Hazardous alcohol use and alcohol-related harm in rural and remote communities: a scoping review

Erik Loewen Friesen, Jacob Bailey, Sarah Hyett, Sina Sedighi, Mitchell Lennox de Snoo, Kenneth Williams, Rebecca Barry, Anders Erickson, Farid Foroutan, Peter Selby, Laura Rosella, Paul Kurdyak

Alcohol use is a major risk factor for death and disease worldwide and alcohol-related harms appear to be more prevalent in rural and remote, relative to urban, communities. This Review synthesised international research on rural–urban disparities in hazardous and harmful alcohol use and risk factors for these outcomes within rural and remote communities. 280 studies from 49 countries were included in the Scoping Review. Most studies (60%) found rural, relative to urban, residence to be associated with an increased likelihood of hazardous alcohol use or alcohol-related harm. This proportion increased between 1990 and 2019 and varied by country, age group, and outcome type, being highest in Australia, among young adults, and for more severe alcohol-related harms, such as drink driving and alcohol-related suicide. Improved public health strategies to reduce the burden of alcohol use in rural communities are required but their efficacy will depend on how well they are tailored to the unique needs of the region they are implemented in.

Lancet Public Health 2022; 7: e177–87

Published Online November 10, 2021 https://doi.org/10.1016/S2468-2667(21)00159-6

Institute for Health Policy, Management and Evaluation (E L Friesen MSc, L Rosella PhD, Prof P Kurdyak PhD), **Temerty Faculty of Medicine** (E L Friesen, J Bailey BHSc, S Hyett MSc, M L de Snoo MSc, K Williams MSc, A Erickson BSc, Prof P Selby MD, L Rosella), **Dalla Lana School of Public Health** (R Barry, Prof P Selby, L Rosella), **University of Toronto, Toronto, ON, Canada; Centre for Addiction and Mental Health, Toronto, ON, Canada** (E L Friesen, R Barry MSc, Prof P Selby, Prof P Kurdyak); **ICES, Toronto, ON, Canada** (E L Friesen, L Rosella, Prof P Kurdyak); **Faculty of Medicine, Dalhousie University, Halifax, NS, Canada** (S Sedighi BScN); **Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, ON, Canada** (F Foroutan PhD); **Institute for Better Health, Trillium Health Partners, Mississauga, ON, Canada** (L Rosella)

Correspondence to: Mr Erik Loewen Friesen, Institute for Health Policy, Management and Evaluation, University of Toronto, Toronto M5T 3M6, ON, Canada
erik.friesen@mail.utoronto.ca

See Online for appendix

Introduction

Alcohol use is a leading cause of morbidity and mortality worldwide, causing short-term harms associated with acute intoxication and long-term harms associated with chronic overuse.[1–4] There is substantial geographical variation in alcohol use and alcohol-related harm, both between and within countries, driven by a complex combination of region-specific demographic, social, cultural, and economic factors, including local drinking norms.[1,4] Understanding the extent and causes of this geographical variation is important from a public health standpoint as it informs the development and implementation of regionally tailored public health strategies to reduce the extensive health burden of alcohol use.[5]

A substantial amount of research has been done on understanding how alcohol use and alcohol-related harms vary between rural and urban communities.[6,7] This research has, in general, indicated that hazardous alcohol use and alcohol-related harms are more prevalent in rural or remote communities relative to urban communities.[6] Importantly, however, some studies have found the opposite association and other studies have found little to no difference between rural and urban populations.[7] The reasons for these differences between studies are not always evident, and, in turn, the association between rurality, alcohol use, and alcohol-related harm is incompletely understood. Very few reviews have been done on rural alcohol research. Indeed, only two reviews on this topic have been published in the past decade, and both restrict their scope to a single country (Australia[6] for one review and the USA[7] for another). A comprehensive understanding of rural alcohol use research is missing, and, without a clear sense of the gaps in literature that need to be addressed, capacity to develop novel research questions to advance understanding of this topic is limited, and undermines policy makers' ability to create alcohol regulation policies that are tailored to the unique complexities of rural and remote environments.

To address this issue, this Scoping Review synthesises the international literature on hazardous alcohol use and alcohol-related harm in rural and remote communities. We considered studies that evaluated disparities in hazardous alcohol use and alcohol-related harm between rural, remote, and urban communities, and those that examined factors associated with these outcomes within rural and remote communities. This approach aligns with a larger goal of developing regionally tailored, evidence-based public health strategies to reduce the burden of alcohol-related harm in rural and remote communities, which not only requires understanding if hazardous alcohol use and alcohol-related harms vary between rural and urban communities, but also why these differences exist, such that modifiable risk factors can be targeted, and high-risk subpopulations can be prioritised.

Methods

Study design

This Scoping Review adhered to the six-stage method developed by Arksey and O'Malley,[8] Levac and colleagues,[9] and the Joanna Briggs Institute,[10] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist (appendix p 1).[11] The methods for this Scoping Review are described in depth in a previously published protocol,[12] and summarised here.

Our aim was to find what literature exists on the factors that modify the prevalence or risk of either hazardous alcohol use or alcohol-related harm in communities defined as rural or remote. Factors referred to any variable associated with these outcomes, including rural or remote, relative to non-rural or non-remote, residence itself. In turn, we sought to identify two types of study: (1) those evaluating if rural or remote residence, relative to non-rural or non-remote (eg, urban) residence, is associated with hazardous alcohol use or alcohol-related harm (hereafter referred to as rural–urban comparison studies); and (2) those evaluating variables associated with hazardous alcohol use or alcohol-related harm

within communities defined as rural or remote (hereafter referred to as rural risk factor studies).[12]

Outcomes and definitions

Within these studies, only those that evaluated hazardous alcohol use or alcohol-related harm were included. Hazardous alcohol use, alternatively phrased as heavy or high-risk alcohol use, refers to patterns of alcohol use associated with a clinically meaningful increase in the risk of alcohol-related harm, whereas alcohol-related harm refers to the harmful outcomes caused by alcohol use. Studies evaluating lower risk patterns of alcohol use such as abstinence or low volume, and occasional drinking were excluded. This decision aligned with our objective to understand the health burden of alcohol use in rural and remote communities. Although any amount of alcohol consumption is associated with some risk of harm,[1] low-risk alcohol use has, by definition, a low or negligible effect on downstream health outcomes.[13] Nonetheless, the line between low risk and hazardous alcohol use is debated and varies between global regions.[14] Therefore, if uncertainty existed as to whether the alcohol use described in a given study met the threshold of hazardous use, the study was not excluded on this criterion. Examples of hazardous alcohol use outcomes that were included and low-risk alcohol outcomes that were excluded are described in the appendix (p 3). Alcohol-related harms were defined as harms 100% attributable to alcohol use,[2] and studies that evaluated harms partially attributable to alcohol use were excluded (appendix p 3).

