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Area-Level Social Determinants of Alcohol-Related Mortality: Knowledge Gaps and Implications for Community Health

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PURPOSE: Rates of alcohol-related mortality (including deaths attributed to chronic alcohol use as well as acute causes involving alcohol) have been increasing in the United States, particularly for certain population subgroups, such as women. This review summarizes associations of area-level social determinants of health with alcohol-related mortality. These determinants, measured at the community, county, or state level, include alcohol control policies, health care availability, and a community's socioeconomic environment. Examining multiple geographic levels illuminates how macro-level social determinants and local contexts contribute to alcohol-related mortality to inform intervention. Attention to the broad variety of social determinants of alcohol-related mortality could ultimately improve community health.

SEARCH METHODS: A literature search of three databases—PubMed, Web of Science, and Cumulative Index to Nursing and Allied Health Literature (CINAHL)—conducted between March 13 and May 16, 2023, identified peer-reviewed studies published from 1990 to May 2023 that modeled at least one area-level social determinant of health as a predictor or correlate of area-level rates of alcohol-related mortality in the United States. Unpublished dissertations, commentaries, editorials, review papers, and articles published in languages other than English were excluded. Two team members reviewed each abstract to verify that the article addressed alcohol-related mortality and included at least one area-level social determinant of health.

SEARCH RESULTS: The authors screened 313 abstracts and excluded 210 that did not meet inclusion criteria. The full texts of 103 articles were retrieved. Upon further screening, 30 articles were excluded (two were not obtained), leaving 71 studies for detailed review.

DISCUSSION AND CONCLUSIONS: Many studies analyzed fatal alcohol-related motor vehicle crashes or cirrhosis/liver disease mortality. Fewer analyzed other mortality causes related to chronic alcohol consumption. No studies focused on racism and discrimination, community-level prevention activities, or community social services in relation to alcohol-related mortality. Few studies examined major health policy changes or addressed health care system factors. Although the variation across studies complicates systematic comparison of the results, some key themes did emerge from the reviewed studies, such as the beneficial effects of stronger alcohol policies and the importance of socioeconomic conditions as determinants of alcohol-related mortality. Research using a more diverse set of theoretically informed social determinants may help examine whether, how, and for whom racism and discrimination as well as health policies and social services impact alcohol-related mortality. Finally, there is a gap in research linking local community contexts with alcohol-related mortality. Better understanding of subgroup differences, interactions between different contextual factors, and specific mechanisms of action may help identify promising new strategies to improve population health and reduce alcohol-related mortality.

KEYWORDS: alcohol; alcohol-related disorders; mortality; social determinants of health; socioeconomic factors; social context; community health

More than 50 causes of death are linked to excessive alcohol use.¹ This broad range of conditions—including those caused by chronic alcohol use, such as cirrhosis or cancers, as well as by acute events associated with heavy episodic or binge alcohol use, such as injuries—results in more than 178,000 annual deaths in the United States² and more than 3 million annual deaths globally.³ In one U.S. study, excessive alcohol use (e.g., daily alcohol consumption of more than 2 drinks for women and more than 4 drinks for men) was estimated to contribute to 12.9% of the mortality of the population between ages 20 to 69, with large differences by sex/gender (15% in men, 9.4% in women).¹ Additionally, there was wide variability between U.S. states, with estimates ranging from 9.3% of total deaths in Mississippi to 21.7% in New Mexico attributable at least partly to alcohol.¹ Results from a meta-analysis suggest that people with alcohol use disorder (AUD) have higher mortality risk compared to the general population as well as to people without AUD who drink heavily.⁴ Mortality trend data show that alcohol-related deaths increased markedly between 2013 and 2016 across sex/gender and racial and ethnic groups,⁵ and these deaths continued to increase between 2019 and 2020.⁶ This review uses a social determinants of health (SDOH) framework to broadly conceptualize area-level characteristics that may influence alcohol-related mortality.

Alcohol-related mortality includes deaths caused by acute individual behaviors, such as driving under the influence (DUI), and deaths caused by chronic heavy alcohol consumption.¹ Many studies have focused on the contributions of chronic and acute alcohol use and AUD to specific causes of mortality and on variability in alcohol-related mortality across demographic and geographic subgroups. SDOH also contribute to alcohol-related deaths⁷ and may help explain demographic and geographic variations in mortality. As conceptualized by the U.S. Department of Health and Human Services⁸ and the World Health Organization,⁹ SDOH encompass a broad range of social, economic, and political conditions present in the environments where people live, work, and relax, including social integration, exposure to racial or other forms of discrimination, educational and economic conditions, and access to high-quality health care and social services.^{8,9}

This review focuses on area-level SDOH likely to be linked to mortality resulting from either acute or chronic alcohol-related causes. For alcohol-related deaths attributable to acute intoxication (e.g., those caused by motor vehicle crashes [MVCs] or violence), social and policy factors related to the promotion and control of excessive alcohol consumption are especially relevant.⁷ Structural factors in the built environment, such as roadway design and lighting, also may play a role, particularly in rural areas. Alcohol availability and alcohol control policies, along with health care availability, also are germane for deaths attributable to alcohol misuse or AUD. Adequate health care is crucial for treating chronic physical health conditions caused

KEY TAKEAWAYS

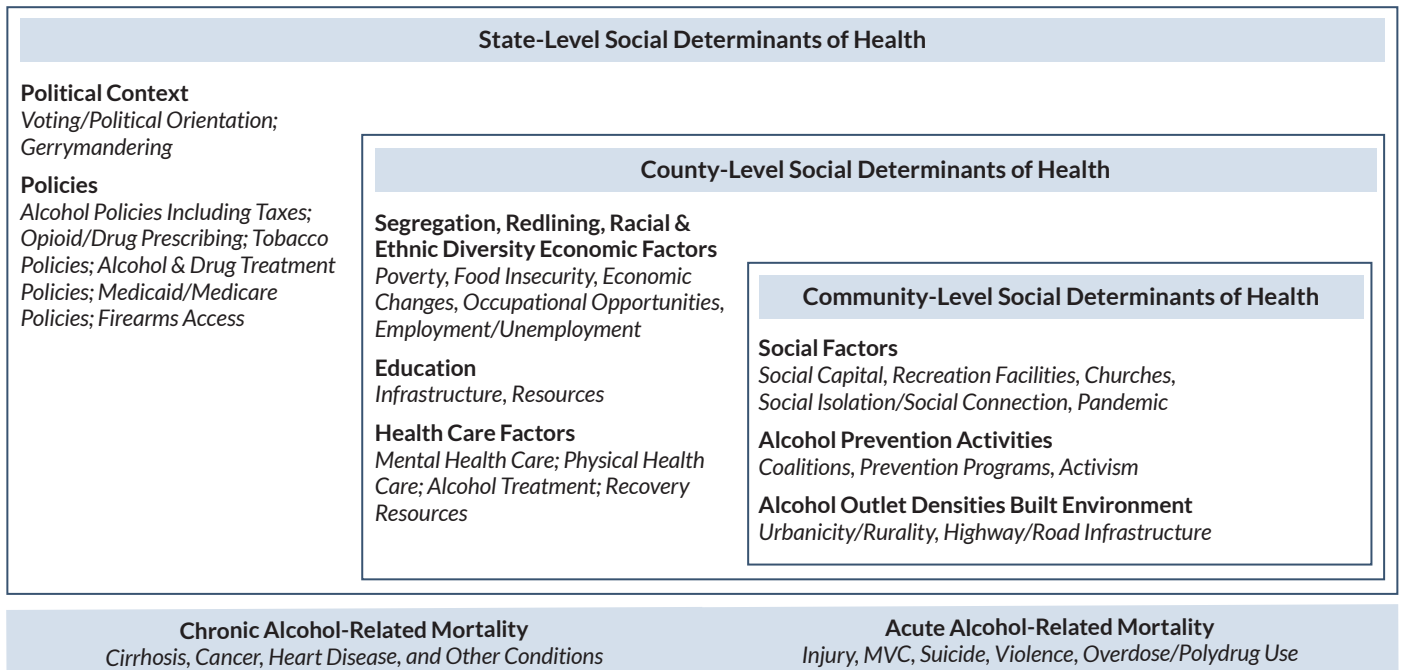
- The literature on social determinants of alcohol-related mortality includes many studies focused on area-level determinants of alcohol-involved motor vehicle crashes and cirrhosis or liver disease mortality.
- Extant research highlights the benefits of stronger alcohol policies and the importance of socioeconomic conditions as determinants of alcohol-related mortality.
- Substantial gaps in knowledge remain, particularly related to potential impacts of structural racism, community-level prevention, and community social and medical services on alcohol-related mortality.

or exacerbated by alcohol use and behavioral health conditions such as AUD, depression, and anxiety. As described by Monnat,¹⁰ socioeconomic disadvantages are likely determinants of higher drug-related (and alcohol-related) mortality through effects of economic stressors on family relationships, social connections, hopelessness, and social disorder. Conversely, indicators of social capital (such as community engagement and social cohesion) may serve to buffer against social isolation and depression, resulting in lower drug- and alcohol-related mortality. Socioecological frameworks of human development have identified key contextual factors (i.e., SDOH) at the state, county, and community levels that are hypothesized to be related to mortality from chronic and/or acute alcohol consumption and that provide a guiding taxonomy for this review (see Figure 1).¹¹ Examining evidence across these multiple levels of influence enables understanding of how macro and more local social determinants contribute to alcohol-related mortality, which can help inform intervention.

Recent reviews have explored social determinants of opioid and other drug overdose mortality.¹²⁻¹⁴ However, such studies often overlook alcohol-related mortality, even though alcohol is the most commonly co-used substance among people who misuse opioids.¹⁵ There also are many shared causes contributing to recent mortality trends related to alcohol and other drug use, such as the “deaths of despair” theory, which centers on deaths involving drug and/or alcohol overdose, alcohol-related diseases, and suicide.¹⁶⁻¹⁸ Social distress has been identified as an upstream explanatory factor related to overdose mortality and deaths of despair, but strong gender differences suggest that causes of death might not share the same underlying factors for men and women.^{17,18}

A recent systematic review of factors associated with drug overdose mortality in the United States¹⁴ identified consistent associations with greater economic strain, mining employment (compared to other sectors), less substance use disorder treatment availability, less social capital, and greater density of marijuana dispensaries. A small scoping review of social determinants of deaths of despair in the United States¹⁹ found associations with rurality, low socioeconomic position, high job

Figure 1 . Social determinants of chronic and acute alcohol-related mortality at various levels of aggregation.



Note: MVC, motor vehicle crash.

insecurity, and high unemployment. The systematic review also found that associations of health care professional shortages, physicians per capita, and socioeconomic context with overdose mortality often differed for groups defined by race/ethnicity, sex/gender, age, and rurality.¹⁴ Specific contextual factors affecting excessive alcohol use and subsequent mortality likely also vary across population subgroups.

To identify actionable policy and intervention opportunities, this review examines extant literature on area-level SDOH associated with alcohol-related mortality. By highlighting robust evidence and identifying knowledge gaps, the review aims to provide insights for evidence-based population-level strategies to reduce alcohol-related mortality and promote healthier communities.

Search Methods Employed

Between March 13 and May 16, 2023, the authors searched PubMed, Web of Science, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) for peer-reviewed studies published from January 1990 to May 2023 that modeled at least one area-level indicator (e.g., county poverty rates, alcohol outlet density, alcohol policies, racism/discrimination, alcohol treatment access) as a predictor or correlate of area-level rates of alcohol-related mortality. Outcomes of interest were alcohol-related deaths due to either chronic or acute alcohol consumption, including those causes that were 100% alcohol-attributable (such as alcohol-associated liver disease) as well as those only partially

attributable to alcohol (such as cancers).¹ Accordingly, the search strategy for this review included broad, cause-unspecified terms (e.g., “alcohol*” AND (“mortality” OR “death” OR “fatal*”)) as well as cause-specific terms (e.g., cirrhosis). Table 1 presents a detailed list of search terms for each database. This review also includes studies where alcohol-related mortalities were combined with drug-related mortalities in a single outcome (e.g., “drug- and/or alcohol-related mortality”). U.S. studies using general population and subgroup data are included. Excluded from this review were unpublished dissertations, commentaries or editorials, literature reviews, and articles published in languages other than English.

Review methods focused on identifying how studies approached area-level SDOH and different mortality outcomes. After removing duplicates, two reviewers screened each abstract to verify that the article examined the association between alcohol-related mortality and at least one area-level variable. The authors reviewed the full texts when the abstract lacked sufficient information to determine eligibility. Also reviewed were reference lists of included papers and relevant review articles to identify additional cited references that met inclusion criteria. A limitation of the search strategy is that, although approximately half of cirrhosis and liver disease deaths are related to alcohol,²⁰ not all studies specified whether they included only alcohol-related cirrhosis/liver disease or any type of cirrhosis/liver disease. Thus, this review may include mortality from liver diseases not attributable to alcohol. Another limitation is the systematic exclusion of general mortality outcomes and deaths that might be related to alcohol (e.g., homicide) as well as other serious alcohol-related outcomes (e.g., alcohol-involved MVCs or violence) that did not result in mortality.

Table 1. Search Strategy Details, by Database

<p>PubMed</p> <p>#1 (("census tract"[tiab] OR "zip code"[tiab] OR "ZCTA"[tiab] OR "ZCTAs"[tiab] OR neighborhood*[tiab] OR "county"[tiab] OR "counties"[tiab] OR "state-level"[tiab] OR "state"[ti] OR "area-level"[tiab] OR "Census Tract"[MeSH]) AND (alcohol*[ti] OR "alcohol-related"[tiab] OR "alcohol-involved"[tiab] OR "alcoholic hepatitis"[tiab] OR "cirrhosis"[tiab] OR (("liver disease"[tiab] OR "fatty liver"[tiab]) AND alcohol*[tiab]) OR ("deaths of despair"[tiab] AND ("mortality"[tiab] OR "liver disease"[tiab] OR "cirrhosis"[tiab]))) AND ("mortality"[tiab] OR death*[tiab] OR fatal*[tiab] OR poisoning*[tiab] OR decedent*[tiab] OR "died"[tiab] OR suicide*[tiab] OR "Alcohol-Related Disorders/mortality"[MeSH]) AND ("United States"[MeSH] OR "United States"[Title/Abstract] OR "USA"[Title/Abstract] OR "U.S.A."[Title/Abstract] OR "U.S."[Title/Abstract] OR "United States"[Affiliation] OR "USA"[Affiliation] OR "U.S.A."[Affiliation] OR "U.S."[Affiliation] OR "US"[Affiliation] OR "Black or African American"[MeSH] OR "Asian American Native Hawaiian and Pacific Islander"[MeSH] OR "Hispanic or Latino"[MeSH] OR "Mexican Americans"[MeSH] OR "American Indian or Alaska Native"[MeSH] OR "Indians, North American"[MeSH:NoExp] OR review*[ti] OR "Review"[Publication Type] OR "Review Literature as Topic"[MeSH] OR "Systematic Review"[Publication Type] OR "Systematic Reviews as Topic"[MeSH]) AND ("1990/01/01"[Date - Publication]: "3000"[Date - Publication])) NOT ("non-alcoholic"[tw] OR "nonalcoholic"[tw] OR ("Animals"[MeSH] NOT "Humans"[MeSH]) OR "Comment"[Publication Type] OR "Letter"[Publication Type] OR "Editorial"[Publication Type]) Filters: English</p>	Final Result: 258 articles
<p>Web of Science</p> <p>#1 (TI=("census tract" OR "zip code" OR "ZCTA" OR "ZCTAs" OR neighborhood* OR "county" OR "counties" OR "state-level" OR "state" OR "area-level") OR AB=("census tract" OR "zip code" OR "ZCTA" OR "ZCTAs" OR neighborhood* OR "county" OR "counties" OR "state-level" OR "area-level")) AND (TI=(alcohol* OR "alcohol-related" OR "alcohol-involved" OR "alcoholic hepatitis" OR "cirrhosis" OR (("liver disease" OR "fatty liver") AND alcohol*) OR ("deaths of despair" AND ("mortality" OR "liver disease" OR "cirrhosis"))) OR AB=("alcohol-related" OR "alcohol-involved" OR "alcoholic hepatitis" OR "cirrhosis" OR (("liver disease" OR "fatty liver") AND alcohol*) OR ("deaths of despair" AND ("mortality" OR "liver disease" OR "cirrhosis")))) AND (TI=("mortality" OR death* OR fatal* OR poisoning* OR decedent* OR "died" OR suicide*) OR AB=("mortality" OR death* OR fatal* OR poisoning* OR decedent* OR "died" OR suicide*)) Timespan: 1990-01-01 to 2023-12-31 (Publication Date)</p>	Initial Result: 394 articles
<p>#2 #1 NOT TS=("non-alcoholic" OR "nonalcoholic") and English (Languages) and USA (Countries/Regions) and Review Article or Article (Document Types) Timespan: 1990-01-01 to 2023-12-31 (Publication Date)</p>	Final Result: 234 articles
<p>CINAHL</p> <p>S1 (ti ("census tract" or "zip code" or "zcta" or "zctas" or neighborhood* or "county" or "counties" or "state-level" or "state" or "area-level") or ab ("census tract" or "zip code" or "zcta" or "zctas" or neighborhood* or "county" or "counties" or "state-level" or "area-level")) and (ti (alcohol* or "alcohol-related" or "alcohol-involved" or "alcoholic hepatitis" or "cirrhosis" or (("liver disease" or "fatty liver") and alcohol*) or ("deaths of despair" and ("mortality" or "liver disease" or "cirrhosis"))) or ab ("alcohol-related" or "alcohol-involved" or "alcoholic hepatitis" or "cirrhosis" or (("liver disease" or "fatty liver") and alcohol*) or ("deaths of despair" and ("mortality" or "liver disease" or "cirrhosis")))) and (ti ("mortality" or death* or fatal* or poisoning* or decedent* or "died" or suicide*) or ab ("mortality" or death* or fatal* or poisoning* or decedent* or "died" or suicide*) or mh "alcohol-related disorders+/mo") limiters - published date: 19900101-20231231; English Language; Peer Reviewed; exclude MEDLINE records</p>	Initial Result: 55 articles
<p>S2 S1 NOT ("non-alcoholic" OR "nonalcoholic" OR ZT "commentary" OR ZT "editorial" OR ZT "letter" OR ZT "letter to the editor") Limiters - Published Date: 19900101-20231231; English Language; Peer Reviewed; Exclude MEDLINE records</p>	Refined Result: 48 articles
<p>S3 S2 AND (ZZ "usa" OR MH "United States+" OR ZS "usa" OR MH "African Americans" OR MH "Hispanic Americans+" OR "United States" OR "USA" OR "U.S.A.") Limiters - Published Date: 19900101-20231231; English Language; Peer Reviewed; Exclude MEDLINE records</p>	Final Result: 38 articles

Note: CINAHL, Cumulative Index to Nursing and Allied Health Literature; S1, search 1; S2, search 2; S3, search 3.

Search Results

The database searches yielded 437 total records (210 from PubMed, 193 from Web of Science, 34 from CINAHL). Another 12 articles were identified from reference lists. After removing 136 duplicate records, 313 unique abstracts remained for screening. Of these, 210 abstracts were excluded that did not meet inclusion criteria, such as not examining alcohol-related mortality ($n = 142$), not including area-level variables ($n = 64$), or not being U.S.-based studies ($n = 4$). The authors sought 103 full-text articles for further consideration. Two articles could not be obtained, and 30 additional articles did not satisfy review inclusion criteria, such as not reporting on the association between an area-level variable and alcohol-related mortality, or not providing sufficient data for analysis. Thus, 71 articles were included in the detailed review (see the flow diagram²¹ in Figure 2).

