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Association between smoking and alcohol consumption: A time-series analysis

Dr Emma Beard

Department of Epidemiology and Public Health, University College London
Department of Clinical, Educational and Health Psychology, University College London

Professor Robert West
Department of Epidemiology and Public Health, University College London, London

Professor Susan Michie
Department of Clinical, Educational and Health Psychology, University College London

Dr Jamie Brown
Department of Epidemiology and Public Health, University College London
Department of Clinical, Educational and Health Psychology, University College London
What are the Smoking and Alcohol Toolkit Studies?

• Monthly household survey of representative samples of adults in England aged 16+
• Established in 2006 & 2014
• Collected data from over 200,000 smokers & 50,000 individuals on alcohol use

They aim to:
• Provide insight into population-wide influences on alcohol and smoking
• Evaluation of policies/interventions
• Populations trends and monitoring
• ‘Real world’ effectiveness of treatments
• Characterising groups

Advantages of the Toolkit
• Intended to be a ‘toolkit’ for policymakers and collaborators
  • Easily add questions and retain context of other questions
• Cross-sectional and follow-up at six months
• Widely validated tool of alcohol use (AUDIT)
• Same respondents in both surveys
• Publishes data in a timely manner

www.alcoholinengland.info
www.smokinginengland.info
Acknowledgements

• I have received unrestricted research funding from Pfizer for the Smoking Toolkit Study (www.smokinginengland)

• I am funded by Cancer Research UK and the National Institute for Health Research’s School for Public Health Research (NIHR SPHR)

This is a partnership between:

• The University of Sheffield
• The University of Bristol
• The University of Cambridge
• University College London
• The London School for Hygiene and Tropical Medicine
• The University of Exeter Medical School

• The LiLaC collaboration between the Universities of Liverpool and Lancaster
• Fuse; The Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities

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The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.
Background

- Smoking and alcohol consumption have a complex relationship
  - Individuals dependent on alcohol are more likely to smoke (Lasser et al, 2000; Falk et al, 2000; Kalman et al, 2005; Kessler et al, 2005; Hasin et al, 2007)
  - Dose response between the number of cigarettes consumed and alcohol intake (Friedman et al, 1991)
  - Attempts to quit smoking are less successful among those with an alcohol use disorder (Hughes et al, 2006; Weinberger et al, 2013; Leeman et al, 2008)
  - Alcohol consumption during smoking cessation is associated with greater risk of relapse (Kahler et al, 2010)
Background

• Several explanations have been put forward (Flay et al, 195; Taylor et al, 2014; WHO, 2014; Prescott et al, 1995; Robinson et al, 1993; Abrams et al, 1992)

  • Genes involved in regulating neurotransmitters
  • Cross tolerance and cross sensitization to both drugs
  • Conditioning mechanisms (i.e. cravings for alcohol or nicotine are elicited by certain environmental cues)
  • Psychosocial factors (e.g. personality characteristics and psychiatric conditions)
Background

- Recommend that smokers are advised to restrict their alcohol intake when they are attempting to stop (Kahler et al, 2010; Gulliver et al, 2006; Friend et al, 2005)

- Survey data suggest that many smokers follow this advice (Brown et al, 2016)

- However, use of cross-sectional epidemiological data means it is not possible to rule out reverse causation
  - Association may be driven by people with lower alcohol intake being more likely to attempt to quit

Figure 1: High risk drinking and binge drinking as a function of quit attempts in the past week (Brown et al, 2016)
Aims

- Selection bias can be partially addressed by using time series analysis.

- Where associations are found, they cannot establish a causal association but can be indicative.

