Prevention of alcohol-related injuries in the Americas: from evidence to policy action

Cheryl J. Cherpitel, Guilherme Borges, Norman Giesbrecht, Maristela Monteiro, and Tim Stockwell, editors

Pan American Health Organization

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Washington DC, 2013

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PREFACE

Alcohol consumption has been associated with injuries in a wide variety of settings and from a number of causes, including those related to traffic, falls, fires, sports, and the workplace, and those resulting from interpersonal and self-inflicted violence. In the Americas, interpersonal violence (including intimate partner violence) and traffic injuries are a matter of great concern for governments and the general population.

The Pan American Health Organization (PAHO) has been paying increased attention to alcohol-related injuries over the past decade, starting with a multicountry study on alcohol, gender, culture, and harm in 2004 that led to the publication of a book[1] that uses comparable data from 10 countries in the region. In 2008–2011, a cooperative agreement with the Government of Valencia, Spain, supported research in six countries (Dominican Republic, Guatemala, Guyana, Honduras, Nicaragua, and Panama) evaluating the role of alcohol on injuries in emergency room patients. This research also examined the relationship between alcohol and domestic violence in the general population. PAHO's member states endorsed the Plan of Action to Reduce the Harmful Use of Alcohol during the 51st Directing Council in September 2011. This plan highlights priority areas for action against the harmful use of alcohol, including the promotion of research to inform policy implementation.

National information and evidence is needed to raise awareness and support advocacy for public health–oriented policies. Therefore, I am proud to introduce this book, which explores the relationship between alcohol consumption and injuries in the Americas. The research presented here brings to light the impact of alcohol on nonfatal injuries in various countries, and represents an enormous effort to collect, analyze, and compare information obtained from emergency rooms in these countries. The results clearly illustrate the significant impact of alcohol consumption on violence and the burden it causes to health systems and societies as a whole.

The book also describes various ways to reduce alcohol-related injuries, including the use of cost-effective policies to decrease harmful drinking at the population as well as the individual level. Given that these strategies have proven to be effective and feasible, we now need to secure the political will to implement them. My hope is that the contents of this book will spark concerted action among governments in the Americas to make our communities safer and healthier for present and future generations.

Carissa F. Etienne
Director

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[1] Graham K, Bernards S, Munné M, Wilsnack S, editors. Unhappy hours: alcohol and partner aggression in the Americas. Washington: Pan American Health Organization; 2009. (PAHO Scientific Publication No. 631).

FOREWORD

The countries and territories of the two continents and multiple islands of the Americas encompass enormous diversity. Geographic environments range from those below sea level to those of great height, stretching from close to Antarctica across the Equator to the Arctic. The societies they comprise vary from isolated tribal groups (in the Amazon), and some of the poorest populations in the world, living subsistence lifestyles, to some of the richest people in the world, in the cosmopolitan metropolises of São Paulo, Mexico City, and New York. There is, however, one important commonality, which is addressed in this book. Alcoholic beverages are consumed in every nation in the Americas. On average, as described in Chapter 1, there are more drinkers as a percentage of the population in the Americas than in the world at large, and the level of alcohol consumption in the region is generally above the world average. As a result, alcohol is a substantial health and social problem throughout the Americas.

The book is primarily concerned with one aspect of the problems that accompany drinking: alcohol as a cause of injury. The burden of alcohol-related injury includes unintended harms (such as those resulting from the lack of physical and mental coordination that occurs after drinking) as well as intentional harms (such as those resulting from violent behavior caused by the effects of alcohol on judgment and mood). A consistent theme in this book is the fact that while alcohol contributes to both intended and unintended injuries, the former category comprises a higher proportion of alcohol-related harms.

As illustrated in the early chapters of the book, the role alcohol plays in injuries is a substantial part of the health harm that results from drinking. Hence the sponsorship of this book by the Pan American Health Organization (PAHO), as a part of the World Health Organization's (WHO) work documenting and reducing the burden of harms from alcohol.

In all of the societies from which the data for this book were collected and analyzed, those who are injured are commonly taken to emergency rooms (ERs) or emergency departments (EDs) for medical care. Therefore, if one wishes to study the role of alcohol in injuries, ERs and EDs are a good place to begin. That is the thinking behind the research and writing for this book, which in many cases presents research that has extended over decades[1] and is thus the culmination of various programs of work by many people in diverse places.

As shown in this book, the picture emerging from research on alcohol's role in the flow of injury cases into an ER is multi-faceted. Rates of alcohol involvement in injury vary by demography—with injured men reporting drinking during the injury event more often than injured women—and by injury type and context––including the circumstance surrounding the drinking, and whether the injured person felt affected by the alcohol they had consumed. They also differ across countries/territories in the region, and by country/territory characteristics. For example, as shown in Figure 3 of Chapter 9, injury cases from ERs in Central America consumed the highest average number of drinks in the six-hour period before injury and were most likely to report feeling drunk at the time of the injury event. As reported in Chapter 1, it is this region of the Americas, along with "Tropical Latin America" (mostly Brazil), that has the highest per-drinker consumption in the Americas.

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[1] See also: Cherpitel CJ, Borges G, Giesbrecht N, Hungerford D, Peden M, Poznyak V, et al., editors, Alcohol and injuries: emergency department studies in an international perspective. Geneva: World Health Organization; 2009.

The last part of the book turns to the issue of recommended future directions, based on the evidence, in terms of policies and societal responses. One part of the answer, discussed in Chapter 15, is what can be done in the ER itself, with screening and brief intervention. In a number of countries, as ER doctors and nurses tire of the endless flow of casualties related to drinking, there have been substantial efforts in this direction. However, institutionalizing these procedures as a regular part of the routine in the ER is not an easy task (*1*). Given the recurrent emergencies and crowded caseloads experienced in ERs region-wide, these additional tasks are likely to require specific funding and additional health personnel rather than simply being added on to the job descriptions of existing, often overextended staff.

A second part of the answer is to look outside the door of the ER and consider what preventive measures can be taken by governments to cut down the flow of alcohol within society and/or channel the drinking into less risky forms and contexts. As outlined in Chapters 14 and 16, there are several important steps government can take to reduce the adverse effects of alcohol on the health and well-being of its people. Implementing these types of alcohol control measures are important not only with respect to injuries but also because alcohol is a major risk factor in many chronic diseases and conditions that have become a global focus of attention, including cancers, heart disease, high blood pressure, and cirrhosis (*2*).

For such measures to be adopted and effectively implemented, however, strong political commitment and popular support is required, particularly because many economic interests are in opposition. Preventive actions by national governments are an important part of WHO's Global Strategy to Reduce the Harmful Use of Alcohol (*3*). These actions must involve more than just putting laws on the books. Some years ago, a former Minister of Health took on the task of reviewing existing alcohol-related legislation in Central American countries. He reported back that there was "abundant legislation" but among these laws "many are not applied," and that often "the health authorities are largely unfamiliar with them (*4*)." Therefore, implementing and enforcing laws and regulations to control the use of alcohol is a necessary follow-up to putting them in place.

Responding to and reducing the level of alcohol-related problems is not the sole responsibility of national governments. In fact, controlling the sale and service of alcohol in a way that reduces harms is often primarily a matter for action at more local levels. Examples can found in many parts of the Americas of success stories in reducing alcohol-related injuries by local action. For example, the city council of Diadema, Brazil, reduced the city's high homicide rate by 44% by moving back the closing hour for alcohol sales outlets to 11 p.m. (*5*). Particularly in indigenous communities, preventive measures have often come from below. For example, in San Pedro Chenalhó, in the highland of Chiapas, Mexico, after women spoke out in public forums about community problems stemming from alcohol, and as part of local movements for autonomy, by the late 1990s almost half the population had committed themselves to abstaining from drinking (*6*). Women also played an important role in communal sobering-up among the Quichua speakers in Otavalo, Ecuador, in the late 1980s, when the community, taking an earthquake as a sign from God, began listening to warnings from Protestants, Catholic catechists, and reformist civil servants about the harmful effects of alcohol (*7*).

Studies on the effects of alcohol on emergency room caseloads, which constitute the heart of this book, have provided important evidence and documentation on the heavy burden of alcohol-related injuries in all areas of the Americas. Reducing the toll is an important public health objective in every country/territory in the region. Drawing on international experience has provided ample evidence of which policies and strategies work best to accomplish this goal. Governments and communities throughout the region should seize the opportunity to move forward by implementing these measures.

<div align="right">

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ACRONYMS

AAF	alcohol-attributable fraction
AOD	alcohol and other drug
ASSIST	Alcohol, Smoking, and Substance Involvement Screening Test
AUDIT	Alcohol Use Disorders Identification Test
BAC	blood alcohol concentration
BC	British Columbia
BI	brief intervention
BSS	Behavioral Surveillance Survey
CHMSL	center-high mount stop lamps
CI	confidence interval
CRA	Comparative Risk Assessment
CSW	commercial sex workers
CWC	centering within context
DALY	disability-adjusted life year
DDP	detrimental drinking pattern
DUI	driving under the influence
DW5S	DrugWipe® 5 S
ED	emergency department
EDIS	Emergency Department Information System
ER	emergency room
ERCAAP	Emergency Room Collaborative Alcohol Analysis Project
FRAMES	Feedback, Responsibility, Advice, Menu of strategies, Empathy, and Self-efficacy
GBD	Global Burden of Disease Study (also used for "regions")
GDP	gross domestic product
GENACIS	Gender, Alcohol and Culture Study
GNI	gross national income
GNP	gross national product
GPHC	Georgetown Public Hospital Corporation (in Guyana chapter only)
GSHS	Global School-based Student Health Survey

HLM	hierarchical linear models
ICD-10	International Classification of Diseases, 10th Revision
IPV	intimate partner violence
LAC	Latin America and the Caribbean
L	liter
MI	motivational interviewing
MSM	men who have sex with men
NIAAA	National Institute on Alcohol Abuse and Alcoholism
OR	odds ratio
PAF	population-attributable fraction
PAHO	Pan American Health Organization
PAHO-ER	Pan American Health Organization/Valencia emergency room studies
POC	point-of-collection device (re: saliva test)
PPP	purchase power parity (re: GDP)
RAPS4	Rapid Alcohol Problems Screen
RAPS-QF	RAPS4 quantity and frequency
RJH	Royal Jubilee Hospital, Victoria, BC
RR	relative risk
SBI	screening and brief intervention
SBIR	screening, brief intervention, and referral
SBIRT	screening, brief intervention, and referral to treatment
SD	standard deviation
SE	standard error
SES	socioeconomic status
WHO	World Health Organization
WHO-ER	WHO Collaborative Study on Alcohol and Injuries
VGH	Vancouver General Hospital
YLD	years lived with disability
YLL	years of life lost

OVERVIEW

Cheryl J. Cherpitel and Maristela Monteiro

This edited volume on alcohol and injuries provides an overview of the burden of alcohol in injuries in the Americas plus research and policy perspectives of the current state of knowledge on alcohol's association with injuries, based on emergency room (ER) studies in the region. These include studies conducted in Argentina, Brazil, Canada, Dominican Republic, Guatemala, Guyana, Mexico, Nicaragua, Panama, and the United States, over a number of years, using the same methodology and protocol (including probability sampling of injured patients). Therefore, the samples drawn from individual ERs can be considered representative of that ER. While alcohol is known to be highly associated with injury, studies in the Americas are relatively few and the magnitude and diversity of the association across country contexts has not been explored. This book focuses on epidemiologic evidence from ER studies in the region, including those recently supported by the Pan American Health Organization (PAHO) in five countries, and addresses issues related to ongoing surveillance, intervention, prevention, and policy strategies aimed at reducing alcohol-related injury.

This book is the first to focus on alcohol and injuries in the Americas, and draws on contributions from multiple researchers in the region with broad and long-term experience in this field of study. The terms "emergency room" (ER) and "emergency department" (ED) are used interchangeably throughout the book to refer to facilities that treat injuries of all levels of severity, as opposed to "trauma centers," which are based within emergency service departments in the United States, and only treat the most severe injuries.
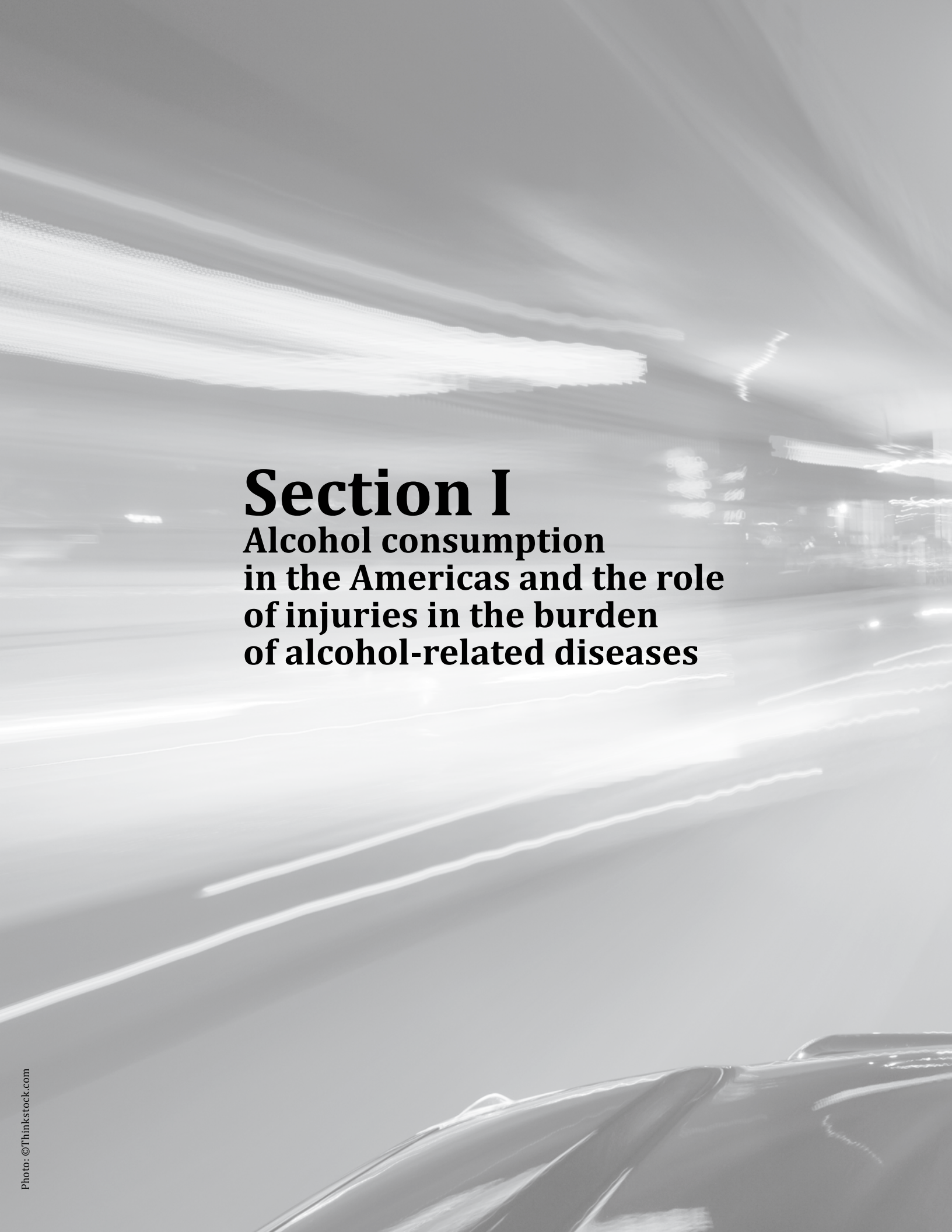
The first section of the book provides an overview of alcohol consumption in the region and the role of fatal and nonfatal injuries in the burden of alcohol-related diseases. Alcohol consumption and patterns of drinking resulting in harmful outcomes, including injury, are discussed, as well as the most recent World Health Organization (WHO) estimates of the burden of injuries attributable to alcohol (from the 2010 Comparative Risk Assessment) compared to those for 1990, by gender. Alcohol's role in violence-related injuries and those resulting from traffic crashes, which together are the most common causes of morbidity and mortality in the region, is also highlighted.

The second section of the book addresses the epidemiological evidence of alcohol's association with injury in the region, based on ER studies. Following a review of the literature on ER studies conducted in the Americas, a description is provided of the methodology used in these studies, and a recent study is highlighted as one example of the diverse political and health services contexts across these studies. Prevalence of alcohol-related injury is reported across countries by cause of injury, along with differences in alcohol-related injury by country-level contextual variables, including income, societal drinking patterns, and alcohol control policies. Relative risk of injury is estimated by cause of injury and amount of alcohol consumed prior to the injury event, and the alcohol-attributable fraction (AAF) is calculated, taking into account country-level drinking pattern and alcohol policy. Differences in the context of drinking and injury are examined across countries in relation to the number and type of alcoholic beverages consumed, and demographic predictors of alcohol-related injury are analyzed by country income level. Drinking pattern as a predictor of alcohol-related injury is also examined, taking into account individual usual volume of consumption and aggregate-level volume, pattern, and alcohol policy measures.

The third section of the book focuses on identification of alcohol-related injury in the ER and intervention and policy strategies. Surveillance of alcohol-related injuries is discussed, along with assessment of alcohol intoxication based on blood alcohol concentration (BAC), using the ICD-10[1] Y90 codes, compared to clinical assessment, using the ICD-10 Y91 codes. Strategies to prevent alcohol-related injury targeted to high-risk products, settings, and populations are also discussed, along with implementation of screening and brief intervention (BI) in the ER setting. The volume concludes with a discussion of implementation and enforcement of various alcohol policies aimed at reducing the public health impact of alcohol-related injuries in the Americas, including their prevention and management, in concordance with WHO global strategy for reducing the harmful use of alcohol.

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[1] International Classification of Diseases, 10th Revision, World Health Organization.

Section I
**Alcohol consumption
in the Americas and the role
of injuries in the burden
of alcohol-related diseases**

INTRODUCTION

Section I provides an overview of the extent and impact of alcohol consumption in the Americas and the role of injuries in the burden of alcohol-related diseases. Alcohol consumption is one of the leading risk factors for disease and disability worldwide, and in the Americas, it is linked to more than 200 ICD-10[1] conditions and diseases. The overall volume of exposure to alcohol and the pattern of consumption are causally related with these disease outcomes—usually in a dose–response relationship—with variations by sex and age. The proportion or fraction of a particular disease or injury attributable to alcohol can be calculated—along with years of life lost (YLL), number of deaths, and disability-adjusted life years (DALYs)—to indicate the relative impact of alcohol compared to other risk factors on the total burden of injury in the Americas, at both the sub-regional and country level, where such estimations have been undertaken. Therefore, information on how much alcohol people drink and how they drink it is very important. There is considerable information available in the Americas, from studies among youth as well as the adult general population, collected over a number of years. These data are presented in Chapter 1.

In the Americas, the volume of alcohol consumption and the way in which it is consumed present major public health problems. Per capita consumption of alcohol in the Americas is higher than the world average per capita consumption. The prevalence of heavy episodic drinking in the region is also high, along with the prevalence of drinkers among students, compared to other regions and countries worldwide. The link between injuries and alcohol consumption has long been recognized, and alcohol is a large contributor to the burden of injuries, as described in Chapter 2. The alcohol-attributable burden of injuries in the Americas in 2010 was large, especially among men and those 15–34 years years old; compared to 1990, the alcohol-attributable burden in the region had increased in both absolute magnitude and in rates per 100 000 people.

Among all causes of injuries, those caused by interpersonal violence and traffic crashes are the ones most commonly associated with alcohol consumption. The overview of the evidence provided in Chapter 3 clearly demonstrates that the most vulnerable populations such as young people and women are disproportionally affected, and that low- and middle-income countries have a great challenge ahead regarding the implementation of effective public health policies targeting the harmful use of alcohol.

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[1] International Classification of Diseases, 10th Revision, World Health Organization.

CHAPTER 1

Alcohol consumption and drinking patterns in the Americas

Kevin D Shield, Jürgen Rehm, and Maristela Monteiro

SUMMARY

In the Americas, the volume of alcohol consumption and the way in which it is consumed present major public health problems. In 2005, adult per capita consumption of alcohol in the Americas was 8.7 L per year—higher than the world average of 6.1 L. Even more worrisome is the fact that alcohol consumption prevalence among students in the region is much higher than that for other regions. In addition, heavy chronic alcohol consumption is much higher in the Americas compared to the world average. By World Health Organization (WHO) Global Burden of Disease (GBD) region,[1] Central and Tropical Latin America exhibit the worst drinking patterns in the Americas, including a low rate of drinking with meals and a high prevalence of festive drinking. To reduce the burden of disease, economic loss, and social problems in the Americas that result from alcohol consumption and harmful drinking patterns, policy makers should aim to reduce both per capita consumption of alcohol and the prevalence of harmful drinking patterns. This chapter describes adult per capita consumption of alcohol; drinking patterns, including country scores[2]; and the prevalence of current drinkers, former drinkers, abstainers (lifetime and in past 30 days), and heavy chronic and heavy episodic drinkers, by sex and age, for the Americas region.

INTRODUCTION

There have been a number of attempts to gather country- and territory-level data on the volume of alcohol consumption in the Americas, most recently by WHO, in its Global Status Report on Alcohol and Health (*1*), and by the Institute for Health Metrics and Evaluation in its 2010 Global Burden of Disease Study (*2*). Often, the only data available for country alcohol consumption are measures of yearly per capita consumption (liters of pure alcohol consumed per year by those aged 15 years and older), based on national statistics on recorded and unrecorded[3] alcohol consumption. While considered the most accurate measure of alcohol consumption, these aggregate data are insufficient for estimating the health impact on drinkers, as risk for many alcohol-related diseases, conditions, and injuries is calculated based on average daily consumption and drinking patterns among current drinkers (*3*). If total per capita consumption data are used for detailed risk analyses, they must be triangulated with population survey data for variables such as sex, age, drinking status (current, former, or abstainer), and daily consumption in order to obtain meaningful results. Survey data are particularly important for determining the proportion of abstainers in a country, and for describing the distribution of average daily

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[1] Regional classification of WHO member states based on epidemiological criteria.

[2] A system for scoring drinking patterns by level of risk for alcohol-attributable burden of disease developed by Rehm et al (2001 and 2003).

[3] Alcohol that is produced, distributed, and sold outside formal channels and therefore is not taxed. Includes consumption of homemade or illegaly produced alcohol (legal or illegal), smuggled alcohol, alcohol intended for industrial or medical uses, alcohol obtained through cross-border shopping, and consumption of alcohol by tourists (WHO Global status report on alcohol and health 2011).

alcohol consumption disaggregated by sex and age. Survey data can also be used to estimate unrecorded consumption (*4*).

The volume of alcohol consumed and the way in which it is consumed have been shown to vary substantially between countries and territories in the Americas, by sex, and across different cultures and age groups, contributing to a wide variation in the global burden of disease attributable to alcohol observed across different GBD regions (*5*). Reliable health data and statistics on alcohol exposure are required to formulate health policies and strategies aimed at reducing the alcohol-attributable burden of disease, and for the evaluation and monitoring of this burden. The need for accurate statistics on alcohol exposure was recognized by member states of WHO, which agreed on a global strategy for reducing the harmful use of alcohol at the 63rd World Health Assembly (*6*).

This chapter describes alcohol exposure estimates for 1) total adult per capita consumption of alcohol; 2) drinking patterns and country drinking pattern scores[4]; and 3) prevalence of current drinkers, former drinkers, abstainers (lifetime and in past 30 days), and heavy chronic and episodic drinkers, by sex and age, for the Americas in 2005, based on population data from a variety of sources (*1, 7, 8*).

PER CAPITA ALCOHOL CONSUMPTION

Total adult per capita alcohol consumption is the adult (15 years and over) per capita amount of alcohol consumed in litres of pure alcohol in a given population. This measure is considered the most accurate indicator of a country or territory's alcohol consumption (*9*). Compared to data on total per capita consumption, estimates of alcohol consumption based on population surveys are frequently underestimated (*10, 11*). Total adult per capita consumption for most countries in the Americas is higher than the world average. For the region as a whole,

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[4] System for rating drinking patterns by level of risk for alcohol-attributable burden of disease developed by Rehm et al (2001 and 2003).

total adult per capita alcohol consumption was estimated at 8.7 L in 2005, 30% higher than the adult per capita world average of 6.1 L, though consumption measurements vary greatly by country. Figure 1 and Table 1 show total per capita consumption of alcohol by country and GBD region, respectively. Of all GBD regions in the Americas (see Box 1), the High-income North America region had the largest per capita consumption at 9.5 L, followed by Latin America's Southern and Tropical GBD regions, where estimated average consumption was 9.4 L and 9.1 L, respectively. The GBD Caribbean region had the lowest per capita consumption, with an average of 6.0 L.

From 2000 to 2005, per capita consumption remained stable in most countries in the Americas but increased in Belize, Bolivia, Cuba, Peru, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago. During that period, 5.3% of all inhabitants of the Americas resided in a country where per capita alcohol consumption was increasing, and 94.7% of all inhabitants of the Americas resided in a country where per capita consumption remained stable. The percentage of people in the Americas living in a country with a decreasing trend in per capita consumption was negligible. The most recent data available for this measure are from 2005 and thus may not reflect the current situation.

Unrecorded alcohol

Consumption of unrecorded alcohol is a concern in the GBD regions of Latin America, all of which have estimates for this metric above 2.0 L. Unrecorded alcohol has some additional health risks versus recorded alcohol because it may contain methanol or harmful levels of other ingredients such as acetaldehyde (*12*), ethyl carbamate (*13*), and/or coumarin (*14*). Consumption of these ingredients may lead to poisoning and other potential dangers, but an insufficient number of systematic, large-scale investigations of the quality of alcohol in different parts of the world makes it difficult to conclude definitively that the quality of unrecorded alcohol has had a significant impact on health in the Americas. Another problem related to unrecorded alcohol is the fact that it tends to increase after implementation of cer-

TABLE 1. Total per capita consumption of alcohol among all adults[a] and average daily consumption of alcohol among adult drinkers, by country and sex, worldwide and by World Health Organization Global Burden of Disease (GBD) region,[b] 2005

Region	Total per capita consumption (total liters of pure alcohol sold/distributed per year, based on national statistics, divided by total adult population)				Adult population (in 100 000s)	Average daily consumption per drinker (liters of pure alcohol consumed per drinker per day based on population survey data)				
	Recorded	Unrecorded	Tourist	Per capita[d]		Women			Men	
Caribbean	5.2	0.9	0.0	6.0	25 771	12.2	13 014	7.8	12 757	14.4
Latin America										
Andean	3.2	4.1	0.0	7.3	33 488	15.2	16 861	10.0	16 627	18.6
Central	4.8	2.5	0.0	7.3	145 398	19.3	74 512	12.4	70 886	22.7
Southern	7.4	2.0	0.0	9.4	42 908	12.5	22 169	8.1	20 739	16.2
Tropical	6.2	3.0	0.0	9.1	138 603	18.3	71 023	10.6	67 580	24.1
North America, High-income[c]	8.4	1.1	0.0	9.5	262 060	14.3	134 181	8.3	127 879	19.8
World	4.3	1.7	0.0	6.1	4 656 421	17.1	2 331 120	9.5	2 325 301	20.5

[a] ≥ 15 years old.
[b] Classified according to epidemiological criteria
[c] Canada, Saint Pierre et Miquelon, and the United States.
[d] Total recorded consumption plus total unrecorded consumption minus total tourist consumption among people aged 15 years and older, divided by the population (in liters of pure alcohol).

FIGURE 1. Total adult per capita consumption of alcohol,[a] Americas region, 2005[b]

Per capita consumption (litres)
- < 2.50
- 2.50 - 4.99
- 5.00 - 7.49
- 7.50 - 9.99
- 10.00 - 12.49
- ≥ 12.50
- Data not available
- Not aplicable

[a] Total recorded consumption plus total unrecorded consumption minus total tourist consumption among people aged 15 years and older, divided by the population (in liters of pure alcohol).

[b] Modified version of Figure in (1).

BOX 1. GBD 2010: countries by region[5]	
Region name	Country name
Andean Latin America	Bolivia, Ecuador, Peru
Caribbean	Antigua and Barbuda, Bahamas, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago
Central Latin America	Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Venezuela
High-income North America	Canada, United States
Southern Latin America	Argentina, Chile, Uruguay
Tropical Latin America	Brazil, Paraguay

[5] Institute for Health Metrics and Evaluation. GBD 2010 regions. http://www.healthmetricsandevaluation.org/sites/default/files/publication_summary/GBD2010_Regions_countries.pdf. Accessed 3 October 2013.

tain public health policies designed to reduce the burden of recorded alcohol consumption (e.g., taxation of alcoholic products) (*15*).

Tourist consumption

For the majority of countries the amount of alcohol consumed by foreign tourists is approximately equal to the amount of alcohol consumed by the countries' inhabitants when they travel outside their own country. In these cases, no adjustment to total per capita consumption needs to be made to account for tourist consumption. However, in countries with small populations and a large volume of tourism (e.g., the Caribbean countries), tourist consumption has a substantial impact on per capita consumption, and will therefore distort estimates of the alcohol-attributable burden of disease and injury if not taken into account. For the GBD Caribbean region overall, tourist consumption of alcohol was low, with only 0.05 L consumed per capita. However, the results for this metric varied greatly by country. Antigua and Barbuda, the Bahamas, and Saint Lucia all had a large proportion of alcohol consumption attributable to tourists (2.0 L, 2.6 L, and 1.0 L per capita respectively).

Alcohol by type

In most countries in the Americas, beer is the most consumed beverage. However, in Argentina, Chile, and Uruguay, wine is the most consumed alcoholic beverage, and in many Caribbean and Central American countries, spirits are the most consumed alcoholic beverages. For the majority of countries where wine or spirits are the most consumed alcoholic beverages, beer also makes up a large proportion of adult per capita consumption (with the exception of Dominica, Guyana, and Haiti, where consumption of beer contributes very little to total per capita consumption).

DRINKING STATUS BY TYPE OF POPULATION (CURRENT DRINKERS AND PAST-YEAR ABSTAINERS)

In 2005 in the Americas, 41.7% of adults (49.8% of women and 33.0% of men) were past-year abstainers (defined as those who have not consumed any stan-

dard alcoholic drinks in the past year). Of the past-year abstainers, 48.4% of adults (45.0% of women and 54.0% of men) were former drinkers (defined as those who have consumed at least one standard alcoholic drink in their lifetime, but have not done so in the past year). For comparison purposes, worldwide, in 2005, 58.2% of adults (67.5% of women and 48.7% of men) were past-year abstainers and 22.6% of them (18.5% of women and 28.4% of men) were former drinkers. Table 2 shows the prevalence of current drinkers, former drinkers, and lifetime abstainers, by GBD regions in the Americas, in 2005. The prevalence of lifetime abstainers in Central Latin America was high, with 47.6% of all adult women and 26.3% of all adult men never having consumed one standard alcoholic drink. Prevalence of this characteristic was particularly high in Guatemala (where 84.7% of women and 49.4% of men were lifetime abstainers) and Mexico (where 64.3% of women and 37.5% of men were lifetime abstainers). Both per capita consumption of alcohol and prevalence of current drinkers have been shown to be strongly correlated with gross domestic product adjusted for purchase power parity (GDP-PPP), so prevalence of current drinkers in countries with a high prevalence of lifetime abstainers may increase as GDP-PPP and affordability of alcohol increase (*16*).

Average daily consumption among current drinkers

Average daily consumption for male and female drinkers is outlined in Table 1 by GBD region. For the Central and Tropical Latin America regions, total per capita alcohol consumption per adult drinker was greater than the world average (17.1 L). For the Caribbean, Andean, and Southern Latin America regions, and the High-income North America region, total adult per capita consumption was lower than the world average. Ecuador, Saint Kitts and Nevis, and Mexico had the highest adult per capita consumption values for current drinkers in the Americas (30.1 L, 28.5 L, and 27.3 L respectively).

A method proposed by Rehm and colleagues was used to calculate the distribution of alcohol consumption among current drinkers (*17, 18*). This

method triangulates adult per capita consumption data with estimated prevalence of current drinkers to estimate the distribution of alcohol consumption for specific age groups and by sex. (*18*). Estimated prevalence of current drinkers was differentiated by category of average daily alcohol consumption, by GBD region, for 2005, as shown in Table 2.

To quantify harmful alcohol consumption in the Americas, indicators of long-term risk according to average daily ethanol consumption are applied where there is heavy chronic consumption of alcohol (defined as on average more than 40 grams of alcohol per day for women, which is equal to about 3.33 international standard alcoholic drinks, and more than 60 g of alcohol per day for men, which is equal to at least 5.0 international standardized alcoholic drinks) (*19*). Heavy chronic drinkers are at a much greater risk of alcohol-related diseases, conditions, and injuries (*3, 6*). In the GBD Central and Southern Latin America regions, 10.6% and 13.2% of female current drinkers are heavy chronic drinkers respectively. Both of these prevalence rates are greater than the world average among women (9.2%). Among male current drinkers in the GBD regions of Central Latin America, Southern Latin America, and High-income North America, 18.9%, 23.6%, and 18.1% respectively were heavy chronic drinkers – all higher prevalence rates than the world average (17.0%).

In the GBD regions of Andean, Central, and Southern Latin America, and the Caribbean, there was a higher prevalence of heavy chronic drinkers among men 35 to 64 years old compared to men 15 to 34 years old. In contrast, for men in Tropical Latin America and in High-income North America, the prevalence of heavy chronic drinkers 15 to 34 years of age was greater than the prevalence of heavy chronic drinkers 35 to 64 years of age. For women in Central and Andean Latin America, the Caribbean, and High-income North America, the prevalence of heavy chronic drinkers among women 15 to 34 year of age was greater than for women 35 to 64 years of age. In Southern and Tropical Latin America the prevalence of heavy chronic drinkers 15 to 34 years of age was greater than for women 35 to 64 years of age.

DRINKING PATTERNS

Drinking patterns reflect how people consume alcohol rather than how much they consume and are strongly associated with the alcohol-attributable burden of disease of a country. Different drinking patterns give rise to very different health outcomes in population groups with the same level of consumption, and strongly affect the risk of intentional and unintentional injury. In the scoring system developed by Rehm and others (*20, 21*), drinking patterns are scored on a scale of 1 (least risky drinking pattern, lesser burden of disease) to 5 (most risky drinking pattern, greater burden of disease). The drinking pattern score for a country is based on six criteria: 1) the usual quantity of alcohol consumed per occasion, 2) the prevalence of festive drinking, 3) the proportion of drinking events when drinkers get drunk, 4) the proportion of drinkers who drink daily or nearly daily, 5) the proportion of drinking occasions that occur during meals, and 6) the proportion of drinking occasions that occur in public places. Each measure is weighted differently to produce a drinking pattern score scale ranging from 1 to 5. Figure 2 shows the drinking pattern scores for countries/territories in the Americas in 2005. Table 2 shows the drinking pattern scores for the same period worldwide and for each GBD region. The highest pattern of drinking scores for the Americas was observed for Central Latin America (3.6), Andean Latin America (3.3), and Tropical Latin America (3.0). These scores (3 or above) indicate a high prevalence of festive drinking and drinking outside of meals.

Heavy episodic drinking

Heavy episodic drinking in the Americas differs greatly between regions and countries. In 2005, 12.0% of adult drinkers in the region (4.5% of female drinkers and 17.9% of male drinkers) engaged in weekly heavy episodic drinking, defined for both men and women as having consumed more than 60 g (equal to at least 5.0 international standardized alcoholic drinks) on one occasion (*19, 22*). These results are similar to the world average of 11.5% of adult drinkers (4.2% of female drinkers and 16.1% of male drinkers) who engaged in weekly heavy ep-

TABLE 2. Drinking pattern scores and drinking status estimates (by sex and age group), worldwide and by World Health Organization Global Burden of Disease (GBD) regions,[a] 2005

Region	Age group (years)	Drinking pattern score[b]	Drinking status estimates (%)											
			Women						Men					
			Lifetime abstainers	Former drinkers	Current drinkers (by average daily consumption)				Lifetime abstainers	Former drinkers	Current drinkers (by average daily consumption)			
					>0–<20 g	20–<40 g	40–<60 g	≥60 g			>0–<40 g	40–<60 g	60–<100 g	≥100 g
Caribbean	15–34	–	34.9	17.8	33.9	8.1	3.1	2.2	15.8	14.6	57.2	6.4	4.5	1.5
	35–64	–	49.5	22.9	23.5	3.2	0.7	0.2	12.6	20.0	51.6	7.1	5.9	2.7
	≥ 65	–	81.5	9.8	8.1	0.5	0.1	0.0	39.5	24.9	28.2	3.6	2.7	1.1
	Total	2.3	46.6	19.1	26.4	5.1	1.7	1.1	16.8	18.0	51.8	6.4	4.9	2.0
Latin America														
Andean	15–34	–	30.2	21.4	36.7	7.6	2.6	1.5	23.4	9.1	53.0	6.9	5.4	2.2
	35–64	–	18.1	32.0	41.5	6.3	1.6	0.6	3.1	19.5	54.9	9.0	8.4	5.1
	≥ 65	–	51.3	21.1	22.9	3.5	0.9	0.3	50.9	26.9	19.4	1.6	0.9	0.2
	Total	3.3	27.3	25.5	37.4	6.7	2.0	1.0	17.6	14.5	51.2	7.3	6.3	3.2
Central	15–34	–	48.3	15.2	25.3	6.5	2.7	2.2	33.3	13.4	37.6	6.2	5.9	3.7
	35–64	–	45.6	20.0	25.9	5.5	1.9	1.1	16.6	17.6	44.8	7.8	7.8	5.4
	≥ 65	–	53.6	19.8	24.3	2.0	0.3	0.1	30.2	24.3	32.1	5.3	5.0	3.1
	Total	3.6	47.6	17.5	25.5	5.7	2.1	1.6	26.3	15.9	40.1	6.8	6.6	4.3
Southern	15–34	–	3.4	19.1	64.3	9.8	2.5	0.9	6.3	2.0	70.6	9.7	7.9	3.5
	35–64	–	14.1	24.2	42.8	10.9	4.4	3.6	5.2	9.4	64.0	9.3	8.0	4.0
	≥ 65	–	19.0	29.3	42.8	6.5	1.7	0.6	17.4	13.0	55.0	7.0	5.4	2.2
	Total	2.3	10.4	22.9	51.7	9.8	3.2	2.0	7.1	6.5	66.0	9.2	7.7	3.6
Tropical	15–34	–	19.5	30.3	36.5	8.5	3.1	2.1	12.4	18.8	44.8	8.3	8.7	6.9
	35–64	–	24.5	39.0	22.9	6.9	3.2	3.5	14.3	33.3	32.3	6.4	7.1	6.5
	≥ 65	–	33.1	47.8	16.6	2.0	0.4	0.1	27.0	46.0	21.7	2.6	2.0	0.7
	Total	3.0	22.9	35.6	28.8	7.2	2.9	2.5	14.3	27.0	37.7	7.1	7.5	6.3
North America High-income[c]	15–34	–	19.4	9.7	51.8	11.9	4.4	2.9	13.0	8.9	50.8	9.5	9.9	7.9
	35–64	-	17.2	18.4	49.1	10.1	3.4	1.9	9.4	16.9	53.5	8.3	7.6	4.2
	65+	-	38.9	28.9	27.6	3.6	0.8	0.2	14.1	31.4	44.0	5.3	3.9	1.4
	Total	2.0	21.7	17.3	46.2	9.6	3.2	2.0	11.4	15.9	51.2	8.3	7.9	5.2
World	15–34	-	60.4	11.0	23.0	3.4	1.2	1.0	42.4	12.8	35.1	3.9	3.4	2.4
	35–64	-	51.5	13.5	25.2	5.8	2.2	1.8	30.2	14.3	37.3	6.5	6.6	5.1
	65+	-	52.9	19.5	23.2	3.2	0.8	0.4	31.5	19.4	37.4	5.1	4.3	2.2
	Total	2.6	55.6	13.1	24.0	4.4	1.6	1.3	36.0	14.1	36.3	5.2	4.9	3.6

a Classified according to epidemiological criteria.
b Based on a score of 1 (least risky) to 5 (most risky) using the system developed by Rehm at al (2001 and 2003).
– indicates missing data.
c Canada, Saint Pierre et Miquelon, and the United States.

FIGURE 2. Drinking pattern scores[a] for countries/ territories, Americas region, 2005[b]

Drinking patterns
- ▇ Most risky drinking pattern
- ▇
- ▇
- ▇
- ▇ Least risky drinking pattern
- ▇ Data not available
- ▇ Not aplicable

[a] Based on system developed by Rehm et al (*20, 21*) for rating drinking patterns by level of risk for alcohol-attributable burden of disease (with 1 = low risk and 5 = high risk).

[b] Modified version of Figure in (*1*).
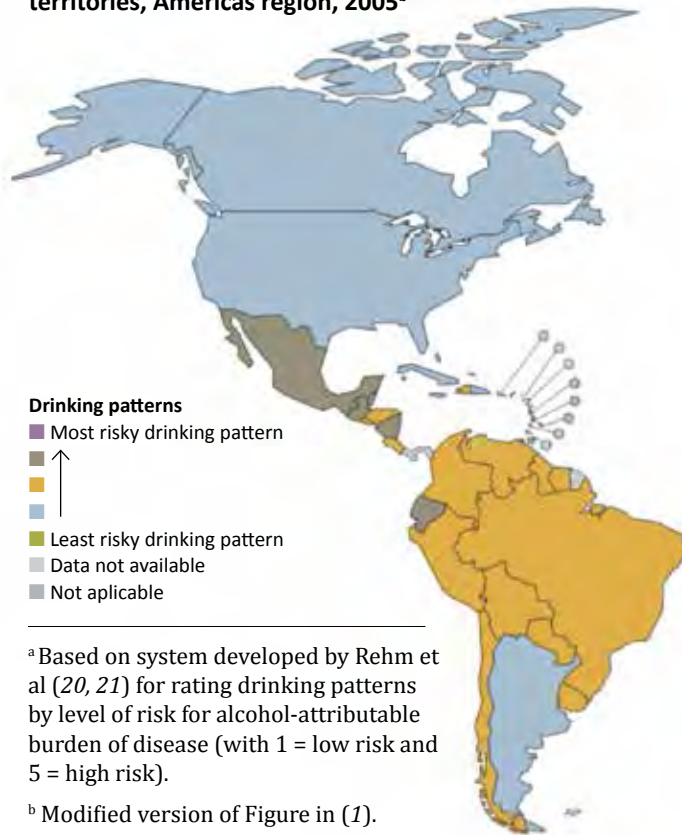
isodic drinking. For women, weekly heavy episodic drinking was most prevalent in Brazil (10.1% of all female drinkers), Costa Rica (12.5%), the Dominican Republic (10.0%), and Nicaragua (11.0%). For men, weekly heavy episodic drinking was most prevalent in Brazil (32.4% of all male drinkers), Nicaragua (32.7%), and Paraguay (37.7%). Figure 3A outlines the prevalence of weekly heavy episodic drinkers by country for adult men and Figure 3B outlines the same information for adult women.

For each GBD region, estimates of people who engaged in heavy episodic drinking were calculated as a weighted average of heavy episodic drinker prevalence estimates from good-quality population alcohol consumption surveys from the largest countries in a particular GBD region. Table 3 outlines the prevalence of people who engaged in heavy episodic drinking, by GBD region, differentiated by sex and by age group. For women, heavy episodic alcohol consumption among current drinkers was most prevalent in the Caribbean region (5.1% of all female drinkers) and the Tropical Latin America region (5.4%). For men, heavy episodic alcohol consump-

FIGURE 3. Prevalence of heavy episodic drinking[a] among past-year male drinkers (A) and past-year female drinkers (B), Americas region, 2005[b]

(A)

Percentage (%)
- ▇ < 5.0
- ▇ 5.0 - 9.9
- ▇ 10.0 - 19.9
- ▇ 20.0 - 29.9
- ▇ ≥ 30
- ▇ Data not available
- ▇ Not aplicable

(B)

[a] Defined by WHO as having consumed ≥ 60 g (equal to at least 5.0 international standardized alcoholic drinks) on one occasion.