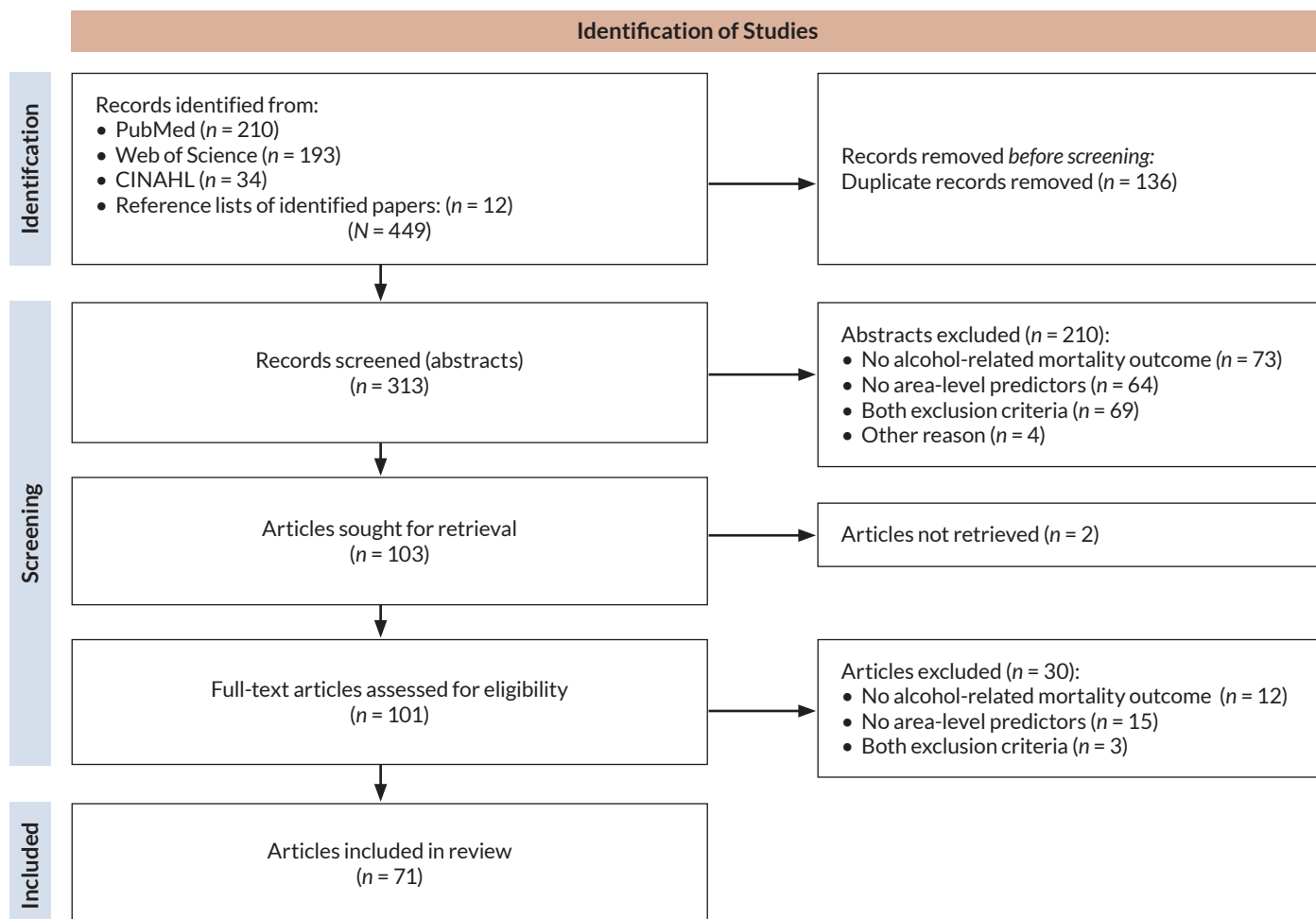
Results of the Reviewed Studies

Alcohol-Related Mortality Outcomes

The reviewed studies most commonly assessed mortality at the county level (37 studies) or the state level (31 studies). Despite the importance of community-level SDOH,^{8,9} only three studies used smaller areas of aggregation such as Census tracts or zip codes. This shortcoming of the literature limits understanding of how local factors influence alcohol-related mortality. Accordingly, there is an opportunity for future research to explore associations at smaller scales, such as census tracts or neighborhoods, to inform more targeted interventions and local policy solutions.

Table 2 summarizes the different alcohol-related mortality outcomes across the levels of aggregation. The most commonly assessed outcome—by far—was alcohol-involved MVC fatalities, which were examined in 16 state-level studies²²⁻³⁸ and 11 county-level studies.³⁹⁻⁴⁸ Cirrhosis and alcohol-related

Figure 2. Flow diagram for study selection during the narrative review of area-level social determinants of alcohol-related mortality.



Note: CINAHL, Cumulative Index to Nursing and Allied Health Literature.

Table 2. Alcohol-Related Mortality Outcomes Assessed by Level of Aggregation (N = 71 Studies)

Specific alcohol-related mortality outcomes	Count of studies
State-level studies (n = 30)	
Alcohol-involved MVC fatalities	16
Cirrhosis/liver disease	2
Other chronic cause	4
Alcohol-related suicide/violence	1
Other acute cause	2
Unspecified alcohol-related mortality	2
Multiple causes of death	3
County-level studies (n = 38)	
Alcohol-involved MVC fatalities	11
Cirrhosis/liver disease	9
Other chronic cause	2
Alcohol-related suicide/violence	3
Deaths of despair	6
Alcohol- and other drug-related mortality combined	3
Unspecified alcohol-related mortality	1
Multiple causes of death	3
Neighborhood-level studies (n = 3)	
Cirrhosis/liver disease	2
Other acute cause	1

Note: MVC, motor vehicle crash.

Table 3. Primary Area-Level Predictors Assessed by Level of Aggregation (N = 71 Studies)

Primary area-level predictors	Count of studies
State-level studies (n = 30)	
Alcohol and drug policies	25
Economic context	1
Employment/work environment	1
Health policies	1
Health care and social services	1
Built environment	1
County-level studies (n = 38)	
Alcohol and drug policies	7
Economic context	5
Employment/work environment	3
Health care and social services	2
Social context	2
Built environment	16
Multiple domains	3
Neighborhood-level studies (n = 3)	
Economic context	3

liver disease mortality were the most common chronic health outcomes studied and were evaluated in two neighborhood-level studies,^{49,50} nine county-level studies,⁵¹⁻⁵⁹ and two state-level studies.^{60,61} Relatively few studies examined mortality related to other diseases caused by chronic alcohol consumption, such as cancer,⁶² or other conditions with alcohol as a contributing cause.⁶³⁻⁶⁷ Several studies combined alcohol- and other drug-related mortality,⁶⁸⁻⁷⁰ at times adding suicide as a measure of deaths of despair,⁷¹⁻⁷⁶ whereas others did not specify the exact underlying causes or included many different causes in a composite alcohol-related mortality outcome.^{5,77,78} In the sections that follow, results of reviewed studies are grouped for specific outcomes (e.g., alcohol-involved MVC fatalities) to summarize cause-specific relationships with SDOH and are compared across different outcomes to demonstrate the breadth of impacts of SDOH on causes of alcohol-related mortality.

Area-Level Variables

Area-level variables were coded into categories of predictors based on the guiding taxonomy. The authors specifically coded indicators of political context; policy context; racial and ethnic segregation, diversity, or discrimination; socioeconomic factors; health care and social services availability and accessibility, including alcohol treatment and other mental and physical health care resources; social factors, including social capital, social connection, and social isolation; alcohol prevention activities; alcohol availability; and built environment factors, such as urbanicity and road infrastructure. Some factors may impact mortality at multiple levels (e.g., state, county, and community economic contexts), while others may be concentrated at specific levels (e.g., state alcohol policies, a community's built environment).

The majority of studies used multiple years of mortality data, with study designs falling primarily into two categories. Cross-sectional designs using multiple years of data focused on population associations (e.g., economic disadvantage with mortality). Retrospective longitudinal designs focused on specific temporal trends for a specific unit of analysis (e.g., mortality for states that adopted a policy). Appendix 1 summarizes the main characteristics and results of the reviewed studies.

Table 3 summarizes the different contextual variables across the levels of aggregation. Most state-level studies (25 of 30) examined some dimension of alcohol or drug policy in relation to mortality,^{22,24-31,33-38,61-63,66,67,77,79-82} with some studies taking advantage of lengthy time series data to capture fluctuations in mortality rates in response to policy changes in specific states.^{22,33,63,67,77} Other studies capitalized on between-state variability in policies over time.^{24-26,28,30,31,34-38,61,62,66,79-82}

Some county-level studies also focused on alcohol or drug policies,^{42,45,47,48,64,83,84} but most county-level studies (16 of 38) addressed built environment characteristics such as urbanicity or population demographic distributions.^{23,39-41,51,53,57,59,65,68-70,73,75,85,86}

Several county-level studies examined multiple area-level characteristics.^{72,76,78} Overall, 26 studies addressed area-level socioeconomic status (SES),^{26,37,40,44-47,49,50,54-56,58,60,68,71,72,74,76,77,86-90} although only 9 studies centered SES as a focal contextual variable and the other 17 studies included SES as a covariate. As discussed below, most of these analyses were descriptive, and very few studies examined specific mechanisms of action linking the built environment or socioeconomic SDOH with the mortality outcomes. Notable results on the SDOH represented in the reviewed studies that were examined as focal contextual variables or covariates are presented in the sections that follow and in Appendix 1.

Alcohol and Drug Policies

Thirty-two studies identified by the review focused on relationships between alcohol (and occasionally, drug) policies with mortality outcomes. In many studies, singular alcohol policies were evaluated, particularly for their association with alcohol-involved MVC fatalities. These analyses showed lower mortality rates associated with laws such as 0.08% legal blood alcohol concentration (BAC) limits for driving,²⁹ Sunday sales bans in New Mexico,⁴⁵ higher beer taxes,⁸² ignition interlock requirements for DUI offenders,^{31,36,37} minimum legal drinking age of 21 years,²⁴ zero-tolerance laws (ZTLs; making it illegal for any driver under age 21 to have a BAC greater than 0.00%),²² greater police enforcement of DUI laws (measured by DUI arrests),⁴⁷ and administratively revoking licenses of DUI offenders.²⁷ One study using synthetic control methods found that a spirits tax increase in Illinois was associated with a temporary reduction in alcohol-involved MVC fatalities but only in counties that did not border another state.³³ A recent study using a data set spanning from 1986 to 2005⁴⁸ compared the impact of several state- and county-level policies on alcohol-related MVC deaths using longitudinal state-level fixed-effects models (which assess how policy changes within states impact mortality outcomes over time), difference-in-differences models (which assess how trends vary across areas with different policies), and fixed-effects models for pairs of contiguous counties located in different states (which assess policy impacts in areas that are geographically similar). The authors concluded that, at the state level, the most effective policies were beer taxes, open container prohibitions, and higher fines for DUI offenses, while at the county level, the most effective policies were ZTLs, open container prohibitions, and license revocation for DUI. These policies were significantly associated with reductions in alcohol-involved MVC deaths. Other policies, such as 0.08% BAC limits, keg registration laws, mandated community service for DUI offenses, and mandatory jail sentences for DUI offenses, were not significantly associated with either state- or county-level MVC deaths in models that also included the aforementioned effective policies.

Evidence suggests that alcohol policies also impact alcohol-related mortality due to causes other than MVC. One investigation⁷⁹ showed that prohibition laws from 1900 to 1920 were associated with significant reductions in alcohol-related mortality attributed to diseases (e.g., circulatory disease, cirrhosis, liver disease) and to other causes (e.g., accidents, homicides, suicides). Evaluation of South Dakota's 24/7 Sobriety program for repeat DUI offenders⁹¹ showed a reduction in both all-cause mortality and deaths attributed to circulatory diseases likely to be alcohol-related.⁶⁴ One national study⁸² found that increased wine taxes reduced alcohol-involved suicide and alcohol-attributed deaths due to falls. Further, tax increases on alcohol beverages reduced mortality from alcohol-related diseases (excluding injuries) in New York,⁷⁷ Alaska,⁶⁷ and Florida.⁶³ By contrast, another national study⁶⁶ found that, rather than beer or spirits tax rates, government control of spirits sales was associated with reduced mortality from alcohol-related diseases. Finally, increased density of both on-premise and off-premise alcohol outlets was associated with alcohol-involved suicides in 14 U.S. states, and these effects were particularly strong for men and American Indian and Alaska Native decedents.⁸³

Conflicting evidence regarding policy impacts also exists, however. Using difference-in-differences models, Freeman²⁷ showed a lack of evidence of effectiveness for 0.08% BAC limits on weekend nighttime MVC fatalities (presumed to be alcohol-related), although that study did not have data on actual alcohol-involved MVC incidents. Studies also failed to detect relationships between a county's status as "dry" (no alcohol sales), "moist" (some local restrictions on sales), or "wet" (alcohol widely available) and alcohol-involved MVC fatalities nationally,⁴⁶ or with alcohol-related homicide victimization in Kentucky.⁸⁴ Weak evidence was found for impacts of beer taxes on MVC fatalities for young adults ages 18 to 20.²⁴ Finally, higher spirits taxes were associated with increased alcohol-involved deaths from falls in a different study,⁸² which those authors attributed to substitution effects (i.e., as spirits prices increase, people may purchase other alcohol beverages).

Some other studies revealed complex associations of alcohol policies with mortality. For example, one study³⁰ documented interactive effects of DUI arrests with both 0.08% BAC limits and ZTLs on alcohol-related MVC fatalities, suggesting that stronger alcohol control policies must be actively enforced to be effective. In another study, a California state law banning sales of both alcohol and gasoline at a given site (e.g., a gas station) was associated with reduced alcohol-related MVC fatalities.⁴² However, at the same time, analyses of this policy's effects in five counties in the Los Angeles area also suggested that some locations in suburban areas experienced an increase in alcohol-related MVCs causing property damage, and some locations in urban areas experienced an increase in serious injury.⁴² Thus, some policies may have unintended consequences impacting outcomes other than mortality.

A few studies focused on how other drug policies contributed to alcohol-involved mortality. For example, a study using data from 1982 to 1988⁸¹ found that increased cigarette taxes were associated with reduced mortality where alcohol was a contributing cause of death (including oral and liver cancers), but not with deaths where alcohol was the primary cause (e.g., alcohol-related cirrhosis), suggesting some specificity in the effects. A recent study⁶⁸ found states that had laws ensuring access to the overdose reversal drug naloxone had a reduced relative risk of deaths attributable to alcohol-involved polysubstance use (opioids plus alcohol and benzodiazepines) compared to those attributable to opioids alone. Another study examined deaths of despair in the state of Illinois,⁷² documenting that alcohol-related deaths were positively associated with the opioid prescribing rate and with drug arrest rates. These findings suggest that policies targeting substances other than alcohol may help reduce alcohol-related mortality.

Five studies considered the joint effects of multiple policies simultaneously. Fixed effects regression models using data from 1982 to 1988 showed increased alcohol prices were associated with reductions in deaths where alcohol is a contributing cause, but not with deaths where alcohol is a primary cause.⁸¹ Those models also accounted for mandatory jail sentences for DUI and dram shop liability laws (i.e., laws that hold businesses liable for harm caused by individuals who were served or sold alcohol at the establishment), neither of which were associated with mortality due to alcohol as either a primary or contributing cause. Another study³⁸ found that three key alcohol safety laws—license revocation for DUI, 0.10% BAC, and 0.08% BAC—jointly were associated with a significant downward trend in fatal alcohol-involved MVCs between 1982 and 1997. Two studies by Fell and colleagues examined 16 laws targeting underage alcohol use and DUI. One study found that possession and purchase laws and the strength of false identification laws were associated with reductions in alcohol-involved MVC fatalities among drivers under age 21.²⁵ The other study²⁶ showed that a suite of four laws targeting underage alcohol use and DUI (possession, purchasing, use and lose [suspended driver's license with an underage drinking violation], and ZTLs) as well as three laws targeting all drivers (0.08% BAC, license revocation, and primary seat belt laws) were associated with significant declines in alcohol-involved MVC fatalities among drivers under age 21. Additionally, the latter set of laws was associated with reductions in these fatalities among drivers age 26 or older as well. Scherer and colleagues³⁵ also found that both dram shop liability and responsible beverage service training were associated with reductions in alcohol-involved MVC fatalities in drivers under age 21, even when accounting for minimum legal drinking age laws and other DUI-related policies (including 0.08% BAC).

In a series of studies, researchers used the composite alcohol policy scores (APS) developed by Naimi and colleagues⁹² to describe the strength of a state's combined alcohol policy environment in relation to different alcohol-involved mortality

outcomes. Stronger alcohol policy environments (indicated by higher APS) were associated with reduced rates of alcohol-related cirrhosis deaths nationally among women (but not among men) and among all racial and ethnic groups other than American Indian and Alaska Native people⁶¹ as well as with reduced rates of alcohol-attributable cancers.⁶² These environments also were associated nationally with reduced alcohol-involved MVC fatalities among males and females under age 21, including deaths of drivers and passengers,²⁸ and with reduced alcohol-involved MVC fatalities among people age 21 or older, including crashes involving driver(s) with BAC greater than 0.00% but less than 0.08%.³⁴ Finally, higher APS were associated with reduced alcohol-related homicide victimization among people in 17 states, including reductions in firearm homicides and those related to intimate partner violence.⁸⁰ Of note, one study⁹³ documented a trend of nationally increasing APS from 1999 to 2018, which the authors attributed to increased stringency of laws pertaining to alcohol-impaired driving.

Overall, evidence supports the beneficial effects of alcohol policies such as higher alcohol taxes, ZTLs, license revocation, and fines for DUI on alcohol-related mortality. These effects include both reductions in alcohol-involved MVC fatalities and deaths attributed to alcohol-related diseases (including but not limited to cirrhosis and liver disease). Evidence is less robust for mandatory jail sentences for DUI, although enforcement of DUI restrictions (as indicated by DUI arrests³⁰) appears to be important for reducing alcohol-related MVC fatalities. Future research may consider sub-state variations in policy effects as well as subgroup differences in impacts on alcohol-related mortality. Continued updates to composite measures of state-level alcohol policy strength (such as the APS⁹²) would enable comparison of future research with the large extant evidence base that encompasses diverse causes of alcohol-related mortality.

Socioeconomic Factors

The most common measures of socioeconomic SDOH assessed in the studies identified in this review were median household income or proportion of the population living below poverty level, with some variability in associations with the mortality outcomes. Descriptive analyses of national data showed states in the highest quartile of chronic liver disease mortality had a lower median income compared with states in the lower mortality risk quartiles.⁶⁰ A study of New York State (excluding New York City) found that alcohol-related disease mortality was inversely associated with state-level per capita personal income over time.⁷⁷ At the zip code level, one study of New York City found that a 10% increase in area-level poverty was associated with a 10% increase in alcohol-poisoning deaths,⁸⁹ another study of New York City neighborhoods found higher poverty rates were associated with increased liver disease mortality,⁴⁹ and data from both New York and California counties showed cirrhosis

mortality was associated with lower SES.⁵⁴ Moreover, another study found that higher county-level poverty was associated with a higher likelihood of opioid-related suicides involving alcohol compared with opioid-only suicides.⁶⁸ However, several other studies did not detect such associations. A study of four states in the U.S.-Mexico border region found no association between county-level alcohol-related mortality and poverty rates, proportion of county residents with less than a high school education, or unemployment rates.⁸⁶ Two studies examining the association between economic factors and alcohol-involved MVC fatalities found that lower county-level poverty⁴⁷ and higher income per capita³⁷ were associated with a higher number of alcohol-related fatal MVCs. Another study focusing on major metropolitan areas did not detect an association between median household income and alcohol-involved MVC deaths.⁴⁰

Other indicators of socioeconomic context included unemployment and educational attainment. Unemployment was associated with more alcohol-related fatal MVCs among drivers under age 21 nationally²⁵ and among drivers in New Mexico⁴⁵ and Idaho,⁴⁴ as well as with increases in deaths due to cirrhosis and chronic liver disease,⁵⁸ and deaths from acute causes (e.g., alcohol poisoning and alcohol-involved suicide).⁹⁰ Kerr and colleagues⁸⁷ found that unemployment rates were associated with reduced alcohol-involved suicide rates for some groups (men ages 45 to 64 and women age 65 or older), but they also noted that these associations were no longer significant when adjusting for poverty rates. Five studies also reported associations between educational measures and alcohol-related mortality, with three studies finding that the proportion of residents with a bachelor's degree or higher was associated with lower mortality^{44,47,76} and two studies finding no statistical significance.^{40,86}

A few studies looked at economic security or SES as a composite measure. Knapp and colleagues⁸⁸ found that deaths due to alcohol poisoning and chronic liver disease from 2000 to 2015 were higher in counties with greater economic insecurity, and Khatana and Goldberg⁵⁵ showed increases in economic prosperity were associated with reductions in chronic liver disease mortality. Another study of six states and two metropolitan areas found that neighborhood socioeconomic deprivation was associated with increased risk of chronic liver disease mortality.⁵⁰ One national study found that a stronger economy was associated with a lower ratio of alcohol-involved fatal MVCs.²⁶ Again, however, not all studies identified such associations. A study based in Illinois did not find an association between the composite Distressed Communities Index⁹⁴ and overall alcohol-related mortality at the county level.⁷² Similarly, Stringer found no association between county-level alcohol-related MVC fatalities and a composite measure of SES.⁴⁶ Finally, Pierce and Schott found no association between the impact of permanent normal trade relations (based on proportion of the county workforce affected by manufacturing and agricultural import tariffs) and county rates of alcohol-related liver disease.⁵⁶

Only four studies looked at how economic SDOH may interact with other factors. One study found that the association between age distributions and deaths of despair was moderated by median county income in Florida,⁷⁶ such that alcohol-related mortality was positively associated with median age only in counties with lower median income. Another study found differences in associations of county-level poverty with alcohol-involved suicides by the decedent's age group: Higher county-level poverty was associated with a higher likelihood of alcohol involvement in suicide among men ages 45 to 64, but with a lower likelihood among men ages 20 to 44.⁸⁷ One study found no associations between county median income or county poverty and alcohol-related mortality when all counties from 46 states were analyzed together, but did find that a higher percentage of the population in poverty was associated with more alcohol-poisoning deaths in urban counties.⁷¹ Finally, Seto and colleagues found that the association between religiosity and deaths of despair varied by socioeconomic deprivation.⁷⁴ In counties with lower economic disadvantage, six of the eight measures of religiosity (adherence and congregation size per capita for four different religions) were not correlated with deaths of despair, while two measures (percentage adherence to mainline Protestantism and percentage Catholic) were negatively associated. However, in highly disadvantaged counties, the percentage adherence to mainline Protestantism and both percentage Catholic and larger Catholic congregation size per capita were positively associated with deaths of despair, whereas both percentage adherence to Black Protestant churches and larger congregation size per capita were negatively associated with deaths of despair.

