Institution: University of Aberdeen

Unit of Assessment: UoA2: Public Health, Health Services and Primary Care

Title of case study: Preventing exposure to second-hand tobacco smoke

Period when the underpinning research was undertaken: 2012 - 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Dr Sean Semple	Senior Lecturer	1998 to 2018
Prof Steve Turner	Professor, Child Health	2013 to 2020
Dr Smita Dick	Research Fellow	2009 to present

Period when the claimed impact occurred: 2013 and ongoing

Is this case study continued from a case study submitted in 2014? No

1. Summary of the impact (indicative maximum 100 words)

Homes and cars were exempt from the UK's 2006/07 smoke-free legislation, in part because of a lack of data on potential harms. Since 2013, research staff within the Respiratory Group at the University of Aberdeen have worked to fill this evidence gap and assessing the potential harm of second-hand tobacco smoke on the health of non-smokers, particularly young children, in homes and cars. Findings from our research have influenced UK policy to ban smoking in cars carrying children, enhanced public awareness of the risks of second-hand smoke, informed Scottish Government strategy on tobacco and reduced the number of children most at risk from exposure to second-hand smoke.

2. Underpinning research (indicative maximum 500 words)

Homes and cars were exempt from the UK's 2006/07 smoke-free legislation for a range of reasons, including a lack of data on potential harms and a subsequent political unwillingness to interfere in decisions about private spaces. The University of Aberdeen's programme of research on exposure to second-hand smoke has targeted this evidence gap with regard to children, especially very young children.

Our work determined in-car concentrations of fine Particulate Matter, PM2.5, a well-recognised marker of second-hand smoke levels used by WHO and aerosol scientists, during more than 100 typical car journeys [**R1**]. We used methods developed for measuring occupational exposure to airborne hazards and combined these with the science on the public health impacts of air quality and state-of-the-art optical particle measuring equipment to record second-hand smoke concentrations during both smoking and smoke-free car journeys. Our results showed that smoking car journeys had average PM2.5 concentrations more than 10 times higher than those encountered during smoke-free journeys with a mean PM2.5 concentration for 41 non-smoking journeys of 7.4µg/m^3 but 85µg/m^3 during 63 smoking journeys. WHO considers a safe annual mean limit for PM2.5 to be 10µg/m^3. The work also demonstrated that during smoking journeys window-opening and ventilation had minimal impact on reducing PM2.5 exposure concentrations.

Moreover, we provided second-hand smoke exposure data for home settings for the first time. This work involved smoking mothers of young children (<6y) in 103 households recruited through GPs or the NHS Lanarkshire First Steps support system, a program to support vulnerable first-time mothers. We developed ways of effectively using the Dylos DC1700 monitor, a device costing 1/10th that of instruments generally used for this work, which opened up a means of getting far greater data coverage. Moreover, we were able train local staff to install these instruments in

participants' homes to measure air quality for extended time periods, which led to novel methods of delivering personalised air quality data to smokers. This could then be used to encourage smoking parents to create a smoke-free home for their child [**R2; R3; R4**]. A key finding was that second-hand smoke can linger indoors for up to 5 hours after a cigarette. Data collected from these studies has produced one of the largest datasets on PM2.5 concentrations in homes in the world.

International discussion of air pollution (e.g. in cities) uses PM2.5. The framing by Aberdeen researchers of second-hand smoke in homes and cars through this lens is novel. It allowed comparisons to be made between household concentrations and air pollution in cities such as Beijing and Moscow. The approach provided a data-driven, evidence-based and accessible context for policy makers who recognised the need to improve outdoor air quality but, prior to our data, were unaware of the much worse air quality experienced by non-smokers in proximity to smokers in indoor settings, leading to a government campaign. The impact of the campaign was measured by further research which established a reduction was then seen in asthma hospital admissions in young children [**R5**].

3. References to the research (indicative maximum of six references)

The quality of the research is deemed to be at least of 2* quality as corroborated by the following peer-reviewed, international publications (with Google Scholar **citations**):

R1. Semple S, Apsley A, Galea KS, MacCalman L, Friel B, Snelgrove V. Secondhand smoke in cars: assessing children's potential exposure during typical journey conditions. Tob Control. 2012; 21:578-83. https://doi.org/10.1136/tobaccocontrol-2011-050197 (**75**)

R2. Semple S, Latif N. How long does secondhand smoke remain in household air: analysis of PM2.5 data from smokers' homes. Nicotine Tob Res. 2014 Oct;16(10):1365-70. https://doi.org/10.1093/ntr/ntu089 (**31**)

R3. Semple S, Ibrahim AE, Apsley A, Steiner M, **Turner S**. Using a new, low-cost air quality sensor to quantify second-hand smoke (SHS) levels in homes. Tob Control. 2015 Mar;24(2):153-8. https://doi.org/10.1136/tobaccocontrol-2013-051188 (**81**)

R4. Semple S, Apsley A, Azmina Ibrahim T, **Turner SW**, Cherrie JW. Fine particulate matter concentrations in smoking households: just how much secondhand smoke do you breathe in if you live with a smoker who smokes indoors? Tob Control. 2015 Oct;24(e3):e205-11. https://doi.org/10.1136/tobaccocontrol-2014-051635 (**59**)