For studies that evaluated differences in hazardous alcohol use or alcohol-related harm between rural or remote and urban communities, a definition of rural or remote and urban was required to facilitate comparisons between studies. Any rural definition was sufficient (including, for example, self-reported rural or urban residence), so long as it provided enough information to understand how rural and urban populations were differentiated from each other.

Search strategy and selection criteria

We searched MEDLINE, PsycInfo, Embase, CINAHL, and Sociological Abstracts on Dec 5, 2019, using search strategies described in the study protocol and provided in the appendix (pp 5–7).[12] Identified studies were downloaded into EndNote (version X9) and uploaded to Covidence systematic review software for study selection. Study selection was done by a team of nine reviewers and occurred in two stages, which consisted of title and abstract followed by full-text screening. In each stage, two reviewers independently reviewed each study against a set of pre-specified inclusion and exclusion criteria to determine whether it should move forward. Disagreements were resolved via discussion, or, in the case of no consensus, a third reviewer was involved. The inclusion and exclusion criteria are fully explained in the study protocol and were operationalised as a study eligibility form (appendix p 8) for title and abstract and a decision tree (appendix p 9) for full-text screening. Cohen's Kappa and percent agreement were calculated for both stages.[15]

Studies were not excluded based on language or country. Studies published in a language other than English were translated using the language skill available within our research group. The included non-English studies (n=8) are indicated in the appendix (p 33). Due to the dynamic nature of rural definitions and substance use through time, studies were excluded if they were published before Jan 1, 1990. Several reviews on rural alcohol use were published in the early 1990s, and we direct the reader to these publications for information on rural alcohol use before 1990.[16,17] Reviews, commentaries, and dissertations were excluded; however, primary, peer-reviewed research was not restricted on the basis of methodological design, and quantitative, qualitative, and mixed-methods research was included.

Data extraction

Data from included studies were independently extracted by reviewers into a pre-tested Microsoft Excel (version 2010) sheet developed collaboratively by the research team to capture all relevant information. The complete data extraction has been provided in the appendix (p 33). To facilitate sorting and interpretation of the extracted data, key variables were grouped into thematic categories (appendix p 10). These variables included age group, rural–urban comparison, and outcome. Briefly, age group referred to the age structure of the study population and was categorised as child (younger than 12 years), youth (12–17 years), young adult (18–24 years), adult (22–55 years), older adult (older than 55 years), and entire population (ie, population-based study with no age restrictions). Rural–urban comparison referred to whether a study found hazardous alcohol use or alcohol-related harm to be more prevalent or probable in rural communities, urban communities, or the same between rural and urban communities. Outcomes were divided into ten categories: three hazardous alcohol use categories, including acute intoxication (eg, binge drinking and drunkenness), chronic hazardous alcohol use (eg, daily drinking, long-term drinking above low-risk guidelines, and Alcohol Use Disorders Identification Test [AUDIT] scores above a defined threshold), and alcohol use disorder (a clinical diagnosis), and seven alcohol-related harm categories including alcohol use during pregnancy, drink driving, alcohol-related mortality (ie, non-suicide), alcohol-related suicide, alcohol-related health service use, alcohol-related crime, and other alcohol-related harms.

Results

Characteristics of identified studies

A PRISMA flow diagram for study selection is presented in the figure. 12 005 eligible articles were identified after duplicates were removed, of which 11 192 were excluded

during title and abstract screening (93·8% agreement, κ=0·67) and 543 articles were excluded during full-text screening (90·4% agreement, κ=0·79). Ten articles were included after searching the reference lists of included studies and excluded reviews, resulting in the inclusion of 280 articles (appendix pp 15–32).

49 countries were represented, with the USA (n=113 studies), Australia (n=38), South Africa (n=15), India (n=14), and Canada (n=11) being the top five contributors (appendix p 12). More studies assessed risk factors for hazardous alcohol use and alcohol-related harm in rural and remote communities (n=144) than compared these outcomes between rural and urban communities (n=126; appendix p 13). 17 rural–urban comparison studies also assessed risk factors for hazardous alcohol use and alcohol-related harm. The annual number of either type of article increased from approximately 0–5 per year in the early 1990s to approximately 15–20 per year in the late 2010s (appendix p 13).

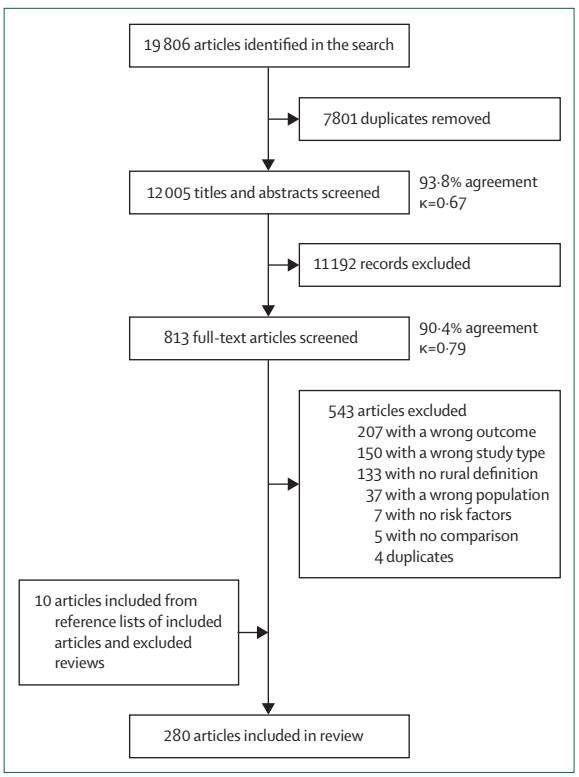

Figure: **PRISMA flow diagram of study selection**

Rural–urban differences in hazardous alcohol use and alcohol-related harm

Many data types and statistical methods were used to compare hazardous alcohol use and alcohol-related harm between rural and urban communities. Due to the nature of this Scoping Review, which did not exclude studies based on methodological design, the intent was not to meta-analyse these results but to generally understand whether the prevalence, rate, and hazard of the outcome was higher in rural communities versus urban communities, urban versus rural communities, or if no rural–urban difference was observed. Of the 126 rural–urban comparison studies, 59·5% (75 of 126 studies) found these outcomes to be more likely in rural communities, 17·5% (22 of 126) found them to be more likely in urban communities, and 13·5% (17 of 126) found no difference between rural and urban communities (appendix p 13). 9·5% (12 of 126) showed a more complex association between rurality, hazardous alcohol use, and alcohol-related harm (appendix p 13), such as opposing associations between rurality and outcomes between sexes, age groups, time-periods, or outcome types. Between 1990 and 2019, the cumulative proportion of studies showing hazardous alcohol use and alcohol-related harm to be more probable in rural, relative to urban, communities increased (appendix p 13), suggesting that the rural–urban disparity in hazardous alcohol use and alcohol-related harm could have increased over time.