[b] Modified version of Figure in (*1*).
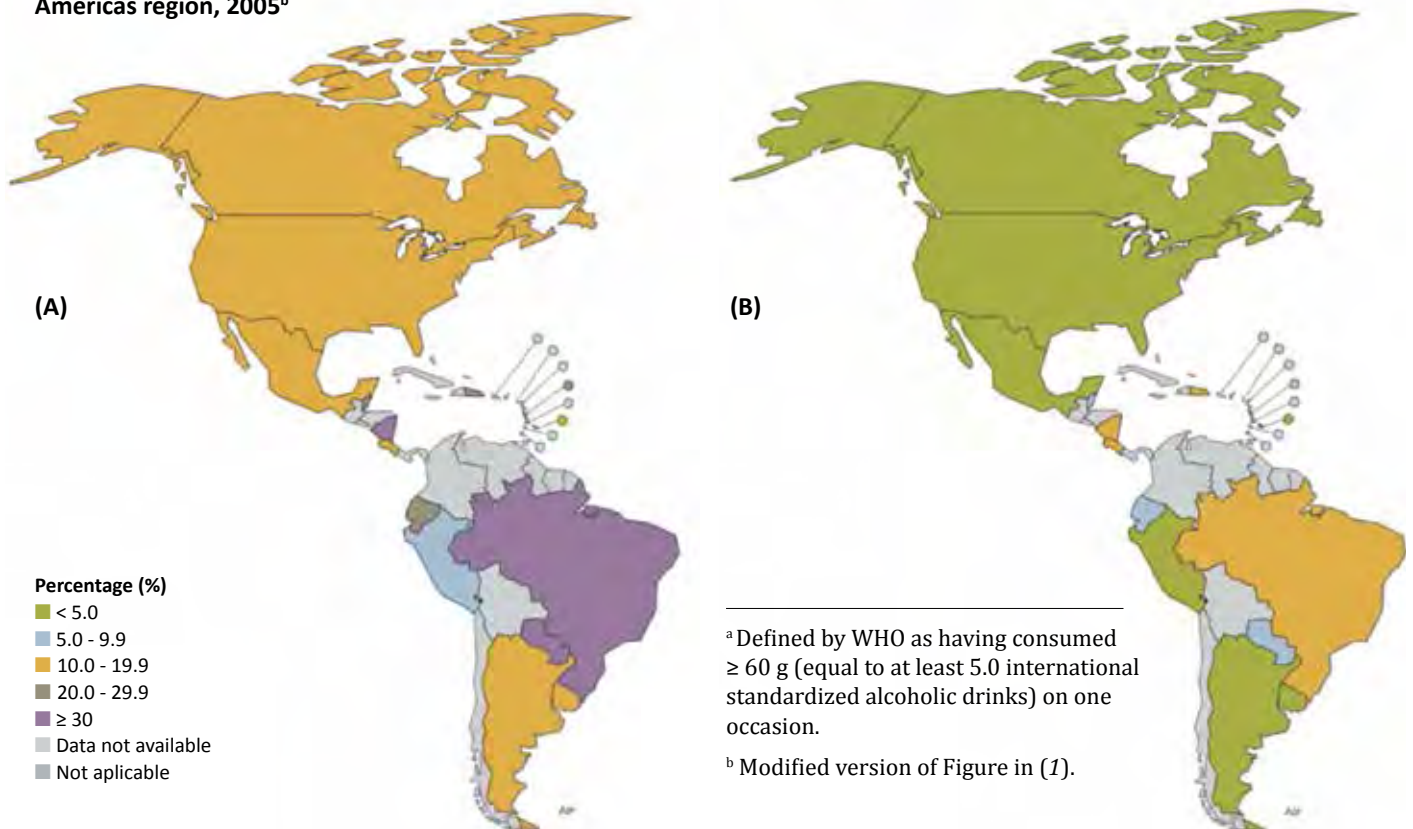
TABLE 3. Prevalence of heavy drinkers among current drinkers according to sex and age, worldwide and by World Health Organization Global Burden of Disease (GBD) regions[a] for the Americas, 2005

Region	Women (%)				Men (%)			
	15–34 years	35–64 years	≥ 65 years	Total	15–34 years	35–64 years	≥ 65 years	Total
Caribbean	7.4	4.1	0.0	5.1	22.5	20.6	7.6	20.2
Latin America								
Andean	4.3	3.7	1.8	3.8	19.5	18.9	9.0	18.5
Central	2.1	1.1	0.5	1.6	22.8	23.6	14.9	22.5
Southern	0.0	0.4	0.0	0.2	23.3	12.7	6.4	16.8
Tropical	7.0	4.7	0.0	5.4	27.3	16.8	4.5	21.1
North America, High-income[b]	7.5	1.8	0.0	3.4	24.5	8.6	3.8	13.7
World	3.6	7.4	2.7	5.2	23.6	27.2	11.3	24.0

[a] Classified according to epidemiological criteria.
[b] Canada, Saint Pierre et Miquelon, and the United States.

tion among current drinkers was most prevalent for the Caribbean region (20.2% of all male drinkers), the Central Latin America region (22.5%), and Tropical Latin America region (21.1%). Heavy episodic alcohol consumption in the Americas was a particular problem for both men and women between 15 and 64 years old. Furthermore, heavy episodic consumption of alcohol was often more prevalent among drinkers 15 to 34 years old versus drinkers 35 to 64 years old (with the exception of men in Central Latin America).

ALCOHOL CONSUMPTION AMONG ADOLESCENTS

Consumption of alcohol is a particular problem among students in the countries of the Americas. Table 4 presents data obtained from the WHO Global School-based Student Health Survey (*22, 23*). The past 30-day drinking prevalence for countries in the Americas was high for both female and male students, with a higher drinking prevalence among female students versus male students in Anguilla, Antigua and Barbuda, British Virgin Islands, Costa Rica, Colombia, Ecuador, Saint Vincent and the Grenadines, and Trinidad and Tobago. The prevalence of female students who drank enough to become drunk one or more times in their life was greater than the prevalence for male students for Anguilla, British

Virgin Islands, Montserrat, Saint Lucia, and Uruguay. In addition, the prevalence of female students who had their first drink of alcohol when they were less than 14 years old was greater than the prevalence for male students for Antigua and Barbuda, Cayman Islands, Suriname, Trinidad and Tobago, and Uruguay. The prevalence of drinking among both female and male students was above 50% in Argentina, Colombia, Dominica, Jamaica, Saint Lucia, and Saint Vincent and the Grenadines. This high prevalence of current drinkers among adolescents is a major public health concern given their higher risk of heavy episodic drinking, alcohol use disorders, problems with school achievement, injuries, and violence.

In Brazil, among adolescents (14 to 18 years old), the prevalence of heavy episodic drinking (consumption of 4 or more drinks on one occasion for girls and 5 or more drinks on one occasion for boys) increased from 36% in 2006 to 42% in 2012 for all adolescents (28% to 39% for adolescent girls and 42% to 46% for adolescent boys) (*24*). This represents an increase of 17% in the prevalence of heavy episodic drinking among adolescents from 2006 to 2012 (an increase of 39% for adolescent girls and 10% for adolescent boys). It is currently unknown if other countries in the Americas are experiencing a similar increase in heavy episodic drinking among adolescents.

TABLE 4. Results of World Health Organization (WHO) Global School-based Student Health Survey, Americas region, 2003–2010

WHO member state (survey year)	% of students 13–15 years old who drank at least one alcoholic drink on one or more of the past 30 days		% of students 13–15 years old who drank so much alcohol that they were drunk[a] one or more times in their life		% of students 13–15 years old who had their first drink of alcohol when they were less than 14 years old	
	Girls	Boys	Girls	Boys	Girls	Boys
Anguilla (2009)	48.0	43.3	28.7	25.3	87.7	94.0
Antigua and Barbuda (2009)	54.7	45.1	19.5	26.1	88.2	85.9
Argentina (2007)	49.0	55.4	18.4	20.7	27.1	30.9
Barbados (2008)	45.8	46.9	19.0	29.0	88.6	88.7
British Virgin Islands (2009)	35.5	30.5	20.7	17.7	84.2	89.1
Cayman Islands (2007)	36.9	41.4	18.9	21.2	27.9	27.7
Costa Rica (2007)	23.6	23.4	22.2	23.9	43.3	47.2
Colombia (2007)	59.7	56.8	15.6	15.8	76.7	82.9
Dominica (2009)	54.0	54.9	28.8	37.6	87.9	88.8
Ecuador (2007)	29.8	28.6	16.7	20.3	23.6	25.0
Grenada (2008)	43.0	49.1	13.1	19.2	22.1	33.9
Guatemala (2009)	14.2	18.1	8.8	13.1	69.2	74.4
Guyana (2010)	25.9	46.9	24.5	34.7	77.1	80.5
Jamaica (2010)	47.1	57.8	27.0	43.5	74.3	84.6
Montserrat (2008)	31.5	35.6	13.3	12.5	22.2	34.0
Peru (2010)	26.0	28.4	10.2	16.8	62.0	70.2
Saint Kitts and Nevis (2010)	2.3	4.7	12.1	16.6	32.5	32.6
Saint Lucia (2007)	52.2	59.2	31.0	15.4	30.0	41.5
Saint Vincent and the Grenadines (2007)	53.5	52.6	14.6	18.1	30.0	40.6
Suriname (2009)	30.0	35.6	9.0	21.0	74.2	73.7
Trinidad and Tobago (2007)	42.0	39.6	22.3	25.3	86.7	86.3
Uruguay (2006)	57.7	62.0	24.7	24.5	69.1	46.9
Venezuela (2003)	32.4	34.9	8.1	14.0	15.0	25.5

[a] Defined as "staggering, slurred speech, or vomiting."

DATA LIMITATIONS

The estimates of alcohol consumption indictors for the Americas presented in this chapter have certain limitations. The prevalence estimates of current drinkers, lifetime abstainers, former drinkers, and heavy chronic and episodic drinkers are often underestimated in general population surveys. This underestimation stems from the multiple biases (i.e., response bias, nonresponse bias, excluded populations, and measurement error) to which surveys are susceptible (7, 25, 26). In addition, because the systematic error in estimating these prevalence estimates is not the same across countries or surveys, caution should be taken when making between-country comparisons of prevalence estimates, especially where the designs of the surveys differ. Furthermore, the alcohol consumption pattern estimates are cross-sectional and do not provide an indication of trends in consumption patterns, and the data on alcohol consumption and alcohol consumption patterns are missing for a great number of countries.

Regional estimates of prevalence of drinkers who drink heavily episodically were based on the largest countries in the Americas. This approach may lead to biased estimates of the prevalence of heavy

drinkers among current drinkers, and may be the basis for the estimated prevalence of heavy drinkers among current drinkers for women in Southern Latin America (0.2% of all female drinkers). Given the prevalence of heavy episodic drinking by men in Southern Latin America, the heavy episodic drinking prevalence estimates for women in this region seem implausibly low. However, these estimates are likely based only on data from Argentina, where weekly heavy episodic drinking among adult women was estimated to be 0.3% in 2005. Future heavy drinking prevalence estimates for the GBD region of Southern Latin America should incorporate prevalence estimates from other countries in this region, such as Uruguay, where it is estimated that 4.6% of all women drinkers engaged in weekly heavy episodic drinking in 2005.

As mentioned above, the estimates in this report are cross-sectional and do not provide an indication of trends in consumption patterns. Data on trends in total per capita consumption of alcohol are available elsewhere (*1*). Data on global trends in the prevalence of various drinking statuses have not yet been collected. Because the volume and patterns of alcohol consumption are not static, data on trends could be used to formulate effective public policies to minimize any increases in alcohol-related harms. Future research should focus on collecting longitudinal data for the Americas on adult per capita consumption of alcohol, pattern of drinking scores, and the prevalence of current drinkers, former drinkers, lifetime abstainers, heavy chronic drinkers, and heavy episodic drinkers, differentiated by sex and age group.

In the Americas, data on total per capita consumption of alcohol, prevalence of current drinkers, and drinking patterns are missing for a large number of countries (particularly the smaller countries). For example, data on total per capita consumption are available for 51.6% of the countries/territories in the Caribbean region, 100.0% of the countries in Andean Latin America region, 75.0% of the countries in Southern Latin America region, and 66.7% of the countries/territories in the High-income North America region. In contrast, worldwide, data on to-

tal per capita consumption are available for 78.4% of all countries/territories.

Missing data are even more problematic when attempting to measure the prevalence of current drinkers, former drinkers, and lifetime abstainers. Data on the prevalence of drinking statuses were available for 29.0% of countries/territories in the Caribbean region, 100.0% of countries in the Andean and Tropical Latin America regions, 55.6% of countries in the Central Latin America region, 75.0% of countries in the Southern Latin America region, and 66.7% of countries/territories in the High-income North America region.

Data on weekly heavy drinking occasions are available for 15 of the 52 countries and territories (28.8%) of the Americas. Data on the number of people who engaged in weekly heavy drinking occasions are available for 12.9% of the Caribbean countries/territories, 66.7% of the Andean Latin America countries, 33.3% of the Central Latin America countries, 50.0% of the Southern Latin American countries, 100.0% of the Tropical Latin American countries, and 66.7% of the High-income North American countries. Currently, there is no global system for collecting data on 1) the amount of alcohol consumed during heavy drinking occasions or 2) the number of occasions when people engage in heavy consumption of alcohol. These kinds of data are often collected in national alcohol consumption surveys and are essential for calculating the global burden of alcohol-attributable injuries (see Chapter 2 in this volume). Therefore, there is a need for systematic collection of global information on these variables.

Given the need for estimates of total per capita consumption, prevalence of different drinking status types, and drinking pattern scores for countries where these data are not currently available—and the need to validate the available data—a mathematical model that provides accurate estimates over multiple years, similar to a mathematical model that has been used for systolic blood pressure data (*27*), is required. This type of model requires large amounts of data and should not be used as a replacement for a population survey on alcohol consumption and abuse.

CONCLUSIONS

Most representations of country/region alcohol consumption are clouded by myths and false assumptions. A statistical presentation and mapping of the levels and patterns of regional and country alcohol consumption among people aged 15 years and older provide a sound basis for the analysis of problems related to alcohol consumption in the Americas. However, reliable health data and statistics on alcohol exposure are required to formulate health policies and strategies aimed at reducing the alcohol-attributable burden of disease, and for the evaluation and monitoring of this burden. Therefore, there is an urgent need to measure the volume and patterns of alcohol consumption in countries where these data are not currently available. Future population surveys and data collection efforts should focus on age-specific drinking prevalence estimates to measure the prevalence of current drinkers in young

populations at the global level. In addition, alcohol consumption statistics are not always static, with many countries exhibiting shifts in total alcohol consumption and drinking practices over time. Future surveys should build upon the indicators of alcohol consumption that are currently tracked in an effort to provide an increasingly clearer picture of the level of effort and effectiveness of national responses to the many health and social challenges caused by the harmful use of alcohol.

In the Americas, the volume of alcohol consumption and the way in which it is consumed present major public health problems, especially in the Central and Tropical Latin America regions. Policy makers should aim to reduce total per capita consumption of alcohol and the prevalence of harmful drinking in order to reduce the resulting burden of disease, economic loss, and social problems that result from alcohol consumption in the region. ■

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CHAPTER 2

The burden of injuries attributable to alcohol in the Americas

Kevin D Shield, Jürgen Rehm, and Maristela Monteiro

SUMMARY

The Global Burden of Disease Study (GBD) measured the number of injuries in 1990 and 2010, and the corresponding Comparative Risk Assessment study estimated the number of these injuries that would not have occurred if no one consumed alcohol. This chapter describes the results. In the Americas, in 2010, injuries were responsible for 762 600 deaths (12.1% of all deaths) and 39 989 000 disability-adjusted life years (DALYs) lost (16.6% of all DALYs lost) for those ≥ 1 year old. These proportions are greater than the world averages of 10.3% of all deaths and 13.0% of all DALYs lost due to alcohol consumption. The 2010 alcohol-attributable burden of injuries in the Americas was large, with 115 300 deaths (1.8% of all deaths) and 5 957 000 DALYs lost (2.5% of all DALYs lost; 12.5 deaths, and 656.0 DALYs lost per 100 000 people) caused by alcohol consumption. During the same period, the groups that experienced the greatest number of deaths and DALYs lost caused by injuries attributable to alcohol consumption in the Americas were men and people 15 to 49 years old. Compared to 1990, the alcohol-attributable burden of injuries in 2010 for the Americas increased in absolute magnitude and in rates per 100 000 people for the Andean and Tropical regions of Latin America defined by the GBD. Based on these data, the burden of alcohol-attributable injuries in the Americas is a critical health problem, and immediate public policy action should be undertaken, including the implementation of effective public health policies such as lowering the legal blood alcohol concentration for drivers, decreasing alcohol availability, and increasing alcohol prices through taxation.

INTRODUCTION

Accurate estimates of the number of deaths caused by diseases and health conditions worldwide is crucial for the assessment of the global burden of disease and injury. Information on country-level mortality rates by sex and age (especially premature mortality, measured by years of life lost (YLL)) is critical for formulating and advocating effective public health policy action, especially when the causes of premature mortality can be reliably established (*1, 2*). Ideally, summary measures of population health would indicate health loss due to premature mortality and health loss due to nonfatal outcomes. The 2010 Global Burden of Disease Study (GBD) measured the amount of disability caused by diseases and injuries using the statistical metric "years lived with disability" (YLD). YLD is calculated based on how disabling a condition is and how long the disability is expected to last (*3*). To measure both YLL to death and YLL lost due to disability, the GDB study looks at loss from disability-adjusted life years (DALYs), which is calculated by adding YLL and YLD (*4*). Information on DALYs lost plus information on the costs, intervention effectiveness, and equity implications of health interventions and policy options provides a foundation for determining health policy action and research priorities that are informed by the best available evidence. The objective of the 2010 GBD was to measure deaths and DALYs lost due to different causes at the country level by age and sex (*2, 4, 5*).

Equally important as the measurement of disease is assessment of the contribution of potentially modifiable risk factors for different types of injuries.

The attribution of disease burden to the consumption of alcohol and other risk factors provides an account of the key drivers of patterns and trends of injuries worldwide. Thus, it is essential to estimate the number of deaths and DALYs lost caused by injuries attributable to alcohol consumption. As part of the 2010 GBD, the Comparative Risk Assessment (CRA) estimated the number of deaths and DALYs lost that would not have occurred if alcohol was not consumed in 1990 and 2010 based on population-attributable fractions (*6*).

This chapter describes the results of the 2010 GBD and CRA, with a focus on 1) mortality caused by injuries, differentiated by injury type, for the GBD regions of the Americas (Caribbean, Andean Latin America, Central Latin America, Southern Latin America, Tropical Latin America, and High-income North America), for 1990 and 2010, and 2) the number of these injuries that would not have occurred if no one had consumed alcohol (i.e., the number of injuries attributable to alcohol consumption) for those 1 year of age and older.

BURDEN OF INJURIES IN 1990 AND 2010

In 2010, injury was a leading cause of mortality, responsible for 4 921 200 deaths globally (1 548 700 among women and 3 372 500 among men), representing 10.3% of all deaths (7.2% of all deaths among women and 12.9% of all deaths among men), as well as 267 779 000 DALYs lost globally (81 740 000 among women and 186 039 000 among men), representing 13.0% of all DALYs lost (8.8% of all DALYs lost among women and 16.5% of all DALYs lost among men). In the Americas, in 2010, injuries were responsible for 762 600 deaths (206 300 among women and 556 300 among men), representing 12.1% of all deaths (6.9% of all deaths among women and 16.7% of all deaths among men), as well as 39 989 000 DALYs lost (10 168 000 among women and 29 821 000 among men), representing 16.6% of all DALYs lost (9.4% of all DALYs lost among women and 22.6% of all DALYs lost among men). Globally, injuries were responsible for 72.8 deaths per 100 000 people (45.4 per 100 000 women and 97.1 per 100 000 men) and 3 963.0 DALYs lost per 100 000 people (2 393.8 among women

and 5 356.0 among men). Comparatively, in the Americas, adjusted for population structure (based on the world population), injuries were responsible for 80.6 deaths per 100 000 people (41.2 per 100 000 women and 117.8 per 100 000 men) and 4 372.2 DALYs lost per 100 000 people (2 138.3 among women and 6 485.6 among men).

The burden of injuries varied widely in 2010 in the various GBD study regions of the Americas, with the Caribbean experiencing the greatest burden (434.7 deaths and 26 531.8 DALYs lost per 100 000 people) and High-income North America experiencing the lowest (49.0 deaths and 2 442.1 DALYs lost per 100 000 people). The unusually large burden of injuries in the Caribbean for 2010 can be explained by the devastating earthquake in Haiti that caused approximately 230 000 deaths (*7*). Figures 1 and 2 show the number of injury deaths and DALYs lost (respectively) per 100 000 people by sex, worldwide, and by GBD region.

In 1990, injuries were attributed to 499 300 deaths (117 300 among women and 382 000 among men) and 27 200 000 DALYs lost (6 235 000 among women and 20 965 000 among men) in the Americas. This burden represents 72.9 deaths per 100 000 people (32.6 per 100 000 women and 111.7 per 100 000 men) and 3 921.8 DALYs lost per 100 000 people (1 720.4 per 100 000 women and 6 036.6 per 100 000 men). A comparison of 1990 and 2010 estimates of the burden of injuries for the Americas indicates an increase in the rate and absolute magnitude of deaths and in DALYs lost per 100 000 people. As previously mentioned, the increase in the number of deaths and DALYs lost in 2010 compared to 1990 are partially due to the earthquake in Haiti. It is therefore not surprising that when examining the number of deaths and DALYs lost caused by injuries per 100 000 people by region there is a decrease for every region in the Americas except the Caribbean.

ALCOHOL-ATTRIBUTABLE INJURIES

The causal role of alcohol consumption in increasing the risk of an injury has long been recognized, with a large body of literature, based on cross-

FIGURE 1. Deaths per 100 000 people caused by injuries, by sex, worldwide and by Global Burden of Disease regions[a] in the Americas, 2010

	Caribbean	Latin America, Anden	Latin America, Central	Latin America, Southern	Latin America, Tropical	North America, High Income	Americas	World
Women	287.5	31.9	27.5	26.8	28.2	30.7	41.2	45.4
Men	567.8	78.3	125.9	78.3	125.0	65.4	117.8	97.1
Total	434.7	56.2	77.2	53.0	77.1	49.0	80.6	72.8
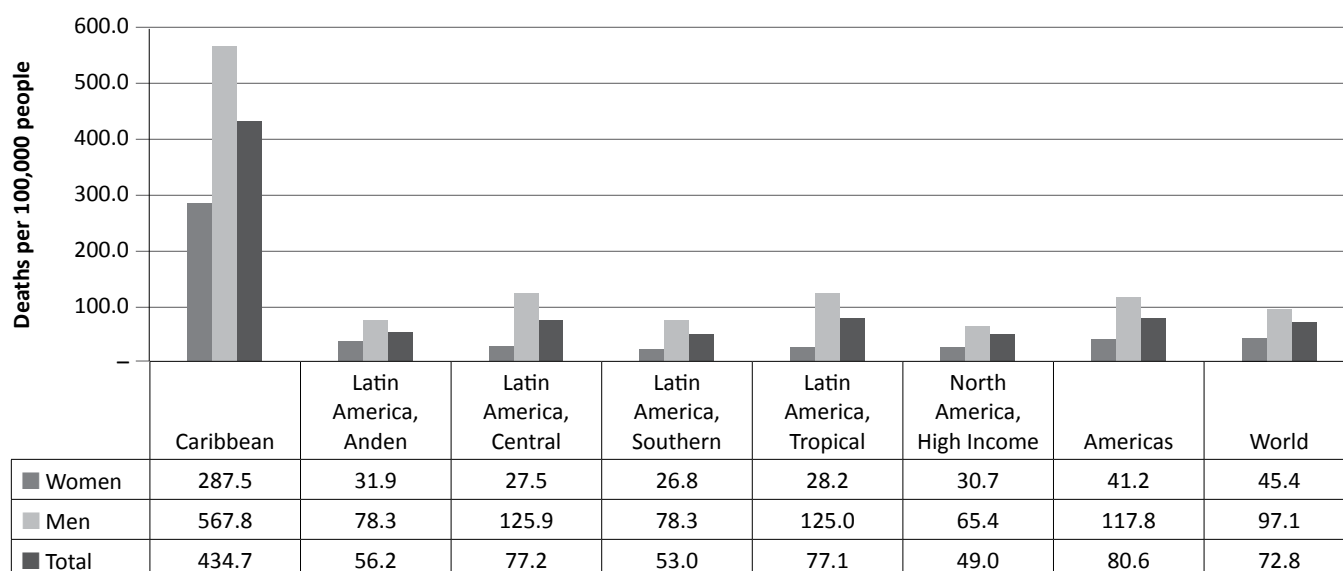
[a] Classified by the Institute for Health Metrics and Evaluation based on epidemiological similarity and geographic closeness.

FIGURE 2. Disability-adjusted life years (DALYs) lost per 100 000 people caused by injuries, by sex, worldwide and by Global Burden of Disease regions[a] in the Americas, 2010

	Caribbean	Latin America, Anden	Latin America, Central	Latin America, Southern	Latin America, Tropical	North America, High Income	Americas	World
Women	17,002.2	1,714.0	1,367.6	1,361.4	1,360.8	1,387.8	2,138.3	2,398.8
Men	35,226.8	4,389.3	6,468.6	4,238.3	6,570.3	3,400.1	6,485.6	5,356.0
Total	26,531.8	3,107.7	3,937.0	2,832.8	3,992.3	2,442.1	4,372.2	3,963.0
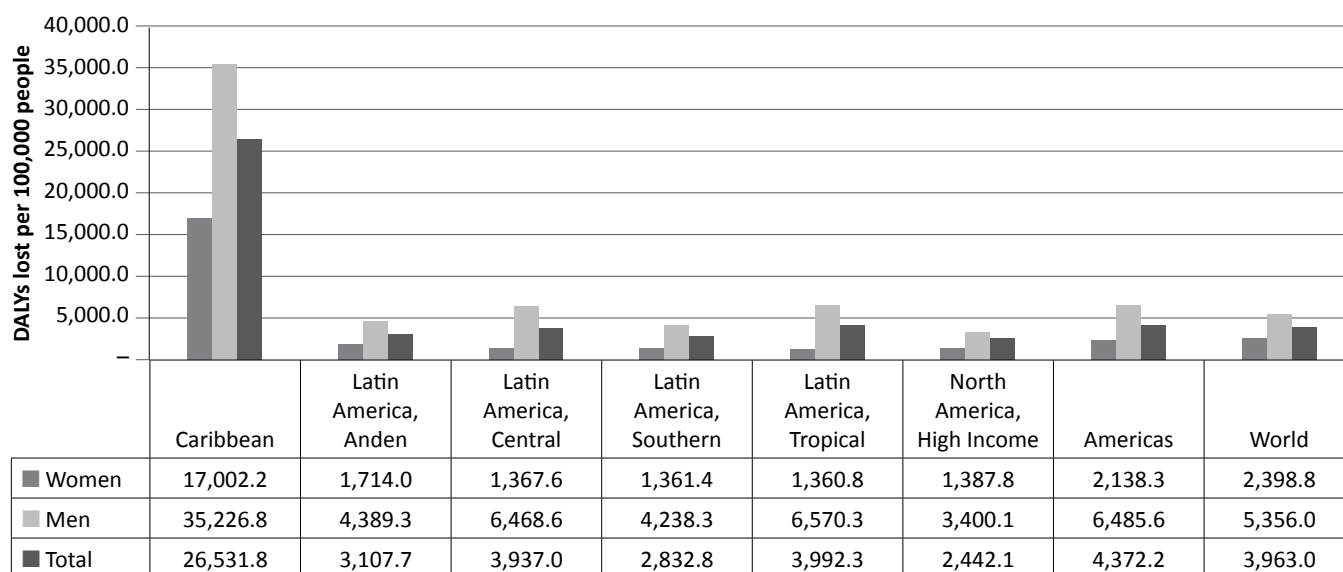
[a] Classified by the World Health Organization based on epidemiological criteria.

sectional (*8*), case-crossover (*9*), case-control studies (*10*), and systematic reviews and meta-analyses (*11–13*), revealing a consistent dose–response relationship between acute alcohol consumption and risk for intentional and unintentional injuries. Alcohol consumption has been causally linked to deaths and disability caused by road traffic injuries; poison-ings; falls; fires, heat and hot substances; drowning; machinery accidents; other unintentional injuries; self-inflicted injuries; and those caused by interpersonal violence. There is inconclusive evidence of alcohol's role in deaths and disability from natural disasters, adverse effects of medical treatment, injuries due to animal bites or contact with marine

TABLE 1. Causal role of alcohol ("yes" versus "inconclusive") for different types of injuries, grouped according to the categories of the Global Burden of Disease Study, 2010

Type of injury	ICD-10[a] code	Caused at least in part by alcohol consumption
Unintentional		
Road traffic injuries	V01-V04, V06, V09-V80, V87, V89, V99, Y85.0	Yes
Poisonings	X40-X49	Yes
Falls	W00-W19	Yes
Injuries from fires, heat, and hot substances	X00-X19	Yes
Drowning	W65-W74	Yes
Machinery accidents	W28-W31	Yes
Injuries from natural disasters	X34-X39	Inconclusive
Adverse effects of medical treatment	Y40-Y84, Y88, Y95	Inconclusive
Injuries from animal bites or contact with marine animal	W53-W59	Inconclusive
Other	V05, V80-V86, V88, V90-V98, W20-W27, W32-W52, W60-W99, X20-X33, X50-X58	Yes
Intentional		
Self-inflicted injuries	X60-X84, Y87.0	Yes
Interpersonal violence	X85-Y09, Y87.1	Yes
Collective violence	Y36, Y89.1	Inconclusive
Legally sanctioned deaths	Y35, Y89.0	Inconclusive

[a] International Classification of Diseases, 10th Revision, World Health Organization.

animals, collective violence, and legally sanctioned deaths, although alcohol is currently considered to be related to those categories of injuries.[1] Table 1 provides an overview of the injury categories causally linked with alcohol consumption. (*14*)

The critical meta-analysis by Taylor and colleagues outlined the risk of motor vehicle accident injuries and non-motor vehicle accident injuries due to alcohol consumption (*12*). Although limited by the categorization of injuries into motor vehicle accident injuries and non–motor vehicle accident injuries, this meta-analysis found that people with low blood alcohol concentrations (BACs) (< 0.10 g of alcohol / dL of blood) are more at risk for non–motor vehicle accident injuries than for those from motor vehicle accidents. Conversely, people with moderate

to high BACs are more at risk for motor vehicle accident injuries compared to non–motor vehicle accident injuries. Furthermore, the risk relationship between BACs and the risk of non–motor vehicle injuries and motor vehicle injuries is exponential, and the risk of injury is very high when a person has a moderate to high BAC, whereas the risk of injury is still present when a person has a low BAC. In addition, alcohol-related accidents are much more likely to result in death, as the alcohol relative risk (RR) function for injury mortality is greater than the alcohol RR function for injury morbidity at all levels of BAC.

Calculation methods

Attributable fractions were used to calculate the number of injuries that occurred in the Americas for 2010 that would not be present under the counterfactual scenario that no one consumed alcohol (*15*).

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[1] This was not the case in 2010, when the above-mentioned categories for injury were devised for the GBD.

This methodology uses alcohol exposure data on average alcohol consumption and binge consumption (see Chapter 1 in this book), and injury data on the number of deaths, YLL, YLD, and DALYs lost.

The alcohol-attributable fractions (AAFs) for intentional and unintentional injuries were calculated according to the methodology outlined by Shield and colleagues (*16*). These methods use data on the amount of alcohol consumed by a population (on both drinking days and binge drinking days), the number of drinkers and binge drinkers in a population, and risk data on the increased risk of injury during a drinking occasion. The meta-analysis by Taylor and colleagues outlined the risk of motor vehicle accident injuries and non–motor vehicle accident injuries due to alcohol consumption (*12*). The period of time for which a person was at risk for injury after a drinking occasion was determined using data on metabolic rates for alcohol (*16*).

Harms caused by motor vehicle accidents due to alcohol consumption by others and harms to others due to assault were determined for 2010 in the Americas based on 1) the number of drinkers and binge drinkers in a population, 2) risk data on the increased risk of injury during a drinking occasion, and 3) data on harms caused by motor vehicle accidents due to alcohol consumption by others and harms to others due to assault obtained from the National Study in Australia (*17*).

Burden of alcohol injuries in the Americas

In 2010 in the Americas, 115 400 deaths (7 600 for women and 107 800 for men) (12.5 deaths per 100 000 people; 1.6 per 100 000 women and 23.2 per 100 000 men) were caused by injuries attributable to alcohol consumption. This represents 15.1% of all deaths due to injuries (3.7% of all injury deaths for women and 19.4% of all injury deaths for men), and 1.8% of all deaths (0.3% of all deaths for women and 3.2% of all deaths for men). Globally in 2010, 667 900 deaths (70 500 for women and 597 400 for men) (9.9 deaths per 100 000 people; 2.1 per 100 000 women and 17.2 per 100 000 men) were caused by injuries attributable to alcohol consumption.

In 2010 in the Americas, injuries attributable to alcohol consumption caused 5 957 000 DALYs lost (414 000 for women and 5 543 000 for men) (656.0 DALYs lost per 100 000 people; 88.5 per 100 000 women and 1 210.7 per 100 000 men). This represents 14.9% of all DALYs lost due to injuries (4.1% of all injury DALYs lost for women and 18.6% of all injury DALYs lost for men), and 2.5% of all alcohol-attributable DALYs lost (0.4% of all alcohol-attributable DALYs lost for women and 4.2% of all alcohol-attributable DALYs lost for men). Globally, in 2010, 32 271 000 DALYs lost (3 580 000 for women and 28 691 000 for men) (477.6 DALYs lost per 100 000 people; 104.8 per 100 000 women and 826.0 per 100 000 men) were caused by injuries attributable to alcohol consumption.

Furthermore, of the alcohol-attributable DALYs lost from injuries in the Americas in 2010, 94.2% were from YLL and 5.8% were from YLD. For women, 86.9% of alcohol-attributable DALYs lost in the Americas were caused by YLL and 13.1% were caused by YLD, whereas for men, 94.7% of alcohol-attributable DALYs lost in the Americas were caused by YLL and 5.3% were caused by YLD. Thus, in the Americas alcohol had a much greater impact on injury mortality than on disability.

In the Americas in 2010, people 15 to 49 years old experienced the greatest burden of alcohol-attributable injury, with 75.3% of all alcohol-attributable injury deaths occurring in this age group (64.1% among women and 76.0% among men). This age group also consumed the most alcohol in the Americas and experienced the greatest number of deaths and DALYs lost due to injuries.

Contribution of different types of injuries

Of the total burden of alcohol-attributable injuries in the Americas for 2010, traffic injuries caused 24.9% of all alcohol-attributable injury deaths (47.5% for women and 23.3% for men) and 26.1% of all alcohol-attributable DALYs lost (51.7% for women and 24.2% for men). Alcohol-attributable deaths from self-harm and intentional violence were responsible for 57.9% of all alcohol-attributable injury deaths (33.9% for women and 59.6% for men) and 57.5%

of all alcohol-attributable injury DALYs lost (32.4% for women and 59.4% for men). Alcohol-attributable unintentional injuries (excluding transport injuries) were responsible for 17.2% of all alcohol-attributable injury deaths (18.6% for women and 17.1% for men) and 16.4% of all alcohol-attributable injury DALYs lost (15.9% for women and 16.4% for men).

Contribution by GBD region

The number of deaths and DALYs lost caused by alcohol-attributable injuries per 100 000 people varied widely across the GBD regions of the Americas in 2010. Tropical Latin America had the greatest burden (19.4 deaths and 1 046.6 DALYs lost per 100 000 people) and Central Latin America had the second-greatest burden (18.9 deaths and 926.4 DALYs lost per 100 000 people). The Caribbean had the lowest burden of alcohol-attributable injuries, with 4.4 deaths and 252.8 DALYs lost per 100 000 people in 2010. Figures 3 and 4 show the number of deaths and DALYs lost (respectively) due to alcohol-attributable injuries in the Americas by GBD region and sex.

Changes over time (1990–2010)

In 1990 in the Americas, 87 700 deaths (6 100 for women and 81 700 for men) and 4 708 000 DALYs lost (353 000 among women and 4 355 000 among men) were caused by injuries attributable to alcohol consumption. This represents 13.0 deaths per 100 000 people (1.7 per 100 000 women and 24.1 per 100 000 men) and 689.5 DALYs lost per 100 000 people (98.6 per 100 000 women and 1 270.8 per 100 000 men). From 1990 to 2010, the burden of alcohol-attributable mortality and DALYs lost from injuries in the Americas increased in absolute magnitude, but the rate of deaths and DALYs lost per 100 000 people decreased (using the 2010 global population as the standardizing population). Comparison of the rates of deaths and DALYs lost attributable to alcohol consumption by region shows an increase in the rate of alcohol-attributable deaths and DALYs lost for Andean and Tropical Latin America and a decrease for the other GBD regions of the Americas.

DATA LIMITATIONS

The GBD and CRA had several limitations. First, the methods used to estimate the number of deaths from injuries attributable to alcohol consumption were limited in terms of data availability and reliability. For most low- and middle-income countries, reliable mortality data from a vital registry do not exist. For countries without a vital registry, measurement of adult mortality is performed by verbal autopsies or surveys, but data collection on mortality is infrequent, and therefore estimates of mortality from injuries have a large degree of uncertainty (*2*). For countries with vital registries, information about the principal cause of death has been proven to contain inaccuracies (*18, 19*). To correct for any inaccuracies and inconsistencies in mortality data by cause of death, the 2010 GBD modeled the number of deaths mathematically (*2*). The second limitation involved the data used for the measures of alcohol consumption (see Chapter 1 in this book). Surveys tend to underestimate the prevalence of binge drinkers in the population, and the number of days that binge drinkers engage in binge drinking is also often underestimated. As a result, the burden of alcohol-attributable injuries presented in this chapter underestimate the true burden of alcohol-attributable injuries (*20*) (see Chapter 1 for additional details about biases associated with measuring alcohol consumption using population surveys). Finally, the estimates of alcohol-attributable injuries were limited by the use of one alcohol RR function for all non–motor vehicle accident injuries. It is very likely that the alcohol RR function varies by injury type, but the body of research relating alcohol consumption to injury is relatively sparse (except with respect to motor vehicle accidents). This means that meta-analytic techniques used to generate stable risk curves do not produce a stable alcohol RR function for specific non–motor vehicle accident injuries due to a scarcity of alcohol RR injury estimates. This limitation is especially important for the estimated number of intentional and unintentional non-transport accident injuries, as alcohol consumption plays a very different role in each of these types of injuries (*12*). However, in their meta-analysis, Taylor and colleagues found that heterogeneity was not found to be significant among all studies that reported an alcohol

FIGURE 3. Alcohol-attributable deaths per 100 000 people caused by injuries, by sex, worldwide and by Global Burden of Disease regions[a] in the Americas, 2010

	Caribbean	Latin America, Anden	Latin America, Central	Latin America, Southern	Latin America, Tropical	North America, High Income	Americas	World
■ Women	0.7	1.5	2.2	0.9	1.7	1.3	1.6	2.1
■ Men	7.9	13.1	35.5	10.9	37.1	13.2	23.2	17.2
■ Total	4.4	7.4	18.9	5.9	19.4	7.4	12.5	9.9
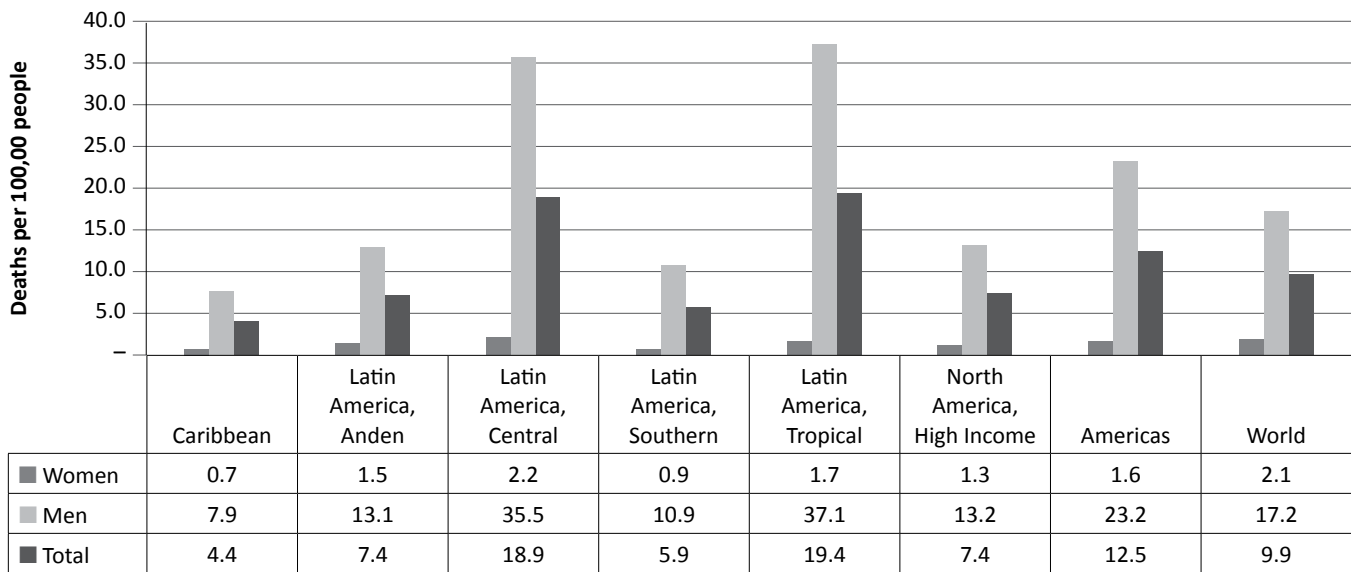
[a] Classified by the World Health Organization based on epidemiological criteria.

FIGURE 4. Alcohol-attributable disability-adjusted life years (DALYs) lost per 100 000 people caused by injuries, by sex, worldwide and by Global Burden of Disease regions[a] in the Americas, 2010

	Caribbean	Latin America, Anden	Latin America, Central	Latin America, Southern	Latin America, Tropical	North America, High Income	Americas	World
■ Women	53.3	85.6	120.5	48.0	99.9	72.2	88.5	104.8
■ Men	446.2	670.2	1.732.5	552.2	1,990.0	699.3	1,210.7	826.0
■ Total	252.8	384.1	926.4	302.5	1,046.6	394.1	656.0	477.6
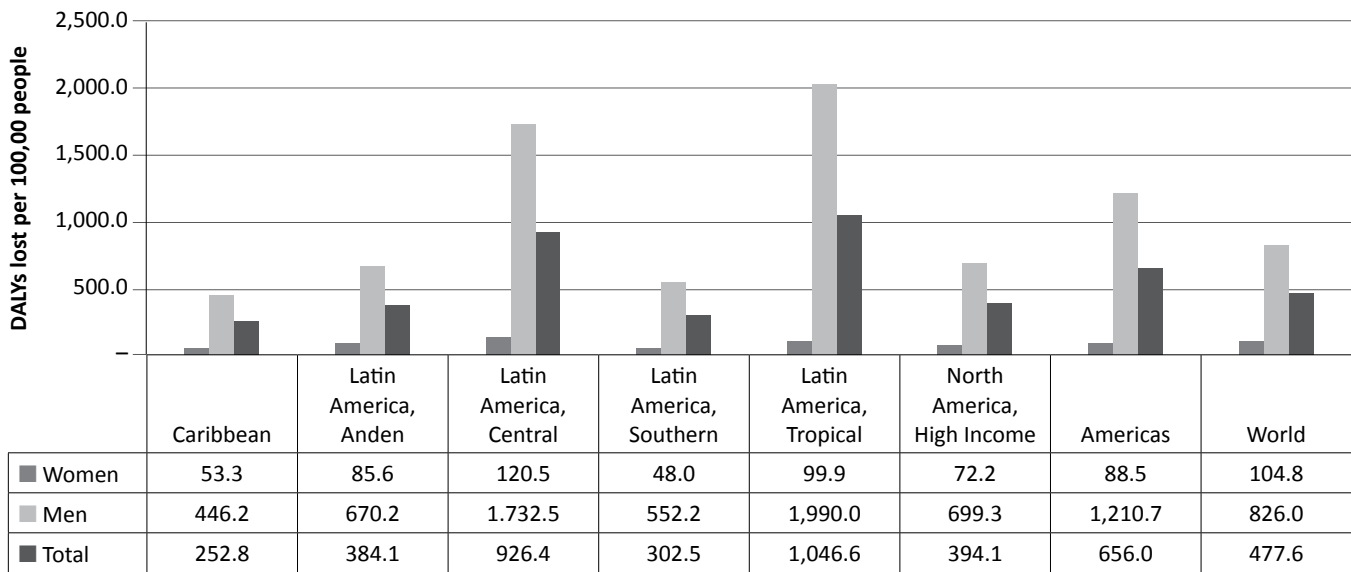
[a] Classified by the World Health Organization based on epidemiological criteria.

RR function for injuries other than from motor vehicle accidents (*12*).

CONCLUSIONS

The burden of injuries attributable to alcohol consumption in the Americas is large—and preventable—and the 2010 GBD estimates for Andean and Tropical Latin America show an increase in the burden per 100 000 people compared to those for 1990. Men and those 15 to 49 years old experienced the greatest burden of alcohol-attributable injury. Self-harm and intentional violence, followed by transport injuries, contributed the most to the burden of alco-

hol-attributable injuries, with unintentional injuries (other than transport injuries) contributing the least to this burden. The GBD regions of the Americas with high per capita consumption of alcohol and detrimental drinking patterns, such as Central and Tropical Latin America, are the most affected by alcohol consumption. Given the severity of the alcohol-attributable burden of injuries in the Americas, and the expectation that it will increase in developing countries (*21, 22*), it is imperative to accurately characterize this burden. It is also of utmost importance to develop and implement effective strategies aimed at reducing the burden by measures that have proven effective, such as reducing the maximum legal BAC limit for drivers (to at least 0.5 g/dL); reducing the availability of alcohol (using measures such as limited days / hours of operation for alcohol sales outlets, and lowering alcohol outlet density); and increasing alcohol prices (through methods such as taxation and price) (*23, 24*). ∎

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CHAPTER 3
Alcohol's causal role in interpersonal violence and road traffic injuries in the Americas

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SUMMARY

This chapter examines two of the most prevalent harmful consequences of alcohol use in the Americas: interpersonal violence and traffic-related injuries. Whether by facilitating the precipitation of aggressive behavior that may culminate in violence between individuals, or by diminishing the coordination of a driver who may get involved in a vehicle crash, alcohol plays an important causal role in these two kinds of injury. The magnitude of violence and traffic injuries caused by alcohol use in different countries from the region is discussed, as well as some strategies aimed to control alcohol-related violence and driving after drinking. The evidence clearly demonstrates that both behaviors impact the most vulnerable populations such as women and young people, and that developing regions have a great challenge ahead regarding the implementation of effective public health policies targeting the harmful use of alcohol based on local evidence. Ultimately, research gaps in the region, such as the need for additional data on the harm produced by others' drinking, underscore the relevance of a systematic collection of data able to support interventions to reduce alcohol-related violence and traffic injuries in the Americas.