R5. Turner S, Mackay D, **Dick S**, Semple S, & Pell JP (2020). Associations between a smoke-free homes intervention and childhood admissions to hospital in Scotland: an interrupted time series analysis of whole population data. Lancet Public Health, 5(9), e493-e500. https://doi.org/10.1016/S2468-2667(20)30178-X (**4**)

Research Funding:

- **Semple, S**., Principal Investigator, 1/03/08 → 28/02/11, Characterisation of second-hand smoke levels in the homes and cars of smokers. Funder Project Reference: P0052831 NHS Health Scotland: GBP56,936.00
- **Semple, S**., Principal Investigator, 1/03/12 → 31/07/13, University of Glasgow Validation of a new air quality monitor for smoking intervention studies. Scottish School of Public Health (University Pool): GBP5,673.00
- Fernandez E, Lopez MJ, Gallus S, **Semple S**, Clancy L, Behrakis P, Boffi R, Gorini G, López-Nicolás A, Grogna F, Soriano JB. 2015-2019. Tackling second-hand tobacco smoke and e-cigarette emissions: exposure assessment, novel interventions, impact on lung diseases and economic burden in diverse European populations. The TackSHS Project. European Commission. EUR2,987,794. **Semple** at University of Aberdeen led

for the UK in this multi-national project representing geographical, legislative and cultural variations across Europe. Abdn portion EUR199,979.

4. Details of the impact (indicative maximum 750 words)

The University of Aberdeen research programme on preventing exposure to second-hand tobacco smoke has influenced UK policy on smoking in cars, enhanced public awareness of the risks of second-hand smoke, informed Scottish Government strategy on tobacco and reduced the number of children exposed to second-hand smoke.

Influencing UK policy on smoking in cars

Aberdeen research findings have been cited in debates in both the Scottish and UK parliaments. Dr Semple was invited to present the research to the Scottish Parliament in May 2013 and the research was subsequently acknowledged as a particular influence by Mr Hume MSP in the Scottish Parliament chamber when the bill banning smoking in cars carrying children passed in December 2015 [**S1; S2**]. The bill's stated goal is to protect children and young people under the age of 18 from the harmful effects of second-hand smoke. Our work was cited in the debate in the House of Lords (29th Jan 2014) on the Children & Families Bill [**S3**]:

'..a study conducted in Scotland..suggested that air quality inside a smoker's car was comparable to industrial smog in cities such as Beijing or Moscow, even when the driver has the window open.. Research by Aberdeen University found that 7% of 11-year olds experience smoking in cars.'

A ban on smoking in cars carrying children in England & Wales was introduced 1st October 2015 [**S4**].

Enhancing public awareness of the health risks of in-home smoking

The unique analysis of second-hand smoke levels in 103 homes undertaken by the Aberdeen research team provided material for the Scottish Government's *'Take it Right Outside'* media campaign, which included an advert that ran on national TV and radio and was used by many local public health campaigns [**S5**; **S6**]. The campaign focused on one of the key research outcomes - second-hand smoke can linger for up to 5 hours after your last cigarette. The campaign had one of the highest recall of any health education advert among the target group of smoking parents, with over 88% of adults living in a home with a child under 5 years old confirming recall [**S6**]. The main messages were well understood with 38% identifying the key message of not smoking in the home or car when children are present, 33% saying stating that smoking indoors was bad and 12% saying second-hand smoke was bad for children [**S6**].

Informing the Scottish Government's Tobacco strategy

The quantification of second-hand smoke in smokers' homes – particularly homes where children lived – was also used to develop one of the central elements of the Scottish Government's Tobacco strategy: a Ministerial target to reduce the proportion of children in Scotland exposed to second-hand smoke at home by 50% by 2020. This target was met five years early [**S6**; **S7**].

Reducing the number of Scottish children exposed to second-hand smoking

Our input to policy [**S1**; **S2**] and public health campaigns [**S5**; **S6**] has resulted in significant health improvements for the Scottish population. Previous estimates from PhD research carried out in the group of Semple suggested that 60,000 children in Scotland, and approximately 10 times that figure across the UK, were regularly exposed to second-hand smoke in cars. For in-home smoking, the annual Scottish Health Survey found that the proportion of children exposed to second-hand smoke at home fell from 12% to 6% between 2012 and 2015 [**S7**]. This equates to some 50,000 children in Scotland now being protected from the harms of second-hand smoke within their home space.

Smoke-free homes and cars are likely to bring much greater health benefits to children than those seen from the 2006 smoke-free public spaces legislation, which primarily impacted on environments where adults spent their time (pubs, restaurants, workplaces). This is especially true

for children 5 years and under– younger children spend more time at home than school-age children, have a faster respiratory rate and their short stature places their nose and mouth at the height of a lit cigarette held at waist-height by an adult. A study of Scottish hospital asthma admissions published in 2020 linked to the *'Take it Right Outside (TiRO)'* campaign, underpinned by Aberdeen research [**S5**] found a fall of 0.5% per month in admissions for under 5s relative to the underlying trend [**S8**]. Figure 1 shows asthma admissions in Scotland for the under 5s; TiRO ran in 2014 and smoking in cars carrying children, again underpinned by our work (see above), came into force in Jan 2016.

