Approaches to triangulation of alcohol data in Scotland: a response to Rehm and colleagues

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Abstract

Rehm *et al* highlight the ongoing difficulties in accurately estimating alcohol consumption using surveys. Population surveys, in particular, suffer from non-response and sampling bias, which affects their representativeness, but they are one of the few ways of estimating differences in consumption across population subgroups. In this article, we highlight different approaches that have been taken in Scotland to try to overcome these problems, from the pragmatic to the sophisticated.

Key words

Alcohol, survey, non-response, representativeness

Running head

Non-response in population surveys

The limitations of self-reported surveys for estimating levels and patterns of alcohol consumption in populations have been acknowledged for decades. In a 1998 *Addiction* Editorial, Dawson and colleagues remarked that *"Improving the measurement of consumption has remained one of the most elusive goals of alcohol research*" (1). Predating the subsequent demise of response levels, its focus was on the design of consumption measures within surveys, rather than the issue of representativeness, which is the focus of Rehm *et al*'s latest contribution (2). But the solution Rehm *et al* propose, statistical modelling innovation and triangulating data from other sources, may actually provide a solution to both problems. In this response to the Rehm *et al* article, we reflect on our experience of exploring and addressing the shortcomings of estimating alcohol consumption using general population surveys in Scotland, using examples that range from pragmatic to sophisticated.

Consistent with Rehm *et al*'s call to action, we have been exploring novel methodologies applied to adjust national health survey data on alcohol for non-representativeness (3). The Scottish Health Survey, which uses the quantity-frequency method to derive weekly alcohol consumption estimates, is record-linked to data on hospital admissions and deaths. We identified differences in socio-demographic characteristics, alcohol-related harm and all-cause mortality between survey participants in six surveys conducted between 1995 and 2010, linked to prospective administrative data up to 2011, and the general population of Scotland (using unlinked administrative data). Then, creating synthetic observations for non-respondents, we assessed the impact on levels and patterns of consumption of applying multiple imputation under a range of missingness assumptions, including missing not at random (MNAR), by pattern mixture modelling. For example, we modelled a scenario that incorporated consumption data reported by patients with serious alcohol problems in two Scottish hospitals (drinking, on average, 198 alcohol units per week) as an example of a subpopulation likely to have been missing from the population survey respondents. We also calibrated our overall population estimates of mean weekly consumption with per-capita alcohol sales data using the approach of Rehm *et al* (4).

Application of multiple imputation under missing at random resulted in estimates of mean weekly consumption that were up to a fifth higher than corrections based solely on the standard socio-demographic-based weighting procedure. Under more extreme MNAR assumptions the overall difference was up to around 50%, and calibrating to sales estimates resulted in almost doubling the survey estimates. Considering specific subgroups, the increases observed were especially pronounced among males living in socioeconomically deprived areas, the very population group

Rehm *et al* highlight as not participating in sufficient numbers. We are also exploring whether basic nonresponse weights can be enhanced by deriving refined weights calibrated to match the population with alcohol related harms and deaths using machine learning techniques such as random forests and gradient boosting (5).

This example in Scotland showcases a range of methodological advances in estimating alcohol consumption using survey data alongside other data sources. It is a generalisable approach that can be applied that benefits from record-linked data. Nonetheless, the extent to which such advanced post-hoc methods can move beyond interesting academic insights to influencing routine population monitoring and evaluation of alcohol consumption is uncertain for several reasons. First, it is a labour-intensive process, requiring specialist statistical expertise over a sustained period. Second, while the range of scenarios that can be tested using the method is a strength, it also poses the question: which should be used as the main indicator of alcohol consumption? Finally, the challenge of comparability both over time and between countries, highlighted by Rehm *et al*, may be even more difficult given the broader range of country-specific data and assumptions involved.

Alongside the innovative research, a wide range of alcohol data are regularly being collated and triangulated in more pragmatic ways as part of the Monitoring and Evaluating Scotland's Alcohol Strategy (MESAS) work programme (6). The primary data source for estimating population alcohol consumption is alcohol retail sales, with useful breakdowns by trade sector and beverage category. The same data are also used to explore trends in alcohol prices. As these data cannot be broken down by population subgroup, self-reported consumption estimates fill this important gap. Data on alcohol-related harms, disproportionately accounted for by those least likely to respond to surveys, also form part of the compendium. Through a detailed understanding of the strengths and limitations of the range of data, the MESAS programme has produced informed interpretation on emerging trends and patterns.

An understanding of the strengths and limitations of different data sources, enhanced through the MESAS programme, has also supported the design of the portfolio of studies set up to evaluate Scotland's minimum unit pricing (MUP) policy. Recognising the impact of non-response on representativeness in the national health survey, the impact of MUP on alcohol consumption among population subgroups will be supplemented with additional methods, including non-probabilistic surveys of those engaged with alcohol services (7), attending emergency departments and sexual health clinics (8). Considering the technical sophistication required in the multiple imputation and machine learning approaches to addressing non-response, we are implementing a simpler alternative approach of calibration weighting which adjusts survey weights assigned to survey

respondents to reflect the population with alcohol related harms and deaths obtained from administrative health data. Calibration weighting also controls for coverage errors (9). In addition, alcohol consumption estimates derived from retrospective 7-day drinking diaries obtained from quota-based samples of a large market research panel will be used to provide insights into any changes in the context of drinking occasions (7). In the absence of any alcohol consumption data that can be considered a gold-standard, we believe that such triangulation will enable a more robust assessment of whether the policy achieves its intended effect.

We thank Rehm and colleagues for reminding us that we should continually aspire to improve how we measure consumption in alcohol research and to question the quality of the estimates our surveys produce. We support the triangulation of data, including those based on non-probabilistic approaches, and application of post-hoc statistical techniques (10). Sophisticated modelling can certainly help in this endeavour, but, to paraphrase Dawson (1), our continued efforts to improve methods for estimating consumption need to be moderated by the realisation that no method is likely to be ideal for all purposes.

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