INTRODUCTION

Injury is a major public health problem in both developed and developing countries and is among the leading causes of death and disability in the world, affecting all populations, regardless of age, sex, income, or geographic region (*1*). Of all deaths from injury among adults, about 57% are classified as intentional (e.g., violence-related events such as assaults, homicides, and suicides) in the Latin America and Caribbean (LAC) region. Unintentional injury also accounts for substantial proportions of mortality and morbidity in the region, with 25% of adult mortality due to road traffic injuries (*1*). Alcohol use is among the most important risk factors for both morbidity-related disability and mortality, being a causal factor in almost every type of injury, including those precipitated by aggressive behavior (*2*) or those resulting from diminished coordination (*3*). Moreover, alcohol-related injuries are a particularly alarming problem in many developing countries from the Americas, where alcohol consumption is rapidly increasing, injury rates are extremely high, and appropriate public policies have not been implemented (*4*). Studying the causal attribution of injury to alcohol involves consideration of a number of factors that should be taken into account when prevention strategies targeting complex behaviors, such as violence influenced by alcohol use, are implemented cross-nationally. Alcohol's causal role in these types of injury may be related to alcohol's psychopharmacological effects, alcohol expectancies, and/or social-contextual factors that may vary according to cultural specificities (*5*). This chapter examines two of the most prevalent harmful consequences of alcohol use in the Americas: injuries related to violence, and road traffic injuries.

ASSOCIATION BETWEEN ALCOHOL AND VIOLENCE

Alcohol-related violence is among the main public health challenges worldwide. The definition used by the World Health Organization (WHO) for a vio-

lence-related injury is broad, defined as the result of intentional acts, caused by the use of physical force or power against another person or self-inflicted, including all types of physical, sexual, and psychological abuse (*6*). In addition, both alcohol misuse and interpersonal violence act as catalysts to each other through the interaction of several factors. For instance, alcohol can increase the likelihood of violence by reducing self-control, inhibitions, the recognition of warning signs in dangerous situations, and impairing judgment (*7*).

Age, gender, and drinking patterns are among individual factors associated with the chance of becoming a victim or perpetrator of a violent event related to alcohol use. Moreover, societal factors such as cultural norms (e.g., alcohol use may be culturally accepted as an excuse for the perpetration of violence) and poverty can play an important role in the frequency and severity of violent acts (*6*).

Numerous studies have documented the association between alcohol use and many types of violence, including assaults, domestic violence, homicides, sexual aggression and suicides (*6, 8–10*). Because it is difficult to cover the whole spectrum of violent acts, this chapter focuses on intimate partner violence (IPV) and assaults/homicides.

IPV, including either current or former spouses or partners, is of particular concern and affects people in all countries, regardless of their social, economic, or religious status. There is a clear gender pattern with regard to this type of violence, in which the majority of victims are women and the perpetrators are men. Men and women also differ regarding the prevalence of drinking and differential drinking patterns that may be associated with IPV, with variations across countries as well as within countries (*11*).

Across different settings, various studies and surveys have provided a large body of evidence that alcohol is an important risk factor for IPV. In the Americas, results from a comparative analysis of population-based data from 12 countries showed that in almost all surveys women who experienced IPV in the past 12 months reported that their partner's drunkenness or drug use was the most com-

mon situation that triggered IPV perpetration. This situation was mentioned by 54% of women in Ecuador and 30% of women in Guatemala (*12*).

Population-based surveys conducted in Brazil, Canada, Chile, Colombia, Costa Rica, El Salvador, Nicaragua, and Venezuela have shown similar results, indicating a positive relationship between a woman's risk of becoming a victim of violence and her partner's drinking pattern (*6*), and a Canadian study found violence-related incidents involving drinking by one or both partners were more severe than those not involving alcohol (*11*). In Latin and North American countries, it has also been shown that women in cohabiting relationships (not married but living together) are more likely to drink heavily and experience IPV episodes from male partners than married counterparts (*13*).

Table 1 shows data on women who reported IPV episodes from GENACIS (Gender, Alcohol, and Culture: An International Study) conducted in 10 countries in the Americas (*11*). The prevalence of IPV-victimization among women ranged from 5.3% in Canada to 19.8% in Peru, with a similar prevalence range observed among women who reported aggression toward a partner (4.4% in Brazil to 12.6% in Peru).

In general, IPV episodes in which the woman reported being a victim had a higher frequency of one or both partners reporting they had been drinking than episodes in which the woman was the aggressor. Moreover, in all countries, women who drank five or more drinks on at least one occasion in the past year were more likely to report partner aggression than those not drinking at that level (Table 1).

Harm caused by IPV can last a lifetime, with serious effects on health, education, and employment, as well as the economic well-being of individuals, families, and communities (*14*). For example, suicidal behaviors are considered a major contributor to the global burden of disease among women, and the results from the WHO multi-country study on women's health and domestic violence against women found that IPV was among the most consistent risk factors for suicide attempts (*15*).

TABLE 1. Proportion of women reporting intimate partner violence (IPV) episodes according to 1) their participation as victims or aggressors and 2) the presence of alcohol use by one or both partners in the incident, in 10 countries in the Americas, 2008

Country	% of women reporting IPV, by whether the woman was the victim or the aggressor		% of incidents in which one or both partners had been drinking, by whether the woman was the victim or aggressor		% of women reporting aggression by a partner (i.e., victims), by whether they reported drinking five or more drinks on at least one occasion in the past year[a]	
	Victim	Aggressor	Victim	Aggressor	Yes	No
Argentina	9.4	8.4	26.8	12.0	13.9	10.1
Uruguay	6.6	6.1	14.6	15.8	15.2	6.1
Brazil	5.5	4.4	57.1	49.9	18.2	6.3
Peru (Lima)	8.4	8.8	41.0	27.0	11.2	9.3
Peru (Ayacucho)	19.8	12.6	43.6	22.9	26.9	9.5
Costa Rica	7.1	5.3	40.0	26.6	13.8	6.3
Nicaragua	6.0	6.4	35.7	30.3	9.7	9.1
Belize	4.4	—[b]	52.8	–	10.7	6.8
Mexico	7.6	–	39.0	–	15.1	6.0
United States	6.1	–	–	–	–	–
Canada	5.3	5.7	31.0	25.6	9.8	3.5

Source: (11).
[a] In the U.S. survey, respondents were asked whether they drank *six* or more drinks on at least one occasion in past year.
[b] Missing data.

For assaults and homicides, the levels and rates vary widely among countries in the Americas. Although studies generally show that substantial proportions of violence, victimization, and perpetration are attributable to alcohol consumption (*16*), alcohol involvement in violent injuries is not measured routinely by countries in the Americas.

WHO estimates that, across countries, harmful alcohol use is responsible for 26% of male and 16% of female disability-adjusted life years (DALYs) attributable to homicides (*17*). In Trinidad and Tobago, toxicological test results from 2001 to 2007 showed that 29% of homicides victims tested positive for alcohol (*18*). In the United States, 35% of victims of assaults reported that they believed that their offenders were under alcohol influence (*19*). In São Paulo, Brazil, 42% of homicide victims had used alcohol prior to death (*20*).

ALCOHOL-RELATED TRAFFIC INJURIES

Road traffic injuries are among the 10 leading causes of death worldwide, with approximately 1.2 million deaths each year and at least a 20-fold larger number of nonfatal injuries. In many middle-income countries, these numbers are rising steadily. Although these countries have only about half of all registered vehicles globally, they account for 80% of the world's road fatalities (*21*).

This is clear evidence that road traffic injuries are a major public health issue, with a strikingly disproportionate distribution depending on the socioeconomic level of the population. There are many reasons for this difference between developed and developing countries, but the lack of traffic safety regulations is pointed out as a large contributor to the burden of road traffic injuries in developing regions. For example, less than 35% of low- to mid-

dle-income countries have adequate policies aimed at protecting cyclists and pedestrians, who account for over one-third of all road traffic fatal victims in these countries (*21*).

The use of alcohol is also recognized as an important contributing factor to the occurrence of traffic injuries, with almost half of the countries that have data available on the proportion of road traffic deaths attributable to alcohol reporting over 20% of fatal crashes are alcohol-related (*22*). The Americas region is of special concern with regard to the association between alcohol and traffic casualties, with alcohol consumption nearly 40% higher than the global average (*23*) and injuries (25% of which are caused by motor vehicle accidents) representing the main cause of death for adult men in the low- and middle-income countries (*1*).

To enhance the effectiveness of these measures, low- to middle-income countries from the Americas need stronger enforcement of current drinking and driving laws (e.g., random breath testing), which have been shown to be effective in high-income countries in the region (*21*). Only 6.3% of the countries in the Americas have drinking and driving legislation with a blood alcohol concentration (BAC) limit ≥ 0.05%, a lower BAC limit for novice drivers, and a high level of enforcement (*24*).

Brazil, the country with the largest population in the LAC region, has an average road traffic fatality rate of 20 deaths per 100 000 inhabitants, which has remained relatively stable over the last decade (*25*). Although data are not available on the proportion of alcohol-related traffic deaths for the country as a whole, regional estimates are around 40% (*26, 27*), demonstrating that the drink-driving problem in this country deserves urgent attention.

Fatal motorcycle injuries in the Americas have increased steadily during the last decade, with poorer countries from the region demonstrating greater rates of motorcycle fatalities. Rates increased nearly 13% in the region as a whole between 1998 and 2010, with Ecuador and Costa Rica showing the greatest increase (78.3 and 60%, respectively) (*28*).

Despite the link between alcohol and mortality from road traffic injuries, alcohol's actual contribution to these deaths is poorly documented. Recent estimates from the region indicate that in some emergency rooms (ERs) the majority of traffic injuries are represented by motorcycle riders, with 25% reporting drinking in the 24 hours prior to the traffic accident (*29*). This suggests that future efforts should be directed toward the implementation and enforcement of measures that are consistent with local contexts and available scientific evidence, particularly regarding drinking and driving strategies in LAC countries.

VULNERABLE POPULATIONS: IMPACT ON WOMEN AND YOUNG PEOPLE

Violent- and traffic-related injuries are considered important public health issues that cause enormous collective and individual costs, reaching the most vulnerable populations such as women and young people (*30, 31*). Over the past 30 years there has been increasing recognition worldwide that violence against women is a major public health problem and human rights concern, being responsible for a number of negative consequences related to both physical health and mental health of women (*12, 32*).

Alcohol use is also closely related to victimization from sexual assault, as the ability to defend against and to perceive risk situations is also impaired (*33*). A prospective study examining the relationship between alcohol use and sexual assault in a sample of first-year college women in the United States found that 1) 19.3% reported frequent binge drinking and experiencing at least one sexual assault over the course of their freshman year, and 2) frequent drinking predicted subsequent sexual assault (*34*).

Some studies have reported higher levels of hazardous drinking and higher rates of sexual victimization among sexual minority women[1] versus heterosexual women (*35, 36*). Data from the U.S. National Alcohol Survey on 11 169 women who answered questions regarding sexual identity and be-

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[1] Nonheterosexual women such as lesbians and bisexuals.

havior found that sexual minority groups reported significantly higher rates of lifetime violence victimization (76% and 59% among bisexuals and lesbians respectively) than exclusively heterosexual women (42%) (*37*).

Injuries also affect the lives of 10–30 million children and adolescents globally each year, and have been acknowledged as the leading cause of mortality among young people in the age range of 15–19 years (*38*). Most adolescent deaths are caused by unintentional injuries, with motor vehicle accidents ranked as the most common cause, followed by homicides (*39*).

In the United States, in 2010, approximately 2 700 teens (ages 16–19) died due to traffic accidents, and another 282 000 were treated in ERs due to injuries resulting from the accidents. In the same year, 20% of drivers in the same age range who were involved in fatal crashes had consumed alcohol prior to the accident (*40*). Worldwide, 250 000 people aged 10–29 die each year from homicides, representing 41% of the annual total number of homicide victims. For each young person killed, there are 20–40 more with injuries that require hospital treatment (*6*).

The homicide rate in the Americas (16 per 100 000) is more than twice as high as the global average (6.9 per 100 000) (*41*). Among the countries with available data the rates of homicide among youth are highest among low- to middle-income countries from the LAC region (e.g., 84.4 per 100 000 in Colombia, 50.2 per 100 000 in El Salvador, and 41.8 per 100 000 in Puerto Rico, compared to 11.0 per 100 000 in the United States) (*6*).

The etiology of youth injury involves a complex interplay between human and environmental factors. Many injuries are a result of youth taking risks and not avoiding potentially risky situations (*42*). Some studies have identified multiple risk behaviors including alcohol and other substance use; bullying; psychological distress; obesity; low socioeconomic status; being male; and home and school environments associated with injury risk (*38*).

Alcohol-related violence is a large contributor to morbidity and mortality among adolescents. Both early initiation of alcohol use and heavy drinking are linked to injury occurrence in this vulnerable group. One in four homicides involving male victims between 15–29 years old globally is attributable to alcohol (*43*).

A cross-sectional study conducted in public schools in Southern Brazil with students aged 10–19 years found that boys and girls who reported drinking alcohol at least once during the previous 30 days reported 2.6 and 1.8 times more severe victimization from violence episodes respectively than those not reporting drinking during the same time period. In addition, exposure to violence was found to be associated with frequency of drunkenness; 32% of the boys and 22% of the girls who had been victims of severe violence reported being drunk at least once during the previous month (*44*).

In conclusion, vulnerable populations are at a high risk for violence and trauma associated with alcohol consumption, usually without the benefit of preventive public health policies that have been shown to be effective in reducing alcohol-related violence (1*2, 33, 35*).

RESEARCH GAPS AMONG COUNTRIES FROM THE REGION

One area in need of additional research, for both injuries related to violence and those resulting from motor vehicle accidents, is drinking on the part of individuals who may have been responsible for the event but have not incurred injury. The literature on harm in the form of violence-related injury from others' drinking is relatively limited (and virtually nonexistent for harm from motor vehicle crashes) because the victims are not likely to be acquainted with the individual who may have been responsible for the accident and thus would have no idea whether or not that person had been drinking. For instance, in the United States, it is estimated that only 24% of drivers who have survived a vehicle crash and 66% of those killed undergo BAC testing (*45*).

Data on violence-related injury from ERs in 14 countries, including three LAC countries, found that

drinking on the part of the perpetrator as perceived by the victim ranged from 14% to 73% (rates for Argentina, Brazil, and Mexico were 26%, 31%, and 38% respectively). Across all countries, the alcohol-attributable fraction (AAF) increased from 24% when only the patient's drinking was taken into account, to 39% when drinking by both the victim and perpetrator were considered, and varied by country-level drinking pattern, with countries exhibiting high-risk drinking patterns, typically LAC countries, demonstrating the highest AAFs (*46*). Additional research on others' drinking is important to consider in estimating the global burden of disease due to alcohol in the Americas, and in developing more effective policies and programs to reduce alcohol-related injury, especially those related to violence and traffic accidents in the region.

The lack of research on injuries that are not brought to the attention of an ER (including those that go untreated) is another issue of concern, particularly because these types of injuries are more prevalent than severe injuries or fatalities. Although few studies have examined this issue in the LAC region, studies have shown that overall health costs attributed to injuries are extremely damaging to developing economies. In Brazil, the total cost for treatment of injuries by the public health system is estimated at approximately US$ 1.2 billion on an annual basis. For treatment of aggression and traffic injuries alone, the costs correspond to US$ 66 million and US$ 251 million respectively (*47*).

Finally, the differences between countries in the proportion of ER patients who consume alcohol is likely to reflect the variation in the patterns of alcohol consumption within each country, as well as cultural divergences, and differences in both alcohol policies and medical care scenarios for injured patients (*48*). Thus, as pointed out in Chapter 1, a better understanding of how drinking linked to injuries is influenced by local contexts may produce new inputs that could contribute to the more effective alcohol policies that could be implemented in the Americas.

CONCLUSIONS

Research on violence- and traffic-related injuries attributable to alcohol is still scarce for the majority of the countries from the LAC region, and most of the data able to support effective alcohol policies are derived from North American countries. However, some LAC countries have made some progress in terms of legislation and action plans, such as reducing the BAC limit for drivers, establishing all-female police stations, and implementing protective laws for female victims of domestic violence caused by the partner (*49, 50*).

The adverse relationship between alcohol and violence can be changed, based on the evidence. For example, a time-series analysis conducted in the 91 largest U.S. cities from 1984 to 2006 that showed that density of retail alcohol outlets had a significant impact on youth homicide (13–24 years old). Based on the results, the authors suggested that a reduction in the density of these outlets might be an effective policy to reduce violent crimes among adolescents and young adults (*51*).

Another example is the case of Diadema, a large Brazilian city that had the highest homicide rate in the country at the end of the 1990s, with most crimes occurring near or inside bars. In response, since 2002, the city has required bars to close by 11 p.m., which has resulted in a significant decrease in the number of murders and violence against women (*52*).

Another time-series study, carried out in Cali, Colombia, which has the highest homicide rate nationwide, concluded that extended hours for alcohol sales and consumption were associated with an increased risk for homicides, and that severe restrictions on alcohol availability could reduce the incidence of interpersonal violence (*50*).

Other studies have shown the positive impact of reducing the BAC limit to 0.05% or lower on the reduction of traffic injuries and alcohol-impaired driving in LAC countries (*49, 53*). These experiences emphasize that violence related to alcohol can be prevented, especially through cooperative efforts

across various sectors such as public health, social services, education, justice, and policy. However, the lack of data on alcohol-related road traffic deaths and the limited resources available for enforcement of recommended practices restrict the development of effective traffic safety strategies based on local evidence in countries in the region (*54*).

The main challenge seems to be assessment of the outcomes of various strategies, based on best practices and available scientific evidence, to identify, extend, integrate, and sustain those that are found to be successful, a topic which deserves special attention and will be reviewed further in Section 3 of this book. ■
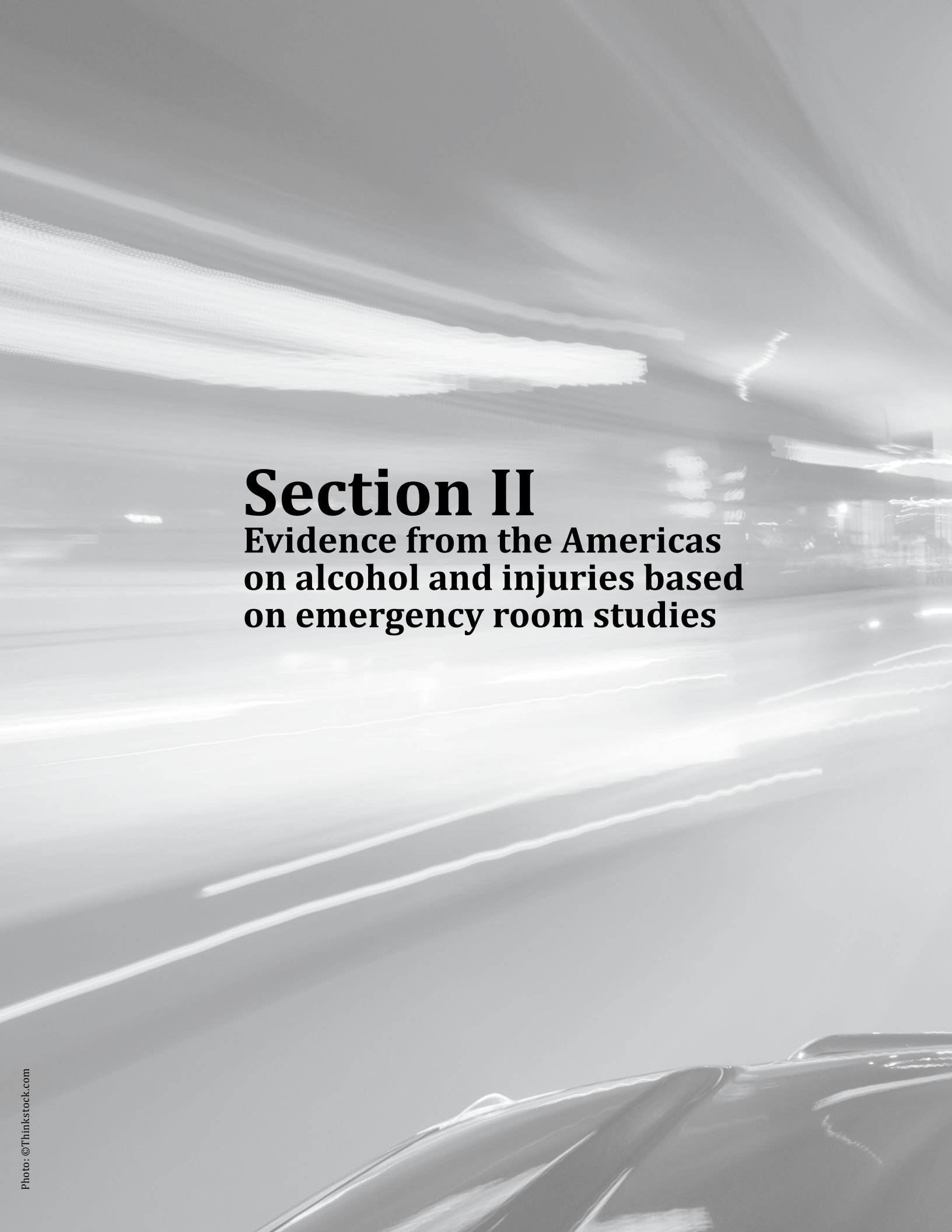
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Section II
Evidence from the Americas on alcohol and injuries based on emergency room studies

INTRODUCTION

The eight chapters in Section II present the latest epidemiological evidence on alcohol's strong association with injury based on emergency room (ER) studies in the Americas. Chapter 4 provides a review of ER studies in the region based on representative samples of patients. Chapter 5 describes the methodology used in all of the studies in the Americas that provided the data analyzed here, plus a case study carried out in Guyana that illustrates the diverse political and health services contexts of the various study sites.

The next three chapters present epidemiological measurements of alcohol and injury based on the ER studies. Chapter 6 describes the prevalence of alcohol-related injuries across the 10 countries, for all causes and for specific types and causes, and the influence of societal-level variables, including the detrimental drinking pattern (DDP) and alcohol control policies, on prevalence. Chapter 7 presents relative risk (RR) estimates of injury based on case-crossover analysis in which previous day / previous week drinking at the same time of day in which the injury occurred are used as control periods. Estimates are provided for all injuries and by type and cause, as well as for the amount consumed before injury. Chapter 8 compares the alcohol-attributable fraction (AAF) of injury across the 10 countries for all injuries and for those related to violence. The relationship of AAF to societal-level variables, including DDP, drinking context, and alcohol use policies, is also evaluated.

Chapter 9 describes various drinking-before-injury contexts across the 10 countries, including the type and amount of alcoholic beverage consumed, where the patient was drinking, and where the injury event occurred. Chapter 10 describes the socio-demographic characteristics that predict alcohol-related injury across the 10 countries, by country-level income and by gender, underscoring the need for cross-country and gender perspectives. The final chapter in this section, Chapter 11, analyzes the association of individual usual drinking pattern with injury, taking into account individual usual volume of consumption over the previous 12 months, as well as aggregate-level average volume, DDPs, and alcohol policy measures related to driving and access to alcohol.

CHAPTER 4

A historical perspective on alcohol and injuries based on emergency room studies conducted in the Americas

Gabriel Andreuccetti and Cheryl J. Cherpitel

SUMMARY

The burden of injury attributable to alcohol is one of the most important public health issues in the region of the Americas. Although knowledge on alcohol's association with injuries has progressed in developed countries from this region, along with the implementation of evidenced-based alcohol policies, this has not been the case in the Latin America and Caribbean (LAC) countries. Existing evidence corroborates that alcohol has a high prevalence among injured patients in the emergency room setting in the Americas, with violence-related injuries showing an increased association with alcohol use compared to unintentional injuries. The amount of alcohol consumed in the injury event and usual heavy drinking seem to be strongly associated with injury occurrence, but a paucity of data relating to social-contextual factors limits interpretation of the heterogeneity in the magnitude of the association of alcohol and injuries found across studies, especially among LAC countries. Future research should focus on understanding how drinking behaviors influenced by local contexts can affect the risk of injury, taking into account cultural specificities from each country. The effectiveness of alcohol strategies aiming to reduce harmful alcohol use in the LAC region might depend on understanding how these factors interact with the high rates of alcohol-related injuries in the region. This chapter provides a historical perspective on alcohol and injuries based on emergency room studies conducted in the Americas.

INTRODUCTION

In 2004, more than 5 million people died from injuries, representing 9.8% of total deaths in the world. Injuries alone accounted for 42% of the deaths attributable to alcohol worldwide, with unintentional injuries corresponding to 21.8% of all deaths that alcohol is estimated to cause, followed by violence-related injuries (8.0%), self-inflicted injuries (4.0%), poisonings (3%), drowning (2.7%), and falls (2.1%) (*1*). In the Latin America and the Caribbean (LAC) region, injuries are considered the main cause of death for adult men (*2*). Concurrently, alcohol use in the Americas has a tremendous impact on the burden of disease, with alcohol ranked as the most important risk factor to health in low- and middle-income countries from this region (*3*). Despite the large body of research-based evidence on the association between alcohol consumption and injury occurrence, appropriate public health policies aiming at the reduction of alcohol-related injuries are insufficient in most countries of the Americas (*4*).

Studies conducted in the emergency room (ER) over the last three decades have provided substantial data on the risk of injury associated with alcohol, demonstrating a great potential for guiding policies toward the control of the harmful consequences of alcohol use. The Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) was the first international collaborative study that quantified the role of alcohol in injured individuals, using the same methodology across a number of different countries (*5*).

The first phase of ERCAAP was initiated in 1984 (*6*). The research was based on the Cherpitel model (*7*), in which probability samples of injured and non-injured patients are interviewed and an estimate of blood alcohol concentration (BAC) obtained at the time of the ER visit. By 2002, this ongoing data collection effort included information from 21 509 patients admitted to hospital ERs from eight countries. A few years before that, the World Health Organization (WHO) Department of Mental Health and Substance Dependence Collaborative Study on Alcohol and Injuries was initiated (2000), which resulted in the collection of similar data on 5 243 injured patients from 12 countries, using the same questionnaire and protocols as were used in ERCAAP. In addition to offering the opportunity to accumulate valuable information on how alcohol consumption and other related variables might affect the likelihood of an injury event, these studies allowed for cross-national analysis of alcohol and injuries for countries with different consumption patterns and socio-cultural norms regarding alcohol use. In the case of the Americas, however, the available data on the alcohol-injury relationship is still rather limited as it is based on ER studies conducted in only a few countries from the region. In addition, there is a substantial difference between developed and developing countries in the region in terms of the availability of data and the practical strategies that are applied to address the issue of alcohol-related injuries. These two limitations are explored further in this chapter, which provides a historical perspective on alcohol and injuries based on ER studies conducted in the Americas.

DEVELOPED COUNTRIES IN THE AMERICAS: CANADA AND THE UNITED STATES

The first study from the ERCAAP project was initiated in 1984, at San Francisco General Hospital (*8*). This study was followed by a series of similar studies conducted in different cities in the state of California and Mississippi. All of the studies used the model developed by Cherpitel (*6*) in which probability samples of patients aged 18 and older are interviewed and breathalyzed. Medical (non-injured) patients in the ERCAAP studies were used as quasi-control subjects for the injured patients in determining if alcohol consumption had occurred in the six hours before the injury (by either BAC or self-report).

Table 1 presents details from the ER studies conducted in the United States and Canada, all of which used probability sampling of ER patients (*9, 10*). In the studies conducted in the United States, self-reported prevalence estimates for alcohol use among injured patients ranged from 8% to 35%, while in Canada these estimates varied from 6% to 28%. For both countries, BAC estimates were lower than those derived from self-reported questions (6%–23% and 4%–21% in the United States and Canada, respectively). Injured patients were more likely than non-injured to report drinking before the event and to be positive for BAC.

Previous studies in the region demonstrated that the validity of self-report estimates were considerably high in comparison with breathalyzer readings, with low rates of those reporting not drinking before injury while showing a positive result on breath analysis (*6, 11*). However, fairly large proportions (more than 60%) reported drinking while registering negative on the breathalyzer. Thus, inferring alcohol's association with injuries based on self-reports was found to be a reliable tool for assessing alcohol-related injuries, and more reliable than BAC estimates, at ER admission.

The ER studies conducted in North American countries paved the way for studies in other countries, and demonstrated that the risk for injury after alcohol use is higher compared with no alcohol consumption. However, less has been learned from these studies regarding a dose–response relationship between drinking and injuries. Vinson et al. (*12*), studying injured patients from three ERs in the state of Missouri (USA), found a significant risk for injury after the consumption of one or two drinks (odds ratio (OR) = 1.8) when participants were used as their own control in a case-crossover analysis comparing drinking before injury with consumption at the same time the day before. The risk increased steadily when consumption was higher, with ORs of 6.2 after three or four drinks, and 13.5 after five or six drinks.

TABLE 1. Positive tests for alcohol consumption among injured and non-injured emergency room (ER) patients based on nine studies in various locales, Canada and the United States, 1984-2002.

Country	Study	Locale	Length of data collection (year)	Alcohol consumption measure	ER patients positive for alcohol consumption % (n)	
					Injured	Non-injured
United States	(8)	1 ER, San Francisco, CA	2 months (1984–1985)	Self-report / breathalyzer	35 (555) / 23 (502)	16 (1 278) / 10 (1 192)
	(14)	4 ERs, Contra Costa, CA	3 months (1985)	Self-report / breathalyzer[a]	19 (1 001) / 11 (1 026)	15 (1 378) / 5 (1 306)
	(16)	1 ER, Martinez, CA	1 year (1986–1987)	Self-report / breathalyzer[a]	13 (1 004) / –[b]	–
	(17)	3 ERs in Contra Costa, CA	6 weeks (1989)	Self-report / breathalyzer[a]	8 (409) / 6 (452)	7 (548) / 3 (614)
	(14)	1 ER, Jackson, MS	6 months (1992)	Self-report / breathalyzer	23 (275) / 12 (348)	–
	(18)	1 ER, Santa Clara, CA	14 weeks (1995–1996)	Self-report / breathalyzer	15 (298) / 7 (298)	7 (1 027) / 3 (1 027)
	(12)	1 ER, Columbia, MO	14 months (1998–2000)	Self-report	12.3 (2 161)	5.2 (1 856)
Canada	(15)	1 ER, Quebec City, Quebec	2 weeks (1989)	Self-report / urine test	16 (349) / 21 (196)	13 (436) / 6 (348)
	(15)	1 ER in Edmonton, Alberta	2 weeks (1989)	Self-report / urine test	28 (376) / 7 (256)	10 (547) / 3 (337)
	(19)	1 ER in Orangeville, Ontario	3 months (2002)	Self-report / breathalyzer[a]	6 (222) / 4 (222)	–

[a] Conducted within six-hours of arrival in the ER.
[b] Missing data.

When making assumptions regarding the level of risk for injury incurred by the individual as a result of alcohol use, the interaction between acute consumption in the injury event and usual frequency of drinking must be taken into account, since the likelihood of an alcohol-related injury is expected to vary according to different drinking patterns (*13*). For example, social-cultural factors such as heavy alcohol consumption related to regional-specific social behaviors may increase the risk of an injury event.

Samples of ER patients from two regions in the United States with distinct differences in terms of the integration of alcohol in society (Mississippi, considered a "dry" region, where rates of abstention are high, and California, a "wet" region, where abstention rates are relatively low) were compared

regarding the role of drinking patterns in the injury event. Although higher rates of abstention among injured patients from Mississippi were observed, no differences were found for rates of heavy drinking between the two regions. While quantity and frequency of usual drinking were found to be predictive of injury in both regions, those in the Mississippi sample were more likely to report a shorter time lapse between the last drink and the injury event but less likely to report feeling drunk at the time of the event versus those in the California sample (*14*).

Another study conducted in two Canadian provinces, Alberta (with stronger pro-temperance social norms) and Quebec (a wine-drinking culture where consuming smaller quantities of alcohol with a greater frequency is common), found great-

er support for the hypothesis that typical drinking customs may influence alcohol's involvement in injury. Injured ER patients in Alberta were more likely to be heavy drinkers and to report alcohol-related problems than their counterparts in Quebec, where light to moderate drinkers were predominant. Furthermore, the injured in Alberta were more likely to report drinking before injury and to present to the ER with higher BAC levels than those in Quebec (*15*).

Likewise, it is also expected that alcohol's influence on injury risk will vary according to different types and causes of injury. As found in other regions (*20*), evidence from ER studies in North America suggests that those involved in violence-related injuries have a greater likelihood of 1) reporting drinking before the injury event, 2) harmful consequences of drinking (including alcohol dependence experiences) (*21*), and 3) presenting with higher BAC levels compared to those with unintentional injuries (*22*).

Few studies have explored the context in which drinking occurred, such as the location where the injury took place, the type of alcoholic beverage consumed, and the specific activity engaged in at the time of the event, all of which may predispose an individual to an injury event related to alcohol use. Prior research has shown that injured patients in the United States, classified according to their ethnicity (black, Hispanic, or white) present differences regarding the likelihood of drinking by place of injury, with Hispanic and white patients who reported drinking more likely to be injured in a public setting, a trend that was not found among black patients (*18*).

Data on the association of different types of alcoholic beverages with the likelihood of injury in different cultural contexts are even scarcer, especially those derived from ER studies. Nevertheless, prior research suggests that there may be important differences between drinkers of beer, spirits, and wine, with the first group being more likely to be involved in traffic injuries, the second group to manifest aggressive behavior potentially resulting in violence-related injury, and the third group tending to present fewer alcohol-related problems overall (*23*).

EMERGENCY ROOM STUDIES CONDUCTED IN LATIN AMERICA AND THE CARIBBEAN

Although the pattern of alcohol use in LAC countries is considered one of the most harmful globally (*3*), studies on the influence of relevant factors such as heavy episodic drinking on the occurrence of injuries are still needed in this region. For example, while LAC countries suffered 17.4% of the global burden of disease attributable to alcohol in 2001, only 2.5% of all alcohol-related publications between 2000 and 2003 are from this region (*24*).

The first study for the ERCAAP project in the LAC region was carried out in eight ERs (representing the varying types of emergency care available) in Mexico City in 1986 (*25*). Following that a similar study was conducted in three ERs in Acapulco in 1987 (*26*) and three ERs in Pachuca, Mexico, between 1996–1997 (*27*). A similar study was undertaken in Mar del Plata, Argentina, in 2001 (*17*). Subsequently, the WHO Collaborative Study on Alcohol and Injuries added an additional sample in Argentina, Brazil, and Mexico *(19)*, increasing the representation of the LAC region in the data sets for the ERCAAP/WHO project.

A recent systematic review by Andreuccetti et al. (*28*) of ER studies on alcohol and injuries conducted in the LAC region found a total of 32 publications from eight different countries, with more than half of the articles derived from Brazil and Mexico. Among those studies, in which probability samples of ER patients were selected across all types of injury (Table 2), prevalence estimates for alcohol use derived from self-report ranged from 13% to 29.2%, whereas estimates derived from BAC ranged from 11% to 21.3% when breath samples were obtained.

Reviews of the literature have indicated that BAC estimates usually provide a smaller prevalence of positive cases for alcohol use among ER injured patients compared to self-report (*9, 10*), which might be explained by the fact that the alcohol consumed before the injury event may have been already metabolized by the time the BAC was estimated (*29*). Thus, limiting the time interval between patients' last drink and the BAC measurement should be con-

TABLE 2. Positive tests for alcohol consumption among injured and non-injured emergency room (ER) patients based on 12 studies in various locales, Latin America and the Caribbean, 1986–2007

Country	Study	Locale	Length of data collection (year)	Alcohol consumption measure	ER patients positive for alcohol consumption % (n)	
					Injured	Non-injured
Argentina	(19)	1 ER, Mar del Plata	7 months (2001)	Self-report / breathalyzer	28 / 14 (230)	13 / 3 (337)
			3 months (2001)	Self-report / breathalyzer	22 / 15 (452)	—[a]
Brazil	(35)	1 ER, São Paulo	1 year (1998–1999)	Blood	28.9 (464)	–
	(19)	1 ER, São Paulo	3 months (2001)	Self-report / breathalyzer	13 / 12 (496)	–
	(36)	1 ER, São Paulo	3 months (2001)	Self-report / breathalyzer	13.4 / 11 (353)	–
	(37)	1 ER, Uberândia	7 months (2004)	Blood	31.8 (85)	–
	(38)	1 ER, Alta Floresta	3 months (2006)	Clinical signs and/or self-report	12 (409)	–
	(39)	63 ERs, 26 states and the Federal District	60 days (2006–2007)	Clinical signs and/or self-report	11 (106 075)	–
Colombia	(40)	16 ERs, Pasto	1 year (2006)	Clinical signs	21.6 (9 601)	–
Mexico	(41)	8 ERs in Mexico City 3 ERs in Acapulco 1 ER in Tlalpan	1 week (1986) 5 weeks (1987) 6.5 weeks (2002)	Self-report / breathalyzer	27.5 / 21.3 (1 620) 29.2 / 21.2 (343) 17.4 / 15.5 (705)	11.4 / 6.4 (568) 11.9 / 5.4 (297) –
	(27)	3 ERs in Pachuca	4 months (1996–1997)	Self-report / breathalyzer	15.8 / 17.7 (756)	3 / 2.6 (755)
	(42)	1 ER in Mexico City	2 months (2002)	Self-report / breathalyzer	17.4 (703) / 15.5 (452)	–
	(19)	1 ER in Mexico City	2 months (2002)	Self-report / breathalyzer	21 / 18 (456)	–

[a] – Missing data.

sidered (e.g., by including only patients whose injury occurred within six hours of arrival at the ER), as well as the use of both self-report and BAC estimates in the same study, as done in all studies conducted in the LAC region under the auspices of WHO (*30*).

Similar to the findings from developed countries in the Americas, evidence from LAC countries suggests a dose–response relationship between the quantity of alcohol consumed and the injury risk, which has been found to increase even with consumption of a single drink (*31*).

Relatively little is known about the risk of injury associated with different drinking patterns in LAC countries. Although there is evidence that even low levels of consumption can increase the risk of injury (*31*), it is still unknown if drinking patterns such as heavy episodic drinking are more important than the overall volume of alcohol consumed in influencing the risk of injury in the region. Risk of injury may be influenced by tolerance to alcohol developed by heavy users and dependent individuals, who have been found in some studies to be at lower risk of injury than nondependent individuals (*31*). This may be related to a greater short-term risk incurred by those who only occasionally drink heavily, but further studies are needed on the influence of drinking patterns on the risk of injury in the LAC region to examine this supposition.

Generally, studies from LAC countries that included patients sustaining specific types and causes

of injury have shown that violence-related injuries presented higher prevalence estimates for alcohol use than unintentional injuries. However, most of the studies reporting unintentional injuries focused on traffic crashes, and other causes of injury have not been fully investigated (*28*).

In addition, few studies conducted in the LAC region have examined the influence of social-contextual and contextual factors on the involvement of alcohol in injuries. For example, countries with higher levels of detrimental drinking patterns[1] (like many countries in the LAC region), and greater acceptance toward heavy alcohol consumption, also tend to have increased rates of alcohol-related injuries (*19*). Context of injury also appears to play a role, with violence-related injuries more likely to occur in public places, whereas self-inflicted injuries are more frequent in private contexts (*33, 34*).

CONCLUSIONS

Data presented here confirmed that alcohol is associated with a significant proportion of injuries in the region of the Americas. Although no major differences were found in the prevalence of positive BACs or self-reported consumption before in-

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[1] DDP, a measure developed by WHO that includes indicators for heavy drinking occasions, drinking with meals, and drinking in public places for different countries, with higher scores indicating a higher postulated detrimental effect of the same alcohol per capita consumption (*32*).

jury between the LAC countries and those in North America, ranges of alcohol involvement in injury varied considerable in both regions, and may be accounted for by variation in drinking patterns, as found elsewhere (*13*). Risk of injury related to alcohol consumption was not included in this review, and may differ considerably between the LAC countries and North American countries, where more detailed studies have been completed, and such differences would likely reflect differences in drinking patterns and related harms, although more data, especially from LAC countries, are necessary to support this supposition.

To fill in some of the knowledge gaps with regard to alcohol and injury in LAC countries, additional epidemiologic studies based in ERs that implement sound sampling strategies, as well as improved measures to control for biases inherent in these studies, are needed. Future efforts should also concentrate on exploring the role of individual-level drinking behaviors and social-contextual variables on the risk of injury, as has been undertaken, to some extent, in the developed countries of the Americas.

In addition, very few research-derived strategies for reducing alcohol-related harmful consequences, including injury, have been implemented in the LAC region. Thus, improving knowledge on cultural aspects of drinking in LAC countries is necessary to advance the implementation of well-established alcohol strategies in the region, where strengthening evidence-based alcohol policies is an urgent necessity. ∎

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CHAPTER 5

Emergency room studies in the Americas: methods and context

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SUMMARY

This chapter describes the methodology of emergency room (ER) studies conducted in the Americas, including patient sampling, obtaining a breathalyzer reading as an estimate of blood alcohol level, and interviewing patients on questions related to 1) type and cause of injury; 2) alcohol use within six hours of the injury event; 3) usual drinking patterns and alcohol-related problems, and, for those reporting drinking before the event, 4) whether the patient was feeling drunk at the time of injury; and 5) whether he/she believed the injury would have happened even if he/she had not been drinking at the time (i.e., patient's causal attribution of injury to alcohol). An ER study undertaken in Guyana is highlighted as an example of the political and health services context underlying the implementation of these studies, the lessons learned, and future recommended steps.

INTRODUCTION

Following the methodology and protocols of the Cherpitel model (*2*) developed for the Emergency Room Collaborative Alcohol Analysis Project (ER-CAAP) and the World Health Organization Collaborative Study on Alcohol and Injuries (WHO-ER), the Pan American Health Organization (PAHO) supported a series of emergency room studies (PAHO-ER) in five countries in the Americas: Dominican Republic, Guatemala, Guyana, Nicaragua, and Panama. The goal of these studies, which were cross-sectional, has been to establish the association of alcohol and injury. While the ERCAAP studies collected data on injured ER patients and non-injured ER patients (as quasi controls), the WHO and PAHO studies restricted sampling to injured patients arriving at the ER within six hours of the injury event. This chapter describes the methodology and protocols used in the ER studies, plus highlights of the PAHO study carried out in Guyana.

At the time of their admission to the ER, both injured and non-injured patients underwent a breath test via breathalyzer, for an objective measure of blood alcohol concentration (BAC), and were then asked the following questions during a structured interview about 25 minutes long: type and cause of injury; place of injury; if they had used alcohol during the six-hour period preceding the injury (to determine if it was an alcohol-related injury); 1) if they had alcohol use within the same six-hour period the previous day and the previous week (as control periods for establishing the risk of injury in case-crossover analysis), 2) usual drinking patterns and higher consumption times, 3) alcohol-related problems, and 4) dependence symptoms). For those patients who reporting drinking before the event (and during the control periods), data were also obtained about the number and types of drinks consumed, and the activity in which the patient was engaged at the time. Those same patients were also asked about 1) the amount of time that had lapsed between their last drink and the injury, 2) their drinking companions and venues before the injury, 3) whether they were feeling drunk at the time of the injury, and 4) whether they believed the injury would have happened if they had not been drinking (i.e., the patient's causal attribution of injury to alcohol) (*1*).

In the WHO and PAHO ER studies, clinicians were trained in clinical observational assessment of level of intoxication of the patient (using ICD-101 Y91 codes). After the interviewer obtained the estimated BAC using the breathalyzer, patients were assessed observationally by a trained clinician blinded to the BAC estimate to determine concordance of the Y91 codes with an objectively measured BAC (using ICD-10 Y90 codes).

PATIENT SAMPLING AND INTERVIEWING

As it generally was not possible to sample every patient coming to the ER for treatment of their injury during the study period, varying sampling schemes of every nth patient were used (according to patient flow at each ER) to obtain a probability or representative sample of patients in each ER. This required sampling each ER shift over a 24-hour period an equal number of times across all days of the week during the study period. Injured patients eligible for the sample were those 18 years and older who arrived at the ER within six hours of the injury event. Patients falling into the sampling frame were selected from ER admission forms that generally reach a central location consecutively (i.e., in sequence of patient arrival in the ER) for people arriving by ambulance as well as those arriving on their own. Patients were selected as soon as possible after their arrival in the ER and approached for informed consent to participate in the study. After the patients were breathalyzed, the clinical assessment of intoxication was obtained for the WHO and PAHO studies. Patients were then interviewed, usually in a private area in or near the waiting room (as interviews were not supposed to interfere with or delay treatment), but also in the treatment area, or following treatment. Patients too severely injured to participate in the study at the time were admitted to the hospital and approached later (after their condition had stabilized). A cadre of interviewers was trained at each site to select the patient sample and obtain the breath sample and interview.

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[1] International Classification of Diseases, 10th Revision, World Health Organization.

