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Public Health Thinking Around Alcohol-Related Harm: Why Does Per Capita Consumption Matter?

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Received: May 15, 2020. Revision: September 15, 2020.

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ABSTRACT. Objective: Alcohol per capita consumption (APC) is used for monitoring harmful alcohol exposure in populations and assessing progress with goals set internationally and nationally. Recently, the alcohol industry challenged the use of this indicator. Here, we assessed the validity of APC as an indicator for reducing alcohol-related harm. **Method:** We conducted a narrative review of association between population-level drinking and harm rates, and the underlying mechanisms of this association. **Results:** A substantial literature demonstrates quite consistently close associations between APC and population harm levels for various types of health and social harms. Across populations with different total consumption, the distribution of consumption displays a fairly fixed shape, with no clear distinction between heavy drinkers and other drinkers. The mean consumption in a population is closely associated with the prevalence of heavy drinking; an increase in APC arises from a change in the whole distribution, heavy drinkers included. Although risk of harms from drinking increases with consumption, it seems that for many harm types the majority of drinkers, who do not drink heavily, account for a large proportion of harms from alcohol. **Conclusions:** By reducing APC, decreases in drinking among heavy drinkers as well as among ordinary drinkers will lead to fewer alcohol-related harms. The evidence strongly suggests public health gains from universal policies targeting APC. Reducing APC is furthermore an investment in future public health, as it is likely an efficient way of preventing people from becoming very heavy drinkers, who may cause themselves and others severe health and social problems. (*J. Stud. Alcohol Drugs, 82*, 000–000, 2021)

ALCOHOL USE IS A MAJOR determinant of mortality, injuries, and disease (GBD 2017 Risk Factors Collaborators, 2017). Hence, reduction of harmful alcohol use is among the targets in several global efforts, including the World Health Organization's (2013) action plan, to prevent noncommunicable diseases and the United Nations' Sustainable Development Goals (United Nations Statistics Division, 2019b). In these efforts, alcohol per capita consumption (APC) is used as an indicator to assess progress in meeting goals. APC is a measure of total alcohol consumption (recorded sales + unrecorded consumption) in liters of pure alcohol per adult inhabitant (ages 15 years and older) per year. APC is also used for similar purposes nationally in many countries (e.g., Department of Health–Commonwealth of Australia, 2018; Norwegian Ministry of Health, 2012).

Recently, however, the International Alliance for Responsible Drinking, an organization funded by leading alcohol producers, proposed that two other indicators should replace APC or be added to it as a United Nations' Sustainable Development Goals indicator of harmful alcohol use—prevalence of heavy episodic drinking (HED) and alcohol-related morbidity and mortality—among both adolescents and adults (United Nations Statistics Division, 2019a). The International Alliance for Responsible Drinking argued that (a) APC does not measure alcohol-related harms or patterns of drinking and (b) APC is insufficient on its own to compare between member states because it does not account for the size of the drinking population. Thus, current interest is high to assess the utility and appropriateness of APC as an indicator of harmful alcohol use and its relevance to goals for public health policies.

In this article, we reviewed relevant literature for assessing the validity of APC as an indicator for reducing alcohol-related harm. We first reviewed literature on the association between population-level drinking and harm rates and thereby provide the first overview of such studies since Norström and Ramstedt (2005). We then elaborate on the mechanisms of this connection as well as further reasons for why population consumption matters: the distribution of alcohol consumption and the ensuing association between mean consumption and heavy consumption; whose drinking accounts for most of the alcohol harm; and identification and prevention of alcohol problems through various stages of problem development. Compared with previous reviews, the latter point, which introduces a time dimension, brings a new perspective to the value of reducing APC. In addition, we elaborate on the relationship between APC and the proportion of abstainers and add a new empirical analysis, using recent data from various parts of the world. Last, we review implications for public policy.

