The International Model of Alcohol Harms and Policies: Two Case Studies Illustrating the Application of a New International Resource for Alcohol Policy Research

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Presentation 1: An Introduction to InterMAHP
As required by the Alcohol Policy 18 Conference, I/we have signed a disclosure statement and note the following conflict(s) of interest:

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Overview of the International Model of Alcohol Harms and Policies (InterMAHP)

- Developed by team led by CISUR and authors of WHO GSRAH/GBD
- First open access alcohol harms estimator (morbidity and mortality)
- Version 1: comprehensive framework for calculating alcohol-attributable fractions
- Downloadable package: (1) methodological guide, (2) user’s manual with worked example, (3) SAS program interface & software
- Upcoming improvements to InterMAHP v2.0:
  - Translation into internet-based R package run through Shiny interface
  - Addition functionality to allow study of policy changes on changes in alcohol-attributable harms
  - Continued improvement of ICD10 condition grouping with rationale
Automates the estimation of alcohol-attributable fractions (AAFs)

AAF is the percentage of each alcohol-related condition that would not occur in the absence of exposure to alcohol

InterMAHP provides unique AAF estimation for each region, year, gender, age group (15-34, 35-64,65+) and alcohol-related condition

Who is InterMAHP intended for?

Alcohol research teams estimating alcohol harms in their region
Region may be a country, state, province, city, health region
InterMAHP: Downloadable open access package

- www.intermahp.cisur.ca
- (1) 100 page comprehensive methodological guide, (2) user’s manual with worked example for first time users, (3) program software
Methods: Alcohol-attributable fractions

- Extension of the Levin/classical form of the population attributable fraction:

\[ PAF = \frac{\sum_{i=1}^{k} P_i (RR_i - 1)}{1 + \sum_{i=1}^{k} P_i (RR_i - 1)} \]

- InterMAHP employs the modern AAF formulation developed by co-author Rehm for the WHO GSRAH/GBD:

\[ AAF = \frac{P_{FD}[RR_{FD} - 1] + \int_{0.03}^{Z} P(x)[RR(x) - 1] \, dx}{1 + P_{FD}[RR_{FD} - 1] + \int_{0.03}^{Z} P(x)[RR(x) - 1] \, dx} \]
Methods: Former drinkers

- Categorical definition of former drinkers
- Prevalence of former drinkers ($P_{FD}$) from surveys
- Relative risk of former drinkers ($RR_{FD}$) from international meta-analyses for each alcohol-related condition (collected by InterMAHP)

Schütze et al. (2011) Table 2

$RR_{FD}$ (men) = 1.54
$RR_{FD}$ (women) = 2.28

Based on the prospective cohort EPIC study (European Prospective Investigation into Cancer and Nutrition). Data analyzed from eight western European countries; context therefore not as broad as a large meta-analysis. $RR_{FD}$ (men) same as that for total cancer as there were not enough cases to uniquely estimate for liver cancer.
Methods: Modelling alcohol consumption

- Prevalence for current drinkers, $P(x)$, at consumption level $x$ in grams/day is modelled using a one-parameter definition of the Gamma distribution, $f(x | \mu)$

- Gamma distribution reduced to depend on only $\mu$, per capita consumption in grams/day

- Sales/survey information necessary:
  
  i. Per capita consumption in litres/year
  
  ii. Relative consumption between six gender-age subgroups
  
  iii. Any two prevalences (current drinkers, former drinkers, lifetime abstainers)
  
  iv. Prevalence of binge drinkers
Methods: Modelling relative risk functions

- Relative risk functions, $RR(x)$, for all alcohol-related conditions (by gender and outcome) collected from international literature
- Closely match those to be used for the 2016 GBD and 2018 GSRAH studies
- RR functions contained in InterMAHP input spreadsheet and can be easily modified as new meta-analyses are published
InterMAHP Content 1: ICD10 condition coding

- Complete ICD10 code operationalization for all 43 alcohol-related conditions
- From the publication, *A comprehensive guide to the estimation of alcohol-attributable morbidity and mortality*

