that state between 2001 and

2016 utilising data from annual cross sectional surveys.(127) This study measured several hardening indicators over a significant period of time as follows: i) daily smoking, ii) cigarette consumption, iii) a lack of a quit attempt in the past 5 years or past 12 months, iv) a lack of intent to quit in the next 6 months or next 30 days, and v) happiness to keep smoking. The study identified a significant decline in the rate of smokers classified as hard-core from 17.20% in 2001 to 9.10% in 2016 and concluded that the findings do not support claims of hardening amongst Australian smokers.

This present study is the first national analysis of hardening amongst Australian smokers since the results of the 2016 NDSHS results were released. The present study is needed because, with the exception of the recent study from Victoria (Australia), previous studies on hardening in Australia occurred in a period in which there were continuous substantial declines in prevalence rates and a relative absence of e-cigarettes. The overall objective of the present study was to investigate whether Australian smokers have hardened by calculating hard-core smoking rates derived from data from the NDSHS from 2010 to 2016. This time period captures national reporting of e-cigarette use by the NDSHS and includes the period 2013–2016 in which no significant declines were achieved in prevalence rates. Moreover, recognising the great variability in definitions of hard-core smoking, this study utilises two different definitions in order to capture the highest and lowest rates of hard-core smoking in Australia. The specific aims of this study are to: i) identify if the Australian smoking population experienced hardening between 2010 and 2016 as evidenced by increasing proportions of hard-core smokers in the smoking population; 2) demonstrate the effect of different operational definitions of the hard-core smoker concept on prevalence rates; and, 3) determine whether factors such as psychological distress or socio-economic status continue to be associated with a hard-core smoking profile amongst Australian smokers. As a final aim, this paper also explored whether the rates of smoking and the prevalence of hard-core smoking differed between males and females. This is important

given that research has consistently identified sex differences in the prevalence of smoking, and also because sex is a potential predictor of hard-core smoking.

3.2 Methods

3.2.1 Data

Data are from three waves of the National Drug Strategy Household Survey (NDSHS) from 2010, 2013 and 2016. The NDSHS are household based, cross-sectional, and nationally representative surveys of drug use behaviour with a sample of approximately 24 000 individuals per wave and a response rate of around 50%. The target population was non-institutional residents of Australia aged 12 years and older. More information on the NDSHS methodology is available at: https://www.aihw.gov.au/about-our-data/our-data-collections/national-drug-strategy-household-survey.

3.2.2 Measures

3.2.2.1 Smoking status

All participants were asked questions about smoking behaviours. Current smokers were defined as participants who smoked any tobacco products on a daily, weekly or less than weekly basis.

3.2.2.2 Hard-core smokers

As hard-core smoking rates tend to decrease with greater numbers of variables, we utilised two definitions to determine hard-core smoking rates at both the most stringent and least restrictive scenarios.(90, 91) First, we simply included all respondents who answered the question “Are you planning on giving up smoking?” with the response: “No, I am not planning to give up”. This highly inclusive definition is consistent with the study by Docherty et al and was chosen in order to achieve a high rate of hard-core smokers in Australia. (91) However, this approach is also premised on the assumption that in the Australian context a smoker who has no intention to quit is likely to possess “extensive knowledge about the hazards of smoking” and will encounter “substantial social disapprobation of smoking”

thereby satisfying hard-core smoker characteristics proposed by Warner and Burns.(11) For this group of smokers we also report on number of quit attempts and consumption levels of cigarettes as these are additional behaviours associated with a hard-core smoker profile.

The second definition aligns with the definition of hard-core smoker proposed by Emery et al.(10) This requires a hard-core smoker to meet each of the following criteria: i) current daily smoker, ii) aged 26 years or over, iii) lifetime consumption of at least 100 cigarettes, iv) at least 15 cigarettes per day (CPD), v) no quit attempt in the past 12 months, and vi) no intention to stop smoking.(10) Age 26 was chosen so as to exclude smokers who were not yet established in their smoking behaviour.(10, 83, 85, 91, 94, 97, 102-104)

3.2.2.3 Psychological Distress

The Kessler 10 scale was included in the NDSHS and measured global psychological distress. The scale consists of 10 Likert scale items (e.g., "how often did you feel hopeless") examining how individuals have been feeling over the past 30 days. Item scores were summed to provide a total K10 score, which was then split in the NDSHS data set into four categories as follows: 1 = low, 2 = moderate, 3 = high and 4 = very high.(134)

3.2.2.4 Socio-demographic variables

Socio-demographic variables included age, sex, socio-economic status, highest educational qualification, and marital status. Age was examined in relation to eight categories representing increments of 10 years (with the exception of the younger age category). Because the number of smokers in the 12–18 years age category was very small, we used the 19–29 years group as the reference category.

Socio-economic status was reported in the NDSHS datasets as the Socio-Economic Indexes for Areas (SEIFA) variable. SEIFA is an Australian Bureau of Statistics measure which ranks geographical areas by levels of relative advantage or disadvantage. The NDSHS reports the SEIFA variable as quintiles with 20% of the areas with the greatest overall level of disadvantage described as the 'lowest socio-economic area' and the top fifth

described as the ‘highest socio-economic area’. Socio-demographic variables are presented in Table 3.1.

3.2.3 Statistical analyses

All analyses were performed using SAS (release 9.4, 2012; SAS Institute). Sampling weights (absolute person weight ‘000s) were included in the analysis in order to standardise all analysis performed to the Australian population and are reported as weighted percentages in the results tables. Descriptive statistics were used to describe respondents’ characteristics. Smoking prevalence and socio-demographic variables were reported as frequencies and percentage for each survey year. Chi-square tests were used investigate any differences across the survey years.

Logistic regression models were tested to determine the predictors of hard-core smoking, and whether there were any changes in hard-core smoking prevalence over time. These models were initially tested without covariates to provide an indication of the crude relationships. The models were then tested again adjusting for all predictors (age, sex, income, marital status, Kessler scores and education); in the remainder of this paper we refer primarily to these adjusted odds ratios.

Given the potential sex differences with males being more likely to be hard-core smokers, we also added a sex-by-year interaction term to the adjusted model to test whether the prevalence of hard-core smoking in each year varied by sex.(81) A pooled dataset of all years was used to run the logistic regression. Several of the covariates had a small percentage of missing data; these missing data were handled by creating an additional ‘missing’ category for the relevant variables, and then including them in the analyses.

The sample sizes were different for the less stringent definition and more stringent definition. This reflects the varying criteria underpinning these definitions. As noted earlier, the less stringent definition is inclusive and does not include any criteria around age. The analyses for this definition therefore included all individuals regardless of age (i.e., aged 12 years and over). In contrast, the more stringent definition includes an age-related criterion;

that is, an individual can only be a hard-core smoker if aged 26 years and over. In order to avoid underestimating the prevalence of hard-core smoking using this definition, the analyses were restricted to individuals aged 26 years and over.

3.3 Results

Table 3.1 details the socio-demographic characteristics of smokers in each of the three waves of the NDSHS. The characteristics of the sample in each wave were not significantly different, with the exception of some evidence of increasing levels of disadvantage and increases in undergraduate education with a decrease in certificate level education.

The prevalence of smoking decreased significantly from 18.10% in 2010 to 14.90% in 2016.(5) Pairwise comparisons indicated a significant decrease in daily smoking rates between 2010 and 2013, but there were no significant differences in daily smoking rates between 2013 and 2016.

Table 3.1: Weighted participant characteristics according to survey year

Demographic characteristics	2010 (%)	2013 (%)	2016 (%)	p value
Sample size (N = 74275)	26648	23855	23772	
Smoking prevalence, N (%)				<0.001
Male	2462 (20.17)	1992 (18.64)	1915 (17.56)	
Female	2527 (16.57)	1978 (13.70)	1780 (13.02)	
Total	4989 (18.35)	3970 (16.14)	3695 (15.26)	
Daily smoking prevalence, N (%)	4079 (14.68)	3182 (12.44)	2964 (11.88)	<0.001
Gender, N (%)				0.9
Male	11946 (49.13)	10624 (49.07)	10840 (49.42)	
Female	14702 (50.87)	13231 (50.93)	12909 (50.58)	

Marital status				0.6
Never married	5229 (25.39)	4862 (24.99)	5252 (28.45)	
Divorced/separated/widowed	4541 (13.46)	4189 (13.77)	4394 (11.79)	
Married/de facto	15383 (61.15)	14205 (61.24)	13543 (59.76)	
Age-groups (yrs)				1.00
12–18	1839 (9.9)	1371 (9.46)	1377 (9.00)	
19–29	3563 (18.18)	3110 (18.08)	2928 (17.42)	
30–39	4612 (17.07)	4058 (15.98)	3827 (17.01)	
40–49	4366 (16.32)	3947 (15.85)	3731 (15.48)	
50–59	4438 (14.72)	3861 (15.02)	3718 (14.57)	
60–69	4068 (11.57)	4068 (12.51)	4252 (12.84)	
70–79	2581 (7.26)	2281 (7.78)	2711 (8.34)	
≥ 80	1181 (5.00)	1157 (5.33)	1205 (5.35)	
SEIFA Quintile				<0.001
Quintile 1 (lowest)	4664 (18.13)	4081 (17.55)	4654 (20.75)	
Quintile 2	4996 (18.57)	4726 (19.57)	4816 (20.13)	
Quintile 3	5258 (19.92)	4593 (19.60)	4656 (19.71)	
Quintile 4	5981 (22.17)	5257 (22.12)	4860 (19.48)	
Quintile 5 (highest)	5748 (21.21)	5198 (21.17)	4763 (19.92)	
Education				0.016

Certificate	6169 (42.92)	5637 (41.52)	5514 (39.26)	
Associate or undergraduate diploma	2573 (17.03)	2409 (16.51)	2473 (16.36)	
Bachelor degree	3593 (24.82)	3554 (25.63)	3821 (27.57)	
Post-graduate degree	2339 (15.22)	2459 (16.34)	2549 (16.82)	
Kessler 10 Scale				<0.0001
Low	17210 (70.06)	16383 (68.42)	16049 (67.00)	
Moderate	5052 (20.03)	4824 (20.91)	4764 (20.79)	
High	1800 (7.40)	1754 (7.58)	1995 (8.68)	
Very high	608 (2.51)	680 (3.09)	778 (3.53)	

3.3.1 Prevalence and Characteristics of Hard-core Smokers using Definition 1: No Intent to Quit

There was no significant change in the percentage of smokers across the three waves with no plan to quit. Amongst this group of smokers, nearly 50% made a quit attempt in the previous 12 months. Furthermore, the proportion of smokers who had no intent to quit and consumed more than 15 CPD, decreased significantly from 49.24% in 2010 to 38.68% in 2016.

Table 3.2: Weighted proportions of current smokers who have no plan to quit and the percentage of those smokers with no quit attempt and smoking more than 15CPD

All Smokers	Total (weighted %) N = 12654^	2010 (weighted %) N = 4989^	2013 (weighted %) N = 3970^	2016 (weighted %) N = 3695^	p value unadjusted
Heavy smokers+ with no plan to quit	1887 (43.89)	824 (49.24)	588 (43.56)	475 (38.68)	<0.0001
No quit attempt in the past 12 months with no plan to quit	1791 (47.61)	657 (44.86)	600 (49.35)	534 (48.80)	0.77
No plan to quit in smoking population	3914 (29.60)	1529 (29.05)	1235 (29.20)	1150 (30.56)	0.16
Smokers with no plan to quit: population prevalence	3914 (5.08)	1529 (5.49)	1235 (4.92)	1150 (4.85)	0.021

^ N refers to the total number of current smokers overall and for each survey wave.

+Heavy smokers were smokers who smoked ≥ 15 CPD.

Table 3.3 shows the results of the multivariate logistic regression models examining smokers with no intent to quit. Smokers with no plan to quit were more likely to be male, aged 40–59 years, separated or widowed and experienced higher levels of psychological distress. They were most likely to be drawn from the lower SEIFA quintiles and less likely to

hold higher education qualifications. The results of the sex-by-year interactions did not indicate any significant difference between male and female rates of hard-core smoking by survey wave.

Table 3.3: Multivariate logistic regression analysis examining predictors of no quit intent across the three surveys (N = 74,252+)

Predictor variables	Crude OR (95% CI)	Adjusted OR (95% CI)
Survey year		
2010	Ref	Ref
2013	0.89 (0.85-0.94)*	0.91 (0.86-0.97)
2016	0.88 (0.73-1.05)	0.84 (0.72-0.98)
Gender		
Female	Ref	Ref
Male	1.33 (1.08-1.66)*	1.37(1.30-1.44)*
Age group		
Dec-18	0.38 (0.26-0.57)*	0.33 (0.29- 0.39)*
19-29	Ref	Ref
30-39	0.73 (0.55-0.96)*	1.08 (0.72-1.60)
40-49	0.88 (0.73-1.05)	1.30 (1.13-1.48)*
50-59	0.94 (0.57-1.54)	1.33 (1.20-1.49)*
60-69	0.69 (0.52-0.91)*	0.97 (0.79-1.19)
70-79	0.51 (0.42-0.61)*	0.65 (0.52-0.80)*
80+	0.30 (0.23-0.39)*	0.33 (0.21-0.53)*
Marital status		
Married/de facto	Ref	Ref
Never married	1.75 (0.94-3.20)	2.08 (1.73-2.51)*
Widowed/divorced/separated	1.97 (1.47-2.63)	2.11 (2.00-2.23)*

SEIFA Quintile*		
Quintile 5 (highest)	Ref	Ref
Quintile 4	1.18 (0.95-1.47)	1.13 (0.94-1.35)
Quintile 3	1.53 (1.24-1.90)*	1.43 (1.26-1.61)*
Quintile 2	1.88 (1.52-2.33)*	1.71 (1.51-1.93)*
Quintile 1 (lowest)	2.41 (1.67-3.48)*	2.12 (1.69-2.65)*
Highest Qualification		
Post-graduate degree	Ref	Ref
Bachelor degree	1.20 (0.92-1.55)	1.13 (0.87-1.47)
Associate/undergraduate Diploma	1.69 (1.40-2.04)*	1.57 (1.29-1.92)*
Certificate	2.09 (1.89-2.32)*	1.77 (1.58-1.99)*
Kessler 10 score		
Low	Ref	Ref
Moderate	1.11 (1.02-1.21)*	1.07 (1.01-1.14)
High	1.56 (1.27-1.90)*	1.37 (1.23-1.53)*
Very High	2.05 (1.57-2.69)*	1.75 (1.52-2.02)*

*significant at 95% CI.

[+] 23 individuals had missing data on all variables and so were excluded from these analyses.

3.3.2 Prevalence of Hard-core Smokers using Definition 2: Emery et al

As shown in Table 3.4, the prevalence of hard-core smokers according to the stringent definition proposed by Emery et al, did not vary significantly across the three waves.(10) In addition, no significant differences were observed across the three waves in

relation to lack of quit intent and quit attempts in the previous 12 months. However, the proportion of smokers who smoked 15 or more cigarettes per day ('heavy smokers') decreased significantly between 2010 and 2016.

Table 3.4: Weighted frequencies and proportions of current smokers meeting Emery et al.'s definition of hard-core smoking and the associated hard-core smoking characteristics.

