The Smoke Ring—are your friends a drag?
Social network analysis and tobacco use

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Abstract

Background
Smoking is the single most preventable cause of morbidity and mortality within Australia. While there have been reductions in smoking in Australia, Aboriginal and Torres Strait Islander people are twice as likely as non-Indigenous people to smoke.

This study (the Smoke Ring Study) comprises two components: a systematic review to examine the influence of social networks on tobacco use; and a prospective mixed-method study. The prospective study explored and assessed the evidence on Aboriginal and Torres Strait Islander social networks and tobacco use and also Action Area 1 of the Australian Capital Territory (ACT) Aboriginal and Torres Strait Islander Tobacco Control Strategy 2010/11–2013/14 (the ACT Strategy). Development and implementation of components of the ACT Strategy commenced in 2010, with engagement of local Aboriginal and Torres Strait Islander community organisations and development of community communications commencing in 2012.

Methods

Systematic review

The systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review searched the following databases: CINAHL (Cumulative Index to Nursing and Allied Health Literature); Informit Health Collection; PsycINFO; PubMed/MEDLINE; Scopus / Embase; Web of Science; and Wiley Online Library.

A narrative approach was used to summarise the 279 papers that were included in the systematic review. This systematic review helped to inform and focus the primary data collection that formed part of the Smoke Ring Study.

Prospective mixed-method study

The prospective study used a mixed-method pre- and post-test design, pre- and post-implementation of the ACT Aboriginal and Torres Strait Islander Tobacco Control Strategy. The study used a panel survey (n=204 baseline; n=103 follow-up), individual interviews (n=10 baseline; n=9 follow-up) and focus groups (baseline: 3 focus groups, 40 participants; follow-up: 3 focus groups, 30 participants). Logistic regression and social network analyses were used for the survey. Grounded theory was used to analyse the interviews and focus groups.
Results

Systematic review

Synthesis of the findings of the systematic review indicated that social network structures, positions and relationships influence tobacco use (that is, initiating, maintaining and ceasing tobacco use). Social network analysis is relevant to tobacco use given that social relations and social contexts impact on the decision to smoke or not to smoke.

Prospective mixed-method study

Baseline data from the prospective study identified a prevalence of smoking of 36.4% (95% CI, 27.8–44.9) among the Aboriginal and Torres Strait Islander community in the ACT region—a figure that is significantly higher than that for the general Australian population (which is approximately 15%).

While participants were not representative of the ACT Aboriginal and Torres Strait Islander population, a broad cross-section of the Aboriginal and Torres Strait Islander community in the region, covering a wide range of smoking behaviours, participated in the prospective study. The mean age in the study was 35 years (12 to 75 years of age). The sample was 65% female and 35% male and reported a median household income category of $67,600–$83,199 per annum. Household size ranged from one to seven people and 47% of participants had completed education to year 12 or above at baseline.

At baseline, logistic regression models were used to determine factors significantly associated with smoking. Two independent variables made a unique, statistically significant contribution to whether respondents smoked:

- completing education to at least year 12 or equivalent (p=0.003) (OR=21.5; 95% CI, 2.9-158.7); and
- the number of housemates who smoke (p=0.046) (OR=11.8; 95% CI, 1.1-132.2).

Social network analysis at baseline revealed that the total participant-nominated network (that is, the social network that participants in the survey claimed to belong to) included sub-groups that were mostly inaccessible through recognised relationships—i.e. connected via a small number of relationships—and there was significant difference between smokers’ and non-smokers’ networks. When smoking and non-smoking networks were examined separately, it was found that the average distance between connected smokers and non-smokers was 2.8 and 2.7 steps or relationships respectively. This indicated that, when considered independently, smoking and non-smoking
networks were more cohesive than the total network. Members of the total network were a mean distance of 11.0 steps away from each other.

At follow-up, there was a statistically significant difference (p=0.007) in the number of smokers (42.9% and 44.4% of the network at baseline and follow up) and non-smokers (21.1% and 22.7% of the network at baseline and follow up) who reported that their best friend was a smoker. This also suggested some polarisation, or independence among smoking and non-smoking groups respectively.