Overall, research suggests poor economic conditions are associated with higher rates of alcohol-related mortality, particularly deaths due to alcohol-involved cirrhosis and/or liver diseases. However, there was substantial variability in measures used to assess economic conditions and in the units of analysis. Future research into associations between economic conditions and alcohol-related mortality would benefit from including measures comparable with prior studies (e.g., median household income, unemployment rates, percentage in poverty, proportion of residents with a college degree, and composite measures of economic security or prosperity) and contrasting effects of economic conditions at different spatial levels (state, county, and community). Few studies explicitly examined explanations for associations of socioeconomic SDOH with alcohol-related mortality outcomes—other than noted exceptions of studies by Khatana and Goldberg,⁵⁵ who explored the role of access to health care in disadvantaged counties, and by Major and colleagues,⁵⁰ who explored the role of both alcohol outlet density and health care access in disadvantaged communities. Conceptually driven studies focused on mechanisms of action would greatly advance knowledge of how socioeconomic SDOH impact specific causes of alcohol-related mortality.

Built Environment Characteristics

County-level urbanicity/metropolitan status was the most common built environment characteristic included as a focal variable^{23,39,53,57,65,68,70,73,75} or covariate.^{25,40,46,47,55,72,86}

The associations between urbanicity/metropolitan status and alcohol-related mortality varied substantially. Most studies found that alcohol-related mortality—including DUI fatalities,^{23,25,39,46} combined alcohol- and other drug-related mortality,^{68,70} deaths of despair,⁷³ cirrhosis/liver disease mortality,^{53,57} and other chronic alcohol mortality⁶⁵—was higher in rural counties. In contrast, three studies using mortality data from 2010 onward found that mortality from multiple causes^{72,86} and cirrhosis/liver disease mortality⁵⁵ were higher in urban areas. Four studies found a nonsignificant relationship between urbanicity/metropolitan status and DUI fatalities^{40,47} and deaths of despair.^{72,75} The heterogeneity in these results suggests there may be important effect modifiers for further consideration.

Several studies used total/daily vehicle miles traveled (a proxy for traffic volume) as a covariate in models examining the relationship between DUI fatalities and area-level predictors.^{25,44,46,47} In each study, more vehicle miles traveled were associated with higher DUI fatality rates. Relatedly, the availability of ridesharing was assessed as a potential mechanism to reduce DUI fatalities. Brazil and Kirk⁴⁰ found that overall Uber availability was not related to DUI fatalities, but it was associated with more DUI fatalities in population-dense or urban areas, perhaps due to an increase in traffic volume.

Other characteristics of the built environment also affected alcohol-mortality rates. Cotti and Walker⁴¹ found that casino openings were related to more DUI fatalities both in the county in which the casino was located and in neighboring counties. Zemore and colleagues⁸⁶ found that alcohol- and other drug-related mortality was highest in off- versus on-border counties in the four U.S.-Mexico border states, despite off-border counties having higher proportions of college-educated residents and a lower likelihood of being designated as a high-intensity drug trafficking area.

Several other studies found regional variation in alcohol-related mortality outcomes;^{5,51,59,69} however, explanations were not tested empirically. Seto⁷⁴ found that Appalachian status, percentage of veterans, and economic reliance on mining as employment (relative to nonspecialized) were all positively associated with deaths of despair in U.S. counties, although a county's economic reliance on farming and manufacturing for employment was negatively associated with deaths of despair. These employment factors may help explain regional variation in alcohol-related mortality as well.

Future studies could advance interventions to improve community health by explicitly examining mechanisms contributing to urban and rural differences in mortality outcomes, as there may be specific drivers of cause-specific deaths. For example, physical and mental health care access and

economic disinvestment may contribute to deaths due to chronic heavy alcohol use in rural communities, while other SDOH such as alcohol outlet densities and social connection may be more relevant in urban and suburban areas.

Other Domains

Health care and social services

Some studies included measures of health care and social services, which are important determinants of mortality.⁹⁵ Six studies reported associations between area-level health care factors and alcohol-related mortality outcomes. Two studies focused on deaths of despair,^{71,76} two examined alcohol-related MVC fatalities,^{32,43} and two examined liver-related mortality.^{52,55} No studies focused on social services factors per se, although one study of U.S. state preemption laws that constrain local governments' ability to enact legislation to raise the minimum wage or mandate paid sick leave⁹⁰ found statistically significant associations between availability of paid sick leave and reductions in fatal alcohol poisonings for women.

Bradford and Bradford,⁷¹ in a study investigating the relationship between county-level eviction rates and combined alcohol- and other drug-related mortality rates, used the number of active physicians per 1,000 county residents and percentage of residents without health insurance as covariates. The number of active physicians was positively associated with alcohol poisoning in models including data for all counties nationally, but this variable did not remain statistically significant when analyses were stratified by urbanicity. The percentage of the population without health insurance was not statistically significant in any of their models. Zeglin and colleagues⁷⁶ found that above-average rates of regular medical care (e.g., proportion of adults with recent medical checkups) were associated with fewer deaths of despair, but above-average mental health care availability (e.g., number of licensed social workers, psychologists, marriage/family therapists, and counselors per 10,000 residents) was unexpectedly associated with more deaths of despair. The percentage of adults with health insurance coverage and public health department expenditures were not significantly related to county-level deaths of despair, however.

Freeborn and McManus⁴³ evaluated whether the county-level number of substance use treatment clinics was associated with alcohol-related MVC fatalities in non-metropolitan counties across the United States. Predictive models estimated that each additional inpatient or residential clinic was associated with 15% fewer alcohol-related MVC fatalities, while each additional outpatient clinic was associated with 26% fewer alcohol-related MVC fatalities in the county where the additional clinic was located. Nonsignificant findings in models predicting overall MVC fatalities suggested that the effects of county-level substance use treatment availability were specific to alcohol-related fatalities. Using national data, Mann and colleagues³²

tested whether the number of Alcoholics Anonymous (AA) members and number of people receiving any alcohol or drug treatment were associated with state-level alcohol-related MVC fatalities. Higher AA membership was associated with lower rates of alcohol-related MVC fatalities, but the number of people receiving alcohol or drug treatment was unrelated to MVC fatalities.

Goldberg and colleagues⁵² found liver disease mortality was higher in counties with a greater proportion of uninsured adults and in counties located farther away from a liver transplant center. Counties with higher transplant wait-listing rates paradoxically had lower liver disease-related mortality rates. Gastroenterologist access was not significantly associated with liver disease mortality. Finally, in their study of county-level economic prosperity and liver disease-related mortality among U.S. adults, Khatana and Goldberg⁵⁵ found that the percentage of insured individuals and number of primary care providers were not statistically significant predictors, although a larger number of county hospital beds was associated with higher liver disease-related mortality.

Although associations between health care and social services factors and alcohol-related mortality were mixed, some patterns did emerge. Indicators of health care use^{32,76} were more strongly related to alcohol mortality outcomes than were indicators of general health care availability.^{52,55,71} This might be because health care service availability does not necessarily guarantee health care access or indicate that such access is equitable across individuals with varying risk for alcohol-related mortality. Another conclusion from this small set of studies is that health care factors protected against negative alcohol use consequences more strongly as they became more specific to alcohol use.^{32,43} This might partially explain the observation that health insurance coverage was only significantly related to alcohol mortality in one of four studies that accounted for this factor.⁵² It could be that insurance plans did not sufficiently cover prevention or treatment services for alcohol use and associated consequences. The single study that focused on health policies and alcohol-related mortality⁹⁶ found reductions in deaths caused by acute effects of alcohol (e.g., alcohol poisonings) after the implementation of California's Mental Health Services Act in 2006, which the authors attributed to improvements in access to prevention and treatment.

Two studies found that greater health care access was associated with worse alcohol-related mortality outcomes.^{55,76} One potential explanation is that services are made more available and providers choose specific geographic markets precisely because alcohol-related problems are more prevalent in that area. As most of these studies were retrospective and cross-sectional, however, inferences regarding causality or directionality are limited. Longitudinal studies testing mediation pathways could advance understanding of how health care and social services may reduce alcohol-related mortality.

Racism, discrimination, and racial or ethnic composition

Racism and discrimination are key SDOH and drivers of alcohol-related health inequities.⁹⁷⁻⁹⁹ To date, the strongest evidence linking racial discrimination to health inequities in the United States is through discrimination's adverse effects on psychological wellbeing, mental health, and related health practices, including alcohol use.¹⁰⁰ Yet no studies of alcohol-related mortality included formal measures of racism or discrimination, and relatively few studies included related indicators, such as an area's racial or ethnic group composition, including percentage of White/Caucasian or non-Hispanic residents;^{47,71,74} percentage of non-Hispanic Black or African American residents;^{37,47,55,74,86} percentage of Hispanic or Latinx residents;^{47,55,74,78,86} or percentage of residents of another racial or ethnic group.³⁷ Of note, racial and/or ethnic group composition was always included as a covariate and never an exposure of interest.

Findings on area-level racial and/or ethnic group composition in relation to alcohol-related mortality were quite mixed. One study found lower rates of alcohol-involved mortality in counties that had higher proportions of Hispanic residents with low levels of acculturation.⁷⁸ Similarly, other studies found that a higher percentage of non-Hispanic Black people in an area was associated with fewer cirrhosis/liver disease⁵⁵ and DUI fatalities.³⁷ Seto⁷⁴ found that a high relative concentration of three major racial or ethnic groups (Caucasian, African American, Hispanic) each was negatively associated with deaths of despair, but another study found no statistically significant associations of racial or ethnic composition with deaths of despair.⁷¹ Using data from states in the U.S.–Mexico border region, Zemore and colleagues⁸⁶ found that higher county-level percentages of Black and Latinx people were associated with less drug mortality and less combined alcohol- and other drug-related mortality, but not with alcohol-related mortality when considered alone, suggesting there may be different determinants of drug-related and alcohol-related deaths. By contrast, another study found that the proportion of Hispanic residents was associated with higher risk of unspecified alcohol mortality.⁷⁸ Finally, Stringer⁴⁷ found that county proportions of residents who were Caucasian, African American, or Hispanic were not significantly related to DUI fatalities when assessed with linear models, although each of these racial or ethnic composition variables was associated with lower mortality risk in quadratic models, suggesting that race and ethnicity may have complex relationships with alcohol-related mortality. Of note, most of these studies compared mortality outcomes of areas with high proportions of certain racial or ethnic group residents (e.g., Caucasian, African American, Hispanic) with those in areas with high proportions of other populations who do not identify as any of the listed groups (e.g., American Indian and Alaska Native people), rather than directly testing associations of American Indian and Alaska Native resident density with mortality outcomes. However, one

early study using data from the 1980s noted that alcohol-related mortality was higher among urban American Indian and Alaska Native people than among White people in Washington state.⁸⁵

Studies that explicitly operationalize area-based measures of structural racism, including segregation and redlining, could help the field move beyond purely descriptive analysis of racial and ethnic composition in relation to alcohol-related mortality. Analysis of the political context also was lacking, and studies of how gerrymandering and state actions designed to increase or decrease racial and ethnic segregation may impact mortality due to alcohol use also would be informative. In future research, attention to both subgroup differences and pathways from racism and discrimination to alcohol-related mortality would advance efforts to improve community health.

Social norms and social control of high-risk alcohol use

Area-level drinking cultures may either increase or decrease alcohol-related mortality risks. For example, higher proportions of young residents (particularly young men) in an area might foster social norms encouraging heavy alcohol consumption, whereas higher proportions of certain religious groups might discourage alcohol consumption. Ransome and colleagues⁸⁹ found that an increase in area-level prevalence of heavy drinking in New York City was associated with higher subsequent risk of alcohol-poisoning deaths. Similarly, one national study showed that county-level per-capita alcohol consumption was a significant predictor of DUI fatalities.⁴⁷ However, in another study conducted in the 100 largest metropolitan areas in the United States, a county's percentage of adults reporting recent binge drinking (defined as five or more drinks per occasion for men and four or more drinks for women) or heavy alcohol use (defined as 15 or more drinks per week for men and eight or more drinks per week for women) was not significantly associated with DUI fatalities.⁴⁰ Stringer⁴⁶ found that increases in anti-alcohol community norms, values, attitudes, and beliefs were related to decreases in alcohol-related MVC fatalities, and Ahern and colleagues⁴⁹ showed that higher levels of social control were associated with lower rates of liver disease mortality in New York City neighborhoods.

Several studies assessed the relationships of mortality outcomes with area-level demographic correlates, yielding mixed results. Other than the findings related to socioeconomic factors and racial and ethnic composition reviewed in the previous sections, results for aggregated demographic characteristics are not reviewed in depth, as these measures are difficult to interpret in relation to SDOH. Appendix 1 indicates studies that considered an area's age distribution^{40,47,71,72,74} or gender or sex distributions^{37,44,47,53,55,71,72,74} in relation to the mortality outcomes. Theoretically driven future research could provide more meaningful investigation of how demographic composition might either cause or reduce alcohol-related mortality, such as through social norms related to alcohol use

or attitudes about driving after drinking. Multilevel analyses may be most informative for addressing these questions.

Discussion

This review synthesizes research on area-level SDOH associated with alcohol-related mortality. Although some of these determinants are shared with drug overdose deaths (such as socioeconomic disadvantage), others are more specific to mortality due to acute and/or chronic alcohol use (such as alcohol control policies). Research published since 1990 has studied a wide variety of alcohol-related mortality outcomes at different levels of analysis, using diverse analytic strategies and varied sets of covariates, and using different years of data from various places across the country.

Several limitations should be noted regarding how area-level factors were assessed across studies. For example, findings summarized here were limited to area-level relationships (ecological analyses) and did not include multilevel analyses assessing impacts of contextual determinants on individual-level mortality risk. Additionally, with the exception of most of the alcohol policy studies, many studies were cross-sectional or descriptive, limiting causal inferences for the effects of many SDOH. There also was wide variability in the degree to which specific mortality causes were examined in relation to SDOH. For example, although many studies analyzed alcohol-related MVC or cirrhosis/liver disease fatalities, fewer studies analyzed other mortality causes due to chronic alcohol consumption. Additionally, many studies relied on derived measures¹⁰¹ based on aggregated characteristics of individuals or households in an area (e.g., county-level median income, proportion of people without a college degree, proportion of residents from a specific racial or ethnic group) rather than using integral measures¹⁰¹ of the area's structural characteristics (e.g., descriptions of the health care or education environment, measures of racism or redlining). Although both types of measures can provide valuable information on geographic differences in mortality, the latter provides more direct assessment of associations with fundamental SDOH.¹⁰ Finally, only seven articles^{44,45,48,51,74,86,89} incorporated statistical methods to address spatial autocorrelation—that is, the associations between adjacent or nearby spatial units of analysis (e.g., county, Census tract). Ignoring spatial autocorrelation may lead to incorrect statistical inferences because the assumption of independence is violated.¹⁰² Future mortality studies could assess spatial autocorrelation and address it analytically if needed.

Overall, this review found that the literature in most of the thematic areas addressed is theoretically underdeveloped. Consistent with the primary conclusion of a smaller review of social determinants of deaths of despair,¹⁹ future research

could focus on a more diverse set of SDOH and area-level predictors of alcohol-related mortality in community health research and prevention. As few studies examined major health policy changes or focused on health care system factors beyond inclusion as covariates, prospective studies could better disentangle effects of care availability and access on alcohol-related mortality outcomes by examining factors such as the prevalence of different treatment models (e.g., abstinence, harm reduction, integrated physical and behavioral health care) and approaches (e.g., pharmacotherapy, cognitive behavior therapy, community support). Further, few U.S. states have restrictive alcohol policy environments;⁹³ therefore, future work examining sub-state variation in alcohol policies and impacts on alcohol-related mortality may yield useful findings. Policies targeting other substances also may contribute to reduced alcohol-related mortality, and these policies may interact with health care services as well.

This review did not identify any studies that advanced the understanding of how racism and discrimination, community-level prevention activities, or social services relate to alcohol-related mortality. Further work could help to better characterize the specific social determinants of increased alcohol-related mortality in Indigenous communities, such as increased alcohol availability or targeted marketing tactics.¹⁰³ Recent research examining the impact of state-level structural racism on alcohol use behaviors found that some dimensions of structural racism (e.g., incarceration segregation) but not others (e.g., residential segregation, economic segregation) were related to increased alcohol use.¹⁰⁴ Moreover, discrimination, often measured as an interpersonal psychosocial stressor, is associated with increased alcohol consumption.⁹⁹ Future studies could directly assess relationships of structural racism and discrimination with alcohol-related mortality attributed to different causes (both acute and chronic) while considering new and alternative measures of racism and discrimination at different geographic scales.

Additional studies could provide insights into the link between local community and neighborhood contexts and alcohol-related mortality, given that preventive interventions are more likely to be implemented at the local level than are policy changes (commonly addressed by states) or health care system improvements (typically addressed by states and counties). Future work also could explore subgroup differences, interactions between different SDOH, and specific mechanisms of action to identify strategies to improve population health. Given the length of time it takes to see the effects of SDOH interventions on mortality, simulation models may allow cost-effective exploration of potential benefits of combinations of interventions, as well as variation in impacts across geographic contexts and for high-priority demographic subgroups.

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Appendix 1. Characteristics of the Reviewed Studies and Selected Results

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Ahern et al. (2008) ⁴⁹	New York City Neighborhood	2000 Cirrhosis/liver disease	Economic context	Cross-sectional Poisson and negative binomial regression	Key predictor: Economic disadvantage was a risk factor Covariates: Social context was a protective factor
Alattas et al. (2020) ⁶²	United States State	2006–2010 Other chronic cause	Alcohol & drug policies	Retrospective longitudinal/lagged Linear regression with 1-year lag from alcohol policy score	Key predictor: Alcohol & drug policies were a protective factor
Baeseman (2009) ³⁹	Wisconsin County	1999–2006 (pooled) DUI fatalities	Built environment	Cross-sectional (pooled data) Breslow-Day test for homogeneity of trends across urban and rural counties	Key predictor: Built environment was a risk factor
Bensley et al. (2020) ⁶⁸	27 U.S. states County	2012–2015 (pooled) AOD combined	Built environment	Cross-sectional (pooled data) Multinomial logistic regression	Key predictor: Built environment was a risk factor Covariates: Economic disadvantage was a risk factor and alcohol & drug policies had mixed effects
Blackman et al. (2001) ²²	Washington State	1990–1998 DUI fatalities	Alcohol & drug policies	Interrupted time series ARIMA with partial-trend indicator	Key predictor: Alcohol & drug policies were a protective factor
Borgialli et al. (2000) ²³	Michigan County	1994–1996 DUI fatalities	Built environment	Retrospective longitudinal Logistic regression, mediation analysis	Key predictor: Built environment was a risk factor
Bradford & Bradford (2020) ⁷¹	46 U.S. states and District of Columbia County	2004–2016 Deaths of despair	Economic context	Observational panel analysis Linear regression with time and county fixed effects and control function (2SR) to address endogeneity	Key predictor: Economic disadvantage had mixed effects Covariates: Health care/social services had mixed effects
Brazil & Kirk (2020) ⁴⁰	United States County	2009–2017 DUI fatalities	Built environment	Observational panel analysis Poisson regression with county fixed effects, month-by-year fixed effects, county-specific linear time trend; standard errors adjusted for county-level clustering	Key predictor: Built environment was a predictor with mixed effect
Cataldo (2022) ⁷²	Illinois County	2010–2014; 2015–2019 Deaths of despair	Multiple domains	Repeated cross-section Linear regression	Key predictors: Alcohol & drug policies were a risk factor and built environment had mixed effects
Cotti & Walker (2010) ⁴¹	United States County	1990–2000 DUI fatalities	Built environment	Retrospective longitudinal/lagged Fixed effects logistic regression with robust standard errors to account for clustering of counties in states; 1-year, 2-year, and 3-year lags from casino opening	Key predictor: Built environment had mixed effect

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Dee (1999) ²⁴	United States State	1977–1992 DUI fatalities	Alcohol & drug policies	Observational panel analysis Weighted least squares	Key predictor: Alcohol & drug policies had mixed effects
Delcher et al. (2012) ⁷⁷	New York (excl. New York City) State	1969–2006 Unspecified alcohol-related mortality	Alcohol & drug policies	Quasi-experimental time series Seasonal ARIMA; generalized linear mixed model to assess effect of tax increase or decrease on outcome	Key predictor: Alcohol & drug policies were a protective factor Covariates: Economic disadvantage additionally was a risk factor
Desai et al. (2018) ⁶⁰	United States State	2010 Cirrhosis/liver disease	Economic context	Cross-sectional Chi-square tests, Kruskal-Wallis test	Key predictor: Economic disadvantage was a risk factor
Dwyer-Lindgren et al. (2016) ⁵¹	United States County	1980–2014 (pooled) Cirrhosis/liver disease	Built environment	Cross sectional (pooled data) Small area estimation methods, Bayesian spatially explicit mixed-effects regression model	Key predictor: Built environment was a risk factor
Farmer et al. (2005) ⁴²	California County	1982–1989 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal Seemingly unrelated regression	Key predictor: Alcohol & drug policies were a protective factor
Fell et al. (2008) ²⁵	United States State	1982–1990 (pooled) DUI fatalities	Alcohol & drug policies	Cross-sectional (pooled data), between-state design ANOVA & stepwise linear regression	Key predictor: Alcohol & drug policies were a protective factor Covariates: Unemployment/work environment and built environment was risk factors
Fell et al. (2009) ²⁶	United States State	1982–2004 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal, pre-test/post-test Structural equation modeling	Key predictor: Alcohol & drug policies were a protective factor Covariates: Economic disadvantage additionally was a risk factor
Freeborn & McManus (2010) ⁴³	United States County	1998, 2000, 2002–2004 DUI fatalities	Health care & social services	Repeated cross-section Linear regression with state fixed effects and standard errors adjusted for state-level clustering	Key predictor: Health care/social services were a protective factor
Freeman (2007) ²⁷	United States State	1980–2004 DUI fatalities	Alcohol & drug policies	Time series Two-way fixed effects specification of the pooled time series cross-section regression (DID estimators)	Key predictor: Alcohol & drug policies had mixed effects
Giesbrecht et al. (2015) ⁸³	14 of 17 U.S. states participating in NVDRS County	2003–2011 Alcohol-related suicide/violence	Alcohol & drug policies	Cross-sectional Correlation, multilevel logistic regression	Key predictor: Alcohol & drug policies were a risk factor