All Smokers	Total (%) N = 12654^	2010 (%) N = 4989^	2013 (%) N = 3970^	2016 (%) N = 3695^	Unadjusted p value
All smokers: Aged 26yrs	10,969 (79.74)	4275 (78.57)	3436 (79.01)	3258 (81.73)	0.52
All smokers: No quit attempt in the past 12 months	3136 (25.53)	1207 (24.94)	1004 (25.21)	925 (26.49)	0.77
All smokers: No plan to quit	3771 (29.43)	1489 (29.06)	1177 (28.97)	1105 (30.29)	0.16
All smokers: Heavy smokers[+,]	5179 (37.87)	2283 (42.77)	1620 (38.14)	1276 (32.25)	<0.0001
'Hard-core smoker' in smoking population	748 (5.31)	307 (5.56)	240 (5.11)	201 (5.24)	0.054

'Hard-core smoker' population prevalence	748 (0.88)	307 (1.02)	240 (0.83)	201 (0.80)	0.062

^ N refers to the total number of current smokers overall and for each survey wave.

[+]Heavy smokers were smokers who smoked ≥ 15 CPD.

Table 3.5 details the multivariate logistic regression analysis on the pooled dataset and demonstrates males were more likely than females to be hard-core smokers, as were those who were separated compared with those in a married or in a de facto relationship. Individuals aged 40–69 years had significantly higher odds of hard-core smoking compared with younger adults aged 26–29 years. Furthermore, low SES (SEIFA) and high psychological distress (K10) were linked with increased odds of hard-core smoking.

Table 3.5: Predictors of hard-core smoking using Emery et al's definition (Multivariate logistic regression analysis for hard-core smokers and hard-core smoking variables according to socio-demographic status and psychological distress (N = 64,080).

Predictor variables	Crude OR (95% CI)	Adjusted OR (95% CI)
Survey year		
2010	REF	REF
2013	0.81 (0.60-1.08)	0.83 (0.68-1.02)
2016	0.78 (0.59-1.03)	0.75 (0.60-0.94)*
Gender		
Female	REF	REF
Male	1.52 (1.19– 1.94)*	1.61 (1.34-1.92)*
Age group		
26-29	REF	REF
30-39	1.15 (0.65-2.06)	1.41 (0.89-2.24)

Predictor variables	Crude OR (95% CI)	Adjusted OR (95% CI)
40-49	1.70 (1.24-2.31)*	2.11 (1.35-3.29)*
50-59	1.87 (1.11-3.15)*	2.23 (1.42-3.48)*
60-69	1.44 (0.91-2.29)*	1.69 (1.07-2.68)*
70-79	0.75 (0.41-1.36)	0.79 (0.46-1.36)
80+	0.40 (0.17-0.94)*	0.38 (0.17-0.83)*
Marital status		
Married/de facto	REF	REF
Never married	0.84 (0.22-3.24)	2.33 (1.80-3.00)*
Widowed/divorced/separated	2.07 (1.55-2.76)*	2.08 (1.68-2.57)*
SEIFA Quintile*		
Quintile 5 (highest)	REF	REF
Quintile 4	1.63 (1.11-2.39)*	1.47 (1.01-2.15)*
Quintile 3	2.56 (1.95-3.40)*	2.21 (1.53-3.19)*
Quintile 2	3.24 (2.12-4.96)*	2.69 (1.88-3.84)*
Quintile 1 (lowest)	4.65 (3.20-6.76)*	3.69 (2.59-5.27)*
Highest Qualification		
Post-graduate degree	REF	REF
Bachelor degree	1.11 (0.57-2.17)	1.18 (0.73-1.91)
Associate/undergrad	2.04 (0.73-5.75)	1.92 (1.20-3.07)*
Diploma	2.42 (1.30-4.44)*	2.05 (1.36-3.11)*
Certificate		

Predictor variables	Crude OR (95% CI)	Adjusted OR (95% CI)
Kessler score		
Low	REF	REF
Moderate	1.03 (0.92-1.15)	1.07 (0.86-1.34)
High	1.45 (1.01-2.10)*	1.35 (1.02-1.80)*
Very High	1.04 (0.35-3.12)	0.94 (0.60-1.47)

*significant at 95% CI.

3.4 Discussion

The present study provides an important insight into the extent and characteristics of hard-core smoking in Australia, and whether hardening is occurring. The findings of this study are important because they suggest that hard-core smoking is not becoming more common, nor is the Australian smoking population hardening. There were significant declines in cigarette consumption between 2010 and 2016 which reflects the success of Australian tobacco control policy initiatives designed to restrict opportunities for smoking in public and enclosed spaces. The reduction in CPD is important because smokers who smoked less than 20CPD were more likely to achieve success in modifying their smoking behaviour (e.g. cutting down or quit attempts).(5)

Our first key finding is that the two different definitions of hard-core smoking led to different prevalence rates: < 1% of the population for the most stringent definition to < 5% for the less stringent definition. Moreover, the rates of change for hard-core smoking over time were dependent on how it was defined. According to the less stringent definition, the percentage of hard-core smokers decreased significantly from 5.49% in 2010 to 4.85% in 2016. This definition had no limits on cigarette consumption, smoking history or age thereby ensuring any smoker who may be hard-core was included. By contrast, according to the more stringent definition of hard-core smoking, the percentage of hard-core smokers was stable between 2010 and 2016. This definition may be an underestimate as it precludes

possible hard-core smokers younger than 26 years or those smoking fewer than 15CPD. Therefore, by including both definitions, we are able to identify that the rates of hard-core smoking in Australia ranged between 0.80 and 4.85% in 2016.

Between 2010 and 2016, smoking prevalence significantly declined while the proportion of smokers with no plan to quit did not significantly change. Collectively, these findings indicate that there is not a hardening problem in Australia. Nearly half of those smokers with no intent to quit had made a quit attempt in the past twelve months suggesting that they are not immune to public health pressures to quit. With nearly 70% percent of Australian smokers indicating they wish to quit and around half of unmotivated to quit smokers making a quit attempt in the previous twelve months, tobacco control initiatives that focus on effective, proven interventions that drive and sustain cessation are required in order to support further reductions in prevalence.

The more stringent definition indicated that less than 1% of the Australian were hard-core smokers, and this did not change significantly between 2010 and 2016. According to this definition, these findings indicate that the prevalence of hard-core smoking stabilised over time. It is plausible that the stabilisation of hard-core smoking reflects a natural limit of smoking rates in Australia. There has long been acceptance amongst tobacco control advocates that achieving zero prevalence is unlikely but very close to zero is achievable through effective tobacco control interventions.(135)

The second key finding of this paper is that we identified socio-demographic correlates of hard-core smokers, which were fairly consistent for the two definitions. That is, hard-core smokers were more likely to be male, have lower levels of education attainment, and live in more disadvantaged socio-economic areas. These findings suggest that rates of hard-core smoking, and indeed smoking more generally, remain most evident in smokers who experience the greatest socio-economic disadvantage, experience psychological distress and who have lower educational attainment. These findings suggest that interventions need to continue to target these at-risk populations to further reduce smoking rates.

The findings of this paper may have a number of practical and policy implications for further improving smoking cessation. First, according to both definitions, the rates of hard-core smoking declined slightly or remained largely unchanged between 2010 and 2016. It is notable, however, that there was an increase in e-cigarette use during this period. E-cigarette use is frequently promoted as an effective method to help hard-core smokers to quit smoking. It is feasible that e-cigarettes are not currently having a notable impact on reducing the percentage of hard-core smokers in Australia. Although more research is needed, this is a plausible explanation because the evidence supporting e-cigarette use for cessation is limited although they may be of some use if used by motivated quitters as part of a smoking cessation program.(136) This potential benefit however is offset by evidence demonstrating that e-cigarettes may convert young people to smoking.(128) Extreme caution should be exercised in how e-cigarettes are regulated and used. We strongly recommend that future research is needed to investigate whether e-cigarettes are a useful strategy for hard-core smokers, or whether another strategy would be more effective.

In addition, the percentage of successful quit attempts did not change significantly between 2013 and 2016.(5) Nearly a third of smokers had unsuccessful quit attempts and a quarter of smokers made no change to their smoking behaviour.(5) Whilst there are certainly smokers who struggle to quit using existing cessation support, it is not the case that Australia's remaining smokers are hardened. Tobacco control policy makers should be sceptical of any proposed intervention which seeks to address a (non-existent) crisis of hardening. There is, however, a pressing need to achieve increased cessation rates from quit attempts.

From a policy and intervention perspective, it is worth noting that the majority of smokers in each wave of the survey had some intention of quitting and cited cost and health as the main prompts for quitting whilst enjoyment and relaxation were the main reasons for continued smoking in 2016.(5) Tobacco control initiatives at a population level need to further understand what smokers mean when they cite enjoyment as the main reason for

continuing. This enjoyment factor appears to function even in the absence of high nicotine dependence.(137)

3.4.1 Study limitations

There are some limitations of this study that warrant discussion. A major limitation is the lack of a consistent definition of hard-core smoking. Most studies on hard-core smoking include at least one criteria to demonstrate established smoking. Emery et al's definition uses age and at least 100 cigarettes smoked in a lifetime to establish entrenched smoking behaviour.(10) However, other criteria such as at least five years smoking history and differing age ranges are also used in alternative definitions.(84, 91) Our prevalence rates may well be different had we used a measure such as at least a five year smoking history as opposed to age 26 years and over as a means of demonstrating established smoking. Another key limitation (consistent with many studies assessing hard-core smoking) is the lack of a robust measure of nicotine dependence. Studies of hard-core smoking routinely use 15 CPD as a proxy measure of dependence and we have, in the absence of more robust measures, done likewise. Consumption may be more influenced by opportunity to smoke than dependence and so estimates of hard-core smoking may differ from those that might be obtained with a time to first cigarette or cotinine measures.

This paper (consistent with many previous studies) demonstrates a link between hard-core smoking and socio-economic disadvantage. In this paper socio-economic status was assessed using SEIFA, which combines a number of indicators such as employment and income for a given geographic area. While a highly robust and utilised measure, SEIFA does not provide an indication of socio-economic status at an individual level; this is a potential limitation given possible differences between individual and area socio-economic status.

A further limitation of this paper is that the NDSHS is not a longitudinal study; rather it collects data from representative cohorts at different time points which means it is not possible to track individuals over time. However, this limitation is offset by the large and

representative sample. Longitudinal study of hard-core smokers would be an important contribution to the literature to better understand the factors influencing smoking behaviour over time, (e.g., quit attempt successes and failures) and also assess the effectiveness of tobacco control policies. This research would benefit from focusing on at-risk populations, such as those from low socio-economic backgrounds or Aboriginal and Torres Strait Islander populations.

Finally, whilst the NDSHS is a representative population-based survey it may under-represent the most disadvantaged populations where rates of smoking are likely to be higher such as prisoners and inpatients in mental health facilities. It is also a voluntary survey and hard-core smokers may self-select out of completing the survey.

3.4.2 Acknowledgement

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Chapter 4. Smokers Who Do Not Quit: Can the Precaution Adoption Process Model Help Identify Hard-core Smokers? (Paper 3)

This chapter has been published in the Journal of Smoking Cessation. The chapter is identical to the published manuscript except for table numbers and references which have been altered to ensure uniformity in formatting across the thesis.

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https://doi:10.1017/jsc.2019.20

Abstract

Introduction: Hard-core smokers have been identified as a potential public health challenge. The trans-theoretical model lacks the specificity to identify hard-core smokers. The precaution adoption process model (PAPM) is a stage-based behaviour change model which includes 'no intent to quit' as a distinct stage and so may be useful in identifying hard-core smokers.

Aims: The aim of this study was to apply the PAPM to a community based sample of smokers to determine whether it provides a useful approach to identifying hard-core smokers.

Methods: We surveyed smokers in Australia who were recruited through social media and an online data collection agency.

Results: The sample included 336 current smokers, 11.9% were in Stage 4 of the PAPM – i.e. had decided not to quit. Stage 4 smokers are more resistant to quitting and marked by their similarities to hard-core smokers. This is further amplified when addressing Stage 4 smokers with no previous quit attempt.

Conclusions: Stage 4 smokers with no previous quit attempts are aligned with a hard-core smoker profile with higher levels of nicotine dependence, greater cigarette consumption and low socio-economic status. Further research is required to determine if PAPM is a valid predictive model for identifying hard-core smokers in clinical practice.

4.1 Introduction

Australia has enjoyed decades of declining smoking prevalence rates; however, prevalence rates have recently remained static, and approximately one third of smokers currently indicate they do not intend to quit smoking.(5) This environment has prompted suggestions that smokers are increasingly 'hard-core' and unable to quit.(7, 78) While definitions vary, a hard-core smoker can be defined as 'a daily, long-term smoker who is unable or unwilling to quit and who is likely to remain so even when possessing extensive knowledge about the hazards of smoking and when confronting substantial social disapprobation of smoking'.(11) It is important to note that an unwillingness to quit is not, in and of itself, an indicator of hard-core smoking. A lack of intent to quit, along with various other indicators such as lack of previous quit attempts, greater cigarette consumption and higher levels of dependence are used to determine whether an individual is a hard-core smoker.

The hardening hypothesis argues that as smoking prevalence rates decline, the remaining smokers are more hard-core and will be more resistant to quitting.(11) While the hardening hypothesis has received little support in studies to date (88, 90, 101, 108-110), it has been argued that hardening may be most relevant in countries in the mature stages of the tobacco epidemic such as Australia.(30, 87, 89, 100, 107-109) The existence of smokers who are hard-core does not necessarily indicate population hardening. However, a failure to accurately identify and treat hard core-smokers coupled with failure to implement effective population level policy initiatives to reduce smoking could result in population level hardening.

Available studies indicate that hard-core smokers in Australia have accounted for between 5.5%–17% of all smokers and they are over-represented in groups who experience high levels of socio-economic disadvantage and mental health illness.(14, 88, 103, 127, 138). However, existing studies are limited by the use of different criteria to identify hard-core smokers as well as the lack of a theoretical framework to examine this

population. For example, health professionals have been largely trained in deploying the trans-theoretical model to assess smokers' willingness to quit. This model asks about intent to quit within set time frames. The lack of quit intent is one of the key characteristics of hard-core smoking so it is not so surprising that the trans-theoretical model has been widely used in hard-core smoking studies. However, the pre-contemplation stage of the trans-theoretical model is unable to distinguish between smokers who do not wish to quit in the next 6 months compared to smokers who do not wish to ever quit.(32, 38, 118, 139) Further, latent class analysis has revealed the pre-contemplation stage is comprised of subclasses of smokers including hard-core smokers. (33, 34, 98, 119) The trans-theoretical model does not provide cessation providers with an easily deployed method to readily distinguish between those who do not want to quit right now and those who do not want to ever quit and those who may be identified as hard-core.

Like the trans-theoretical model, the Precaution Adoption Process Model (PAPM) is also a stage model of health behaviour change. While the two models share similarities, the number and nature of the stages are different and progression through the PAPM stages is not time bound.(39) The PAPM comprises of seven stages: (1) unaware of the hazards; (2) aware but unengaged with the idea of quitting; (3) engaged and making decision about future quitting; (4) decides not to quit; (5) decides to quit; (6) makes a quit attempt and, (7) maintains abstinence.(40)

The PAPM was initially applied to home radon testing.(42, 43) Since then, it has been used in behaviour change research on sun protection, oral hygiene, teen pregnancy, colorectal screening, HIV/AIDS, nutrition, osteo-protective behaviour and treatment, mammography, and drug and alcohol use.(44-58) A small number of studies have applied the PAPM to smoking but these studies are limited because they have not developed the psychological and behavioural characteristics of each stage of the model.(59, 60) There is a need for more research to understand how each stage of the PAPM model can be applied to smoking cessation, especially with respect to increasing our understanding of smokers who have decided not to quit and hard-core smokers as a subset of that group.