Themes from the study, but specifically the qualitative analysis at baseline and follow up included:

- social normalisation of smoking;
- tobacco being convenient and easy to obtain;
- role modelling; and
- smoking being seen as a way to facilitate social interactions.

The results that were obtained from the study indicated that the ACT Strategy may have had an impact on smoking behaviour, noting that other local and national tobacco control measures have also been implemented. Therefore it is not possible to attribute changes specifically to the Strategy. Among Aboriginal and Torres Strait Islander people in the ACT, there was a reduction in smoking, an increase in the number of people who had never smoked and a decrease in the number of participants who reported incorrect perceptions that ‘some cigarette brands were more harmful than others’.

Limitations

This thesis has a number of limitations. The systematic review may have incurred publication bias, and included studies with different methods, different settings and at various points in time. In relation to the primary data collection, the use of a survey name generator question may not have provided a complete list of participants’ networks. The prospective study also used self-reported measures of smoking and network characteristic behaviours and the study’s attrition at follow-up was also a limitation.

Conclusions

The Smoke Ring Study was the first mixed-method longitudinal study to utilise social network analysis to examine Aboriginal and Torres Strait Islander social connections and how they impact on smoking. This study demonstrated that achieving at least a year 12 level of education was protective against smoking. It also supported the hypothesis that exposure to smokers in one’s social network
strongly influenced smoking behaviours. It would appear that having a best friend who smoked was strongly associated with whether a person was a smoker.

These findings imply that social networks can facilitate smoking behaviours, providing insight into the nuanced nature of social networks. They also suggest that good work has been undertaken as part of the ACT Strategy to reduce smoking prevalence. However, more work is required. The findings demonstrate that there is a need to focus policy, program and service delivery on smoking networks in order to reduce smoking rates and on non-smoking networks to minimise smoking uptake.
Supervisors’ statement
As co-authors of the papers listed below, as part of The Smoke Ring—are your friends a drag? Social network analysis and tobacco use, we confirm that Raglan Maddox has made the following significant contributions:

- conception and design of the research proposal;
- gaining of ethical approval to conduct the research;
- conducting the research and data collection;
- analysis and interpretation of data;
- writing the papers and critical appraisal of content;
- drafting, submitting and finalising the manuscripts for publication; and
- acting as corresponding author for journal communication and the publication peer-review process.


ii. Social Network Analysis of Tobacco Use: Systematic Review. [Under review, *Tobacco Control*]


iv. Factors Influencing Smoking Among Aboriginal and Torres Strait Islander People in the Australian Capital Territory: A Mixed Method Study. *International Journal of Health, Wellness and Society*. [In press]


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Signed: ___________________________ Date: 10 February 2016

Tom Coddane
Signed: ___________________________ Date: 10 February 2015

Joan Corbett
Signed: ___________________________ Date: 10 February 2015

Ray Lorkett
Signed: ___________________________ Date: 10 February 2015

Anke van der Sterren
Signed: ___________________________ Date: 10 February 2015
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<th>Full Form</th>
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<tbody>
<tr>
<td>ACT</td>
<td>Australian Capital Territory</td>
</tr>
<tr>
<td>Add Health</td>
<td>National Longitudinal Study of Adolescent Health</td>
</tr>
<tr>
<td>AGD</td>
<td>Average Geodesic Distance</td>
</tr>
<tr>
<td>AMS</td>
<td>Aboriginal Medical Service</td>
</tr>
<tr>
<td>APL</td>
<td>Average Path Length</td>
</tr>
<tr>
<td>AQF</td>
<td>Australian Qualifications Framework</td>
</tr>
<tr>
<td>ATODA</td>
<td>ACT Alcohol, Tobacco and Other Drug Association</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>HREC</td>
<td>Human Research Ethics Committee</td>
</tr>
<tr>
<td>NRT</td>
<td>Nicotine Replacement Therapy</td>
</tr>
<tr>
<td>IHIG</td>
<td>Indigenous Health Interest Group</td>
</tr>
<tr>
<td>IPAA</td>
<td>Institute of Public Administration Australia</td>
</tr>
<tr>
<td>OR</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>P/A</td>
<td>Per Annum</td>
</tr>
<tr>
<td>PBS</td>
<td>Pharmaceutical Benefit Scheme</td>
</tr>
<tr>
<td>UC</td>
<td>University of Canberra</td>
</tr>
<tr>
<td>RE-AIM</td>
<td>Reach, Effectiveness, Adoption, Implementation, Maintenance</td>
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Definitions