Rural–urban comparison studies most commonly came from North America, namely the USA, and studied chronic hazardous alcohol use in adult populations (appendix p 14). There was marked variability between continents, countries, age groups, and outcome types in the proportion of studies that found hazardous alcohol use or alcohol-related harm to be more probable in rural, relative to urban, communities. In terms of geographical region, this proportion was highest in Oceanic countries (namely Australia) and lowest in Asian countries (namely China and India), with North American, European, African countries falling in between (appendix p 14). One rural–urban comparison was done in South America in Peru, which found no difference in self-reported heavy drinking between rural and urban populations.[18] In terms of age group, this proportion was highest in younger age groups and decreased stepwise in older age groups (appendix p 14). Finally, in terms of outcome type, this proportion was higher among studies that evaluated alcohol-related harms than those studies that evaluated hazardous alcohol use (appendix p 14).

Risk factors for hazardous alcohol use and alcohol-related harm in rural and remote communities

Within the studies that evaluated variables associated with hazardous alcohol use and alcohol-related harm in rural and remote communities, 55 unique variables were identified. Each variable, alongside the outcome it was associated with and the study or country it was identified in, are listed in the appendix (pp 34–48). The direction and magnitude of the association between these variables and specific outcomes varied between studies, countries, and outcome types; however, several consistent risk factors for hazardous alcohol use and alcohol-related harm were observed across these strata. These risk factors included male sex, having less

relative to more education, smoking, having family members or friends who drink alcohol, living in a less supportive or stable household as a child, being single, unmarried, divorced, or widowed, having a mental illness, having a history of arrest or incarceration, having experienced abuse or trauma as a child or adult, and having less or no religious involvement (appendix pp 34–48). Early age of onset of alcohol use and high volumes or frequency of alcohol use were consistently associated with alcohol use disorder, drink driving, and other alcohol-related harms in rural and remote communities.

The association between age and rural alcohol outcomes was more complex, whereby studies among children and youth generally found that older age was associated with an increased likelihood of hazardous alcohol use and alcohol-related harm, and studies among adults generally found the opposite. Together, this finding indicated that young adults, relative to either older adults or younger adolescents, were most likely to

	Number of rural–urban comparison studies	Proportion of studies rural>urban*	Study numbers†	Number of rural risk factor studies	Top predictors‡	Study numbers†
USA						
Acute intoxication	22	0·64	4, 8, 9, 12, 26, 29, 30–33, 36, 41, 44, 61, 66, 70, 83, 89, 96, 108, 118, and 119	23	Sex, factors regarding alcohol use, factors regarding family (eg, parental or sibling alcohol use, stability), peer alcohol use, and personality traits	4, 9, 31, 129, 131, 142, 143, 154, 157, 164, 174, 177, 196, 197, 205, 209, 214, 244, 246, 259, and 265
Alcohol use disorder	12	0·75	2, 14, 17, 24, 33, 37–39, 81, 87, 95, and 119	15	Sex, race and ethnicity, drug use, and trauma	128, 144, 169, 173, 176, 181, 216, 223, and 226
Chronic hazardous alcohol use	27	0·41	8, 9, 10, 11, 14, 21, 31, 33, 36, 39, 42, 43, 44, 47, 52, 65, 66, 67, 75, 77, 78, 89, 96, 100, 104, 118, and 119	29	Sex, factors regarding family, and age	8, 9, 14, 31, 75, 104, 129, 134, 138, 139, 141, 149, 150, 155, 159, 164, 173, 181, 183, 189, 193, 196, 211, 215, 251, 255, 256, 260, and 261
Alcohol-related crime	0	..	..	0	..	..
Alcohol-related mortality	2	1·00	6 and 122	2	Community type, and race and ethnicity	127 and 146
Drink driving	13	0·77	8, 11, 26, 29, 30, 42, 44, 47, 50, 66, 90, 115, and 117	11	Age, factors regarding alcohol use, drug use, and sex	26, 50, 130, 137, 138, 197, 214, 221, and 228
Alcohol-related harm (other)	5	0·80	41, 87, 89, 121, and 122	11	Family factors, sex, factors regarding alcohol use, and education	150, 157, 198, 216, and 265
Drinking during pregnancy	2	0·50	6 and 82	0	..	..
Alcohol-related service use	2	0·50	17 and 93	8	Age, factors regarding alcohol use, criminality and law enforcement, health service use, mental illness, occupation employment, physical pain, and trauma	93, 133, and 156
Alcohol-related suicide	1	1·00	63	0	..	..
Australia						
Acute intoxication	1	1·00	80	7	Age, alcohol outlet density, immigration status, occupation employment, race and ethnicity, and socioeconomic status	231 and 258
Alcohol use disorder	0	..	..	0	..	..
Chronic hazardous alcohol use	8	0·88	40, 46, 67, 69, 74, 88, 92, and 113	18	Sex, family factors, and marital status	46, 88, 166, 171, 203, 217, 220, and 231
Alcohol-related crime	1	1·00	64	7	Timing, age, alcohol outlet density, health care infrastructure, the place that alcohol is used, socioeconomic status, and sex	64, 186, and 206
Alcohol-related mortality	1	1·00	98	1	Community type	152
Drink driving	5	0·80	15, 58, 98, 102, and 106	0	..	..
Alcohol-related harm (other)	1	1·00	113	4	Sex, age, and race and ethnicity	161, 179, and 247
Drinking during pregnancy	1	1·00	60	7	Smoking, age, immigration status, obesity, pregnancy factors, race and ethnicity, and community type	60, 158, 238, and 254
Alcohol-related service use	2	1·00	16 and 60	6	Timing, age, community type, health service use, the place that alcohol is used, and sex	152, 186, 207, and 233
Alcohol-related suicide	0	..	..	0	..	..

(Table 1 continues on next page)

	Number of rural–urban comparison studies	Proportion of studies rural>urban*	Study numbers†	Number of rural risk factor studies	Top predictors‡	Study numbers†
(Continued from previous page)						
India						
Acute intoxication	2	0·00	53 and 109	1	Sex	263
Alcohol use disorder	2	0·00	34 and 53	3	Age, education, and occupation and employment	232 and 252
Chronic hazardous alcohol use	3	0·33	25, 53, and 109	11	Education, socioeconomic status, alcohol use factors, and mental illness	148, 194, 237, 248, and 253
Alcohol-related crime	0	..	..	0	..	..
Alcohol-related mortality	0	..	..	0	..	..
Drink driving	0	..	..	0	..	..
Alcohol-related harm (other)	2	1·00	91 and 99	0	..	..
Drinking during pregnancy	0	..	..	0	..	..
Alcohol-related service use	0	..	..	0	..	..
Alcohol-related suicide	0	..	..	0	..	..