- This study aimed to assess, using a time series approach, whether at a population level:
  - Smoking $\rightarrow$ High-risk drinking
  - Strong motivation to quit $\rightarrow$ Strong motivation to cut down
  - Attempts to stop smoking $\rightarrow$ Attempts to cut down on alcohol intake
Methodology

• Data came from the Smoking Toolkit and Alcohol Toolkit Studies

  • Cross-sectional household computer-assisted interviews conducted by Ipsos Mori

  • ~1,800 adults aged 16+ in England each month

  • Used data between April 2014 to June 2016 on n=45,414

www.alcoholinengland.info  www.smokinginengland.info
Methodology

- **Measures:**
  - Smoked or had smoked cigarettes (including hand-rolled) daily or non-daily in the past year
  - Alcohol Use Disorders Identification Test (AUDIT)
    - Those scoring greater than or equal to 8 were classed as high-risk drinkers
  - Serious quit attempt in the past 12 months or serious attempt to cut down on alcohol intake
  - Wanted to quit smoking (Motivation to Stop Scale; MTSS) or reduce alcohol intake in the next month or next three months (i.e. high motivation)
Analysis

- Pre-registered on Open Science Framework (https://osf.io/p5uc8/)

ARIMA

Autoregressive Integrated Moving Average with Exogenous input
Analysis

- **ARIMAX** can be viewed as a "filter" that separates the signal from the noise.
- The signal is then extrapolated into the future to obtain forecasts.

\[ Y_t \rightarrow \text{AR filter} \rightarrow \text{Integration filter} \rightarrow \text{MA filter} \rightarrow \varepsilon_t \]

- (long term) \hspace{1cm} (stochastic trend) \hspace{1cm} (short term) \hspace{1cm} (error)

- **AR filter** models *autoregressive autocorrelation*
  - Any given value \( X(t) \) can be explained by some function of its previous value, \( X(t-1) \), plus some unexplainable random error, \( E(t) \).

- **MA filter** models *moving average autocorrelation*
  - Any given value of \( X(t) \) is directly related to the random error in a previous period, \( E(t-1) \), and to the current error, \( E(t) \).
Analysis

- **Integration filter** aims to make the series **stationary**
  - Statistical properties such as mean and variance are all **constant over time**
  - **Aids prediction** as properties will be the same in the future as they have been in the past
  - We can achieve this through:
    a) **Transformations** (e.g. logarithmic)
    b) **Differencing** which removes underlying trends and seasonality (e.g. 1 2 3 → 1 1 1)

"I have seen the future and it is very much like the present, only longer"

*Kehlog Albran*

ARIMAX describes the movements in a **stationary** time series as a function of:
- **Prior values** in the time series (**autoregressive**)
- **Errors** made by previous predictions (**moving average**)
Results

- Every 1% decrease in smoking prevalence resulted in a 0.19% decrease in prevalence of high-risk drinking ($p=0.017$)

Figure 1: Prevalence overtime of smoking and high-risk drinking
Results

• Inconclusive as to whether an association existed between prevalence of high motivation to quit and prevalence of high motivation to reduce ($\beta$ 0.324, $p=0.360$)

• Inconclusive as to whether an association existed between prevalence of attempts to quit and attempts to reduce alcohol intake ($\beta$ -0.026, $p=0.969$)

![Figure 2: Prevalence overtime of motivation to quit smoking and to reduce alcohol consumption](image1)

![Figure 3: Prevalence overtime of attempts to quit smoking and attempts to cut down on alcohol intake](image2)
Conclusion

- Changes in prevalence of smoking in England are positively associated with changes in prevalence of high-risk drinking.
- No clear association has been found between motivation to stop and motivation to cut down on alcohol consumption.
- No clear association has been found between attempts to quit smoking and attempts to reduce alcohol intake.
<table>
<thead>
<tr>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• First time series analysis of the association between smoking and alcohol related behaviours</td>
<td>Respondents may underestimate or fail to report their drinking and smoking</td>
</tr>
<tr>
<td>• Used representative survey’s conducted on a large sample of the adult population in England</td>
<td>Findings may not generalise to other countries. England has a strong tobacco control climate and generally high motivation to quit among smokers</td>
</tr>
<tr>
<td>• Used the AUDIT which allows international comparisons</td>
<td>Did not adjust for population level policies (unaware of any during the study period)</td>
</tr>
</tbody>
</table>
Discussion

• Data may have been **insensitive** to detect associations

• Smoking and alcohol only co-vary in relation to longer term behaviour change \(\rightarrow\) picked up by prevalence

• There are several implications:
  • Need to pay attention to **cross-over effects** when evaluating interventions
  • Provide smokers with **advice** on their alcohol use
  • Need to **adjust** for co-varying health behaviours in time series analyses
Thank you for listening