Reducing per capita consumption implies reduction of harms from alcohol

Time-series studies offered good evidence about the impact of APC on harms. These were studies in which (e.g., annual or quarterly) changes in APC or in recorded alcohol sales within a jurisdiction were followed for a period and compared to changes in population levels of harm. The types of harm in these analyses were known to be either wholly or partially attributable to alcohol use. In Table 1, we present a summary of findings from time-series analyses of APC and population-level harm, based on previous reviews of the literature (Holmes et al., 2012; Norström & Ramstedt, 2005; Norström & Rossow, 2016; Norström et al., 2002; Room & Rossow, 2001; Rossow & Bye, 2013) and on more recent primary studies. The studies have used data mainly from European and North American countries and examined a broad range of outcomes. Overall, there is empirical evidence of a likely increase in population harm with an increase in total consumption, and vice versa, for various harm indicators: mainly to all-cause mortality as well as cause-specific mortality (e.g., liver cirrhosis, accidental injuries, suicide, and homicide), violent crimes, and in some cases also to cancer mortality and alcohol-related morbidity (Table 1). The strength of the association (i.e., the extent to which a harm rate changes with a 1-L change in APC) varies considerably with the type of harm and is typically larger for harms fully or mainly attributable to alcohol compared with other harms. Of note, no significant associations or a small positive association between APC and ischemic heart disease mortality had been reported, suggesting no cardioprotective effect of alcohol at the population level (Kerr et al., 2011; Norström et al., 2002).

[COMP: Table 1 about here]

In several projects, the impact of APC on mortality rates was estimated for a set of countries or jurisdictions, allowing for comparisons of “harm per liter” estimates across countries, drinking cultures, and genders. The European Comparative Alcohol Study was the first larger study of this kind (Norström, 2002), and similar studies using the same methodology were later conducted for Canadian provinces (Norström & Ramstedt, 2005), states in the United States (Kerr et al., 2011), seven Eastern European countries (Bye, 2008; Landberg, 2008), and for smaller groups of countries and specific outcomes (e.g., Kerr et al., 2000; Lenke, 1990; Norström, 1988). Overall, results from these comparisons suggest that more harm per liter is experienced in regions or cultures characterized by a more hazardous drinking pattern (Norström & Rossow, 2016; Norström et al., 2002). Moreover, there is a tendency for effect estimates to be larger (and more often statistically significant) for men than for women, which can be due to APC being dominated by men’s alcohol use (Mäkelä et al., 2006). To illustrate how such associations translate to public health, Sweden can be used as an example (Holder et al., 2008): With an adult population of about 7 million people, an increase in APC of 1.4 liters was estimated to lead to 700 additional deaths, 6,700 additional police-reported assaults, and more than 7 million additional sickness absence days per year.

The literature on APC and various harms is large, and study findings vary. Table 1 shows positive and statistically significant associations between APC and population harm for a substantial fraction of jurisdictions under study, but not all. The time-series analyses have typically applied a filtering technique to account for unmeasured confounders, leading to large standard errors and increased risk that causal relationships of substantive importance are not statistically significant (Skog, 1993). One countermeasure to this problem is pooling of estimates from several countries/jurisdictions (Norström & Skog, 2001; Norström et al., 2002). Another approach is to use time series with large variation in APC, as illustrated by data from Denmark, where consumption dropped by almost 80% during World War I (Skog, 1993). With both approaches, even small effect estimates are often statistically significant (Norström et al., 2002; Skog, 1993).

For harms connected to the acute effects of alcohol (e.g., accidents and violence), the association between APC and harm rates is typically found to be immediate. Chronic harms from long-term heavy drinking may take years to develop. Yet, most studies on cirrhosis mortality find not only lagged effects but also immediate effects of a change in APC, which is explained by a “reservoir” effect (Holmes et al., 2012).

The association between APC and population-level harm has also been studied using beverage-specific data, with spirits implicated more often than other beverages. However, the interpretation of these results is far from simple (Mäkelä et al., 2011).

In time-series analyses, recorded alcohol sales are generally used as a proxy measure for APC (Norström & Mäkelä, 2019). In many jurisdictions, particularly in low-income countries, unrecorded consumption accounts for a large fraction of APC (Rehm et al., 2016), and recorded alcohol sales can hence be deemed a poor indicator of total consumption (Stickley et al., 2009).

In some cases, unrecorded consumption has been accounted for in the analyses of APC and alcohol-related harms (Norström & Mäkelä, 2019), suggesting that the effect of recorded consumption on harm rates was similar to the effect of unrecorded consumption. However, even a true impact of alcohol on population-level harms is difficult to demonstrate, if only recorded consumption is known and a large unmeasured part of consumption has a different trend.