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Goldberg et al. (2021) ⁵²	United States County	2009–2019 Cirrhosis/liver disease	Health care & social services	Cross-sectional Multivariable regression models, cluster analysis with optimized hotspot analysis	Key predictor: Health care/social services had mixed effects Covariates: Built environment was a risk factor
Grossman et al. (1994) ⁸⁵	Washington County	1981–1990 Multiple	Built environment	Cross-sectional Descriptive analyses comparing mortality rates and confidence intervals across race/urban groups	Key predictor: Built environment was a risk factor
Ha et al. (2022) ⁵³	United States County	1999–2019 Cirrhosis/liver disease	Built environment	Retrospective longitudinal Piecewise linear regression (Joinpoint regression) for trends	Key predictor: Built environment was a predictor with mixed effects
Hadland et al. (2015) ⁶¹	United States State	2010–2011 Cirrhosis/liver disease	Alcohol & drug policies	Retrospective longitudinal/lagged Poisson regression accounting for state-level clustering and a 3-year lag between policies and alcohol-related cirrhosis mortality	Key predictor: Alcohol & drug policies had mixed effects
Hadland et al. (2017) ²⁸	United States State	2000–2013 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal/lagged Logistic regression with a 1-year lag from alcohol policy score	Key predictor: Alcohol & drug policies were a protective factor
Hingson et al. (1996) ²⁹	Utah, Oregon, Maine, California, & Vermont compared to Idaho, Washington, Massachusetts, Texas & New Hampshire State	1976–1993 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal Ratio of relative risk of alcohol-involved fatal crashes between comparison states (with 95% CIs), pre and post passage of 0.08% BAC limit in 5 U.S. states	Key predictor: Alcohol & drug policies were a protective factor
Hosseinihimeh et al. (2022) ³⁰	United States State	1985–2019 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal/lagged Fixed-effects linear regression models with 1-year lag for DUI arrests per 100 and DUI laws	Key predictor: Alcohol & drug policies had mixed effects
Karpati et al. (2002) ⁵⁴	New York & California County	1997 Cirrhosis/liver disease	Economic context	Cross-sectional Comparison of relative mortality rates between counties in lowest and highest socioeconomic quartiles (rate ratios), Pearson's correlations	Key predictor: Economic disadvantage was a risk factor

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Kaufman & Wiebe (2016) ³¹	United States State	1999–2013 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal/lagged DID analysis, state fixed effects models with 3-year lag for policy adoption	Key predictor: Alcohol & drug policies were a protective factor
Kerr et al. (2017) ⁸⁷	16 U.S. states participating in NVDRS (excluding Ohio) County	2005–2011 (pooled) Alcohol-related suicide/violence	Economic context	Cross-sectional (pooled data) Generalized estimation equations (normal/Gaussian distribution, link identify function, unstructured correlation matrix)	Key predictor: Economic disadvantage had mixed effects Covariates: Unemployment/work environment had mixed effects
Khaleel et al. (2019) ⁸⁴	Kentucky County	2005–2012 Alcohol-related suicide/violence	Alcohol & drug policies	Cross-sectional Multilevel logistic regression model with random county intercept	Key predictor: Alcohol & drug policies had nonsignificant effects
Khatana & Goldberg (2022) ⁵⁵	United States County	2010–2017 Cirrhosis/liver disease	Economic context	Retrospective longitudinal Negative binomial generalized linear mixed model with random state intercept	Key predictor: Economic disadvantage was a risk factor Covariates: Health care/social services, racism/discrimination, and built environment/other spatial characteristics all had mixed effects
Knapp et al. (2019) ⁸⁸	7 U.S. states in the Mid-Atlantic region County	2001–2005; 2006–2010; 2011–2015 Multiple	Economic context	Retrospective longitudinal Log-linear mixed effects regression models with robust standard errors	Key predictor: Economic disadvantage was a risk factor
Landen et al. (2014) ⁶⁹	United States County	1999–2009 AOD combined	Built environment	Retrospective longitudinal Standardized rate ratios for American Indian/Alaska Native populations using White age-adjusted mortality rates for comparison	Key predictor: Built environment was a risk factor
Law & Marks (2020) ⁷⁹	United States State	1900–1920 Multiple	Alcohol & drug policies	Pre-test/post-test DID regression	Key predictor: Alcohol & drug policies were a protective factor
Li et al. (2019) ⁴⁴	Idaho County	2010–2015 DUI fatalities	Employment/work environment	Observational panel analysis Hierarchical Bayesian random parameters models with spatiotemporal interactions	Key predictor: Unemployment/work environment was a risk factor Covariates: Education was a protective factor, and built environment was a risk factor

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Major et al. (2014) ⁵⁰	6 U.S. states (California, Florida, Louisiana, New Jersey, North Carolina, Pennsylvania) & 2 metropolitan areas (Atlanta, Georgia; Detroit, Michigan) Neighborhood	1995–2008 Cirrhosis/liver disease	Economic context	Retrospective longitudinal Multilevel/hierarchical Cox proportional hazards regression models with census tract random effects	Key predictor: Economic disadvantage was a risk factor
Maldonado-Molina & Wagenaar (2010) ⁶³	Florida State	1969–2004 Other chronic cause	Alcohol & drug policies	Lagged time series analysis Time series analyses including Box-Jenkins method to fit ARIMA models, fixed-effects and random-effects models	Key predictor: Alcohol & drug policies were a protective factor
Mann et al. (1996) ³²	United States State	1982 and 1990 DUI fatalities	Health care & social services	Repeated cross-section Ordinary least squares regression models using data from two time points	Key predictor: Health care/social services had mixed effects
McClelland & Iselin (2019) ³³	Illinois State	1992–2015 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal Synthetic control methodology	Key predictor: Alcohol & drug policies had mixed effects
McMillan et al. (2007) ⁴⁵	New Mexico County	1990–2000 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal Bayesian hierarchical binomial regression models with county random effects and adjustment for spatial pattern motor vehicle crash rates	Key predictor: Alcohol & drug policies were a protective factor Covariates: Unemployment/work environment and social context were risk factors
Mejia de Grubb et al. (2016) ⁷⁸	United States County	1999–2014 Unspecified alcohol-related mortality	Multiple domains	Repeated cross-section Joinpoint regression models for trends, ecological correlations with county demographics	Key predictors: Racism/discrimination was a risk factor and built environment was a protective factor
Monnat (2020) ⁷³	United States County	1990–2018 Deaths of despair	Built environment	Retrospective longitudinal Descriptive tabulations of trends for areas defined by urbanicity and by 1989 economic dependency	Key predictor: Built environment was a risk factor
Naimi et al. (2017) ⁸⁰	United States State	2003–2012 Alcohol-related suicide/violence	Alcohol & drug policies	Repeated cross-section Generalized estimating equations logistic models	Key predictor: Alcohol & drug policies were a protective factor

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Naimi et al. (2018) ³⁴	United States State	2000–2015 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal/lagged Logit generalized estimating equations with 1-year lag from policy, mediation analysis	Key predictor: Alcohol & drug policies were a protective factor
Nicosia et al. (2016) ⁶⁴	South Dakota County	2000–2011 Other chronic cause	Alcohol & drug policies	Retrospective longitudinal DID, Poisson regression	Key predictor: Alcohol & drug policies were a protective factor
Pierce & Schott (2020) ⁵⁶	United States County	1990–2013 Cirrhosis/liver disease	Employment/work environment	Retrospective longitudinal DID	Key predictor: Unemployment/work environment had nonsignificant effects
Ransome et al. (2020) ⁸⁹	New York City Neighborhood	2009–2014 Other acute cause	Economic context	Retrospective longitudinal Hierarchical Bayesian spatiotemporal multivariate Poisson regression model with multiple random effects	Key predictor: Economic disadvantage was a risk factor
Scherer et al. (2015) ³⁵	United States State	1982–2012 (pooled) DUI fatalities	Alcohol & drug policies	Cross-sectional (pooled data) Structural equation modeling	Key predictor: Alcohol & drug policies were a protective factor
Seto (2022) ⁷⁴	United States County	2010–2019 (pooled) Deaths of despair	Social context	Cross-sectional (pooled data) Spatial autoregressive models	Key predictor: Social context had mixed effects. Covariates: Racism/discrimination was a protective factor; built environment was a risk factor; and unemployment/work environment had mixed effects
Shiels et al. (2020) ⁶⁵	United States County	2000–2017 Other chronic cause	Built environment	Repeated cross-section Descriptive analysis; hot spot analysis for identifying clusters of high-rate counties	Key predictor: Built environment was a risk factor
Simon & Masters (2021) ⁷⁵	United States County	1990–2017 (pooled) Deaths of despair	Built environment	Cross-sectional (pooled data) Correlations in mortality change scores between 1990–1991 and 2016–2017 by urbanization	Key predictor: Built environment had nonsignificant effects
Singh & Siahpush (2014) ⁵⁷	United States County	1990–1992 & 2005–2009 Cirrhosis/liver disease	Built environment	Repeated cross-section Log-linear regression models; rate ratios or relative risks and rate differences comparing two time periods; Poisson regression models	Key predictor: Built environment was a risk factor
Singh & Siahpush (2016) ⁵⁸	United States County	1990–1992 & 2006–2010 Cirrhosis/liver disease	Employment/work environment	Repeated cross-section Descriptive analysis for 1990–1992 and 2006–2010 for low and high unemployment rates	Key predictor: Unemployment/work environment was a risk factor

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Sloan et al. (1994) ⁸¹	United States (excl. Alaska, Hawaii) State	1982–1988 Multiple	Alcohol & drug policies	Pre-test/post-test Fixed effects regression modeling, weighted by state population ages 25 to 64 years; some models removed time series variation using year indicator variables	Key predictor: Alcohol & drug policies had mixed effects
Son & Topyan (2011) ⁸²	United States State	1995–2004 Multiple	Alcohol & drug policies	Retrospective longitudinal/lagged Regression weighted by state-year population ages 25 to 64 years with 1-year lag from excise taxes	Key predictor: Alcohol & drug policies had mixed effects
Spencer et al. (2020) ⁷⁰	United States County	2000–2018 AOD combined	Built environment	Observational panel analysis Joinpoint weighted least-squares regression models	Key predictor: Built environment was a risk factor
Spillane et al. (2020) ⁵	United States State	2000–2016 Unspecified alcohol-related mortality	Built environment	Repeated cross-section Descriptive trends	Key predictor: Built environment was a risk factor
Stringer (2018) ⁴⁶	United States County	1993–2015 DUI fatalities	Social context	Retrospective longitudinal Multilevel growth curve modeling (level 1 = repeated measures over time, level 2 = county, level 3 = state)	Key predictor: Alcohol & drug policies were a protective factor Covariates: Economic disadvantage and education were protective factors; racism/discrimination and built environment had mixed effects
Stringer (2019) ⁴⁷	48 U.S. states & District of Columbia (excl. Florida, Illinois) County	1985–2015 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal/lagged Multilevel latent growth curve modeling with 1-year lag	Key predictor: Social context was a protective factor Covariates: Built environment had mixed effects
Studnicki et al. (2005) ⁵⁹	Florida County	2001 Cirrhosis/liver disease	Built environment	Cross-sectional Descriptive comparisons of selected health status indicators across populations, time	Key predictor: Built environment was a risk factor
Subbaraman et al. (2021) ⁶⁶	United States State	1999–2016 Other chronic cause	Alcohol & drug policies	Retrospective longitudinal/lagged Fixed-effect log-log models with 1-year lag for policies	Key predictor: Alcohol & drug policies had mixed effects
Teoh et al. (2021) ³⁶	United States (excl. California) State	2001–2019 DUI fatalities	Alcohol & drug policies	Repeated cross-section Poisson regression with log link scale parameter to allow for overdispersion	Key predictor: Alcohol & drug policies were a protective factor

Appendix 1. Characteristics of the Reviewed Studies and Selected Results (Continued)

Study Authors & Year of Publication	Setting Level of Aggregation	Years Measured Outcomes Measured	Primary Area-Level Predictors	Study Design/Analysis Method(s)	Results for Focal Predictor(s) & Notable Covariates Discussed in Review
Ullman (2016) ³⁷	United States (excl. Alaska, District of Columbia) State	2001–2012 DUI fatalities	Alcohol & drug policies	Retrospective longitudinal Weighted least-squares regression models; DID fixed effects	Key predictor: Alcohol & drug policies were a protective factor Covariates: Economic disadvantage was a protective factor; built environment was a risk factor; and racism/discrimination had mixed effects
Voas et al. (2000) ³⁸	United States State	1982–1997 (pooled) DUI fatalities	Alcohol & drug policies	Cross-sectional (pooled data) Weighted least-squares regression models	Key predictor: Alcohol & drug policies were a protective factor
Wagenaar et al. (2009) ⁶⁷	Alaska State	1976–2004 Other chronic cause	Alcohol & drug policies	Lagged time series analysis Combination of ARIMA model with structural parameters in interrupted time-series models	Key predictor: Alcohol & drug policies were a protective factor
Wolf et al. (2022) ⁹⁰	United States State	1999–2019 (pooled) Other acute cause	Employment/work environment	Cross-sectional (pooled data) Negative binomial regression with fixed effects for state and year and adjusted standard errors for state-level clustering; the predicted mortality using counterfactual values	Key predictor: Unemployment/work environment had mixed effects
Wright & Lee (2021) ⁴⁸	United States (excl. Alaska, Hawaii)	1986–2004 DUI fatalities	Alcohol & drug policies	Pre-test/post-test Longitudinal state fixed effects models; DID; and contiguous counties fixed effects designs	Key predictor: Alcohol & drug policies were a protective factor
Zeglin et al. (2019) ⁷⁶	Florida County	2016 Deaths of despair	Multiple	Cross-sectional Backwards regression	Key predictors: Economic disadvantage and education were protective factors; health care/social services and built environment had mixed effects
Zemore et al. (2022) ⁸⁶	Four U.S.-Mexico border states County	2008–2017 (pooled) Multiple	Built environment	Cross-sectional (pooled data) Spatial lag models	Key predictor: Built environment had mixed effects Covariates: Racism/discrimination had mixed effects; other predictors had nonsignificant effects
Zimmerman et al. (2021) ⁹⁶	United States State	1976–2015 Other acute cause	Health policies	Retrospective longitudinal Generalization of the quasi-experimental synthetic control method incorporating least absolute shrinkage and selection operator (LASSO)-penalized linear elastic net regression	Key predictor: Health policies were a protective factor

Notes: AOD, alcohol and other drugs; ARIMA, autoregressive integrated moving average; DID, difference-in-differences; DUI, driving under the influence; NVDRS, National Violent Death Reporting System. A spreadsheet with the detailed information is available upon request from the corresponding author.

THE ROLE OF THE FAMILY IN ALCOHOL USE DISORDER RECOVERY FOR ADULTS

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Alcohol use disorder (AUD) and family functioning are inextricably bound, and families are impacted negatively by AUD, but families show substantial improvements with AUD recovery. Family members can successfully motivate a person with AUD to initiate changes in drinking or to seek AUD treatment. During recovery, family members can provide active support for recovery. Several couple- or family-involved treatments for AUD have been developed and tested in rigorous efficacy trials. Efficacious treatments based in family systems theory or cognitive behavioral approaches focus on the concerned family member alone, or they engage the couple or family as a unit in the treatment. However, most treatments have been studied in fairly homogeneous, heterosexual, White, non-Hispanic populations, limiting the potential generalizability of these treatments. Substantial gaps remain in our understanding of family processes associated with the initiation and maintenance of AUD recovery among adults. This review outlines the existing literature and describes opportunities for future research to address knowledge gaps in understanding the mechanisms by which these treatments are efficacious, use of family-based treatments with diverse populations, integration of pharmacotherapies with family-involved treatment, role of families in recovery-oriented systems of care, and how to improve treatment development and dissemination.

KEY WORDS: alcohol; adult; alcohol treatment; couples; family therapy; recovery

It is almost axiomatic that alcohol use disorder (AUD) and the family are inextricably bound. AUD harms individual family members and the functioning of the family as a whole, and family members' actions may exacerbate problematic drinking. Conversely, families play a key role in recovery from AUD, and recovery has a positive impact on family members and family functioning. Scientific research to understand the interrelationships between drinking and family functioning began in the early 1900s, and treatment models that address both drinking and family functioning have been developed and tested for close to 75 years. This article reviews the conceptual and empirical literature on the impact of AUD on families, the role of the family in recovery from AUD, the role of family-involved treatment in fostering recovery, and issues related to specific populations. The review concludes with suggested future directions for research. When discussing families, we are using the term broadly to refer to a broad range of kinship relationships. When discussing couples, we are referring to couples in intimate relationships regardless of marital or co-habiting status, and using the term "partner" to refer to either individual in the intimate relationship. However, where research findings apply to a more limited group (e.g., spouse versus partner) we use the correct term to delimit the population studied. Given the limitations of current research findings, we are referring to different-sex couples unless otherwise specified.

THE IMPACT OF AUD ON FAMILIES

AUD affects the functioning of families: Family members take on additional household and childcare responsibilities, social events are disrupted, and families may experience significant financial difficulties.¹ Individual members of these families suffer as well. Spouses and children of adults with AUD or other substance use disorder (SUD) experience psychological distress as well as health and behavioral problems. For example, women with a male partner who has AUD and is actively drinking reported elevated levels of

depression, anxiety and psychosomatic complaints, and disruptions to work and social/leisure activities, and they utilize more health care resources.²⁻⁴ Similarly, children who have a parent with AUD experience a variety of psychological, behavioral, and school problems.^{5,6}

Research also has demonstrated a reciprocal relationship between drinking, AUD, and the quality of intimate relationships. For example, longitudinal studies of engaged different-sex couples have found that the husband's drinking prior to marriage is a strong predictor of the wife's drinking a year into marriage,⁷ that the female partner's drinking influences the male partner's drinking in the next year,⁸ and that relationship distress and AUD are strongly related.⁹ A recent meta-analysis of 17 studies ($N = 10,553$ couples) focused on different-sex couples found that partners influence one another's drinking, although the magnitude of effects was modest. The extent to which women influenced men's drinking ($\beta = .19$) was slightly greater than the extent to which men influenced women's drinking ($\beta = .12$).⁸ Results from clinical and nonclinical samples also reveal a close association between heavy drinking and the perpetration of intimate partner violence.¹⁰ Couples with at least one partner with AUD have high rates of intimate partner violence, regardless of the sex of the partner with AUD,¹¹ and drinking is common during episodes of interpersonal violence.¹² Most typically, interpersonal violence is bidirectional in these couples.

Orford and his colleagues have proposed that the functioning of family members of those with AUD is best understood within a stress-strain-coping-support (SSCS) framework.¹³ The SSCS model assumes that living with a family member with AUD is a stressful circumstance, putting family members at risk of a variety of psychological and physical health problems. Within this model, families are seen as engaging in a variety of behaviors to cope with this chronic stressor, some of which are more effective in helping families to cope with and to influence the drinker's behavior, and others that are less effective. The SSCS framework has informed much of contemporary research on AUD and the family.

THE ROLE OF THE FAMILY IN RECOVERY FROM AUD

There are strong connections between family functioning and drinking outcomes. Family behaviors can contribute to changes in drinking, and, conversely, changes in drinking can contribute to more positive family functioning. For example, in early studies, Moos and colleagues examined the longitudinal course of functioning in families of men receiving treatment for AUD. At 2-year follow-up, they compared family functioning for men who were in recovery to men who had relapsed. Wives of men in recovery, compared to wives of men who relapsed, drank less, were less depressed and anxious, had fewer negative life events, and had higher family incomes.¹⁴ Similarly, the children of the men in recovery showed fewer symptoms of emotional distress.¹⁵ As a whole, families of men in recovery had greater family cohesion, greater expressiveness, a higher orientation toward recreational activities, and greater agreement in how they viewed the overall environment of their families, compared to families of men who had relapsed.¹⁶ These studies highlight the positive impact of recovery on families.