Stage 4 of PAPM (decided not to quit) is directly relevant to hard-core smokers. For example, individuals in Stage 4 can be described as knowledgeable, failing to personalise the risks, more resistant to persuasion to change, and unlikely to change their behaviour.(42) This is a similar profile to hard-core smokers: no intention to quit smoking, less likely to agree smoking is bad for their health, and less tolerant of social pressure to quit.(10, 30, 90, 92) The PAPM could therefore, provide a useful framework to identify and understand the characteristics of hard-core smokers. Being able to easily and accurately identify the characteristics of hard-core smokers as a subset of those who say they do not want to quit enables the appropriate management and resourcing required shifting cessation towards tobacco end-game levels.

The purpose of the present paper was to utilise the PAPM staging algorithm to populate the stages in order to determine if the PAPM model could identify hard-core smokers within Stage 4. We defined hard-core smokers as aged over 25 years, smoke 15 or more cigarettes per day (CPD), high addiction levels, no intention to quit, lacking previous quit attempts and knowledgeable about the risks of smoking.

4.2 Methods

4.2.1 Participants

This study consisted of a survey of Australian smokers. The data was collected via two recruitment methods. First, a referral sampling method was used to promote a Survey Monkey (SM) link across the social media platforms Facebook, Twitter and Linked In. The recruitment text clearly stated that the research was not a quit programme. Respondents were offered the chance to win a $100 gift voucher. Between June 2014 and March 2015, 350 respondents commenced the SM survey. Smokers were also recruited via an online data collection agency (Online Research Unit [ORU]) between March and April 2015. The ORU is an Australian-based company accredited with ISO 20252 and ISO 26362 (Global Panel Standard). ORU manages a panel of more than 350,000 Australians recruited online, by telephone and/or postal recruitment.

The inclusion criteria for both recruitment methods were the same: (i) current Australian resident, (ii) aged 25–55 years and (iii) current smoker. In combination, the use of these two methods provided a heterogeneous sample of current Australian smokers. The age range (25–55 years) attempts to exclude young adults experimenting with smoking, as well as older smokers who want to quit because of the onset of tobacco related illness. In total, 634 people commenced the survey and 406 respondents met the eligibility criteria (ORU, *n* = 159 and SM, *n* = 247). Incomplete surveys were excluded leaving 341 complete and valid surveys. There were only five responses in PAPM Stage 2 and these were removed from the analysis leaving 336 (ORU, *n* = 138 and SM, *n* = 198) valid and complete survey responses.

Ethics approval was obtained from the University of Wollongong Human Research Ethics Committee.

4.2.2 Measures

The survey was comprised of several sections assessing demographic variables, PAPM staging, smoking behaviour, and psychological characteristics. These sections are detailed further below. (See Appendix 1 for Survey Questions)

4.2.2.1 Demographic Variables

Demographic variables were collected and coded as detailed in Table 4.1.

4.2.2.2 PAPM Stage

The survey used a modified version of the PAPM staging algorithm that did not include either Stage 1 (which is unlikely to exist at a meaningful level in an Australian context) or Stage 7 (as the study is concerned with current smokers rather than those who are maintaining abstinence). The PAPM staging algorithm is a self-categorisation staging algorithm and was modified to include only Stages 2–6 rather than all stages of PAPM.(140) Participants were asked to indicate which of the following best described their thoughts about quitting smoking: ’I have never thought about quitting‘ (Stage 2);

‘I am undecided about quitting‘ (Stage 3); ’I do not want to quit‘ (Stage 4); ’I want to quit‘ (Stage 5); and, ’I have started a quit attempt or quit program’ (Stage 6).

4.2.2.3 Smoking behaviours

Participants were asked to indicate the age they commenced smoking, number of cigarettes smoked per day, frequency of smoking, and quit attempt history. Nicotine dependence was assessed via the Fagerstrom Test for Nicotine Dependence(141) which had a Cronbach’s α of 0.73 in this study. Time to first cigarette (TTFC) and number of cigarettes smoked per day (CPD) were also calculated.

4.2.2.4 Risk belief measures

An 18-item scale was used to examine self-exempting beliefs.(142) This scale is scored in relation to two individual belief statements regarding informed choice and dangers of low tar cigarettes as well as four belief domains:

(1) The Bulletproof domain (α = 0.904) comprised five items and reflected smokers’ beliefs about having some personal immunity to the risks associated with smoking.
(2) The Sceptic domain (α = 0.922) comprised five items and reflected smokers’ doubts about the scientific and medical evidence regarding smoking.
(3) The Jungle domain (α = 0.761) consisted of four items and reflected smokers’ normalisation of the risks of smoking because life in general is risky.
(4) The Worth it domain (α = 0.905) included two items and reflected beliefs that the risks of smoking were worth it.

4.2.2.5 Psychological Measures

Psychological variables included decisional balance, locus of control, enjoyment, self-efficacy, self-perception and social influences and self-health ratings. Decisional balance was assessed using the six item short form test.(143) Three items reflect the pros of smoking (DB-Pros; α = 0.808) with the other three items reflecting the cons of smoking (DB-Cons: α = 0.777).

We administered the Multi-dimensional Health Locus of Control Form B which comprised 18 items in three, six item subscales of control: internal, powerful others and chance.(144)

Self-efficacy was conceptualised as a situation specific item and participants were asked to rate their likelihood of success in quitting. We assessed social influences by asking participants to rank the statement 'People who are important to me encourage me to quit smoking' on a 5 point Likert scale. We also assessed subjective norms by asking participants to rate the statement 'People who are important to me believe I should quit smoking' on a 5 point Likert scale.

Self-perception was assessed as a descriptive norm using a 5 point Likert scale and we asked participants when compared to others did they smoke more or less and had they been smoking for longer or shorter periods of time.

We asked participants to rate both their perception of their health and their perception of the impact smoking was having on their health using a 5 point Likert scale. Finally, we asked smokers to rate their enjoyment of smoking using a 5 point Likert scale.

4.2.2.6 Knowledge measures

We assessed smoking risk knowledge with true or false answers to the statements:

- 'Smoking is a risk factor for heart disease and lung cancer'
- 'Passive smoking is a risk factor for lung cancer in others'

We also asked participants to select the cause of the most deaths in Australia each year from a drop-down list in which smoking was the correct answer.

4.2.3 Statistical Analysis

All statistical analyses were conducted using SPSS Version 25, with statistical significance determined by $P < 0.05$. The first step was to examine the demographic characteristics of smokers in the different PAPM stages. This involved conducting chi-square and analysis of variances (ANOVAs) to compare demographic characteristics and

smoking behaviour between the different smoking groups. The second step in the analysis was to investigate whether risk attitudes and/or the other variables differed between the PAPM stages. Univariate differences were first examined using ANOVAs, with post-hoc comparisons performed. General linear models were then tested to investigate the differences between PAPM stages controlling for age, gender, marital status, education level, employment, ethnicity and income. The results of the general linear models examining differences between the stages in relation to dependence, knowledge, risk attitudes, and other psychological variables are shown in Tables 4.3 and 4.4.

4.3 Results

Most smokers wanted to quit and only 11.9% were in Stage 4 (I do not want to quit) of the PAPM.

4.3.1 Demographic variables

The demographic composition of the sample is detailed in Table 4.1. There was no significant difference between the two recruitment groups in terms of age (mean 40.89, SD 8.665 $P = 0.080$), marital status ($P = 0.459$), ethnicity ($P = 0.147$) or income ($P = 0.060$). There was a significant difference between the two groups with respect to gender ($P < 0.001$) with the SM arm having significantly greater female representation (63.1%) than the ORU arm (42%).

Table 4.1: Demographic Variables by PAPM Stage

Stage/Variables	**Stage 3 – Undecided**	**Stage 4 – Do not want to quit**	**Stage 5 – Want to quit**	**Stage 6 – Making quit attempt**	**Total**	*P* ***value***
Stage Size, *N* (%)	89 (26.5)	40 (11.9)	165 (49.1)	42 (12.5)	336 (100)	
Age, mean (SD)	40.91 (9.38)	40.65 (10.02)	41.28 (7.90)	39.55 (8.79)	40.89 (8.67)	0.712
Gender, *N* (%)						0.276
Male	37 (41.6)	22 (55.0)	71 (43.0)	23 (54.8)	153 (45.5)	
Female	52 (58.4)	18 (45.0)	94 (57.0)	19 (45.2)	183 (54.5)	
Employment, *N* (%)						0.366
Full time	51(57.3)	20 (50.0)	96 (58.2)	20 (47.6)	187 (55.7)	
Part time	20 (22.5)	9 (22.5)	38 (23)	7 (16.7)	74 (22.0)	
Not in employment	18 (20.2)	11 (27.5)	31 (18.8)	15 (35.7)	75 (22.3)	
Marital Status, *N* (%)						0.797
Single	37 (41.6)	19 (47.5)	74 (44.8)	16 (38.1)	146 (43.5)	
Partner	52 (58.4)	21 (52.5)	91 (55.2)	26 (61.9)	190 (56.5)	
Education, *N* (%)						0.730
Secondary school or less	23 (26.1)	7 (17.5)	31(18.8)	9 (21.4)	70 (20.9)	
Vocational education	26 (29.5)	14 (35)	52 (31.5)	9 (21.4)	101 (30.1)	
University	37 (42)	18 (45)	81 (49.1)	23 (54.8)	159 (47.5)	
Other	2 (2.3)	1(2.5)	1 (0.6)	1 (2.4)	5 (1.5)	
Income, *N* (%)						0.380
≤ $41599 pa	34 (38.2)	20 (50)	54 (32.7)	21 (50)	129 (38.4)	

$41,600-$64,999	26 (29.2)	5 (12.5)	40 (24.2)	7 (16.7)	78 (23.2)	
$65,000-$77,999	6 (6.7)	5 (12.5)	16 (9.7)	2(4.8)	29 (8.6)	
$78,000-$103,000	14 (15.7)	7 (17.5)	34 (20.6)	6 (14.3)	61 (18.2)	
$103,000+	9 (10.1)	3 (7.5)	21 (12.7)	6 (14.3)	39 (11.6)	
Ethnicity, *N* (%)						0.293
Australian	70 (79.5)	31 (77.5)	121 (73.8)	27 (64.3)	249 (74.6)	
Other	18 (20.5)	9 (22.5)	43 (26.2)	15 (35.7)	85 (25.4)	

4.3.2 Smoking behaviour

The mean number of cigarettes smoked was 13.94 (SD = 9.656 and *P* = 0.319), there was no significant variation in daily smoking frequency between the groups. The age of smoking initiation had a mean of 18.31 years. In total, 85.1% smoked on a daily basis and there was a significant difference (*P* = <0.001) in daily smoking frequency between the stages with, as would be expected, fewer participants in Stage 6 (making a quit attempt) smoking on a daily basis.

More than 80% of smokers had made a previous quit attempt with a significant difference between the stages (*P* = 0.001) and distinct differences between Stages 3 and 4 (*P* = 0.029) and Stages 4 and 5 (*P* = 0.037). Fifty-seven smokers had never made a quit attempt and were distributed as 25% of Stage 3 (I am undecided) smokers, 30% of Stage 4 (I do not want to quit) smokers and 12% of Stage 5 (I want to quit) smokers. Nearly 5% of smokers in Stage 6 (making a quit attempt) claimed no previous quit attempt; it might be that they were making their first quit attempt at the time of the survey.

Amongst smokers in Stages 3, 4 and 5 who had not made a quit attempt there was non-significant trend for smokers in Stage 4 to be older, to smoke more CPD, to have increased nicotine dependence, greater enjoyment and use of worth it and jungle beliefs as outlined in Table 4.2.

Table 4.2: Smokers without previous quit attempts

PAPM Stage/Variables	**Stage 3**	**Stage 4**	**Stage 5**	***P***
Age	38.13 (9.314)	42.92 (9.615)	38.35 (7.936)	0.336
Age of commencement	19.61 (7.476)	20.80 (3.288)	19.80 (3.563)	0.274
Cigarettes per day	10.65 (8.742)	16.58 (10.908)	12.89 (10.252)	0.388
Time to first cigarette[b]	2.65 (1.027)	2.25 (0.866)	2.70 (1.174)	0.667
Fagerstrom Test of Nicotine Dependence[a]	2.13 (1.014)	2.83 (.835)	2.47 (1.020)	0.249
Enjoyment	3.91 (0.668)	4.08 (0.793)	3.74 (0.872)	0.664
Worth it beliefs	2.83 (1.239)	2.92 (1.222)	2.60 (1.046)	0.861
Jungle beliefs	3.22 (0.843)	3.44 (1.108)	2.88 (0.940)	0.356

[a]Fagerstrom Test of Nicotine Dependence: lower score = lower dependence

[b]Time to First Cigarette (TTFC): lower score = shorter TTFC

4.3.3 Dependence

The general linear modelling indicated a significant difference between the stages for the Fagerstrom Test of Nicotine Dependence (FTND) and time to first cigarette (TTFC) but not for cigarettes per day (CPD) as outlined in Table 4.3. Stage 5 smokers had the highest dependence scores and all stages had a mean well under the usual 15CPD used to classify hard-core smokers. Stage 6 smokers are making a quit attempt and therefore their results are difficult to reconcile. It might be that they were reporting on their smoking behaviour including TTFC and CPD prior to their quit attempt.

Table 4.3: Dependence Measures for the PAPM Stages

PAPM Stage/ Dependence Measures	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**	***p***
Fagerstrom Test of Nicotine Dependence [a]	2.40 (0.172)	2.37 (0.208)	2.76 (0.156)	2.44 (0.205)	0.021
Cigarettes per day	12.93 (1.598)	13.96 (1.931)	14.42 (1.444)	12.239 (1.905)	0.479
Time to first cigarette[b]	2.53 (0.175)[a]	2.60 (0.212)	2.16 (0.158)[a]	2.61 (0.208)	0.006

a Fagerstrom Test of Nicotine Dependence (lower score =low dependence.

b Time to First Cigarette lower score = shorter TTFC

Note: Columns with same superscript letter are significantly different from one another at $P < 0.05$.
All analyses control for the following covariates: age, gender, marital status, education level, employment, ethnicity and income

4.3.4 Knowledge

The general linear modelling indicated there was no statistically significant difference in knowledge levels between the stages.

4.3.5 Psychological Variables and Risk Attitudes

Table 4.4 shows the relationship between each of the PAPM stages and the psychological variables and risk attitudes for which there were differences between the stages. The general linear modelling indicated there was no significant difference between the stages for decisional balance pros of smoking, for self-perception of smoking behaviour or for the locus of control scales. Stage 4 smokers recorded higher levels of agreement with worth it and jungle beliefs compared with the other stages as outlined in Table 4.4. The majority of smokers (59.8%) agreed with the statement that they had made an informed choice to smoke in full knowledge of the risks. Nearly half (42.5%) of the

smokers in Stage 4 totally agreed with the informed consent statement compared to 22.5% amongst Stage 3 smokers and 16% in Stages 5 and 6.