Special thank you to my collaborators:
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and the ATS team:
Crispin Acton, Alan Brennan, Colin Drummond, Matthew Hickman, John Holmes, Eileen Kaner, Karen Lock, Matthew Walmsley, Colin Angus, Rona Campbell, Duncan Gillespie, Frank de Vocht, Zarnie Khadjesari
UK Society for Behavioural Medicine
2016 12th Annual Scientific Meeting
Complex interventions in a complex world: applications of Behavioural Medicine

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Are brief interventions for smoking and excessive alcohol consumption in primary care contributing to or reducing health inequalities?

Colin Angus, Jamie Brown, Emma Beard, Duncan Gillespie, Penny Buykx, Eileen Kaner, Susan Michie & Petra Meier
**Problem**

- Tobacco & alcohol are leading causes of disease in UK and internationally.

<table>
<thead>
<tr>
<th></th>
<th>Alcohol</th>
<th>Tobacco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalisations</td>
<td>1 million</td>
<td>1.6 million</td>
</tr>
<tr>
<td>Deaths</td>
<td>6,600</td>
<td>78,200</td>
</tr>
</tbody>
</table>

Socially and economically costly!
Evidence of social inequalities

• Smoking
  • More common in lower SES, more harms, fewer successful quit attempts

• Alcohol use
  • Less consumed by lower SES, BUT greater harms ‘alcohol harm paradox’
E.g. Inequalities in alcohol-related health

Men in the lowest socioeconomic groups are 3.5 times more likely to die from an alcohol-related condition than those in the highest (5.7 times for women)

Reducing the burden: Screening & brief intervention in primary care

For alcohol or tobacco:

- Initial screening
- Feedback
- Brief structured advice/behaviour change counselling
- Referral to specialist services if necessary e.g. alcohol dependence
- May be targeted or opportunistic
- Evidence that effective AND cost-effective
Potential health inequality effects?

UK stands to gain the most of any EU country from implementing a large-scale national IBA programme in primary care, AND it would save the NHS money.
Aims

To examine

• To what extent socio-demography explains observed differences in SBI delivery for alcohol and tobacco

• Whether there is a socio-economic gradient in SBI delivery (adjusting for demographic characteristics - age, gender, region, #children in household, disability and ethnicity, and behaviour - smoking status, drinking status and motivation to cut down/quit)
Data

• Alcohol & Smoking Toolkit Study: 03/2014-07/2016
• Risky drinkers: AUDIT score 8+
• Smokers: used cigarettes or other tobacco at least occasionally past 12 months
• N=8,978
  Risky drinkers only = 2,528
  Smokers only = 5,004
  Both = 1,446

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Self-report receipt of BI

Alcohol

• Q: “In the last 12 months, has a doctor or other health worker within your GP surgery discussed your drinking?”
  • A: offered advice, help/support or referral

Smoking

• Q “Has your GP spoken to you about your smoking in the past year?”
  • A: offered advice, referral or prescription
Prevalence

Clear SES gradient in smoking

Less, opposite gradient in risky drinking

Population

Social grade

Prevalence in adult population

Risky drinkers
Smokers
Primary Care attendance in past year

Smokers visit their GP less -> less opportunities for BI

Population

AB

C1

C2

D

E

Proportion of at-risk group visiting their GP in past year

Risky drinkers

Smokers

09/12/2016 © The University of Sheffield
If attended past year, receipt of Brief Intervention

Smokers are 8 times more likely to receive a BI than risky drinkers when they visit their GP.
Social gradients in BI

Lowest SES drinkers 203% more likely to receive a BI than highest SES group. Figure for smokers is 32%.
Conclusions

• There is a socio-economic gradient in SBI for alcohol and tobacco

• Eligible patients in lower SES groups MORE likely to receive intervention than higher SES

• Considerable room for improvement in delivery of SBI for alcohol
Limitations

• Broad definition of intervention
• May be recall bias

However alternative data also has limitations, e.g:
• GP data cannot tell us whether intervention actually ‘heard’ by patient
• GP data may also have biases e.g. recording may be affected by financial and other incentives
Implications