Australian Capital Territory

The Australian Capital Territory (ACT) is an autonomous region in the south-east of Australia, enclaved within New South Wales. Canberra is the only city in the ACT and is the capital of Australia, with a resident population of approximately 386,000 people [1].

The ACT Aboriginal and Torres Strait Islander Tobacco Control Strategy 2010/11–2013/14

In 2010, the ACT Government made a commitment to reduce the relatively high smoking rates among Aboriginal and Torres Strait Islander people living in the ACT [2]. The commitment involved the development of an Aboriginal and Torres Strait Islander Tobacco Control Strategy 2010/11 2013/14 (the ACT Strategy). The ACT Strategy is included in this paper at Appendix i: ACT Aboriginal and Torres Strait Islander Tobacco Control Strategy 2010/11–2013/14.

The ACT Strategy outlined four areas for action:

- Action Area 1—Development and implementation of a multi-component cessation and reduction program based on family, social and workplace networks;
- Action Area 2—Social marketing;
- Action Area 3—Research and evaluation; and
- Action Area 4—Building on existing legislation, bans and policy initiatives.

The research and evaluation in this paper was included as part of the ACT Strategy.

The ACT Aboriginal and Torres Strait Islander Tobacco Control Advisory Group

The ACT Aboriginal and Torres Strait Islander Tobacco Control Advisory Group (the Advisory Group) was established to provide the driving force behind the work set out in the ACT Strategy and to advise the ACT Government to ensure implementation, monitoring and evaluation of the ACT Strategy. The Advisory Group is made up of key stakeholders including representatives from:

- the ACT Asthma Foundation;
- the Australian Institute of Aboriginal and Torres Strait Islander Studies;
- the Australian National University;
- the ACT Alcohol, Tobacco and Other Drug Association (ATODA);
- the Cancer Council;
- Gugan Gulwan Youth Aboriginal Corporation;
- the University of Melbourne; and
- Winnunga Nimmityjah Aboriginal Health Service.
The ACT Strategy
See the ACT Aboriginal and Torres Strait Islander Tobacco Control Strategy 2010/11–2013/14.

Centrality
‘Centrality’ refers to indicators that identify the most important or central node within a graph [3]. The degree of centrality can be interpreted in terms of the potential risk of a node for catching whatever is flowing through the network (for example, smoking, smoking knowledge or another contagion). In the case of a directed network, as identified within this thesis, there are two separate measures regarding degree of centrality: in-degree and out-degree. In-degree is a count of the number of ties directed to the node (i.e. popularity, influence) and out-degree is the number of ties that the node directs to other nodes (i.e. selection) [3].

Contagion
‘Contagion’ refers to exchange among interacting units that can influence people, groups and/or organisations [4–9]. This influence is also known or referred to as ‘peer effects’ or ‘induction’ [4–9].

Dyads
‘Dyads’ are two individuals or units regarded as a pair—for example, a husband and wife and partners [10].

Ego
‘Ego’ is a single actor or participant [10].

Egocentric
‘Egocentric’ is centered on individual node/s or participant/s. For example, an egocentric social network is a social network based around a participant or sample of participants [10].

Former smoker
‘Former Smoker’ are participants who reported smoking at least 100 cigarettes in their lifetime, but at the time of the data collection did not smoke at all.

Funding Body
The ‘Funding Body’ refers to the Australian Capital Territory (ACT) Health Directorate.

Indigenous Australians
The term ‘Indigenous Australians’ is sometimes used within this thesis to refer to the First Nations’ people of Australia—Aboriginal and Torres Strait Islander peoples. No offence is intended. I acknowledge and respect that Aboriginal and Torres Strait Islander people constitute many nations, language groups and cultures.
Isolate
An ‘isolate’ is a node or person that has no connections to other actors, nodes or people [10].