Table 4.4: Differences in psychological characteristics between the PAPM stages

		Stage 3	Stage 4	Stage 5	Stage 6	*P*
Self-exempting beliefs scales						
Sceptic Beliefs	*α = 0.922*	2.56 (0.172)[a]	2.41 (0.211)	2.15 (0.155)[a]	2.19 (0.203)	0.020
Bulletproof beliefs	*α = 0.904*	2.47 (0.164)	2.39 (0.197)	2.19 (0.147)	2.12 (0.195)	0.103
Worth it beliefs	*α = 0.905*	2.56 (0.187)[b]	2.65 (0.226)[c]	2.04 (0.169)[b,c]	2.05 (0.222)	<0.001
Jungle beliefs	*α = 0.761*	3.07 (0.160)	3.10 (0.191)	2.75 (0.143)	2.81 (0.187)	0.034
Self-exempting beliefs *Single items*						
I have made an informed choice to smoke …		2.43 (0.197)[d]	2.36 (0.238)	2.62 (0.177)	3.02 (0.233) [d]	0.030
Self-rated health		2.15 (0.178) [e]	2.14 (0.209) [f]	2.67 (0.166) [e,f]	2.65 (0.214)	<0.001
Perceived impact of smoking on health		2.57 (0.178)	2.36 (0.215)[g,h]	2.94 (0.161)[g]	2.99 (0.211)[h]	0.002
Enjoyment		4.12 (0.147)	4.27 (0.178)[i]	3.88 (0.133)[i]	3.75 (0.175)	0.012
Decisional Balance *(cons)*		8.84(0.451)[j,k]	9.44 (0.545)[j]	10.43 (0.407)[k]	10.91 (0.534)	<0.001
Self-efficacy		3.14 (0.184)[l]	3.09 (0.223)[m]	3.11 (0.166)[l]	4.41 (0.219)[m]	<0.001
Social Influences						
Significant others believe I should quit smoking		3.86 (0.145)[n,o]	3.85 (0.175)[p,q]	4.45 (0.131)[n,p]	4.41 (0.172)[o,q]	<0.001
Significant others encourage me to quit smoking		3.21 (0.165)[r,s]	3.35 (0.199)[t,u]	3.86 (0.149)[r,t]	4.12 (0.195)[s,u]	<0.001

*Note. *Columns with same superscript letter are significantly different from one another at P <0.05*
All analyses control for the following covariates: age, gender, marital status, education level, employment, ethnicity and income.

4.4 Discussion

For the PAPM to be able to easily assist cessation practitioners with identifying hard-core smokers it must be able to distinguish between those who say they do not want to quit smoking and those who are hard-core smokers. Smokers in Stage 4 of PAPM represent the approximately 30% of Australian smokers who say they do not intend to quit smoking.(5) This sizeable percentage of smokers with no intent to quit presents as a potential public health challenge and are certainly clinically challenging with respect to achieving successful cessation.

Smokers in Stage 4 of our study demonstrated several hard-core smoking traits. They were knowledgeable and understood the risks of smoking, however, that was true of the sample as a whole and probably reflects the fact the Australia is at mature stage of the tobacco epidemic. These characteristics are also the defining features of individuals in this PAPM stage of change who have been described as more knowledgeable and unconvinced that they are personally at risk compared to those in the other stages.(42) As such, individuals in Stage 4 are more resistant to changing behaviour.(42)

Stage 4 smokers were marked by their enjoyment of smoking, a failure to perceive their smoking as negatively impacting on their health and were not particularly influenced by significant others' desire for them to quit. They utilised both worth it and jungle risk minimising beliefs to support continued smoking. Smokers in Stage 4 exhibited a greater use of worth it beliefs than the other stages, a risk belief domain associated with low quit rates.(142) Whilst there was a trend for a decrease in bulletproof beliefs across the stages, the reduction was not significantly different between the PAPM stages. This sample was highly knowledgeable about the harms of smoking and this may explain the lack of significance in the bullet proof scale as respondents did not see themselves as exempt from the harms of smoking.

Stage 4 smokers were not characterised by much higher rates of nicotine dependence than the other stages. The dependence results indicate that Stage 5 smokers

report the highest levels of nicotine dependence. It may be that these smokers experience their dependence more acutely and that is sufficient to drive intent to quit. Therefore, the reason Stage 4 smokers continue to smoke is not completely due to dependence. Understanding the other factors that motivate continued smoking, especially risk beliefs and what smokers mean when they cite enjoyment of smoking are important research questions. Previous work in understanding smokers' enjoyment identified that enjoyment and dependence both had a role in continued smoking however, enjoyment was predictive of making a quit attempt whereas dependence was predictive of cessation success.(145)

PAPM Stage 4 was not, in itself, a clear indicator of hard-core smoking status as unwillingness to quit is only one of a number of indicators of hard-core smoking. It was however, amongst Stage 4 smokers with no previous quit attempts that the hard-core smoker profile became most evident, with regard to increased dependence, consumption and disproportionate levels of low socio-economic status. These individuals were older, more likely to be single, more than half earnt less than $41,599 per annum, 75% reported moderate to high FTND and they consumed an average of 16.58 CPD. In our sample of smokers, it was only Stage 4 smokers with no previous quit attempts who consumed more than 15 CPD. However, these results were non-significant which likely reflects our small sample size and indicates the need for more research. The most recent research on hard-core smokers in Australia suggests that less than 10% of smokers are hard-core, making this a challenging group to identify and study.(127)

Health professionals may wish to consider using the PAPM algorithm when assessing a smoker's readiness to quit. For smokers in Stage 4 with no previous quit attempts, providers should recognise the potential for a hard-core smoker profile, utilise teachable moments in which the smoker's perception of their good health is being challenged, ensure nicotine dependence is addressed effectively and consider addressing smokers' ideas of enjoyment as well as worth it and jungle beliefs. Ultimately however, hard-core smoking rates will be addressed by both sustained population level tobacco control strategies *and* effective individual level cessation services.

4.4.1 Study Limitations

There are some limitations of this study that warrant discussion. One key limitation of the survey was the reliance on self-selection to participate: recruitment bias is likely to have occurred, and the sample is unlikely to be generalisable to the broader smoking population. Smokers in Stage 4 may be under-represented as they are highly likely not to participate despite the recruitment information clearly stating that there was no requirement to change behaviour and that there was no quit programme included. Studies of hard-core smoking prevalence have identified that smokers with greatest disadvantage, and especially alcohol and other drug treatment populations, have higher rates of hard-core smoking. Future research should consider targeting this population. Moreover, Stage 2 numbers were too small to be statistically useful, possibly because comprehensive tobacco control action has resulted in very few smokers in Australia in this stage. Whilst the PAPM staging algorithm was utilised, no work to assess the reliability of this staging format has been conducted to date. Further work needs to be done to validate the algorithm. In completing the survey, participants provided self-reported measures which may not be accurate. No clinical assessment of health or of smoking status through biological measures was conducted. There are a number of methods available to assess stage-based theories. The gold standard for testing stage-based behaviour change models is a match-mismatch test which is beyond the scope of this study. It is not possible, using a cross sectional methodology to state that the stages are valid.

4.5 Conclusion

Our results suggest that further research with the PAPM algorithm may be useful. Smokers in Stage 4 and especially those with no previous quit attempts are likely to be more resistant to quitting than other smokers. Further research is required to determine the model's utility with a randomised and larger data set of smokers.

Chapter 5. Smoke-free environments: current status and remaining challenges in Australia (Paper 4)

This chapter has been published in the Journal of Public Health Research & Practice as an invited peer reviewed paper. As declared in the published paper, the authors were all equally responsible for the design, drafting, analysis of data, and editing of the manuscript. The chapter is identical to the published manuscript except for table numbers and references which have been altered to ensure uniformity in formatting across the thesis.

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Abstract

Objectives: Smoke-free environments have been one of the great success stories in tobacco control in Australia. In this paper, we describe the current situation with respect to smoke-free environments in Australia, identify opportunities for extending and/or strengthening smoke-free environments, and discuss the challenges alternative nicotine delivery devices such as e-cigarettes pose to the traditional notion of 'smoke-free'.

Type of program: Smoke-free environments are an essential element in a comprehensive approach to tobacco control. They are recognised in the World Health Organization Framework Convention on Tobacco Control and in the Australian National Tobacco Strategy.

Results: There is strong evidence that smoke-free environments support smokers to make a quit attempt, support ex-smokers to maintain their resolve, and protect the health of non-smokers and ex-smokers alike.

Lessons learnt: Smoke-free environments have contributed to reductions in smoking prevalence. They are not yet fully deployed in public policy in Australia, and policy makers should extend smoke-free environments to areas such as high-roller rooms in casinos, prisons, residential mental health facilities and multi-unit residences. E-cigarettes are challenging the ways we think about 'smoke-free', and have the capacity to undermine smoke-free successes if regulation does not prevent their use in smoke-free environments.

5.1 Introduction

Smoke-free environments are an essential element in a comprehensive approach to tobacco control, addressed in both Article 8 of the World Health Organization's Framework Convention on Tobacco Control (FCTC) (147) and in the Australian National Tobacco Strategy.(6, 146) Smoke-free environments support smokers to reduce the number of cigarettes they smoke and to make quit attempts.(147) Smoke-free environments also support ex-smokers to maintain their resolve and protect the health of non-smokers and ex-smokers alike.(147) Second-hand smoke is harmful to health with no safe level of exposure.(146)

One in four Australians live in a household in which there are one or more people who smoke.(4) Despite this, only 2.1% of Australian children and 2.4% of non-smoking adults are exposed to tobacco smoke in their home (4), signalling the support for smoke-free environments by Australians in protecting children and non-smokers from the established harms of tobacco smoke. However, out of the home, the implementation of smoke-free environments across Australia has lacked consistency. Nonetheless, smoke-free policy continues to be needed as a key lever in tobacco control within Australia. This paper explores the current state, the challenges and the future of smoke-free environments from an Australian context.

5.2 Current state of smoke-free environments in Australia

Smoke-free environments have been one of the great success stories in tobacco control in Australia. Not only have they directly contributed to the significant reduction in smoking prevalence and reduced individual consumption of tobacco products, but they have gained widespread community support and changed social norms and expectations relating to smoking.(148-150) In Australia, legislation regarding smoke-free environments is under the jurisdiction of state and territory governments. Initial legislative interventions to introduce smoke-free environments sought to address the dangers of exposure to tobacco smoke in

workplaces. The success of legal action against employers was one of the initial drivers of the smoke-free legislation. With increasing levels of community support for smoke-free environments, legislation that bans smoking in cars carrying children, in restaurants, including outdoor dining areas and in licensed premises, has been enacted across Australia, albeit at different times and with different requirements.

Smoke-free environments are increasingly being implemented through the power of community expectation. In fact, this is an area of tobacco control where the community has raced ahead of policy makers. In a 2019 New South Wales (NSW) survey, more than half of respondents expressed support for legislation to create smoke-free environments.(151) Smoke-free homes are now normalised, without legislative intervention. Local councils are now finding strong community support for banning smoking in many outdoor areas not covered by state smoke-free legislation such as children's playgrounds, sporting fields, public beaches and city shopping precincts.(152) Whether smoke-free environments are implemented via legislation, local government regulations or voluntarily by the public, concerns regarding health impacts of tobacco smoke, fire hazard, workplace health and safety, environmental impacts, public amenity, threat of legal action and political expediency have all been equally strong drivers for their implementation.

Most indoor venues and a large number of outdoor venues, such as bus stops and stadiums, are now smoke-free across Australia. Table 5.1 provides a summary of smoke-free environments across the Australian states and territories.

Table 5.1. Current state and territory smoke-free environments

Smoke-free area	NSW	VIC	QLD	SA	NT	TAS	WA	ACT
Indoor Public Spaces								
Indoor (enclosed) public places (%closed space required for space to be considered enclosed	Y (75)	Y (75)	Y (50)	Y (70)	Y (75)	Y (50)	Y (50)	Y (75)
High-roller rooms in casinos	N	N	N	Y	N	Y	N	Y
Outdoor public places								
Play equipment	Y	Y	Y	Y	NI	Y	Y	Y
Public transport stops	Y	Y	Y	Y	Y	Y	N	Y
Taxi ranks	Y	NI	Y	NI	Y	NI	NI	NI
Sports grounds/ stadium	Y	Y[a]	Y[b]	NI	NI	Y	NI	NI
Swimming pools (public)	Y	Y	Y	Y	NI	Y	NI	NI
Beaches (only patrolled areas)	Y[a]	Y	Y	Y	NI	Y	Y	NI
Skate parks	NI	Y	Y	NI	Y	NI	NI	NI
National Parks	Y	NI	Y	NI	NI	NI	NI	NI
Outdoor shopping/pedestrian malls	Y[a]	N	Y	Y	NI	Y	N	Y
Events	NI	NI	NI	NI	Y[b]	Y	NI	Y[a]
Under-age events	NI	NI	Y	NI	NI	NI	NI	Y
Near building entry/exit	Y[a]	Y[a]	Y	N	Y	Y	Y	Y
Near air conditioning vents	NI	NI	NI	N	Y	Y	Y	NI
Commercial outdoor eating	Y	Y	Y	Y	Y[b]	Y	Y[b]	Y
Commercial outdoor drinking	N	N	Y[b]	N	N	N	N	Y[b]
Other								
Cars carrying children (age)	16	18	16	16	16	18	17	16
Health facilities	Y[b]	NI	Y	NI	NI	NI	NI	NI
Government-funded	NI	NI	NI	NI	NI	NI	N	NI

housing								
Prisons	Y[b]	Y[b]	Y	Y	Y	Y	Y	Y[b]
Multi-unit dwellings	Y	NI	NI	Y[a]	NI	NI	N	NI
Residential aged care facilities	NI	Y	Y[b]	Y[a]	NI	NI	NI	NI
Early childhood centres	NI	Y	Y	NI	Y	NI	NI	NI
Schools (primary, secondary)	NI	Y	Y	Y[b]	Y[b]	NI	NI	NI
Tertiary/ technical/other education facilities	NI	NI	NI	Y[b]	Y[b]	NI	NI	NI

NSW = New South Wales; VIC = Victoria; QLD = Queensland; SA = South Australia; NT = Northern Territory; TAS = Tasmania; WA = Western Australia; ACT = Australian Capital Territory; Y= specifically covered in legislation; N = specifically not covered in legislation; NI = not identified or covered in legislation

[a] Legislation exists with significant variation (e.g. legislation present at a local council level)

[b] Allows for designated outdoor smoking areas.

Note: This table covers relevant legislation and regulations, not individual or sector policies or guidelines.

