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Risk, individual perception of risk, and population health

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We thank Annie Britton for her thoughtful comments (1) on our study investigating the lifetime risk of mortality at differing levels of alcohol consumption in seven European countries (2). These comments consider key concepts of epidemiology, social psychology and causality.

One comment concerns differences in the risk of an alcohol-attributable death across European Union countries, despite cultural and socio-economic similarities. Alcohol use and other factors affect the risk of death via complex interacting pathways (3, 4); for a death to occur, a combination of biopsychosocial factors are needed. Indeed, differences in alcohol-attributable death risk across countries, despite similar levels of consumption, are in part due to these factors differing across countries. Furthermore, different mortality risks also exist across socio-economic strata for similar levels of alcohol consumption (5, 6). Thus, differences in risk across countries and socio-economic strata result from differing health risk behaviours and environmental factors which form part of the interacting pathways affecting risk (7, 8). While epidemiological concepts of causality are based on these complex pathways, empirical studies, including the underlying studies used in our paper, simplify the relationships between the biopsychosocial factors by isolating the impact of a single factor on mortality through regressions while accounting for relatively few confounding and interacting factors. The results from such studies are often interpreted as an absolute "biological impact" of this single risk factor ("one drink leads to x fewer minutes of life"), irrespective of other factors. However, this approach is limited, as exemplified by the marked differences in alcohol-attributable mortality across countries with similar drinking levels.

The implications for advice based on the mortality risk are not straightforward. Our analyses found that national risk curves vary widely at higher levels of drinking, while at lower levels of drinking which confer

a lifetime mortality risk below 1 in 1000, the variations in risk across European countries are not large (2). Another consideration is whether guidelines should extend beyond the basic advice of low-risk average consumption. It is now common to also specify a risk threshold for a single drinking occasion – found, for example, in the current Australian and UK guidelines (9, 10). Thus, a consideration of drinking patterns addresses a dimension of risk obscured by cumulative guidelines; drinking patterns affect the risk of injuries, and also some chronic, mental and infectious diseases (11, 12). Additionally, separate guidelines are often formulated for drinking during pregnancy and teenage drinking, though these implicit risk thresholds are set based on social norms, more or less at 'any risk'.

Another comment concerns the potential of the presented risk information to change behaviour. Cognitive psychology has shown that humans are far from the rational *homo economicus* (11, 12), as despite being informed about the effects of alcohol, humans underestimate the overall risks of drinking (13). Therefore, comprehensive alcohol policies which include low-risk drinking guidelines also require pricing, marketing and availability policies (the "best buys": (14, 15)), and other promising interventions such as minimum pricing (16, 17) or lowering of the ethanol concentration in alcoholic beverages (18).

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