• Current delivery of Brief Interventions likely to be reducing health inequalities

• There is scope to address ‘missed opportunities’, especially for alcohol
Acknowledgements
Thanks for listening

p.f.buykx@sheffield.ac.uk

@pennybuykx

c.r.angus@sheffield.ac.uk

@VictimOfMaths

Google: Sheffield Alcohol Research Group
UK Society for Behavioural Medicine
2016 12th Annual Scientific Meeting
Complex interventions in a complex world: applications of Behavioural Medicine

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Is use of varenicline during an attempt to quit smoking associated with reduced alcohol consumption in heavy drinkers?

Findings from a longitudinal population survey

Jamie Brown, Susan Michie, Colin Angus, Emma Beard, Eileen Kaner, Matt Hickman & Robert West

@jamiebrown10
Acknowledgments & COI

• Funders
  – SSA, NIHR SPHR & CRUK

• Co-authors & investigators

• JB & EB have held unrestricted grants from Pfizer; RW undertakes research & consultancy, & receives fees for speaking from companies that manufacture smoking cessation medications (including Pfizer). Pfizer manufacture varenicline.
Varenicline, smoking & alcohol

- Varenicline has agonist effects at several nicotinic acetylcholine receptor subunits\(^1\)
- Receptors appear to play role in rewarding effects of both nicotine and alcohol\(^2\)
- High quality evidence that varenicline can improve the success rates of smokers attempting to stop
  - widely approved as a first-line treatment for smoking cessation\(^3\)
- Emerging evidence varenicline may also affect alcohol consumption\(^4\)

Evidence on varenicline & alcohol

- Varenicline reduces craving & alcohol self-administration by heavy drinkers in lab settings\(^1\)
- Clinical trials indicate varenicline reduces craving & consumption over longer period\(^2\)
- Together constitute modest evidence to support use of varenicline to reduce alcohol consumption
  - however, not currently approved as treatment

1 McKee et al., 2009; 2 Schacht et al., 2014; Plebani et al., 2013; R. Z. Litten et al., 2013; Mitchell, Teague, Kayser, Bartlett, & Fields, 2012; Fucito et al., 2011 Erwin & Slaton, 2014
Epidemiological opportunity

- Epidemiological evidence of an association between use of varenicline and reduction in alcohol consumption would support emerging evidence base
- Large naturally-occurring population of heavy drinkers incidentally using varenicline
  - Use of varenicline by smokers is relatively widespread in England
  - Heavy drinking, especially among smokers, is common

1 McKee et al., 2009; 2 Schacht et al., 2014; Plebani et al., 2013; R. Z. Litten et al., 2013; Mitchell, Teague, Kayser, Bartlett, & Fields, 2012; Fucito et al., 2011; 3 Erwin & Slaton, 2014
Aim

• To assess in real-world settings whether the use of varenicline by smokers attempting to quit was associated with lower alcohol consumption at baseline and 6 months later
Design

- Cross-sectional household surveys of representative samples of adults in England
- Each month new sample of ~1700 adults (16+)*
- Six-month telephone follow-up of high-risk drinkers and past-year smokers

* Fidler et al. 2011, Beard et al. 2015
Sample & measures

Outcome measures: Baseline & 6-month follow-up
• Past-week alcohol consumption; Frequency of heavy drinking; Full AUDIT score

Co-variables
• Sex, age, social grade, smoking status and survey year
Recontact

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Not recontacted (n=826)</th>
<th>Recontacted (n=217)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>35.2</td>
<td>41.7*</td>
</tr>
<tr>
<td>% Women</td>
<td>41.5</td>
<td>39.2</td>
</tr>
<tr>
<td>% Social grade C2DE</td>
<td>51.5</td>
<td>38.7*</td>
</tr>
<tr>
<td>% Current smoker</td>
<td>81.9</td>
<td>73.3*</td>
</tr>
</tbody>
</table>

- No interactions between likelihood of being recontacted and use of varenicline on baseline characteristics
Analysis