Families may play a key role in fostering the initiation of recovery. Although popular literature and 12-step mutual help groups for families, such as Al-Anon (<https://al-anon.org/>), emphasize detachment for family members and empirically supported interventions for families, such as Community Reinforcement and Family Training (CRAFT),¹⁷ it has been found that family behavior can increase the probability that an individual will seek help for AUD.¹⁸ Key family behaviors that support the initiation of change include ignoring behaviors associated with using alcohol or drugs, reinforcing positive or desirable behaviors related to sobriety or help-seeking, allowing the drinker to experience the naturally occurring negative consequences of drinking, and making specific and positive requests for changes in behavior related to drinking, such as reducing consumption or seeking help.¹⁷

Families and other members of the social network of persons with AUD also play an

important role in supporting successful changes in drinking.¹⁹ Although the scientific literature is limited on specific family behaviors that facilitate and support successful recovery from AUD, there is evidence that active partner coping predicts positive outcomes. Specific types of active partner coping that support successful change include (a) decreasing negative or controlling behaviors that serve as antecedents to drinking; (b) increasing supportive and problem-solving communication; (c) reinforcing positive behavior change by the partner with an alcohol problem; (d) increasing shared positive activities; and (e) reducing family member drinking behavior to support changes in the drinking of the person with AUD.²⁰

Families also may make recovery more difficult. For example, individuals with AUD perceive relationship problems as significant relapse precipitants,²¹ and believing that one's partner also has AUD predicts poorer drinking outcomes compared to individuals who did not believe that their partners have AUD.²² Specific family behaviors associated with relapse include negative attitudes, emotional responding, and low levels of distress tolerance.¹⁹

THE ROLE OF FAMILY-INVOLVED TREATMENT IN FOSTERING RECOVERY

Knowledge of the impact of AUD on families has led to the development of family-engaged treatments. Considerable research has focused on the development and testing of these family-engaged treatments to foster recovery from AUD. These treatments have focused on the role of the family in the initiation of help seeking, initiation of change, and maintenance of long-term change. The following sections describe and review treatments for affected family members in their own right, and as a way to help effect change in the identified individual with AUD. This is then followed by a review of the array of interventions influenced by cognitive behavioral therapy (CBT) and family systems models. Table 1 provides a summary of key elements in each of the treatments reviewed.

Table 1 Family Interventions for AUD

Intervention	Number of Sessions	Target Population	Key Interventions
5-Step Method ²³	Variable/ as needed	Family members	Explore sources of stress/strain Provide psychoeducation Identify ways of coping Identify social supports Address other family needs
Community Reinforcement and Family Training (CRAFT) ¹⁷	12 or more	Family members	Decrease behaviors protecting from negative consequences Increase self-care Increase positive responses to changes in drinking Enhance self-care Protect from domestic violence Enhance communication skills
A Relational Intervention Sequence for Engagement (ARISE) ²⁴	3 or more	Family members	Level 1: telephone coaching to invite person with AUD to a meeting Level 2: face-to-face coaching with family Level 3: coaching family to set limits and consequences
Significant Other engagement in Motivational Interviewing (SOMI) ²⁶	1	Couples	Single session of motivational interviewing Partner skills to enhance motivation to change drinking Partner skills to support drinking reductions
Alcohol Behavioral Couple Therapy (ABCT) ²⁰	12 (weekly)	Couples	Cognitive behavioral therapy interventions to change drinking Partner skills to support change Partner skills to decrease antecedents to drinking Couple skills to manage drinking situations Enhance positive couple interactions Enhance couple communication skills
Behavioral Couples Therapy (BCT) ³¹	12–20 (weekly)	Couples	Implement daily recovery contract Enhance positive couple interactions Enhance couple communication skills
Brief Family-Involved Treatment (B-FIT) ⁴¹	3 (weekly)	Family member and person with AUD	Increase positive interactions Implement recovery contract Enhance family communication skills
Brief Strategic Family Therapy (BSFT) ⁴³	12–16 (weekly)	Whole families	Influence maladaptive family interactions, alliances, and boundaries Decrease scapegoating
Multidimensional Family Therapy (MDFT) ⁴⁴	40–48 (twice weekly for 5 to 6 months)	Whole families	Develop multiple therapeutic alliances Restructure family functioning
Multisystemic Therapy (MST) ⁴⁵	Approximately 20	Whole families; youth involved with juvenile justice system	Individual treatment Family intervention School-based intervention Peer-based intervention Community-based intervention

Treatments for Affected Family Members

The 5-Step Method, a systematic intervention based on the SSCS model, is designed to help families cope more effectively with the AUD of a family member. The focus of the intervention is on the families in their own right, rather than on the relationship between family behaviors and outcomes for the person with AUD. The 5-Step Method helps families explore sources of stress and strain in their lives, provides psychoeducation about the SSCS model, helps them identify effective ways of coping with these sources of stress, assists them in identifying sources of social support for themselves, and assists with other needs that family members might have. The 5-Step Method has been tested with families in primary care as well as specialty care settings, with results supporting the effectiveness of the approach in reducing family-related harm in terms of both physical and psychological symptoms.²³

Two treatments focus on providing family members with skills to help a family member to seek AUD treatment. CRAFT helps concerned family members to change contingencies for drinking by decreasing behaviors that protect the drinker from naturally occurring consequences of drinking, increasing positive family responses to changes in drinking, learning self-care and protection from intimate partner violence, and learning how to communicate positive requests for change and/or help seeking.¹⁷ Compared to Al-Anon, CRAFT results in significantly greater rates of help seeking, and comparable rates of improvement in family members' depression and anxiety. The ARISE method (A Relational Intervention Sequence for Engagement) provides a series of steps that family members may use to encourage their loved one to seek treatment; ARISE also is effective in encouraging persons with AUD to seek treatment.²⁴ In addition to treatments for the affected family member alone, there are several treatment models and approaches that involve both the affected family members and the individual with AUD. Treatments with strong empirical support have drawn largely from

cognitive behavioral and family systems concepts; the following sections review these approaches.

Cognitive Behavioral Approaches

Cognitive behavioral therapy (CBT) approaches view alcohol use as a learned behavior, cued by environmental stimuli and maintained by the positive consequences of alcohol use. Family-engaged CBT approaches view family behaviors as potential cues for drinking, as providing positive consequences of drinking, and as having the potential to provide positive consequences for changes in drinking behavior.

Adding partner-assisted components to individual treatment might involve partners assisting the person with AUD with accurate self-monitoring of alcohol intake and contributing to functional analysis of drinking patterns to help identify high-risk situations in which craving and alcohol consumption are likely to present a challenge. Psychoeducation is also common to help the partner more clearly understand the treatment needs and program of recovery for the person with AUD. Partner involvement might provide additional benefits such as helping the partner without AUD to develop new skills to reinforce changes in drinking and minimize behaviors that might contribute to maladaptive couple and family interactions. One recent study exemplifying this approach found support for integrating romantic partners into individual motivational interviewing interventions to improve individual AUD outcomes.^{25,26}

Several manual-guided conjoint couple therapies incorporate cognitive behavioral techniques that have proven useful in individual treatments along with couple-focused interventions. One such modality with strong empirical support for both men and women with AUD is Alcohol Behavioral Couple Therapy (ABCT).²⁰ ABCT is a 12-week, cognitive behavioral treatment that has demonstrated efficacy in reducing alcohol consumption, enhancing relationship functioning, and improving partners' skills to facilitate reductions in drinking.²⁷ Core components of ABCT include (a) CBT interventions to help the person with AUD change his or her drinking,

(b) psychoeducation for the intimate partner to learn how to support changes in the behavior of their partner with AUD and to decrease behaviors that might serve as triggers for drinking, (c) interventions to teach the couple how to deal more effectively with drinking situations and drinking urges, (d) behavioral couple therapy interventions to increase positive interactions and improve communication skills, and (e) couple-focused relapse prevention. Figure 1 summarizes the hypothesized mechanisms by which ABCT impacts drinking outcomes. Recent ABCT literature indicates a strong association between partner participation in treatment and AUD outcomes. Reductions in drinking have been associated with increases in partner coping, conflict resolution skills, relationship satisfaction, and support behaviors.²⁸ Greater relationship quality before treatment predicted abstinence and alcohol consumption posttreatment.²⁹ Greater relationship satisfaction also is associated with fewer drinking urges and greater reduction in drinking urges during ABCT.³⁰ One notable strength of ABCT

is that it results in positive outcomes for couples presenting with poor relationship functioning and high levels of psychiatric comorbidity, and it is equipped to treat couples in which one or both partners have AUD.²⁷

A second well-researched approach to couple-involved therapy is behavioral couples therapy (BCT) for AUD and other SUD.³¹ BCT is a 12- to 20-session intervention that lasts 3 to 6 months. The core components of BCT include (a) a daily “recovery contract” to encourage abstinence from substance use, (b) interventions to increase positive couple behaviors, and (c) training in behavioral communication skills. Participants with SUD also complete weekly urine drug screens, and progress is monitored in a calendar-assisted approach (similar to the Timeline Follow-Back procedure).³²

Like ABCT, BCT is suitable to implement alongside 12-step groups such as Alcoholics Anonymous (<https://aa.org/>) and individual AUD treatments. Data from randomized controlled trials suggest that BCT has excellent feasibility, participant acceptability, and efficacy.^{33,34,35}

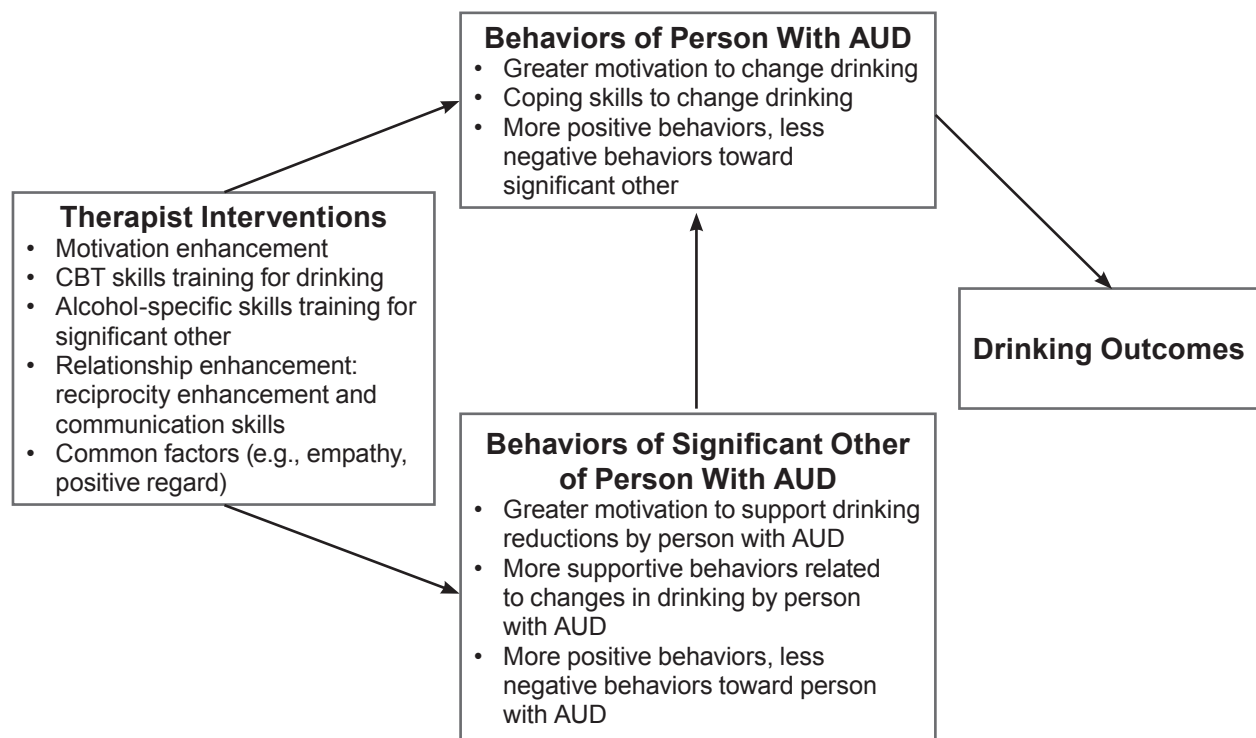


Figure 1 Hypothesized mechanisms of change in Alcohol Behavioral Couple Therapy. *Note:* AUD, alcohol use disorder; CBT, cognitive behavioral therapy.

BCT also has the ability to reduce maladaptive couple conflict behaviors such as intimate partner violence³⁶ and has been tested for use among military veterans with positive outcomes³⁷ and with couples in which both partners have AUD.³⁸ However, findings from one recent trial indicate that a group adaptation to BCT to treat multiple couples simultaneously did not perform as well as when couples were treated separately.³⁹

Brief family-involved treatment (B-FIT) is a three-session intervention that aims to improve family functioning, increase family-related incentives associated with reduced alcohol consumption, and implement proven techniques for family treatment of AUD to achieve and maintain long-term abstinence.⁴⁰ Specifically, B-FIT incorporates adaptations such as (a) involving any concerned family member rather than romantic partners only, (b) implementation within a patient's multifaceted program of recovery, (c) targeting the key components of ABCT in an accelerated manner, and (d) leveraging behavioral contracting techniques to increase treatment efficiency.⁴¹ B-FIT was recently examined in a pilot randomized controlled trial ($N = 35$ couples) with promising outcomes.⁴²

Family Systems Approaches

Treatment models based in family systems theory assume that the actions of individual family members affect all other members of the family, and that families have typical and repetitive ways of interacting that maintain dysfunctional behavior patterns of the family as a whole and of individuals within the family. Thus, these models focus on change in the structure and functioning of the family to effect change in dysfunctional behaviors, such as alcohol or drug use, in individual family members. Three major approaches in family systems therapy have evidence supporting their efficacy and should be noted, although most of the controlled trials of these treatments have been conducted primarily with adolescents with AUD or other SUD.

Brief strategic family therapy (BSFT) combines interventions from structural and strategic family

therapies and assumes that substance use as well as other behavioral problems are symptoms of family dysfunction. Thus, the treatment focuses on influencing maladaptive patterns of family interaction, alliances, boundaries, and scapegoating of individual family members. Data reported from multiple studies support that BSFT is efficacious in decreasing adolescent substance use a year after treatment, that changes in family functioning mediate the relationship between BSFT and outcomes, and that parents receiving BSFT also decreased their drinking after treatment.⁴³

Multidimensional family therapy (MDFT) views adolescent problems as multidimensional and addresses factors on multiple levels (i.e., individual, family, environment) that may be contributing to the adolescent's problem behaviors. The treatment involves establishing multiple relationships between the therapist and the adolescent, family, and other systems, and it uses a range of interventions to restructure family and individual functioning. Data suggest that MDFT is more effective than comparison treatments,⁴³ although it is more costly to deliver. However, when the associated costs of delinquency are considered, the cost-effectiveness of MDFT is comparable to cognitive behavioral interventions.⁴⁴

Multisystemic therapy (MST), developed as a family intervention for youth involved with the juvenile justice system, intervenes in multiple systems, including the individual, family, school, peer, and community. The primary focus of MST has been on antisocial behaviors, but data also suggest that, compared to community treatment as usual, MST leads to positive substance use outcomes.⁴³ Combined with interventions to strengthen families with parental AUD and child maltreatment, MST has been found to decrease child negative symptoms, parental substance abuse, and instances of child maltreatment.⁴⁵

Summary of Family-Involved Treatments

Efficacious treatments drawn from cognitive behavioral and family systems theories have been developed both for family members alone and for

family members together with the individual with AUD. Most controlled trials of these treatments have compared either the family-involved treatment to treatment without the family member, or variations on the specific treatment (e.g., ABCT with or without involvement in Alcoholics Anonymous). Thus, the research literature to date does not provide guidance to clinicians about selecting a treatment from among those with empirical support.

SPECIFIC POPULATIONS

A great deal has been learned to date regarding efficacious family and couple treatment models. However, the empirical literature is also clear that AUD is a condition characterized by a great deal of heterogeneity in etiology, course, and factors influencing treatment outcomes. The following section describes treatment considerations for populations that might require tailored treatment considerations and adaptations to optimize outcomes.

Military and Veteran Families

Rates of hazardous and harmful alcohol use and AUD are high among active duty military and veteran populations. Compared to age- and sex-matched civilian samples, both women and men in active duty and veteran populations consume alcohol more frequently and heavily as well as incur a nearly fivefold greater risk for experiencing harmful alcohol-related health outcomes and developing AUD. Toward the goal of improving the health of the U.S. armed forces, their partners, and their families, emerging research has examined existing or adapted behavioral treatment approaches to determine their appropriateness in military and veteran populations, including couple therapy and treatment for families of veterans with AUD. For example, one recent open-label trial examined an adaptation of ABCT for returning military veterans ($N = 44$ couples).⁴⁶ This study utilized a 15-session format and incorporated relevant topics for combat veterans, including intimate partner violence, depression, post-traumatic stress disorder (PTSD), and traumatic brain injury, which are all known

to co-occur at high rates with heavy drinking and to affect military populations disproportionately. Similarly, BCT has demonstrated efficacy among veterans with AUD and co-occurring PTSD. More recently, a novel integrated approach that combines BCT with Cognitive Behavioral Couples Therapy for PTSD (Couple Treatment for AUD and PTSD) has shown promise in a preliminary open-label pilot study ($N = 13$ couples).³⁷ Given that military culture places heavy emphasis on marriage and family, this population is ripe with opportunities to advance dyadic alcohol research to better understand how veteran and active duty families cope with and encourage recovery from AUD, and how the family as a whole changes as the person with AUD recovers. In addition, more attention is needed to address the unique challenges to implementing dyadic treatment in active duty and veteran treatment settings (e.g., frequent relocations, extended deployments).

Women

Women with AUD experience different challenges than men with AUD in general and particularly in terms of intimate relationships. Data from longitudinal research suggest that husbands' drinking patterns prior to marriage strongly predict women's drinking in the first year of marriage, and male partners of women with AUD are more likely than wives of men with AUD to have AUD as well.⁴⁷ Women with AUD see relationship problems and the male partner's drinking as important antecedents to relapse, and they use alcohol to cope with relationship problems. Male partners of women with AUD tend to avoid confrontation as a way to cope with the woman's drinking.⁴⁸

The efficacy of ABCT and BCT has been tested with women with AUD and their male partners.^{47,49,50} In all three studies, ABCT or BCT led to better alcohol use outcomes for the women compared to the control condition. McCrady and colleagues also found that women who entered treatment with higher levels of relationship distress and women who presented with another clinical and personality disorders had greater improvements in drinking with BCT than individual therapy.⁴⁷

However, if given the choice, women with AUD prefer individual rather than conjoint therapy, citing as reasons their desire to work on individual problems, their perception of a lack of support from their partner, and logistical challenges to attending treatment together.⁵¹

Racial and Ethnic Minority Populations

Race and ethnicity play a significant role in family and couple relationship structure and functioning for many persons with AUD, thereby influencing the complex role of the family in AUD treatment seeking and recovery trajectories. To develop the knowledge base regarding the mechanisms by which race and ethnicity influence AUD recovery in families, dyadic AUD research must improve diversity within samples and must focus on treatment development adaptations for specific diverse populations. The existing literature demonstrates that substantial differences exist in alcohol consumption patterns, etiology, and risk factors associated with developing AUD as well as treatment engagement and outcomes in different racial and ethnic groups.⁵² Racially and ethnically diverse minority populations are persistently underrepresented as participants in randomized controlled trials focused on alcohol use. AUD research on families and couples faces a similar constraint that currently limits the generalizability of current findings.

Cultural constructs and institutional marginalization are likely to impact AUD recovery among racial and ethnic minority groups in varying ways. Furthermore, the complex intersectionality of various cultural and institutional factors is likely to influence drinking and recovery. Among other factors, gender roles, socioeconomic status, health care access, employment status, immigration status, involvement with the criminal justice system, religion, and language barriers are likely to manifest in separate but overlapping ways among families who belong to racial and ethnic minority groups.^{53,54} Some research suggests that acculturation and “traditional” family structures more often identified in non-White, non-Hispanic families might prevent the onset of AUD and

facilitate effective treatment seeking and change in racial and ethnic minority groups.^{52,55} Conversely, stigma and cultural beliefs related to AUD and help seeking, as well as couple and family therapy specifically, might negatively influence AUD recovery processes for some members of racial and ethnic minority groups. However, these mechanisms have not been well tested in the context of couple or family treatment for AUD.

Socioeconomic Status

Socioeconomic status (SES) is defined by many variables, including educational access and level, occupational status, housing access, neighborhood factors, and income.⁵⁶ Although AUD occurs among individuals and families from all socioeconomic backgrounds, the direct association between socioeconomic status, AUD, and alcohol-related harms is complex.⁵⁷ However, research indicates that families with lower SES (based on factors such as income and educational level) might incur increased negative physical and mental health sequelae of AUD, encounter barriers to accessing treatment, and confront more barriers to successful treatment outcomes, compared to families with higher SES.^{53,54,57,58} Minimal research has been conducted regarding socioeconomic barriers to accessing couple therapy for AUD specifically; thus, research is necessary to identify potential socioeconomic disparities and pathways to mitigating them. One study of access to general couple therapy was conducted among couples living in neighborhoods with at least 30% of households below the poverty threshold. Results showed that when couples in this sample obtained access to treatment, they utilized couple therapy services and derived positive gains.⁵⁹ Thus, research is needed to better understand AUD recovery among families with different socioeconomic advantages or disadvantages. Studies investigating effective methods to increase access to low-cost treatment options—including those with technological adaptations to increase treatment availability—are warranted. Leveraging existing study data and using qualitative data collection techniques to identify barriers and methods to overcoming barriers are also needed.