*Based on the rural–urban comparison categories used for figure 2 (p 13) and figure 3 (p 14) in the appendix. †Study numbers for reference to appendix (p 33) and appendix (pp 34–48). ‡Top three most common predictor variables associated with the outcome in rural risk factor studies. In the case of a tie for 3rd, all tied variables are listed. Additional information available in the appendix (pp 34–58).

Table 1: **Rural–urban comparisons and risk factors by country and outcome**

engage in hazardous alcohol use or experience alcohol-related harm in rural communities, which is a finding echoed in several individual population-based studies, such as in the study by Stickley and Razvodovsky.[19]

The association between race and ethnicity and hazardous alcohol use and alcohol-related harm in rural communities was complicated by regional variation in the races and ethnicities included, and regional differences in structural and systemic barriers and sociocultural histories of racism and colonialism. For example, indigeneity was explored as a risk factor for alcohol-related harm in studies from Canada, Australia, USA, and Taiwan. While Indigenous Nations globally share experiences of colonisation and racism, they are nonetheless hugely diverse and defining them under a single racial identifier would be inappropriate. Therefore, we encourage the reader to consider each of these studies on race and ethnicity within their own historical and sociological context.[20–39]

Rural relative to urban residence was not universally associated with an increased likelihood of harmful alcohol use. Building on this finding, the community that one lived in was another commonly identified risk factor for negative alcohol-related outcomes, indicating that, even within rural regions, there is substantial variability in the likelihood of hazardous alcohol use and alcohol-related harms. Risk factors for hazardous alcohol use and alcohol-related harm, the specific outcomes they were related to, and the methods that were used to identify them also varied between rural communities from different geographical regions, indicating that caution should be taken in generalising risk factors between geographical or sociocultural contexts (appendix pp 34–48). Using income as an example, Boyd and colleagues[36] found that low income (defined as making less than US$20 000 per year) was associated with an increased prevalence of alcohol-related problems (measured with the Michigan Alcoholism Screening Test) in a rural US population using an unadjusted ANOVA, whereas Yeung and colleagues[40] found that higher monthly income was associated with an increased odds of alcohol use disorder (measured with the AUDIT-C questionnaire) in a rural Cambodian population using a multivariable adjusted logistic regression model.

These differences make it challenging to form generalised conclusions about risk factors for hazardous alcohol use and alcohol-related harm in rural communities between different regions. Therefore, to facilitate an understanding of the complex region-specific risk factors for hazardous alcohol use and alcohol-related harm, table 1 (also available as an interactive map [appendix p 1] and continued for all countries in appendix pp 49–61) outlines the variables that have been associated with specific outcomes in rural communities within each country and indicates the studies in which these associations were identified, so that the methods and study populations for each finding can be easily identified in the quantitative extraction sheet (appendix p 33). These data are presented alongside rural–urban comparison results, such that risk factors can be contextualised within the rural–urban disparity that exists for that outcome in each country.

The tables allow for rural–urban disparities and risk factors for specific outcomes within rural communities to be evaluated and compared between countries, and for gaps in knowledge to be easily identified. As an illustrative example using table 1, in the USA, 77% of

studies on drink driving found that it was more prevalent in rural, relative to urban, communities, and age, alcohol use behaviours, concurrent drug use, and sex were identified as key variables associated with drink driving in rural American communities. In Australia, however, although 80% of studies on drink driving found that it was more probable in rural, relative to urban, communities, no studies specifically evaluated risk factors for drink driving in rural populations. Furthermore, in India, no rural–urban comparison or rural risk factor studies on drink driving were identified, indicating several, country-specific avenues of future research.

Finally, many of the variables that were associated with hazardous alcohol use and alcohol-related harm in rural and remote communities are known risk factors for alcohol-related harm more generally. To understand the risk factors specific to rural communities, we subsequently reviewed the rural–urban comparison studies that concurrently evaluated variables associated with hazardous or harmful alcohol use. These studies are unique in that they contain both rural and urban subgroups, and, in turn, provide an opportunity to do internal comparisons of how the direction or magnitude of an association varies between rural and urban populations. 17 studies of this type were identified; however, as above, interstudy differences in study populations and methodological design made it challenging to make head-to-head comparisons (table 2).[28,29,41–55] Despite this, multiple studies corroborated that male sex, family instability, and low education level were more strongly associated with hazardous and harmful alcohol use in rural areas compared with urban areas. Furthermore, two Australian studies found that alcohol-related harms (eg, drink driving and alcohol-related violence) were more likely to occur earlier in the evening and after drinking at private residences (compared with licensed establishments) in more remote, relative to more urban, settings.[50,54]

Qualitative research

Ten qualitative studies were identified, all of which focused on hazardous alcohol use within rural and remote communities, and not one evaluated rural–urban differences in hazardous alcohol use or alcohol-related harm (appendix p 33). Each study was markedly different in its tone, purpose, and study population, which, overall, illustrated the heterogeneity in alcohol use behaviours that exist between rural communities around the world. Despite this heterogeneity, however, some common themes emerged.

The most consistent theme identified was a centrality of alcohol use to rural culture. Participants from multiple studies, who came from notably different countries and age groups, described that it can be difficult to stop drinking alcohol or abstain from drinking due to the so-called social benefits associated with alcohol use in rural communities, such as feelings of inclusion and community support, or the importance of alcohol to participation in community events. In several studies, hazardous alcohol use was described as expected of rural community members, and that abstinence could lead to social isolation. A participant from a US study also noted that, although the social pressures to drink can exist in both rural and urban communities, hazardous drinking practices, such as drink driving, become increasingly common and normalised with increasing rurality.[56] However, hazardous drinking was not always related to rural expectations or pressures. In a study of rural Australians, participants indicated that adolescent binge drinking was more related to exploration and having fun than to peer or community pressures.[57]

Study participants also discussed an awareness of the negative effects of hazardous alcohol use, including poor health outcomes, financial instability, or negative social effects, such as judgment from peers and other community members. In a study by Sundararajan and colleagues done in Uganda,[58] this awareness contributed to a conflict between the social benefits of alcohol use and its negative repercussions, which culminated into variable, binge–abstinence patterns of alcohol use. A somewhat similar cognitive dissonance was described by Greene and colleagues,[56] in which young adults in the USA felt a simultaneous pressure to engage in high-risk alcohol use but to never appear drunk, as drunkenness could be interpreted as a sign of weakness by other community members, including peers and parents. This internal conflict led some participants to drive after drinking so as not to appear as though they were drunk. Of note, however, drink driving in this study was also related to a shortage of transportation options and police enforcement in rural communities, indicating the multifactorial nature of the problem.