5.3 The challenges and opportunities for smoke-free environments

Despite the successes achieved to date in implementing smoke-free environments, there remain substantial challenges to fully deploying them across Australia. Policy inconsistency and incremental change have been the hallmark for smoking bans in Australia since they were first introduced, as seen in Table 5.1. Ironically, Australian Government offices were made smoke free by policy in 1986, long before most governments were prepared to pass legislation to protect the rest of the community in other areas. There remain many areas where people continue to be exposed to cigarette smoke.(153) Political hesitancy in the face of the tobacco, gambling and alcohol lobby appeared to be an underlying driver of amendments to the *NSW Smoke-free Environment Act 2000*, which gave hotels and clubs an exemption from the Act – a decision that was justified based on economic grounds (subsequently found to be incorrect).(154) Similarly, in Victoria, the gambling lobby argued that as smokers were the biggest poker machine users, forcing them to take a break from their gambling to move outside to smoke would result in a reduction in poker machine revenue (and subsequently poker machine tax to the government).(155)

The power of the tobacco, gambling and alcohol lobbies continues to undermine the potential effectiveness of smoke-free legislation. Smoking continues in some poker machine areas in NSW, which have been specially designed to take advantage of inconsistencies and unclear definitions of an “enclosed public place” in the legislation. Likewise, high-roller rooms in casinos across most states of Australia remain exempt for smoke-free legislation. This is despite the 2003 guidance note on the elimination of environmental tobacco smoke in the workplace(156) under occupational health and safety legislation, where employers are required to take all measures that are practicable to protect the health and safety of employees and others in the workplace. Employers are obliged to provide healthy and safe workplaces. Allowing workers and others to harm persons through passive smoking in the workplace contravenes this obligation; workers who are exposed in pubs and clubs while servicing smoking areas and outdoor workers on building sites are just two examples where further regulation and compliance with existing regulation needs to be strengthened.

Multi-unit residences also present particular challenges, as residents leave their apartments to smoke on balconies and in communal areas, only for their smoke to waft back into their neighbours' residences. Almost 40% of people living in multi-unit housing report being exposed to tobacco smoke (153), and these private areas present regulatory and compliance challenges as governments are loath to face the ‘nanny state’ accusations which regulation and enforcement would inevitably bring. However, progress is being made in some jurisdictions with regard to multi-unit dwellings. In NSW, for example, smoke-free multi-unit housing has become possible through the introduction of strata by-laws for all new buildings from November 2016. As this option is open to owners in both new and existing buildings, this is small step forward for all new buildings as well as creating the opportunity for individuals to advocate for change in existing buildings. There is an opportunity for other states to capitalise on this change in legislation and replicate for consistency across the federation. Although there are inconsistencies among states, this can also provide an opportunity for states to leverage off the success of others to increase their own smoke-free

areas. Policy makers can use this as an opportunity to reset the bar and create consistent policy among states, and community and advocacy groups can use the inconsistencies to drive the need for equitable access to an environment that is free from second-hand smoke.

Areas where people with high rates of smoking live or frequent present opportunities for smoke-free policies. Prisons, community housing and mental health settings are key environments which would benefit from a combination of smoke-free policy reinforced with supportive quit programs needed for these smokers. It is vital that policy makers work with communities where smoking prevalence is high to facilitate regulation, ongoing compliance and or voluntary implementation of smoke-free environments.

Public education and support for smoke-free areas remain key components of successfully achieving new legislation. For example, between 2000 and 2005 a 'Smoke-free homes and cars' campaign aimed to influence parental smoking around children in private spaces like cars and homes. This campaign educated the public on the harms of second-hand smoke, thereby building public support and easing the passage of legislation that makes it an offence to smoke with a child aged below 16 years in a vehicle.

5.4 A new challenge: alternative nicotine delivery systems

The use of alternate nicotine delivery systems (ANDS), such as e-cigarettes, heat-not-burn devices and other emerging consumer products, are currently prohibited for use in all smoke-free environments in all states and territories except in Western Australia. The tobacco industry and vaping lobby have taken an aggressive position in promoting these products as safe or safer alternatives to combustible cigarettes and argue that they should be able to be used in smoke-free environments. Phillip Morris International has gone as far as to argue that it has a "smoke-free future" and that smokers should move to "unsmoking" with use of their ANDS products.(157, 158)

One of the significant achievements of smoke-free environments has been a sustained decline in the number of cigarettes consumed by smokers.(159) This decline in consumption

is no doubt a key driver behind the tobacco industry's move into ANDS as they are a potential solution to declining markets. If ANDS can be promoted as not generating harmful smoke, they can also be used to challenge smoke-free policies, which occurred recently in New Zealand.(160)

In Australia, the majority of states and territories have demonstrated leadership in prohibiting e-cigarette use in smoke-free environments and public support for regulating e-cigarette use in smoke-free environments is high. In 2019, 69% of Australian respondents supported restricting e-cigarette use in public places.(4) As more disruptive smoking technology enters the market place, the challenge will be to continue to be vigilant in achieving the goals of smoke-free policies, even if these new devices appear to function in the absence of actual smoke. New ways of thinking about smoke-free environments need to develop to inform appropriate policy and regulatory responses. This includes:

1) Ceasing to compare ANDS with combustible cigarettes, which are deadly, and compare them to the known healthy alternative of clean air

2) Ensuring that non-users are not exposed without their knowledge or consent to addictive substances and emissions from these products, especially when the long-term health consequences are poorly understood

3) Continue the focus of advocacy efforts on comprehensive tobacco control policies including smoke-free environments to further reduce smoking prevalence rates and prevent smoking initiation.

5.5 Conclusion

Increasing community expectations for a smoke-free environment, including an e-cigarette-free environment, should provide policy makers and legislators with confidence to explore extending smoke-free environments, including those in residential settings as well as confronting the influence of the tobacco, gambling and alcohol lobbies to close loopholes

such as high-roller rooms. It is vital that public health practitioners identify and work with communities where smoking prevalence rates are high and where exposure to second-hand smoke remains high. Community support in combination with expert political champions is paramount in navigating new smoke-free environments.

Smoke-free areas have reduced smoking prevalence, helping smokers find ways to control and then overcome their nicotine addiction, making smoking less tempting to young non-smokers and supporting ex-smokers to maintain their decision to quit. The tobacco industry is not going to let that go unchallenged. The industry is adept at seeking new ways to reduce the effectiveness of tobacco control strategies. Their future profitability – in fact their entire future – depends on maintaining existing customers and recruiting new users for their products. ANDS have the potential to replace their dwindling customer base and to confuse the discussion about what constitutes a smoke-free environment. Companies such as Phillip Morris International are actively claiming the smoke-free space as they attempt to legitimate the sale of their ANDS products.

There is a need for health advocates to be vigilant and assume that the current smoke-free legislation will not automatically deal with future developments in smoking technology. Tobacco control regulation needs to be constantly evaluated and monitored to ensure that it is delivering against its objectives. As technology changes we need to ensure that legislation is amended in a timely fashion and that any attempts by the tobacco industry and its supporters to continue damaging the health of Australians are vigorously opposed.

Recent history has shown us – the Phillip Morris-funded Foundation for a Smoke-free World being just one example – that the tobacco industry will not just attack tobacco control legislation but subvert the language of tobacco control to help promote its products.(161) Ensuring the efficacy of existing smoke-free areas and increasing smoke-free areas will be the new challenge for tobacco control in coming years.

Chapter 6. Time to Rethink Tobacco Dependence Treatment in Australia (Paper 5)

This chapter has been published inin the Australian and New Zealand Journal of Public Health. The chapter is identical to the accepted manuscript except for references, which have been altered to ensure uniformity in formatting across the thesis.

Buchanan, T., White, S.L., Marshall, H., Kelly, P.J., Carson-Chahhoud, K.V., Magee, C.A. Time to Rethink Tobacco Dependence Treatment in Australia. *Australian and New Zealand Journal of Public Health.* https://doi.org/10.1111/1753-6405.13151

https://doi.org/10.1111/1753-6405.13151

As the paper is a commentary, no abstract was required.

This Chapter is informed by the peer reviewed publication dealing with e-cigarettes as detailed below:

McDonald, C.F., Jones, S., Beckert, L., Bonevski, B., **Buchanan, T.**, Bozier, J., Carson-Chahhoud, K.V., Chapman, D.G., Dobler, C., Foster, J.M., Hamor, P., Hodge, S., Holmes, P.W., Larcombe, A.N, Marshall, H.M., McCallum, G.B., Miller, A., Pattemore, P., Roseby, R., See, H.V., Stone, E., Thompson, B.R., Ween, W.P., Peters, M.J. Electronic cigarettes: A position statement from the Thoracic Society of Australia and New Zealand. *Respirology*. 2020; **25**: 1082–1089.

https://doi.org/10.1111/resp.13904

6.1 Introduction

Despite, widespread success and reductions in smoking prevalence rates, tobacco use remains the leading modifiable risk factor for ill health in Australia accounting for 22% of the cancer burden, 12% of cardiovascular disease and 41% of respiratory illness.(19) The forthcoming National Preventive Health Strategy identifies reducing tobacco use as a priority for all Australian Governments and cites “increased provision and access to evidence-based cessation services and support to help people who use tobacco to quit” as a key policy area. (162)

Australia, as a signatory to the Framework Convention on Tobacco Control (FCTC), has an obligation to provide evidence-based tobacco dependence treatment (TDT) as part of routine health care. Article 14 of the FCTC requires signatories to ensure cessation access and develop and implement a national cessation strategy, national treatment guidelines and a consistent approach to training health practitioners to provide brief advice, all of which must be free from conflicts of interest and integrated with comprehensive population level tobacco control measures.(66)

The recent TGA decision on liquid nicotine and the introduction of smoking cessation via telehealth together with the aspiration of increasing cessation in the new National Preventive Health Strategy provides an opportune moment for a commitment to improving the provision of TDT. In this commentary, we argue that TDT is an overlooked component of Australia’s comprehensive national tobacco strategy and must be implemented urgently to complement population level actions that prevent uptake and encourage cessation.

6.2 Most Smokers Want to Quit

The proportion of Australians smoking daily more than halved between 1991 and 2019, declining from 24.3% to 11.6%.(3) Moreover, smoking has become increasingly de-normalised with very few young Australians initiating smoking: less than 2% of 14-17 year olds report daily smoking and the proportion of 18-24 year olds never smoking rose to 80%

in 2019.(4) However, there is still significant work to be done to improve cessation outcomes. For example, around one third of Australian smokers made unsuccessful quit attempts in 2019 and this figure has been relatively stagnant for the past decade.(4)

Australia's success in lowering smoking rates reflects comprehensive population level tobacco control interventions designed to reduce supply and demand (e.g. mass media campaigns, taxation, smoke-free spaces and bans on marketing and promotion).(163) Nonetheless, there are still considerable disparities in smoking prevalence rates with individuals from socially disadvantaged backgrounds more likely to be daily smokers compared to those from socially advantaged backgrounds (18% vs 5%).(4) Furthermore, while smoking rates have declined overall, they remain much higher in at-risk groups including those with a diagnosed mental illness (including substance use disorders), the unemployed, people living in remote areas, and Aboriginal and Torres Strait Islander peoples.(4)

For the past decade, around 30% of smokers have said they do not want to quit; a statistic that seems to support the idea that there are large numbers of smokers who are unwilling to quit.(4) However, around half of these "unwilling to quit" smokers have made a quit attempt in the past 12 months.(164) Only a quarter reported there was nothing that could motivate them to quit, meaning that most Australian smokers who say they are unwilling to quit also say they could be prompted to make a quit attempt.(4) Even if the 30% of smokers who say they do not want to quit represented the last remaining smokers in Australia, the population prevalence of smoking would be less than 5%.(164) Clearly then, most Australian smokers either want to quit or can be readily motivated to make a quit attempt.

6.3 Currrent TDT in Australia

Although there is a sizeable cohort of future quitters, system-wide efforts to promote cessation and improve the provision of TDT to individuals, to increase both quit attempts and quit success are currently lacking. Very few Australian health professionals routinely

promote cessation and fewer still deliver evidence-based TDT; a combination of multi-session behavioural intervention plus combination pharmacotherapy.(165, 166) While not all smokers require TDT, subgroups with complex psychosocial issues (e.g., mental illness, substance use disorder, low self-efficacy) or with existing health conditions or treatment plans affected adversely by smoking (e.g. pregnancy, pre-surgery, after a cancer diagnosis or cardiovascular event etc) should be offered evidence-based cessation support. Health agencies have noted that underutilisation of existing services and current structures of access to pharmacotherapy may be exacerbating tobacco related inequities.(167-171) Addressing these problems, by ensuring smoking cessation is core business in the health system is required urgently to both motivate people to make a quit attempt and to maximise best practice support for quitting.

There have been innumerable pilots and trials promoting and testing practice change in Australian settings, ranging from the use of targets and financial incentives in whole subsets of a state health system down to clinical pathway “tools” in single inpatient units in hospitals. (172, 173) The feasibility and acceptability of embedding TDT in routine care in Australia is not in doubt. However, achieving sustainability of practice change, in the absence of policy and structural changes engendered by a national commitment is highly questionable. The key focus of Article 14 is coordinated system level actions rather than sporadic or isolated activity.

Current TDT service provision in Australia has a number of challenges. For example, it is disjointed, does not reach populations with higher levels of smoking effectively and consistently, is not embedded in health care delivery, slips through the cracks of health care professional education, and is often not evidence based in practice. (174) Complicating these issues is the federated structure in which the Commonwealth derives benefits from tobacco taxation and is responsible for Australia’s commitment to the FCTC and the subsidisation of some pharmaceuticals. However, it is the states/territories that are

responsible for funding and delivery of behavioural support via quit lines and integration into the health care sector.

Ill health and cost have been identified as the leading reasons cited by smokers for making quit attempts; thus each contact with healthcare workers represents an opportunity for cessation intervention.(4) However, documentation of smoking status and active delivery of TDT is inconsistent across the health sector and key settings such as alcohol and other drug treatment centres.(175) In 2018, the Australian Council on Health Care Standards clinical indicator for documenting preoperative smoking status was the least commonly collected anaesthesia indictor – reported by only one health care organisation.(176) Since the first version of the Royal Australian College of General Practitioners (RACGP) Smoking Cessation Guidelines was published in 2011, systematic identification of all people who smoke has been strongly recommended. However, despite a decade of unequivocal guidance, there is no such system routinely in place.(177)

The Federal Government subsidises nicotine replacement therapy (NRT) in the form of patches, gum and lozenge, as well bupropion and varenicline, via the Pharmaceutical Benefits Scheme (PBS). PBS subsidisation, however, does not reflect the well-established evidence base when it comes to effective prescribing of NRT. Combination therapy is not subsidised and subsidies are only available to people on very low incomes and Aboriginal and Torres Strait Islander peoples. The general patient charge for Nicorette Invisipatch 25mg/16hr x28 patches on the PBS is $41.30 (plus the cost of a GP appointment if the GP does not bulk bill). The same product retails for $40.99 from a large pharmacy chain store. By making the subsidised cost essentially the same as purchasing NRT over the counter, there is a lost opportunity to incentivise people who smoke to visit a health professional for subsidised pharmacotherapy and receive advice and a referral for behavioural intervention.

Pharmacotherapy is most effective when combined with multi-session behavioural intervention, such as that provided by Quitlines in Australia.(177, 178) However, the number of health professionals actively referring to Quitline is very low. In 2018 in Victoria, an

estimated 32,000 NRT prescriptions were dispensed, but Quitline received only 1,555 referrals.(170) When pharmacotherapy is used in isolation of behavioural intervention, neither government investment in subsidised pharmacotherapy nor quitting success are maximised.