EMERGENCY ROOM STUDIES ACROSS THE AMERICAS

Table 1 shows the results of the ER studies in the Americas that used probability sampling and the methods described above, as well as demographic characteristics of injured patients arriving at the ER within six hours of the injury event. The ER-CAAP studies included ERs in the United States (10 cities), Mexico (three cities), Canada (two cities), and Argentina (one city). The WHO project included ERs in one city each in Argentina, Brazil, Canada, and Mexico. The PAHO project included ERs in one city each in the Dominican Republic, Guatemala, Guyana, and Nicaragua, and in three cities in Panama. While the sample size of the ER-CAAP project varied, the WHO and PAHO studies targeted a sample size of about 500 injured patients per site. Each individual study included either a single ER facility (as in the WHO studies) or a group of ERs (with the largest group covered by the ERCAAP Mexico City study, which included eight ERs). As shown in Table 1, the majority of injured patients interviewed were male and young (with about 50% aged 18–29 years), with varying levels of schooling that reflected the general level of education in each country.

PAHO studies and country context

To study the impact of alcohol use on injury among ER patients in Latin America and the Caribbean (LAC), PAHO conducted ER studies between 2010 and 2011 on injured patients in five countries: Dominican Republic, Guatemala, Guyana, Nicaragua, and Panama. These studies included a total of 2 503 injured patients arriving at the ER within six hours of the injury event, representing an overall completion rate of 92.6%. Results from the study in Guyana are highlighted as an example of the political and health services context of these studies, lessons learned, and future recommended steps.

Guyana. In Guyana, the majority of the population lives in rural areas, and alcohol is prominent in the epidemiological profile and exerts a considerable burden as a risk factor for negative consequences.

**TABLE 1. Characteristics of three different series of emergency room studies in the Americas
(ERCAAP,[a] PAHO-ER,[b] and WHO-ER[c]), 1984 – 2011[d]**

Study site	Year	n	Study	Males (%)	≥ 30 years old (%)	Some college or above (%)
San Francisco, CA, USA	1984–1985	311	ERCAAP	70.4	53.7	44.1
Contra Costa County, CA, USA	1985	616	ERCAAP	61.4	49.2	40.2
Martinez, CA, USA	1987	406	ERCAAP	61.6	48.5	38.8
Kaiser (Contra Costa County, CA)	1989	193	ERCAAP	60.4	61.2	63.2
Jackson, MS, USA	1992	141	ERCAAP	52.5	42.6	37.6
Santa Clara, CA, USA	1995–1996	152	ERCAAP	67.5	60.1	44.1
Mexico City, Mexico	1986	1 034	ERCAAP	71.9	40.3	16.4
Acapulco, Mexico	1987	271	ERCAAP	70.1	39.3	14.1
Pachuca, Mexico	1996–1997	486	ERCAAP	66.1	54.4	16.2
Alberta, Canada	1989	173	ERCAAP	68.6	54.4	29.0
Quebec, Canada	1989	143	ERCAAP	57.2	50.7	62.0
Mar del Plata, Argentina	2001	230	ERCAAP	68.2	49.5	8.1
Mar del Plata, Argentina	2001	452	WHO-ER	68.5	52.0	16.3
São Paulo, Brazil	2001	496	WHO-ER	66.8	50.5	16.4
Ontario, Canada	2001	222	WHO-ER	62.1	72.6	51.3
Tlalpan, Mexico	2002	456	WHO-ER	59.9	47.8	18.6
Vancouver, Canada	2009	249	ERCAAP	62.7	64.9	74.7
Santo Domingo, Dominican Republic	2010	497	PAHO-ER	80.8	46.9	8.2
Guatemala City, Guatemala	2011	513	PAHO-ER	69.4	53.6	8.4
Georgetown, Guyana	2011	485	PAHO-ER	72.4	56.8	36.8
Managua, Nicaragua	2010	518	PAHO-ER	69.1	46.8	16.9
Panama (La Chorrera, Colon, Vearaguas)	2010	490	PAHO-ER	68.4	58.4	16.0
Total		8 534		67.5	50.9	25.8

[a] Percentages are weighted.
[b] Emergency Room Collaborative Alcohol Analysis Project.
[c] World Health Organization Collaborative Study on Alcohol and Injuries.
[d] Samples only include those arriving at the ER within six hours of the injury event.

The Guyana study illustrates the large role of alcohol in injuries and the large risk associated with drinking in Guyana. Considerable work has been done by the Ministry of Health to quantify alcohol consumption and its consequences. The Guyana ER study shows the difficulties inherent in developing a research protocol, and how the results can be used to help mobilize the community to take action against alcohol-related injury.

The PAHO initiative is a successful example of research implementation with limited resources (both human and financial) in five LAC countries. The results of the initiative provided participating countries with new and updated epidemiological data and helped train and consolidate research teams. The findings have been applied successfully by health ministries in the region to call attention to the large, and often, hidden problem of alcohol-related injury in their countries. ■

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CHAPTER 5.1
Collaborative study of alcohol and injury in Guyana

Marcia Paltoo

BACKGROUND

The harmful use of alcohol is a problem worldwide, due to the difficulties that drinking presents to public health, and Guyana is by no means exempt. Alcohol is an important contributor to the high incidence of injury, violence, and disease in the country, where rates of alcohol consumption per capita are higher than both the world average and average consumption in the Americas. Taxes on alcohol are low and there is no comprehensive national program to manage all alcohol-related issues.

COUNTRY STATISTICS

The estimated population of Guyana is 754 000, with approximately 65% over the age of 18. Twenty-eight percent of the population lives in urban areas, and-nearly 62% is concentrated in two of the country's 10 administrative regions. Guyana has a unique and diverse mix of cultures, with 43% of the population classified as East Indian and 30% of African heritage, plus Amerindian, Chinese, and European populations (*1*). The gross national income (GNI) per capita was US$ 3 270 in 2010, putting Guyana in the lower-middle income bracket for countries worldwide (*2*).

ALCOHOL CONSUMPTION PATTERNS

Alcohol consumption in the country is high but comparable to other Caribbean nations where alcohol, particularly spirits such as rum, are an ingrained part of the culture. The World Health Organization (WHO) reported that total per capita consumption of alcohol by adults (people 15 years and older) for the year 2005 was 9.5 L of pure alcohol per capita

(7.5 L recorded plus 2.0 L unrecorded), which is higher than average total per capita consumption in the Americas (8.7 L), and much higher than the world average of 6.13 L (*3*). Of the total per capita consumption in Guyana, 80% was consumed in the form of spirits, 16% in beer, and the remaining 4% in wine and other alcoholic drinks. Alcohol intake in Guyana rose steadily from the 1960s until the early 1990s, when consumption was measured at a high of approximately 15 L per capita. Consumption decreased dramatically in the mid-1990s to a low of about 4 L per person, increased slowly through the beginning of the 21st century, and has recently been leveling off at about 9.5 L (*3*). In 2002, a Pan American Health Organization (PAHO) report stated that 20% of men and 40% of women in Guyana abstain from drinking alcohol (Monteiro, 2002). While this statistic may have changed since the report was published, it shows that among those who do drink, actual average alcohol consumption is a good deal higher than the 9.5 L per capita reported by WHO, as the consumption figure does not adjust for non-drinkers.

In Guyana, like most countries, adults are not the only population drinking alcohol. The Global School-based Student Health Survey (GSHS) conducted countrywide in 2010 among students 13–15 years old showed that many youth drink alcohol. The results of the survey, representative of all regions in Guyana, showed that 44% of boys and 34% of girls in the surveyed age group had had an alcoholic drink within the last 30 days. Youth are starting to drink at a young age, with 80% of boys and 77% of girls who consume alcohol having their first drink before age 14. Another worrisome statistic from the study is that 35% of boys and 25% of girls reported hav-

ing had so much alcohol that they were very drunk on at least one occasion *(5)*. The Behavioral Surveillance Survey (BSS) conducted in 2008 also addressed aspects of alcohol use. Based on interviews with youth, the survey found that 61% of those in school had used alcohol in their lifetime, and 7% drank at least once a week. Among those who were not in school, 68% had used alcohol in their lifetime, and 18% drank at least once a week (BSS, 2008). Evidence that youth are drinking at a very young age, and are often binge drinking (drinking five or more standard drinks[1] in one sitting) indicates the need to focus more attention on this segment of the population in implementing alcohol control measures such as taxation of alcohol and bans on advertising of alcohol products. As reported in 2009 (*6*), the alcohol industry in Guyana earns about US$ 22 billion per year from underage drinkers.

The multinational Gender, Alcohol and Culture Study (GENACIS) conducted in 2010 also provided some data on patterns of drinking and the relationship of drinking to gender in Guyana. The preliminary results of this study showed that 69% of men and 47% of women had had at least once episode of binge drinking in the last 12 months (*7*). As previous studies have shown that 20% of men and 40% of women do not drink, this leaves few people who are drinkers but do not engage in binge drinking. Overall, based on WHO's drinking pattern scale of 1–5 (with 5 corresponding to the most risky drinking pattern), Guyana was rated "3" in the 2011 Global Status Report on Alcohol and Health. This is the same score as neighboring country Brazil, but lower than the score of 4 given to Guatemala and Nicaragua for the same period (*3*).

ALCOHOL CONCERNS

Alcohol has been identified as the number-one drug problem in Guyana (*6*). The effect of alcohol on health in Guyana is extremely significant. In 2002, PAHO reported the leading risk factors for burden of disease, ranked by percentage of disability-adjusted life years (DALYs) attributed to each

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[1] One standard drink = 16 ml of pure ethanol.

factor. In Latin America and the Caribbean, alcohol ranked first, accounting for 11.4% of DALYs, and outranking smoking, obesity, and hypertension, due to the contribution of alcohol-related diseases such as cardiovascular, diabetes, unintentional and intentional injuries, and cirrhosis of the liver, among others (*4*).

In 2009, Guyana's Minister of Health noted that alcohol played a significant role in many of the social ills Guyana faces (including domestic violence, injury, traffic injuries, and the spread of HIV/AIDS) and that alcohol problems were hindering the development of the country (*8*). It has been proven that alcohol affects many people other than drinkers, in the form of domestic violence, marital problems, financial problems, child abuse, and the costs of health and emergency care for family members who use alcohol (*9*). The high social cost of alcohol use among Guyana's youth has also been documented. The 2010 GSHS found that almost 16% of Guyanese youth 13–15 years old got into trouble with friends or family, missed school, or got into fights as a result of their drinking (*5*). Alcohol also has a high cost in terms of mental health. Among school-age adolescents in Guyana, suicidal ideation was associated with drinking alcohol, with an odds ratio (OR) of 2.09 for males and 1.93 for females (*10*). Preliminary results from the 2010 GENACIS also show evidence of social issues related to drinking, with 12% of men and 4% of women reporting that they got into a physical fight while drinking in the 12 months before the survey. Of those who had experienced aggression in their romantic relationship in the last two years, 62% of women and 56% of men reported that their partner had been drinking at the time of the aggression (*7*). The fact that over half of those who have experienced aggression admit that alcohol was involved shows that injuries to drinkers is not the only concern.

In 2004, WHO reported that 12-month prevalence of alcohol use disorders in Guyana was 5.6% for males and 1% for females (*3*). As shown in the 2008 BSS, some populations in Guyana have higher rates of alcohol abuse and problem drinking than others. For example, 50% of men who have sex with men (MSM)

were classified as problem drinkers, along with 36% of the military and 54% of the police force. The study also found that 46% of commercial sex workers (CSWs) used alcohol at least once a week, and 28% of them had used alcohol every day in the 30 days before the survey (BSS, 2008). Among these populations a high level of alcohol consumption is particularly worrisome as alcohol use is a known risk factor for increased risk-taking during sex, and CSW are at high risk for contracting HIV (*11, 12*).

ALCOHOL POLICIES AND PROGRAMS

In Guyana, the national minimum age for purchasing alcohol off-premises (outside commercial establishments) is 16, and the minimum age for serving alcohol on-premises (i.e., by drinking establishments such as restaurants and bars) is 18. The legal blood alcohol concentration (BAC) limit for driving is 0.08 % for all age groups. Guyana has excise taxes placed on beer, wine, and liquor, as well as some laws to restrict the sale of alcohol by time of day in restaurants (but not at gas stations or other commercial establishments that sell alcohol). There are no restrictions on the days on which alcohol may be sold, although the sale of alcohol is sometimes banned on specific dates such as election day (which occurs once every four years) (*3*). There are no laws specifying how much a person can drink, provided they are not driving (*6*). The typical drinking context in Guyana has been shifting to private residences and other non-licensed premises, for which no laws are in place regarding liability for the consequences of alcohol consumption (*13*). In 2009, the Minister of Health called for a review of Guyana's taxes on alcohol, stating that they were not high enough and that access to alcohol was too easy (*8*). Unfortunately there are few data for Guyana on the extent of problems related to alcohol, especially with regard to the types of injuries that may be related to alcohol use, and thus little available evidence to support these types of initiatives, and no nationwide programs designed to control the use of alcohol. There are some treatment and rehabilitation facilities for alcoholism, run by the Ministry

of Health, as well as school- and community-based programs focusing on the prevention of initiation of substance abuse, but these programs are not accessible nationwide. As a result, despite the apparent political will for more stringent legislation on alcohol sales and consumption, more taxation of alcohol products, and larger-scale programs to address alcohol use, no such laws, measures, or programs have been put in place.

EMERGENCY ROOM STUDY ON ALCOHOL AND INJURIES

PAHO's emergency room studies on alcohol and injuries in Guyana (PAHO-ER) was conducted to gain a better understanding of the scope of the alcohol problem in Guyana. Information on alcohol as a risk factor for injuries is vital to understanding the epidemiology of injuries and how to prevent them. The study was carried out in the emergency room (ER) in Georgetown Public Hospital Corporation (GPHC) between October 2010 and January 2011. Informed consent was obtained before patients were interviewed about demographic characteristics, cause of injury, and alcohol use patterns by a field worker using a questionnaire designed for the WHO-ER study. Alcohol-related injuries were defined as injuries in which the patient had a positive blood alcohol concentration (BAC) reading of 0.01 or more, or self-reported consumption of alcohol within six hours of the injury event.

Eligible patients (those older than 18 years presenting to the ER within six hours of injury who were not returning to the ER for a previous injury) were approached by one or more of the 20 survey team members rotated through six daily shifts at the ER and asked to participate in the study. Of the 493 injury cases sampled, 47 refused to participate. Some patients feared taking the BAC test because they thought there could be legal consequences. The final response rate was 90.5%. Of the patients included in the study, 72.4% were male and most were 30-49 years old (Table 1).

TABLE 1. Age-group distribution by sex, PAHO Emergency Room Study on Alcohol and Injuries, Georgetown, Guyana, October 2010-January 2011[a]

Age group (years)	Sex					
	Female		Male		Total	
	Frequency	%	Frequency	%	Frequency	%
≤ 29	52	38.8	156	45.0	208	43.2
30−49	57	42.5	158	45.5	215	44.7
≥ 50	25	18.7	33	9.5	58	12.1
Total	134	100.0	347	100.0	481	100.0

[a] Pearson's chi-squared test statistic (2 degrees of freedom (df)) = 7.75 (P = 0.021) for differences between females and males.

TABLE 2. Number of drinks[a] consumed by those self-reporting alcohol use during six-hour period before injury, by sex, Emergency Room Study on Alcohol and Injuries, Georgetown, Guyana, October 2010-January 2011[b]

Number of drinks consumed	Sex					
	Female		Male		Total	
	Frequency	%	Frequency	%	Frequency	%
1	0	0.0	9	10.1	9	9.3
2−3	3	37.5	26	29.2	29	29.9
4−5	2	25.0	7	7.9	9	9.3
≥ 6	3	37.5	47	52.8	50	51.5
Total	8	100.0	89	100.0	97	100.0

[a] One standard drink = 16 ml of pure ethanol.
[b] Fisher's exact probability test (P = 0.343) for differences between females and males.

Use of alcohol before injury event, drinking patterns and problems, and risk of injury

Of those with injuries, 17% had a positive BAC and 21% reported consuming alcohol during the six hours before the injury event. Drinking rates differed by sex, with 6% of females and 26.8% of males reporting drinking before the injury (data not shown). Among drinkers there was no significant difference in the number of drinks consumed before the injury (Table 2). Only eight women (6%) reported having a drink in the six-hour period preceding their injury compared to 85 men (26.8%). Of those who drank, the majority (51.5%) reported drinking six or more drinks, suggesting a high level of binge drinking among those presenting to the ER who reported drinking before injury—an issue that needs to be addressed. The most commonly consumed type of alcohol for men was spirits, while the majority of women drank beer. Drinking before injury was more common for those admitted to the ER on weekends (23%) compared to weekdays (14%). This finding was not surprising because people generally have more free time during the weekends and thus tend to drink more frequently, and in higher quantities.

Data were also obtained from patients about their drinking history in the past 12 months. Of all patients surveyed, 76% described themselves as current drinkers. Nearly 7% reported drinking daily or nearly daily and over 34% reported typically drinking six or more drinks when they drank. Over half (55%) of men and 30% of women said they drink either moderately or heavily. The Rapid Alcohol Problems Screen (RAPS4) (14) was used to identify those who were alcohol dependent, and 40% of drinkers in the study scored positive (total score ≥ 1 for four items). Men and women were equally likely to score positive on the RAPS4, suggesting that males and females are equally prone to problem drinking, and underscoring the need for problem drinking to be addressed nationally.

The use of control periods (analysis of alcohol use by patients the day before the injury event, and one week before the injury event) allowed for the determination of the relative risks (RR) of alcohol use before injury. Drinking was found to increase the risk of injury that resulted in attending the ER by 4.26 times compared to not drinking, suggesting that alcohol is a serious risk factor for injury. While many injuries occur without the influence of alcohol, this problem cannot be ignored.

Types of injuries

The predominant type of injury reported in the study was intentional injuries (47%), either self-inflicted or inflicted by someone else, followed by traffic injuries (16.9%) and falls (14%) (Table 3). The fact that the majority of injuries are not accidental reflects the high level of violence (particularly domestic violence) countrywide, which is exacerbated

by the hazardous use of alcohol (partially addressed by Guyana's programs to control drink-driving, another big problem for the country, as it is in many developing countries). Differences in type of injury were only marginally different (P = 0.08) between females and males.

Patients with injuries related to violence were significantly more likely to report drinking before the injury event versus those with unintentional injuries (Table 4). Alcohol may cause people to become more violent, or less inhibited in their actions, and thus more prone to getting into fights. Considering the high rates of violence in the country, it is clear that a focus on alcohol use alone is not sufficient to address the high rate of injuries, and that other measures to address violence are required.

For men, injuries were most likely to occur in public places (58%), but 26% took place at home and 16% at work. For women, the most common

TABLE 3. Distribution of type of injury by sex, Emergency Room Study on Alcohol and Injuries, Georgetown, Guyana, October 2010-January 2011[a]

Type of injury	Sex				Total	
	Female		Male			
	Frequency	%	Frequency	%	Frequency	%
Intentional (by someone else / self-inflicted)	58	43.9	167	48.1	225	47.0
Traffic injury	23	17.4	58	16.7	81	16.9
Blunt force injury (struck against / caught between)	9	6.8	30	8.6	39	8.1
Stab, cut, bite/gunshot	8	6.1	23	6.6	31	6.5
Fall, trip	28	21.2	39	11.2	67	14.0
Other / choking, hanging / drowning / poisoning / burn with fire, hot liquid / don't know	6	4.5	30	8.6	36	7.5
Total	132	100.0	347	100.0	479	100.0

[a] Pearson's chi-squared test statistic (5 df) = 9.76 (P = 0.082) for differences between females and males.

TABLE 4. Self-report on alcohol use during six-hour period before injury, by violence-related injury. Emergency Room Study on Alcohol and Injuries, Georgetown, Guyana, October 2010-January 2011[a]

Alcohol use in six-hour period before injury	Violence / intentional harm				Total	
	No		Yes			
	Frequency	%	Frequency	%	Frequency	%
No	224	86.5	149	70.0	373	79.0
Yes	35	13.5	64	30.0	99	21.0
Total	259	100.0	213	100.0	472	100.0

[a] Pearson's chi-squared test statistic (1 df) = 19.28 (P < 0.001) for differences between intentional and unintentional injuries.

place for injuries to occur was at home (54%), compared to 37% in public places and 9% at work. The large difference in place of injury occurrence by sex may be due to more women staying close to home versus men. Injuries among women obtained in the household may also be related to the high incidence of domestic violence. The largest difference in type of injury between males and females was for falls, with nearly twice as many females (21%) as males (11%) reporting this type of injury. While men and women may naturally suffer different rates of injuries from falls, it is also possible that women are misreporting injury due to domestic violence as falls, which is common among this population due to fear of repercussions for admitting abuse from their partner.

IMPACT OF THE STUDY IN GUYANA

This study was the first research effort to gain valuable information on and address the problem of alcohol-related injuries in Guyana, a category for which there were no previous data in the country. The study also provided additional information on drinking patterns in Guyana, which has only been examined in two prior surveys. The study results were covered by the national press, which increased public awareness of the dangers of alcohol. In addition, participating in the study allowed Guyanese researchers to participate in the network of researchers worldwide collaborating on studies addressing alcohol use, and provided the opportunity for information-sharing across countries about alcohol regulation and methods of improving public health programs related to alcohol. The study also provided additional evidence for the claims made by the Ministry of Health that alcohol in Guyana contributes to interpersonal violence, both at home and at work (*15*). Alcohol abuse has the potential to cost the health sector millions of dollars, and the study provided data to support the need for legislative and policy change.

LESSONS FOR FUTURE INITIATIVES

ERs have proven to be convenient places for conducting screening of patients under the influence of alcohol. They also provide the opportunity to educate and intervene in cases of problem drinking. Protocols need to be established to screen patients for BAC and problem drinking and provide referrals to treatment providers and programs. Not all injuries are caused by drinking, but alcohol has now been shown to be a serious risk factor for the injury burden in Guyana, and this problem must be addressed. Injury due to violence is high and therefore should be the subject of serious investigation and public health programming. This study only analyzed alcohol-related injury from the perspective of whether or not the injured person had been drinking, so the proportion of injuries caused by others' drinking is still unknown. Due to high rates of violence in the country, determining these proportions is especially important. In addition, this study was only conducted at one hospital in an urban setting. Data on alcohol use and abuse in rural communities, which may vary considerably from the more highly populated urban areas, are very limited. Finally, all those under age 18 were excluded. Due to the high rates of underage drinking, this is another important population to include in future research. Additional information on other costs associated with injury due to alcohol use would also be helpful, including income lost due to time off from work caused by injuries.

In 2009, a comprehensive review of the current laws on alcohol was conducted and the resulting report addressed the key areas that need to be updated—mainly drink-driving policies, pricing and taxation, marketing and advertising, and political commitment to programs to address alcohol (*13*). In light of the new data provided by the current study, alcohol clearly needs to be moved up on the public agenda, and changes like those recommended in the review fully implemented. ∎

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CHAPTER 6

Alcohol-related injuries in the Americas: variation by cause and country

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SUMMARY

This chapter describes 1) the proportion of alcohol-related injuries by injury causes in emergency department (ED) studies in 10 countries of the Americas, and 2) country differences in alcohol-related injuries by country-level contextual variables, including income, societal drinking pattern, and alcohol control polices. Alcohol-related injury is defined as acute alcohol involvement among injury patients and is measured by a positive blood alcohol concentration (BAC) or self-report of any drinking before injury. For each of the 10 countries, the percentage of alcohol involvement was higher for injuries related to violence than for those from traffic injuries, falls, or other types of injuries. For the 10 countries combined, 38% and 46% of those with violence-related injuries had a positive BAC or self-report of drinking before injury, respectively, compared to 17% and 21% of those with traffic injuries, 12% and 14% of those with injuries due to falls, and 10% and 13% of those with other injuries. Results from meta-regression showed countries with a higher level of detrimental drinking pattern (DDP) and less restrictive alcohol control policies had a higher proportion of alcohol-related injuries. Alcohol involvement in traffic injuries was most strongly related to DDP, while the effects of alcohol control policies were seen for all four causes of injury, particularly in relation to a positive BAC. Significant results from meta-regression were primarily observed for current drinkers, suggesting the importance of addressing alcohol-related harm among the smaller population of drinkers in a country, even when the country-level drinking consequences are not problematic.

INTRODUCTION

Traditionally, information about the presence of alcohol in injuries has been collected to investigate the role intoxication plays in injury-related morbidity and mortality ([1, 2]). Not all alcohol consumption before injury is causally related to the accident, but the prevalence of alcohol in the context of injury (alcohol-related injury) can be used as a crude measure of the burden of injury attributable to alcohol ([3]).[1] For example, Smith et al. ([4]) reviewed 65 medical examiner studies on injury fatalities in the United States and found that the aggregate percentage determined to be intoxicated (blood alcohol concentration (BAC) ≥ 0.10%) was 32.8% among deaths from motor vehicle crashes, 31.0% for non–traffic-related unintentional injury deaths, 31.5% among homicide cases, and 22.7% among suicides. Alcohol's presence was somewhat lower among nonfatal injuries. Cherpitel et al. ([5]) reported the prevalence of alcohol-related injury for 46 emergency department (ED) studies from 19 counties, finding the aggregate percentage of any self-reported drinking before the injury event was 20.6% for all injuries, while the percentage of alcohol intoxication (BAC ≥ 0.08%) was 8.7%. In another study using data from these same ED studies across 16 countries, the percentage of alcohol intoxication (BAC ≥ 0.08%) was estimated at 22% for violent injuries and 8% for motor vehicle injuries ([6]).

Prior ED studies found the likelihood of alcohol-related injury was associated with injury patients' usual alcohol consumption, including both

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[1] See Chapter 8 of this book for more details on alcohol-attributable fraction (AAF) of injury.

average volume and usual drinking pattern (e.g., the frequency of drinking five or more drinks on one occasion) (*5, 7, 8*). In addition, alcohol-related injuries across ED studies were shown to be related to societal drinking pattern and alcohol control policies, when analysis focused on drinkers only (*5*). These findings are particularly important in explaining and predicting the potential cross-country differences in alcohol-related injuries for policy makers and public health personnel. Analyses for all injuries combined are the most often reported (see Chapter 11 of this book); less investigated is alcohol-related injury by cause of injury. Injuries vary by the context in which they occur, with motor vehicle accidents happening on roads and violence-related injuries involving interpersonal contact. The effects of drinking on different types of accidents might also differ. For example, alcohol's causal role in motor vehicle accidents is believed to stem from impairment of psychomotor and cognitive skills caused by drinking, whereas conceptual models explaining the link between drinking and aggression include the disinhibition hypothesis and social learning theory (*9*). These speak to the need to examine alcohol-related injury by cause.

This chapter examines alcohol-related injury in ED studies from 10 countries in the Americas, including two high-income countries (Canada and the United States); the three largest countries in Latin America (Argentina, Brazil, and Mexico); and five countries from Central America and the Caribbean (Dominique Republic, Guatemala, Guyana, Nicaragua, and Panama). The goal is to describe the proportion of alcohol-related injury by cause, and explore whether cross-country differences can be explained by country contextual factors such as income, drinking cultures, and alcohol control polices, which vary greatly across the 10 countries.

METHODS

Data were collected from 38 ED sites in 22 studies across 10 countries in the Americas.[2] There were four ED studies in Canada (1989–2009), six studies

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[2] See Table 1 in Chapter 11 of this book and Cherpitel et al. (*5*) for a more detailed description of the ED studies and the sampling methods used.

in the United States (five in California) (1985–1996), four studies in Mexico (1986–2002), one in Brazil (2001), two in Argentina (2001), and one study each in the five countries in Central America and the Caribbean (2010–2011). In all studies probability samples of patients 18 years and older were obtained by approaching consecutive arrivals to each ED, with equal representation of each shift for each day of the week. Sampling was restricted to injured patients who arrived at the ED within six hours of the injury event in most of the studies, so analyses here are restricted to this group of patients. Analysis is performed by country (i.e., studies within the same country are combined to obtain sufficient sample size for analysis by cause of injury).

Alcohol-related injury is measured in two ways: positive BAC ($\geq$ 0.01%), and self-reported drinking during the six hours before the injury event. BAC estimates were obtained as soon as possible after patient admission to the ED. Injuries were classified by four different causes: traffic, violence/intentional, falls, and other, based on injury patients' self-report. Analysis was performed separately for the total sample of injury patients and for current drinkers (those who reported any alcohol consumption in the last 12 months).

Three types of country- or societal-level contextual variables are used to predict cross-country variations in alcohol-related injuries: income, drinking pattern, and societal alcohol control policy. The 10 countries in the Americas are divided into three categories: "high income" (Canada and the United States), "medium income" (Argentina, Brazil, Mexico, and Panama) and "low income" (Dominican Republic, Guatemala, Guyana, and Nicaragua), based on the value of their 2008 gross domestic product (GDP). Societal drinking pattern was measured using the detrimental drinking pattern (DDP) index, an indicator of the "detrimental impact" on health and other alcohol-related harms at a given level of consumption, with values ranging from 1 (lowest detrimental impact) to 4 (highest detrimental impact). This measure includes indicators of heavy drinking occasions, drinking with meals, and drinking in public places, and was developed by the World Health

Organization (WHO) from aggregate survey data or key informant surveys for more than 50 countries (*10*). The 10 countries analyzed here have DDPs ranging from 2 to 4. The two types of alcohol policies—one related to drink-driving and one to alcohol access—are generated as composite measures and each is constructed using four indicators. Indicators for driving-related alcohol policies are: legal intoxication level for driving, random breath testing, sanctions against driving under the influence (DUI), and open-container laws. Indicators for alcohol access policy are: legal drinking age, off-premise sales restrictions, bar closing hours, and sanctions serving minors. As analysis is at the country level, and the policy measures were originally collected at the individual ED study level (see details in Chapter 11 of this book), each of the two policy composite measures were averaged and recoded for each country into three-category variables (with values ranging from 1 to 3, and higher values indicating more restrictive controls). Finally, a combined policy variable was created as the summation of the two policy measures. All country-level contextual variables are shown in Table 1.

The proportion of alcohol-related injury by country is reported in Table 2. Table 3 reports the results from meta-regression (*11*) predicting alcohol-related injury across the 10 countries by country contextual variables. Unlike ordinary linear regression, the random effect meta-regression accounts for both country prevalence and the standard error estimates of the prevalence through an iterative weighted regression procedure.

RESULTS

Table 1 shows, for each of the 10 countries in the Americas, the values for ED sample size and contextual variables (income, DDP, and alcohol control policy). Also shown are the rates of last-year current drinking and the distribution of injuries across the four causes (traffic, violence, falls, and other). A large variation in the distribution of injury by cause was observed. Canada had the lowest percentages of traffic injuries (11%) and violence-related injuries (7%), while the Dominican Republic had the highest rate of traffic injuries (44%), and Guyana had the highest rate of violence-related injuries (44%). Also seen in Table 1 is

TABLE 1. Percentage of current drinkers and injury type among emergency room injury patients and country-level characteristics, 10 countries in the Americas, 1985-2011

Country	n (all injuries)	Current drinkers (%)	Traffic injuries (%)	Violence-related injuries (%)	Falls (%)	Other injuries (%)	Detrimental drinking pattern[a]	Income level[b]	Alcohol control policy		
									Driving[c]	Access[c]	Driving and access[d]
Canada	787	85.9	10.9	7.1	31.3	50.7	2	3	2	2	4
United States	1819	80.9	14.9	17.9	19.3	47.9	2	3	1	3	4
Brazil	496	70.0	16.5	8.3	32.3	42.9	3	2	2	2	4
Argentina	682	83.4	22.8	12.7	29.7	34.8	2	2	2	2	4
Dominican Republic	501	76.6	43.9	18.4	15.8	22.0	2	1	3	2	5
Guatemala	513	57.0	23.4	19.5	29.2	27.9	4	1	1	2	3
Guyana	485	76.2	17.7	44.3	14.0	23.9	3	1	2	2	4
Mexico	2 247	66.6	13.9	20.9	23.8	41.5	4	2	1	1	2
Nicaragua	518	46.8	21.2	31.3	21.4	26.1	4	1	2	1	3
Panama	490	70.2	21.0	16.3	25.1	37.6	3	2	3	1	4

[a] The higher the value, the more detrimentally alcohol is consumed.
[b] Low, 1; medium, 2; high, 3 (based on country domestic gross product).
[c] The higher the value, the more restrictive the alcohol control policy.
[d] Summation of alcohol policy scales on driving and access.

the wide variance in country rates of last-year drinking, which ranged from 47% (Nicaragua) to 86% (Canada). These rates were strongly associated with country DDP (r = –0.89) (the lower the DDP, the larger the proportion of current drinkers).

Table 2 shows the proportion of alcohol-related injuries, by positive BAC and self-report of any drinking before injury, for all injury combined and by cause. For each of the 10 countries, alcohol-involvement for those with violence-related injuries was consistently higher than for those with injury from other causes. The percentages of positive BAC ranged from 13% to 57% across countries (38% total) while the percentages of any self-reported drinking before injury ranged from 30% to 70% (46% total) for violence-related injuries. In comparison, BAC ranged from 5% to 24% (17% total) and self-report from 12% to 26% (21% total) for traffic injuries, from 4% to 16% (12% total) and 4% to 23% (14% total), respectively, for falls, and from 5% to 17% (10% total) and 8% to 18% (13% total), respectively, for other injuries. Also shown in Table 2 is the proportion of alcohol-related injuries among current drinkers; as expected, higher percentages are observed compared to the total sample. Again, for most countries, violence-related injuries showed a much higher percentage of alcohol-involvement than injuries related to traffic accidents, falls, or other causes.

Cross-country differences in alcohol-related injuries, for all injuries combined and by cause, were predicted by country contextual variables, using meta-regression. Indicators of income, drinking pattern, and three types of alcohol control policy measures (driving, access, and combined) were entered into regressions one at a time. The regressions were fitted for alcohol-related injuries using, separately, the total sample and the sample of current drinkers.

The top half of Table 3 shows the meta-regression results when alcohol-related injury was measured by positive BAC. No significant association was seen between the proportion of positive BAC and country income. In contrast, country DDP was significantly associated with the proportion of positive BAC for all injuries combined and for traffic injuries, with a stronger magnitude of association observed when the analysis was restricted to current drinkers. For drinkers, country DDP was also significantly associated with BAC percentage for other injuries, and marginally significant (P < 0.10) for violence-related injuries. Overall, countries in which the drinking pattern was more detrimental tended to have a higher prevalence of positive BAC. While neither alcohol control policies related to driving nor those related to alcohol access significantly predicted a positive BAC, the combined policy measure summing the two domains was significantly associated with the proportion of positive BAC, especially for current drinkers. The more restrictive the alcohol control policies, the less the likelihood of alcohol-related injuries as measured by a positive BAC, and this relationship was significant for all injuries combined and for all causes.

The results of meta-regression predicting any self-reported drinking before injury are shown at the bottom part of Table 3. Similar to findings for positive BAC, DDP was significantly associated with self-report for the total sample and for traffic injuries, when analysis was restricted to current drinkers. While the combined alcohol control policy was negatively associated with the likelihood of an alcohol-related injury based on self-reported consumption, the results were significant only for all injuries combined and not for specific causes of injury, unlike that observed for BAC.

DISCUSSION

This chapter described the percentages of alcohol-related injury by cause of injury (traffic accident, violence, falls, and other), as well as for total injuries combined from ED studies in 10 countries in the Americas. It also examined how cross-country differences in proportions can be predicted by country contextual variables. The percentage of alcohol-related injuries was higher in countries with a higher detrimental pattern of drinking. One new finding in this analysis is the fact that the effect of DDP on alcohol-related injury was found primarily among traffic injury patients for the 10 countries in the Americas, with significant associations observed

TABLE 2. Proportion of alcohol-related injuries by injury cause, for total injury sample and for drinkers only (%), 10 countries in the Americas, 1985–2011

Country	Total sample					Current drinkers only				
	All injuries	Traffic injuries	Violence-related injuries	Falls	Other injuries	All injuries	Traffic injuries	Violence-related injuries	Falls	Other injuries
Positive blood alcohol concentration (BAC)										
Canada	12.1	5.0	56.8	9.7	9.5	14.0	5.5	64.8	12.1	10.5
United States	16.1	10.2	36.9	15.9	10.8	19.8	13.0	41.7	21.8	12.9
Brazil	11.6	15.0	42.1	4.4	10.1	15.1	18.6	48.3	6.7	12.6
Argentina	15.3	19.9	31.8	13.9	7.9	17.2	20.4	35.7	16.4	8.5
Dominican Republic	8.7	8.7	13.0	6.3	6.7	11.2	11.2	15.2	8.5	9.0
Guatemala	20.3	23.9	52.0	8.7	7.0	35.2	37.8	64.6	20.0	13.0
Guyana	17.0	15.5	21.8	11.9	12.2	22.2	19.4	26.6	18.2	16.9
Mexico	20.5	17.9	46.4	14.7	11.6	30.6	27.0	55.8	26.0	17.6
Nicaragua	22.4	14.6	40.4	9.3	17.1	46.8	35.0	58.9	30.3	41.5
Panama	17.1	21.4	44.3	12.8	5.2	23.5	30.8	51.6	21.1	7.1
Total	16.9	15.1	38.3	12.1	10.3	23.0	20.2	45.9	19.1	13.7
Self-reported drinking before injury										
Canada	17.8	11.6	69.9	12.9	14.9	20.6	12.9	79.6	16.0	16.7
United States	21.3	17.3	48.4	19.6	13.2	26.4	22.7	55.2	26.6	16.0
Brazil	12.8	25.9	39.0	3.8	9.6	17.3	32.2	51.6	6.6	11.3
Argentina	23.5	22.8	51.8	22.6	14.4	28.1	26.1	57.7	27.7	17.9
Dominican Republic	19.3	19.4	30.0	9.0	17.8	25.0	24.7	34.6	13.0	23.1
Guatemala	21.1	25.8	50.0	10.7	7.7	36.6	40.3	63.3	23.1	14.5
Guyana	21.0	16.5	30.3	11.9	12.3	27.9	22.6	36.4	18.6	18.2
Mexico	21.9	19.3	52.5	14.0	12.0	33.3	30.0	63.6	25.2	18.9
Nicaragua	21.5	12.8	41.3	7.3	16.5	46.4	32.6	61.3	24.2	41.2
Panama	20.8	25.7	44.3	13.9	12.3	29.3	38.8	52.3	23.9	15.9
Total	20.7	19.5	46.1	14.0	12.9	28.5	27.1	55.7	22.1	17.4

TABLE 3. Coefficients and standard errors for meta-regression analyses of country proportion of alcohol-related injuries predicted by country characteristics (income level, drinking pattern, and alcohol control policy), by positive BAC[a] and self-reported drinking before injury, 10 countries in the Americas, 1985–2011[b]

Predicting prevalence of positive BAC

Country characteristic	Total sample					Current drinkers only				
	All injuries	Traffic injuries	Violence-related injuries	Falls	Other injuries	All injuries	Traffic injuries	Violence-related injuries	Falls	Other injuries
Income level (low, medium, high)	−0.013 (0.019)	−0.029 (0.024)	0.074 (0.055)	0.020 (0.017)	0.001 (0.012)	−0.061 (0.044)	−0.067 (0.040)	0.058 (0.072)	−0.004 (0.033)	−0.032 (0.028)
Detrimental drinking pattern	0.038 (0.011)[c]	0.041 (0.018)[d]	0.064 (0.047)	−0.003 (0.016)	0.010 (0.011)	0.106 (0.023)[e]	0.097 (0.022)[e]	0.105 (0.055)[f]	0.044 (0.027)	0.043 (0.018)[d]
Alcohol control policy										
Driving	−0.031 (0.017)	−0.015 (0.027)	−0.085 (0.054)	−0.023 (0.018)	−0.021 (0.007)[c]	−0.056 (0.048)	−0.030 (0.048)	−0.103 (0.070)	−0.050 (0.029)	−0.032 (0.018)
Access	−0.032 (0.021)	−0.038 (0.029)	−0.051 (0.070)	0.001 (0.022)	−0.001 (0.014)	−0.094 (0.051)	−0.096 (0.047)	−0.091 (0.086)	−0.042 (0.039)	−0.038 (0.036)
Combined (driving and access)	−0.041 (0.010)[e]	−0.033 (0.020)	−0.096 (0.041)[d]	−0.016 (0.016)	−0.014 (0.009)	−0.099 (0.031)[c]	−0.076 (0.033)[d]	−0.134 (0.049)[c]	−0.059 (0.022)[c]	−0.036 (0.012)[c]

Predicting prevalence of self-reported drinking before injury

Country characteristic	Total sample					Current drinkers only				
	All injuries	Traffic	Violence	Fall	Other	All injuries	Traffic	Violence	Fall	Other
Income level (low, medium, high)	−0.006 (0.013)	−0.011 (0.020)	0.098 (0.036)[c]	0.033 (0.023)	0.010 (0.008)	−0.054 (0.031)	−0.050 (0.030)	0.088 (0.050)	0.010 (0.034)	−0.018 (0.012)
Detrimental drinking pattern	0.004 (0.012)	0.007 (0.018)	−0.011 (0.045)	−0.028 (0.021)	−0.012 (0.006)	0.065 (0.024)[c]	0.061 (0.022)[c]	0.026 (0.052)	0.010 (0.031)	0.010 (0.009)
Alcohol control policy										
Driving	−0.009 (0.014)	0.004 (0.022)	−0.064 (0.048)	−0.019 (0.027)	0.011 (0.010)	−0.026 (0.038)	−0.004 (0.038)	−0.080 (0.056)	−0.040 (0.034)	0.006 (0.017)
Access	−0.007 (0.016)	−0.002 (0.024)	0.003 (0.062)	0.026 (0.030)	0.003 (0.008)	−0.067 (0.039)	−0.058 (0.039)	−0.032 (0.071)	−0.011 (0.042)	−0.016 (0.010)
Combined (driving and access)	−0.011 (0.012)	0.001 (0.018)	−0.048 (0.044)	0.001 (0.024)	0.008 (0.006)	−0.060 (0.028)[d]	−0.035 (0.030)	−0.081 (0.047)	−0.037 (0.030)	−0.013 (0.009)

[a] BAC: blood alcohol concentration.
[b] Predictors entered separately.
[c] $P < 0.01$.
[d] $P < 0.05$.
[e] $P < 0.001$.
[f] $P < 0.10$.

based on both positive BAC and any self-reported drinking. Less evidence of a significant association was seen for other causes of injuries, although all showed a positive relationship with DDP.

Based on a positive BAC, the combined alcohol control policy measure summing both those related to driving and those related to access had a significant effect for all injury causes among current drinkers, while neither policy, alone, was significant. Contrary to expectation, alcohol-related injury for a specific cause (e.g., traffic injury) was not sensitive to a specific policy domain (e.g., alcohol policy related to driving), which may imply that alcohol control policies are most effective as preventive measures collectively, suggesting that future research should examine not only policies related to specific domains but also combined measures of policy.

One interesting finding is that country income did not seem to have a strong relationship with alcohol-related injury. A similar finding was seen in an earlier analysis of 28 ED studies (*8*) in which country gross national product (GNP) was significant in predicting a positive BAC but not significant when other contextual variables such as DDP were entered into the model simultaneously. Coupled with findings here, this suggests societal drinking culture and alcohol control policies are more important factors to determine alcohol involvement in injury than level of country economic development.

The findings of this chapter also highlight how the analysis approach can shape the results. Similar to findings from earlier studies (*5, 8*), the majority of significant results of the meta-regression analysis was observed when analysis was restricted to drinkers only, with both DDP and alcohol control policies showing the strongest association with alcohol-related injury when abstainers were excluded. This may suggest that alcohol involvement in injuries is more related to how a person drinks when he or she does drink, which would be in turn affected by DDP and alcohol control polices, rather than whether a person chooses to be a drinker. The country DDP level is negatively correlated with drinking rate (r = –0.89) for the 10 countries studied. Thus, in countries with a high abstention rate,

those who do drink tend to drink in patterns having more detrimental impact on their health at a given volume of consumption. This finding may have special meaning for policy and prevention as it suggests that while drinking consequence in some countries might not be as severe for the society as a whole, special prevention measures are needed to address the alcohol-related harm concentrated in the smaller population of drinkers.

The difference between the two indicators of alcohol-related injury is significant. The results from meta-regression showed stronger effects of DDP and alcohol policies when positive BAC was evaluated compared to self-report of any drinking before injury. However, an earlier cross-country ED study on alcohol-related injury found positive BAC and self-reported drinking were both associated with DDP and other policy measures (*8*). In comparison, a more recent similar study (*5*) found that the effects of DDP and alcohol policies were stronger for a more restrictive definition of alcohol-related injuries (e.g., BAC ≥ 0.08%) than for self-report of any drinking. As measures of alcohol involvement, BAC and self-report both have their weakness. BAC measures, though not as subject to report bias as self-reported consumption, were taken after patient arrival in the ED. For the 10 countries studied, the total percentage of any self-reported drinking was 21%, compared to 17% for a positive BAC. Among those with a positive BAC, 87% also had a positive self-report, while among those with a positive self-report, 72% had a positive BAC. This suggests that positive BAC may be a more restrictive definition of alcohol involvement than self-report of any drinking due to the time lag between drinking and ED arrival. While this might partly explain the somewhat different results between positive BAC and self-reported drinking, indicators of more restrictive measures (e.g., BAC ≥ 0.08%) could not be examined here given the limits of sample size.