Liaison
A ‘liaison’ is a node or person that brokers a relation between two groups but is not part of either group [10].

Never Smoker
‘Never Smoker’ is defined as participants who reported never having smoked 100 in their lifetime.

Node
A ‘node’ represents an individual actor or person within the social network [10].

No More Boondah
‘No More Boondah’ is a quit smoking program developed by Winnunga Nimmityjah Aboriginal Health Service that aims to: support, encourage and facilitate quit attempts; educate on the harms of tobacco and addiction; and promote smoke free spaces and workplaces.

Nominated network
‘Nominated network’ is a network that is identified, reported or nominated by a participant or sample of participants [10]. This is different from a complete network, such as a school class or workplace, where all potential nodes have been identified.

Non-smoker
‘Non-smoker’ is defined as anyone who reported not smoking, either never smokers or former smokers.

Smoker
‘Smoker’ is defined as anyone who reported smoking, either every day or some days.

The Smoke Ring
A central component of the Smoke Ring Study has been community engagement. The Aboriginal and Torres Strait Islander community has provided input and participation at all stages of the research process. The study involved a partnership with Winnunga Nimmityjah Aboriginal Health Service and regular reporting to the ACT Aboriginal and Torres Strait Islander Tobacco Control Advisory Group.

Members of the Advisory Group include representatives of various community organisations that have provided input, support and engagement throughout this research project.
The title ‘The Smoke Ring’ was proposed for the research by a survey participant. It reflects the idea of community relationships, or ‘rings’, and tobacco use. The Advisory Group supported and endorsed this title because it resonated with the aim of the research and subsequent findings. As a result, the research has become known as ‘the Smoke Ring Study’.

The title ‘The Smoke Ring’ was reinforced by Aunty Lorraine Webb, a Wiradjuri and Ngunnawal woman from Cowra, New South Wales. Aunty Lorraine produced the artwork *The Smoke Ring* (see Appendix ii: Aunty Lorraine Webb’s artwork). *The Smoke Ring* represents the community striving for good health and wellbeing. The footprints that can be seen in the artwork pose the question: ‘Which way – which path will you take?’ The artwork questions attitudes, beliefs and behaviours about smoking and being smoke free and therefore it captures the essence of the research.

**Social network analysis**

Social network analysis provides theories, methods, and techniques to characterise and understand social relationships and how they may influence behaviours and vice versa [11]. This set of tools assists when undertaking methodical analysis of social networks—for example, mapping, measuring and analysing relationships and exchange among interacting units that can influence people, groups and/or organisations [4-9]. This influence is often known or referred to as ‘contagion’ (see above), ‘peer effects’ or ‘induction’ [4-9].

**Talking About the Smokes**

Talking About the Smokes is a national research project incorporating:

- a longitudinal study of Aboriginal and Torres Strait Islander smokers and recent ex-smokers;
- a cross-sectional survey of non-smokers;
- two cross-sectional surveys of Aboriginal community controlled health organisation staff; and
- descriptive analysis of the tobacco policies and practices at the Aboriginal community controlled health organisations [12].

**Ties**

‘Ties’ or ‘edges’ represent relationships between ‘nodes’, also referred to as individuals. Relationships include friendship, kinship or shared living arrangements [10, 13].

**Total network**

The ‘total network’, ‘total nominated network’ or ‘total participant-nominated network’ includes all participants, the smoking and non-smoking social networks combined.
Winnunga Nimmityjah Aboriginal Health Service

Winnunga Nimmityjah Aboriginal Health Service (Winnunga) is an Aboriginal community controlled primary health care service, established in 1988. Winnunga is operated by the Aboriginal community of the Australian Capital Territory (ACT). The Winnunga Board consists of six Aboriginal people elected by the community.