Sometimes, it is argued that policies based on per capita consumption are flawed, on the basis that cross-sectional comparisons of countries do not always show a connection between per capita consumption and harm rates, or between alcohol policy strictness and harm rates (Poikolainen, 2016). However, even when a causal relationship between population drinking and harm exists, such cross-sectional correlations are not necessarily expected, as the recorded level of a harm outcome depends on many other factors, such as quality of medical care and drinking patterns. The importance of this was illustrated by Ramstedt (2002). Across 14 European countries, there was no cross-sectional correlation between APC and alcohol-related mortality. However, when the countries were grouped to three categories of drinking pattern, a clear connection between APC and alcohol-related mortality emerged in each group.

As illustrated above, there is a fairly consistent pattern of substantial effects of population drinking on rates of alcohol-related harm. This suggests that strategies effective in reducing per capita consumption may have an important impact on public health and welfare. We next turn to the question of what explains the associations between drinking and harms at the population level.

Heaviest drinkers are most at risk, but much alcohol harm stems from “ordinary” drinkers

In epidemiological studies, the risk of harm from drinking is described as risk curves, in which the risk of a specific type of harm is plotted against a measure of an individuals’ alcohol consumption (e.g., in grams of pure alcohol per day). These risk curves have been depicted for a large number of outcomes, and they typically illustrate that the more a person drinks, the higher is the risk of harm (Rehm et al., 2017; Sherk et al., 2017).

The shape of these risk curves, however, is different for various types of harms and can broadly be categorized into three types: curvilinear, linear, and accelerating (Rehm et al., 2017; Sherk et al., 2017). The curvilinear risk curve illustrates a seeming protective effect of small/moderate amounts of alcohol (e.g., for cardiovascular diseases and diabetes), and the accelerating risk curve indicates that the risk is greatly elevated only at relatively high consumption levels (e.g., for alcoholic liver cirrhosis). However, for many types of harms, including accidents and cancers, and also for all health loss combined, the risk curve is linear and thus the risk is elevated already at low consumption levels (Griswold et al., 2018; Rehm et al., 2017; Sherk et al., 2017). This suggests that when considering all health and social harms from alcohol, there is no “safe” amount, and most drinkers are at some risk of experiencing some kind of harm from their drinking.

For the sake of simplicity, the individuals with highest consumption levels could be denoted as *heavy drinkers* and the other drinkers as *ordinary drinkers.* For harms with a linearly increasing risk curve, much of the harm has been shown to be attributable to the large majority of ordinary drinkers (Danielsson et al., 2012; Rossow & Romelsjö, 2006; Rossow et al., 2013; Skog, 1999b). Given the linear risk curve also for all health loss combined (Griswold et al., 2018), ordinary drinkers account for a large part of the overall health loss because of alcohol. Considering social harms and third-party harms from drinking, the literature seems sparse, but similar lines of reasoning are likely to apply. Some of these harms are connected mainly to HED occasions among ordinary drinkers (e.g., physical assaults, quarrels) (e.g., Rossow & Romelsjö, 2006), whereas other harms (e.g., severe financial problems) are more likely to stem from the smaller group of heavy drinkers. Thus, health and social harms from drinking are, to a varying extent, attributable to the drinking by ordinary drinkers as well as to that by heavy drinkers. This is one explanation why reduced alcohol consumption among both ordinary and heavy drinkers will reduce the overall level of harm in society and is thus a partial explanation why we observe an effect of APC on population-level harms.

Although we have contrasted heavy drinkers and ordinary drinkers for argument's sake, there is actually no clear distinction between heavy drinkers (or people with alcohol use disorder) and other drinkers. We will address this in more detail in the following.

The population mean predicts the number of deviant individuals

This heading is taken from the title of a classic article by Rose and Day (1990). They found that, for various health risk factors, such as blood pressure or body mass index, there is a strong association between the population mean of that risk factor and the prevalence of "cases," that is, people with a problematically high value of that risk factor. This finding implied that "distributions of health-related characteristics move up and down as a whole: the frequency of 'cases' can be understood only in the context of a population's characteristics." (p. 1,031). This applied also for alcohol.