Given smoking cessation is not addressed routinely and that safe, high quality and efficacious TDT is underutilised, it is not difficult to see that low cost system level interventions to embed TDT in routine care have the potential to significantly increase quitting outcomes. It is also unsurprising that, in the absence of consistent advice on quitting and the underutilisation of TDT, e-cigarettes have come to be viewed by some as a possible "magic bullet" for increasing cessation rates.

The case for e-cigarettes as a form of NRT for cessation is reasonable in theory but not, as yet, unequivocally supported by evidence. A 2020 Cochrane review found moderate-certainty evidence "limited by imprecision" that e-cigarettes may assist with cessation.(179) A randomised controlled trial of e-cigarettes versus NRT for smoking cessation demonstrated that e-cigarettes were more effective than NRT.(136) The critical factor in this study by Hajek et al was that e-cigarettes were successful when combined with high-intensity face to face behavioural intervention such as that provided by Quitline. (136)

An important secondary finding from the Hajek study was that combustible cigarette quitters substituted e-cigarettes for cigarettes; 80% of e-cigarette users persisted in using an e-cigarette at 12 months (compared to only 9% of NRT users persisting with NRT use).(136) This is highly consistent with the pharmacokinetic profile of e-cigarette delivery of nicotine mimicking the rapid peaks and troughs seen with combustible cigarettes compared to the lower level, steadier nicotine levels achieved using NRT patches. The concern is that smokers who switch to e-cigarettes maintain nicotine addiction and are at high risk of relapse to combustible cigarettes.(26, 180-182)

Whether or not e-cigarettes increase cessation, a similar approach to promotion and utilisation of TDT described above will be required.(136) We should ensure TGA-approved pharmacotherapies are used first and with behavioural intervention. If necessary, e-cigarettes can then be used as a second-line approach with behavioural intervention, as recommended by the RACGP Smoking Cessation Guidelines 2020.(177) And, as a whole, the system will need to be ready to treat people who are dependent on e-cigarettes, probably (and perhaps ironically) using pharmacotherapy and behavioural intervention used to treat people who are dependent on cigarettes.

6.4 Opportunities to Improve TDT

A consistent national approach to TDT guidance and training and national TDT coordination are foundation pieces to implement Article 14 and thus improve TDT. The reasons why health care professionals do not routinely deliver TDT have been studied repeatedly. Some of the main reasons include lack of confidence, time, skills or experience in discussing smoking, taboos around addressing personal matters, lack of knowledge about TDT options, lack of reimbursement for a TDT consult and systems issues such as unclear follow up procedures or referral pathways.(183) Providing effective training in TDT to health care professionals would enhance delivery of quit smoking support using established therapies by addressing many of these barriers and changing practitioner attitudes and behaviours when it comes to promoting cessation and facilitating uptake of TDT. Quit training uses evidence-based skills development that is based on the latest research evidence as it becomes available.

Khan et al provide an important reminder that evaluation of smoking cessation studies, such as those designed to increase clinicians' willingness to deliver brief advice, is vital to ensure shared learning.(184) This call to evaluate is equally important for interventions that are successful and for those which are not. However, at the present time, Australia lacks a coordination mechanism or clearing house by which these outcomes can be reviewed and considered by jurisdictions for scale up and deployment as usual care. This

leads to inefficiencies and redundancies in the funding and execution of research studies and clinical trials.

System level improvements to record interventions as part of a management reporting framework have been demonstrated to ensure TDT is offered more frequently.(172) System level advocacy and coordination is also required to ensure there is a system level (and sustainable) change in health care practice. Addressing attitudes and behaviours in individuals (e.g. through professional standards set by national peak bodies), organisations (e.g. by incorporating TDT in national quality and safety standards) and governments (e.g. by including TDT targets in service and funding contracts) will all be required.

6.5 Conclusion

Australia leads in many other aspects of FCTC implementation but is not yet delivering a systematic approach to TDT systems as part of a comprehensive national approach to reducing smoking prevalence. This is not an either/or scenario in which TDT for individuals is prioritised over population level interventions. Article 14 specifically recognises the role population level interventions have in driving motivation to quit. There is no ‘magic bullet’ that can reduce smoking prevalence. It requires a multi-faceted, coordinated and comprehensive approach.

Chapter 7 – General Discussion and Conclusion

7.1 Summary of Findings

The overarching aim of this thesis was to develop a detailed understanding of hard-core smoking in Australia in order to understand the implications for tobacco control policy and in particular for product-based THR approaches. Whilst the thesis was primarily concerned with developing an evidence base for public health policy, it also sought to: i) investigate whether the Precaution Process Adoption Model provided a useful clinical framework for hard-core smokers; ii) address the knowledge gap about the contemporary nature of hard-core smoking in Australia; and iii) consider theoretical concepts including the challenges of defining hard-core smoking, the characteristics of hard-core smokers and identification of psychological traits that could support an enhanced understanding of hard-core smokers in an Australian context and potentially in other countries in the mature phase of the smoking epidemic.

To answer these questions a systematic review of the international literature on hardening and hard-core smoking was conducted (Chapter 2). We then used two definitions of hard-core smoker drawn from the literature to calculate the upper and lower rates of hard-core smoking prevalence in Australia and to identify whether hardening was occurring (Chapter 3). This study also provided information regarding characteristics of Australian hard-core smokers as the sample was drawn from three waves of the NDSHS. In Chapter 4, smokers were recruited via social media sources and a panel data set to further develop our understanding of Australian hard-core smoker characteristics and to test the PAPM as a potential model for hard-core smoking.

Finally, utilising the findings from each of the studies above, this thesis argues for a policy approach to THR that focuses on maintaining and strengthening smoke-free spaces as an effective population level harm reduction approach (Chapter 5) and maximising cessation outcomes for all smokers (Chapter 6).

7.1.1 Findings from Paper 1

Paper 1 (Chapter 2) was a systematic review of hard-core smoking and hardening internationally. It addressed aims one and three of this thesis and the results are detailed below.

> Aim 1. Identify whether the smoking population is hardening in Australia and overseas
>
> Aim 3. Examine how hard-core smoking is defined and operationalised, and investigate how this influences variability in the scale and nature of hard-core smoking

The results of the systematic review which included 40 studies published in English in a peer reviewed journal between 1970 and 2018 in the adult population demonstrated that smoking populations are not hardening. Only one study, by Fagerstrom and Furberg found evidence of hardening occurring, although this study had significant methodological challenges.(105) There was, however, significant evidence that softening was occurring: that is, smokers were more likely to be modifying their smoking behaviour. Whilst the smoking population as a whole is not hardening, there was some indication that hardening may be occurring in drug and alcohol treatment seekers, low SES groups and amongst women.

The review identified that whilst the concept of a hard-core smoker as someone who cannot and/or will not quit is relatively straight forward, how this concept is measured is subject to tremendous variability. Twenty-four studies resulted in 30 unique operational and empirical measures of a hard-core smoker. Definitions with fewer variables resulted in higher rates of hard-core smoking. Intent to quit was the most frequently measured variable to assess hard-core smoking with most studies also including previous quit attempts and proxy measures of tobacco dependence, especially cigarettes per day (CPD). Hard-core smoking rates ranged from 0.03-41.6% of smokers depending on the definition used.

The systematic review also identified characteristics of hard-core smokers internationally. Despite the variability in measuring hard-core smoking, hard-core smokers were more likely to be older, male, less exposed to smoking bans, and to have initiated smoking at a younger age. Lower rates of employment in developed nations with robust tobacco control were evident, but hard-core smokers in developing nations or with poor tobacco control may exhibit higher employment rates.

7.1.2 Findings from Paper 2

Paper 2 (Chapter 3) analysed three waves of the NDSHS from 2010, 2013 and 2016 to determine rates of hard-core smoking in Australia. If rates of hard-core smokers had increased over this period that would have provided support for claims that smokers in Australia were hardening. The analysis used two definitions of hard-core smoker, drawn from the systematic review, to provide an upper and lower range of hard-core smoking rates in Australia. As this study calculated hard-core smoking rates over three waves of a population level representative survey, it was able to assess whether hardening was occurring in the Australian smoking population. Paper 2 addressed aims 1, 2, 4, and 5 of this thesis and the results are detailed below.

> Aim 1. Identify whether the smoking population is hardening in Australia and overseas
>
> Aim 2: Assess whether hardening is occurring amongst Australian smokers during a period in which e-cigarette/ANDS use and advocacy has significantly increased
>
> Aim 4. Estimate the proportion of Australian smokers who could be classified as hard-core
>
> Aim 5. Investigate the characteristics and risk exempting beliefs of Australian

The least stringent definition of a hard-core smoker used in the study was derived from Docherty et al as a smoker who does not want to quit.(91) Using this definition, declining rates of hard-core smoking were identified between 2010 and 2016 (population

prevalence of 5.49%-4.85%) indicating that Australian smokers were not hardening. As the decline was significant, it supports a softening of the Australian smoking population rather than any hardening.

The more stringent definition in the study was derived from Emery et al and defined hard-core smokers as a current daily smoker of at least 15 CPD, aged 26 years or over, with no intention to quit, a lifetime consumption of at least 100 cigarettes, and no quit attempt in the past 12 months.(10) This definition returned very low levels of hard-core smoking rates. Whilst the population prevalence rates of hard-core smoking decreased using the most stringent definition from 1.02% in 2010 to 0.80% in 2016, the decline was statistically non-significant. This indicated that the size of this group of smokers may be fairly stable. Endgame policy planning accepts that there will always be a small number of smokers who will persist in their smoking. It is possible that this small group of smokers represent the natural limit of smoking prevalence and the smoking endgame goal for Australia.(135)

Rates of hard-core smoking were low using both definitions. The rate of decline was only statistically significant for the least stringent definition, but both definitions experienced significant declines in smokers consuming more than 15 CPD. This reduction in CPD is a further indication that hard-core smokers are not a credible threat to achieving further smoking prevalence declines because Australian smokers who consume less than 20 CPD are more likely to successfully modify their smoking behaviour.(4) The reduction in CPD is further support for softening occurring amongst Australian smokers. Further robust tobacco control policy interventions should result in continued softening and further declines in smoking prevalence.(126)

Despite using two different definitions for hard-core smoking, the socio-demographic characteristics of hard-core smokers were remarkably consistent. Australian hard-core smokers were more likely to be male, have lower levels of educational attainment, higher levels of psychological distress and experience higher level of socio-economic disadvantage.

These findings are consistent with the characteristics of hard-core smokers from other developed countries with robust tobacco control policies identified through the systematic review (Chapter 2). Whilst the literature review suggested possible hardening amongst women, this result was not evident amongst Australian smokers.(84)

7.1.3 Findings from Paper 3

Paper 3 (Chapter 4) sought to further explore the characteristics of Australian hard-core smokers by applying the PAPM as a theoretical model for identifying and understanding hard-core smokers. This paper addressed aims 5 and 6 of the thesis and the results are summarised below.

> Aim 5. Investigate the characteristics and risk exempting beliefs of Australian hard-core smokers
>
> Aim 6. Determine whether PAPM might be a useful theoretical framework for clinicians to identify hard-core smokers

Smokers who identified as not wanting to quit (Stage 4 of the PAPM) are the same group of smokers in the least stringent definition applied in Paper 2. These smokers demonstrated several traits: they failed to perceive smoking as negatively impacting on their health, rated their enjoyment of smoking highly and were not influenced by significant others' desire for them to quit. They were most likely to utilise "jungle" and "worth it" risk exempting beliefs to support their continued smoking. Stage 4 smokers did not have higher rates of nicotine dependence than the other stages, suggesting that it is not only nicotine which influences a smoker's decision to continue to smoke.(145) When the criteria of no previous quit attempts was added to Stage 4 of the PAPM, then the hard-core smoker traits of higher levels of nicotine addiction, increased consumption and increased levels of socio-economic disadvantage were evidenced. These smokers were also most likely to be older and single.

Australian hard-core smokers are knowledgeable about the harms of smoking. Therefore, when considering population level interventions, it is important to consider that it

is not lack of knowledge which drives continued smoking but other factors such as enjoyment and the utilisation of risk exempting beliefs.

It is not the case that all smokers who do not want to quit, also have high levels of nicotine dependence. Most smokers who do not want to quit cite enjoyment as the reason they continue to smoke.(4) Understanding the interplay between enjoyment and risk exempting beliefs as a means of sustaining smoking behaviour and nicotine dependence as an indicator of potential successful quitting are crucial to working successfully with all smokers and especially with hard-core smokers.(145)

Smokers in Stage 4 of the PAPM, and especially those with no previous quit attempts, are likely to be more resistant to quitting than other smokers. The PAPM may assist clinicians in assessing a smoker's readiness to quit. When working with smokers in Stage 4 of the PAPM who have no previous quit attempts clinicians should recognise the possibility of a hard-core smoker profile.

7.1.4 Findings from Paper 4

Paper 4 (Chapter 5) provides an overview of the history, current status and challenges to smoke-free spaces in Australia. The paper identifies the important role smoke-free spaces have played in supporting smoking cessation, protecting non-smokers from exposure and preventing smoking relapse amongst former smokers. It also outlines the high level of social acceptance of smoke-free spaces, noting that Australians have embraced the concept in their homes with only 2.1% of Australian children exposed to smoke in the home. This paper addressed aim 7.

> Aim 7: Drawing on evidence for aims 1-6, consider policy responses to harm reduction, focussing on the population level THR approach of smoke-free spaces and tobacco dependence treatment in Australian tobacco control policy

The enactment of smoke-free spaces occurs at the personal level in the home but also across regulation, voluntary codes, local government processes and via state and

federal legislation. However, the implementation of smoke-free spaces is marked by inconsistency and the influence of the tobacco and other vested lobby groups. As a result, high roller rooms in casinos are exempt in most states and territories from being smoke-free. At the other end of the socio-economic spectrum from the high roller rooms at casinos, are the areas with greatest levels of socio-economic deprivation such as multi-unit community housing complexes, prisons, mental health settings. Smoking rates in these settings are very high and implementing smoke-free spaces in these environments requires policy makers to work with communities to develop appropriate voluntary, regulatory and compliance frameworks.

The tobacco industry's attempt to subvert smoke-free language and to undermine smoke-free spaces by promoting ANDS as a form of THR and suitable for use in smoke-free spaces is noted as a challenge to tobacco control. It will be necessary for tobacco control policy to re-think smoke-free terminology and smoke-free environments in light of the tobacco industry's appropriation of the term. In discussing ANDS and smoke-free environments, it is argued that rather than comparing their effects to cigarettes, the effects of ANDS should be compared with the known health alternative of breathing clean air and that non-users should be protected from being unknowingly exposed to ANDS emissions. Moreover, policy makers must ensure their focus is on a **comprehensive** approach to tobacco control and must continue to monitor and evaluate the impact of ANDS on protecting smoke-free spaces.

7.1.5 Findings from Paper 5

In Paper 5 (Chapter 6), Australian approaches to tobacco dependence treatment (TDT) are examined with a demonstration that there are still more gains to be achieved by improved deployment of existing evidence-based approaches to TDT. This paper addressed aim 7.

> Aim 7: Drawing on evidence for aims 1-6, consider policy responses to harm reduction, focussing on the population level THR approach of smoke-free spaces and tobacco dependence treatment in Australian tobacco control policy

Paper 5 argues that the current Australian TDT service provision models are ineffective and do not easily support smokers to access evidence-based best practice support to quit. A comprehensive approach to delivering TDT, which may also include provision of ANDS which is consistent with the WHO FCTC Article 14 on the provision of smoking cessation within a robust framework of a National Tobacco Strategy is advocated.