Definitions of rurality

Many different definitions of rurality were identified. These differences were most pronounced between countries, but also existed within them. In rural–urban comparison studies, most definitions focused on population size, or distance to the nearest health services or urban centres. Among those focusing on population size, many different cutoff values (<2500–100 000 inhabitants) were used to delineate rural from urban communities. Other studies went beyond dichotomous definitions, instead creating multiple categories along a rural–urban continuum. The additional detail the multiple categories provided often showed a more complex association between alcohol outcomes and rurality not captured by dichotomous rural-to-urban comparisons. For example, Roxburgh and colleagues[59] divided their study population into metropolitan, inner regional, outer regional, and remote groups using Accessibility-Remoteness Index of Australia scores, and found that the odds of risky alcohol use (ie, binge drinking) were significantly higher in the inner regional group relative to the metropolitan group,

	Study number*	Country	Age category†	Outcome category	Main finding‡
Booth et al (1999)[41]	14	USA	Adult	Chronic hazardous alcohol use	Rural problem drinkers had lower incomes and less education compared with urban problem drinkers
Booth et al (2000)[42]	17	USA	Adult	Alcohol use disorder	Rural at-risk drinkers had lower incomes, less education (lower % high school graduate), more chronic physical and mental health problems, and lived further away from residential addiction treatment and mental health services than urban at-risk drinkers
Kim et al (2002)[48]	18	South Korea	Older adult	Alcohol use disorder	Not having had an education reduced the odds of alcoholism in urban men but increased the odds of alcoholism in rural men
Shaffer et al (2004)[43]	23	Kenya	Adult	Chronic hazardous alcohol use	Men were more likely than women to report hazardous drinking. This sex disparity was larger in the rural, relative to the urban, subgroup.
Shears et al (2006)[28]	31	USA	Youth	Acute intoxication	Level of rurality did not moderate the association between school bonding and drunkenness in an adolescent, school-aged sample
Simmons and Havens (2007)[44]	38	USA	Adult	Alcohol use disorder	No rural–urban difference in alcohol abuse or dependence was observed in the whole sample; however, rural, relative to urban, residents with major depression, antisocial personality disorder, or any mental disorder (composite) were more likely to meet the criteria for abuse or dependence.
Kenny and Schreiner (2009)[45]	46	Australia	Youth	Chronic hazardous alcohol use	Not attending school was associated with high-risk drinking in urban but not rural adolescents, and father absence was associated with high-risk drinking in rural but not urban adolescents.
Ojo et al (2010)[49]	54	South Africa	Adult	Chronic hazardous alcohol use	Among adult women, being employed reduced the odds of high-risk drinking in the urban, but not the rural, subgroup; being a smoker increased the odds of high-risk drinking in the rural, but not the urban, subgroup.
Burns et al (2011)[46]	60	Australia	Adult	Alcohol use during pregnancy	Rural, relative to urban, alcohol-exposed pregnancies were more likely to be among younger (ages 20–29 years versus older than 30 years) Australian-born women.
Rowe et al (2012)[50]	64	Australia	Adult	Alcohol-related crime	In more remote areas, relative to more urban areas, alcohol-related violence and crime tended to peak earlier in the evening and occur following alcohol use at private residences (*vs* licenced premises)
Taylor et al (2013)[51]	75	USA	Youth	Chronic hazardous alcohol use	The association between negative affect and alcohol use was stronger for urban males than for urban females, rural males, or rural females.
Liao and Lin (2015)[29]	84	Taiwan	Adult	Alcohol-related mortality	Higher proportion of industry was associated with a reduced risk of alcohol-related mortality in rural, but not urban, townships; labour force participation rate was associated with a reduced risk of alcohol-related mortality in urban, but not rural, townships.
Zenic et al (2015)[52]	85	Bosnia and Herzegovina	Youth	Chronic hazardous alcohol use	Male sex increased the odds of harmful alcohol drinking in both rural and urban adolescents, but the magnitude of this association was larger in rural areas; among males, higher academic achievement, school absence, and parental absence are associated with an increased odds of harmful drinking in urban, but not rural, areas, whereas reduced religiosity is associated with an increased odds of harmful drinking in rural, but not urban, areas; among females, higher academic achievement, higher financial status, conflict with parents, and participation in sports are associated with an increased odds of harmful drinking in urban, but not rural, areas, whereas school absence is associated with an increased odds of harmful drinking in rural, but not urban, areas.
Azar et al (2016)[53]	88	Australia	Youth	Chronic hazardous alcohol use	Off-premise alcohol outlet density and club density are associated with risky drinking among urban, but not rural, adolescents.
Jiang et al (2016)[47]	90	USA	Youth	Drink driving	Family structure and relationship variables (eg, living with a single parent *vs* two parents, and feeling close to your mother) mediated the positive association between rurality and increased rates of drink driving.
Armstrong et al (2017)[54]	106	Australia	Population	Drink driving	In more remote communities, relative to more urban communities, individuals apprehended for drink driving tended to be younger and male, and apprehensions tended to happen earlier in the evening after the individual had been drinking in a setting other than a licensed premise
Obradors-Rial et al (2020)[55]	116	Spain	Youth	Acute intoxication	Lower self-reported academic level and not living with both parents was associated with an increased odds of risky alcohol consumption in rural, but not urban, settings; higher socioeconomic status was associated with an increased odds of risky alcohol consumption in urban, but not rural, settings.

*For comparison to the quantitative extraction sheet (appendix p 33). †See appendix (p 10). ‡Main finding with regards to rural–urban differences in the variables associated with hazardous alcohol use or alcohol-related harm, not necessarily the main finding of the overall manuscript.

Table 2: **Studies evaluating rural–urban differences in variables associated with hazardous alcohol use or alcohol-related harm**

whereas the odds of daily alcohol use were significantly higher in outer regional and remote groups, but not inner regional group, relative to the metropolitan group.[59]

Different countries had different degrees of heterogeneity in the number and type of rurality measures used. For example, in Australia, most (ten of 15) rural–urban comparison studies used Accessibility-Remoteness Index of Australia scores to define rurality, whereas less consistent rural definitions were observed between studies from Asian, African, European, and South American countries. North American countries fell in between, in which a few rurality measures were commonly

cited (eg, Rural–Urban Continuum Codes and Metropolitan-Micropolitan Statistical Areas), but many other rural definitions were used that did not reference an established framework. Specific information on the definitions of rurality used in each study can be found in the appendix (p 33; see column "definition of rural").

Of the 144 studies that evaluated predictors of hazardous alcohol use and alcohol-related harm in rural and remote communities, 47·2% (68 of 144 studies) did not provide a definition of rural, 31·9% (46 of 144) provided a definition that referenced quantitative measures such as population size or regional rurality scores, and 20·8% (30 of 144) provided a qualitative description of the study population. Qualitative descriptions often included explanations of main occupation types (eg, farming and manual labour) or aspects of the sociocultural or socioeconomic landscape that were considered central to a region's rural identity.