Winnunga is funded by both the Australian Government and the ACT Government. It sees over 3,000 clients per year and this figure continues to grow, with approximately 80 new clients per month. Winnunga’s primary purpose is to provide culturally safe and holistic health services to Aboriginal and Torres Strait Islander people in the ACT region. It provides a range of clinical services as well as health promotion and tobacco control programs such as the No More Boondah program.

Year 12 or equivalent

‘Year 12’ refers to completion of Australian year 12 or equivalent education—i.e. Australian Qualifications Framework (AQF) Certificate Level II or above.
Social network definitions

Centrality
‘Centrality’ refers to indicators that identify the most important or central node within a graph [3]. The degree of centrality can be interpreted in terms of the potential risk of a node for catching whatever is flowing through the network (for example, smoking, smoking knowledge or another contagion). In the case of a directed network, as identified within this thesis, there are two separate measures regarding degree of centrality: in-degree and out-degree. In-degree is a count of the number of ties directed to the node (i.e. popularity, influence) and out-degree is the number of ties that the node directs to other nodes (i.e. selection) [3].

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List of publications and conference presentations

Papers published / in press

*Raglan Maddox*, Rachel Davey, Ray Lovett, Tom Cochrane, Anke van der Sterren and Joan Corbett.


Papers submitted and accepted for review


Presentations

*Raglan Maddox*. Aboriginal and Torres Strait Islander people, smoking and social networking. November 2014. *Alcohol, Tobacco and Other Drug Research Symposium*. Canberra, Australia. (oral)


Raglan Maddox. Social network analysis and tobacco use among the Aboriginal and Torres Strait Islander population in Canberra and surrounds. June 2014. Australian National University Indigenous Health Interest Group (IHIG). (oral)

Raglan Maddox. The Smoke Ring—smoking among Aboriginal and Torres Strait Islander people in the ACT region. March 2014. The Australian Institute of Aboriginal and Torres Strait Islander Studies’ National Indigenous Studies Conference. Canberra, Australia. (oral)


Raglan Maddox and Ray Lovett. Dangerous consumption: tobacco and alcohol use—leading risk factors for chronic disease among Aboriginal and Torres Strait Islander people in Australia. 2014.
- University of North Carolina, Gillings School of Global Public Health. Chapel Hill, USA. February 2014. (oral)
- University of California Berkley School of Public Health. Berkley, USA. February 2014. (oral)


Raglan Maddox. Smoking among Aboriginal and Torres Strait Islander people. February 2014. Maryland Department of Health & Mental Hygiene. Baltimore, USA. (oral)


*Raglan Maddox*. Department of Immigration. Reconciliation Week. May 2013. Canberra, Australia. (oral)


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This thesis was funded by ACT Health. I would like to thank them for their generous support. As a member of ACT Health’s Aboriginal and Torres Strait Islander Tobacco Control Strategy Advisory group as well as having roles at the University of Canberra and the Australian Government Department of Health, I have had the pleasure and the privilege to be surrounded by wonderful colleagues and friends who are undertaking invaluable work to improve the health and wellbeing of the community.

There are many people who have contributed to this PhD. To all of them I am sincerely grateful. Without their assistance and support, we would not have made it! Firstly, I would like to thank the community. Without the participants, the study would not have been possible. I am extremely grateful for their time and effort completing a time-intensive survey and participating in interviews and focus groups that were fairly personal in nature. It was an absolute pleasure having every one of you take part in this research.

I extend a big thank-you to Winnunga, the Winnunga Board and the Winnunga Tobacco Control team for their willingness to partner in this research. The study would not have been achievable without the time, effort and support of Julie Tongs OAM, Chanel Webb, Perri Chapman and Ian Bateman. I also trust this research will be useful in refining tobacco programs and policies for the community.

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In particular, I thank Ray Lovett, who nurtured my caffeine addiction while providing input and guidance throughout the PhD process. I make special mention of the fantastic opportunity we had to present our respective research at the University of Oxford Sir Richard Doll Seminar as well as the Harvard School of Public Health, the University of North Carolina Gillings School of Global Public Health, the Johns Hopkins Bloomberg School of Public Health and the University of California Berkley School of Public Health. We concluded with a presentation at the University of British Columbia.

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