Sexual and Gender Minority Populations

Individuals identifying as sexual and gender minorities are more likely to consume alcohol and have higher rates of AUD than individuals identifying as heterosexual.⁶⁰ Some accruing research suggests connections between alcohol use, AUD, and relationship functioning in this population. For example, in same-sex male couples, poorer relationship functioning appears related to higher rates of alcohol problems;⁶⁰ in same-sex female couples, higher levels of verbal aggression and physical violence are associated with higher levels of alcohol use;⁶¹ and differences in alcohol use in same-sex female couples are associated with poorer relationship functioning (e.g., poor conflict resolution, poor satisfaction).⁶² However, research on intimate or family relationships and recovery in sexual minority groups is very limited. One qualitative study of gay men in recovery examined familial and other social network influences on recovery.⁶³ Family and other social network factors cited as important to their recovery included acceptance of their sexual orientation and a sense of social connectedness. Conversely, although the men indicated that they continued to look to their families for support, many continued to experience family rejection of their sexual orientation and perceived this as a stressor that made recovery more difficult.

Engaging Communities in AUD Treatment

A crucial shift emerging in the AUD treatment community is the recognition that treatment approaches need to be adapted to accommodate families from diverse backgrounds, rather than expecting individuals and families to adapt to current treatment methods. To achieve this goal, research is needed on how to modify current approaches to reduce pervasive barriers to identification of AUD, how to develop evidence-supported approaches to treatment access and engagement relevant to diverse populations, and how to include diverse communities in the scientific process (as both participants and

investigators). Increasing partnerships between research and AUD provider teams with health systems and community representatives serving racial and ethnic minority families, families with limited economic resources, and sexual minority populations might reveal pathways to achieve this goal. Community-based participatory research is an approach that provides one framework for developing research through true community partnerships.⁶⁴

FUTURE DIRECTIONS FOR RESEARCH

During the past several decades, the empirical literature has expanded significantly to develop a critical foundation of knowledge and advance the implementation of family and couples-based approaches to AUD treatment. This section reviews promising areas for future research to further advance the state of the science in this area and to inform clinical best practices to optimize the AUD recovery process by incorporating family members.

Understanding Couple and Family Support in Recovery

Data are limited on the role of couple and family support in AUD recovery processes outside of treatment; most of our knowledge to date has come from clinical trials of specific couple- or family-involved treatments or from studies using patients in treatment programs. A related question that warrants attention in the literature is learning about the circumstances under which partners and family members are well suited versus possibly inappropriate for conjoint therapies. Clinical guidelines for couple therapy for AUD suggest that conjoint therapy should not be attempted for couples with intimate partner violence that has resulted in physical harm or fear of retaliation or for couples in which one partner is planning to leave the relationship.²⁰ Gaining a clearer understanding of the specific couple and family behaviors that support or are detrimental in AUD recovery, as well as the mechanisms by which these behaviors influence

AUD recovery, is crucial to improve alcohol prevention and treatment efforts. For example, studies examining family-specific interactive behaviors that increase or mitigate known precipitants to drinking and relapse risk, such as heightened craving, are warranted. Similarly, this literature can be improved by examining thoughts, behaviors, and emotions that acutely predict both positive and negative AUD treatment outcomes, including those that occur within and between treatment sessions.

Exploring Partner and Family Integration in Recovery-Oriented Systems of Care

Although the majority of the current review has focused on manual-guided and single-episode treatment approaches, it is widely recognized that more integrated and sustainable resources often are warranted to initiate and maintain AUD recovery across populations. During the last two decades, research focused on recovery-oriented systems of care (ROSC) has demonstrated positive findings.⁶⁵⁻⁶⁹ ROSC is defined as “networks of organizations, agencies, and community members that coordinate a wide spectrum of services to prevent, intervene in, and treat substance use problems and disorder.”⁶⁵ Identifying pathways to integrate partners and family members, where appropriate, into ROSC models holds promise, but has not been investigated thoroughly. Future research directed at examining facilitators and barriers—at the patient, provider, and system levels—to inviting family members into AUD treatment under this model is necessary. For example, some individuals engaged in ROSC might be facing obstacles such as homelessness or incarceration that might make it more challenging to identify and engage a supportive peer, partner, or family member. Under these circumstances, an adjunctive approach to developing or strengthening nonfamilial social support relationships could be explored. It also is possible that improved training in existing couple and family theory and treatment modalities could facilitate greater accessibility and treatment outcomes.

Role of Partners and Family in AUD Resilience

The existing literature can be improved by developing a better understanding of couple- and family-level factors promoting AUD resilience, with a particular focus on individuals, couples, and families who choose to change their drinking behaviors without engaging formal treatment resources. Recent literature has begun to expand the knowledge base regarding individual-level behavioral and neurobiological factors associated with greater likelihood of sustained recovery. However, less research has focused on the specific roles of partner and family members in changing drinking behaviors, neurobiological functioning associated with recovery-related cognitions and behaviors, and recovery when formal treatments are not engaged.⁷⁰⁻⁷² Extending this area of the literature might be particularly useful for diverse populations with disproportionate risk for developing AUD or disparities and barriers to accessing formal or traditional AUD treatment resources.^{73,74}

Specific Populations

Couples and families from diverse backgrounds differ in their values, the structure and functioning of the families, gender roles within these relationships, how family members influence and support each other, and the role of alcohol use and AUD in the family. Although awareness of diversity in family functioning among different racial and ethnic groups, socioeconomically challenged populations, sexual and gender minorities, and veteran populations is increasing, the specific associations between alcohol use, AUD, family functioning, and AUD recovery have not been studied. Future research needs to focus on developing a more nuanced understanding of family structure and function around AUD in diverse populations to develop effective family-engaged treatments and dissemination of knowledge of effective practices to support recovery for these populations.

Expanding Couple and Family Treatment for AUD

Technology

One new direction for dyadic AUD treatment is the integration of existing and emerging modalities with electronic and technologically based adaptations (e.g., smartphone/online access, e-health [electronic health], m-health [mobile health]). Such adaptations hold promise to facilitate treatment access and engagement, enable accuracy in assessment, reduce participant burden, and streamline delivery of treatment content.

Among individual participants, technology-assisted and fully technology-based interventions are rapidly proliferating in the alcohol field. Technology-based approaches have proven utility to inform novel treatment development efforts, and they focus existing interventions on key components that are most likely to yield significant impacts on alcohol-related cognitions and behavior. Studies conducted among individuals consistently find that technology-assisted modalities are highly feasible and acceptable among participants. They show promise to increase participant access, engagement, and outcomes; to improve reach and cost-effectiveness; and ultimately to provide a viable AUD treatment option for individuals in a variety of populations.^{75,76} An emerging body of literature is examining technology-based, e-health, or mobile interventions for couples with AUD. Findings from the limited emerging literature on technology-based couple interventions are encouraging. For example, one recent study tested a mobile support system to facilitate family communication among families affected by AUD ($N = 9$).⁷⁷ Another study examined the feasibility and acceptability of a novel, four-session, web-based AUD intervention for military and veteran couples ($N = 12$) with promising outcomes.⁷⁸ As remote telehealth (e.g., using telephone and/or videoconferencing) approaches are evolving in the AUD treatment field, an emerging literature suggests that telehealth implementation of couple and family therapy is also feasible and acceptable.⁷⁹ Recent research on a brief, in-person, home-based

couple intervention found positive results for enhancing accessibility and efficacy.⁸⁰ Creating a home-based family telehealth intervention model of recovery has the potential to improve treatment access for individuals in AUD recovery and their partners and families.

A recently completed Small Business Innovation Research Phase 1 development project created a novel e-health intervention for families to reduce driving while intoxicated (DWI) and DWI recidivism.⁸¹ The intervention, B-SMART, was designed to help reduce risk for DWI reoffending by leveraging environmental support (e.g., family support) known to reinforce and thus increase the likelihood of alcohol abstinence and simultaneously reduce harmful drinking outcomes. Participants ($N = 32$) were family members of individuals with a recent DWI arrest and an interlocking ignition device installed on their vehicle, who rated the useability of the smartphone app. A Small Business Technology Transfer Phase 2 grant is underway to develop additional intervention modules and to conduct a randomized trial of the efficacy of the intervention.⁸² Overall, a great deal more research is needed to adapt existing dyadic AUD treatment modalities to incorporate technology such as mobile or online assessment monitoring, telehealth sessions, or self-guided online interventions.

Pharmacological treatment of AUD for couples and families

Combining pharmacological interventions with evidence-based behavioral treatments has the potential to optimize and sustain AUD treatment outcomes.⁸³⁻⁸⁵ However, few studies have examined the role of pharmacological interventions in trials of conjoint or family treatments for AUD. Research aimed at examining the role of medication utilization and compliance in dyadic and family modalities is needed. More specifically, medication-enhanced psychotherapy for AUD, in which medications and behavioral interventions are designed to work synergistically within or between sessions, is a promising new direction for couples. As new medications for AUD are being developed specifically with the goal of

targeting brain stress and social reward systems (e.g., intervening in the withdrawal/negative affect and preoccupation/anticipation stages of AUD), medications to simultaneously maximize AUD outcomes and enhance relationship functioning could optimize AUD and relationship functioning outcomes among couples.⁸⁶⁻⁹¹ One such medication, intranasal oxytocin, is currently being examined among couples with AUD for that purpose.⁹² Phase II trials of 3,4-methylenedioxymethamphetamine (MDMA) also are being conducted for a variety of psychiatric conditions, including among couples, and could hold promise to augment dyadic intervention for AUD.⁹³

Neurobiological underpinnings of AUD

Current AUD research has a heavy emphasis on understanding the neurobiological and behavioral underpinnings of AUD and interactions between them. Such approaches have proven utility in novel treatment development efforts. However, advanced neurobiological measures and techniques, which have proven useful in treatment development efforts with individuals, have not yet been applied to couples. For example, clinically relevant AUD biomarkers are rarely examined in epidemiological or treatment research with couples. Similarly, although functional magnetic resonance neuroimaging is widely used in laboratory and treatment research in the alcohol field, there is a scarcity of literature examining resting state or task-related neural functioning in romantic couples. Some novel directions include hyperscanning, in which two participants are scanned simultaneously in response to shared stimuli, and adapting imaging paradigms to address relational behaviors relevant to AUD.^{94,95} Preliminary evidence from a small sample of couples with relationship distress and substance misuse suggests that intimate partner violence in the relationship might exacerbate neural stress responses associated with couple conflict cues.⁹⁶ When applied to either mechanistic or treatment development efforts, this emerging line of literature might help to develop neural prognostic and diagnostic indicators of positive AUD treatment outcomes, risk for AUD

relapse, and short- and long-term correlates of AUD relapse risk.

Another area of potential for future research is applying the existing literature on dyadic physiological and neuroendocrine co-regulation to the alcohol field, an effort that has begun but needs to be extended. Data collected from samples of couples experiencing relationship distress and who enrolled in treatment trials for problems other than AUD indicate that discordant dyadic autonomic dysregulation is associated with acute and more severe couple conflict,⁹⁷ whereas synchrony in autonomic functioning is indicative of constructive couple therapy processes such as working alliance and improved health outcomes.⁹⁸ As biofeedback intervention approaches continue to evolve in the AUD field, these emerging data can help to inform the development and refinement of remote and in-person dyadic biofeedback to support recovery efforts among families affected by AUD.

Involvement of partners and family members in AUD therapies in the context of co-occurring mental health conditions

Identifying pathways to successfully treat AUD and co-occurring conditions among individual participants remains an area of intense scientific inquiry. However, far less attention has been dedicated to understanding how partners and family members might contribute to adjunct or conjoint therapies. One preliminary pilot study found promising feasibility and acceptability outcomes when examining a novel integrated approach that combines BCT with Cognitive Behavioral Couples Therapy⁹⁹ for PTSD ($N = 13$ couples).³⁷ Research also suggests that ABCT is more efficacious than individual CBT for women with AUD and co-occurring clinical and personality disorders.⁴⁷ A great deal more research is needed to identify dyadic pathways to treating AUD and commonly co-occurring conditions such as PTSD and depression.

Dissemination and implementation

Despite the abundance of rigorously conducted studies and findings supporting the efficacy of

dyadic AUD treatment, evidence-based couple and family therapies are rarely applied in frontline treatment settings. Literature identifying barriers to provider uptake and patient utilization is also limited. The scant data available suggest that a lack of familiarity with modalities such as BCT among treatment providers and administrators of treatment clinics are among the most commonly cited challenges.¹⁰⁰ Additional challenges include (a) logistical and time-related barriers to scheduling sessions with both members of a couple; (b) a lack of clarity regarding insurance reimbursements available for couple therapies (and whether reimbursements are greater than for individual sessions); (c) lack of formal training in couples therapies for AUD; and (d) perceived increase in the difficulty of implementing dyadic treatment compared to treating individuals with AUD.¹⁰⁰ As a result, dissemination and implementation efforts are needed to identify more clearly provider and administrative barriers to uptake across various treatment settings (e.g., community clinics, Veterans Affairs clinics, academically affiliated clinics), to develop accessible provider education models, and ultimately to develop a more robust and diverse pipeline of capable and confident providers.

The majority of individuals with AUD who change successfully do so on their own, without any formal treatment.¹⁰¹ As knowledge accrues about the most effective ways for families to motivate persons with AUD to change and to support change efforts, models to disseminate this knowledge in provider training programs and outside of treatment settings are needed. Community-based studies of these dissemination efforts also are needed to advance provider education and training efforts and to promote utilization of the full scope of couple and family treatments for AUD that are both available and efficacious.

Mechanisms of Treatment Response

Although efficacious couple and family treatments for AUD have been developed and tested, knowledge regarding behavioral mechanisms of action underlying treatment response largely remains untested. It is possible that both individual

and relational mechanisms specific to family and couple interactions might facilitate improved treatment outcomes, maintenance of recovery programs and sobriety, and long-term health. Thus, studies examining the mechanisms of action underlying effective couple and family treatments for AUD—as well as secondary analyses of extant data sets and studies combining data sets from multiple randomized controlled trials—are warranted. One avenue to addressing this gap in the literature is the use of observational coding schemes to examine within-session behaviors indicative of treatment response. A recent study examined the association between pronoun utilization (i.e., “I” versus “we”) within ABCT sessions and found that greater “we” language utilization was associated with greater alcohol abstinence at end of treatment and follow-up.¹⁰² Recent analyses based on coding of within-session language in ABCT sessions have found that contemptuousness by individuals with AUD toward their partners predicts poorer drinking outcomes¹⁰³ and that within an ABCT treatment session there is a complex interaction among client and partner change language and positive and negative relationship behaviors.¹⁰⁴ This line of research can be expanded to further improve our understanding of within-session behaviors relevant to AUD recovery among couples and families, given that several reliable and valid observational coding systems (i.e., the Rapid Marital Interaction Coding System [RMICS]; System for Coding Couple Interaction in Therapy–Alcohol [SCCIT-A]) have been developed and are widely used among couples in laboratory settings.

One specific mechanistic aspect of this literature that has not been thoroughly explored is the role of specific conflict behaviors and dyadic processes (both adaptive and maladaptive) in influencing alcohol craving as well as risk for lapse and relapse in AUD. The daily process and micro-longitudinal research designs and methods that have proven essential to understand some individual and dyadic mechanisms linking alcohol with couple conflict behaviors, such as intimate partner violence, have not been extended to nonviolent dyadic processes and recovery-related cognitions

and behaviors. This literature could be advanced through innovative intersections of multi-method approaches that link laboratory, neurobiological, and naturalistic data, such as incorporating traditional clinical trial designs with micro-longitudinal and remote assessment methods. Such data might be used to inform novel and accessible adjunct interventions and tailored treatment modifications to insulate people with AUD and their families from high-risk situations.

Leveraging Representative Samples

Future large-scale and multisite studies examining nationally representative samples (such as the National Epidemiologic Survey on Alcohol and Related Conditions [NESARC] data set,¹⁰⁵ etiological processes (such as the Adolescent Brain Cognitive Development study [ABCD]),¹⁰⁶ and treatment development (such as the Combined Pharmacotherapies and Behavioral Interventions for Alcohol Dependence [COMBINE study])¹⁰⁷ have the ability to leverage rich infrastructures and diverse resources, often in a longitudinal fashion, to measure dyadic and family functioning using reliable and valid measures. To date, measurement of partner- and family-related variables has been limited in existing efforts. Increased collaboration between investigators and treatment providers with dyadic and family expertise pertaining to AUD is warranted in future integrated and large-scale efforts. As brief and empirically sound measurement approaches become more widely available, such collaborative efforts have the potential to reduce existing silos between fields of expertise within the AUD research community and ultimately to provide critical new information to drive the AUD field forward.

SUMMARY AND CONCLUSIONS

The existing literature suggests that families play a key role in motivating persons with AUD to recognize the need to change, providing support for change, and supporting long-term recovery and that AUD recovery is good for families. Most of

our current knowledge, however, has come from studies of relatively small clinical samples or from treatment studies. The lack of community-based research, multisite randomized controlled trials, research on integration of partners and family members in recovery-oriented systems of care, conduct of AUD treatment-specific meta-analyses, and the exclusion of couple- and family-level variables in large-scale longitudinal studies of the onset and course of AUD remain important areas for future research. Similarly, the lack of research on the role of the family in AUD recovery in diverse populations is a major gap in the current literature.

The existing literature from treatment studies suggests that integrating partners and family members into AUD treatment is a highly effective way to maximize positive treatment outcomes and to facilitate long-term AUD recovery and health of individuals with AUD and their families. Several manual-guided approaches have proven efficacy, but efforts to improve provider education and increase uptake of evidence-supported couple- and family-based AUD treatment modalities are needed to improve access and maximize the reach of available interventions. Challenges also might emerge if social relationships are persistently strained, if it is not safe or appropriate to include partners and family members in these modalities, or if individuals with an alcohol problem are navigating additional challenges such as incarceration or homelessness that are likely to influence day-to-day social contact and implementation of currently available modalities. There is an abundance of new opportunities to integrate emerging novel scientific methods—such as multimodal, multidisciplinary assessment and intervention approaches—into research focused on couples and families with a family member with AUD. The literature also is clear that improved access to AUD treatments among diverse populations is needed. It is crucial to improve synergy between existing alcohol research and the treatment community as well as the vast population of individuals in need of AUD treatment and their partners and families. Progress toward meeting these goals can be facilitated through increased collaboration with community partners

to develop culturally informed modifications to research inclusion, AUD assessment, and intervention. Increased collaboration between investigators, administrators, and clinical providers to maximize existing federal funding investments in couple and family AUD treatment and recovery processes also holds potential to reduce treatment barriers and improve long-term outcomes for couples and families.

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Community Indicators

Assessing the Impact of Alcohol Use on Communities

Andrea Flynn, Ph.D., and Samantha Wells, Ph.D.

Community indicators are used to assess the impact of alcohol on communities. This article reviews the main data sources for community indicators, discusses their strengths and limitations, and discusses indicators used in reference to four main topics relating to alcohol use and problems at the community level: alcohol use, patterns, and problems; alcohol availability; alcohol-related health outcomes/trauma; and alcohol-related crime and enforcement. It also reviews the challenges associated with collecting community indicator data, along with important innovations in the field that have contributed to better knowledge of how to collect and analyze community-level data on the impact of alcohol. **KEY WORDS: Alcohol use, abuse, and dependence; alcohol burden; problematic alcohol use; harmful drinking; alcohol-related harm; alcohol use patterns; alcohol effects and consequences; alcohol availability; risk factors; environmental impact; crime; community indicators; community monitoring; community epidemiology; data collection; public policy on alcohol**

In the United States and other countries around the world, researchers have long been interested in community-level measurement of population health in the form of community indicators. Community indicators are measures that communicate information about a given dimension of a community's well-being (Besleme and Mullin 1997). In the United States, the current popularity of community indicators can be traced back to the social-indicators movement of the 1960s and 1970s (see Gross and Straussman 1974; Land and Spilerman 1975; MacRae 1985), which saw growing research attention paid to the measurement of social problems and issues such as divorce, crime, education, and social mobility. Although the social-indicators movement initially focused on issues at the national level, recognition of considerable regional and local variation in the prevalence and causes of social problems led to increased interest in measurement at the local level and, as such, the development of "community indicators."

Community indicators that assess alcohol use and related harm are of great interest to community stakeholders and researchers. Alcohol use has been identified as a major risk factor for acute and chronic health harms and imparts eco-

nomie, health, and social costs to individuals, communities, and societies (Rehm et al. 2009). Alcohol intoxication is linked to injury, violence, and traffic crashes (Edwards et al. 1994) and chronic alcohol use increases the risk of liver damage and various cancers, among other health harms (Edwards et al. 1994; Rehm et al. 2003; Room et al. 2005). National surveys have revealed a great deal of variability across different communities in the extent of alcohol use and related harms (Gruenewald et al. 1997). Thus, it may not be practical or fiscally responsible to base local prevention and intervention initiatives on national data that do not reflect patterns or problems within a particular community. Moreover, prevention, treatment, and enforcement activities are commonly enacted at the local level (Gruenewald et al. 1997). Therefore, community-level data on the impact of alcohol use that take into consideration the local economic, social, and policy context are key to guiding local decisionmaking and maximizing the effectiveness of prevention and intervention approaches.

Community indicators have been used extensively for a variety of purposes by both researchers and community stakeholders. For communities, indicator data can be used to inform priority-setting agendas by identifying specific concerns within a community, guide policy and education initiatives, monitor community status on a particular measure over time or in comparison with other communities, and evaluate programs or policies (Besleme and Mullin 1997; Gabriel 1997; Gruenewald et al. 1997; Mansfield and Wilson 2008; Metzler et al. 2008). Local-level data also are critical for justifying requests for funding and provide a powerful tool for resource allocation within communities (Mansfield and Wilson 2008). For researchers, community indicators are central for improving knowledge of factors influencing community well-being, advancing innovative theoretical models and analytical approaches for use in research and prevention planning (for example, see Holder 1998a), and monitoring and evaluating community prevention/intervention initiatives (Metzler et al. 2008).