Discussion

This Scoping Review presents the first compilation of the international research on hazardous alcohol use and alcohol-related harm in rural and remote communities. Most studies found rural, relative to urban, residence to be associated with hazardous alcohol use and alcohol-related harm, fewer found urban, relative to rural, residence to be associated with these outcomes, and the rest found either no rural–urban difference or a more complex association between rurality and these outcomes. The proportion of studies finding hazardous and harmful alcohol use to be more common in rural, relative to urban, communities increased between 1990 and 2019 and varied between geographical regions, age groups, and outcome types, being highest in Australia, among young age groups (particulary individuals aged 18–24 years), and for more severe alcohol-related harms, such as alcohol-related suicide, alcohol-related health service use, and drink driving.

The association between rurality and adverse alcohol outcomes also became more pronounced when increasingly hazardous and harmful patterns of alcohol use were evaluated. For example, Davis and colleagues[60] found that urban residents were more likely than rural residents to have an AUDIT-C score more than 4, but rural residents were more likely than urban residents to have an AUDIT-C score of more than 8, in which increasing scores reflect increasingly hazardous patterns of alcohol use. Similarly, Patrick and colleagues[61] found that rural, relative to urban, high school students (modal age 18 years) were more likely to engage in extreme binge drinking (ie, 15 or more drinks per occasion) but that no rural–urban difference existed for regular binge drinking (more than five drinks per occasion).

Numerous risk factors for hazardous alcohol use and alcohol-related harm in rural and remote communities were identified. Unsurprisingly, most of these risk factors, such as male sex, younger age, mental illness, peer or parental alcohol use, and sexual or physical abuse have been previously identified in non-rural populations,[4,62–64] indicating the ubiquitous effect of some exposures on hazardous alcohol use across the rural–urban divide. In turn, understanding hazardous and harmful alcohol use within a particular rural or remote community can, to some extent, be achieved by generalising the results from other urban or rural populations.

Importantly, however, we also identified substantial geographical variability in the association between rurality, hazardous alcohol use, and alcohol-related harm, and the risk factors for these outcomes. The variability indicated that a balance must be struck between generalising knowledge between geographical regions and ensuring that this knowledge is regionally applicable through local research. To better understand this geographical complexity, we outlined the rural–urban disparities and regional risk factors for hazardous alcohol use and alcohol-related harm for each of the 49 countries included in this Review. We also highlighted the risk factors that were specific to, or more pronounced, in rural, relative to urban, communities, such as male sex, the timing and place of alcohol use, and factors related to family stability and education. This regional understanding of rural–urban disparities and rural-specific risk factors for hazardous alcohol use and alcohol-related harm will be helpful for guiding regionally tailored, evidence-based alcohol and health policies for rural and remote communities. Nonetheless, there are still substantial gaps in knowledge surrounding why these rural–urban disparities exist, and what can be done to address the problem. This is clearly evidenced by the fact that only 17 studies worldwide have quantified how risk factors for alcohol-related harm differ between rural and urban populations, indicating that more studies of this type are required. Qualitative methods will also be important to address these gaps in knowledge, as they provide local insights into complex sociocultural factors associated with alcohol use behaviours beyond what is possible using quantitative approaches.

Finally, the ability to generalise results between studies and geographical regions depends on how well rurality has been defined. Therefore, the variable rural definitions identified in this Review, particularly within individual countries, is a limitation in the field that undermines generalisability, and, in turn, research efficiency. These variable definitions are also a source of confusion. Indeed, with multiple definitions of rural, it becomes difficult to understand whether conflicting results reflect meaningful regional differences in hazardous and harmful alcohol use, or simply conflicting definitions of rurality. As such, more clear and consistent rural definitions are required, particularly within individual countries. Despite the need for methodological consistency to facilitate comparisons between studies, it is important to recognise that defining rurality is a nuanced endeavour, and definitions should be chosen based on the unique purposes of each

project.[65] Therefore, broadly applying a singular, inflexible definition of rurality is not the solution to this problem. Rather, it would be helpful for researchers to delineate the definitions of rurality that are available in their jurisdiction and provide a clear rationale for why a particular definition was chosen. Sensitivity analyses to evaluate if and how results change under different definitions of rurality should also be considered.

Finally, given the apparent non-linear relationship between rurality and alcohol use, rural alcohol use research could also benefit from moving beyond binary rural–urban comparisons by using multiple strata on a rural–urban continuum or more sophisticated geospatial analyses, such as spatial autocorrelation methods to identify geographical clusters of alcohol-related harm or spatially varying coefficient models to identify local risk factors.

Our Scoping Review has several limitations. First, research on hazardous alcohol use and alcohol-related harm in rural and remote communities is commonly found in grey literature sources, such as within government and stakeholder reports. This type of research was not captured in this Scoping Review as an international grey literature search was beyond the scope of this study. This could bias the results of this Scoping Review, particularly if some countries are more likely than others to publish rural alcohol research in the grey literature. Second, although studies were not excluded based on language or country of origin, the databases used to identify studies for this Scoping Review are generally biased towards English language studies, which could similarly skew this review to be more representative of high-income, English-speaking countries. Indeed, nearly half of the studies included were from the USA, which biases the overall results of this Scoping Review to be more representative of the USA and countries that have similar sociodemographic compositions and drinking cultures (eg, Canada). To circumvent this issue and facilitate a region-specific understanding of rural and remote alcohol use, we stratified articles by country so that region-specific evidence can be evaluated and used to guide local policy and research. This stratification also illustrated global disparities in the availability of evidence on rural alcohol use, which could indicate the countries in which future research on this topic is warranted. Nonetheless, even these country-specific results must be interpreted with caution as drinking cultures can vary substantially between demographic subgroups within countries. In turn, some findings might not apply uniformly across the entire population, which must be considered in local policy development.

Third, studies evaluating low-risk alcohol use in rural communities were excluded to focus on the health burden of alcohol use in rural populations. However, studies on low-risk alcohol use are not irrelevant, as they provide a more complete understanding of the entire spectrum of alcohol use behaviour in rural and remote communities. We direct the reader to a review by Dixon and Chartier[7] which discusses rural–urban disparities across a full spectrum of low-risk to high-risk alcohol use outcomes in the USA. Similarly, we chose to focus on harms that are completely attributable to alcohol use; however, alcohol use is a partial contributor to many health outcomes.[2] Future reviews could consider evaluating rural–urban differences in health outcomes partially attributable to alcohol use to get a more complete picture of alcohol-related harm in rural and remote communities.

Conclusion

Internationally, most studies have found that rural, relative to urban, residence is associated with an increased likelihood of hazardous alcohol use and alcohol-related harm. This rural–urban disparity appears to be worsening over time, but also varies in magnitude between geographical regions, demographic subgroups, and outcome types. This finding suggests that improved public health strategies to reduce the burden of rural alcohol use are urgently required but must be tailored to the unique needs of the region they are designed for. Additional research is required to fully understand rural–urban differences in hazardous and harmful alcohol use, including the modifiable risk factors and high-risk subpopulations that should be prioritised by public health interventions and policies. Although some knowledge can be generalised between studies and geographical regions, more local, particularly qualitative, research, and more clear and consistent definitions of rurality, will be helpful for more effective alcohol policy and prevention efforts.