The distribution of alcohol consumption in a population has a relatively fixed shape across populations: it is smooth and skew, with a long right tail (Kehoe et al., 2012). The skew distribution of consumption has been explained as resulting from interactions between individual predisposing factors (including genetics) and societal factors (including availability of alcohol socially and physically) (e.g., Braeker & Soellner, 2017; Skog, 1985). The skew distribution implies that the small fraction of drinkers who drink most heavily account for a disproportionately high fraction of total consumption. For instance, in Australia, the heaviest drinking 10% of the population drank more than half of all alcohol consumed (Livingston & Callinan, 2019).

The smoothness of the distribution means that there is no clear distinction between heavy or dependent drinkers and other drinkers, irrespective of where we choose to set the cut-off between “heavy” and other drinking (Johnstone & Rossow, 2009). A small fraction of a population will meet the criteria for alcohol use disorder and can, in that regard, be separated from other drinkers. However, alcohol use disorder is no longer considered a single entity but is categorized by degree of severity, from mild to severe. Rehm and colleagues (2013) even suggested that heavy alcohol use over time could be used as a definition of alcohol use disorder, which also implies no sharp distinction between alcohol use disorder and other heavy drinkers. Correspondingly, genetic factors affect the risk of heavy alcohol use, alcohol use disorder, and alcohol dependence (Liu et al., 2019; Sanchez-Roige et al., 2018) but as a continuum, in a relatively linear fashion (Kiiskinen et al., 2019).

The relatively fixed shape of the distribution, often referred to as “the distribution of consumption model” (Room & Livingston, 2017), has been observed in widely varying populations and drinking cultures (Kehoe et al., 2012; Rossow & Clausen, 2013; Skog, 1985). Kehoe and colleagues (2012) found that alcohol consumption distribution in all 66 countries they studied was relatively well captured by a gamma distribution and that the distribution could be estimated using the mean consumption among drinkers.

Several studies have shown that the close connection between mean consumption, consumption distribution, and prevalence of heavy drinking pertains also to within-country changes over time (Brunborg et al., 2014; Gomes de Matos et al., 2015; Norström & Svensson, 2014; Raninen et al., 2014; Rossow et al., 2014). All these studies show that when mean consumption changes, so does consumption at low, medium, and high levels, implying that a change in mean consumption is not alone the result of a change in heavy drinking—or that heavy drinkers would not change along with others. Changes in APC, therefore, typically occur as collective changes where the whole distribution of drinkers "tends to move up and down the scale of consumption" (Skog, 1985, p. 97). In other words, when policies or cultural change affect APC, it is typically the whole distribution that is affected, and this is the mechanism that causes the proportion of heavy drinkers to follow changes in APC. It should be noted, however, that these are not hard laws but empirical observations of what has happened. Therefore, exceptions are also reported, such as polarization in younger British male cohorts (Holmes et al., 2019), and sometimes APC and harms may have different trends (see Raninen & Livingston, 2020). As Skog (2001) pointed out, collectivity is one mechanism affecting population alcohol consumption but not the only one, and if strong enough, those other factors could completely override the collective pull.

What causes the aforementioned connection between mean consumption and heavy drinkers and other groups of drinkers? Skog (1980, 1985) developed and showed empirical evidence for a sociological theory of the distribution of alcohol consumption. Through social interaction, each individual's drinking behavior is indirectly or directly affected by others, and therefore drinking groups tend to behave collectively, with parallel changes in drinking among drinkers at all consumption levels.

One type of critique on Skog's theory has arisen from the observation that population subgroups have moved in different directions in their alcohol use—that is, not collectively. These include the recent decline in adolescent drinking in various countries concurrent with stable or increasing overall consumption (Pape et al., 2018), the divergent trends in drinking of the Black and White populations of the United States, and the diverging trends in alcohol consumption in northern and southern Sweden (Room & Livingston, 2017). However, Skog's theory predicts that when there are barriers for the diffusion of drinking habits, for instance because of little drinking-related social interaction across subgroups of the population, exceptions from the overall pattern may result (Skog, 2001). Ideally, APC measures would be available separately for all relevant subgroups, whether it is regions, religious groups, ethnicities, or other divisions. Often, however, statistics are available only for the country as a whole. The association between mean consumption, or APC, and harm rates for national populations suggests APC in most cases captures a relevant entity.