Given the smaller sample size when specific causes of injury are analyzed, the country, rather than the ED study, was used as the study unit (n = 10) in the meta-regression, which results in limited

power of the analysis. The meta-regression analysis also fails to control for individual level variables such as patient drinking patterns, making the analysis here more descriptive in nature. Another limitation is the fact that the EDs were not randomly selected and therefore may not be representative of the countries from which they were drawn. One final limitation is that, in some of the countries, the samples may contain some response bias, especially in relation to alcohol-related traffic injuries, where potential subjects may have been less likely to participate, due to fear of possible increased likelihood of criminal prosecution. Despite these limitations, findings are similar to those assessing alcohol-related injuries for all injuries combined reported in this volume (see Chapter 11) and elsewhere across a larger number of ED studies (*5, 8*), where both DDP and alcohol control policies were associated with proportions of alcohol-related injuries, particularly among current drinkers.

CONCLUSIONS

This chapter described the prevalence of alcohol-related injuries by injury causes for ED studies in 10 countries of the Americas. For each of the 10 countries, percentage of alcohol involvement among violence-related injuries was higher than that for traffic injuries, falls, and other types of injuries. Country differences in alcohol-related injuries were explained by country-level contextual variables including income, societal drinking pattern, and country alcohol control polices. Results from meta-regression showed countries with a higher DDP and less restrictive alcohol control policies had a higher proportion of alcohol-related injuries. Alcohol involvement in traffic injuries was most strongly related to DDP, while the effects of alcohol control policies were seen for all four causes of injuries, based on a positive BAC. There results provide important data to policy makers and public health personnel for prevention of alcohol-related harm in the region of the Americas. ■

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CHAPTER 7
Relative risk of injury from alcohol: findings from case crossover analysis

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SUMMARY

This chapter provides comparative estimates of relative risk (RR) between acute alcohol use and injuries from emergency departments (EDs) in the Americas, and dose–response estimates for RR for all types of injuries, by type of injury. These estimates are needed to have updated and more local information to calculate burden of disease for alcohol attributable injury. Case-crossover methodology was used to obtain estimates of the RR of injury within six hours of drinking alcohol, with control periods based on the same time of day, one week before injury, and the usual frequency of drinking. A total of 8 534 patients in EDs in 10 countries in the Americas were asked the number of drinks consumed six hours before the injury, the same day of the injury the week before, and their usual drinking in the last 12 months. The RR of injury after drinking alcohol was elevated for both control periods. Based on drinking the week before, those having one standard drink (eg "16 ml of pure alcohol") had an RR of 2.95, those drinking 2–4 had an RR of 3.75, those drinking 5–10 had an RR of 5.71, and those having 11 or more had an RR of 5.16. Significant dose–response relationships were also found for intentional injuries (inflicted by someone else or self-inflected), traffic injuries, and falls. Therefore, drinking was found to be related to injury in the countries of the Americas, with risk of injury increasing with the amount of alcohol consumed.

INTRODUCTION

The Americas includes countries with both the highest level of development (such as Canada and the United States) and the lowest level of development (such as Haiti). The cultural contexts of these countries also varies considerably, along with country drinking patterns, with some countries tending to drink more at meals (such as Argentina) while others tend toward heavy episodic (binge) drinking (such as Mexico). Any attempt to characterize the role of alcohol in the region must take the extreme variations across countries into account. However, regardless of the contextual conditions in which drinking occurs, alcohol is causally associated with a number of medical conditions and injuries (*1*) and thus exerts a heavy burden to society (*2*). Injuries are one of the largest contributors to this burden, and those related to violence are a key component of the overall burden of disease in the Americas. About 34% of alcohol-related disability-adjusted life years (DALYS) lost are attributable to unintentional injury and about 25% to intentional injury (*3, 4*). In addition, about 24% of homicides, 11% of suicides, and 20% of traffic injuries are associated with alcohol (*2*), for an overall alcohol burden that is generally higher in the Americas versus other regions of the world (*4*).

Despite alcohol's large role in the occurrence of intentional and unintentional injuries, and the large percentage of alcohol-related DALYS for injury in the region, few estimates of the relative risk (RR) for an injury after alcohol consumption are available for Latin American countries (*5*). Several studies have

reported on alcohol and injury in emergency department (EDs) in Latin America and the Caribbean (LAC), including recent research by Andreuccetti et al. (*6*), but most are descriptive case series. According to Andreuccetti et al. (*6*), prevalence estimates for self-reported alcohol use before injury range from 12.8% to 29.2% in ED studies in the region, but no comparative RR estimates for all types of injury or for specific types of injury have been reported in these studies. Comparative RR estimates are necessary for contrasting the impact of alcohol on injury in the Americas with other parts of the world, and for providing local estimates of the burden of disease related to alcohol in the region.

This chapter presents data from ED studies on alcohol and injuries among patients in Argentina, Brazil, Canada, Dominican Republic, Guatemala, Guyana, Mexico, Nicaragua, Panama, and the United States. The data include the association between drinking and injury for the Americas region; comparative estimates of RR obtained from case-crossover studies, using the usual frequency method and the pair-matching method; the variability of the estimates across study sites; and potential key effect modifiers of risk, including violence-related injuries, which are a great concern in the region. Potential dose–response relationships (alcohol use and injury) is also examined, for all injuries combined and by type of injury.

METHODS

Using the methodology described in Chapter 5 of this book, which is similar to the one applied in the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) (*7*), the World Health Organization Collaborative Study on Alcohol and Injuries (WHO-ER) (*8*), and the ER studies from the PAHO-Valencia cooperation (PAHO-ER) (*9*), the ED studies were aggregated to provide a large data set for examining the RR of nonfatal injury associated with alcohol consumption.

The interviews included questions on whether the study participant consumed alcohol during the six hours preceding the injury, the estimated amount of alcohol consumed during this period (and during the same six-hour period the previous week), and the usual quantity of alcohol consumed and frequency of use in the past year. Questions on quantity and frequency of drinking were based on questionnaires used in a number of other ED studies. In all studies, mode of injury was assessed as either intentional (violence-related or self-inflicted) or unintentional (traffic injury, fall, or other type of injury).

Data on the quantity and frequency of usual drinking from the ERCAAP, WHO, and PAHO studies were used for case-crossover analyses using the usual frequency method (*10*). This approach compares, for each patient, the reported use of alcohol during the six-hour period preceding the injury with the usual frequency and quantity of alcohol consumption during the last 12 months. The pair-matching method (*10*) was also used, with the data from the WHO and PAHO projects.[1] The pair-matching method compares, for each patient, the reported use of alcohol during the six-hour period before the injury with the use of alcohol during the same period on the same day in the previous week. Details and examples of both analytic methods can be found elsewhere (*7, 11, 12*).

Data analysis

Patients who reported drinking at any time during the six hours preceding their injury were considered exposed cases. The volume of alcohol consumed in that six-hour period was analyzed by converting the number and size of glasses of wine, beer, spirits, and local beverages to number of standard drinks[2] and summing across all beverage types.

The usual frequency approach was modified to take into account the amount of alcohol consumed during the six hours before injury, with each drink consumed presumed to have an effect period of one hour. The expected person-time exposure to alcohol was estimated by multiplying the reported usual annual frequency of drinking by the effect period on a

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[1] The ERCAAP studies did not collect the data required for use of this method.

[2] 16 ml of pure alcohol (ethanol).

drinking day. Unexposed person-time was then calculated by subtracting the estimated exposed person-time from the number of total hours in one year (8 466 hours).

The pair-matching approach compared the reported use of alcohol of each patient during the six hours before injury with the use of alcohol during the same period on the same day in the previous week. Patients were asked the following "Yes"/"No" question: "In the six hours before and up to you having your injury/accident, did you have any alcohol to drink—even one drink?" Similar information on alcohol use at the same time in the previous week was also elicited. The number of drinks consumed on each of the two occasions was obtained and transformed into a measure of volume, as described above.

All analysis was performed on current drinkers (those reporting any alcohol use within the last 12 months and presumably at risk for an alcohol-related injury). Techniques for handling sparse person-time data analyses are appropriate to calculate the RR and 95% confidence intervals (CI) for the usual frequency approach. Conditional logistic regression was used to calculate matched-pair RRs and 95% CIs (*10*). Variation in the magnitude of the RR across levels of fixed characteristics, such as age and sex, was examined using the chi-squared test of homogeneity (*13*). After obtaining the RR estimate for each study site, a random RR pooled across studies was obtained (Table 2). Meta-analysis was used to report results for fixed effects and random effects (when fixed effects were not applicable) along with tests of homogeneity (*14*). Linear trend and dose–response associations across categories of number of standard drinks were assessed examining the incremental risk ratios (*15*).

RESULTS

Table 1 shows drinking characteristics and intentional injuries by ED study. The sample included a total of 8 534 injury cases, of which 21% reported drinking during the six hours before the injury (exposed cases), ranging from 6% (Ontario, Canada) to 33% (San Francisco, CA, USA). Injured patients were predominantly male and < 30 years old (not shown) and 20% reported a violence-related injury, ranging from 2% (Ontario, Canada) to 45% (Guyana).

In Table 2, RR estimates for alcohol use in the six hours before injury are reported for the two methods of estimation. The chi-squared tests for the pooled estimates for both the usual frequency and pair-matched methods suggest a random estimate is a better approximation for the data due to heterogeneity (variability) in estimates across studies. The random pooled RR obtained from the usual frequency method suggests an RR of 5.66 (95% CI: 4.11–7.81) whereas the pair-matched method suggests an RR of 4.25 (95% CI: 3.13–5.77). The funnel graphs to the right of the table show that the usual frequency method generates a large degree of heterogeneity in RR estimates, which range from 1.05 (Ontario) to 22.82 (Acapulco, Mexico). Results for the pair-matched method suggest that only Ontario is an outlier in the funnel graph, with a RR of 0.50. All other sites where the matched-pair approach was used suggest a lower level of heterogeneity in the funnel graph, with RRs ranging from 3.2 (Guyana) to 9.4 (Dominican Republic). These results indicate alcohol consumption was significantly related to injuries in 21 of the 22 ED studies.

The possibility that some key variables functioned as potential effect modifiers for the relationship between alcohol and injury, either increasing or decreasing the common RR reported in Table 2, was also explored (Table 3). Using the usual frequency method, the RR for females was 6.41 (CI: 4.65–8.84) and the RR for males was 5.61 (CI: 4.00–7.87). The chi-squared test for significant differences between the two RRs found none (P = 0.574), suggesting that risk is similar for males and females. In Table 3, for each estimate (e.g., females versus males) there is an estimate of the heterogeneity of the RR by study (with variable degrees of freedom, depending on the number of studies included). As seen in Table 2, the only variable that emerged as a possible effect modifier was intentionality of the injury, which had a significantly larger RR for injuries related to violence versus unintentional injuries. This trend was found using both methods.

TABLE 1. Violence-related injury and alcohol use among patient sample across 22 emergency room (ER) studies (n = 8534), Americas region, 1984–2011[a,b]

Study site	n	Current drinkers[c] %	Alcohol use before injury[d] %	Violence-related injury %
San Francisco, CA, USA	311	84.2	32.8	29.9
Contra Costa county, CA, USA	616	80.2	17.9	11.4
Martinez, CA, USA	406	84.5	21.9	22.3
Kaiser (Contra Costa County), CA, USA	193	81.1	10.0	3.8
Jackson, MS, USA	141	73.8	28.4	33.1
Santa Clara, CA, USA	152	73.5	18.3	17.3
Mexico City, Mexico	1 034	70.4	26.5	27.3
Acapulco, Mexico	271	62.0	28.4	28.4
Pachuca, Mexico	486	48.0	13.0	13.7
Alberta, Canada	173	88.4	30.6	16.5
Quebec, Canada	143	90.9	12.6	3.1
Mar del Plata I, Argentina	230	82.6	27.8	19.8
Mar del Plata II, Argentina	452	83.9	21.3	10.3
São Paulo, Brazil	496	70.0	12.8	9.2
Ontario, Canada	222	80.8	6.3	1.7
Tlalpan, Mexico	456	83.3	17.2	15.9
Vancouver, Canada	249	85.8	22.2	8.1
Santo Domingo, Dominican Republic	497	75.8	19.3	19.6
Guatemala City, Guatemala	513	57.0	21.1	25.5
Guyana	485	76.1	21.0	45.2
Managua, Nicaragua	518	46.9	21.5	36.5
Panama	490	69.9	20.8	19.1
Total	8 534	72.5	20.7	20.6

[a] Number of missing values by variable: violence-related injury (158), current drinkers (174), alcohol use before injury (59).
[b] Data are weighted due to sampling schemes.
[c] Patients who had at least one drink of any alcoholic beverage in the last 12 months.
[d] Self-report of alcohol use in the six hours before injury.

TABLE 2. Relative risk (RR) for any alcohol use six hours before an injury among patient sample across 22 emergency room (ER) studies (*n* = 8534), by study site and estimation method, Americas region, 1984–2011

Study site	Usual frequency method		Pair-matching method[b]	
	RR	95% CI[a]	RR	95% CI
San Francisco, CA, USA	5.92	4.48–7.82	–[c]	–
Contra Costa county, CA, USA	3.05	2.47–3.77	–	–
Martinez, CA, USA	3.69	2.91–4.68	–	–
Kaiser (Contra Costa county), CA, USA	1.76	1.10–2.80	–	–
Jackson, MS, USA	15.69	8.63–28.55	–	–
Santa Clara, CA, USA	2.64	1.66–4.20	–	–
Mexico City, Mexico	17.18	14.44–20.44	–	–
Acapulco, Mexico	22.82	15.93–32.70	–	–
Pachuca, Mexico	17.22	12.49–23.75	–	–
Alberta, Canada	8.86	6.15–12.77	–	–
Quebec, Canada	3.47	2.11–5.70	–	–
Mar del Plata I, Argentina	4.34	3.21–5.87	–	–
Mar del Plata II, Argentina	4.47	3.52–5.67	4.76	2.46–9.20
São Paulo, Brazil	2.34	1.78–3.06	5.43	2.42–12.17
Ontario, Canada	1.05	0.58–1.88	0.50	0.15–1.67
Tlalpan, Mexico	12.35	9.49–16.08	6.70	3.44–13.04
Vancouver, Canada	3.65	2.66–5.02	4.25	1.96–9.20
Santo Domingo, Dominican Republic	4.33	3.35–5.61	9.43	4.32–20.57
Guatemala City, Guatemala	17.48	13.92–21.95	4.53	2.75–7.45
Guyana	3.99	3.23–4.93	3.24	2.07–5.08
Managua, Nicaragua	9.15	6.91–12.10	4.08	2.22–7.49
Panama	5.12	3.97–6.60	3.94	2.35–6.62
Pooled estimate (across study sites)				
Fixed	6.30	5.93–6.68	4.25	3.49–5.18
Random	5.66	4.11–7.81	4.25	3.13–5.77
Chi-squared test statistic (degrees of freedom)	$X^2_{(21)}$ = 590.85 (*P* < 0.001)		$X^2_{(9)}$ = 19.98 (*P* = 0.018)	

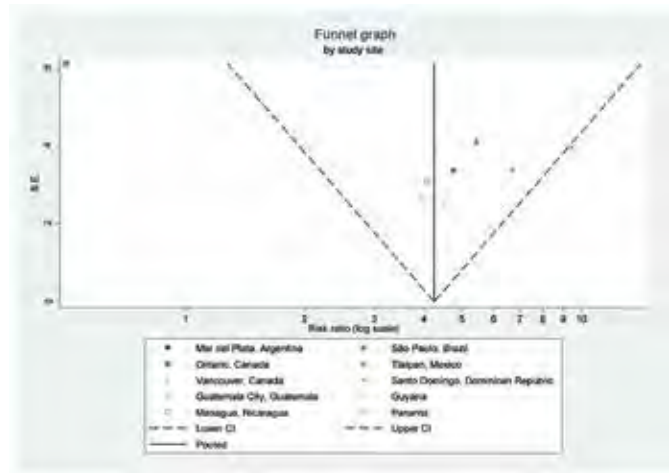[a] CI: confidence interval.
[b] Based on alcohol use during previous week (as control period); weighted data.
[c] Data no collected.

Funnel graph, usual frequency method:
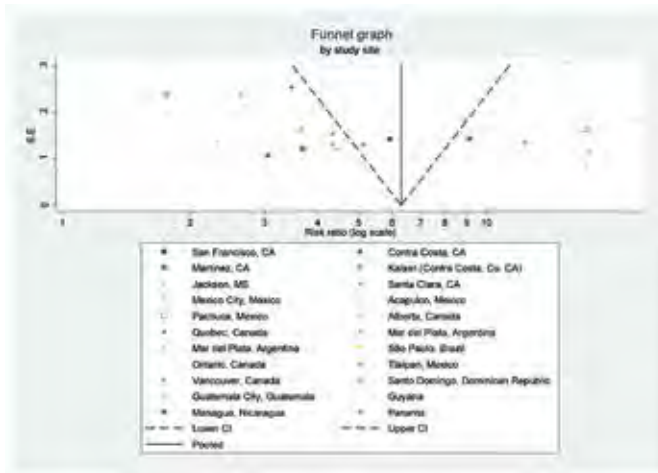
Funnel graph, pair-matching method:

TABLE 3. Pooled random estimates of alcohol-related injury by estimation method and demographic characteristics and presence of violence-related injury among patient sample across multiple emergency room (ER) studies (n = 8534), Americas region, 1984–2011

	Pooled estimates[a]									
	Usual frequency method[b]					Pair-matching method[c]				
Characteristic	RR[d]	95% CI[e]	X^2	Df[f]	P	RR	95% CI	X^2	Df[f]	P
Sex	6.02	4.77–7.60	0.32	1	0.574	4.14	3.16–5.43	0.20	1	0.654
Female	6.41	4.65–8.84	92.95	21	< 0.001	3.69	2.08–6.55	4.77	7	0.689
Male	5.61	4.00–7.87	537.45	21	< 0.001	4.28	3.15–5.82	17.26	9	0.045
Age (years)	5.61	4.08–7.73	1.83	1	0.176	4.31	3.53–5.27	0.24	1	0.626
< 30	6.74	4.65–9.75	408.36	21	< 0.001	4.52	3.44–5.95	6.66	8	0.574
≥ 30	4.85	3.59–6.55	225.80	21	< 0.001	4.09	3.06–5.48	6.84	9	0.654
Violence-related injury	8.81	1.73–44.97	36.66	1	< 0.001	4.23	2.43–7.38	5.29	1	0.021
No	3.88	2.99–5.04	251.90	21	< 0.001	3.20	2.30–4.45	15.90	9	0.069
Yes	20.48	12.79–32.79	243.43	21	< 0.001	5.64	3.96–8.04	5.17	7	0.639

[a] By meta-analysis, all estimates random.
[b] 22 study sites.
[c] 10 study sites; weighted data.
[d] RR: relative risks.
[e] CI: confidence interval.
[f] Df: degrees of freedom. Differ across strata due to zero cells in the RR estimate (Brazil and Nicaragua for females, Canada for < 30 years, and Canada and Dominican Republic for violence-related injury).

Dose–response estimates for number of drinks consumed in the six hours before injury was calculated only for the sites with pair-matched data. As seen in Table 4, those who had a single standard drink (eg "16 ml of pure alcohol") had an RR of 2.95 (CI: 1.73–5.01), suggesting that even at a low level of alcohol consumption there is increased risk for injury. The RR increased with 2–4 drinks, and again with 5–10 drinks, but then dropped slightly at ≥ 11 drinks. A chi-squared test for linear trend (X^2 = 203.8) is significant (< 0.001), but visual inspection of these RR estimates suggests a leveling off of risk at higher levels of consumption.

Table 5 shows RR estimates by type of injury for any drinking in the six hours preceding the injury (and in the week prior) and by number of drinks consumed. Violence-related injuries (self-inflicted or by

TABLE 4. Matched-pair analyses of alcohol consumption during six-hour period before injury and (during same time and day) one week before injury by number of drinks among patient sample across multiple emergency room (ER) studies (*n* = 8534), Americas region, 1984–2011[a,b]

Number of drinks	Pair-matching estimate	
	Relative risk	95% CI[c]
None	1.00	—[d]
1	2.95	1.73–5.01
2–4	3.75	2.78–5.08
5–10	5.71	4.07–8.01
≥ 11	5.16	3.66–7.28

[a] 10 study sites; weighted data.
[b] Wald chi-squared test statistic $_{(degrees\ of\ freedom)}$ = 203.8$_{(4)}$; P < 0.001.
[c] CI: confidence interval.
[d] Missing data.

TABLE 5. Matched-pair analyses of alcohol consumption in six-hour period before injury and (during same time and day) one week prior to injury by type of injury and number of drinks in patient sample across multiple emergency room (ER) studies (*n* = 8534), Americas region, 1984–2011

Alcohol consumption	Type of injury	Number of drinks	RR[a]	95% CI[b]
Any[c]	Intentional by someone else	—[d]	6.81	4.82–9.62
	Self-inflicted	—	8.03	2.38–27.09
	Traffic	—	5.37	3.17–9.11
	Fall, trip	—	2.69	1.75–4.12
	Other	—	2.16	1.43–3.26
By number of drinks[e]	Intentional by someone else and self-inflicted	1	4.54	2.07–9.92
		2–4	5.90	3.63–9.59
		5–10	10.91	5.98–19.89
		≥ 11	8.44	4.86–14.67
	Traffic	1	2.42	0.71–8.20
		2–4	4.21	1.99–8.91
		5–10	4.93	2.09–11.62
		≥ 11	15.92	4.30–58.95
	Fall	1	2.81	0.85–9.34
		2–4	2.32	1.24–4.34
		5–10	3.81	1.80–8.06
		≥ 11	2.93	1.35–6.39
	Other	1	2.12	0.77–5.82
		2–4	2.46	1.32–4.55
		5–10	2.41	1.27–4.59
		≥ 11	1.28	0.60–2.72

[a] RR: relative risk.
[b] CI: confidence interval.
[c] Reference: no alcohol use.
[d] Not applicable.
[e] Reference: zero drinks.

someone else) were associated with higher RR estimates than other types of injuries, although all other types of injuries were at increased risk of occurring with any drinking during the six hours before the event. RR estimates by number of drinks suggest the dose–response relationship (alcohol and risk of injury) varies by type of injury. For traffic injuries, the dose–response association increased monotonically with increased number of drinks. For intentional injuries and falls, risk increased up to 5–10 drinks and then fell, although still maintaining significance at ≥ 11 drinks. For other types of injury, risk increase up to 5–10 drinks, and then fell to a nonsignificant level. While the risk of injury increased at even one drink for intentional injury, this was not found for traffic injuries, falls, or other types of injuries, for which the RR estimates at one drink were elevated but lacked statistical significance. However, the wide CIs for all RR estimates by type of injury, which are due to the small sample numbers, suggest these results should be interpreted with caution.

DISCUSSION

Consistent with findings from other studies worldwide, alcohol consumption was significantly related to injury in 21 out of 22 studies from countries in the Americas, with risk increasing with increased amounts of drinking before injury, providing persuasive epidemiological evidence of a causal role of alcohol in injury occurrence. About 21% of the patients across these countries reported drinking during the six hours before injury. Among those, the likelihood of sustaining an injury was elevated more than fivefold (RR = 5.66) based on their usual drinking in the last year and more than fourfold (RR = 4.25) based on their drinking the week prior to the injury (during the same time and day of week as their drinking six hours before the injury event). The only variable found to act as an effect modifier for this relationship was intentionality of the injury, with violence-related injuries showing a significantly elevated RR compared to unintentional injuries. Increased consumption (above one drink) was related to increased likelihood of an injury. Most important for policy and preventive measures, consumption at low levels (one drink for

intentional injuries and two drinks for unintentional injuries) was found to be associated with a significantly elevated risk of injury.

Prevalence of drinking before injury varied considerably among studies, consistent with other international research, in which it ranged from 6.3% to 46.4% (*12*). Although drinking may be more prevalent in some cultural contexts versus others, the relationship between drinking and the likelihood of injury has remained fairly consistent across studies. The estimated RR based on drinking in the week prior in this study compared to the estimated RR based on the same period in the 12-country WHO Collaborative Study on Alcohol and Injuries (*11*) was lower (4.25 versus 5.7 in the WHO study). In addition, the current study found that those with a violence-related injury had an increased RR compared to those with unintentional injuries, as found in a prior study in the region (*5*). Future research in EDs in a larger number of countries in the LAC region may shed further light on the increased risk for violence-related injuries, an issue of great importance in the Americas (*16*). This study confirms the pervasive perception of clinical personnel in the EDs studied here of the prominent role of alcohol in their caseloads, especially for violence-related injuries. The RR estimates based on the usual frequency method differed from those based on the paired-matching approach quite substantially in some of the studies analyzed here, and future work is necessary to explore possible reasons for such variation. For example, in Guatemala, the RR based on the usual frequency method was 17.5, whereas the RR based on the paired-matching method was only 4.5. Nevertheless, the pooled random RR estimates obtained using both methods are closer to each other than the RRs from individual study site comparisons, and both types of estimates suggested a high and positive association between alcohol use and injury.

Prior estimates of a dose–response relationship based on case-crossover studies of drinking before the event have been reported in the literature (*11*). Estimates from the current study suggest that risk of injury is significantly elevated at a minimum level of consumption (one drink) when all types of injuries are considered together, and that risk increases up

to 5–10 drinks and then levels off. Pooled data from the WHO Collaborative Study on Alcohol and Injuries (*11*) also indicated an increased RR with one drink for all injuries combined but suggested that risk remains relatively stable up to six drinks, and then increases sharply.

Analyses of increases in RR by type of injury is less common in the literature, and data here found RR to increase for each type of injury. A significant dose–response relationship was also found for each type of injury, beginning with one drink for intentional injuries and two drinks for unintentional injuries. For traffic injuries, RR of injury continued to increase with increasing consumption before the event (≥ 11 drinks), while for other types of injuries risk leveled off after 5–10 drinks. These results differ from other estimates for violence-related injuries in the Americas that suggest sharper increases in risk (*8*), although more gradual increases have also been reported (*17*). Regardless of a dose–response relationship, findings here as well as those from prior studies and a recent meta-analysis (*18*) show similarities in that even low levels of drinking are associated with increases in risk of injury. These results indicate that public health messages in the Americas should include all drinkers rather than just those who drink at heavier levels. Further studies, with larger sample sizes, are necessary for a better understanding of the dose–response relationship of alcohol and injury by type and cause, with important implications for public health in the region.

Limitations

This study is limited to analysis of data from patients with nonfatal injuries who attended specific EDs. Although the study design provides a representative sample of patients from each facility, patients may not be representative of other facilities in the area or the country. In addition, as is common with other studies conducted in EDs, cases cannot be assumed to be representative of other individuals who were injured but did not seek medical attention. All analyses reported here are based on the patient's reported alcohol consumption across different periods, and it is possible that participants were more likely to recall their consumption more accurately immediately before an injury than during any previous period, thereby producing an overestimate of the association between alcohol and injury. On the other hand, legal or other issues may have encouraged patients to minimize their reports of drinking before an injury, as in the case of drivers in motor vehicle accidents. It is also possible, for various reasons, that patients purposely inflate the level of their drinking. For example, those with violence-related injuries may over-report alcohol consumption to excuse behavior that would otherwise be viewed as socially unacceptable (*19*). Clearly, more research on the validity of methods for eliciting alcohol use in case-crossover analyses is needed. Despite the fact that case-crossover studies are well suited to control for between-person confounders, they do not eliminate the possibility of within-person confounders. Due to the lack of measures for other variables that vary over time and could be considered possible confounders of the relationship between acute alcohol use and injury, there is no means of adjusting for these potential biases.

CONCLUSIONS

Regardless of the study limitations, this data reported here suggest that in 10 countries of the Americas, as in other regions of the world, alcohol is a trigger for injury, and the greater the consumption the larger the risk for injury. These findings have important implications for the region. ER patients in particular should be strongly encouraged to reduce their drinking, or in some cases abstain, to avoid future injuries, especially those related to violence. Alcohol policies aimed at reducing overall consumption and drink-driving would decrease the prevalence of alcohol-related injuries and the resulting alcohol-related harms among both men and women. ∎

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CHAPTER 8

Comparison of alcohol-attributable fractions across 10 countries in the Americas

Jason Bond and Guilherme Borges

SUMMARY

Samples of injured patients from emergency rooms spread across 10 countries in the Americas were used to estimate alcohol-attributable fractions (AAFs) for both all-cause and violence-related injury among the full sample as well as among only those reporting drinking any alcohol in the past 12 months (current drinkers). The relationship between the AAF and a number of country-level variables including detrimental pattern of alcohol use, drinking culture, and a number of alcohol use policies were examined to identify societal characteristics associated with the preventable burden of alcohol on injuries. Among the full population, results suggested that 16% and 42% of all-cause and violence-related injuries, respectively, were attributable to acute alcohol use assessed over a six-hour period before injury. Among current drinkers only, AAF estimates rose to 23% and 52%, respectively. Several country-level variables were also associated with variability in AAF estimates. Among current drinkers, increased AAFs for all-cause injury were associated with higher detrimental pattern of drinking and fewer sanctions against bars for serving minors. Increased AAFs for violence-related injuries were associated with lack of random breath testing of drivers and more off-premise restrictions on alcohol sales. No country-level variables were associated with AAFs for analyses using the full samples. Findings from the present study identify potentially important societal characteristics associated with the burden of injury due to alcohol use, several of which are policies that may be useful tools in reducing this burden. This chapter focuses on the study of how AAFs vary with a number of relevant country-level drinking culture and alcohol-policy variables.

INTRODUCTION

Alcohol's contribution to the burden placed on society due to disease and injury is increasing. In 1990, it was estimated to be the sixth largest contributor to disability worldwide, as measured from disability-adjusted life years (DALYs) lost, with injury responsible for close to half of these DALYs (*1*). In 2010, it rose to the fifth leading contributor, and third among males (see Chapter 2 in this book). Although DALYs are a useful metric for estimating and assigning costs to society associated with exposure to a given risk factor, a more easily understood and practical measure is the alcohol-attributable fraction (AAF) of injuries, defined as the proportion of injuries that could have been prevented had an individual not consumed alcohol before the occurrence of their injury.

In practice, AAF estimation has been carried out for a range of countries around the world (e.g., (*2, 3, 4*)). Early multinational work (*3*) estimating AAFs relied on relative risks (RRs) produced from English et al. (*5*). However, these RR estimates were not generated from epidemiologic studies based on probability samples of injury patients. Instead, their injury risk calculations and AAFs relied on a meta-analysis of pooled RRs estimated from clinical or blood alcohol case series in published studies. In addition, AAF estimates in (*3*) also assumed the same RR for all countries and cultures, which is problematic given what is known about differences across cultures in drinking patterns that have a higher probability of resulting in health harms, including injury (*6, 7*). More recently, using data from 14 emergency room (ER) studies in the United States, Canada, Mexico, Spain, Italy, Argentina, and Poland (several of which

are used in the present analyses), Cherpitel et al. (*2*) estimated AAFs using data from a case-control design consisting of samples of injured and non-injured ER patients. Estimates were formulated for all injury types combined (all-cause injury) and for violence-related injury, each by sex and age group, and variation in these estimates were studied as a function of contextual variables (including detrimental drinking pattern (*8*)), as well as other relevant social and policy variables. Although these estimates were formed using data from studies on probability samples of ER patients (*9*), some concern has been expressed regarding the use of samples of non-injured patients as controls (*10, 11*) with respect to whether drinking among such patients is representative of that of the population served by the ER. This research parallels that carried out by (*2*) but estimates AAFs based on case-only (i.e., injury) samples for each of 10 countries in the Americas for which these type of data are available. This chapter focuses on the study of how AAFs vary with a number of relevant country-level drinking culture and alcohol-policy variables (*12, 13*). In addition, as the prevalence of reports of any drinking in the past 12 months affects the variability in rates of acute alcohol exposure (and thus AAF estimates), and as those who do not drink are not at risk for acute alcohol use prior to injury, AAF estimates and the study of their variability across countries is performed using both the full sample and the sample of only those reporting any drinking in the past 12 months.

METHODS

Individual ER data

As described in detail in Chapter 5, data used here were taken from 22 ER studies spread across 10 countries in the Americas. Three separate projects contributed data for these analyses including the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) (*14*), the World Health Organization Collaborative Study on Alcohol and Injuries (WHO-ER) (*15*) and the ER studies from the PAHO-Valencia cooperation (*16*). For each of these projects, data were collected using a similar meth-

odology developed by Cherpitel (*17*). Probability samples of patients 18 years and older reflected consecutive arrivals to the ER with equal representation of each shift for each day of the week. All patients were approached with an informed consent to participate in the study, and were interviewed for about 25 minutes using a standardized questionnaire. Completion rates for interviews ranged from 68% to 93%, with non-interviews resulting from refusal, incapacitation, leaving before completing the interview, police custody and language barriers. Patients who were too severely injured to be approached in the ER were followed into the hospital and interviewed once their condition had stabilized. Interviews included, among other items, the reason for the ER visit, drinking in the six hours prior to the injury, quantity, and frequency of usual drinking and higher consumption times during the last year, and demographic characteristics.

Contextual data

Contextual data were collected on a number of social and policy variables thought to be important in describing variability in AAF estimates across countries in the Americas. Detrimental drinking patterns (DDPs) were obtained for each country as a whole, based on a survey of key informants selected by the WHO (*18*) but recoded within country with multiple studies where information was available regarding relative patterns within country. Key informant responses were evaluated on validity (*6*), and ratings were analyzed using optimal scaling analysis (*19*) with one dimension identified and called "detrimental impact." Detrimental impact scores ranged from 1 to 4, with the higher the score the higher the postulated detrimental effect of the same per capita consumption of alcohol resulting in harm (*6*). Study variables included country gross domestic product (GDP) and per capita alcohol consumption of ethanol (in liters) for the region or area in which the research was conducted, as well as level of societal stigmatization of alcohol use (coded as 1 = low and 2 = high), which may affect the validity of self-reports of alcohol use and can be used to study variation in AAFs.

Data for minimum legal drinking age (coded as 1 = < 18, 2 = 18–20, and 3 = ≥ 21); legal blood alcohol concentration (BAC) limit for driving; level of sanctions against bars for serving minors; level of severity of driving under the influence (DUI) sanctions (coded as 1 = low, 2 = medium, and 3 = high); level of restrictions of off-premise alcohol sales (including hours and locations of sale, and coded as 1 = low, and 2 = high); whether random alcohol breath tests are performed for drivers (with 1 = "No," and 2 = "Yes"); and bar closing hours (coded as 1 = after 2 a.m. or none, 2 = at 2 a.m., and 3 = before 2 a.m.) were obtained from the collaborators for each ER study for the period when the ER data were collected. Table 1 shows the distribution of contextual variables across ER studies.

Analysis

Traditionally, estimation of the AAF requires data on 1) acute alcohol use during the six-hour period before injury among a sample experiencing an injury, often taken from ER studies (*9, 20*), and 2) use during a similar period for a control sample not experiencing an injury. Here, the control sample periods during which alcohol use is assessed are the same six-hour periods (i.e., same time of day, and day of week) the week prior for the sample of injured patients, where it is assumed an injury did not occur, leading to a case-only (or case-crossover) design. Using case and control periods for injured patients, AAF estimation requires the availability of estimates of two quantities: the RR of injury, and the prevalence of acute exposure to alcohol during the six-hour period before injury.

For each ER study, separate estimates of the RR of injury, based on the usual frequency case-crossover method and self-reported prevalence of any drinking six hours before injury, were formulated using samples of injured patients only. Chapter 7 provides a detailed explanation of the usual-frequency case-crossover method used to estimate the RR of injury associated with acute alcohol use. Patients who reported any drinking within the six hours before injury were considered acutely exposed cases. The amount of expected control-period person-time ex-

posure to alcohol over the past 12 months was then estimated by multiplying the reported usual annual frequency by the effect period on a drinking day. The amount of unexposed control-period person-time was obtained by subtracting the estimated exposed person-time from the number of total hours in one year (8,466 hours). Along with information on any self-reported alcohol use six hours before injury, the estimated amounts of exposed and unexposed time in the last 12 months were used to estimate the RR and its 95% confidence interval (CI) for each study, using methods appropriate for sparse person-time data. More detailed information describing RR estimation can be found elsewhere (*21*).

Using estimates for the RR of injury and the weighted prevalence of drinking six hours before injury (p_e) among the injured cases only, estimates for the AAF were then created using the formula AAF = $p_e \cdot (1-1/RR)$ (*22*). Corresponding 95% CI estimates for the AAF were constructed based on variance estimates provided elsewhere (*22*). After obtaining AAF estimates separately for each study site, a pooled estimate was also obtained across studies.

To investigate the relationship between AAF estimates and candidate country-level variables, random-effects meta-analyses (*23*) were used to predict ln(1–AAF) as a function of study-level contextual variables for each of all-cause injury and, separately, violence-related injury. Because a monotonic function (i.e., the natural log) of 1–AAF was estimated as the dependent variable, the interpretation of coefficient signs must be reversed so that a negative coefficient associated with a covariate, for example, implies that increases in values of the covariate correspond to larger estimated AAFs (and vice versa for positive coefficients).

For each outcome variable, several models were estimated in sequence. First, each contextual variable was entered separately as a predictor of the outcome in Model 1. Then, in an attempt to control for effects due to variability in level of economic development or of societal drinking patterns across countries, if GDP, DDP, or per capita alcohol consumption were found to be significant marginal predictors of the outcome, the relevant significant predictors

were used as controls, along with any country-level policy variables found to be significant marginal predictors, and entered in separate models (Models 2 and 3). Model 4 included all covariates found to be significant in Model 1.

RESULTS

Table 1 provides information for each of the ER studies used in the present analyses, including the year the study was conducted, the proportion of injured patients reporting drinking any alcohol in the past 12 months, societal contextual variables (GDP, DDP, per capita alcohol consumption, and stigmatization), and a range of alcohol policy variables.

Among the full sample of injured patients, Table 2 shows the number of injured patients and estimates of the prevalence of any alcohol use six hours before injury, the RR of injury (or violence-related injury), and the corresponding AAF estimate (along with its 95% CI) for both all-cause injury and violence-related injuries. For both all-cause and violence-related injury, the chi-squared test of homogeneity was significant, indicating significant variability in AAF estimates and that random effect estimates should be used to estimate the effect size. For all-cause injury, the pooled AAF estimate was 0.16 (95% CI: 0.13, 0.19). For violence-related injuries, the AAF estimate was 0.42 (95% CI: 0.37, 0.47), more than double that of the corresponding estimate for all-cause injury. Due to the small numbers of violence-related injuries in each of the Kaiser (Contra Costa County, CA), Quebec, and Ontario studies, corresponding estimates were not provided for those studies nor were their data used in pooled effect size or meta-regression estimation.

Analogous prevalence, RR, and AAF estimates among only those reporting any alcohol use in the last 12 months are shown in Table 3. Using only the sample of current drinkers, the chi-squared test of homogeneity was significant, with a test statistic more than twice as large in magnitude as that produced from analyses using the full sample. The pooled AAF estimate for all-cause injury was 0.23 (95% CI: 0.18, 0.28). For violence-related injuries,

the pooled AAF estimate was 0.52 (95% CI: 0.45, 0.57). As non-current drinkers are removed exclusively from the denominator of acute exposure prevalence estimates, AAF estimates for current drinkers are uniformly higher than those for the full sample.

Using current drinkers only, Table 4 shows results from meta-regression analyses predicting ln(1–AAF) as a function of study-level contextual variables for both all-cause injury and, separately, violence-related injury. As ln(1–AAF) is used as the outcome, discussions of the direction of the effects between a predictor and the AAF estimate will be in the opposite direction as that of the sign of the coefficient in Table 3. For all-cause injury, Model 1 in Table 4 shows that, in addition to the marginally significant negative relationship between GDP and AAF, DDP was positively related to AAF, and sanctions against bars for serving minors was negatively associated with AAF. For Models 2 and 3, controlling for GDP, DDP as well as sanctions against bars for serving minors retained their relationship direction and significance (with DDPs' level of significance dropping from 0.01 to 0.05 from Model 1 to Model 2) while GDP was only marginally significant and positive in Model 3. Finally, when controlling for all three predictors, Model 4 shows that only sanctions against bars for serving minors remained significant and negatively associated with AAF.

Table 5 shows meta-analysis results for violence-related injuries among current drinkers only. From Model 1, AAF estimates were higher for studies with no random breath testing policies (compared to "any") and for studies with greater off-premise alcohol sales restrictions. For consistency with results from analyses for all-cause injury, GDP was also entered in Models 2–4. Not surprisingly, as GDP was not significantly associated with AAF in marginal models, each of the marginal relationships held in Models 2 and 3 when GDP was also entered as a predictor. In addition, each of the two significant predictors in marginal models were also significant in Model 4 when all three predictors were entered simultaneously, with GDP again not a significant predictor. Analogous meta-analysis models were also estimated for the full sample of injured patients, for

TABLE 1. Distribution of contextual (country/county) variables for 22 emergency department studies across 10 countries in the Americas, 1984–2011

Study	Year	Population of current drinkers (%)	Gross domestic product	Detrimental drinking pattern (DDP)[a]	Per capita consumption (in liters of pure alcohol)	Sanctions against bars serving minors[a]	Minimum legal drinking age	Maximum legal BAC[b] for driving[a]	Random breath testing[a]	Severity of DUI[c] sanction[a]	Off-premise sales restrictions[a]	Bar closing hours[a]	Level of stigmatization of alcohol use[a]
San Francisco, CA	1984–1985	84.2	45 230	1	11.94	2	21	1.0	1	2	1	2	1
Contra Costa, CA	1985	80.2	45 230	1	11.81	2	21	1.0	1	2	1	2	2
Martinez, CA	1987	84.5	45 230	1	11.47	2	21	1.0	1	2	1	2	2
Kaiser (Contra Costa County), CA, USA	1989	81.1	45 230	1	10.56	2	21	1.0	1	2	1	2	2
Jackson, MS, USA	1992	73.8	45 230	3	7.91	2	21	1.0	1	3	2	3	2
Santa Clara, CA, USA	1995–1996	73.5	45 230	1	8.46	2	21	0.8	1	2	1	2	1
Mexico City, Mexico	1986	70.4	9 964	4	8.59	1	18	0.8	1	2	2	1	1
Acapulco, Mexico	1987	62.0	9 964	4	8.64	1	18	0.8	1	2	2	1	1
Pachuca, Mexico	1996–1997	48.0	9 964	4	9.14	1	18	0.8	1	2	1	1	1
Alberta, Canada	1989	88.4	45 166	3	9.76	2	18	0.8	1	3	2	2	2
Quebec, Canada	1989	90.9	45 166	1	8.33	2	18	0.8	1	3	2	1	1
Mar del Plata I, Argentina	2001	82.6	8 358	2	16.3	3	18	0.5	2	1	2	1	2
Mar del Plata II, Argentina	2001	83.9	8 358	2	16.3	3	18	0.5	2	1	2	1	2
São Paulo, Brazil	2001	70.0	8 311	3	8.6	3	18	0.6	1	3	1	3	2
Ontario, Canada	2002	80.8	45 166	2	9.4	3	19	0.8	2	3	2	2	1
Tlalpan, Mexico	2002	83.3	9 964	4	8.2	3	18	0.8	1	3	1	2	1
Vancouver, Canada	2009	85.8	45 166	2	11.0	2	19	0.8	1	3	2	1	2
Dominican Republic	2010	75.8	4574	2	6.4	2	18	0.3	2	1	1	2	1
Guatemala City, Guatemala	2011	57.0	2 848	4	4.0	2	18	1.0	2	2	1	2	1
Guyana	2010	76.1	1 543	3	9.5	2	18	0.8	2	2	1	2	1
Managua, Nicaragua	2010	46.9	1 228	4	5.4	1	18	0.5	1	2	1	2	1
Panama	2010	69.9	6 793	3	6.9	2	18	0.5	2	2	1	1	1

[a] DDP coded as 1=lowest, …, 4=highest; sanctions against bars serving minor coded as 1=low, 2=medium, 3=high; random alcohol breath testing coded as 1 = "No," and 2 = "Yes"; DUI sanction severity coded as 1 = low, 2 = medium, and 3 = high; severity of off-premise alcohol sales restrictions (including hours and locations of sale) coded as 1= low, 2 = high; bar closing hours coded as 1 = after 2 a.m. or none, 2 = at 2 a.m., and 3 = before 2 a.m.; level of stigmatization of alcohol use coded as 1 = low and 2 = high; data obtained from country collaborators for each ER study for the period when the ER data were collected.

[b] BAC: blood alcohol concentration.

[c] DUI: driving under the influence.