• Unadjusted linear regression models
• Multivariable regression models including co-variables
• For non-significant results, Bayes factors calculated to determine relative likelihood of null vs experimental hypothesis
  – http://www.lifesci.sussex.ac.uk/home/Zoltan_Dienes
  – Experimental hypothesis reflected effect from power calculation (d=0.6) & conservatively represented by half-normal distribution
• Analysis plan was registered at osf.io/ch7kr
## Results: Sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No varenicline (n=187)</th>
<th>Varenicline (n=21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>41.3</td>
<td>44.6</td>
</tr>
<tr>
<td>% Women</td>
<td>35.3</td>
<td>71.4*</td>
</tr>
<tr>
<td>%Social grade C2DE</td>
<td>40.1</td>
<td>19.0</td>
</tr>
<tr>
<td>% Current smoker</td>
<td>73.3</td>
<td>61.9</td>
</tr>
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</table>
Results: Baseline associations

Past-week consumption

<table>
<thead>
<tr>
<th>Units</th>
<th>No varenicline (n=187)</th>
<th>Varenicline (n=21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
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<tr>
<td>16</td>
<td></td>
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<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Freq. heavy drinking

<table>
<thead>
<tr>
<th>AUDIT 3 score (0-4)</th>
<th>No varenicline (n=187)</th>
<th>Varenicline (n=21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
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</tbody>
</table>

AUDIT score

<table>
<thead>
<tr>
<th>AUDIT score (0-40)</th>
<th>No varenicline (n=187)</th>
<th>Varenicline (n=21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ B = -3.8 \ (11.0 \text{ to } 3.4), \ p=0.30 \]

\[ B_{adj} = -2.6 \ (10.1 \text{ to } 5.0), \ p=0.50 \]

\[ B = -0.2 \ (-0.7 \text{ to } 0.27), \ p=0.41, \]

\[ B_{adj} = -0.2 \ (-0.7 \text{ to } 0.3), \ p=0.38 \]

\[ B = -1.6 \ (-3.6 \text{ to } 0.5), \ p=0.13 \]

\[ B_{adj} = -0.8 \ (-2.8 \text{ to } 1.3), \ p=0.46 \]
Results: Baseline associations

Past-week consumption

Freq. heavy drinking

AUDIT score

B = -3.8 (-11.0 to 3.4), p=0.30
Bayes factor = 1

B = -0.2 (-0.7 to 0.27), p=0.41,
Bayes factor = 0.8

B = -1.6 (-3.6 to 0.5), p=0.13
Bayes factor = 1.7

B_{adj} = -2.6 (-10.1 to 5.0), p=0.50
Bayes factor = 0.7

B_{adj} = -0.2 (-0.7 to 0.3), p=0.38
Bayes factor = 0.9

B_{adj} = -0.8 (-2.8 to 1.3), p=0.46
Bayes factor = 0.6
Sensitivity analysis: Complete sample

**Past-week consumption**
- No varenicline (n=981)
- Varenicline (n=60)

**Freq. heavy drinking**
- No varenicline (n=981)
- Varenicline (n=60)

**AUDIT score**
- No varenicline (n=981)
- Varenicline (n=60)

\[ B_{adj} = -1.5 \ (-5.5 \text{ to } 2.6), \quad \text{Bayes factor} = 0.4 \]

\[ B_{adj} = 0.1 \ (-0.1 \text{ to } 0.4), \quad \text{Bayes factor} = 0.1 \]

\[ B_{adj} = -0.6 \ (-1.8 \text{ to } 0.7), \quad \text{Bayes factor} = 0.5 \]
Results: 6-month prospective associations

Past-week consumption

Freq. heavy drinking

AUDIT score

B = -7.1 (-15.4 to 1.3), p = 0.10

B = -0.5 (-1.0 to 0.0), p = 0.04*

B = -1.4 (-3.8 to 1.0), p = 0.25
Results: 6-month prospective associations

**Past-week consumption**

- No varenicline (n=187)
- Varenicline (n=21)

**Freq. heavy drinking**

- No varenicline (n=187)
- Varenicline (n=21)

**AUDIT score**

- No varenicline (n=187)
- Varenicline (n=21)

**Comparisons**

- **Past-week consumption**:
  - B = -7.1 (-15.4 to 1.3), p = 0.10
  - Bayes factor = 2.5