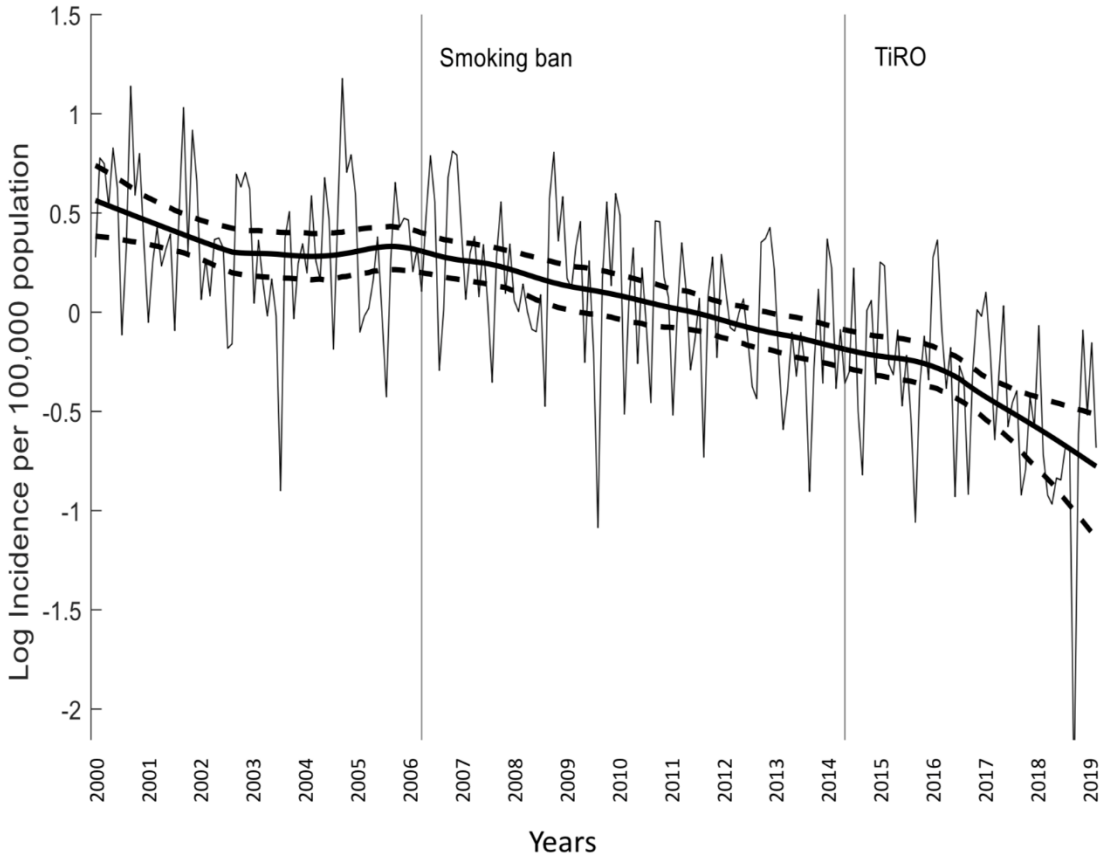

Figure 1. Monthly number of admissions for asthma/100,000 to hospitals in Scotland for children <5 years between Jan 2000 and Dec 2018. Smoothed solid line indicates the mean log-transformed standardised number of admissions and the broken lines indicate the bootstrapped 95% confidence intervals. There were significant reductions in monthly number of admissions after TiRO was launched [**S8**].

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1. Debate on Smoking Prohibition (Children in Motor Vehicles) (Scotland) Bill 17th December 2015. http://www.parliament.scot/parliamentarybusiness/report.aspx?r=10282&i=94632&c=1896228#ScotParlOR

S2. Testimonial from Mr Jim Hume, former MSP corroborating the importance of the research findings for the decision-making process leading to legislation in Scotland. 30/7/2018.

S3. Debate on the Children and Families Bill in the House of Lords 29th January 2014. http://www.publications.parliament.uk/pa/ld201314/ldhansrd/text/140129-0001.htm#14012956000437

S4. The Smoke-free (Private Vehicles) Regulations 2015 http://www.legislation.gov.uk/uksi/2015/286/contents/made

S5. Testimonial from Siobhan Mackay, Head of the Tobacco Control Team of the Scottish Government confirming the use of the Aberdeen research findings.

S6. Take It Right Outside Campaign Evaluation - Summary

S7. Fall in second-hand smoke exposure https://www.gov.scot/news/dramatic-fall-in-second-hand-smoke-exposure/

S8. Turner S, Mackay D, Dick S, Semple S, Pell JP. Associations between a smoke-free homes intervention and childhood admissions to hospital – an interrupted time series analysis of whole population data. Lancet Public Health 2020; 5(9):e493-e500. doi: 10.1016/S2468-2667(20)30178-X.