Contributors

ELF, PS, LR, and PK designed the study. ELF, JB, SH, SS, MLdS, KW, RB, AE, and FF did the study selection and data extraction. Data interpretation was done by ELF, JB, SH, KW, PS, LR, and PK. Figures are by ELF. The writing of the original draft was done by ELF and review and editing by ELF, JB, SH, KW, AE, PS, LR, and PK. All authors approved the final version of the manuscript.

Declaration of interests

ELF is supported by the Frederick Banting and Charles Best Canada Graduate Scholarship—Doctoral Award from the Canadian Institutes of Health Research. PS has received speaking honoraria from the Fundamentals of Addiction Medicine TeleECHO Clinic. All other authors declare no competing interests.

References

1 Griswold MG, Fullman N, Hawley C, et al. Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet* 2018; **392:** 1015–35.

2 Rehm J. The risks associated with alcohol use and alcoholism. *Alcohol Res Health* 2011; **34:** 135–43.

3 Rehm J, Gmel GE Sr, Gmel G, et al. The relationship between different dimensions of alcohol use and the burden of disease—an update. *Addiction* 2017; **112:** 968–1001.

4 Rehm J, Mathers C, Popova S, Thavorncharoensap M, Teerawattananon Y, Patra J. Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *Lancet* 2009; **373:** 2223–33.

5 Egan M, Brennan A, Buykx P, et al. Local policies to tackle a national problem: comparative qualitative case studies of an English local authority alcohol availability intervention. *Health Place* 2016; **41:** 11–18.

6 Miller PG, Coomber K, Staiger P, Zinkiewicz L, Toumbourou JW. Review of rural and regional alcohol research in Australia. *Aust J Rural Health* 2010; **18:** 110–17.

7 Dixon MA, Chartier KG. Alcohol use patterns among urban and rural residents: demographic and social influences. *Alcohol Res* 2016; **38:** 69–77.

8 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005; **8:** 19–32.

9 Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010; **5:** 69.

10 Peters MDJ, Godfrey C, McInerney P, et al. Chapter 11. In: Aromataris E, Munn Z, eds. Scoping Reviews. Joanna Briggs Institute Reviewer's Manual. The Joanna Briggs Institute, 2017.

11 Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med* 2018; **169:** 467–73.

12 Friesen EL, Kurdyak P. Alcohol use and alcohol-related harm in rural and remote communities: protocol for a scoping review. *BMJ Open* 2020; **10:** e036753.

13 WHO. Brief intervention for hazardous and harmful drinking: a manual for use in primary care. https://apps.who.int/iris/handle/10665/67210 (accessed Dec 5, 2019).

14 Kalinowski A, Humphreys K. Governmental standard drink definitions and low-risk alcohol consumption guidelines in 37 countries. *Addiction* 2016; **111:** 1293–98.

15 McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med* 2012; **22:** 276–82.

16 Fanner FL, Kelleher KJ, Rickert VI. Rural adolescent alcohol use: an overview. *J Rural Health* 1991; **7:** 293–303.

17 Joesph F, Donnermeyer JF. The use of alcohol, marijuana, and hard drugs by rural adolescents: a review of recent research. *Drugs Soc* 1993; **7:** 31–75.

18 Taype-Rondan A, Bernabe-Ortiz A, Alvarado GF, Gilman RH, Smeeth L, Miranda JJ. Smoking and heavy drinking patterns in rural, urban and rural-to-urban migrants: the PERU MIGRANT Study. *BMC Public Health* 2017; **17:** 165.

19 Stickley A, Razvodovsky Y. Alcohol poisoning in Belarus: a comparison of urban-rural trends, 1990–2005. *Alcohol Alcohol* 2009; **44:** 326–31.

20 Yen CF, Yang MS, Chen CC, et al. Effects of childhood physical abuse on depression, problem drinking and perceived poor health status in adolescents living in rural Taiwan. *Psychiatry Clin Neurosci* 2008; **62:** 575–83.

21 Haren MT, Li M, Petkov J, McDermott RA. Alcohol, metabolic risk and elevated serum gamma-glutamyl transferase (GGT) in Indigenous Australians. *BMC Public Health* 2010; **10:** 454.

22 Luo XF, Duan S, Duan QX, et al. Prevalence and correlates of alcohol use and subsequent sexual activity among adult males in a rural community of ethnic minorities in Yunnan Province, China. *Biosci Trends* 2012; **6:** 288–95.

23 Luo X, Duan S, Duan Q, et al. Alcohol use and subsequent sex among HIV-infected patients in an ethnic minority area of Yunnan Province, China. *PLoS One* 2013; **8:** e61660.

24 Amit N, Hasking P, Manderson L. Demographic factors associated with alcohol use among young men in rural areas of Sarawak. *Addict Res Theory* 2013; **21:** 391–401.

25 Breen C, Shakeshaft A, Sanson-Fisher R, D'Este C, Mattick RP, Gilmour S. Identifying individual- and population-level characteristics that influence rates of risky alcohol consumption in regional communities. *Aust N Z J Public Health* 2014; **38:** 60–65.

26 James CV, Moonesinghe R, Wilson-Frederick SM, Hall JE, Penman-Aguilar A, Bouye K. Racial/ethnic health disparities among rural adults—United States, 2012–2015. *MMWR Surveill Summ* 2017; **66:** 1–9.

27 Wong JJ, Cucciare MA, Booth BM, Timko C. Predicting substance use patterns among rural adults: the roles of mothers, fathers, and parenthood. *Fam Process* 2018: **58**: 431–45.

28 Shears J, Edwards RW, Stanley LR. School bonding and substance use in rural communities. *Soc Work Res* 2006; **30:** 6–18.

29 Liao CM, Lin CM. Geographical inequalities in alcohol-related mortality rates in Taiwan due to socio-demographic differences. *Alcohol Alcohol* 2015; **50:** 558–64.

30 Campos-Outcalt D, Bay C, Dellapenna A, Cota MK. Pedestrian fatalities by race/ethnicity in Arizona, 1990–1996. *Am J Prev Med* 2002; **23:** 129–35.

31 Diala CC, Muntaner C, Walrath C. Gender, occupational, and socioeconomic correlates of alcohol and drug abuse among U.S. rural, metropolitan, and urban residents. *Am J Drug Alcohol Abuse* 2004; **30:** 409–28.

32 Banahan BF, McCaffrey DJ. Rural students' exposure to risk from automobile travel when the driver is under the influence of alcohol or drugs. *J Rural Health* 1993; **9:** 50–56.

33 Powell J, Dugdale AE. Obstetric outcomes in an aboriginal community: a comparison with the surrounding rural area. *Aust J Rural Health* 1999; **7:** 13–17.