7.2 Implications

This thesis evidences a number of important implications for tobacco control policy in Australia. Most significantly, it demonstrates that Australian smokers are not hardening. There is good evidence they are increasingly receptive to quitting and that further investment in robust tobacco control policies is likely to result in further softening and increased quitting.

Hard-core smoking continues to be a marker of disadvantage in Australia with the least advantaged smoking at far greater rates than the most advantaged. The characteristics of hard-core smokers in Australia are remarkably consistent with characteristics of hard-core smokers in other developed countries with robust tobacco control environments. In these environments there is mounting evidence that the smoking population is softening, not hardening. Whilst there was some evidence that rates of hard-core smoking may be increasing amongst women in the USA, our study of hard-core smoking in Australia did not did not identify any significant difference between male and female rates of hard-core smoking.(106)

Most Australian smokers want to quit, and even amongst the 30% of smokers who say they do not want to quit, around half make quit attempts. Therefore, Australia has a sizeable population of “quitters in waiting”.(11) It is this group of smokers who can be persuaded to quit through a well-funded and implemented comprehensive tobacco control strategy. However, such a strategy has not been current in Australia since 2018 and Australian investment in tobacco control has been in decline.(185)

Whilst most Australian smokers quit “cold turkey”, for those smokers with significant dependence and/or complex needs, effective TDT is vital. Australia can do more to meet its obligations under Article 14 of the FCTC. Article 14 requires Australia to “implement effective programmes aimed at promoting the cessation of tobacco use” and, as a recent review of Australian cessation services has demonstrated, there are still many improvements necessary, including: the development of a nationally consistent TDT clinical guideline that covers all heath care workers; nationally consistent minimum quality standards for cessation providers; consistent, funded and implemented TDT policy for health care providers; and, of course, removing barriers to effective, evidence based TDT.(175) A new National Tobacco Strategy must commit to a comprehensive review of the delivery of TDT in Australia to ensure is it accessible, affordable and does not contribute to further tobacco-related inequity.

Australian hard-core smoking rates are very low at between 0.80-4.85% in 2016.(164) It is likely that the rate of 0.80% represents close to the natural limit of smoking in Australia and that these really are the smokers who cannot **and** will not quit. However, if Australian tobacco control policy can continue to drive softening amongst Australian smokers and prompt successful quit attempts whilst also preventing new smokers from entering the market, the rate of 4.85% is likely to reduce further because half of these smokers are making quit attempts. Clearly then, it is not hard-core smokers who present a challenge to achieving further reduction in smoking prevalence rates. The greater challenge is in improving smoking cessation outcomes amongst Australia’s “quitters in waiting”, whilst also continuing to prevent uptake by young people. Achieving this requires a comprehensive and well-funded National Tobacco Strategy that is actively monitored and reported on.

Product-based harm reduction with ANDS has been proposed for hard-core smokers. In 2007, the Royal College of Physicians proposed that two questions need to be answered with regard to harm reduction products: i) is the product satisfying and acceptable to smokers such that they would substitute it for cigarettes; and ii) is the safety profile acceptable?(61) A third question is also necessary: in reducing harm to the individual

smoker, does the product pose a risk to non-smokers and/or the wider population? The College also proposed three processes to deliver such products to smokers: i) maintain a focus purely on cessation; ii) make the product as available to adults as cigarettes; and iii) make the product more available to adults than cigarettes.(61)

The processes by which harm reduction products are made available has significant impact on whether a tobacco endgame can be achieved. Some commentators have argued that the use of e-cigarettes by adolescents, whilst concerning, should not undermine making these products widely available so that smokers can transition to a reduced harm product. For example, Levy et al argue that there is a net public health benefit to making e-cigarettes available even if adolescents do start to use them.(186) However, this modelling has been subject to a robust critique and demonstration of the inaccuracies of its underlying assumptions.(187) Even amongst strong supporters of liberal access to e-cigarettes, the concerns of uptake by never smokers and young people are recognised as a legitimate concern to be balanced against getting smokers to quit.(188)

Youth smoking rates in Canada and New Zealand, where ANDS have been highly accessible, have recently been increasing. In the Australian context, most Australians are not currently using e-cigarettes to assist with cessation. Rather, it is mostly young Australians who use e-cigarettes and 20% of them are non-smokers.(4) E-cigarette users are up to three times more likely to transition to smoking cigarettes, which could undermine Australia's success in de-normalising smoking amongst young people and introduce a new generation to the cigarette market.(26, 128, 189, 190) Any outcome that brings a new cohort of smokers into the market cannot be considered population level harm reduction and would be unlikely to contribute to an endgame strategy.(191)

Whilst there is strong evidence that completely substituting e-cigarettes for CCs reduces the user's exposure to known toxins and carcinogens, this does not mean e-cigarettes are harmless.(128) For example, e-cigarette use has been demonstrated to have an adverse impact on respiratory health.(192) The claim that long term use provides a level

of harm reduction has also recently been challenged with a six year follow up study of e-cigarette users (n=228), tobacco smokers (n=469) and dual users (n=215) finding no evidence of harm reduction as measured by smoking related disease rates and self-reported changes to health.(193) This important study also demonstrated that there was no significant difference in the rate of tobacco cessation between smokers and dual users of cigarettes and e-cigarettes.

Long term e-cigarette users may exhibit stronger smoker identities than NRT users, have lower quit intentions and are more likely to continue to use an e-cigarette, thus maintaining a nicotine addiction that places them at risk of relapse to CCs.(194) The principal concern regarding e-cigarettes as a substitution for CCs is that vapers frequently do not substitute entirely and people resort to dual use, i.e. both CC and e-cigarette use. Australian e-cigarette users cite reduction in consumption of CCs as a leading reason for use.(4) However, reducing CC consumption has negligible health benefits unless it is as a pathway towards cessation.(195-197) Dual use brings no health benefits, but manifests the worst of both CC and ANDS because the user incurs the risks associated with smoking as well as the risks associated with vaping.(180, 198-200)

THR must ensure that harm is reduced at a population level and at the individual level. It is vital to ensure that any product-based THR does not increase harm at a population level by either: i) introducing new products to those who would not otherwise have smoked; or ii) retaining smokers who would otherwise have quit all tobacco use had the reduced risk product not been available. If new smokers enter the market, then Australia's trajectory towards achieving an end to the tobacco epidemic may be challenged. The tobacco endgame has been described as both a process and a goal.(16) Internationally, tobacco endgame goals include: i) tobacco use is reduced to close to zero; ii) the commercial sale of tobacco is ceased; iii) tobacco use is de-normalised; and/or iv) children's exposure to tobacco use is nearly zero.(16) Supporting those smokers who are unable and/or unwilling to quit with alternative sources of reduced risk nicotine is a potential

endgame process.(16) However, a number of factors including: lobbying by industry; use of smoked and smokeless tobacco products; the effectiveness of the tobacco control community; and political will, are all noted as challenges to successful endgame planning.

Australia is in an enviable position to commence end-game planning. This requires tobacco control practitioners to consider both endgame goals and processes, and these could be developed in step with a comprehensive and adequately funded National Tobacco Strategy. An endgame goal of less than 5% daily smoking prevalence is achievable, but to achieve this goal the next iteration of Australia's National Tobacco Strategy must maintain Australia's successful legacy of population level interventions whilst also seeking to substantially improve TDT so that smokers who need assistance to quit are provided with accessible evidence-based support. Further research is required specifically to: i) identify who requires product-based harm reduction; ii) what products might be acceptable and safe; and iii) what processes would support access to smokers who require THR without causing population level harms.

In an environment of lapsed tobacco control policy and decreased investment by government, the tobacco and vaping industries have offered up a "quick" fix to reducing prevalence rates by promoting ANDS for smokers who can't or won't quit.(185) In addition to a lack of policy focus and investment by government, there are significant structural impediments in the existing tobacco dependence treatment systems which prevent smokers from accessing inexpensive, evidence-based best practice tobacco dependence treatment (TDT).(168, 170, 175)

7.3 Limitations and Future Directions

This thesis was concerned with hard-core smoking in the Australian population. The evidence suggests that rates of hard-core smoking may be higher amongst those who are socio-economically disadvantaged, who have lower levels of educational attainment and who have mental illnesses or alcohol and other drug addictions. Whilst the rates of smoking in these groups is higher than the national average, it is also the case that smoking rates

have been falling in the most disadvantaged groups, indicating that with effective, targeted cessation services further declines are possible.(24, 201) Moreover, appropriate population level policy interventions for these populations that contribute to softening towards quitting are warranted. Given the consistency of characteristics of hard-core smokers internationally, this finding is likely applicable to all developed countries with robust tobacco control environments in the mature phase of the tobacco epidemic.

The term hard-core smoker can be interpreted in a pejorative manner particularly when it is applied to those who suffer greatest disadvantage. (80) When hard-core smoking is assumed to mean an absolute inability to quit, the term can be used to blame individual smokers for failing to quit and could abrogate responsibility of policy makers and clinicians for effective tobacco control and cessation interventions which could further discourage smokers from quitting. (80) Further research into whether the term hard-core smoker is stigmatising in tobacco control policy would be fruitful.

A detailed understanding of hard-core smoking in at risk populations was not possible in this thesis due to small numbers. For example, the number of participants who identified as being Aboriginal and Torres Strait Islander in Papers 2 and 3 were too small to draw any meaningful conclusions. Understanding of hard-core smoking in at-risk populations would be a useful contribution to the field. Recent research has identified that smoking is responsible for half of all deaths in Aboriginal and Torres Strait Islander people aged over 45 years, and this does not include deaths attributable to second hand smoke exposure.(20) The study authors note that there is high level of knowledge about smoking harms but a degree of fatalism amongst Aboriginal and Torres Strait Islander people in accepting and justifying risk associated with smoking and that this should be addressed in developing effective policy.(20) This finding of fatalism amongst Aboriginal and Torres Strait Islander people may be similar to findings in population studies that persistent smokers demonstrate higher use of ‘jungle’ and ‘worth it’ risk exempting beliefs.

Addressing tobacco smoking is the leading intervention to reduce preventable illness and death amongst Aboriginal and Torres Strait Islander peoples in Australia. This requires sustained and comprehensive population level tobacco control policy interventions such as mass media campaigns, smoke-free spaces and actions to reduce.(20) The Tackling Indigenous Smoking Program is a successful model of working with local communities to reduce smoking prevalence by supporting quitting and preventing uptake.(202) It is funded by the Commonwealth through to June 2022 and it is vital that this program is sustained in order to continue to improve capacity of local services with respect to tobacco control. It should also consider how to address the findings of fatalism as a potential risk exempting belief with respect to smoking with Aboriginal communities.

In Paper 1, a major strength of the systematic review was the large national data sets used by the authors. However, because researchers tend to use existing data sets, the definition of hard-core smoker is driven by the data collected rather than a standardised definition and set of empirical measures. As a consequence, there was extreme variability in hard-core smoking definitions which prevented a meta-analysis from being conducted. Likewise, a range of measures were reviewed for assessing hardening in smoking populations. However, despite this variability, only one study, which was not drawn from nationally representative data sets but from published papers and which used only one measure of hardening, found evidence of hardening occurring. The variability in definitions makes it difficult to accurately estimate the extent of hard-core smoking rates. This thesis accounted for this variability in hard-core smoking definitions by drawing on two definitions from the literature review to calculate a lower and upper limit of hard-core smoking in Australia in Paper 2.

A challenge with assessing hard-core smokers is that they may self-select out of smoking research programs. This limitation applies to both Papers 2 and 3. The number of hard-core smokers in Australia is quite low and caution should be exercised in extrapolating the results of this thesis to countries other than Australia, especially countries which have yet

to hit the mature phase of the tobacco epidemic. Longitudinal studies of hard-core smokers would be an important contribution to the literature to better understand the factors influencing smoking behaviour over time, drivers of quit attempts, engagement with best practice TDT and to assess the impact of tobacco control policies.

Whilst our initial exploration of the PAPM suggests it may be a useful tool in assisting hard-core smokers, our participant numbers in that study were quite small (N=336). Moreover, the staging algorithm requires validation as Stage 2 (I have never thought about quitting) and Stage 4 (I do not want to quit) might be viewed as the same by some smokers. Additionally, because Australia is well advanced in tobacco control messaging, it is probable that there are extremely low numbers of smokers in Stage 2 of the PAPM. There are a number of methods available to assess stage-based theories. The gold standard for testing stage-based behaviour change models is a match–mismatch test which was beyond the scope of this thesis. Therefore, it is not possible to conclude that the PAPM is a valid stage-based model and more research is required.

No clinical assessment of health or biological measures of smoking was conducted in the NDSHS or in Paper 3. Smokers may underestimate or misrepresent their smoking in order to comply with social expectations regarding smoking. Proxy measures of dependence which use consumption as an indicator may not be accurate measures of dependence as smokers regulate their smoking behaviour to manage nicotine consumption. Reductions in consumption may be indicative of increasing smoke-free spaces and public lack of acceptance of smoking rather than an accurate measure of dependence.

7.4 Conclusions

Taken together the results from this thesis demonstrate that, consistent with the international literature, Australian smokers are softening, not hardening. Whilst there are some hard-core smokers, they are not a credible threat to achieving further reductions in smoking prevalence and should not be an impediment to endgame planning. Given the emerging literature that ANDS cause respiratory disease and that no harm reduction is

achieved over long-term use, medical practitioner oversight for quitting CCs and then transitioning off ANDS is warranted for smokers who are unable to quit using existing evidence based therapeutic products.(192, 193)

Clinicians working with a smoker who: i) says they do not want to quit (Stage 4 of PAPM); and ii) have not made a quit attempt in the last 12 months or more, should recognise the potential for that person to be a hard-core smoker. This clinical picture may be further developed by understanding the characteristics of Australian hard-core smokers. Australian hard-core smokers are most likely to be older males, come from low socio-economic areas, have lower educational attainment and higher rates of psychological distress. They are more likely to utilise 'worth it' and 'jungle' risk exempting beliefs and view smoking as highly enjoyable. These smokers are less likely to want to engage in a quit attempt and motivational interviewing which address the 'worth it' and 'jungle' risk exempting beliefs may be beneficial.

It is of note that amongst smokers in Stage 4 (I do not want to quit) approximately 50% make a quit attempt and that ill health is a leading reason for smokers in this group making a quit attempt. Health care professionals are therefore best placed to address the impact of smoking on health and to discuss the risk exempting beliefs held by hard-core smokers. However, it is vital that all health care providers have capacity and capability to offer evidence-based effective TDT to maximise quitting outcomes.