- **Freq. heavy drinking**:
  - B = -0.5 (-1.0 to 0.0), p = 0.04*
  - Bayes factor = 4.4

- **AUDIT score**:
  - B = -1.4 (-3.8 to 1.0), p = 0.25
  - Bayes factor = 1.2

**Adj. comparisons**

- **Past-week consumption**:
  - B_{adj} = -4.4 (-12.2 to 3.5), p = 0.27
  - Bayes factor = 1.1

- **Freq. heavy drinking**:
  - B_{adj} = -0.4 (-0.9 to 0.1), p = 0.12
  - Bayes factor = 2

- **AUDIT score**:
  - B_{adj} = -0.5 (-2.8 to 1.9), p = 0.70
  - Bayes factor = 0.5
Summary

• **No baseline** differences in alcohol consumption, frequency of heavy drinking or AUDIT score by use of varenicline

• At **follow-up**, there was less frequent heavy drinking among those using varenicline
  – Only modest evidence remained after adjustment
  – Data were fairly insensitive on whether there was difference in consumption but supported no difference in AUDIT score
Discussion

- Modest real-world support of emerging trial evidence that varenicline may help reduce heavy drinking\(^1\)
- Caution required
  - Only on measure of heavy drinking
  - Low follow-up rate
  - Alcohol use unknown before varenicline exposure

\(^1\) McKee et al., 2009 Schacht et al., 2014; Plebani et al., 2013; R. Z. Litten et al., 2013; Mitchell, Teague, Kayser, Bartlett, & Fields, 2012; Fucito et al., 2011, Erwin & Slaton, 2014
Conclusion

- In real-world settings, use of varenicline during an attempt to quit smoking is not cross-sectionally associated with alcohol consumption, frequency of heavy drinking or overall alcohol use in higher-risk drinkers.

- Modest evidence that use of varenicline is prospectively associated with less frequent heavy drinking reported six months later.
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@jamiebrown10

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Views are those of the authors(s) and not necessarily those of the NHS, the NIHR or the Department of Health. SPHR is a partnership between the Universities of Sheffield; Bristol; Cambridge; Exeter; UCL; The London School for Hygiene and Tropical Medicine; the LiLaC collaboration between the Universities of Liverpool and Lancaster and Fuse; The Centre for Translational Research in Public Health, a collaboration between Newcastle, Durham, Northumbria, Sunderland and Teesside Universities
Discussion

- Could effective pharmacotherapy for alcohol problems increase likelihood of brief interventions?
  - Health professionals may view the non-pharmacological paradigm of alcohol as a barrier to treatment\(^1\)

- Additional reason for brief intervention on alcohol to be encouraged during intervention on smoking?
  - BI on smoking is much more common and could help to increase interventions on alcohol

\(^1\) Rehm et al., 2015
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Some questions

• Which kinds of policies are and aren't well-suited to evaluation using the Toolkit?
  • policies where effects are gradual vs. instantaneous,
  • where there are complex causal chains or
  • where effects may be highly heterogeneous across subgroups meaning that averages become problematic.

• What could the Toolkit be used for that it isn't already OR what data should be included but are not currently?

• What are the mechanisms which produce observed relationships between tobacco and alcohol use - what links the two behaviours together?
• What do population level aggregated analyses add or contribute beyond individual level analyses?
  • temporal trends and population level policies, accounting for seasonality, use past values used to predict future values and gets around selection bias. Two together give complementary information

• What are the benefits of looking at these relationships using the Alcohol Toolkit Study compared to a clinical trial?
  • ecological validity, cost, timing, ethics etc

• Use of Bayes Factors is a rather novel approach. What do they add to the analysis?
  • determine if data are insensitive or evidence for the null effect of no difference; unlike frequentist can update with new data from same study or different study. More in line with thinking and fewer misperceptions.
• Is our conception of SES too simple?
  • perhaps we shouldn't use simple dichotomisations.
  • Previous studies in the ATS have shown complex relationships with various measures (e.g. income, social-grade and education), with concentration of poor health behaviours in lowest SES
  • Social-grade (as a scale) does appear to be one of the better measures and we can consider composite scores which combine measures