<table>
<thead>
<tr>
<th>Condition Group</th>
<th>Condition</th>
<th>IM #</th>
<th>ICD10 codes (Primary Dx)</th>
<th>ICD10 codes (External)</th>
<th>Partial or 100% attributable</th>
<th>Causation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Cancer</td>
<td>Oral cavity and pharynx cancer</td>
<td>(2)(1)</td>
<td>C00 – C05, C08 – C10, C12 – C14, D00.0</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oesophageal cancer, squamous cell carcinoma</td>
<td>(2)(2)</td>
<td>C15, D00.1 (portional only)</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Colorectal cancer</td>
<td>(2)(3)</td>
<td>C18 – C21, D01.0-D01.4</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liver cancer</td>
<td>(2)(4)</td>
<td>C22, D01.5</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pancreatic cancer</td>
<td>(2)(5)</td>
<td>C25, D01.7</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laryngeal cancer</td>
<td>(2)(6)</td>
<td>C32, D02.0</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breast cancer</td>
<td>(2)(7)</td>
<td>C50, D05</td>
<td>Partial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Endocrine conditions</td>
<td>Diabetes mellitus, Type 2</td>
<td>(3)(1)</td>
<td>E11, E13, E14</td>
<td>Partial</td>
<td>Howard et al. (2004) [22]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Alcohol-induced pseudo-Cushing’s syndrome</td>
<td>(3)(2)</td>
<td>E24.4</td>
<td>100%</td>
<td>Alcohol-caused by definition</td>
<td></td>
</tr>
</tbody>
</table>
InterMAHP Content 2: Relative risk sourcing

- Sourcing for all $RR_{FD}$ & $RR(x)$ estimates
- From *Comprehensive Guide*:

<table>
<thead>
<tr>
<th>(3) Endocrine conditions</th>
<th>(3).(1)</th>
<th>Men</th>
<th>Combined</th>
<th>Knott et al. (2015) [60] Figure 3</th>
<th>Reported in Rehm et al. (2010) [8] from Ballunus et al. (2009) [61]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes mellitus, Type 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>Combined</td>
<td></td>
<td>Knott et al. (2015) [60] Figure 3</td>
<td>Reported in Rehm et al. (2010) [8] from Ballunus et al. (2009) [61]</td>
<td></td>
</tr>
<tr>
<td>(4) Neuropsychiatric conditions</td>
<td>(4).(5)</td>
<td>Combined</td>
<td>Combined</td>
<td>Samokhvalov et al. (2010) [62] Figure 3</td>
<td>N/A as $RR_{FD} = 1.0$</td>
</tr>
<tr>
<td>Epilepsy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>(5).(1)</td>
<td>Men</td>
<td>Combined</td>
<td>Roerecke et al. (in press)</td>
<td>Roerecke et al. (in press)</td>
</tr>
<tr>
<td>Women</td>
<td>Combined</td>
<td></td>
<td>Roerecke et al. (in press)</td>
<td>Roerecke et al. (in press)</td>
<td></td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>(5).(2)</td>
<td>Men</td>
<td>Mortality two options</td>
<td>Roerecke &amp; Rehm (2012) [30] Figure 3</td>
<td>Roerecke &amp; Rehm (2010) [63] Table 3</td>
</tr>
<tr>
<td>Men</td>
<td>Mortality two options</td>
<td>Roerecke &amp; Rehm (2012) [30] Figure 2</td>
<td>Roerecke &amp; Rehm (2010) [63] Table 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>Mortality</td>
<td>Roerecke &amp; Rehm (2012) [30] Figure 2</td>
<td>Roerecke &amp; Rehm (2010) [63] Table 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Cardiovascular conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation and cardiac arrhythmia</td>
<td>(5).(4)</td>
<td>Combined</td>
<td>Combined</td>
<td>Samokhvalov et al. (2010) [64] Figure 3</td>
<td>Larsson et al. (2014) [65] Table 1</td>
</tr>
</tbody>
</table>
InterMAHP Content 3: Novel functionality

- First open access alcohol harms estimator
- Automatic decomposition of harms into three dynamic drinking groups: low volume, medium volume and heavy volume drinkers
- User-defined upper limit of consumption
- Ability to easily swap in new relative risk function, e.g. IHD
- User-defined, region-specific definition of binge drinking
- Dynamic options for extrapolating relative risk functions, $RR(x)$, at high levels of daily consumption
From sales / surveys, team collects following inputs:

- InterMAHP provides a default relative risk spreadsheet

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>Gender</th>
<th>Age_Group</th>
<th>Population</th>
<th>PCC_litres_year</th>
<th>Correction_factor</th>
<th>Relative_consumption</th>
<th>P_LA</th>
<th>P_FD</th>
<th>P_CD</th>
<th>P_BD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yourregion</td>
<td>2013</td>
<td>Female</td>
<td>15 to 34</td>
<td>1193</td>
<td>9.00</td>
<td>0.8</td>
<td>5.6208</td>
<td>0.1004</td>
<td>0.0416</td>
<td>0.858</td>
<td>0.3432</td>
</tr>
<tr>
<td>Yourregion</td>
<td>2013</td>
<td>Female</td>
<td>35 to 64</td>
<td>1823</td>
<td>9.00</td>
<td>0.8</td>
<td>3.5191</td>
<td>0.0753</td>
<td>0.0307</td>
<td>0.894</td>
<td>0.2128</td>
</tr>
<tr>
<td>Yourregion</td>
<td>2013</td>
<td>Female</td>
<td>65+</td>
<td>1009</td>
<td>9.00</td>
<td>0.8</td>
<td>1.8913</td>
<td>0.1346</td>
<td>0.0504</td>
<td>0.815</td>
<td>0.1353</td>
</tr>
<tr>
<td>Yourregion</td>
<td>2013</td>
<td>Male</td>
<td>15 to 34</td>
<td>1254</td>
<td>9.00</td>
<td>0.8</td>
<td>10</td>
<td>0.0995</td>
<td>0.0215</td>
<td>0.879</td>
<td>0.4817</td>
</tr>
<tr>
<td>Yourregion</td>
<td>2013</td>
<td>Male</td>
<td>35 to 64</td>
<td>1863</td>
<td>9.00</td>
<td>0.8</td>
<td>7.1547</td>
<td>0.0321</td>
<td>0.0429</td>
<td>0.925</td>
<td>0.457</td>
</tr>
<tr>
<td>Yourregion</td>
<td>2013</td>
<td>Male</td>
<td>65+</td>
<td>844</td>
<td>9.00</td>
<td>0.8</td>
<td>3.8947</td>
<td>0.0803</td>
<td>0.0417</td>
<td>0.878</td>
<td>0.3415</td>
</tr>
</tbody>
</table>
InterMAHP Example 2: Run InterMAHP

- SAS interface:
InterMAHP automatically outputs three files: (1) Morbidity AAFs, (2) Mortality AAFs, (3) contextual information.

AAF3 are applied as usual to the enumerated counts of morbidity and mortality for each alcohol-related condition.

**Figure 7: Screenshot of a subset of the output file InterMAHP_AAFs_morbidity**

<table>
<thead>
<tr>
<th>Region</th>
<th>Year</th>
<th>Gender</th>
<th>Age Group</th>
<th>Condition</th>
<th>AAF_FD</th>
<th>AAF_LD</th>
<th>AAF_MD</th>
<th>AAF_HD</th>
<th>AAF_Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>2015</td>
<td>Male</td>
<td>15 to 34</td>
<td>Liver cancer</td>
<td>0.027025</td>
<td>0.01927</td>
<td>0.03135</td>
<td>0.127365</td>
<td>0.205012</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Male</td>
<td>35 to 64</td>
<td>Liver cancer</td>
<td>0.049984</td>
<td>0.01993</td>
<td>0.031525</td>
<td>0.115797</td>
<td>0.217237</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Male</td>
<td>65+</td>
<td>Liver cancer</td>
<td>0.089419</td>
<td>0.017403</td>
<td>0.026117</td>
<td>0.080369</td>
<td>0.213309</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Female</td>
<td>15 to 34</td>
<td>Liver cancer</td>
<td>0.09543</td>
<td>0.013219</td>
<td>0.017746</td>
<td>0.050713</td>
<td>0.177108</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Female</td>
<td>35 to 64</td>
<td>Liver cancer</td>
<td>0.14712</td>
<td>0.01348</td>
<td>0.01668</td>
<td>0.037168</td>
<td>0.214467</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Female</td>
<td>65+</td>
<td>Liver cancer</td>
<td>0.225443</td>
<td>0.010937</td>
<td>0.011129</td>
<td>0.001500</td>
<td>0.26251</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Male</td>
<td>15 to 34</td>
<td>Pancreatic cancer</td>
<td>0.030964</td>
<td>0.006185</td>
<td>0.00997</td>
<td>0.04203</td>
<td>0.089129</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Male</td>
<td>35 to 64</td>
<td>Pancreatic cancer</td>
<td>0.056779</td>
<td>0.008322</td>
<td>0.009939</td>
<td>0.037782</td>
<td>0.110822</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Male</td>
<td>65+</td>
<td>Pancreatic cancer</td>
<td>0.098134</td>
<td>0.005334</td>
<td>0.007955</td>
<td>0.025217</td>
<td>0.13664</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Female</td>
<td>15 to 34</td>
<td>Pancreatic cancer</td>
<td>0.008738</td>
<td>0.004336</td>
<td>0.005788</td>
<td>0.016066</td>
<td>0.035528</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Female</td>
<td>35 to 64</td>
<td>Pancreatic cancer</td>
<td>0.014088</td>
<td>0.004624</td>
<td>0.005696</td>
<td>0.001273</td>
<td>0.037139</td>
</tr>
<tr>
<td>BC</td>
<td>2015</td>
<td>Female</td>
<td>65+</td>
<td>Pancreatic cancer</td>
<td>0.02301</td>
<td>0.003999</td>
<td>0.004047</td>
<td>0.005452</td>
<td>0.036508</td>
</tr>
</tbody>
</table>
Thank you
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