The vast majority of Australian smokers want to quit, and most Australian smokers attempt to manage their smoking each year.(4) For the last decade, approximately 30% of Australian smokers have said they don't want to quit, but around half have made a quit attempt in the previous 12 months. This indicates that not wanting to quit is not a fixed state. Population level interventions such as smoke-free spaces, taxation, marketing campaigns and effective TDT programs can drive softening in this group and achieve further reductions in smoking prevalence rates.(126, 203) It is important therefore for TDT in Australia to function as effectively and as efficiently as possible. Whilst most Australian smokers quit

unassisted, for smokers with significant nicotine dependence and who require enhanced support to manage their tobacco dependence, the current system prevents them easily accessing affordable support and medications. Supporting existing smokers to quit through renewed focus and investment in comprehensive tobacco control activities *and* building the Australian cessation services to deliver affordable and accessible TDT is critical.(204)

If ANDS are to be used for harm reduction, it is important that harm is not introduced to the general population in which cigarette consumption is demonstrably declining and in which willingness to quit is high. Despite the number of hard-core smokers being low in Australia, the quit or die approach for this group is problematic. The highly dependent smoker who is willing to quit requires effective TDT and some may derive benefit from using ANDS.(177) By contrast, it is possible that smokers unwilling to give up will continue to smoke or will dual use if ANDS are widely available. Where dual use allows a smoker to circumvent restrictions on smoking bans, this undermines the effectiveness of such strategies. Finally, the risk of introducing a new generation of smokers through ANDS use is not population harm reduction, and tobacco control strategies must ensure that this outcome is avoided.

In summary, rates of hard-core smoking in Australia are very low and do not prevent Australia from achieving very low rates of smoking prevalence. A goal of less than 5% prevalence can be achieved through population level strategies **and** improved TDT. ANDS may be one option to support highly nicotine dependent smokers to quit, however, existing evidence warrants their availability being restricted to medical supervision because: i) the risk of causing population level harm is significant; ii) the evidence of harm to the individual user is still emerging and harm reduction claims have limited evidence; and iii) the effectiveness of such products in securing successful cessation outcomes is not yet well established. In contrast, the evidence for established tobacco control strategies such as mass media campaigns, taxation, smoke-free spaces and preventing access to young people are well established and supported by evidence. These strategies will likely drive

further softening amongst Australian smokers, including amongst those smokers who say they do not want to quit.

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Appendix 1: Smokers' Attitudes Towards Cigarette Smoking

What is this survey about?

This is an invitation to participate in an online survey conducted by researchers at the Centre for Health Initiatives at the University of Wollongong. The survey aims to investigate knowledge, attitudes and behaviours in regard to cigarette smoking.

This survey will take approximately 15-20 minutes to complete and you will be asked some questions about your:

1. Smoking status

2. Knowledge, beliefs and attitudes towards smoking and quitting

3. Perception of risks associated with smoking.

SURVEY MONKEY ONLY:

All participants have the opportunity to enter the draw to win a $100 Coles Myer voucher. The voucher will be awarded to a randomly chosen participant. To enter into the draw, please supply your email address when prompted at the end of the survey. This information will not be connected to your survey data and will only be used to contact you if you win a voucher.

Confidentiality

This is an anonymous online survey. The research team guarantees your anonymity and confidentiality. Data will be recorded and analysed as group aggregate data and not on an individual basis. The data may be used in academic publications and presentations.

Your involvement in the research is completely voluntary, and you may discontinue the survey at any time. Refusal to participate in the study will not affect your relationship with the University of Wollongong.

While you may withdraw/exit from the survey at any time it may not be possible to have your data deleted after completion/submission of the survey (because it is anonymous).

This research has been reviewed by the Human Research Ethics Committee of the University of Wollongong. If you have any concerns or complaints regarding the way this research has been conducted, you can contact the UOW Ethics Officer on (02) 4221 4457.

Potential Risks

Whilst participating in this survey is a low risk activity, the nature of the questions asked may cause some people to feel distressed. We ask you some questions about how you feel cigarette smoking impacts on your health. What do I need to do if I want to participate? In order to participate, you will need to answer Question 1 and continue to complete the online survey by clicking on next. If you do not wish to participate, you can either click 'No' on question 1, or simply exit the survey now. If you have any further questions, please contact: Tanya Buchanan Centre for Health Initiatives University of Wollongong Ph: 02 4221 4847 Email: tpb996@uow.edu.au Thank you for your interest in this research.

Q1 I consent to participate in this research project

- ❍ Yes, let's get started (1)
- ❍ No (2)

If No Is Selected, Then Skip to End of Survey

Q2 How often do you smoke cigarettes?

- ❍ Every day (1)
- ❍ At least once a week (2)
- ❍ Less than weekly (3)
- ❍ I never smoke (4)

SURVEY MONKEY ONLY: Q3. Where did you see this survey advertised?

Q4. Please provide the Australian postcode at which you usually reside.

Q5 What is your age in years?

Q6 Are you:

- ❍ Male (1)
- ❍ Female (2)

Q7 What is your present marital status?

- ❍ Never married (1)
- ❍ Widowed (2)
- ❍ Divorced (3)
- ❍ Separated but not divorced (4)
- ❍ Married/De facto (5)

Q8 Which of the following best describes your ethnicity?

- ❍ Australian (1)
- ❍ Australian Aboriginal, Australian South Sea Islander or Torres Strait Islander (2)
- ❍ New Zealander (3)
- ❍ Maori (4)
- ❍ Other Oceania (5)
- ❍ British or Irish (6)
- ❍ European (7)
- ❍ African (8)
- ❍ Asian (9)
- ❍ North American (10)
- ❍ South American (11)
- ❍ Other (please specify) (12) _____

Q9 What is the highest level of education you have achieved?

- ❍ No formal education (1)
- ❍ Primary education (2)
- ❍ Secondary education (3)
- ❍ Certificate level (4)
- ❍ Diploma or advanced diploma (5)
- ❍ Bachelor degree (6)
- ❍ Graduate diploma or graduate certificate (7)
- ❍ Postgraduate degree (8)
- ❍ Other (please specify) (9) _____

Q10 What is your current employment status?

- ❍ Employed full-time (work 35 hours or more a week - in all jobs) (1)
- ❍ Employed part-time (work one hour to less than 35 hours a week - in all jobs) (2)
- ❍ Unemployed looking for full-time work (3)
- ❍ Unemployed looking for part-time work (4)
- ❍ Not in the labour force. (5)

Q11 What is your annual income (from all sources)?

- ❍ $0 (1)
- ❍ $1-$10 399 ($1-$199 per week) (2)
- ❍ $10 400 - $15 599 ($200-$299 per week) (3)
- ❍ $15 600 - $20 799 ($300-$399 per week) (4)
- ❍ $20 800 - $31 199 ($400-$599 per week) (5)
- ❍ $31 200 - $41 599 ($600-$799 per week) (6)
- ❍ $41 600 - $51 999 ($800-$999 per week) (7)
- ❍ $52 000 - $64 999 ($1000-$1249 per week) (8)
- ❍ $65 000 - $77 999 ($1250-$1499 per week) (9)
- ❍ $78 000 - $103 000 ($1500-$1999 per week) (10)
- ❍ more than $103 000 (more than $2000 per week) (11)

Q12 How old were you when you first started to smoke regularly (that is, at least once a day)?

Q13 How many cigarettes do you usually smoke in a day?

Q14 How soon after waking up do you smoke your first cigarette?

- ❍ Within 5 minutes (1)
- ❍ 6-30 minutes (2)
- ❍ 31-60 minutes (3)
- ❍ More than 1 hour (4)

Q15 Do you find it difficult to stop smoking in non-smoking areas?

- ❍ Yes (1)
- ❍ No (2)

Q16 Which cigarette would you most hate to give up?

- ❍ The first of the morning (1)
- ❍ Any other (2)

Q17 Do you smoke more often in the first hours after waking than during the rest of the day?

- ❍ Yes (1)
- ❍ No (2)

Q18 Do you smoke even when you are so ill that you are in bed most of the day?

- ❍ Yes (1)
- ❍ No (2)

Q19 Have you ever made a serious attempt to quit smoking? Please include any attempt that you are currently making.

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip to Q22 How much do you enjoy smoking?

Q20 How many serious attempts to stop smoking have you made in the last 12 months? Please include any attempt that you are currently making.

- ❍ none (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 or more (7)

If none is Selected, Then Skip To Q22 How much do you enjoy smoking?

Q21 If you have made a serious quit attempt in the last 12 months when was your last attempt to quit smoking?

- ❍ In the last week (1)
- ❍ More than a week and up to a month (2)
- ❍ More than 1 month and up to 2 months (3)
- ❍ More than 2 months and up to 3 months (4)
- ❍ More than 3 months and up to 6 months (5)
- ❍ More than 6 months and up to a year (6)
- ❍ Don't know/Can't remember (7)

Q22 How much do you enjoy smoking?

- ❍ Very much (1)
- ❍ Quite a bit (2)
- ❍ Not particularly (3)
- ❍ Not at all (4)
- ❍ Don't know (5)

Q23 What do you consider to be the correct answer to the following statements:

	True (1)	False (2)
Smoking is a risk factor for heart disease and lung cancer	❍	❍
Passive smoking is a risk factor for lung cancer in others	❍	❍

Q24 Please indicate which of the following causes the most deaths in Australia each year

- ❍ Illegal drugs (1)
- ❍ Road accidents (2)
- ❍ Smoking (3)
- ❍ Alcohol (4)
- ❍ Suicide (5)

Q25 In general, how would you rate your overall health?

- ❍ Excellent (1)
- ❍ Very Good (2)
- ❍ Good (4)
- ❍ Fair (5)
- ❍ Poor (6)

Q26 What impact does smoking have on the rating you gave your health?

- ❍ No impact (1)
- ❍ A little impact (2)
- ❍ Unsure (3)
- ❍ High impact (4)
- ❍ Very high impact (5)

Q27 Each item below is a belief statement about your health. For each item please indicate the extent to which you agree or disagree with that statement.

	Strongly disagree (1)	Moderately disagree (2)	Slightly disagree (3)	Slightly agree (4)	Moderately agree (5)	Strongly agree (6)
If I become sick, I have the power to make myself well again.	❍	❍	❍	❍	❍	❍
Often I feel that no matter what I do, if I am going to get sick, I will get sick.	❍	❍	❍	❍	❍	❍
If I see an excellent doctor regularly, I am less likely to have health problems.	❍	❍	❍	❍	❍	❍
It seems that my health is greatly influenced by accidental happenings.	❍	❍	❍	❍	❍	❍
I can only maintain my health by consulting health professionals.	❍	❍	❍	❍	❍	❍
I am directly responsible for my health.	❍	❍	❍	❍	❍	❍
Other people play a big part in whether I stay healthy	❍	❍	❍	❍	❍	❍

or become sick.						
Whatever goes wrong with my health is my own fault.	❍	❍	❍	❍	❍	❍
When I am sick, I just have to let nature run its course.	❍	❍	❍	❍	❍	❍
Health professionals keep me healthy.	❍	❍	❍	❍	❍	❍
When I stay healthy, I'm just plain lucky.	❍	❍	❍	❍	❍	❍
My physical well-being depends on how well I take care of myself.	❍	❍	❍	❍	❍	❍
When I feel ill, I know it is because I have not been taking care of myself properly.	❍	❍	❍	❍	❍	❍
The type of care I receive from other people is what is responsible for how well I recover from an illness.	❍	❍	❍	❍	❍	❍
Even when I take care of	❍	❍	❍	❍	❍	❍

myself, it's easy to get sick.						
When I become ill, it's a matter of fate.	❍	❍	❍	❍	❍	❍
I can pretty much stay healthy by taking good care of myself.	❍	❍	❍	❍	❍	❍
Following doctor's orders to the letter is the best way for me to stay healthy.	❍	❍	❍	❍	❍	❍

Q28 If you were to try, how likely is it that you would be successful in quitting smoking?

- ❍ I am sure I would fail (1)
- ❍ I think I might fail (2)
- ❍ I don't know (3)
- ❍ I think I might succeed (4)
- ❍ I am sure I would succeed (5)

Q29 Compared with other smokers, do you think you smoke more or less cigarettes?

- ❍ Much less (1)
- ❍ Less (2)
- ❍ About the same (3)
- ❍ More (4)
- ❍ Much more (5)
- ❍ Don't know (6)

Q30 Compared with other smokers, how long have you been a smoker?

- ❍ Much longer (1)
- ❍ A bit longer (2)
- ❍ About the same (3)
- ❍ A bit less (4)
- ❍ A lot less (5)
- ❍ Don't know (6)

Q31 People who are important to me believe I should quit smoking.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Don't know (3)
- ❍ Agree (4)
- ❍ Strongly Agree (5)

Q32 People who are important to me encourage me to stop smoking.

- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Don't know (3)
- ❍ Agree (4)
- ❍ Strongly Agree (5)

Q33 To what extent are the following items important to your decision to smoke:

	Very unimportant (1)	Unimportant (2)	Neutral (3)	Important (4)	Very Important (5)
Smoking cigarettes relieves tension	❍	❍	❍	❍	❍
Smoking helps me to concentrate and do better work	❍	❍	❍	❍	❍
I am relaxed and therefore more pleasant when smoking	❍	❍	❍	❍	❍
I'm embarrassed to have to smoke	❍	❍	❍	❍	❍
My cigarette smoking bothers other people	❍	❍	❍	❍	❍
People think I am foolish for ignoring the warnings about cigarette smoking	❍	❍	❍	❍	❍

Q34 Please indicate your level of agreement with the statements below:

	Totally Agree (1)	Agree (2)	Neither agree nor disagree (3)	Disagree (4)	Totally Disagree (5)
Lots of doctors and nurses smoke, so it cannot be all that harmful	❍	❍	❍	❍	❍
The medical evidence that smoking is harmful is exaggerated	❍	❍	❍	❍	❍
Smoking cannot be all that bad for you because many people who smoke live long lives	❍	❍	❍	❍	❍
Smoking cannot be all that bad because some top sports people smoke and still perform well	❍	❍	❍	❍	❍
More lung cancer is caused by such things as air pollution, petrol and diesel fumes than smoking	❍	❍	❍	❍	❍
Cancer mostly strikes people with negative attitudes	❍	❍	❍	❍	❍
They will have found cures for cancer and all the other problems smoking causes before I am likely to get any	❍	❍	❍	❍	❍

of them					
You can overcome the harms of smoking by doing things like eating healthy food and exercising regularly	❍	❍	❍	❍	❍
I think I must have the sort of good health or genes that means I can smoke without getting any of the harms	❍	❍	❍	❍	❍
I think I would have to smoke a lot more than I do to put my health at risk	❍	❍	❍	❍	❍
I would rather live a shorter life and enjoy it than a longer one where I will be deprived of the pleasure of smoking	❍	❍	❍	❍	❍
You have got to die of something, so why not enjoy yourself and smoke	❍	❍	❍	❍	❍
Everything causes cancer these days	❍	❍	❍	❍	❍
If smoking was so bad for you, the government would ban tobacco sales	❍	❍	❍	❍	❍

It is dangerous to walk across the street	❍	❍	❍	❍	❍
Smoking is no more risky than lots of other things that people do	❍	❍	❍	❍	❍
I have made an informed choice to smoke in the full knowledge of the risks I am taking	❍	❍	❍	❍	❍
It is not really dangerous to smoke low-tar cigarettes	❍	❍	❍	❍	❍

Q35 Which of the following best describes your thoughts about quitting smoking:

- ❍ I have never thought about quitting (1)
- ❍ I am undecided about quitting (2)
- ❍ I do not want to quit (3)
- ❍ I want to quit (4)
- ❍ I have started a quit attempt or quit program (5)

If I have started a quit attempt... Is Selected, Then Skip to End of Survey

Q36 In the previous question you indicated your thoughts about quitting smoking. Could you please briefly outline the reason for this answer?