TABLE 2. Number of injured patients and estimates of their acute exposure to and relative risk (RR) and alcohol-attributable fraction (AAF) for injury in 22 emergency department studies across 10 countries in the Americas, 1984–2011

Study	All-cause injury cases					Violence-related injury cases				
	N	Alcohol use in six-hour period before injury (%)	RR of injury	AAF	95% CI[a]	N	Alcohol use in six-hour period before injury (%)	RR of injury	AAF	95% CI
San Francisco, CA, USA	311	0.33	5.92	0.27	0.21, 0.33	91	0.55	10.68	0.50	0.39, 0.60
Contra Costa, CA, USA	616	0.17	3.05	0.12	0.08, 0.15	65	0.46	16.06	0.43	0.29, 0.57
Martinez, CA, USA	406	0.22	3.69	0.16	0.11, 0.20	88	0.41	8.98	0.36	0.24, 0.47
Kaiser (Contra Costa County), CA, USA	193	0.10	1.76	0.04	0.00, 0.09	7	–[b]	–	–	–
Jackson, MS, USA	141	0.28	15.69	0.27	0.19, 0.34	46	0.54	51.65	0.53	0.39, 0.66
Santa Clara, CA, USA	152	0.18	2.64	0.11	0.04, 0.18	23	0.47	28.55	0.46	0.16, 0.66
Mexico City, Mexico	1 034	0.26	17.18	0.24	0.22, 0.27	282	0.53	55.08	0.52	0.46, 0.58
Acapulco, Mexico	271	0.28	22.82	0.26	0.21, 0.32	72	0.50	131.05	0.50	0.39, 0.60
Pachuca, Mexico	486	0.13	17.22	0.12	0.09, 0.14	92	0.37	53.26	0.37	0.26, 0.46
Alberta, Canada	173	0.31	8.86	0.26	0.18, 0.33	24	0.79	903.78	0.79	0.54, 0.90
Quebec, Canada	143	0.13	3.47	0.09	0.03, 0.15	4	–	–	–	–
Mar del Plata I, Argentina	230	0.28	4.34	0.21	0.15, 0.27	42	0.48	5.32	0.39	0.18, 0.54
Mar del Plata II, Argentina	452	0.21	4.47	0.17	0.13, 0.20	53	0.52	21.29	0.49	0.33, 0.61
São Paulo, Brazil	496	0.13	2.34	0.07	0.04, 0.10	43	0.33	5.36	0.26	0.10, 0.40
Ontario, Canada	222	0.06	1.05	0.01	0.00, 0.04	2	–	–	–	–
Tlalpan, Mexico	456	0.17	12.35	0.16	0.14, 0.22	60	0.53	26.33	0.51	0.36, 0.63
Vancouver, Canada	249	0.22	3.65	0.16	0.10, 0.21	20	0.60	46.93	0.59	0.29, 0.76
Dominican Republic	497	0.19	4.33	0.15	0.11, 0.19	83	0.33	7.08	0.28	0.16, 0.38
Guatemala City, Guatemala	513	0.21	17.48	0.20	0.16, 0.23	130	0.43	54.92	0.42	0.33, 0.50
Guyana	485	0.21	3.99	0.16	0.12, 0.19	209	0.30	5.26	0.24	0.17, 0.30
Managua, Nicaragua	518	0.22	9.15	0.18	0.15, 0.22	176	0.37	18.52	0.35	0.27, 0.42
Panama	490	0.21	5.12	0.16	0.12, 0.20	84	0.44	25.42	0.42	0.30, 0.52
Pooled estimates										
Fixed effects				0.14	0.13, 0.15				0.38	0.36, 0.41
Random effects				0.16	0.13, 0.19				0.42	0.37, 0.47
Chi-squared test statistic (degrees of freedom)				$\chi^2_{(21)} = 243.77$; P < 0.001					$\chi^2_{(18)} = 70.96$; P < 0.001	

[a] CI: confidence interval.
[b] Missing data.

TABLE 3. Number of current-drinker injured patients and their acute exposure to and relative risk (RR) and alcohol-attributable fraction (AAF) for injury in 22 emergency department studies across 10 countries in the Americas, 1984–2011

Study	N	Alcohol use six hours before injury	RR for injury	AAF	95% CI[a]	N	Alcohol use six hours before injury	RR for injury	AAF	95% CI
		All-cause injury cases					Violence-related injury cases			
San Francisco, CA, USA	260	0.39	5.92	0.32	0.25, 0.39	79	0.63	10.68	0.57	0.45, 0.68
Contra Costa, CA, USA	484	0.22	3.05	0.15	0.11, 0.19	58	0.52	16.06	0.49	0.36, 0.61
Martinez, CA, USA	341	0.26	3.69	0.19	0.14, 0.24	80	0.45	8.98	0.40	0.29, 0.51
Kaiser (Contra Costa County), CA, USA	153	0.13	1.76	0.05	0.01, 0.11	6	—[b]	–	–	–
Jackson, MS, USA	104	0.38	15.69	0.36	0.25, 0.45	39	0.64	51.65	0.63	0.43, 0.76
Santa Clara, CA, USA	111	0.24	2.64	0.15	0.04, 0.24	17	0.61	28.55	0.58	0.38, 0.79
Mexico City, Mexico	712	0.36	17.18	0.34	0.30, 0.37	232	0.63	55.08	0.61	0.54, 0.67
Acapulco, Mexico	162	0.44	22.82	0.42	0.34, 0.50	51	0.69	131.05	0.68	0.56, 0.79
Pachuca, Mexico	244	0.26	17.22	0.24	0.20, 0.28	59	0.53	53.26	0.53	0.39, 0.63
Alberta, Canada	149	0.33	8.86	0.29	0.21, 0.37	23	0.83	903.78	0.83	0.69, 0.93
Quebec, Canada	127	0.14	3.47	0.10	0.04, 0.16	3	–	–	–	–
Mar del Plata I, Argentina	186	0.33	4.34	0.26	0.18, 0.33	37	0.54	5.32	0.44	0.21, 0.60
Mar del Plata II, Argentina	360	0.25	4.47	0.20	0.15 0.24	47	0.57	21.29	0.54	0.39, 0.69
São Paulo, Brazil	330	0.16	2.34	0.09	0.05, 0.14	32	0.44	5.36	0.36	0.13, 0.52
Ontario, Canada	180	0.08	1.05	0.01	0.00, 0.05	1	–	–	–	–
Tlalpan, Mexico	303	0.24	12.35	0.22	0.17, 0.27	55	0.56	26.33	0.54	0.38, 0.66
Vancouver, Canada	210	0.26	3.65	0.19	0.12, 0.25	18	0.67	46.93	0.65	0.48, 0.82
Dominican Republic	310	0.27	4.33	0.21	0.16, 0.26	69	0.39	7.08	0.34	0.23, 0.45
Guatemala City, Guatemala	292	0.36	17.48	0.34	0.28, 0.40	96	0.58	54.92	0.57	0.46, 0.66
Guyana	356	0.28	3.99	0.21	0.15, 0.26	174	0.36	5.26	0.29	0.21, 0.36
Managua, Nicaragua	222	0.46	9.15	0.41	0.35, 0.47	113	0.58	18.52	0.54	0.43, 0.63
Panama	318	0.29	5.12	0.23	0.17, 0.28	71	0.52	25.42	0.50	0.38, 0.61
Pooled estimates										
Fixed effects				0.19	0.17, 0.20				0.47	0.44, 0.50
Random effects				0.23	0.18, 0.28				0.52	0.45, 0.57
Chi-squared test statistic (degrees of freedom)				$\chi^2_{(21)} = 590.85$; P < 0.001					$\chi^2_{(18)} = 76.78$; P < 0.001	

[a] CI: confidence interval.
[b] Missing data.

TABLE 4. Results of meta-regression analyses predicting *ln*(1–AAF[a]) for all-cause injury among current drinkers in 22 emergency department studies across 10 countries in the Americas, 1984–2011

Variable	Model 1[b]	Model 2[c]	Model 3[c]	Model 4[c]
Gross domestic product	0.056[d] (−0.006, 0.118)	−0.007 (−0.084, 0.070)	0.051[d] (−0.001, 0.101)	0.015 (−0.069, 0.083)
Detrimental drinking pattern	−0.072[e] (−0.118, −0.027)	−0.078[f] (−0.144, −0.013)	—[g]	−0.052 (−0.112, 0.014)
Per capita consumption (liters of pure alcohol)	0.011 (−0.009, 0.034)	–	–	–
Bar sanctions for serving minors	0.125[e] (0.042, 0.208)	–	0.118[e] (0.041, 0.195)	0.095[f] (0.015, 0.175)
Minimum legal drinking age	0.023 (−0.021, 0.078)	–	–	–
Legal BAC[h] for driving	0.009 (−0.311, 0.328)	–	–	–
Random breath testing	0.073 (−0.072, 0.218)	–	–	–
Severity of DUI[i] sanctions	0.049 (−0.051, 0.150)	–	–	–
Off-premise sales restrictions	−0.033 (−0.169, 0.103)	–	–	–
Bar closing hours	0.028 (−0.077, 0.134)	–	–	–
Level of stigmatization of alcohol use	0.069 (−0.062, 0.203)	–	–	–

[a] AAF: alcohol-attributable fraction; ln: Natural log transformation.
[b] Predictors entered marginally.
[c] Predictors entered simultaneously.
[d,] P < 0.10.
[e,] P < 0.01.
[f] P < 0.05.
[g] Not applicable.
[h] BAC: blood alcohol concentration.
[i] DUI: Driving under the influence.

TABLE 5. Results of meta-regression analyses predicting *ln*(1–AAF[a]) for violence-related injury among current drinkers, in 22 emergency department studies across 10 countries in the Americas, 1984–2011

Variable	Model 1[b]	Model 2[c]	Model 3[c]	Model 4[c]
Gross domestic product	−0.065 (−0.201, 0.707)	0.003 (−0.135, 0.142)	−0.061 (−0.173, 0.056)	0.019 (−0.086, 0.124)
Detrimental drinking pattern	−0.066 (−0.169, 0.037)	−[d]	−	−
Per capita consumption (in liters of pure alcohol)	0.004 (−0.035, 0.043)	−	−	−
Bar sanctions for serving minors	0.118 (−0.061, 0.297)	−	−	−
Minimum legal drinking age	−0.004 (−0.101, 0.093)	−	−	−
Legal BAC[g] for driving	−0.315 (−0.846, 0.215)	−	−	−
Random breath testing	0.266[e] (0.061, 0.492)	0.275[e] (0.023, 0.527)	−	0.289[f] (0.109, 0.489)
Severity of DUI[h] sanctions	−0.123 (−0.327, 0.081)	−	−	−
Off-premise sales restrictions	−0.298[e] (−0.547, −0.065)	−	−0.295[e] (−0.532, −0.059)	−0.300[f] (−0.486, −0.114)
Bar closing hours	0.117 (−0.078, 0.313)	−	−	−
Level of stigmatization of alcohol use	0.014 (−0.237, 0.266)	−	−	−

[a] AAF: alcohol-attributable fraction; ln: Natural log transformation
[b] Predictors entered marginally.
[c] Predictors entered simultaneously.
[d] Not applicable.
[e] P < 0.05.
[f] P < 0.01.
[g] BAC: blood alcohol concentration.
[h] DUI: Driving under the influence.

both all-cause and violence-related injuries. However, no economic, drinking culture, or alcohol policy variables were found to be significantly associated with variability in AAF estimates.

DISCUSSION

Pooled estimates from 22 ER studies spread across 10 countries in the Americas indicate that, among the full population, the proportion of all-cause and violence-related injuries attributable to alcohol use is approximately 16% and 42%, respectively. Among current drinkers reporting the consumption of any alcohol in the past 12 months, estimates rose to 23% and 52% respectively. Results from meta-analyses were dramatically different based on whether the full sample or only current drinkers were analyzed. As RR estimates do not vary based on which of the two samples were analyzed, the difference in results is clearly due to differences in acute exposure prevalence rates between the two samples. Examining Tables 2 and 3 reveals that in societies with higher DDP levels (e.g., Mexico), where population abstention rates are higher, differences between acute exposure rates for the full sample and among current drinkers only are typically larger than those for countries with lower abstention rates. Such differential attenuation between acute exposure prevalence rates is also suggested by the difference in the magnitude of the chi-squared test statistic for homogeneity of effect sizes across studies. Traditionally, AAF estimates are formed for the entire population. However, acute alcohol use is a somewhat unique risk factor to which individuals selectively elect to expose themselves, and therefore only a subset of the population—and thus a subset of those experiencing an injury—are candidates for cases in which alcohol can be considered a cause of injury. It is therefore recommended that AAF estimates as well as the relationship between these estimates and other covariates be examined among the population eligible for exposure, as long as it is made clear that inferences are confined to the population of current drinkers.

Among current drinking subgroups only, results from meta-analyses of the relationship between AAF estimates and a number of country-level variables across the 22 ER studies in the Americas indicated several interesting findings. For all-cause injury, higher DDPs were associated with a higher AAF, and greater sanctions against bars for serving minors was associated with a lower AAF. The finding for DDP is not surprising and is supportive of the intended DDP construct itself. Unlike DDP, the mechanism through which the negative relationship between severity of sanctions against bars for serving minors and AAF is operationalized is not entirely clear, as only among a very small proportion of injured patients (and only for samples in the United States) would it be considered illegal for them to to drink in a bar. However, it may be that these types of policies are representative of broader policies or attitudes in a society with regard to serving practices for younger bar patrons (e.g., legal ramifications of serving intoxicated or underage minors and whether bars or servers can be held legally liable for related consequences) (*24*).

For current drinkers with violence-related injuries, higher off-premise sales restrictions and not having random breath testing were associated with higher AAF estimates. That the presence of random breath testing is associated with lower AAF estimates is encouraging, as this measure has been found to be effective in a number of prior studies (*25*) (more so than severity of punishment for DUI offences) (*26*). With regard to off-premise sales restrictions, although prior work has often found more consumption and increased rates of domestic violence and disruptive intoxication with greater availability in terms of when (*27*) and where (*28*) alcohol is sold, findings have not always been consistent across different societies (*29*). One possible explanation for this finding may be that those who wish to drink and are affected by strict off-premise sales restrictions may choose to drink in on-premise establishments such as bars, where the likelihood of a violence-related injury is higher. Similar to prior work (*2*), DDP was a significant predictor of AAF estimates for all-cause injury but not for violence-related injury. However, unlike findings in the prior work, for the present analyses stigmatization of alcohol use was not a predictor of AAF estimates for

either all-cause or violence-related injury. It should also be noted that each of the policy results for both all-cause and violence-related injury remained significant after controlling for a country's level of economic development and DDP, potentially providing positive support for the role of alcohol policy in reducing the burden of disease due to alcohol.

Limitations

A number of study limitations should be noted, especially considering the number of inferences that are made based on the findings. First, the sample of countries used and the ER patient populations in those countries are clearly not representative of population distributions of countries in the Americas (or even of ER patient populations within a specific country). Second, compared to use of last-week drinking as the control period, estimates of standard case-crossover RR of injury based on usual frequency of drinking have been found to over-estimate RRs (*30*), which introduces risk of recall bias and thus potential inflation of AAF estimates. For the current analyses, usual quantity of drinking has also been

incorporated in the last 12 months control period in the RR estimation, which produces RR estimates closer to those produced based on use of last-week drinking as the control period. As data assessing last-week drinking were not available for each of the countries reported on here, the usual frequency case-crossover method was chosen for RR estimation. Finally, RR estimates based on usual drinking behavior over the past 12 months do account for contextual characteristics of the injury event, which are hypothesized to play an important role in alcohol–injury relationships, particularly the level of risk of injury associated with the activities in which an individual engages.

CONCLUSION

Despite the study limitations, this research is the first in the Americas to provide AAF estimates for a large number of countries in the region that could be used to guide local policies and set goals for plans that aim to reduce the global burden related to alcohol consumption in the important area of injury epidemiology. ∎

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CHAPTER 9

Comparison of context of drinking-in-the-event and injury among emergency department patients across 10 countries

Ricardo Orozco and Gabriel Andreuccetti

SUMMARY

The context of drinking, including where drinking takes place and the type of alcoholic beverage consumed, is an important field of study as it may modify drinking patterns as well as risk of alcohol-related injury. This chapter reports the results from 22 emergency department studies in 10 countries in the Americas, including the number and type of drinks consumed during the six hours before injury, the drinking location, and whether or not the patient felt drunk before the event and place of injury. Differences across countries were observed regarding type and quantity of alcohol consumed before the injury event. Although beer was most commonly reported before injury in most countries, spirits, either alone or in combination with beer, were consumed in greater quantities than beer alone. Variation in drinking locations across countries was also found. With some exceptions, restaurants and other drinking establishments were most likely to be reported.

INTRODUCTION

Worldwide, alcohol-related injuries are one of the main public health problems, due to excess mortality, impairment, and disability. In most countries in the Americas, the pervasiveness of alcohol sales and cultural permissiveness contribute substantially to this burden. Study of the context in which drinking occurs is important as it may contribute key information about associated factors that can be modified through public policies (such as bar closing hours, law enforcement for drink-driving, etc.).

The context of drinking in the general population is variable across countries, as are the laws that frame consumption. For example, the legal age for drinking is not consistent throughout the countries in the Americas (in the United States it is 21 years old, whereas in most Latin American countries it is 18). Laws and public policies on drink-driving and alcohol consumption in public places, among others, vary even more from country to country (*1*).

Beyond laws and public policies, each culture's attitudes and level of permissiveness toward alcohol use and misuse help determine the context and in many cases the volume of alcohol consumed. Therefore, the risk behaviors are entangled. For example, even though Argentina has had had its "National Law of the fight against alcoholism" (no. 24.788) forbidding alcohol consumption in the streets since 1997, drinking in the streets is more frequent than drinking in restaurants, mainly among young men (*2*). As described by Carlini-Marlatt et al. in their research on drinking practices, "Alcoholic beverages are commercialized like any other manufactured product… [and] can be purchased and consumed at any time of the day of the week in parks, beaches, roads, streets, restaurants, bakeries, gasoline stations, schools and hospital surroundings" (*3*). This scenario exists in most countries south of the United States border.

The link between drinking context and injury has been studied in several countries. No association has been found between drinking setting and part of body injured (*4*), but a relationship has been observed between injury context and impairment caused by alcohol consumption (i.e., blood alcohol concentration (BAC) of at least 80 mg%). Those injured at a bar or

restaurant more likely to be impaired by alcohol, and those injured at school or the workplace are less likely to be alcohol-impaired. In addition, compared with the latter group, up to six times as many people injured in vehicles, streets, or highways were impaired by alcohol (*5*). This chapter describes the differences in drinking context and injury across 10 countries in the Americas, based on results from emergency department (ED) studies from the Americas region, including the number and type of drinks consumed before injury, the drinking location, and whether or not the patient felt drunk before the injury event.

METHODS

As described in Chapter 5, the data used to analyze drinking context came from 22 studies that followed protocols similar to those used in the Emergency Room Collaborative Alcohol Analysis Project (ER-CAAP), the World Health Organization (WHO) Collaborative Study on Alcohol and Injury, and the Pan American Health Organization (PAHO) Collaborative Study. The studies were conducted between 1984 and 2011 in 10 countries in the Americas.

Measures

After obtaining informed consent, patients were given a 25-minute questionnaire that collected data on the type of alcoholic beverages consumed during the six hours before injury (beer, wine, spirits, and/or locally produced beverages); the number of drinks and drink size for each beverage type; whether the respondents felt even slightly drunk at the time of the injury event, the place where it occurred, and any places where the patient had been drinking during the six hours before injury, among other items.

The number of drinks consumed before injury was computed by calculating total absolute alcohol (in ml) for each beverage type, taking the drink size into account, and summing across beverage types for a total volume of consumption. The total sum was then divided by 16 (the number of ml in a standard drink) to obtain the total number of standard drinks consumed per patient.

Answers to pre-coded questions regarding the location where the injury occurred were grouped into five mutually exclusive categories: "home or other's house"; "workplace or school"; "restaurant, bar, or drinking place"; "motor vehicle, street, or highway"; and "other (including other public settings)." Using the same system, answers to pre-coded questions regarding all places where the patient had been drinking before the injury were grouped into seven non-mutually exclusive categories: "own home"; "home or residence of other"; "restaurant, bar, pub, hotel, or other drinking place"; "workplace"; "motor private vehicle"; "street, parking lot, outdoor, public place"; and "other."

Data analysis

Descriptive statistics were calculated for each country. Means, medians, and log transformations of the number of drinks were computed to summarize alcohol intake by country. As the distribution of the quantity of alcohol consumed was skewed and bounded by zero, it was transformed to the log scale for different types of analysis.

Gender differences for alcohol consumed before injury were assessed with simple linear regression, with the log-number of drinks modeled as the dependent variable and gender as the independent variable (Table 1). To test for differences in place of injury among those who did and did not drink alcohol before injury in each country, chi-squared tests were performed between alcohol use before injury and injury place (Table 2). Among those who drank alcohol during the six hours before injury, a chi-squared test was performed for a given place of drinking across all countries (Table 3).

Bar and scatter plot graphs were created to facilitate visualization and interpretation of the findings.

Analyses were performed separately for males and females when possible (due to sample size considerations this was not possible for all variables analyzed).

RESULTS

Overall, about 20% of the ED patients reported drinking in the six hours before injury (Table 1). The

TABLE 1. Amount of alcohol consumed before injury, by sex, based on patient self-report from 22 emergency departments in 10 countries in the Americas, 1984–2011

| Country | *n* | % drinking before injury | Amount consumed before injury (number of standard drinks[a]) | | Gender difference (log scale) |
			Mean	Median	P
Argentina	682	25.7	5.3	3.0	0.002
Brazil	496	12.8	6.1	3.3	0.323
Canada	787	17.7	7.0	4.0	0.002
Dominican Republic	497	19.3	19.5	10.2	0.085
Guatemala	513	21.1	9.3	6.3	0.176
Guyana	485	21.0	8.9	5.2	0.144
Mexico	2 247	23.4	15.9	7.2	0.315
Nicaragua	518	21.5	26.3	13.3	0.100
Panama	490	20.8	10.2	6.2	0.001
United States	1 819	21.3	5.5	3.0	< 0.001

[a] One standard drink = 16 ml of total absolute alcohol

FIGURE 1. Type of beverage consumed before injury among those who consumed alcohol six hours before injury
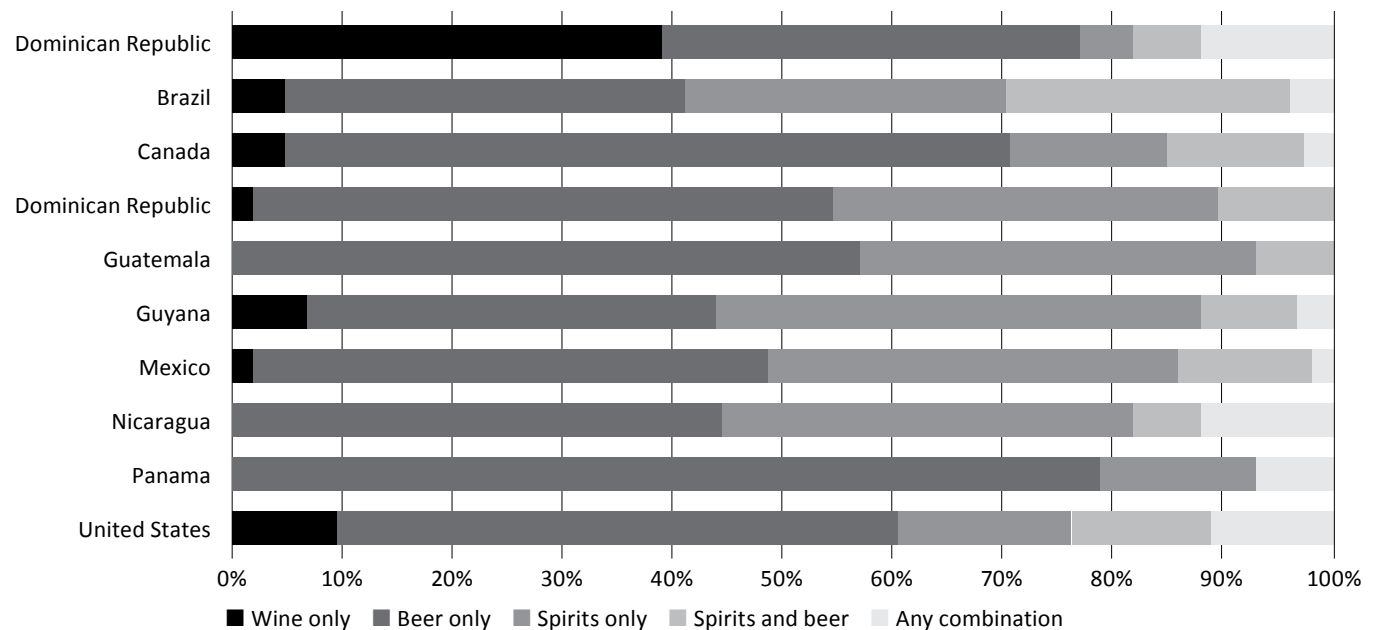
mean number of standard drinks varied considerably across countries, ranging from 5.3 in Argentina to 26.3 in Nicaragua. Due to the skewed distribution of number of drinks, the median number of drinks is also shown in Table 1. Although the median number of drinks is only about half the mean number, for all countries, relative positions across countries are almost the same. Linear regression P values for coefficients of gender differences by country are shown in the last column of the table. Significant statistical

differences in the log-volume of drinks consumed before injury were observed in Argentina, Canada, Panama, and the United States, where males reported a significantly higher consumption of alcohol before injury than females (P < 0.05).

As shown in Figure 1, among those who consumed an alcoholic beverage before injury, beer was the beverage most commonly reported across all countries, with the exception of Argentina and Guyana, where

wine and spirits were most likely to be reported, respectively. A combination of beverages was most likely to be reported in Argentina, Brazil, and the United States, with almost 25% reporting this type of drinking behavior. The final bars in the graph show that in the remaining countries only about 10% reported a combination of beverages, with spirits and beer being most commonly reported.

Although beer was the most commonly reported beverage consumed before injury, the median number of drinks for beer was relatively low in most countries compared to other beverages such as spirits or a combination of beverages. Among those consuming beer only, the median number of drinks varied from two in the United States to almost six in the Dominican Republican, and the median number of drinks for those consuming only spirits ranged from three drinks in Argentina and the United States to 29 in Nicaragua, with an even larger median number of drinks reported by those who also reported consumption of beer and spirits together (Figure 2).

A greater proportion of both females and males tended to report feeling at least a little drunk before injury with a larger number of drinks consumed

(Figure 3). In the United States, the median number of drinks among females was two (i.e., half of them drank at least two drinks), and only 18% of the females reported feeling drunk in the event, regardless of the number of drinks consumed. In contrast, 77% of the males in Nicaragua reported feeling drunk, with a median of 13 drinks before injury. Furthermore, female patients in Guatemala were more likely to report drunkenness (90%) compared to females from Mexico (52%), even when the median number standard drinks consumed before injury in both countries was five.

Differences regarding the place where the injury occurred between patients who did and did not consume alcohol before injury (Table 2) were observed in all the countries (P < 0.001 for all countries). Overall, those who did not report drinking were more likely to be injured in their own homes (or other people's houses) and at work or school, while those who reported drinking were less likely to be injured in those settings and more likely to be injured in public places, in motor vehicles, or on the street or highway, as well as in restaurants or other drinking venues.

FIGURE 2. Number of drinks before injury, by country and type of beverage

■ Wine only ■ Beer only ■ Spirits only ■ Spirits and beer ■ Any combination
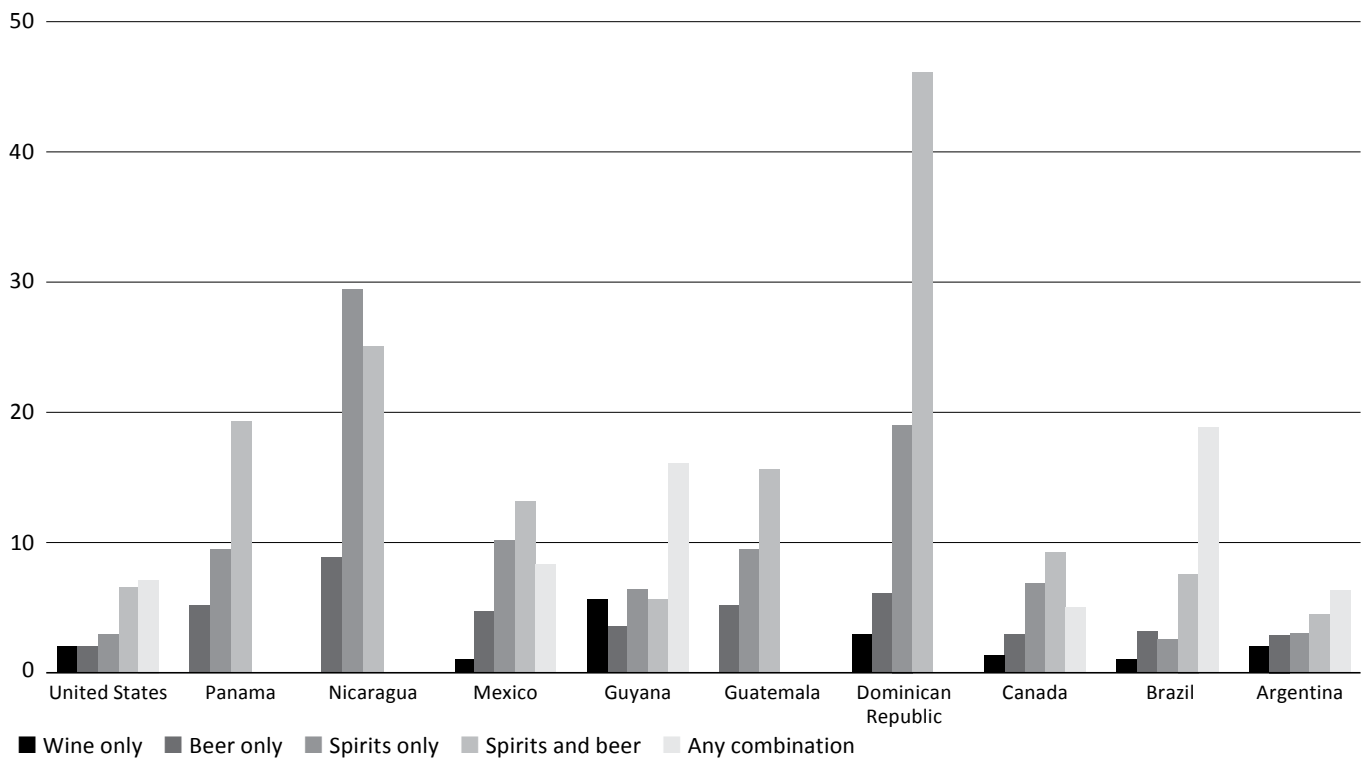
FIGURE 3. Feeling drunk at the event and number of drinks among those who consumed alcohol six hours before injury, by gender and country

◆ Males ■ Females
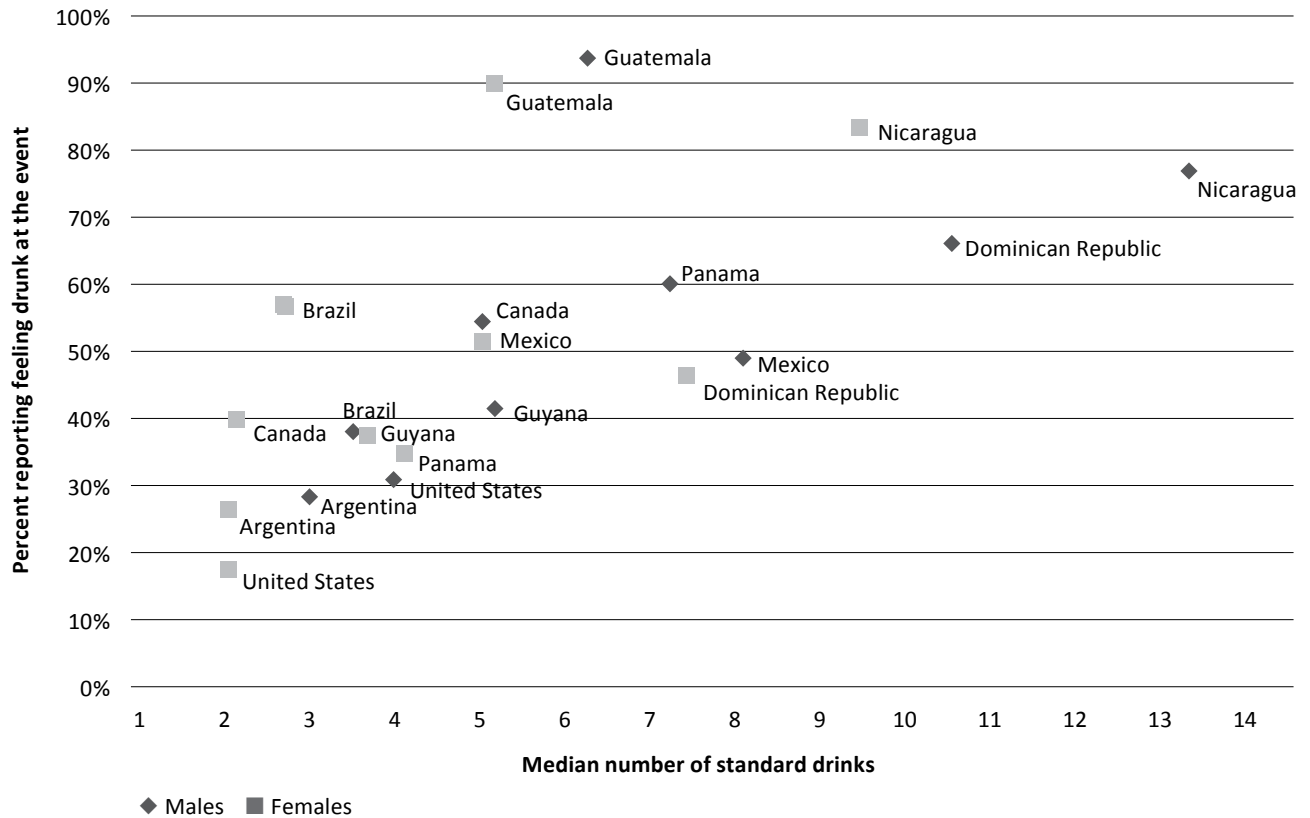
TABLE 2. Place of injury, by country, and alcohol consumption six hours before injury ("Yes"/"No") (%), based on patient self-report from 22 emergency departments in 10 countries in the Americas, 1984–2011

Country	Place of injury									
	Home or other's house		Workplace or school		Restaurant, bar, or other drinking place		Motor vehicle or street / highway		Other (including other public settings)	
	Alcohol use before injury		Alcohol use before injury		Alcohol use before injury		Alcohol use before injury		Alcohol use before injury	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Argentina	30.9	23.4	16.5	7.2	0.0	6.6	29.3	38.3	23.3	24.6
Brazil	18.8	13.0	34.8	22.2	0.7	7.4	36.9	51.9	8.8	5.6
Canada	29.0	33.6	25.8	3.7	2.0	17.2	12.7	13.4	30.5	32.1
Dominican Republic	23.6	21.2	18.1	2.4	3.0	20.0	28.4	29.4	26.9	27.1
Guatemala	24.2	15.7	25.2	3.7	1.0	22.2	10.7	11.1	38.9	47.2
Guyana	31.6	37.8	16.8	4.1	1.1	11.2	2.5	5.1	48.1	41.8
Mexico	29.2	20.1	23.7	7.2	0.1	5.8	37.9	60.8	9.1	6.0
Nicaragua	34.4	29.0	13.0	6.0	1.6	15.0	10.4	5.0	40.6	45.0
Panama	37.9	35.2	27.5	9.1	0.6	11.4	10.7	18.2	23.4	26.1
United States	35.0	43.0	26.4	5.0	0.8	5.0	25.3	32.7	12.6	14.3

TABLE 3. Drinking places frequented during six-hour period before injury, by country (%), based on patient self-report from 22 emergency departments in 10 countries in the Americas, 1984–2011[a]

Country	n	Own home	Home or residence of other	Restaurant, bar, pub, hotel, or other drinking establishments	Workplace	Motor, private vehicle	Street, parking lot, outdoors, public place	Other
Argentina	163	37.4	28.2	28.2	7.4	0.6	11.7	3.1
Brazil	55	14.5	5.5	63.6	7.3	0.0	10.9	1.8
Canada	133	24.8	15.8	43.6	5.3	0.8	12.0	9.8
Dominican Republic	85	15.3	17.6	42.4	3.5	2.4	14.1	9.4
Guatemala	108	8.3	10.2	66.7	4.6	0.9	10.2	0.9
Guyana	98	13.3	17.3	45.9	3.1	0.0	15.3	6.1
Mexico	489	15.7	24.7	21.7	8.2	3.1	22.7	4.6
Nicaragua	101	19.8	20.8	25.7	5.0	0.0	13.9	15.8
Panama	88	22.7	17.0	34.1	11.4	1.1	14.8	5.7
United States	365	32.4	23.5	19.8	3.3	3.8	20.0	0.0

[a] Total row percentages may sum more than 100% where patients listed more than one drinking place visited before injury.

Finally, places of drinking before injury varied across countries (P < 0.05, for all places). For example, while only 8.3% of respondents drank in their own homes in Guatemala, up to 37.4% did so in Argentina (Table 3). With a few exceptions (Argentina, Mexico, and the United States), the most common places for drinking were restaurants, bar, pubs, or other drinking establishments (from 19.8% to 66.7.%), followed by private residences (the drinker's home or someone else's), and the street, parking lots, or outdoor and public places (ranging from 5.5% in Brazil for private residences to 22.7% in Mexico for the street, parking lots, or outdoor or public places).

DISCUSSION

A number of differences were found regarding drinking context before injury in the Americas. For the most part, countries in the Latin America and Caribbean region were more likely to report larger amounts of alcohol consumed in the six hours before injury than other countries in the Americas. The pattern regarding type of alcoholic beverage consumed before injury also varied, and appeared to be different in Argentina compared to other countries in the region. For example, Argentina was the only country where wine was

the predominant beverage consumed. In addition, along with the United States, Argentina reported the lowest median number of drinks consumed before the injury event for any single beverage or combination of beverages. This may be due to various aspects of Argentine culture that integrate alcohol into daily life more than in other countries of the region, such as drinking with meals (2).

In all countries in the region, there was a positive association between the number of drinks consumed before injury and the likelihood of drinkers reporting feeling at least slightly drunk at the time of injury. In most countries, the median number of drinks for both females and males fell well above the National Institute on Alcohol Abuse and Alcoholism (NIAAA, Washington, USA) threshold for binge drinking—four drinks for females and five for males (6)—with Argentina, Brazil, and the United States the only countries where the alcohol consumption of half the injury patients (both male and female) in the six hours before the injury event was under the recommended limit.

Some research has suggested that patients' causal attribution of their injury to drinking is related to the feeling of drunkenness at the time of the event

and to the detrimental drinking pattern (DDP) of the country (*7*). The DDP is an aggregated measure of three indicators that affect the impact of a given volume of alcohol consumption in the general population: heavy drinking occasions, drinking with meals, and drinking in public places (*8–10*). In the current study, variation in the proportion of drinkers who reported feeling drunk across countries despite a similar median number of drinks before injury (e.g., Mexican versus Guatemalan females) might be explained in part by the causal attribution of injury to alcohol consumption but is not likely to be due to differences in DDP, as most countries in the sample have similar drinking patterns. However, further research is needed to ascertain this.

Variation was also observed across countries in places of drinking before injury. Once again, Argentina and the United States differed from the other countries in the region, with 60% of injury patients in those countries reporting drinking in private residences (either their own someone else's) while the majority of people in the other countries reported drinking in public places or drinking establishments. Even though most drinking in the region takes place in restaurants or other drinking establishments (from 19.8% in the United States to 66.7% in Guatemala), only a small percentage of the injuries in the region (among those drinking before the injury) occur in those places (from 5% in the United States to 22% in Guatemala). A high proportion of injuries occur in motor vehicles or the street (up to 60.8%), suggesting the need to reinforce public policies such as those aimed to reduce drinking and driving and bar service hours and similar initiatives in the region (*11*).

Limitations

This analysis has several limitations. First, data collection took place from 1984 (in the United States) to 2011 (in Guatemala). Therefore data comparisons should be made with caution, especially with regard to countries where the earlier studies took place, where the analyzed variables related to drinking context may no longer be valid due to new laws, or changes in attitudes and behaviors. Second, in the analyses of drinking places and injury occurrence, the types of places being compared were not always the same across studies so often had to be grouped into broader categories. This precluded the analysis of some specific settings (e.g., "own home only" or "bar only"). Despite these limitations, the current findings suggest that drinking context may play an important role in drinking before an injury event. Future studies should consider the gender-specific context of drinking and injury to better explain the alcohol-injury relationship in the region of the Americas. ∎

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CHAPTER 10

Comparison of demographic characteristics as predictors of alcohol use and injury by country-level income

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SUMMARY

This chapter reviews the data on the association between demographic characteristics and alcohol use before injury for emergency department (ED) patients in 10 countries in the Americas collected from ED studies. Using World Bank income indicators to examine alcohol use and injury, ED patients in lower-middle-income countries (Guatemala, Guyana, and Nicaragua) and upper-middle-income countries (Argentina, Brazil, the Dominican Republic, Mexico, and Panama) were no different than patients from the high-income countries (Canada and the United States) in their likelihood to report an alcohol-related injury. However, different patterns emerged when gender and current drinking status were considered. Male ED patients showed no significant differences between country income groups overall but when men that were current alcohol users were compared, men in the lower-middle-income countries were 60% more likely to report an alcohol-related injury compared to men in the high-income countries. Conversely, women from high-income countries were nearly twice as likely to report an alcohol-related injury event compared to women lower-middle and upper-middle income groups overall yet, when women that were current users of alcohol were compared, no significant differences were evident between the groups. Overall, an alcohol-related injury was more likely to be reported by men regardless of country income level but other demographic predictors of alcohol-related injury (age, education, and employment) differed by country income group. Findings suggest there are important differences in the alcohol-injury association by country level economic development, and differentially by gender, underscoring the need for a cross-country and gender-focused perspective.

INTRODUCTION

Alcohol consumption is closely tied to social norms and expectancies that dictate how and who may drink and when it is socially acceptable to do so. These standards can vary by a multitude of factors depending on the personal and socio-cultural expectations placed on individuals (*1*), and therefore sex, age, socioeconomic background, and cultural environment may all play a role in the likelihood of alcohol-related injuries. While countries such as Canada and the United States have a substantial body of literature on demographic and socio-cultural characteristics associated with alcohol-related injuries (*2–8*), research in many developing countries in the Latin America and Caribbean (LAC) region is scarce (*9*).

Latin American countries have seen a shift in drinking habits in the past several decades. Changing societal roles in some regions are reflected in an increase in drinking among the elite and middle classes, symbolizing economic prosperity and rejection of older, established cultural norms of drinking (*10–12*). This is demonstrated in the increase of Brazilian and Mexican urban female college students drinking alcohol (*12–14*). However, attainment of higher socioeconomic status (SES), as shown by income or education, is not necessarily indicative of a higher incidence of problematic drinking or injury due to alcohol (although it may be an indicator for alcohol consumption), with the undesirable effects

of alcohol consumption such as abuse and injury more likely to increase with lower SES (*15, 16*).

General population studies in the United States have demonstrated a positive relationship between income and hazardous use of alcohol (*17*) but a negative association between income and alcohol dependence (*18*). The latter association is supported by a study of major injuries in Canada and the United States, where lower income, less education, and higher unemployment were indicative of receipt of emergency care (*19*). Injury related to alcohol is also reflected in gender and education, both of which play a role in the type and degree of an injury (*20–22*).

Men under the age of 30 represent the highest proportion of patients entering emergency departments (EDs) with alcohol-related injuries (*2, 22*). Age of the patient presents a particular concern for LAC countries where approximately a third of the population falls between the ages of 10–29 years old (*23*), critical ages for initiation of drinking and establishing drinking habits throughout adulthood. Younger generations will frequently act as a vanguard for changing societal expectations and may seek out drinking customs dissimilar to previous generations (*11, 24*). For example, Argentina's culture has had a strong Spanish influence, characterized traditionally by a Mediterranean style of drinking (i.e., moderate daily consumption of alcohol with meals), a pattern of consumption less associated with problematic drinking (*25*). This Mediterranean pattern of drinking has changed, however, with younger generations preferring a style of heavy episodic weekend drinking, a drinking style which has been found to be associated with admission to the ER for an alcohol-related injury (*26*). In addition, there is evidence that as the roles of men and women in younger generations converge, there is also a convergence of drinking styles (*17, 27*).

This chapter reviews the data on the association between demographic characteristics and alcohol use before injury in 10 countries in the Americas, using data from ED patients described in Chapter 6. While it is well established that gender plays a significant role in alcohol-related injury (see Chapter 3 of this book), there is a paucity of gender-disaggregated information, especially for LAC countries (*28*).

Therefore, the current analysis of the data includes gender as well as current drinking status.

METHODS

The member states and territories of the Pan American Health Organization (PAHO) comprise tremendous variation in social and demographic characteristics.[1] Because of this variability, data for the 10 countries included in this overview are analyzed by level of country income, based on World Bank indicators.[2] The World Bank derives these classifications using the gross national index (GNI) as its primary measure. The GNI is the dollar value of a country's final income in a year and is the sum of personal consumption expenditures, gross private investment, government expenditures, product taxes, and net receipts of primary income from abroad after deducting gross imports from goods and services and indirect business taxes. The GNI is used because it is a general indicator of the social and economic well-being of a country, with higher GNI representative of longer life expectancies, higher literacy rates, and lower infant mortality. The countries included in the current analyses are defined as lower-middle-income (Guatemala, Guyana, and Nicaragua); upper-middle-income (Argentina, Brazil, the Dominican Republic, Mexico, and Panama); and high-income (Canada and the United States). Data analyzed come from the ERCAAP, WHO, and PAHO data sets described in Chapter 5 of this book. All analyses were conducted using SPSS Statistics version 17 (SPSS, Armonk, NY, USA). Chi-squared tests were used to analyze significant differences in demographic characteristics (Table 1) and the percentage of patients drinking before the injury event (Figure 1). Logistic regression models were used to predict drinking before the injury event (Tables 2 and 3).