The theory of the collectivity of drinking cultures and studies on the consistent pattern of distribution pertain to the population of drinkers, not the whole population of both drinkers and abstainers. In most countries, abstainers constitute a large fraction of the adult population (World Health Organization, 2018), and therefore it is relevant to ask what happens to the proportion of abstainers if APC increases. There are some reported examples that large changes in APC were accompanied by changes in the prevalence of abstainers. In Finland, abstention decreased when APC increased to almost threefold from 1968 to 2008 (Mäkelä et al., 2012). In Russia, abstention increased when APC decreased to almost half in 2003–2016 (Neufeld et al., 2019). In contrast, little change in the proportion of abstainers occurred when APC decreased substantially in Italy from the 1970s to early 2000s (Voller, 2007). To examine this issue further, we retrieved data from 15 countries in which APC changed more than 2 liters from 2010 to 2016 (range: -6.3 to 5.7; Table 2). In 10 of the 15 countries, the pattern concurred with the aforementioned examples from Finland and Russia—that is, the proportion of abstainers changed in the opposite direction compared with the change in APC. In two cases the complete opposite was observed, and in three cases abstinence changed very little. The outcomes probably depend on how close the social interactions between the groups of abstainers and drinkers are and on how immune the motives and reasons for abstinence are to the forces that change APC. Thus, it seems that a change in APC is not always accompanied by a corresponding change in the number of drinkers, although this happens quite often.

[COMP: Table 2 about here]

Focusing only on problem drinkers would mean belated action on problems

It is important to return to the question of problem drinkers and social or “ordinary” drinkers. The view that severe alcohol-related harm stems from identifiable problem drinkers is so widely held among laymen and even policymakers that it cannot be dismissed without consideration. One relevant viewpoint to this has to do with the time dimension and stages of problem development.

It takes a long time to develop serious alcohol problems. When people envision a person with severe alcohol-related harm, they often think about people who are in a terminal stage of an illness. For example, Paljärvi and colleagues (2014) looked at employment histories of people who died of alcohol-related causes in middle age. Only one fourth of them worked in the year preceding death; in that year, most of them would likely have been identifiable problem drinkers. However, 17 years before their alcohol-related death, their work participation was at a similar level with the general population. It is likely that the majority of them could not have been identified as future problem drinkers. Effective strategies that reduce drinking in all consumer groups are likely to slow down the pace of drinking careers that would result in severe problems.

In addition, for individuals to take action to avoid future problems, they need to acknowledge the drinking problem themselves. However, most people scoring very high on an alcohol problem screening test can consider themselves moderate drinkers (Warpenius et al., 2018). Universal prevention strategies avoid the problem of requiring self-identification as a problem drinker.

Implications for public health and public policies

The evidence reviewed here is strongly suggestive of public health gains from effective universal policies targeting APC. Taxation, and thereby a higher price on alcoholic beverages, and restrictions on physical availability of alcohol are considered the most effective policies to reduce APC (Babor et al., 2010; Burton et al., 2017). These tools reduce APC by affecting the whole distribution of alcohol consumption, and hence they reduce harms through reducing consumption and risks among both heavy drinkers and ordinary drinkers. Reducing APC is furthermore an investment in future public health, as it is likely an efficient way of reducing the flow from moderate drinking to problem drinking. Some would argue that the connection between APC and heavy drinking or harms is tautological, and that the same impact would be achieved by only focusing on reducing heavy drinking. However, efficient policies that would reduce population-level harms by affecting heavy drinkers only and thus reshaping the distribution of consumption have not been identified.

Geoffrey Rose (2001) argued that population strategies—that is, attempts to lower the mean level of risk factors and shift the whole distribution of exposure—are powerful, with a large potential for public health. An important disadvantage of such strategies, however, is that they "offer small benefit to each individual, since most of them were going to be all right anyway, at least for many years" (Rose, 2001). This argument fits well with Robin Room's notion that, despite their effectiveness, universal alcohol control policies are unpopular and often "politically impossible" (Room, 2003). However, some arguments favoring control policy measures are acceptable even in a libertarian framework: (a) externalities (i.e., the harms from alcohol caused to others than the drinker); (b) the imperfect rationality of heavy drinkers (i.e., they do not necessarily act to what they themselves think is their own best interest); and (c) the fact that even if everyone rationally follows their own best interests, this will not necessarily lead to an optimum outcome for society (Skog, 1999a). An example of the latter is that most people who defended their right to smoke anywhere in the 1980s would not change back to that smoking culture.