34 Ah-Tye PJ. Pancreatitis in remote Australia: an indigenous perspective. *Aust J Rural Health* 2001; **9:** 134–37.

35 Boyd MR, Phillips K, Dorsey CJ. Alcohol and other drug disorders, comorbidity, and violence: comparison of rural African American and Caucasian women. *Arch Psychiatr Nurs* 2003; **17:** 249–58.

36 Boyd MB, Mackey MC, Phillips KD, Tavakoli A. Alcohol and other drug disorders, comorbidty and violence in rural African American women. *Issues Ment Health Nurs* 2006; **27:** 1017–36.

37 Thommasen HV, Hanlon N, Thommasen C, Zhang W. Alcohol drinking habits and community perspectives on alcohol abuse in the Bella Coola Valley. *Can J Rural Med* 2006; **11:** 15–22.

38 Hamdan-Mansour AM, Puskar K, Sereika SM. Perceived social support, coping strategies and alcohol use among rural adolescents/USA sample. *Int J Ment Health Addict* 2007; **5:** 53–64.

39 Jones DJ, Hussong AM, Manning J, Sterrett E. Adolescent alcohol use in context: the role of parents and peers among African American and European American youth. *Cultur Divers Ethnic Minor Psychol* 2008; **14:** 266–73.

40 Yeung W, Leong WY, Khoun K, et al. alcohol use disorder and heavy episodic drinking in rural communities in Cambodia: risk factors and community-perceived strategies. *Asia Pac J Public Health* 2015; **27:** 835–47.

41 Booth BM, Ross RL, Rost K. Rural and urban problem drinkers in six Southern states. *Subst Use Misuse* 1999; **34:** 471–93.

42 Booth BM, Kirchner J, Fortney J, Ross R, Rost K. Rural at-risk drinkers: correlates and one-year use of alcoholism treatment services. *J Stud Alcohol* 2000; **61:** 267–77.

43 Shaffer DN, Njeri R, Justice AC, Odero WW, Tierney WM. Alcohol abuse among patients with and without HIV infection attending public clinics in western Kenya. *East Afr Med J* 2004; **81:** 594–98.

44 Simmons LA, Havens JR. Comorbid substance and mental disorders among rural Americans: results from the National Comorbidity Survey. *J Affect Disord* 2007; **99:** 265–71.

45 Kenny DT, Schreiner I. Predictors of high-risk alcohol consumption in young offenders on community orders: policy and treatment implications. *Psychol Public Policy Law* 2009; **15:** 54–79.

46 Burns L, Black E, Powers JR, et al. Geographic and maternal characteristics associated with alcohol use in pregnancy. *Alcohol Clin Exp Res* 2011; **35:** 1230–37.

47 Jiang G, Sun F, Marsiglia FF. Rural-urban disparities in adolescent risky behaviors: a family social capital perspective. *J Community Psychol* 2016; **44:** 1027–39.

48 Kim JM, Shin IS, Stewart R, Yoon JS. Alcoholism in older Korean men: prevalence, aetiology, and comorbidity with cognitive impairment and dementia in urban and rural communities. *Int J Geriatr Psychiatry* 2002; **17:** 821–27.

49 Ojo OA, Louwagie G, Morojele N, et al. Factors associated with female high-risk drinking in a rural and an urban South African site. *S Afr Med J* 2010; **100:** 180–82.

50 Rowe S, Wiggers J, Kingsland M, Nicholas C, Wolfenden L. Alcohol consumption and intoxication among people involved in police-recorded incidents of violence and disorder in non-metropolitan New South Wales. *Aust N Z J Public Health* 2012; **36:** 33–40.

51 Taylor MJ, Merritt SM, Austin CC. Negative affect, delinquency, and alcohol use among rural and urban African-American adolescents: a brief report. *J Child Adolesc Subst Abuse* 2013; **22:** 69–84.

52 Zenic N, Ostojic L, Sisic N, et al. Examination of the community-specific prevalence of and factors associated with substance use and misuse among rural and urban adolescents: a cross-sectional analysis in Bosnia and Herzegovina. *BMJ Open* 2015; **5:** e009446.

53 Azar D, White V, Coomber K, et al. The association between alcohol outlet density and alcohol use among urban and regional Australian adolescents. *Addiction* 2016; **111:** 65–72.

54 Armstrong KA, Watling H, Watson A, Davey J. Profile of urban vs rural drivers detected drink driving via Roadside Breath Testing (RBT) in Queensland, Australia, between 2000 and 2011. *Transp Res, Part F Traffic Psychol Behav* 2017; **47:** 114–21.

55 Obradors-Rial N, Ariza C, Continente X, Muntaner C. School and town factors associated with risky alcohol consumption among Catalan adolescents. *Alcohol* 2020; **82:** 71–79.

56 Greene KM, Murphy ST, Rossheim ME. Context and culture: reasons young adults drink and drive in rural America. *Accid Anal Prev* 2018; **121:** 194–201.

57 Carey TA, MacGregor M. Understanding why youth in remote Australia use alcohol in the ways that they do. *Aust J Rural Health* 2019; **27:** 380–85.

58 Sundararajan R, Wyatt MA, Woolf-King S, et al. Qualitative study of changes in alcohol use among HIV-infected adults entering care and treatment for HIV/AIDS in rural southwest Uganda. *AIDS Behav* 2015; **19:** 732–41.

59 Roxburgh A, Miller P, Dunn M. Patterns of alcohol, tobacco and cannabis use and related harm in city, regional and remote areas of Australia. *Int J Drug Policy* 2013; **24:** 488–91.

60 Davis MM, Spurlock M, Dulacki K, et al. Disparities in alcohol, drug use, and mental health condition prevalence and access to care in rural, isolated, and reservation areas: findings from the South Dakota health survey. *J Rural Health* 2016; **32:** 287–302.

61 Patrick ME, Schulenberg JE, Martz ME, Maggs JL, O'Malley PM, Johnston LD. Extreme binge drinking among 12th-grade students in the United States: prevalence and predictors. *JAMA Pediatr* 2013; **167:** 1019–25.

62 Drake RE, Mueser KT. Alcohol-use disorder and severe mental illness. *Alcohol Health Res World* 1996; **20:** 87–93.

63 Edwards AC, Maes HH, Prescott CA, Kendler KS. Multiple mechanisms influencing the relationship between alcohol consumption and peer alcohol use. *Alcohol Clin Exp Res* 2015; **39:** 324–32.

64 Langeland W, Hartgers C. Child sexual and physical abuse and alcoholism: a review. *J Stud Alcohol* 1998; **59:** 336–48.

65 Bennett KJ, Borders TF, Holmes GM, Kozhimannil KB, Ziller E. What is rural? Challenges and implications of definitions that inadequately encompass rural people and places. *Health Aff* 2019; **38:** 1985–92.