This article provides an overview of community indicators of alcohol use and related harms, outlining common sources

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of community indicator data and highlighting the various challenges of collecting data on alcohol at the community level. The literature on community indicators of alcohol use and harms is expansive, spanning a large number of disciplines and extending back for numerous decades. As such, it is beyond the scope of this article to provide a comprehensive review of all the literature and measures pertaining to community indicators on alcohol. Rather, this article provides background information relevant to the use of community indicators in general and in relation to alcohol use and harms, providing examples of some of the most common measures used by alcohol researchers. In addition, the article mentions notable methodological and technological advances that have characterized this field of study over the past few decades, while highlighting the ongoing challenges faced by researchers and community stakeholders interested in assessing alcohol use and alcohol-related harm at the local level. This article draws on extensive knowledge regarding community indicator data on alcohol use and harms that has emerged from key community-based intervention trials, such as the Saving Lives project led by Hingson (Hingson et al. 1996), the Community Trials project led by Holder (Grube 1997; Holder 2000; Holder and Reynolds 1997; Holder and Treno 1997; Holder et al. 1997*a*, 1997*b*, 2000; Millar and Gruenewald 1997; Reynolds et al. 1997; Saltz and Stanghetta 1997; Treno and Holder 1997; Voas 1997; Voas et al. 1997), and the Communities Mobilizing for Change on Alcohol (CMCA) project led by Wagenaar (Wagenaar et al. 1994, 1999, 2000*a*, 2000*b*). The sections that follow outline some of the main community indicators emerging from this literature and other relevant research in reference to four main topics—alcohol use, patterns, and problems; alcohol availability; alcohol-related health outcomes/trauma; and alcohol-related crime and enforcement.

What Is A Community?

A number of different definitions of community have been proposed and used in the social sciences since the 1800s (for a helpful overview of the various ways in which community has been defined historically, see Holder 1992). Generally speaking, the concept of community implies both geographic and social proximity. Gruenewald and colleagues (1997) define a community as “a contiguous geopolitical area overseen by a common political structure with common policing and enforcement agencies and common educational and utility systems, and in which individuals are in daily physical contact for the purposes of economic and social exchange” (pp. 10–11). Holder (1992, 1998*b*) provides a similar definition based on a community-systems perspective and theoretically geared toward the prevention of alcohol problems. Community, in this context, is conceptualized as a dynamic, complex, and adaptive system consisting of “a set or sets of persons engaged in shared socio-cultural-politico-economic processes” (Holder 1998*b*, p. 12). This definition informs the

theoretical premise that reducing alcohol use and alcohol-related problems requires a focus on the community system and structural factors influencing alcohol use rather than on individual-level treatment and prevention (Holder 1998*b*; Holder et al. 2005; Treno and Lee 2002).

Putting these definitions of community into practice when attempting to define and use community indicators is not without its challenges and has direct implications for data collection. When defining the boundaries of the community for the purpose of generating community indicators, it is necessary to consider data availability, methodological requirements of research (i.e., having sufficient cases for meaningful analyses), the catchment area in terms of service provision, other geographic boundaries according to which data are routinely collected by a community, and local stakeholder perspectives on their understanding of community (Gruenewald et al. 1997). These considerations do not always coincide (e.g., available data may not match the catchment area of interest to community stakeholders), making it necessary to weigh the relative importance of these factors when defining the boundaries of the community under study (Gruenewald et al. 1997).

Data Sources for Community Indicators on Alcohol

Community indicators relating to alcohol use and harms are typically gleaned from two main types of data sources: (1) archival sources collected for purposes other than addressing research questions on the impact of alcohol on communities (e.g., data from police and hospital records; crash data from traffic safety databases); and (2) primary data collected by researchers for the purpose of assessing, understanding, and addressing alcohol use and related harms. These different sources of data have inherent advantages and disadvantages in terms of their utility for assessing the community-level impact of alcohol use.

Archival Data

Archival data are an important source of community indicator data. Examples of these archival data sources include administrative and surveillance databases maintained by local city departments, community organizations, municipal/national agencies, schools, hospitals, and police/law enforcement departments, in addition to larger health data-recording systems and traffic crash databases (e.g., the Healthcare Cost and Utilization Project [HCUP] databases and the Fatality Analysis Reporting System [FARS]). A wide range of indicators produced from archival data are used to assess various alcohol-related issues and harms at the community level (examples and discussion of common indicators are presented in the section Community Indicators on Alcohol and Alcohol-Related Harm; see also the table).

A main benefit of using archival sources to produce community indicators is that they can be a cost-effective means of documenting alcohol use and harms, offering a

large volume of retrospective data. In addition, unlike many of the constructs and measures used in social and epidemiological research, archival data often result in indicators that are straightforward, understandable, and of interest to the community, making them easier to use in community planning (Gabriel 1997; Gruenewald et al. 1997; Mansfield and Wilson 2008). Despite these advantages, there also are several limitations associated with using archival data to assess alcohol use/harms in a community. By definition, these data are not gathered for research purposes and thus raise concerns relating to both reliability and validity. Most notably, archival data are subject to various sources of measurement error consequent to the fact that they are not collected according to the systematic and rigorous procedures that characterize social and epidemiological research. In addition, for some measures, the involvement of alcohol may not be explicitly identified. For instance, hospital staff and police typically do not systematically record data on alcohol consumption as part of routine practice (Brinkman et al. 2001; Gruenewald et al. 1997; Stockwell et al. 2000). When alcohol data are recorded in community settings, they may be collected in an inconsistent manner, influenced by subjective judgments and local practices (Brinkman et al. 2001). These limitations affect the extent to which researchers can confidently use existing data such as hospital records or police data to assess alcohol involvement in injury or crime. Moreover, access to such data requires cooperation of local community agencies and/or municipal or regional departments, which may not be always possible.

Another important caveat relates to the use of archival data for conducting community comparisons. Differences across communities in policies and data recording systems (Gruenewald et al. 1997; Brinkman et al. 2001; Stockwell et al. 2000) can make it difficult to conduct comparisons across communities. For example, when using arrest data on alcohol-related crime such as public intoxication or disorderly conduct, the indicator will reflect the definition used by the police department (itself dependent on local or regional statutes) as well as on local enforcement capacity and practices, including levels of police discretion. Thus, data on arrests may not be directly comparable across communities, even if the communities themselves are well matched on demographic or other important baseline measures (Gruenewald et al. 1997). Changes in recording systems or policies also present problems for researchers interested in examining patterns over time within communities. For example, variation over time in the number of alcohol-related arrests may reflect changes in enforcement, recording practices, or policies rather than true variations in alcohol-related crime (Gruenewald et al. 1997).

Events with low levels of incidence present another challenge relating to use of archival data for assessing the impact of alcohol on communities. For instance, although alcohol-related morbidity and mortality are of great interest to communities, these types of indicators may be difficult to provide at the community level, particularly for smaller communities, because of their relatively low baseline rate.

Moreover, in the case of health-related indicators, the problem of low incidence is compounded by the fact that most health-related harms associated with alcohol use are only partially attributable to alcohol (Rehm et al. 2003). Although researchers have developed approaches for estimating the proportion of a given outcome that is attributable to alcohol as a specific risk factor (i.e., the attributable fraction, AF) (see English et al. 1995; Martin et al. 2010; Rehm et al. 2003; Single et al. 1999; Stockwell et al. 2000; World Health Organization [WHO] 2000), these types of analyses require a large volume of data and are typically only conducted at higher levels of aggregation (e.g., State, Federal).

Primary Data

Given that archival data often are unavailable or insufficient to assess alcohol use and harm at the community level, primary data are collected to enhance knowledge of the community-level impact of alcohol use (Gruenewald et al. 1997; Stockwell et al. 2000). Population or subpopulation surveys are the predominant source of primary data used to produce alcohol-related community indicators. Surveys offer the advantage of allowing researchers to define the constructs of interest and use psychometrically sound measures, including measures that have been used in other community-level, State, or Federal surveys, thereby facilitating comparisons. Surveys also permit the collection of self-report data that cannot be gleaned from archival data, such as individual-level alcohol use patterns; underage access to alcohol; and beliefs, attitudes, and perceptions surrounding alcohol. These data allow for individual and group-level risk factors to be determined and permit analyses on subpopulations of interest, such as adolescents or young adults (Gruenewald et al. 1997; Stockwell et al. 2000).

In some instances, it may be possible to extract community-level data from surveys conducted at higher levels of aggregation (e.g., State or national surveys). However, the time frames of State and national surveys often do not meet community or research needs. For example, timing of data collection is an essential factor when monitoring the impact of local policy changes or community initiatives, which may not coincide with national survey data collection (Mansfield and Wilson 2008). Moreover, when attempting to glean information from national or State-level surveys, sample sizes for smaller communities often are insufficient to permit valid conclusions about specific communities or population subgroups within a community (Gruenewald et al. 1997; Mansfield and Wilson 2008; Stockwell et al. 2000). For these reasons, surveys implemented at the community level are key to developing local indicators of alcohol use and harms. Surveys have been widely used in community-based research projects, including both general population surveys and surveys of particular population groups, such as college students (discussed below in Community Indicators on Alcohol and Alcohol-Related Harm; see also the table).

When conducting surveys to produce community indicators, it is necessary to consider the limitations of the survey method. Recent evidence suggests that population surveys

Table Examples, Strengths and Limitations of Community Indicators from Archival and Primary Data Sources

Indicator Category	Indicators from Archival Sources			Indicators from Primary Data Sources		
	Examples of Indicators	Strengths	Limitations	Examples of Indicators	Strengths	Limitations
Alcohol use, patterns and problems	Per capita alcohol consumption	Generated from available sales data	Does not capture patterns of access or use	Self-reported drinking behavior and problems (youth, adults) - age at first use - drinking prevalence - drinking volume - heavy episodic drinking (i.e., binge drinking) - hazardous or harmful drinking	Offer individual- and group-level data unavailable from archival sources that can be aggregated to community level, including drinking pattern	General limitations of surveys and self-report measures - high cost of surveys - possible biases (selection bias, social desirability bias, recall bias, coverage bias)
			Excludes "surrogate" alcohols (homemade, illegal, alcohol not intended for consumption)			
Alcohol availability	Formal access - number of active outlet licenses per 100,000 population - concentration/spatial distribution of outlets - excise taxes on alcoholic beverages - price of alcoholic beverages	Data on outlet licenses are generally maintained with good geographic specificity by Alcohol Control Boards	Data do not capture sales to minors	Alcohol purchase attempts at alcohol outlets by pseudo-underage customers	Capture events not visible in archival data and not affected by self-report biases Useful in evaluations of strategies to reduce youth access to alcohol	Persuasiveness of results potentially undermined by the fact that buyers are actually of legal age
			Data do not capture social access			
			Data do not capture differences between outlets with respect to sales (e.g., small outlets versus large outlets)			
			Community estimates may be affected by migratory patterns and purchases in communities of non-residence			
			Price data difficult to obtain			
				Self-report data collected from underage youth on ability to purchase alcohol at alcohol outlets	Provides data unavailable from archival sources	General limitations of self-report data
	Social access			Self-report data from underage youth on social sources of alcohol (friends, family members, bought by someone else, took from someone else's home)	Data on a high-risk group unavailable from archival data sources	General limitations of self-report data and surveys Additional concerns with coverage bias for telephone surveys due to high rates of cell phone use among youth and young adults

Table Examples, Strengths and Limitations of Community Indicators from Archival and Primary Data Sources (continued)

Indicator Category	Indicators from Archival Sources			Indicators from Primary Data Sources		
	Examples of Indicators	Strengths	Limitations	Examples of Indicators	Strengths	Limitations
Alcohol-related health and trauma	Hospital discharge data	Capture serious health/trauma outcomes – strong impact for communities	Low base rates of mortality from alcohol at the community level	Self-reported health harms and trauma experiences related to alcohol	General strengths of surveys and self-report data	General limitations of self-report data and surveys
	- rates of direct alcohol mortality or morbidity: alcohol cardiomyopathy, alcohol cirrhosis of liver, alcoholic psychoses, accidental ethyl alcohol poisoning, etc.	Nighttime emergency department (ED) presentations and nighttime single vehicle traffic crashes are reliable surrogates of alcohol-involved trauma	Multiple causes of death often poorly recorded in archival data Proportion of mortality/morbidity events attributable to alcohol difficult to estimate at the community level	ED surveys - BAC measurement - self reported alcohol consumption prior to ED presentation	BAC data provides objective measurement of alcohol involvement in injury presentations to ED	Difficulty obtaining permission for ED surveys
	- rates of indirectly-related alcohol deaths: certain malignant tumors, cirrhosis, pancreatitis, etc.		Hospital/ED cases capture only the most severe cases		Self-reported alcohol consumption shown to be valid measure of alcohol use	
	Nighttime presentations of trauma from violence or traffic accidents (surrogate measures)		Blood alcohol concentrations (BAC) not routinely recorded in hospital/emergency settings			
	Alcohol-involved traffic crashes		BAC not always measured in injury-producing/fatal crashes			
	Single-vehicle nighttime traffic crashes		Fatal crashes rare at community level			
Alcohol-related crime	Calls to police for nighttime assaults	If cooperation can be obtained, arrest or EMS records are a cost-effective source of data that is meaningful to community members	Heavily dependent on police enforcement and accuracy in recording	Self-reported crime - alcohol consumption prior to driving/driving while intoxicated	Self-reported crime captures incidents not reported to police	General limitations of self-report data
	Calls to emergency medical services for alcohol-related injury		Difficult to determine if changes are due to changes in police enforcement, valid changes in crime, or prevention programs	- violence perpetration after drinking	BAC provides an objective measure of alcohol consumption	Challenges of implementing roadside surveys
	Calls to police for public drunkenness or disorderly contact			Roadside survey data - BAC readings		- can be difficult to obtain police cooperation
	Arrest rates for driving under the influence		In community prevention trials or when communities are interested in comparisons, different statutes or operational policies affect ability to compare communities			- high cost
	Arrest rates for nighttime assaults					- generally not random (not representative of community)
	Alcohol-related arrests as a percentage of total arrests		Arrests represent only a proportion of offenses – underestimates harm			- can be difficult to find appropriate comparison communities

can underestimate the prevalence of alcohol use and associated harms because of selection bias, response bias, and coverage bias (e.g., exclusion of homeless people) (Shield and Rehm 2012; see also Curtin et al. 2005; Dillman et al. 2002; Kempf and Remington 2007). The growth in use of voicemail, caller ID, cell phones, and do-not-call lists, along with a growing aversion to aggressive telemarketing (Galesic et al. 2006), have contributed to a notable decline in telephone survey response rates (Dillman et al. 2002; Hartge 1999; Kempf and Remington 2007; see also Galea and Tracy 2007). Young people may be particularly underrepresented in population surveys, given their high reliance on cell phones and nonuse of landlines (Blumberg et al. 2007). Large-scale surveys can also be expensive and time consuming to implement.

When collecting primary data on alcohol use and harms, it is also important to consider the limitations of self-report data on drinking behavior and harms associated with drinking. Although self-report data on alcohol use generally are believed to be adequately valid and reliable and are widely used in social and epidemiological research, they have been found to be susceptible to recall error as well as intentional distortion related in part to social desirability (Del Boca and Darkes 2003).

Despite these limitations, surveys are key to answering specific questions about alcohol use and harms in the absence of suitable archival data and are central for cross-validating data gleaned from other sources. Moreover, extensive work on conducting surveys as part of community prevention trials has led to important methodological and statistical innovations, producing advanced knowledge of how to design and analyze surveys better (see Murray 1998; Murray and Short 1995, 1996; Murray et al. 2004).

In addition to surveys, other forms of primary data used to produce community indicators include pseudo-patron studies designed to assess sales of alcohol to individuals appearing underage in both off-premise and on-premise alcohol outlets (see, for example, Freisthler et al. 2003; Saltz and Stanghetta 1997; Toomey et al. 2008; Treno et al. 2006; Wagenaar et al. 2000a) and roadside breath testing to assess drinking and driving (e.g., McCartt et al. 2009; Roeper and Voas 1998). These methods and their strengths and limitations are discussed in later sections on alcohol availability and crime/enforcement, respectively.

Overall, although primary data, particularly surveys, allow for the use of psychometrically sound measures, they suffer from potential biases that researchers must take into account when assessing the impact of alcohol use on a community. Alternatively, archival data sources can provide useful data on alcohol's effects on local communities but require careful interpretation and application and do not always allow researchers to answer questions of interest. Each data source thus offers unique strengths and limitations, such that triangulation of both types of data is a common approach taken by alcohol researchers when assessing the impact of alcohol on communities.

Community Indicators on Alcohol and Alcohol-Related Harm

Table 1 provides a summary of common community indicators of alcohol use and related harms measured in community-based research. These indicators are organized into four broad areas: alcohol use, patterns, and problems; alcohol availability; alcohol-related health outcomes/trauma; and alcohol-related crime/enforcement. Although this table does not provide an exhaustive list of all possible measures used to assess alcohol use and alcohol-related harm at the community level, it provides common measures used in community research (see Saltz et al. 1992). For each category, examples of indicators produced using archival and primary data sources are provided, and general strengths and limitations associated with these data are noted.

Alcohol Use, Patterns, and Problems

At the community level, indicators of alcohol use, patterns, and problems commonly are produced from individual-level self-report (i.e., survey) data. Existing community-based studies have examined a wide range of self-report measures of alcohol use, including, for example, lifetime drinking, drinking frequency, heavy episodic drinking (or binge drinking) and hazardous or harmful drinking, alcohol problems, and alcohol dependence (see Dent et al. 2005; Flewelling et al. 2005; Harrison et al. 2000; Hawkins et al. 2009; Perry et al. 1996, 2000, 2002; Saltz et al. 2009, 2010; Spera et al. 2010; Wagenaar et al. 2006; see table 1). It is beyond the scope of this article to discuss the many different instruments used and all of the methodological challenges associated with measuring self-reported drinking and problems. Choice in how to measure indicators of use, patterns, and problems will depend on the research question being asked and the population under examination. The strengths and limitations of various specific measures of alcohol consumption have been discussed extensively in the literature (see Dawson 2003; Gmel et al. 2006a; Graham et al. 2004; Greenfield 2000; Rehm 1998; Rehm et al. 1999), and recommendations for measurement have been put forward elsewhere (see Dawson and Room 2000).

Drinking behavior among youth often is of particular interest to both researchers and communities. Evidence suggests that youth are more likely than adults to engage in risky patterns of drinking (Adlaf et al. 2005) and to experience harms from drinking, including harms to brain development, physical health, financial well-being, and social life (Adlaf et al. 2005; Kolbe et al. 1993; Toumbourou et al. 2007; White and Swartzwelder 2004). Moreover, drinking at a young age can become an ingrained pattern of behavior, with youth who engage in risky drinking being more likely to exhibit problem drinking later in life (Jefferis et al. 2005). For these reasons, measuring alcohol use and alcohol-related problems among youth often is prioritized in prevention and early-intervention initiatives designed to reduce harm from

alcohol at both the individual and community levels (see DeJong et al. 2009; Nelson et al. 2010). The well-known prevention initiative CMCA (Wagenaar et al. 1994, 1999, 2000*a, b*) is notable for its focus on community-level strategies for reducing alcohol use and problems among youth and its development of indicators of alcohol use and harms to evaluate program effectiveness.

Surveys on youth drinking have commonly captured these populations in their educational environments, including elementary, high school, and college or university settings. The priority of addressing alcohol use among college students is well evidenced by the NIAAA's Rapid Response to College Drinking Problems initiative, which produced recommendations for reducing heavy drinking by this subgroup (see DeJong et al. 2009; Nelson et al. 2010). Alcohol use, patterns, and problems have been measured in the implementation and evaluation of alcohol prevention trials in school and college settings (see reviews by Saltz 2011 for college-based prevention approaches and Stigler et al. 2011 for elementary and high school programs). Examples of measures of alcohol use and problems among college and school-age students include self-reported alcohol use (i.e., measures of frequency of drinking, drinking patterns, and binge drinking) (Flewelling et al. 2005; Harrison 2000; Hawkins et al. 2009; Perry et al. 1996, 2000, 2002; Saltz et al. 2009, 2010), the incidence and likelihood of intoxication at off-campus drinking establishments (Saltz et al. 2010), age of onset of drinking (Hawkins et al. 2009), and perceptions and experiences of negative consequences associated with drinking (Flewelling et al. 2005; Saltz et al. 2009, 2010). Significantly, although surveys of college and university students may provide communities with estimates of alcohol use, patterns, and problems among this segment of the population, these surveys are inherently limited to the sampling frame of youth attending these institutions. As a result, they fail to capture youth from the broader community not attending educational institutions and thus cannot offer community prevalence data for that age range.

With respect to archival data on alcohol use, this type of information is less commonly available at the community level compared with higher levels of aggregation. Most notable in this regard is the use of sales data to examine per capita alcohol consumption. WHO (2000) has recommended that alcohol use among populations be monitored using reliable estimates of per capita alcohol consumption derived from alcohol sales data, in addition to monitoring through population surveys of alcohol use. Sales data commonly have been used at the State, regional, and Federal levels to examine the link between per capita alcohol consumption and various health harms, including suicide (Kerr et al. 2011*b*; Landberg 2009), mortality and morbidity (Kerr et al. 2011*a*; Nordstrom and Ramstedt 2005; Polednak 2012), and traffic crashes (Gruenewald and Ponicki 1995). These types of analyses, however, generally are restricted to large populations (Dawson 2003) and thus are less applicable to alcohol researchers interested in community indicators (i.e., measures below the State level of aggregation), in part as a

result of the low base rate of harms at the community level and in part from challenges associated with obtaining sales data at the community level compared with the State level.