When looking for ways to reduce alcohol-related harm without reducing APC, policymakers and the industry would often like to change the drinking culture, that is reduce episodic heavy drinking and thus minimize acute harms. Policymakers in many countries have shared this aspiration. Room (1992) referred to the phenomenon as the "dream of a better society" and Olsson (1990) as "dream of a better order." Tony Blair's 24-hour drinking policy was part of an idea to transform the United Kingdom to a European-style café culture, and in Finland there were great efforts in the 1950s and 1960s to change the spirits and intoxication-centered drinking culture by promoting mild beverages; yet both consumption and harms increased (Mäkelä et al., 1981). According to Room (1992), there has been no research evidence that a drinking culture could be modified on purpose so that consumption would increase and harms would decrease. However, a "softer version" with harms increasing less than consumption has sometimes occurred. Although some strategies are directed at reducing HED in certain contexts (e.g., Responsible Beverage Service in bars, restrictions at sports events), these seem at best to have limited effects within these specific contexts (Babor et al., 2010), and they will likely have no impact on the overall drinking culture. Strategies effective at reducing APC, however, are likely to reduce the number of various types of drinking occasions, including HED occasions, as implied by the evidence on APC and acute alcohol-related harms.

Political feasibility of using universal control policies depends also on the fact that powerful alcohol industries have great interests in how societies try to tackle problems with alcohol. The industry typically opposes the view that levels of harm go hand in hand with levels of consumption. The industry's proposal of an alternative indicator of harmful alcohol use to replace per capita consumption in the United Nations' Sustainable Development Goals (United Nations Statistics Division, 2019a) is a recent example of this. The increasing involvement of the alcohol industry in alcohol policymaking is a recurring problem (Bakke & Endal, 2010; Karlsson et al., 2020; McCambridge et al., 2018). Typically, alcohol industry representatives try to frame alcohol problems as problems of a small minority of problem drinkers (McCambridge et al., 2018). In doing so, the alcohol industry is one among many industries that form "commercial determinants of health" (Kickbusch et al., 2016). It is therefore essential to bring into the public policy debates the current evidence on APC and population harm as well as the strong regularity in the alcohol consumption distribution, so that the misleading picture provided by the commercial interests and other policy actors can be corrected.

Directions for further research

The very limited empirical research from low- and middle-income countries also applies to this topic. Considering also the strong role of the alcohol industry in policymaking in many of these countries (Bakke & Endal, 2010; Caetano & Laranjeira, 2006), there is a need for a more global perspective in the studies of APC and population harm and for studies from other regions and economies than the most affluent. In addition, much of the empirical evidence from

European and North American countries is somewhat dated, and it is important to replicate previous studies with more recent data.

Our understanding of the underlying mechanisms can also be further improved. The literature on social interaction and collective drinking behavior (e.g., Skog, 1980, 1985) needs validation with current data and should be extended with empirical evidence on the connectedness of the drinking worlds of different population subgroups. We also need to understand when and why exceptions to the collectivity of drinking behavior, such as polarization, occur and when and how the population of abstainers does or does not interact with the population of drinkers to change their behavior along with them. Population subgroup differences also in responsiveness to policy changes require further attention. Although further empirical and theoretical developments of the theory of collectivity are still a welcome contribution to the literature, there is sufficient evidence already for policymakers to act on it.

Acknowledgments

The authors are most grateful for valuable comments by Robin Room and two anonymous reviewers on an earlier version of this article.

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TABLE 1. Overview of findings from studies of alcohol per capita consumption and population harm by outcomes and country.