RESULTS

Demographic characteristics for all injury patients are presented in Table 1. Patients in lower-middle-income countries (Guatemala, Guyana, and Nicaragua) were less likely to be current drinkers compared to

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[1] http://www.paho.org

[2] http://data.worldbank.org/country

TABLE 1. Demographic characteristics of injury patients (*n* = 8 538) by level of income of their country of residence (%), 10 countries in the Americas.[a]

| | Income level of injury patient's country of residence | | | | | | | | |
| | Lower-middle (n = 1 516) | | | Upper-middle (n = 4 416) | | | High (n = 2 606) | | |
Injury patient characteristic	Men	Women	Total	Men	Women	Total	Men	Women	Total
Current drinker	71.3	32.0	59.6	79.9	50.5	71.1	85.9	76.3	82.4
Sex	70.3	29.7	[b]	69.4	30.6	–	62.7	37.3	–
Age < 30 years old	52.7	36.0	47.7	55.5	43.5	51.9	47.7	41.5	45.3
Some college education	20.2	20.5	20.3	14.3	16.8	15.1	45.9	48.9	47.0
Employed ≥ 30 hours per week[c]	84.0	50.7	74.1	83.1	50.3	72.5	71.5	58.9	66.9

[a] All chi-squared comparisons between income groups are significant at P < 0.001.
[b] N/A.
[c] Employment information was not available for the Dominican Republic.

TABLE 2. Logistic regression models of demographic characteristics of injury patients predicting drinking in six-hour period before injury event, by country-level income, 10 countries in the Americas.

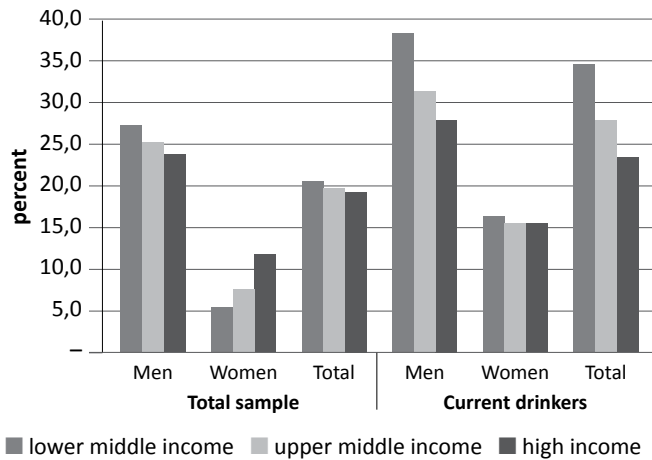| | Level of income of country of residence | | | | | | | | | | | |
| | Lower-middle | | | | Upper-middle | | | | High | | | |
| | All patients (n = 1 454) | | Current drinkers (n = 853) | | All patients (n = 3 663) | | Current drinkers (n = 2 520) | | All patients (n = 2 483) | | Current drinkers (n = 2 043) | |
Injury patient characteristic	OR[a]	95% CI[b]	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Male	6.5***	4.1, 10.2	3.3***	2.0, 5.3	4.4***	3.4, 5.6	2.7***	2.1, 3.5	2.6***	2.0, 3.3	2.3***	1.8, 3.0
Age < 30 years old	0.9	0.7, 1.2	0.8	0.6, 1.1	1.3**	1.1, 1.5	1.1	1.0, 1.4	1.3**	1.1, 1.6	1.1	0.9, 1.4
No college education	1.5*	1.1, 2.2	1.8**	1.2, 2.6	1.2	0.9, 1.5	1.3	1.0, 1.6	1.2*	1.0, 1.5	1.4**	1.1, 1.7
< Full-time employment	0.8	0.6, 1.2	1.0	0.7, 1.5	0.9	0.7, 1.1	1.0	0.8, 1.2	1.9***	1.6, 2.4	2.1***	1.7, 2.7

[a] OR: odds ratio.
[b] CI: confidence interval.
* P < 0.05; ** P < 0.01; *** P < 0.001

**FIGURE 1. Percent of patients reporting any alcohol in the 6 hours prior to the injury**

women displayed some demographic differences by income category. More women in high-income countries were < 30 years old (P < 0.05) and employed full-time (P < 0.001) compared to lower-middle- and upper-middle-income countries.

Figure 1 displays percentage rates of alcohol consumption in the six hours before injury by country income and sex, for the total sample and for current drinkers (patients at risk for incurring an alcohol-related injury). Women in the lower-middle-income countries reported the lowest rates of alcohol consumption before the injury (5.3%), with rates more than doubling among women in high-income countries (11.7%); however, when only current drinkers are considered, no significant differences are found across country-level income groups: 16.2% for lower-middle-income, 15.2% for upper-middle-income and 15.4% for high-income countries. Men display a different pattern with no significant differences across country-level income groups for the total sample, but among current drinkers rates are significantly higher in the lower-middle-income countries (38.3%), compared to upper-middle- (31.4%) and high-income (27.7%) countries, using chi-squared comparisons.

upper-middle- (Argentina, Brazil, the Dominican Republic, Mexico, and Panama) and high-income (Canada and United States) countries. Similar to other international studies on injury patients presenting to the ED, there is a predominance of men, with slightly more gender equity in the high-income countries. Young age (< 30 years old) was evident across all income categories, with a slightly older age for patients from high-income countries. Patients from lower- and upper-middle-income countries had significantly lower rates of a college education and somewhat higher rates of employment compared to patients from high-income countries. All chi-squared comparisons between country-level income groups were significant at P < 0.001. Comparisons of men across the income groups were also highly significant, with all comparisons at P < 0.001, however,

Demographic predictors of alcohol use before the injury

Table 2 displays the odds ratios (ORs) for each demographic predictor of alcohol-related injury for each of the country-level income groups, and Figure 2 is a graphic depiction of the significant predictors reported in Table 2. Although most demographic character-

FIGURE 2. Graphic depiction of significant demographic characteristics of 1) all injury patients (*n* = 8 538) and 2) current drinkers, by country-level income, in 10 countries in the Americas.
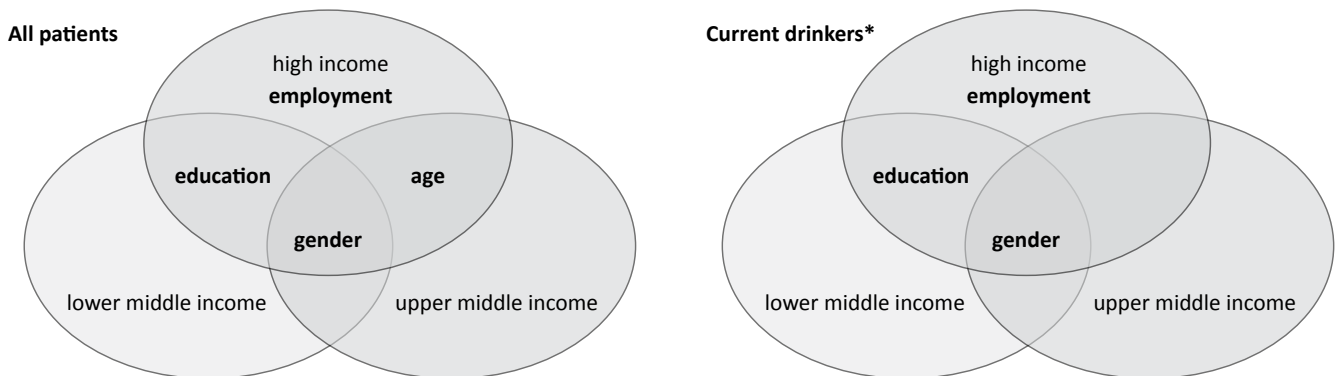
* Age not a significant predictor

TABLE 3. Logistic regression models predicting drinking during the six hours before injury, by sex, and total sample for all injury patients and for current drinkers, 10 countries in the Americas.

| | Men[b] | | | | Women[b] | | | | Total sample[c] | | | |
| | All men (n = 5 032) | | Men drinkers (n = 3 995) | | All men (n = 2 568) | | Women drinkers (n = 1 421) | | Total sample (n = 7 600) | | All current drinkers (n = 6 106) | |
Country-level income[a]	OR[d]	95% CI[e]	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Lower-middle	1.1	0.9, 1.4	1.6[f]	1.3, 1.9	0.4[f]	0.3, 0.7	1.0	0.6, 1.6	1.0	0.8, 1.1	1.4[f]	1.2, 1.7
Upper-middle	1.1	0.9, 1.3	1.2[g]	1.0, 1.4	0.6[h]	0.4, 0.8	0.9	0.6, 1.2	0.9	0.8, 1.1	1.1	1.0, 1.3

[a] Reference = high income.
[b] Model controls for age, education, and employment.
[c] Model controls for sex, age, education, and employment.
[d] OR: odds ratio.
[e] CI: confidence interval.
[f] $P < 0.001$.
[g] $P < 0.05$.
[h] $P < 0.01$.

istics varied by country-level income and by current drinker status, gender was significant for all groups, with men nearly three times more likely to report drinking before injury in the high-income group and over six times more likely in the lower-middle-income group compared to women. These odds decreased somewhat among current drinkers, but maintained significance. Other demographic characteristics varied by income group with fewer significant predictors for lower-middle and upper-middle income groups compared to the high-income group. Only a lack of a college education was predictive for lower-middle-income countries, while being under age 30 was predictive for upper-middle-income countries for the total sample (but not for current drinkers). Significant demographic predictors of an alcohol-related injury for high-income countries were being male, age, education, and employment, but only sex, education, and employment were predictive among current drinkers.

Country income as a predictor of alcohol-related injury

Controlling for sex, age, education, and employment, country-level income group was not a significant predictor of an alcohol-related injury for the total sample, but among current drinkers, those from lower-middle-income countries were 40% more likely to report having consumed alcohol before the injury compared to those from high-income coun-

tries. No difference was found for upper-middle-income countries.

Gender-disaggregated findings in Table 3 show that after controlling for age, education, and employment, only a modest difference for male current drinkers is evident between upper-middle- and high-income groups (OR = 1.2, P < 0.05), with a larger difference between lower-middle- and high-income countries (OR = 1.6, P < 0.001). Women show a very different pattern from men. Similar to the bivariate comparisons reported in Figure 1, lower-middle-income and upper-middle-income women were significantly less likely to report alcohol use before the injury compared to those from high-income countries. However, current drinkers showed similar rates of alcohol use before injury across country-level income groups. Models with interaction terms between age and education were also conducted and were not significant for either sex or the total sample (results not shown).

DISCUSSION

Demographic characteristics as predictors of alcohol-related injuries by country-level income

Among demographic characteristics examined, sex appeared to be the strongest predictor of alcohol-related injury across country-level income

groups. Being male increased the probability of an alcohol-related injury in each of the three income groups, among all patients and among current drinkers. This result confirms a well-known association: not only do males tend to consume greater amounts of alcohol than females (*29*) but they also exhibit higher risk behaviors that could lead to injury, such as impaired driving (*29–31)*. Surprisingly, there were no significant differences across the three country income groups in the proportion of male patients who had been drinking in the six hours before injury among all patients. However, there were differences across the three income groups with regard to current drinkers. More extensive examination of drinking practices (e.g., pattern and context) and how these factors interact with gender is needed but is beyond the scope of this chapter.

Other demographic characteristics examined (age, education, and employment) were neither strong nor consistent predictors of alcohol-related injury among the three country-level income groups, although all were predictive in the high-income group. These predictors have traditionally been identified in the literature as being associated with both injury and drinking, which may reflect the fact that most of the reported studies have come from high-income countries.

Young age (< 30 years old) was a weak predictor of alcohol-related injury only in the upper-middle- and high country-level income groups, and only when all patients were considered. Among current drinkers, age was no longer predictive by these income groups, possibly reflecting a tendency of young people to be drinkers and to have an injury even when alcohol was not involved. These findings are supported by a U.S. study that found young drivers to be less involved in alcohol-related crashes than older drivers but more involved in alcohol-free crashes (*31*).

Having less than a college education was associated with alcohol-related injuries in the lower-middle- and high-income countries among all patients and among current drinkers, although the lower limits of the 95% confidence intervals close to 1 in

the high-income countries suggest it is a weak predictor. Surprisingly, there was a higher prevalence of patients in the lower-middle-income group versus the upper-middle-income group with at least some college education. The percentage was largely skewed by Guyana, where more than one-third (38%) of the patients reported having at least some college education, versus Guatemala and Nicaragua, which had much lower percentages for this factor (8% and 17% respectively).

Low education has been found to be associated with unhealthy behaviors, including risky alcohol consumption (*32*). Furthermore, some studies have found better educated drinkers tend to drink more frequently but in smaller quantities, perhaps diminishing their risk of alcohol-related injury (*33*). Findings here of lower education being predictive of alcohol-related injuries in lower-income countries support previous findings of important variations in the association between education and alcohol problems (including self-reported injuries) found in cross-country comparisons (*34*).

Finally, employment was a significant predictor of alcohol-related injury only in the high-income group and, after sex, was the most important predictor, doubling the odds of an alcohol-related injury for those with less than full-time employment. This finding is in agreement with previous reports from high-income countries such as the United States, where unemployment has been associated with health risk behaviors, such as impaired driving (*31*).

Education and employment have been considered indicators of individual socioeconomic status (SES). However, small area SES, as typified by small geographic areas with similar population attributes such as economic status and living conditions, was not considered in these analyses. There is some evidence that substance use outcomes cluster by geographic area, and that area-level SES might interact with individual SES (*35*) and large-area SES, including macroeconomic trends (*36*) and income inequalities. Variations in reports in the literature have also been related to the different measures of SES used (*37*). The results reported here showing less than a college education as a characteristic as-

sociated with alcohol-related injuries in lower-income countries and less than full-time employment as a characteristic associated with alcohol-related injury in high-income countries suggest that both measures are capturing a distinct dimension of SES. Among diverse measures of SES, education has been found to be the factor most consistently related to injury and to health status in general (*30*). The data reported in this chapter support the notion that the same dimension may hold distinct meanings or behave divergently in different countries. For example, the education gradient may vary between countries. Additionally, completing 12 years of education may be sufficient to obtain gainful employment and career placement in some countries, whereas it would be insufficient in others. Moreover, being under-employed may hold a particular meaning in a prosperous economy as opposed to a depleted one (*36, 38*).

Country income as a predictor of alcohol-related injury

The data presented in this overview indicate that in the total sample, current drinkers in the lower-middle-income group had a higher probability of an alcohol-related injury than current drinkers in the other country income groups, and among males, current drinkers had a higher probability in both the lower-middle and upper-middle income groups compared to those in the high-income group. The findings that indicate a higher probability of alcohol-related injuries in lower-income countries correspond with the general findings of worse health status and higher rates of risky drinking among those with low SES at both the individual and area level (*35, 38*). Conversely, females in the lower-middle and upper-middle income groups had a decreased probability of alcohol-related injury compared to those in the high-income group. However, when only women drinkers are considered, belonging to a lower-income group was

no longer a protective factor. It is possible that women in lower-middle and upper-middle income countries who chose to drink are drinking in patterns similar to that of women in high-income countries, thus resulting in similar risk of injury, but further study of the drinking patterns of women in these regions is needed to verify this supposition.

Limitations

The data presented here had several limitations. First, GNI was used to classify the 10 countries. Although GNI can be regarded as an indicator of the developmental status of a country, it is a limited measure that excludes other dimensions that should be considered in a more exhaustive analysis, such as income disparity/inequality, macroeconomic trends, socio-cultural context, and lifestyle. The scope of the data was also limited in that it only included demographic characteristics of injured patients across different country-level income categories, while other important factors related to drinking and injury that might be expected to vary by country income, such as pattern and context of drinking, as well as type and cause of injury, were not considered. However, these factors are covered in other parts of this book.

CONCLUSIONS

The findings reported here suggest important differences in the alcohol–injury association according to a country's level of economic development, and differentially by sex, thus underscoring the need for a cross-country and gender perspective. While the associations between injury and demographic characteristics by country income level that are explored here are worthy of consideration, examination of a broader spectrum of the causal link between drinking and injury would be advantageous. ■

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CHAPTER 11

Drinking patterns as predictors of alcohol-related injury across 10 countries in the Americas

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SUMMARY

Drinking in an injury event is an important factor for injury risk, but pattern of usual drinking may also be important. This chapter examines the relationship between individual usual drinking pattern and alcohol-related injury (injury with self-reported drinking during the six-hour period prior to the event), taking into account individual usual volume of consumption over the past 12 months, aggregate-level average volume and detrimental drinking pattern (DDP), and alcohol policy measures (drink-driving and access to alcohol), for 6 079 injured drinkers. While individual usual volume strongly predicted alcohol-related injury, episodic heavy drinking and frequent heavy drinking were also predictive (controlling for volume). DDP was also a significant predictor of alcohol-related injury (controlling for individual usual volume and drinking pattern, and for study-level volume), with a greater detrimental pattern resulting in a greater likelihood of an alcohol-related injury among injured drinkers. Policies related to drink-driving were also predictive of an alcohol-related injury, with the stricter the drink-driving policy, the less the likelihood of an alcohol-related injury, and access to alcohol was marginally predictive, with the greater the access the greater the likelihood of alcohol-related injury. While individual- and societal-level drinking patterns may be difficult to influence by preventive measures to reduce alcohol-related injury, alcohol control policy may be a fruitful area for future exploration.

INTRODUCTION

According to Global Burden of Disease (GBD) estimates, alcohol is the leading risk factor in the region of the Americas (see Chapter 2 of this book), and the typical drinking pattern in the majority of countries in the region—episodic heavy consumption—is hazardous to health, resulting in mortality and morbidity from alcohol-related intentional and unintentional injuries (see Section I).

Much of the international data linking alcohol consumption with injury morbidity have come from emergency department (ED) studies using probability samples of patients (in which all times of day and days of week are equally represented). While these studies have found strong associations between alcohol and injury, the magnitude of associations has not been homogeneous across ED sites, studies, and countries. In these studies, drinking during the six hours before injury has been commonly used to identify alcohol-related injuries, and findings suggest an association between the likelihood of reporting drinking before the injury event and the patient's usual drinking pattern. This may account for some of the observed variation in the alcohol–injury relationship across these studies, with alcohol demonstrating a stronger association with injury for particular individual- and societal-level drinking patterns.

In a meta-analysis of data from the Emergency Room Collaborative Alcohol Analysis Project (ER-CAAP) across 30 EDs in six countries, when controlling for age and sex, those who reported drinking before injury were more likely to be admitted to the

ED with an injury than without an injury, but the risk of injury for those reporting drinking was lower for heavier drinkers than lighter drinkers, and was greater in societies with higher levels of detrimental drinking patterns (DDPs) (*1*). Additional meta-analysis of alcohol-related injury of these same data found that among non-heavy drinkers, frequency of drinking had the largest effect size, although heavy drinking, controlling for frequency, was also significant (*2*).

These findings suggest that while the amount of drinking on any particular occasion is an important risk factor in injury occurrence, the pattern of usual drinking may also play an important part in injury risk, and heavy episodic drinking may be more strongly related to injury than volume of consumption, with the usual drinking pattern moderating the association between acute intake before the event and injury (*3, 4*). However, the majority of ED studies have either analyzed drinking-during-the-event separately from usual drinking pattern (*5*) or analyzed only one aspect of the usual drinking patterns—volume (*4, 6*) or frequency of drinking (*7*).

Multi-level analysis of alcohol-related injury in ED data from 28 studies across 16 countries generated by the ERCAAP and the WHO Collaborative Study on Alcohol and Injuries (*8*) found patients' individual volume of alcohol was a significant predictor of alcohol-related injury. Studies with higher overall average consumption reported a higher rate of alcohol-related injury, but controlling for the study-level volume, study-level DDP was also found to be a significant predictor of variation in alcohol-related injury across studies. More recently, similar analysis across 19 countries found that frequent and infrequent heavy drinking were both predictive of an alcohol-related injury; alcohol policy related to drink-driving and access to alcohol was also predictive of variations in this association, with the stronger the alcohol policies, the lower the rates of alcohol-related injury (*9*).

Given the sparseness of available research on alcohol-related injury in the American, particularly in the Latin America and Caribbean (LAC) region, relatively little is known about the types of drink-ers most likely to account for alcohol-related injuries. Are they drinkers who usually consume large quantities of alcohol, or are they drinkers who only occasionally consume large quantities? This chapter describes a study that examined alcohol-related injuries in 10 countries in the Americas for association with individual usual drinking pattern and, separately, volume of consumption over last 12 months, along with study-level average volume and the DDP of a country or region. The association of alcohol policy with cross-study variation in alcohol-related injury is also investigated, focusing on composite measures related to drink-driving and access to alcohol.

These data are important for contributing to a better understanding of the association of alcohol and injury, the homogeneity of the relationship of drinker type with alcohol-related injury across various cultural contexts in the Americas, and the contextual variables that help explain observed heterogeneity, including the influence of alcohol control policies.

METHODS

Samples

Data for 6 079 injured drinkers from 38 ED sites covered in 22 studies across 10 countries in the Americas (Argentina, Brazil, Canada, Dominican Republic, Guatemala, Guyana, Mexico, Nicaragua, Panama, and the United States) comprised by the ERCAAP, the WHO Collaborative Study on Alcohol and Injuries (WHO-ER), and the ER studies from the PAHO-Valencia cooperation (PAHO-ER), were examined (Table 1). All studies used a similar methodology, developed by Cherpitel (*10*), and most covered a country or region within a country, although some (Acapulco, Mexico, 1987; Contra Costa County (CA), USA, 1985; Contra Costa County 1989; Mexico City 1986, and Pachuca, Mexico, 1996–1997) included several EDs within a city (e.g., Mexico City) or county (Contra Costa). Multiple ED sites within a country or region were selected based on the diversity and size of the population served in their respective locales, and to be representative of the different kinds

of health care delivery systems or health plans available in that locale.

In all studies, probability samples of patients 18 years and older were obtained by approaching consecutive arrivals to each ED, with equal representation of each shift for each day of the week. Patients were approached to obtain informed consent for participation in the study. Once informed consent was obtained, a cadre of interviewers trained at each site administered a 25-minute structured questionnaire that included questions about drinking before the injury; quantity and frequency of usual drinking, and higher consumption times during the last year; and demographic characteristics. Completion rates averaged 66% for the ERCAAP studies, 91% for the WHO studies, and 93% for the PAHO studies. Reasons for non-interviews included patients refusing to participate in the study, being incapacitated, leaving before completing the interview, being in police custody, and experiencing language barriers. Patients too severely injured to be approached in the ED were followed into the hospital and interviewed once their condition had stabilized. Data in the WHO and PAHO collaborative studies, and in some of the ERCAAP studies, were only collected for injured patients arriving at the ED within six hours of the injury event. Therefore, analyses here are restricted to that group of patients, who would be expected to have good recall of the injury event and their drinking at the time, and who, arriving in close proximity to the event, may likely have incurred more severe injury than those arriving later.

Measures

Alcohol-related injury. Alcohol-related injury was measured by self-report of any drinking during the six hours before the injury event, as done in prior analyses (*1, 8*).

Individual-level drinking. Two measures of drinking at the individual-level were used to predict the likelihood of alcohol-related injury: overall volume of consumption in the past 12 months, and usual drinking pattern in the past 12 months. Volume of consumption was measured as derived from responses to questions about usual frequency and quantity of drinking. In all studies, a question was asked about the usual frequency of consumption of any alcoholic beverage. In most of the ERCAAP studies, the quantity of drinking was obtained from the usual number of drinks combined over all beverage types. For the WHO and PAHO studies, and some of the ERCAAP studies, quantity questions were asked separately for specific beverages and drink sizes. Estimates of usual quantity were then derived by taking the maximum of the beverage-specific quantity for those reporting more than one beverage. Overall volume of alcohol consumption was estimated in standard drinks, defined as 16 ml of pure ethanol.

Individual usual drinking pattern, also based on the last 12 months, was constructed from a series of questions related to frequency of usual drinking (with "frequent" defined as ≥ weekly and "infrequent" as < weekly) and of heavy drinking (five or more (≥ 5) standard drinks in one sitting). This measure was developed into five mutually exclusive drinking categories: 1) infrequent light / non-heavy (< weekly / never ≥ 5); 2) frequent light / non-heavy (at least weekly / never ≥ 5); 3) infrequent light / infrequent heavy (drinks less than weekly / ≥ 5 less than weekly), 4) frequent light / infrequent heavy (drinks at least weekly / ≥ 5 less than weekly), 5) frequent heavy (≥ 5 at least weekly).

Study-level aggregate measures. Four study-level aggregate measures were used to predict cross-study variation in rates of alcohol-related injury, two related to drinking and two to alcohol policy, as suggested, in part, from prior analyses (*2, 8*). The two aggregate drinking measures are the study-level average 12-month volume of consumption (for drinkers only) and the regional DDP level. These two measures are the aggregate counterparts of the two individual-level drinking measures of 12-month volume and pattern, respectively, which have been found to be significant predictors of cross-study variation in alcohol-related injury (*2, 8*). The DDP measure is an indicator of "detrimental impact" on health and other alcohol-related harms at a given level of consumption, with values ranging from 1 (lowest detrimental impact) to 4 (highest detrimental impact), and was developed from aggregate

survey data or key informant surveys for a number of countries around the world (*11, 12*). DDP was originally constructed as a country-level measure, and for the purpose of this analysis, studies from different regions within the same country believed to demonstrate different drinking patterns were modified accordingly. The study-specific DDP values for this analysis are shown in Table 1.

The two study-level alcohol policy predictors, one related to driving and the other to access, are each a composite measure constructed from four indicators. Indicators for driving-related alcohol policy were: legal intoxication level for driving, random breath testing, sanctions against driving under the influence (DUI), and open container laws. Indicators for alcohol access policy were: legal drinking age, off-premise sales restrictions, bar open hours and sanctions serving minors. Each indicator was coded at three levels (–1, 0, and 1) with higher values indicating more restrictive policy control. Dichotomous measures, such as open container laws, were coded as –1 and 1. The final alcohol policy measures were each constructed, separately, as a summed scale. Table 1 shows the value for the two composite alcohol policy measures for each study.

Analysis

As the focus of the analysis is alcohol-related injury, only current drinkers were included, with abstainers presumably not exposed to risk of alcohol-related injury. Current drinkers were defined as those who reported consuming any alcoholic beverage in the last 12 months.

Multi-level analysis (also known as hierarchical linear models (HLMs) or random effect models) was used to examine individual and study-level aggregate predictors of alcohol-related injury. This is an approach to generalizing linear and non-linear regression models to clustered data, where individuals within clusters are correlated. In this study, injury patients, clustered within each study, are considered Level-1 data, and studies are treated as Level-2 data. As alcohol-related injury is dichotomous, hierarchical logistic regression models were fitted with the likelihood of alcohol-related injury predicted by

individual-level drinking measures, with the cross-study variation in log odds of alcohol-related injury predicted by study-level aggregate measures. Only the intercept of the logit model was allowed to vary across studies (random intercept model). All models were estimated using HLM version 6.02 (Scientific Software International, Skokie, IL, USA) (*13*).

When individual-level 12-month volume of consumption was used as a predictor, it was log-transformed and then centered within studies. The centering within context (CWC) of a predictive variable (*14*) was performed by using the difference between the variable and its study mean as the predictor. This CWC procedure, normally performed in fixed effect models, is an approach to deriving the within-study effect estimate. Then when the aggregate study-level average log volume of consumption is entered, the coefficient for individual-level consumption is interpreted as the pooled within-study effect of volume, while the coefficient of study-level consumption is interpreted as the effect of aggregate volume across studies.

Multiple models were fitted by incrementally including individual- and aggregate-level predictors for alcohol-related injury, allowing for an examination of how the effect of one variable changed when others were entered. Weights were assigned to several studies to adjust for data that were not collected as a probability sample equally representative of all shifts in a day across all days of the week.

RESULTS

Table 1 shows the 22 ED studies in the combined data set, the study sample size of those arriving at the ER within six hours of the injury event, the percentage of current drinkers in each study, and the proportion of drinkers reporting drinking during the six-hour period before [alcohol-related] injury, as well as the prevalence of the drinking pattern categories and the values of the three aggregate measures (DDP and the two alcohol policy composite scales).

As shown in the table, there is substantial variability in rates of alcohol-related injury and drinking

TABLE 1. Alcohol-related injury among drinkers, drinking patterns, and contextual-level variables among patient sample for 22 emergency department (ED) studies in 19 countries in the Americas, 1984–2011

Location, year (study)	n[a]	Current drinkers (%)	Used alcohol during six-hour period before injury (total sample) (%)	Used alcohol during six-hour period before injury (current drinkers) (%)	Infrequent light / non-heavy drinking (< weekly / never ≥ 5 drinks) (current drinkers) (%)	Frequent light / non-heavy drinking (≥ weekly / never ≥ 5 drinks) (current drinkers) (%)	Infrequent light / infrequent heavy drinking (< weekly / ≥ 5 drinks < weekly) (current drinkers) (%)	Frequent light / infrequent heavy drinking (≥ weekly / ≥ 5 drinks < weekly) (current drinkers) (%)	Frequent heavy drinking (≥ 5 drinks ≥ weekly) (current drinkers) (%)	DDP[b]	Lives in area with alcohol driving policy[c]	Lives in area with alcohol access policy[d]
Argentina												
Mar Del Plata I, 2001 (E[e])	230	82.6	27.8	33.7	22.9	21.8	7.4	20.7	27.1	2	-1	0
Mar Del Plata II, 2001 (W[f])	452	83.8	21.3	25.3	30.0	18.1	12.6	21.3	17.9	2	-1	0
Brazil												
São Paulo 2001 (W)	496	70.0	12.8	17.3	36.8	12.6	16.2	15.6	18.9	3	-1	0
Canada												
Edmonton (Alberta) 1989 (E)	173	88.4	30.6	34.6	32.0	4.6	28.1	12.4	22.9	3	-2	1
Quebec City 1989 (E)	143	90.9	12.6	13.8	34.4	10.2	25.0	25.8	4.7	1	-2	0
Orangeville (ON) 2002 (W)	222	80.8	6.3	7.8	30.1	17.1	16.1	28.0	8.8	2	2	2
Vancouver 2009 (E)	249	85.8	22.2	25.6	19.9	14.2	15.6	32.2	18.0	2	0	1
Mexico												
Mexico City 1986 (E)	1,034	70.4	26.5	36.4	30.4	2.7	49.0	4.9	13.0	4	-3	-1
Acapulco 1987 (E)	271	62.0	28.4	45.2	—[g]	–	–	–	–	4	-3	-1
Pachuca 1996–1997 (E)	486	48.0	13.0	26.1	29.5	1.5	53.7	4.8	10.5	4	-3	-3
Mexico City 2002 (W)	456	83.3	17.2	24.8	39.5	1.3	44.0	4.5	10.7	4	-2	-1
Dominican Republic 2010 (P[h])	501	76.5	19.3	25.1	6.8	2.6	55.0	7.1	28.5	2	2	-1
Guatemala 2011 (P)	513	57.0	21.1	36.6	24.3	1.4	56.2	3.4	14.7	4	-3	-1
Guyana 2010–2011 (P)	485	75.9	21.0	27.8	29.9	12.9	22.7	8.0	26.4	3	-1	-1
Nicaragua 2010 (P)	518	46.2	21.5	46.1	9.6	0.9	45.0	0.9	43.7	4	-2	-2
Panama 2010 (P)	490	69.3	20.8	30.6	22.0	3.1	35.5	7.2	32.1	3	0	-2

TABLE 1. Alcohol-related injury among drinkers, drinking patterns, and contextual-level variables among patient sample for 22 emergency department (ED) studies in 19 countries in the Americas, 1984–2011 (cont.)

Location, year (study)	n[a]	Current drinkers (%)	Used alcohol during six-hour period before injury (total sample) (%)	Used alcohol during six-hour period before injury (current drinkers) (%)	Infrequent light / non-heavy drinking (< weekly / never ≥ 5 drinks) (current drinkers) (%)	Frequent light / non-heavy drinking (≥ weekly / never ≥ 5 drinks) (current drinkers) (%)	Infrequent light / infrequent heavy drinking (< weekly / ≥ 5 drinks < weekly) (current drinkers) (%)	Frequent light / infrequent heavy drinking (≥ weekly / ≥ 5 drinks < weekly) (current drinkers) (%)	Frequent heavy drinking (≥ 5 drinks ≥ weekly) (current drinkers) (%)	DDP[b]	Lives in area with alcohol driving policy[c]	Lives in area with alcohol access policy[d]
United States												
San Francisco (CA) 1985 (E)	311	84.2	32.8	38.9	21.9	11.2	16.5	25.0	25.4	1	–3	1
Contra Costa County (CA) 1985 (E)	616	80.2	17.9	22.3	29.1	11.9	14.8	29.1	15.2	1	–3	1
Contra Costa County (CA) 1987 (E)	406	84.5	21.9	25.9	28.2	9.1	18.5	24.6	19.6	1	–3	1
Contra Costa Country (CA) 1989 (E)	193	81.1	10.0	12.4	36.7	17.0	12.4	25.5	8.3	1	–3	1
Jackson (MS) 1992 (E)	141	73.8	28.4	38.5	35.9	17.5	12.6	11.7	22.3	3	–2	4
Santa Clara (CA) 1995–1996 (E)	152	73.5	18.3	24.8	29.5	1.8	19.7	27.9	21.0	1	–3	1

[a] Injury cases arriving at the ER within six hours of injury event.

[b] Detrimental drinking pattern (scored from 1–4, with higher value equal to more detrimental pattern).

[c] Combination of four policy measures (with higher value equal to stricter policy control): legal intoxication level for driving; random breath test; sanctions on driving under the influence (DUI); and open-container law.

[d] Combination of four policy measures (with higher value equal to stricter policy control): legal drinking age; off-premise sales restriction; bar open hours; and sanctions on serving minors.

[e] Emergency Room Collaborative Alcohol Analysis Project (ERCAAP).

[f] World Health Organization Collaborative Study on Alcohol and Injuries (WHO-ER).

[g] Missing data.

[h] ER studies from PAHO-Valencia cooperation (PAHO-ER).

patterns across studies. The percentage of any drinking before injury among current drinkers ranged from 7.8% to 46.1%. LAC countries (with the exception of Argentina, Brazil, and Guyana) showed higher rates of abstention than Canada and the United States, and consequently most LAC rates of drinking before injury among current drinkers were substantially higher than rates among all injured patients. A pattern of infrequent drinking or frequent heavy drinking also predominated in most LAC countries.

Multi-level analysis predicting any drinking before injury

Table 2 shows estimates for the six models from 21 studies for predicting any drinking before injury (the results from Acapulco were excluded from these analyses due to incomplete drinking-pattern data). Gender and age were used as control variables in all models. Individual-level total volume of consumption (log-transformed and centered at study), and drinking pattern, study-level average log

TABLE 2. Odds ratios (ORs) from hierarchical linear models predicting self-reported alcohol consumption before injury among current drinkers in 21 emergency department studies[a] across 19 countries in the Americas, 1984-2011

OR	Model 1 (n = 5 722)	Model 2 (n = 5 749)	Model 3 (n = 5 673)	Model 4 (n = 5 722)	Model 5 (n = 5 673)	Model 6 (n = 5 673)
Level-1 fixed effect						
Men versus women	1.40[b]	1.47[c]	1.30[d]	1.39[b]	1.29[d]	1.28d
Age 18–29 versus ≥ 30 (years)	1.04	0.98	0.98	1.04	0.99	0.98
Alcohol volume last year[e]	1.53[f]		1.40[f]	1.53[f]	1.40[f]	1.40[f]
Drinking pattern last year						
Infrequent light / non-heavy		0.29[f]	0.74		0.74	0.74
Frequent light / non-heavy		Ref (OR = 1)	Ref (OR = 1)		Ref (OR = 1)	Ref (OR = 1)
Infrequent light / infrequent heavy		0.87	1.45[c]		1.43[c]	1.44[c]
Frequent light / infrequent heavy		1.61[f]	1.44[f]		1.45[f]	1.44[f]
Frequent heavy		2.43[f]	1.65[c]		1.63[c]	1.64[c]
Level-2 fixed effect						
Study average volume[g]				2.08[f]	1.85[c]	2.72[f]
Detrimental drinking pattern				1.36[f]	1.33[f]	1.46[f]
Alcohol policy: driving[h]						0.81[f]
Alcohol policy: access[i]						1.07[d]
Level-2 variance[J]	0.267[f]	0.233[f]	0.240[f]	0.151[f]	0.153[f]	0.052[f]

[a] The study in Acapulco, Mexico, was excluded due to incomplete drinking pattern data.

[b] P < 0.05.

[c] P < 0.01.

[d] P < 0.10.

[e] Individual volume consumption (in 16-ml standard drinks, log-transformed) centered at study mean.

[f] P < 0.001.

[g] Study mean of volume consumption (in 16-ml standard drinks, log-transformed).

[h] Combination of four policy measures (with higher value equal to more restrictive policy control): legal intoxication level for driving; random breath test; sanctions on driving under the influence (DUI); and open-container law.

[i] Combination of four policy measures (with higher value equal to more restrictive policy control): legal drinking age; off-premise sales restriction; bar open hours; and sanctions on serving minors.

[J] Chi-squared test of variance larger than zero.

volume of consumption and DDP, as well as the two alcohol policy composite measures, were entered in the models.

The total volume individuals consumed in the last 12 months strongly predicted any drinking before injury (Model 1). When usual drinking pattern was used as the only predictor (other than sex and age) (Model 2), a step function was observed, with infrequent light / non-heavy drinkers least likely to drink before injury, followed by frequent light / non-heavy, infrequent light / infrequent heavy drinkers, frequent light / infrequent heavy, and frequent heavy drinkers most likely to report drinking before injury. This pattern effect on alcohol-related injury changed, however, after log volume of consumption was entered as a predictor of the random intercept (Model 3), and while frequent heavy drinkers were still most likely to drink before injury, little difference was found in likelihood of injury between infrequent light / infrequent heavy and frequent light / infrequent heavy drinkers.

Study-level average log volume and DDP were next examined to predict cross-study variation in rates of any drinking before injury together with individual-level volume of consumption (and sex and age) as Level-1 predictors (Model 4). Both 1) increasing aggregate average log volume and 2) DDP were strongly related (P < 0.001) to variation in the likelihood of an alcohol-related injury, and effects continued when individual-level drinking pattern was also entered in the model (Model 5). Finally, the composite policy measure related to drink-driving significantly predicted cross-study variability in rates of drinking before injury (P < 0.001), while the measure related to alcohol access was marginally predictive (P < 0.10) (Model 6).

DISCUSSION

Large differences in drinking patterns were apparent across studies, and these appear to map well to known differences between country or regional drinking patterns. For example, nearly half of the current drinkers in the LAC samples reported infrequent heavy drinking (infrequent light / infrequent heavy), while frequent drinking was common in Argentina, a country exhibiting a more Mediterranean drinking style.

Although the total volume of alcohol consumed during the last year was predictive of an alcohol-related injury, controlling for volume, individual drinking pattern was also significant. Episodic heavy and frequent heavy drinkers were both found to have the greatest likelihood of an alcohol-related injury, and these two drinking patterns typify the Central American countries represented in this sample. This has also been found in previous analyses across 19 countries (9), and the elevated risk for injury of heavy episodic drinkers has also been reported elsewhere, with those who usually drink little but on occasion drink heavily at higher risk than other drinkers (3).

At the aggregate level, DDP was examined, comparing it as a predictor of the variation in alcohol-related injury across studies, while controlling for individual-level volume (Model 4), and individual-level drinking pattern (Model 5). DDP, which is a measure of the detrimental impact on health and other harms of the same volume of alcohol (with the higher the DDP level the higher the postulated detrimental effect of the same amount of alcohol), was found to be a strong predictor in both models. However this was not the case in the 19-country study, in which DDP was only marginally significant for variation in self-reported drinking before injury (P < 0.10) when individual-level volume was included in the model and became nonsignificant when individual-level drinking pattern was also included (9).

Finally, regional alcohol policies related to driving and access to alcohol were examined, controlling for aggregate-level consumption and pattern (DDP), and both were found to be significant predictors of variation in alcohol-related injury across studies, with the stricter the policy the less the likelihood of alcohol-related injury. Earlier analysis found that legal level of intoxication (8) and legal drinking age (2) were both predictive of alcohol-related injury, but the 19-country study, which analyzed the same drink-driver and access composite measures as those analyzed here (which were developed to be more comprehensive than individual items), did not

find either measure a significant predictor of variation in reporting drinking before injury.

It is important to note that self-reported drinking in the six-hour period before injury likely over-represents alcohol-relatedness of the event, as a relatively small amount of alcohol consumed early in the six-hour period might have little to do with occurrence or causation of the injury. It is also important that while patient samples in all studies were drawn to be representative of their respective EDs, these samples cannot be considered representative of a broader area. In addition, while alcohol policy variables were collected to reflect the same period for which the respective ED data were collected, they may not adequately represent the geographic level relevant to the specific ED study, as they are generally based on aggregate-level statistics, ranging from county- to country-level data.

All data were collected using a comparable study design and data collection procedures with nearly uniform rigor, and a similar questionnaire that ensured comparability of items across studies. Given the diversity of the countries and areas within countries analyzed here, as well as the relatively large and comparable samples across studies, findings here clearly point to the importance of an individual's drinking pattern in predicting the likelihood of an alcohol-related injury, and the patterns most prevalent in the LAC countries appear to be those most highly associated with alcohol-related injury.

New data here on nonfatal injuries and the role of alcohol consumption indicate high levels of harm done by alcohol in the Americas. The burden of alcohol-related injury on health systems, while not yet measured, is clearly high, and is of particular importance in LAC countries, where alcohol consumption is increasing due to emerging markets for the alcohol industry and a lack of alcohol policies to reduce the harmful use of alcohol. Findings here can inform the development of priorities in research and policy development for LAC countries. Alcohol policy was found to be an important predictor of alcohol-related injury. While individual-level and societal-level drinking patterns may be difficult to influence by preventive measures aimed to reduce alcohol-related injury, alcohol control policy appears to be an important focus for future exploration in the Americas, particularly in LAC countries. ■

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Section III
Reducing alcohol-related injuries: identification, intervention, and policy

INTRODUCTION

The five chapters in Section III explore two related questions: 1) Can emergency departments (EDs) provide useful surveillance data on alcohol-related injury? and 2) What types of intervention are recommended to reduce alcohol-related injuries? Chapter 12 explains how efforts to encourage routine recording by clinical staff often result in only partial, and unreliable, reporting, and describes an alternative approach used in two EDs in British Columbia, Canada, in which research interviewers worked at high-risk times (9 p.m.–4 a.m. on weekends) to screen and interview those attending the ED. This surveillance study proved useful for monitoring temporal trends in consumption, and objective measures involving saliva or breath samples were found to be less valuable than self-reports of use.

Chapter 13 examines the value of using ICD-10[1] criteria for clinical assessment of patients in the ED to identify intoxication. Using data from a number of emergency rooms (ERs) in the Americas, they found that results from the use of ICD-10 "Y code" criteria for physician grading of the degree of intoxication based on clinical assessment only very approximately correlate with those from objective measures of blood alcohol concentration (BAC). In other words, while a subjective assessment may be valuable, its use for surveillance purposes is limited.

Chapter 14 provides an overview of several types of interventions that can reduce alcohol-related injury. Based on the evidence, universal policies that address the price and availability of alcohol are considered a main priority. Targeted strategies such as random breath testing, as well as screening and brief intervention, are also recommended. The value of addressing high-risk alcohol products (those with a low price per standard drink[2]), as well as high-risk drinking environments and high-risk drinkers, is also discussed, along with the need for targeted strategies balanced between addressing the "prevention paradox" and the need to direct prevention strategists toward common, mainstream risky-drinking patterns such as occasional heavy drinking, in addition to the rarer subgroup of drinkers with severe problems.

Chapter 15 examines screening and brief intervention (SBI), and monitoring as an effective tool to reduce alcohol-related injuries in the ED. It also provides an overview of intervention models and their main components, the "active ingredients" of BI, and a summary of evidence related to BI effectiveness, including the factors associated with their successful implementation.

Chapter 16 provides an overview of population-level and targeted interventions to reduce alcohol-related injuries, plus a snapshot of the evidence base for 10 different criteria for effective alcohol policies, based on the World Health Organization's 2010 Global Strategy to Reduce the Harmful Use of Alcohol. It also cites several specific examples of best practices from the Americas, and describes the risks to public health if effective action against the harmful use of alcohol is not undertaken.

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[1] International Classification of Diseases, 10th revision.

[2] Approximately 18 mL of pure alcohol. NIH. http://pubs.niaaa.nih.gov/publications/Practitioner/PocketGuide/pocket_guide2.htm.

CHAPTER 12

Surveillance systems and trauma care: what can be done in the emergency department?