Availability

Measuring the availability of alcohol at the community level is essential for assessing the impact of policies designed to reduce alcohol use and alcohol-related harms (see Babor et al. 2003). Availability commonly is measured in terms of commercial access (including alcohol outlet density, days and hours of sales, and price of alcohol) as well as social access (i.e., informal sources of alcohol, such as peers).

With respect to commercial access, although the evidence on the effects of limiting alcohol outlet density on alcohol consumption is somewhat mixed (see Livingston et al. 2007), studies generally have found significant positive relationships between alcohol outlet density and a range of problems at the community level, including rates of violence, drinking and driving, motor vehicle accidents, medical harms, and crime (Britt et al. 2005; Campbell et al. 2009; Gruenewald and Remer 2006; Gruenewald et al. 2006; Livingston et al. 2007; Toomey et al. 2012). Evidence also suggests a positive relationship between days (Middleton et al. 2010) and hours (Hahn et al. 2010) of sale and alcohol consumption and alcohol-related harms (see also Edwards et al. 1994). Alcohol prices and taxes are inversely related to alcohol consumption and heavy drinking (Chaloupka et al. 2002; Edwards et al. 1994; Osterberg 2004; Wagenaar et al. 2009), although the extent of the impact of price changes depends to some extent on cultural context (i.e., drinking norms) and prevailing social and economic circumstances, among other factors (Osterberg 2004; see also Babor et al. 2003). Researchers have used indicators of commercial access to evaluate whether changes in State policies have an impact on alcohol use/problems in communities (see Babor et al. 2003; Edwards et al. 1994; Hahn et al. 2010; Middleton et al. 2010).

Community indicators of economic availability commonly are produced using archival data sources, including alcohol price and tax (excise and sales) data from State departments and alcohol-control boards, although the quality of these data and their utility for research at the community level varies substantially across States (Gruenewald et al. 1997). Archival data on retail alcohol prices are difficult to obtain at the State level, and even more so at the community level. Evidence suggests that available data are prone to substantial measurement error (Young and Bielinska-Kwapisz 2003), leading many researchers to rely on tax data instead. When making comparisons across communities or over time, researchers generally also prefer to use tax rates over price data to avoid conflating price differences with differing tax rates across space and over time. Liquor licensing information from alcohol-control boards commonly is used to generate indicators of commercial availability—namely, number of outlets/population rates and concentration of on- and off-premise outlets (Sherman et al. 1996; see also Gruenewald et al. 1997). However, counts of active licenses represent only

an indirect measure of alcohol availability and can underestimate alcohol sales (Gruenewald et al. 1992). Geographic Information System (GIS) mapping has emerged as an innovative means of generating community indicators of outlet density (including off- and on-premise outlets) and to examine alcohol outlet density and locations in relation to alcohol-related problems, such as assaults and sale of alcohol to minors (see Gruenewald et al. 2002; Millar and Gruenewald et al. 1997).

One major caveat relating to measures of commercial access to alcohol is that archival data obscure who is making purchases, who is consuming the alcohol purchased, and how (in what patterns) the alcohol is being consumed. Therefore, important information about risky drinking behavior (i.e., binge drinking) and populations who engage in such behavior remains unknown from data on alcohol availability. This limitation is particularly salient for measuring drinking among youth, who commonly obtain alcohol from social rather than commercial sources (see Wagenaar et al. 1993).

In light of this limitation, and the fact that early prevention of alcohol use and alcohol-related problems is often a high priority for communities and researchers, other data collection strategies have been implemented to measure access to alcohol among youth. Access surveys involving pseudo-underage youth purchase attempts have produced indicators of youth commercial access, often as part of the evaluation of community prevention initiatives (see Chen et al. 2010; Grube 1997; McCartt et al. 2009; Paschall et al. 2007; Perry et al. 1996, 2000, 2002; Toomey et al. 2008; Wagenaar et al. 1994, 1999, 2000*a, b*). Self-reported social access to alcohol has also been measured in school or community surveys of youth, with participants asked to report on sources from which they obtain alcohol (i.e., commercial [on- or off-premise outlets] versus social [friends, family, etc.] sources) (see Dent et al. 2005; Harrison et al. 2000; Hearst et al. 2007; Jones-Webb et al. 1997; Wagenaar et al. 1994). Some studies also have examined perceived availability of alcohol among youth (Flewelling et al. 2005; Perry et al. 1996, 2000, 2002; Treno et al. 2008).

Health Outcomes/Trauma

As stated previously, evidence reveals a strong and consistent association between alcohol consumption and a variety of negative health outcomes, including morbidity, early mortality, and increased risk of trauma such as burns, falls, drowning, and injury from interpersonal violence (Cherpitel 1995; Gmel et al. 2006*b*; Rehm et al. 2003, 2006; Treno et al. 1997). Collectively, alcohol-related health harms and traumas impose notable demands on local emergency and hospital services. Documenting alcohol-related morbidity, mortality, and trauma is thus often a priority for communities and researchers, with such research informing initiatives geared toward preventing alcohol-related harm and efforts to reduce health costs.

Both archival and primary data have been used to produce community indicators relating to fatal and nonfatal alcohol-involved health harms. Data sources and types of indicators emerging from these data include (1) hospital

data, used to produce indicators of hospitalizations and emergency department (ED) visits associated with acute or chronic alcohol use; (2) traffic fatality data, used to estimate alcohol involvement in crashes; and (3) household or subpopulation surveys, used to generate indicators from self-reported data on alcohol-involved injuries (including violence). As shown in table 1, each of these data sources has strengths and limitations pertaining to their utility for producing community indicators on alcohol-related harms.

Hospital and ED Data. Archival hospital data allow for documentation of cases of alcohol-related health outcomes and trauma requiring urgent or emergent care. Such data can provide powerful information for use by communities (e.g., in educational or prevention campaigns) because of their severity and corresponding psychological impact (Stockwell et al. 2000). Despite this appeal, notable challenges exist to using archival data to produce community indicators on health outcomes and trauma associated with alcohol. First, as stated above, one of the major caveats with measuring alcohol-related mortality and morbidity at the community level is the rarity of cases (Giesbrecht et al. 1989; Stockwell et al. 2000), meaning that there may be insufficient numbers for meaningful analysis at the community level. Second, it often is quite difficult to obtain access to hospital or ED data within communities, particularly data of reasonable quality for developing valid and reliable estimates. Third, it often is challenging or impossible to determine the extent of alcohol involvement in health outcomes. As previously noted, many chronic health harms associated with alcohol, including those leading to hospitalization and mortality, are only partially attributable to this risk factor (Rehm et al. 2003). In terms of emergency cases, archival data frequently do not capture alcohol involvement (Giesbrecht et al. 1989; Stockwell et al. 2000). Blood alcohol concentration (BAC) is not routinely assessed in hospitals or urgent-care centers in relation to traumatic presentations, given that staff generally are operating under time and resource constraints that preclude systematic testing for alcohol use. Staff also may be hesitant to make conclusions about intoxication because of insurance and liability concerns (Giesbrecht et al. 1989, 1997; Stockwell et al. 2000; Treno and Holder 1997). As a result, archival data of emergency cases likely underestimate the role of alcohol in trauma requiring emergent care. In cases where BAC is recorded, determining the role of alcohol in a traumatic event is complicated by time elapsed since the incident and by alcohol consumed after the incident (Young et al. 2004).

In the face of challenges associated with lack of documentation of alcohol involvement in archival data, researchers commonly turn to surrogate measures of alcohol-related trauma. Such measures have been well studied using international data. For instance, Young and colleagues (2004) found that being male, unmarried, younger than age 45, and presenting at EDs in the late night or early morning hours on

Fridays, Saturdays, or Sundays were most highly associated with alcohol consumption prior to injury (based on BAC and self-reported alcohol consumption within 6 hours prior to injury). The strongest predictor of alcohol-related injury was time of day of presentation (odds ratio of 4.92 for presentations occurring between midnight and 4:59 a.m.). It follows that, in the absence of reliable BAC data, proxy measures that take into account time-of-day presentation and demographic variables may offer a means for estimating alcohol-related trauma in a community (Brinkman et al. 2001; Treno et al. 1996). Such estimates require access to medical records that include time-of-day presentation and detailed demographic information.

Archival data on hospitalizations and ED visits are becoming more readily available for use in the development of community indicators. For example, the Healthcare Cost and Utilization Project (see Steiner et al. 2002, <http://www.hcup-us.ahrq.gov/>) consists of a series of health care databases that provide data on inpatient, ambulatory, and ED cases for community hospitals in participating States since 1988. These databases permit research on topics such as diagnoses; procedures; mortality; cost of health services; access to health care programs; and treatment outcomes at the national, State, and local levels (<http://www.hcup-us.ahrq.gov/>). Some participating States allow the release of hospital and patient-level geographic data that may permit analysis at the community level (Steiner et al. 2002).

Researchers have also produced indicators on alcohol-involved trauma at the community level from ED surveys, involving the collection of interview and breathalyzer data from ED patients (see Cherpitel 1994 and 1993 for reviews of ED studies; see also Busset et al. 1995; Cherpitel et al. 2009; Holder et al. 2000; Treno and Holder 1997). Cherpitel (1995) measured alcohol-related problems and injuries or illnesses for which emergency medical care was sought in a countywide representative study of ED data. When comparing these data to a general population sample, Cherpitel (1995) found no difference in frequency of drunkenness related to injury between the two samples, suggesting that ED surveys may be a useful approach for measuring these issues. However, obtaining ED cooperation and producing representative ED samples is a notable challenge faced by researchers when endeavoring to conduct ED surveys (Holder et al. 2000).

Traffic Fatality Data. Alcohol-related traffic fatalities are an important form of trauma in the community-indicator literature on alcohol-related harm. Consistent evidence confirms that alcohol is a leading cause of traffic crashes, particularly those resulting in fatal and nonfatal injuries (Hingson and Winter 2003). Research has demonstrated that the relative risk of fatal injury and fatal crash involvement rises with increasing driver BAC (see the classic Grand Rapids study by Borckenstein et al. [1974] and subsequent studies by Hurst [1973]; Krüger and Vollrath [2004]; Mathijssen and Houwing [2005]; Mayhew et al. [1986];

McCarroll and Haddon [1962]; Perrine et al. [1971]; Zador [1991]; and Zador et al. [2000]). Relative risk data such as these have been widely used to support alcohol safety legislation, including the lowering of BAC driving limits (see review by Mann et al. 2001).

The FARS (formerly the Fatal Accident Reporting System) (see <http://www.nhtsa.gov/FARS>), initially established in 1975, is a reliable database of all fatal crashes in the United States and includes the BACs of drivers involved in fatal crashes. When chemical tests of driver BACs are not performed in fatal crashes, FARS provides imputed data (see Subramanian 2002). FARS data can be disaggregated to the level of the county (see Voas et al. 1998; Williams 2006). Studies using FARS or State traffic safety department databases have generated indicators of various levels of driver BAC associated with traffic fatalities (e.g., Hingson et al. 2005, et al. 2006; Wagenaar and Wolfson 1995). However, fatal crashes are relatively rare events (Voas et al. 1997), and thus aggregation of events over a long time period may be needed to produce sufficient cases for analysis at the community level (e.g., see Wagenaar et al. 2000a).

Researchers commonly also use fatal single-vehicle nighttime crashes as a surrogate for alcohol-involved traffic fatalities, which can be a useful strategy when data on alcohol involvement in crashes are unavailable for the community of interest or too few cases have been documented. These data have been shown to be a reliable proxy for alcohol-related fatalities. They often are available from local or State sources (e.g., police departments or departments of transportation) and, depending on the size of the community, may occur in sufficient numbers for analysis (see Hingson et al. 1996; Roeper and Voas 1998; Treno et al. 2006; Wagenaar and Holder 1991; Wagenaar et al. 2000a, 2006). Nevertheless, caution is warranted when interpreting traffic crash data, particularly in the absence of BAC data, given the myriad of other factors that stand to be involved in crashes, including road conditions, speeding, and use of seat belts. The use of multiple data sources for triangulation of data (Gruenewald et al. 1997) can help overcome the limitations of any one measure of alcohol-involved vehicle crashes.

Population Survey Data. Population or community surveys are used to measure self-reported alcohol-related health outcomes and trauma. An advantage of these surveys is that they can detect events not resulting in fatalities or hospital admissions (Gruenewald et al. 1997). These data are thus useful for documenting less severe cases, which are more common than fatal or near-fatal cases. However, the number of self-reported events (e.g., injury) may still be insufficient for analysis, particularly in small communities. General limitations of population surveys apply to these data, including the cost and time required to conduct them, as well as reporting and coverage biases that may result in underestimates of alcohol-related harms.

Crime/Enforcement

Both primary and archival data sources have been used to generate measures of alcohol-related crime in communities. At the community level, household, telephone, and school surveys have been conducted to measure various self-reported crimes, including driving under the influence (DUI) (e.g., Clapp et al. 2005; Saltz et al. 2009; Wagenaar et al. 2006), underage alcohol purchases (e.g., Harrison et al. 2000), alcohol-related violence (Greenfield and Weisner 1995), and public drunkenness (Greenfield and Weisner 1995). The general strengths and limitations of surveys and self-report measures of alcohol use have been discussed previously. Therefore, this section will focus on roadside surveys and arrest data.

Roadside surveys involve stopping motorists at roadside checkpoints for the purpose of collecting breath alcohol measurements. Two key purposes of roadside surveys are to track drinking and driving trends and to evaluate alcohol safety programs (Lange et al. 1999; Lestina et al. 1999). The majority of roadside studies conducted to track trends in drinking and driving have occurred at the national level (e.g., in the United States, Canada, Britain, Germany, Sweden, Norway, Belgium, and the Netherlands) (see Lacey et al. 2008; Lestina et al. 1999; Lund and Wolfe 1991; Voas et al. 1998; Wolfe 1974 for information on the U.S. National Roadside Surveys). These national surveys typically do not provide sufficient data at the community level for assessment of local drinking and driving because of the exclusion of smaller communities and/or roadways with low daily traffic counts (Voas et al. 1998). At the community level, roadside surveys primarily have been used in the evaluation of community prevention trials (e.g., McCartt et al. 2009; Roeper and Voas 1998). They allow researchers to assess changes in drinking-and-driving behavior in relation to prevention campaigns when fatality and crash data are unavailable (Roeper and Voas 1998). In instances where fatality and crash data are available, roadside survey data may still be useful to confirm that changes in crash data reflect valid changes in drinking-and-driving behavior rather than other changes not related to alcohol consumption (e.g., roadway improvements) (Roeper and Voas 1998).

Two main strategies are used to implement roadside surveys at the community level: (1) “piggybacking” on existing police sobriety check points; and (2) using roadside check points dedicated entirely to research. In both instances, cooperation of local police is imperative, which may create a challenge in communities lacking widespread support for the research (Howard and Barofsky 1992). In addition to the notable cost associated with conducting roadside surveys, there are several limitations and challenges associated with this method of data collection (Lestina et al. 1999). For example, many high-BAC drivers are able to avoid roadside survey check points by driving alternate routes, resulting in underestimates of local levels of drinking and driving (Lestina et al. 1999). Drivers also may refuse to provide a breath sample, and these people may be likely to have higher

BACs than those who consent to a breath test (Lestina et al. 1999). Conversely, overestimates of impaired driving may occur if roadways characterized by high volumes of alcohol-related crashes are targeted for surveys (Lestina et al. 1999). In evaluations of alcohol-safety programs (and other alcohol interventions), it is necessary to compare the intervention community with a comparison community in which the program was not implemented to determine whether changes in drinking and driving can be attributed to the intervention. However, finding adequate comparison sites can be a challenge, given the need for a community with similar population characteristics and policies and the fact that comparison (“non-experimental”) communities may have their own campaigns to reduce drinking and driving (see Voas 1997).

Arrest data on DUI as well as other alcohol-related offenses also represent valuable indicators for communities. Numerous researchers have used archival police and justice records to produce community indicators of alcohol-related crimes, including DUI, liquor law violations, assault, public drunkenness, and disorderly conduct (e.g., Breen et al. 2011; Duncan et al. 2002; Sherman et al. 1996; Treno et al. 2006; Wagenaar et al. 2000a) (see table 1). When using archival data to assess levels of alcohol-related crime, it is important to recognize that such arrests represent only offenses brought to the attention of the police that they have acted upon. Some criminal events (e.g., violent crime) are not commonly reported to the police, or there may be insufficient cause for police to file an arrest report (Brinkman et al. 2001). Moreover, by definition, arrest data are dependent on local and State statutes and also are highly sensitive to enforcement capacity and practices as well as operational changes and recording practices, including police discretion (Gruenewald et al. 1997). These factors are thus critical to consider when making comparisons over time or across communities. As noted previously, changes in alcohol-related arrests can represent changes in actual crime, changes in enforcement or recording practices, or changes in policies and laws (Gruenewald et al. 1997). In some instances, confounding variables (such as police discretion in making arrests) are difficult if not impossible to measure.

Another problem with police data is that for many types of crime (e.g., violence), police do not formally measure alcohol involvement (i.e., through a breath test). Although some research has measured alcohol-involved crime through archival records of cases that police have flagged for alcohol involvement (Wagenaar et al. 2000a), these data are unlikely to be systematic and rely in large part on police discretion (see discussion by Brinkman et al. 2001). To partially address such concerns, surrogate measures have been used to produce indicators of alcohol-related crime from archival data. For example, nighttime assaults have been used as a proxy for alcohol-related violence, given that temporal data are likely to be recorded in police records and violent assaults during nighttime hours have a high likelihood of being alcohol related (Brinkman et al. 2001).

Indicators of enforcement are also related to measurement of alcohol-related crime at the community level. Some investigators have measured enforcement activities in community-based research projects, often for the purpose of evaluating policy changes or prevention efforts (e.g., Grube 1997; McCartt et al. 2009; Voas, Holder and Gruenewald 1997; see also Wagenaar and Wolfson 1995) (see table 1). Indicators of enforcement can provide communities with data on enforcement capacity and, if tracked over time, can allow for an assessment of the impact of enforcement on reducing alcohol-related crime.

Conclusion

Measuring alcohol use and harm in communities is complex and requires researchers to make choices and find creative ways of assessing the local-level impact of alcohol. The data source and indicator used will depend on data availability, the purpose of the research (e.g., to provide a community with descriptive data versus evaluation of an intervention), and, in many cases, community support for the research to facilitate access to archival data or cooperation in primary data collection efforts.

Whether using archival or primary data to produce community indicators, it is important for both researchers and community stakeholders to be aware of the strengths and potential limitations of the data. They must also recognize the value of combining data from multiple sources when making conclusions about the impact of alcohol on communities. Indeed, many community-based projects have relied on both primary and archival data to assess alcohol use and harms in communities and to evaluate the impact of intervention initiatives. Triangulation of indicators is key for validating measures and thus drawing accurate conclusions about research findings.

Despite the limitations and challenges associated with assessing alcohol use and alcohol-related harms at the community level, many significant advances have been made in the field, including important advances in statistical methods (e.g., Murray 1998; Murray and Short 1995, 1996; Murray et al. 2004), refinement of surrogate measures (e.g., Treno et al. 1994, 1996, 1997), and spatial analysis (e.g., Gruenewald et al. 2002; Millar and Gruenewald 1997). Another example of an innovative approach that currently is being employed to develop community indicators involves use of a mobile research laboratory to collect social, epidemiological, and biological data in diverse communities in the province of Ontario, Canada. Led by a multidisciplinary team of researchers, this project involves collection of local data and the development of a community indicator database relating to mental health and addictions in participating communities, including indicators of alcohol use and harms (see Wells et al. 2011).

Building on these types of innovations and the rich history of social indicators in the United States, a number of communities recently have sought to develop comprehensive

community indicator systems consisting of data on a range of factors (e.g., social, economic, and environmental) to allow a detailed examination of influences on community well-being (Besleme and Mullin 1997; Ramos and Jones 2005). National initiatives such as the 2008 Community Health Status Indicators (CHSI) project (see Heitgerd et al. 2008; Metzler et al. 2008; see also www.communityhealth.hhs.gov), the Community Assessment Initiative (<http://www.cdc.gov/ai/index.html>), and the National Neighborhood Indicators Partnership (<http://www.neighborhoodindicators.org>), for example, have sought to improve access to local data and inform use of data in planning efforts and evaluation of health policies and interventions. At the international level, the Community Indicators Consortium, established in 2003, represents one of the most extensive efforts to engage stakeholders from around the world and to document and share knowledge on community indicators (see Ramos and Jones 2005; <http://www.communityindicators.net>). Some projects included in the Community Indicators Consortium database of indicator projects specifically include risky alcohol consumption as part of their examination of community well-being (see <http://www.communityindicators.net>). These types of initiatives suggest that community indicators, including indicators of alcohol use and harm, will continue to grow in the coming years as an area of interest and innovation.

Community indicators are certainly not a panacea for either investigators or community stakeholders. However, when produced with a thorough understanding of the local community system and through thoughtful application of advanced methodological knowledge, they can serve as a powerful tool for understanding, assessing, and addressing alcohol-related problems within their local context. ■

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