Outcomes	Countries	Pattern of findings[a]	References
All-cause mortality	Western European countries (ECAS)	Positive association in half of 14 countries; positive pooled estimates in three of three regions—stronger in northern as compared with southern European countries	Norström et al., 2002; Norström & Ramstedt, 2005
	Canada	Positive association	Norström & Ramstedt, 2005
	Belarus	Positive association	Norström & Razvodovsky, 2010
	Australia	Positive association	Livingston & Wilkinson, 2013
Alcohol-related mortality, and/or liver cirrhosis	Western European countries (ECAS)	Positive association in 13 of 14 countries for men or women; positive pooled estimates in two of three regions—stronger in northern as compared with southern European countries	Holmes et al., 2012; Norström et al., 2002
	Canada	Positive association	Norström & Ramstedt, 2005
	Australia, Canada, New Zealand, United Kingdom, United States, pooled	Positive association	Norström & Ramstedt, 2005
	Eastern European countries	Positive association	Norström & Razvodovsky, 2010; Holmes et al., 2012
	Finland	Positive association also when accounting for unrecorded consumption	Norström & Mäkelä, 2019
Accidental injury mortality	Western European countries (ECAS)	Positive association in 10 of 14 countries for men or women; positive pooled estimates in three of three regions—stronger in northern compared with southern European region	Norström et al., 2002; Norström & Ramstedt, 2018
	United States	Positive association for men	Ramstedt, 2008

	Eastern European countries	Positive associations, higher for males than females	Landberg, 2010
Ischemic heart disease mortality	Western European countries (ECAS)	Positive association in one country, and for one pooled region for women	Norström et al., 2002
	Canada	Positive association for men	Ramstedt, 2006
	United States	Positive association	Kerr et al., 2011
Suicide mortality	22 countries in Europe and North America	Positive association in half (n = 20) of studies among males, in a third (n = 12) among females; stronger associations in countries with more hazardous drinking pattern	Norström & Rossow, 2016
	Japan	Positive association with spirits sales	Norström et al., 2012
Violence, including homicide and violent assaults	Western European countries (ECAS)	Positive association in half of countries for mostly men; pooled estimates for men significant in three of three regions for men, in one of three for women—stronger in northern compared with southern European countries	Norström et al., 2002
	European regions, Canada, Belarus, Russia, former Czechoslovakia, United States, Australia	Mostly positive associations, stronger in countries/regions with more hazardous drinking pattern	Room & Rossow, 2001; Rossow & Bye, 2013
Cancer mortality	Australia	Positive associations with liver, head, and neck cancer mortality	Jiang et al., 2017
Drink driving	Sweden, Norway	Positive association	Norström & Ramstedt, 2018
Sickness absence	Sweden, Norway	Positive association for men only	Norström, 2006; Norström & Moan, 2009

Notes: ECAS = European Comparative Alcohol Study. [a]Reported associations were statistically significant.

TABLE 2. Overview of alcohol per capita consumption (APC) and rates of current abstainers in 2010 and 2016 by country

Country	APC 2010	% abstainers 2010	APC 2016	% abstainers 2016	Change in APC	Change in % abstainers
Angola	9.0	64.4	6.4	52.3	-2.6	-12.1
Seychelles	6.3	55.8	12.0	45.1	**5.7**	**-10.7**
Uganda	13.2	58.7	9.5	63.7	**-3.7**	**5.0**
Venezuela	8.5	40.9	5.6	62.0	**-2.9**	**21.1**
Azerbaijan	2.9	56.0	0.8	78.1	**-2.1**	**22.1**
Belarus	17.5	20.8	11.2	26.4	**-6.3**	**5.6**
Croatia	11.2	19.5	8.9	40.3	**-2.3**	**20.8**
Kyrgyztan	10.1	61.8	6.2	74.1	**-3.9**	**12.3**
Montenegro	11.0	34.8	8.0	46.0	**-3.0**	**11.2**
Moldova	17.9	33.7	15.2	33.4	-2.7	-0.3
Romania	15.0	32.4	12.6	32.8	-2.4	0.4
Russia	15.8	32.2	11.7	41.6	**-4.1**	**9.4**
Ukraine	14.3	31.7	8.6	38.2	**-5.7**	**6.5**
Laos	7.0	52.1	10.4	60.0	3.4	7.9
Vietnam	4.7	61.7	8.3	63.3	3.6	1.6

Notes: Data retrieved from *Global Status Report on Alcohol for 2010 and 2016* (World Health Organization, 2014, 2018). For countries where changes in APC and proportion abstainers go in opposite directions, these are marked in **bold.**