Kate Vallance and Tim Stockwell

SUMMARY

Emergency departments (EDs) provide a useful window through which shifting substance use patterns can be observed as risk factors for injury, overdose, and poisoning across different communities. This chapter describes a methodology for systematic sampling of late-night ED presentations that has been used as one component of a comprehensive alcohol and other drug (AOD) monitoring system in two cities in Western Canada ("the ED Monitoring Study"). It also assesses the feasibility of combining self-report and objective tests in measuring AOD use, and outlines two different challenges that occurred with response rates during the course of the study. In the study, ED patients were interviewed between 9 p.m. and 4 a.m. on weekends at two sites in Victoria and Vancouver, British Columbia, Canada. Standardized survey instrument, breathalyzer, and saliva drug tests were administered. The survey assessed the reason for the ED visit as well as alcohol/drug use history (lifetime use, past 12 months, one month, and six hours before injury/illness). In Vancouver, where the larger of the two hospitals was located, a revised systematic sampling strategy was required to avoid missing potential patients. In addition, low patient participation in Vancouver led to implementation of incentives to increase the response rate. The use of self-report measures identified more alcohol use among attendees than the use of objective measures, although the reverse was true in the case of use of illicit drugs. The overall monitoring approach proved to be viable and achieved a satisfactory rate of participation. Among other indicators, the monitoring system identified an increasing trend in alcohol use and decreasing use of illicit drugs over the four years the surveillance study was conducted.[1]

INTRODUCTION

While the acute effects of risky alcohol use and other substance use contribute to the bulk of alcohol and drug-caused deaths in Canada, historically they have not been systematically monitored. Tracking the rates of serious harms related to alcohol and other drug (AOD) across time and location within the general population is necessary to implement widespread policies that can address them. Emergency departments (EDs) provide a window into emerging trends of risky patterns of alcohol use and other substance use and are useful venues for monitoring injury, illness, and other acute harms. A great proportion of trauma is found in EDs, where alcohol has been shown as a major risk factor for injury (*1, 2*) and the impact of alcohol consumption on acute conditions (e.g., injuries) is related to both volume and pattern of drinking (*3, 4*). Previous international studies have found injured patients more likely to be drinking before the event and to be heavier drinkers in general than non-injured patients presenting to the same ED at the same time (*5, 6*). Late-night and early-morning presentations

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[1] More information on the ED surveillance study is available at: www.AODMonitoring.ca/EmergencyDepartments

have also been identified as especially likely to be related to substance use (*7*).

In an earlier examination of this topic, Stockwell, Macdonald, and Sturge (*8*) noted that national and international statistics on alcohol-related harms tend to emphasize estimates of total numbers of deaths (e.g., (*9*)) or total economic costs (e.g., (*10*)) but rarely report trends or variations across place and time. Monitoring such trends can be valuable as a means of guiding the development and evaluations of interventions at the national, regional, and local level (*11, 12*). While a single estimate of lives lost and economic impacts can raise awareness and build momentum toward new policy initiatives, the monitoring of trends using repeated measures provides a stronger emphasis on whether prevention and treatment policies are being well directed and are effective in practice. When monitoring is done on a continual basis or includes very frequent assessments, this is often termed "surveillance" (*13, 14*). Continuous monitoring or surveillance of alcohol use and other substance use in the ED has the potential to identify new and emerging patterns of risk for serious injury, overdose, and poisoning events in a timely way that may inform strategies aimed at preventing future occurrences.

In this chapter, an example of implementation of a surveillance system designed for ongoing monitoring in an ED setting in two cities (the "ED Monitoring Study") is presented. Also outlined are some of the initial challenges that arose as the monitoring study became established, and the ways in which those obstacles were subsequently overcome. The ED Monitoring Study is part of a broader AOD monitoring system in British Columbia (BC) (Canada) (the "BC Alcohol and Other Drug Monitoring Project") that collects comprehensive data on rates of alcohol-, tobacco- and illicit drug–caused hospitalizations and deaths (*15*); patterns of substance use in the general population, among school students, and among high-risk populations (*16*); province-wide data on alcohol sales (*17*); presentations to the addictions treatment system; and illicit drug seizures (*18*). The ED Monitoring Study component complemented these approaches by collecting data in two

sentinel sites in downtown areas of two cities with substantial and very visible street-entrenched illicit drug using populations using survey items similar to those of other surveys conducted by the broader BC AOD Monitoring Project in terms of drug terms used, time periods considered, and related harms. One initial challenge to overcome when monitoring AOD-related trauma is the reliable identification of cases that are at least partially caused by substance use. Individuals presenting to EDs late at night and in the early hours of the morning on weekends are known to have a high rate of prior substance use contributing to their injury or illness (*7, 19*). The hours (9 p.m.–4 a.m.) and days (Friday and Saturday) of study were chosen because they were likely to capture the highest use of alcohol and other drugs among ED attendees, thereby providing a window through which emerging trends in substances being used separately and in combination could be observed.

Four main opportunities for monitoring and surveillance (as described by Stockwell et al. (*8*)) were explored in this study: 1) survey of attendees presenting at high-risk times; 2) routine, objective testing of recent use of alcohol and other substances; 3) identification of cases with main reason for ED attendance being injury or illness known to have a high probability of involvement of alcohol or other substances; and 4) use of surrogate measures indicative of high involvement of alcohol and/or other substances (*8*). Evidence on surrogate measures for alcohol use was found in a large international study in which 74% of young, single males presenting at EDs with an injury during late-night and early-morning hours on weekends had recently consumed alcohol (*7*). The authors of that report recommended the application of similar data as surrogate measures of alcohol-related harm in the local community, for both evaluation and monitoring purposes.

METHODS

Data collection sites

Sampling was conducted among patients presenting at the EDs of Royal Jubilee Hospital (RJH) (Victoria, BC) and Vancouver General Hospital (VGH) (Vancou-

ver, BC). VGH is a specialist trauma center providing services in almost all medical specialties. RJH provides comprehensive acute care to the downtown population in Victoria. These two sites were chosen because their downtown catchment areas include entertainment districts and venues frequented by users of illicit drugs.

Subjects

Subjects were interviewed one Friday and one Saturday night per month (9 p.m.–4 a.m.) at both sites. Completed interviews were obtained from 1 277 subjects across both sites between April 2008 and September 2011. Patients were between 17 and 75 years of age, spoke English, and gave written consent. Patients who posed a safety risk, came to the ED with a police escort, or were unable to correctly answer comprehension questions about the study were excluded.

Interviewers

Two interviewers worked in tandem on each shift. The interviewers were generally graduate or undergraduate students, medical residents, or nurses who were carefully selected and given in-depth training in administering the questionnaire and conducting the two objective tests.

Sampling strategy

A systematic strategy was used to select subjects from patients presenting during the study period. Patients were approached once they had been registered in the Emergency Department Information System (EDIS), with the most recent being approached first until a new interview was secured. If the approached patient met the study inclusion criteria, the interviewer explained the study and obtained written informed consent. If the approached patient presented an exclusion criterion or refused to participate, he/she was excluded and the next person in the EDIS registry (based on chronological order of patient arrival) was approached.

A confidential exclusion log was kept to ensure the same person was not approached twice during the shift. Sex, age, presenting complaint, and reason for exclusion or refusal were recorded for all patients anonymously. Interviewers continued to approach all accessible, eligible, and consenting patients with this sampling strategy until the end of the shift.

Measures

Self-report survey. The ED Monitoring Study survey was developed based on similar monitoring surveys used in Australia (*20*) and Canada (*21*) and adapted from the one used in the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) data set (*22*). It was also designed to be comparable to other survey instruments in the overall BC AOD Monitoring Project so that its results could contribute to efforts to characterize substance use patterns and related harms among high-risk populations in the participating sites. The survey was piloted in January and February 2008 at both sites before beginning the full implementation phase in April 2008.

The survey assessed reason for the ED visit; alcohol and drug use history (lifetime use, past 12 months, one month, one week use, yesterday use, and use in six-hour period before injury/illness); and demographic profile. Interviews took place at the patient's bedside for stretcher-bound patients and in a private area for all others. The eight-item version of the World Health Organization (WHO) alcohol-screening instrument known as the Alcohol Use Disorders Identification Test (AUDIT) was used to obtain a standardized assessment of alcohol-related problems and dependence (*23*). The WHO instrument for assessing problems and dependence involving other substances, known as the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) (*24*), was used for eight substance categories: opioids (heroin, morphine); cocaine; tobacco; cannabis; amphetamines ("speed," diet pills, "ecstasy"); hallucinogens (LSD, "acid," "mushrooms"); inhalants (nitrous, glue, paint thinner); and sedatives or sleeping pills (Valium, Serepax). These two measures are discussed in more detail below.

BAC testing. In addition to the self-reported use of alcohol, blood alcohol concentration (BAC) was estimated indirectly by measuring the amount of alcohol in the subject's breath using the Alco-Sensor IV

breathalyser (Intoximeters Inc, St. Louis, MO, USA). The instruments were calibrated once a month using a water-based alcohol solution of 0.1% to ensure accuracy of readings. The breathalyzer test requires the subject to blow into a sterile disposable mouthpiece for 5–8 seconds after which the machine provides an electronic BAC reading.

These breathalyzer units were chosen for the project for their ease of use, portability, and unobtrusiveness. Similar devices are used by law enforcement officers for roadside breath testing and in various other venues such as workplace testing, EDs, occupational health centers, and drug and alcohol treatment centers. Previous ED studies (e.g., (*19, 25*) have confirmed that BAC tests correlate well with self-reported alcohol consumption, especially when the delay between last drink and a breath test is accounted for. Delays of longer than two hours, however, will generate increasing numbers of false negative results when using BAC data alone.

Saliva testing. A saliva drug test manufactured by Securetec Detektions-Systeme AG (Neubiberg, Germany) was administered to consenting subjects. The product, known as DrugWipe®5S, is a four-drug sensing test strip. The test indicates the presence of metabolites of drugs (amphetamine-like substances, including amphetamine, methamphetamine, and "ecstasy"; cocaine; opiates, including heroin and morphine; and cannabis) via the development of colored lines in the strip's detection zone.

Traditionally, urine testing has been the standard method for detecting the presence of commonly used illicit substances (cocaine, cannabis, opiates/opioids, benzodiazepines, barbiturates, amphetamines, and methamphetamine). However, based on previous research on drug testing methods, oral fluid testing was chosen for the ED Monitoring Study over urinalysis for a number of reasons. The most important advantages for the context of this study were that oral fluid testing is less invasive, capable of producing results quickly, and designed to be sensitive to recent substance use (*26–28*). Compared to urinalysis, oral fluid testing has proven to be as accurate, with 91%–99% sensitivity for opiates, 98% for cocaine, and 86% for methamphetamine (*29–31*). Although some tests can

detect drugs in urine and hair for weeks (*26, 32*), the current study focused on recent rather than historical use. As oral fluid testing detects drug use within 12–14 hours, and is a better indicator than urinalysis of recent drug use, it was considered the best choice for the ED Monitoring Study.

It was also decided to use disposable saliva strips in a point-of-collection device (POC) rather than laboratory devices that would have required that the samples be sent to a laboratory for analysis (which normally takes 24–72 hours). POC devices fit the objectives of this study as they are inexpensive, give instant results, and have generally been shown to have good sensitivity and specificity (*33*).

The DrugWipe® 5S (DW5S) was chosen over other, similar POC devices for its ease of use, availability to the Canadian market, unobtrusiveness for sample collection, instantaneous results, and reasonable pricing. This device is also being used in Australia by the police for roadside testing, and has shown a specificity of 99% (*34*). Other POC saliva-test devices require that the collection pad be held in the mouth for up to 3 minutes, whereas saliva collection with the DW5S only requires the tongue to be wiped 4–6 times. Results appear within 3–5 minutes, and disappear after 10 minutes (which helps mitigate any concerns about privacy of results). In addition, the DW5S functioned comparatively well for the four drugs of primary interest for this project, whereas other POC devices have tested poorly (*35*). Each DW5S strip cost the project approximately US$ 20 per administration.

AUDIT and ASSIST. AUDIT is a brief screening instrument developed by WHO for identifying hazardous and harmful patterns of alcohol consumption (*23*). The ED Monitoring Study uses AUDIT scores as a measure of risky alcohol use among ED attendees. Low AUDIT scores (ranging from 1–7) are associated with low-risk consumption of alcohol. Moderate scores (ranging from 8–15) indicate alcohol use in excess of low-risk guidelines and moderate-risk of harm, while high scores (16+) are indicative of harmful and hazardous drinking (i.e., high-risk). Extreme scores on the AUDIT (20+) are particularly indicative of dependence. Risk levels for consumption of other substances were generated using the ASSIST, a brief

screening questionnaire developed by WHO and an international team of substance use researchers for assessing use of psychoactive substances. Low-risk scores (ranging from 1 to 3) suggest low risk of health and other problems from current pattern use, while moderate-risk scores (ranging from 4 to 26) indicate an increased risk. High-risk scores (27+) indicate that the individual is at risk of experiencing severe problems (health, social, financial, legal, and relationship) and is likely to be dependent on one or more substances (*24*).

RESULTS

Consent and response rates

Across both sites, 1 277 subjects (RJH = 572, VGH = 705) were recruited with a combined response rate of 76.4%. Response rates were similar among patients approached in Victoria (76.3%) and Vancouver (78%). Reasons for non-response were refusal (20%); age (34%); medical reasons (6%); intoxication (4%); "left before completing the interview" (7%); insufficient consciousness (10%); language barriers (6%); and other reasons (13%).

Initially, between April and October 2008, the response rate at VGH was only 59.4%. The research team subsequently implemented two different strategies to increase the proportion of patients who consented to participate in the study, thereby improving the response rate. As an initial measure, in November 2008, a US$ 10 gift card was offered to those who agreed to participate in the study at the Vancouver site. That incentive had the desired effect, with the response rate increasing more than 7%, eventually reaching 66.4%, by December 2008. To further improve the response rate, in January 2009, the sampling strategy was revised so that interviewers approached sampled patients immediately after they were registered in the EDIS system. Interviewers were also trained to wait up to 45 minutes if the patient was unavailable at the initial time of approach. If the patient was not going to become available within that waiting period, as indicated by health care staff, the interviewer would place the patient on the backlog list and approach the next

chronological patient in the EDIS system that fit the inclusion criteria for the study. The initial patient would then be re-approached later during the shift. This second initiative also proved successful, and between January and September 2011, the response rate at VGH increased another 11.6%, reaching 78%. The difference between the response rates at VGH before (April–October 2008) and after (November 2008–September 2011) the introduction of the US$ 10 gift cards and the more streamlined sampling strategy for approaching selected patients (January 2009) was significant (P < 0.001, two proportions test (*36*)). The lower patient volume at the Victoria site made the introduction of the revised sampling strategy used in Vancouver unecessary, but the US$ 10 gift cards were introduced as incentives to maintain consistency across the two study locations. The response rate in Victoria was not significantly affected by the addition of the gift cards.

Compliance with alcohol and drug tests. The majority of patients consented to the breathalyzer test (87.5%) as well as the saliva drug test (88.7%) (data not shown). Those who did not consent were not significantly different from those who did provide consent.

Demographic characteristics

Across both sites, patients were evenly split between males (51%) and females (49%), with a mean age of 38 years (range 17–75 years). Most identified themselves as Caucasian (70.6%) and worked either full or part time (53%) with 17% reporting currently being unemployed. Close to 20% were students. Close to one-third were married or in a marriage-like relationship ("co-habitating") while half were currently single (Table 1).

Measures

Self-report survey. As noted above, 25% of patients attending the ED on a late weekend night in Vancouver and Victoria during the study period reported using alcohol in the six hours before the onset of their injury or illness, whereas 6% reported using cannabis, 14% used pharmaceutical drugs, and 3% used other illicit drugs (Table 2).

TABLE 1. Characteristics of combined patient sample from two emergency departments (*n* = 1 277), Victoria and Vancouver, British Columbia, Canada, April 2008–September 2011

Characteristic	%[a]
Gender	
Male	50.9
Female	49
Age group (years)	
< 25	28
25–44	40.6
≥ 45	31.3
Ethnicity	
White	70.6
Aboriginal	5.6
Chinese	7.6
Other	16.2
Marital status	
Married / co-habitating	30.7
Single / never married	50.5
Other	14.9
Employment status	
Full-time paid work	39.2
Part-time paid work	13.9
Unemployed	16.5
Retired	9
Current student	18.9
Other	2.5

[a] Percentages may not sum to 100% due to missing values.

TABLE 2. Use of alcohol and other substances in six-hour period preceding injury or illness, and substance use in past 30 days, based on self-report among emergency department patient sample (*n* = 1 277), Victoria and Vancouver, British Columbia, Canada, April 2008–September 2011[a]

Substance	Period used	
	Six-hours preceding injury or illness	Past 30 days
	(%)	
Alcohol	24.7	75.3
Cannabis	5.8	24.3
Tobacco	22.6	38.4
Pharmaceuticals	13.5	—[b]
Other illicit drugs	2.5	13.2

[a] Percentages may not sum to 100% due to missing values. [b] Missing data.

Over the seven waves of data collection in both cities, linear-by-linear trend analysis showed that self-reported use of alcohol in the past 30 days increased significantly ($P < 0.001$) between 2008 and 2011, while past-30-day use of illicit drugs decreased during this period ($P < 0.05$) (Figure 1).

Of those who reported that medication, alcohol, or other drugs they had been taking recently contributed to the injury bringing them to the ED (*n* = 77), the two most frequent types of injury were falls (31.2%) and blunt assault (22%), with 39% reporting their injury was due to some "other" reason (data not shown). The most common substance reported as contributing to the injury was alcohol.

BAC testing. Among those breathalyzed, 25% reported using alcohol in the six hours before their injury or illness while 20% were positive on the breathalyzer (Table 3). Sensitivity of the breathalyzer was 68% and specificity 97% for those who provided self-report data with a maximum of six hours between time of injury or onset of illness and time of interview.

Saliva testing. Among those saliva-tested, 20.4% reported drug use (cannabis, pharmaceuticals, or other illicit drugs) within the six hours before their presenting illness or injury, compared to 7.8% who tested positive for at least one substance on the saliva test (data not shown). Sensitivity and specificity of the saliva drug swab varied by drug: cannabis, sensitivity: 21.1% and specificity: 97.9%,; cocaine, sensitivity: 50% and specificity: 97.9%; amphetamines (including "ecstasy," amphetamines, and crystal methamphetamine), sensitivity: 57.1% and specificity: 98.7% (*37*).

AUDIT and ASSIST. Of the patients attending the ED on a late weekend night, 37% had scores indicating either a moderate or high level of problematic alcohol use as assessed by the AUDIT measure. The ASSIST measure assessed 20% of ED attendees interviewed as having moderate or severe problems from their use of cannabis, 8% from use of cocaine, 5% from use of opiates, and 4% from use of amphetamines (Table 3). Linear-by-linear trend analysis showed no significances changes in AUDIT or

FIGURE 1. Substance use in past 30 days based on self-report among emergency department patient sample (*n* = 1 277), Victoria and Vancouver, British Columbia, Canada, April 2008–September 2011ᵃ

***Alcohol: p<.001;   ***Tobacco: p<.001;   *Other illiscit drugs: p<.05
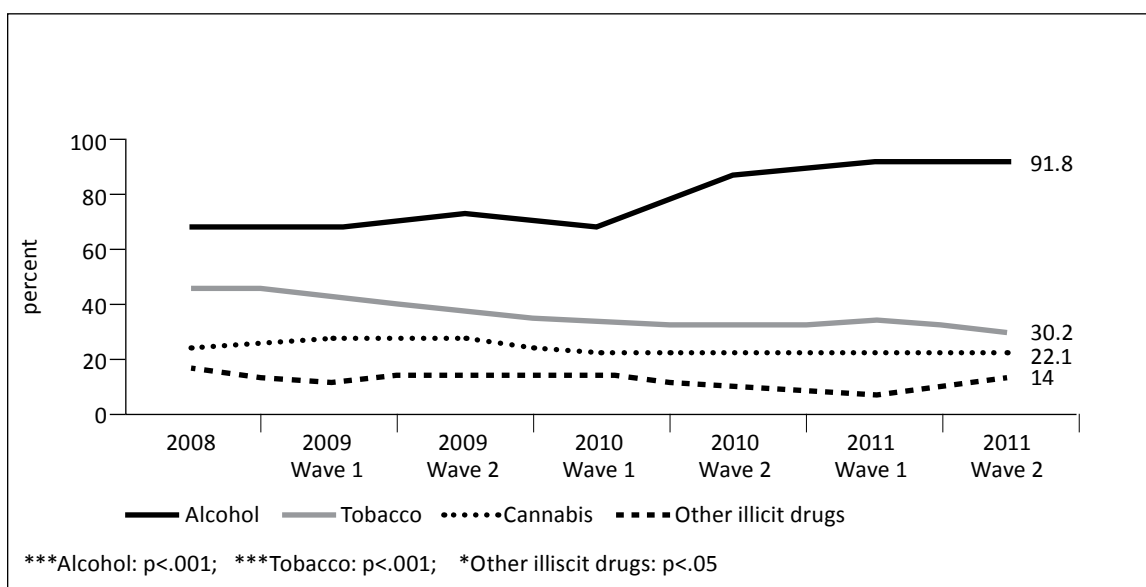
TABLE 3. Indicators for use of alcohol and/or illicit drugs based on self-report and various tests (blood alcohol level, saliva, and two standard screening measures) among patient sample at two emergency departments (*n* = 1 277), Victoria and Vancouver, British Columbia, Canada, April 2008–September 2011

Indicator	%ᵃ
Use of alcohol	
Self-report (six-hour period preceding ED visit)	24.7
Positive blood alcohol concentration (BAC)	20.2
AUDIT–Alcohol score (moderate or high-risk)	37.1
Use of cannabis, pharmaceuticals, and other illicit drugs	
Self-report (six-hour period preceding ED visit)	20.4
Positive DW5Sᵃ	7.8
ASSIST scores (moderate or high-risk)	
ASSIST–Cannabis	19.9
ASSIST–Cocaine	8.2
ASSIST–Opiates	4.8
ASSIST–Amphetamines	4.2
Use of alcohol and illicit drugs	
Self-report (six-hour period preceding ED visit)	6.2
Positive BAC and DW5S	2.4

ᵃ Percentages may not sum to 100% due to missing values.
ᵇ DrugWipe® 5S (DW5S saliva test (Securetec Detektions-Systeme AG, Neubiberg, Germany).

ASSIST scores over the study period (data not shown).

DISCUSSION

This chapter described the implementation of an on-going surveillance system designed to monitor substance use and related harms of patients attending EDs at two sentinel sites in two cities in the Canadian province of British Columbia. Initial challenges were described as well as an evaluation of the objective tools used as part of the study. Descriptive results of different measures of substance use and related harms further illustrated the utility of monitoring EDs on an ongoing basis.

Some challenges identified during the initial stages of the study at the larger of the two sites were addressed satisfactorily once two separate strategies were employed. To increase the response rate at the Vancouver site, US$10 gift cards were introduced in November 2008 to compensate patients for their time and as an incentive to participate. In addition, the sampling strategy was revised in January 2009 to further increase the response rate and patients were followed for up to 45 minutes after the initial approach if the patient was unavailable. Together with the added incentive of the gift cards, the response rate increased significantly at the Vancouver ED, bringing it close to the response rate at the Victoria site.

There was excellent compliance with both of the objective tests, and the majority of patients consented to take both the breathalyzer and the saliva tests. The sensitivity of the breathalyzer test was superior to the saliva drug test; however, the specificity of the saliva test was comparable to the breathalyzer, with sensitivity for both tests close to 100%. There was a larger proportion of self-reports of alcohol use in the six hours before injury or illness than positive results from the breathalyzer test, which has been found in other ED studies, and attributed to the number of hours that may have lapsed between consumption of alcohol and the breathalyzer test (38). The breathalyzer results suggest about two-thirds of those who reported alcohol use in the six hours

before injury or illness were identified by the breath test, and only a small proportion (3%) who were positive denying drinking during this time. Likewise, there was also a larger proportion of self-reports of illicit drug use during the six hours before illness or injury compared to positive saliva drug tests. The saliva test results support findings from previous studies indicating a lower sensitivity for cannabis compared to other drugs (34). Sensitivity for cocaine and amphetamines was also similar to that found previously (28). Sensitivity of the saliva tests proved to be low for each substance, with a larger proportion reporting substance use than indicated by positive saliva tests. The specificity of the saliva tests was high, and in nearly every case where patients reported no use of substances, the saliva tests were also negative. The data suggest saliva tests were not able to improve upon the accuracy of information provided by self-reports of substance use, indicating that they may not provide sufficient benefit to justify their cost. However, it is possible that patients being aware that an objective test would be conducted increased accuracy of their self-reported data (37).

The breathalyzer had stronger all-round performance in terms of sensitivity than the drug saliva test, although specificity was comparable between the two. While the breathalyzer test provides a reliable and cost-effective measure of recent alcohol use, given the lower sensitivity of the saliva test and the higher cost associated with it, data on illicit drug use may be sufficiently captured by the self-report questions included in the survey instrument.

Patterns of substance use during the study period indicated that self-reported use of alcohol in the past 30 days increased significantly over the duration of the study. Use of alcohol in the province as a whole showed a decline during this same period, likely due to the economic recession, but the increase in past-30-day alcohol use may suggest those who attend the ED late at night on the weekends have a slightly different pattern of use than the rest of the general population. Other studies of the effects of the recession on drinking patterns have also suggested increased binge drinking among young males, despite

a general decline in consumption (*39*). Reported use of illicit drugs in the past 30 days (excluding cannabis) also decreased significantly between 2008 and 2011, possibly a result of changes in availability of these substances or of the growing trend toward use of pharmaceutical drugs as a substitute for illicit drugs in this province. More than one-third of patients who attended the ED late at night on the weekends reported moderate or severe problems associated with their alcohol use, and 20% reported similar harms from use of cannabis. These patterns remained fairly steady over the study period, with no significant increases or decreases, suggesting that the harms associated with alcohol and cannabis use remain a consistent and ongoing concern. In addition, alcohol was the substance most commonly reported as contributing to a range of acute injuries bringing patients to the ED for treatment.

The purpose of this surveillance study was the routine collection of survey and objective test data that, over time, provided useful information on trends and prevalence of late-night use of alcohol and other drugs among respondents in an ED setting. While two objective measures were used, the breathalyzer test, which is designed to capture recent alcohol consumption, appeared to be more effective than the saliva test, which is designed to measure recent drug use. These late-night interviews, which primarily gathered data on high-risk ED attendances involving use of alcohol and other drugs, also recorded routinely-collected electronic data on attendees to the ED who might not necessarily be admitted as patients to the hospital. As a result, monitoring data was collected on substance use–related ED visits that would not normally be included in aggregate morbidity data. Standardized test scores of problems related to substance use also provided an ongoing snapshot of substance use patterns among those who attended the ED.

Ongoing monitoring and surveillance of ED presentations in multiple sites in BC and elsewhere in Canada can provide a means of complementing existing comprehensive monitoring systems as well as support for policy making, prevention responses, and evaluation of substance use interventions. More information on the ED surveillance study can be found at the BC AOD Monitoring Project website (*40*). ■

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CHAPTER 13

Clinical assessment versus breathalyzer readings in emergency departments in nine countries: concordance of results based on ICD-10 Y90 and Y91 codes

Jane Witbrodt and Jason Bond

SUMMARY

Through its storage and retrieval of data from health and vital records, the World Health Organization (WHO) International Classification of Diseases (ICD) plays an important role in informing prevention efforts and policy initiatives in reducing morbidity and mortality. This chapter analyzes the concordance between the clinical assessment of alcohol intoxication (ICD 10th revision (ICD-10) code Y91) and estimated blood-alcohol concentration (BAC) (ICD-10 code Y90) among injury patients in emergency departments across nine countries in the Americas. The intended use of the Y90 and Y91 codes are as "supplementary information concerning cause." The value of coding not only a diagnosis (e.g., head injury) but also causative factors (e.g., alcohol consumption) is evident. As currently formulated, the ICD-10 reads that Y91 can be used in cases where BAC testing is unavailable or cannot be funded, suggesting interchangeability of these two measures of intoxication. Findings with this cross-country sample suggest limited interchangeability between the clinical assessment and BAC, especially for individuals consuming alcohol within six hours before the injury event. Moreover, agreement between Y90 and Y91 was poorer for those who reported heavy drinking patterns in the prior year. Cross-country differences for concordance estimates are explored and implications for future directions are discussed.

INTRODUCTION

Alcohol is the leading risk factor for disease burden in the Americas and the Western Pacific (*1*). According to World Health Organization (WHO) estimates, alcohol use is responsible for approximately 4.5% of the global burden of disease and injury worldwide (*2*) and accounts for more than 2 million deaths annually (approximately 4% of all deaths). About half these deaths are the result of intentional and unintentional injuries related to hazardous and harmful drinking (*3*). In addition to volume of consumption, pattern of drinking (especially heavy episodic drinking) has been directly linked to intentional and unintentional injury, including those due to traffic accidents, violence, and suicides (*4*). The relationship between heavy alcohol consumption and injury occurrence is particularly evident in emergency departments (EDs) where estimates suggest that 10%–18% of injury patients are alcohol-related cases (*3*). This chapter analyzes concordance between the clinical assessment of alcohol intoxication (ICD-10 code Y91) and estimated blood-alcohol concentration (BAC) (ICD-10 code Y90) among injury patients in emergency departments across nine countries in the Americas.

Monitoring alcohol injury globally

Involvement of alcohol in injuries has been confirmed in various international studies (*5*), with ED studies providing the best available evidence for measuring the actual association between dose-re-

lated consumption and injury. Alcohol-related injury ED studies mostly emerged after the International Classification of Diseases, 10th revision (ICD-10) (*6*) added two optional codes, Y90 and Y91, for recording levels of intoxication (*7–10*). The ICD, which is updated periodically to remain current with emerging diseases and advances in science and technology, is a key epidemiologic resource used for the storage and retrieval of longitudinal health and vital records data and to generate essential global and international mortality and morbidity statistics (*11*). WHO estimates that about 70% of global health expenditures are allocated according to ICD-coded data (*12*). In terms of reducing alcohol-related injury morbidity and mortality, the ICD plays a critical role in informing policy responses (*11*).

Together, Y90 and Y91 criteria provide relatively quick assessments of dosage via an estimate of BAC and a short clinical assessment of mental / behavioral dysfunction indicating apparent level of intoxication respectively. The Y90 and Y91 codes were appended to ICD-10 Chapter 20 ("External causes of morbidity and mortality" (unintentional / intentional poisoning by alcohol)) as categories to be used as "supplementary information concerning cause." No specification is made in Chapter 20 about the relation between Y90 and Y91 or if one is preferred over the other. However, the following commentary on Y91 and Y90 inclusions in Chapter 5 ("Mental and behavioral disorders") implies that the Y91 clinical assessment may be used interchangeably with Y90: "Code Y91 may be used to specify the clinical severity of intoxication if the blood-alcohol level is not available" (*13*). The sub-codes for Y90 are defined by a series of nine monotonically increasing blood-alcohol levels (< 20 mg/100 ml (0.02); 20–39 mg/100 ml; 40–59 mg/100 ml; 60–79 mg/100 ml; 80–99 mg/100 ml; 100–119 mg/100 ml; 120–199 mg/100 ml; 200–239 mg/100 ml; and ≥ 240–39 mg/100 ml). There is also a code for "presence of alcohol in blood, level not specified." The Y91 records an assessment of alcohol involvement determined by four levels of intoxication: Y91.0 ("mild"), Y91.1 ("moderate"), Y91.2 ("severe"), and Y91.3 ("very severe"). Descriptions in terms of alcohol on the breath, disturbance of functions and responses, and ability to cooperate

are used to differentiate these levels (see Appendix A for details). An additional code is provided to indicate "alcohol involvement, not otherwise specified" (Y91.9).

Discussions leading to proposed revisions in the ICD-10 have given rise to interest in the functionality of the supplemental Y90 and Y91 codes as interchangeable measures of alcohol intoxication. One issue to be clarified is whether the two codes are accurately capturing the same phenomena as currently formulated or whether some reformulation or adaptation might be better at capturing interchangeability, and, further, whether the two codes have common reliability across different drinking cultures. These are highly relevant questions given that the ICD functions as an international standard for the systematic recording, interpretation, and comparison of mortality and morbidity data cross-culturally (*6*). Although the burden of alcohol-related injury in ED caseloads has been well documented in special epidemiological studies, Y90 and Y91 codes have not been generally implemented in ED settings (*14, 15*). Likewise, other types of monitoring and surveillance of alcohol-related ED admissions generally have not been instituted (*14, 16–18*). Researchers and practitioners have posited various reasons for this trend. For example, the collection of BAC data, typically done via a breathalyzer test, is not always possible in ED environments (*19*). Further, some ED staff are hesitant to request BAC readings because patients view them as judgmental or even judicial, and staff are more focused on coding the diagnostic versus the causative factors of injury at admission (*20*). In addition, legal ramifications and concerns about health insurance repercussions can deter staff in some ED locations from conducting BAC assessments (*21*).

Observational or clinical assessments have been met with similar reluctance among ED staff, due in part to lack of resources (*22*). In addition, an observational assessment of intoxication level relies on perceptions and judgment, which raises questions about its validity and agreement with BAC measurement. Assessments are expected to vary according to various factors, including the degree of experi-

ence of the person making the assessment, the timing between the BAC estimation and the clinical assessment, the patient's physical and psychological tolerance to alcohol, cultural-influenced assumptions affecting the clinician's assessment (*13, 23*), and other socioeconomic variations that might be expected to affect either the clinical assessment of intoxication and/or manifestations of intoxication on the part of a patient who had been drinking (*24*).

Patient tolerance to alcohol is a well-recognized mask of their signs of intoxication and requires special mention. Alcohol tolerance is increased by regular drinking, which in turn reduces sensitivity and requires that higher quantities of alcohol be consumed to achieve the same effects experienced before tolerance is established (*25*). In people who drink large amounts of alcohol on a regular basis, the liver adapts to break down alcohol more rapidly than in those who rarely drink, and neurotransmitter systems in the brain adapt to the regular presence of alcohol. Chronic heavy drinkers develop both pharmacological and psychological tolerance (*8*). Biological variation in sensitivity to alcohol and tolerance that develops in response to repeated alcohol consumption is not equally distributed across racial / ethnic cultures, and differences in tolerance levels are also influenced by socioeconomic and cultural differences including diet, average body weight, and patterns of consumption. Taken together, these indications suggest that the current Y91 clinical assessment may not serve as the ideal approximation of BAC (*26*).

Study aims

To augment what is known about the agreement between Y90 and Y91 codes, and to better inform the discourse on ICD-11 revisions, this chapter expands on earlier work that compared Y91 clinical assessments with Y90 breathalyzer estimates using ED admissions data from 12 countries participating in the WHO Collaborative Study on Alcohol and Injuries (WHO-ER) (*3, 27*). That study (*n* = 4 798) found the level of agreement between the two measures to be moderately concordant among all ED patients admitted for intentional and unintentional injuries, but

much lower among those reporting drinking before the injury event. The modest concordance between Y90 and Y91 in the study brought into question the interchangeability of the two intoxication measures. To analyze concordance between Y90 and Y91, the study used a mapping strategy in which thresholds for BAC were reduced from the nine ICD-10 levels to four levels, and two of the five clinical assessment thresholds ("severe" (Y91.3) and "very severe" (Y91.4)) were collapsed into a single category. The WHO-ER study also tested whether the concordance between the clinical assessment and the BAC estimate was moderated by gender, timing of the clinical assessment in relation to the BAC reading, alcohol dependence, and/or tolerance. Only the two latter correlated factors were found to influence the concordance estimates. Dependent/tolerant individuals were more likely to be clinically assessed as intoxicated at relatively low levels of BAC (i.e., their concordance estimates were lower than their counterparts), highlighting the potential mediating effect of tolerance between the physiological blood-alcohol level and clinical signs of intoxication (*8*). Concurrent drug use was not tested, but the authors of the study suggested it too could have masked clinical signs of intoxication. The association of alcohol in combination with other substance use has received scant attention in ED studies compared to alcohol use (*28*) even though psychoactive substances may potentiate the effect of alcohol use and elevate the risk of injury (*29–31*).

Building upon the WHO-ER study (*27*), concordance estimates between the BAC and the clinical assessment were examined with data from nine countries in the Americas (described below). In addition to finding that concordance estimates varied according to other factors, as was the case in the WHO-ER study, the nine-country study probed for cross-country variations between the BAC and the clinical assessment, and examined repartition levels for the nine-category BAC more closely. The use of drugs other than alcohol and patterns of potentially harmful or hazardous drinking were also tested, along with the influence of gender, dependence, and tolerance on concordance estimates (*5, 20, 32, 33*).

METHODS

Sample

The data were obtained from EDs in Argentina, Brazil, Canada, Dominican Republic, Guatemala, Guyana, Mexico, Nicaragua, and Panama. The study methodology across sites was similar to that used in previous ED studies (*7*). In brief, a probability sample of patients admitted for an injury within six hours of the injury event at each site was approached as soon as possible for recruitment and informed consent to participate. The total combined sample across the nine country sites consisted of 3 868 adult injured patients (aged 18 years and older) who supplied a BAC reading (Y91) and for whom a clinical assessment (Y91) was obtained, representing an 89% completion rate. Tests of concordance between the Y90 and Y91 were estimated for the full combined sample as well as for only the 968 patients who reported drinking during the six hours before injury. Besides conducting tests for the nine countries in the aggregate, concordance estimates were generated for each country separately. The latter estimates allowed for closer examination of cross-cultural differences.

Measures

BAC estimates were obtained using an Alco-Sensor® III breath analyzer (Intoximeters, Inc., St. Louis, MO, USA), and patients were given a 25-minute interviewer-administered standard questionnaire. A cohort of interviewers in each site was trained and supervised by study collaborators in their respective locations. The Y91 clinical assessment of intoxication was made after the interviewer had obtained the BAC estimate, by an ED physician or nurse blind to this estimate. Physicians and/or nurses were trained by WHO study staff and site investigators using a module prepared by WHO that included diagnostic criteria for intoxication and impairment and other clinical conditions warranting a differential diagnosis. Clinicians were trained at each ED site to ensure sufficient clinician availability during the periods patients were sampled.

Factors that were expected to influence or bias concordance between the BAC and clinical assessment were coded as "positive" (present) or "negative" (absent). Alcohol dependence was measured based on patient response to four questions from the Rapid Alcohol Problems Screen (RAPS4) (*34, 35*): [During the past 12 months:] 1) Have you had a feeling of guilt or remorse after drinking?" "2) Has a friend or a family member ever told you about things you said or did while you were drinking that you could not remember?" "3) Have you ever failed to do what was normally expected of you because of drinking?" and "4) Do you sometimes take a drink in the morning when you first get up?" A positive response on one or more items was coded as "screened positive for dependence." The RAPS4 has performed equally or better than other screening instruments based on alcohol dependence criteria (*6, 36*) in other ED populations (*37, 38, 39, 40*). The following question from the DSM–IV (*36*), which has been used in other screening assessments (*41, 42*), was used to assess tolerance: "During the past 12 months, have you found that you need to drink much more than before to get the same effect, or that drinking your usual amount began to have less effect on you?" Taking this single tolerance measure a step forward, harmful or hazardous consumption measures not tested in the WHO-ER study were created from items querying the frequency of drinking at various consumption levels. These included two measures of heavy episodic drinking (consuming 12 or more drinks at least monthly (created from an item assessing the frequency of drinking 12 or more drinks on an occasion), and consuming five or more drinks at least weekly), and one high-frequency measure defined as drinking daily (any amount). These measures were chosen based on findings from prior ED studies that showed episodic heavy and frequent heavy drinkers had the highest likelihood of alcohol-related injury (*43*). Drug use—another measure with the potential to interact with signs of intoxication—was assessed using the following question from the Y91 clinical assessment: "Do you think there is any evidence of substance usage other than alcohol?" Positive assessment was based on personal observation of the ED physician or nurse completing the assessment. This measure was included based on literature indicating that those who

use alcohol are more likely to also use other drugs (*40, 44, 45*).

Data analysis

To analyze the level of concordance between Y90 and Y91, mapping of Y90 BAC replicated the following mapping used in the WHO-ER study (*27*): BAC ≤ 0.059 = "no intoxication"; BAC ≥ 0.060–0.099 = Y91.0 ("mild intoxication"); BAC ≥ 0.100–0.199 = Y91.1 ("moderate intoxication"); and BAC ≥ 0.20 = Y91.2/Y91.3 ("severe / very severe intoxication"). This mapping scheme was originally based on available published information on the rough agreement between BAC and levels of behavioral impairment, and on descriptions of the Y90 and Y91 categories in the ICD-10 (27). As these BAC partition levels did not match optimally with the intoxication levels specified in the clinical assessment codes in the WHO-ER, alternative mapping schemes based on a careful examination of matched and mismatched pairs in the cross-tabulation tables, and resulting concordance estimates across the nine countries (described below), were also considered in the analysis of the current ED injury sample. Low-risk drinking guidelines also factored into the BAC repartitioning decisions (*46*). Matched pairs are represented by the diagonal values in cross-tabulation tables (e.g., where both Y90 and Y91 are assessed as "mild") and mismatched pairs are represented by off-diagonal values (Table 1). Like the WHO-ER study, the "severe" and "very severe" categories were combined in the Y90 clinical assessment due to the low number of cases at these levels (especially at the country level).

Kendall's τ_b (tau-b) (*47*) was used to measure the concordance of BAC categorization with clinical assessment. Kendall's τ_b, is a nonparametric measure of association of two ordinal variables with the same number of categories based on the number of paired concordant (matches), discordant (mismatches), and ties in paired observations. Kendall's τ_b was chosen for use in this study because other measures that do not account for ties in paired cases (e.g., Goodman-Kruskal's gamma) have been found to over-estimate the relationship between two categorical variables, especially when both are strongly skewed (*48, 49*). Values of τ_b range from –1

(100% negative association, or perfect inversion) to 1 (100% positive association, or perfect agreement). A value of zero indicates the absence of association. Tests of concordance were estimated for 1) all injured ED patients and 2) only those who either reported drinking in the six hours before the injury event or who had a positive BAC at ED admission. These concordance estimates were also computed separately for each country and by sex, dependence status, tolerance, drug use, and harmful consumption for the aggregated injury samples to test for masking effects on concordance estimates.

RESULTS

Exploring Y90 BAC and Y91 clinical assessment concordance

Based on the Y90 and Y91 categorizations used in the WHO-ER study (*27*), a total of 82.9% of patients with a BAC ≥ 0.060 were clinically assessed as intoxicated ("mild or higher levels of intoxication") in the aggregate nine-country sample (243 of 293 patients), whereas 90.0% of those with a BAC ≤ 0.059 were assessed as not intoxicated (3 218 of 3 575) (Table 1, left panel). Just over 83% of all ED injury patients with a BAC ≤ 0.059 were clinically assessed as not intoxicated, indicating moderate to good agreement for these categorizations. For the full (combined) nine-country sample, the resultant estimate of τ_b was 0.54, and the analogous estimate using only data for those who reported drinking during the six hours before their injury event was 0.40. A total of 82.6% of patients with a BAC ≥ 0.060 were clinically assessed as intoxicated (237 of 287), and 54.4% (BAC ≤ 0.050) were assessed as not intoxicated (371 of 681).

Several exploratory steps were undertaken to understand whether discrepancies between τ_b estimates were driven by differences in the current nine-country sample versus the WHO-ER study sample, or due to idiosyncratic country-level influences in the current sample. First, a cross-classification analysis was conducted for each of the nine countries to determine whether the overall τ_b estimates were strongly influenced by data from individual countries.

TABLE 1. Cross-classification (%) of intoxication level according to ICD-10[a] clinical assessment (code Y91) and blood-alcohol concentration (BAC) (code Y90) for 1) all injury patients (*n* = 3 868) and 2) current-drinker injury patients who drank in the six-hour period before their injury, based on results of emergency department study across nine countries[b] in the Americas (1989-2011)

	ICD-10 clinical assessment (code Y91)									
	All injury patients					Current-drinker injury patients who drank during six-hour period before injury				
ICD-10 BAC (code Y90)[c]	None	Mild	Moderate	Severe+	Total (No.)	None	Mild	Moderate	Severe+	Total (No.)
0−0.059	83.22	5.46	2.92	0.83	92.43 (3 575)	38.33	18.18	10.95	2.89	70.35 (681)
0.060−0.099	0.52	0.39	0.18	0.08	1.16 (45)	2.07	1.45	0.72	0.31	4.55 (44)
0.100−0.199	0.41	0.98	0.78	0.26	2.43 (94)	1.65	3.93	3.10	0.93	9.61 (93)
≥ 0.200	0.36	0.52	1.73	1.37	3.98 (154)	1.45	2.07	6.71	5.27	15.50 (150)
Total (No.)	84.51 (3 269)	7.34 (244)	5.61 (217)	2.53 (98)	100 (3 868)	43.49 (421)	25.62 (248)	21.49 (208)	9.40 (91)	100 (968)
Kendall's τ_b coefficient (standard error)		0.54 (0.01)					0.40 (0.03)			

[a] World Health Organization (WHO) International Classification of Diseases, 10th revision.
[b] Argentina, Brazil, Canada, Dominican Republic, Guatemala, Guyana, Mexico, Nicaragua, and Panama.
[c] BAC thresholds from WHO Collaborative Study on Alcohol and Injuries (WHO-ER).

Results indicated that two countries (the Dominican Republic and Guyana) had significantly lower τ_b estimates for all injury patients (τ_b = 0.05 and 0.03 respectively; Ps < 0.01) than the other seven countries (which had τ_b estimates ranging from 0.36 (Nicaragua) to 0.83 (Guatemala); results not shown). When concordance tests that excluded data from these two countries were conducted, τ_b estimates increased to 0.61 in the seven-country aggregate sample, versus 0.54 in the nine-country aggregate sample. A similar pattern emerged for patients reporting drinking in the six hours before injury. Upon further examination of the distributions of Y91 assessment by Y90 BAC in each country (not shown), the decision was made to consider alternative thresholds for the BAC categories (described below).

Exploring alternative BAC categorizations

Next, a cross-classification of clinical assessment by BAC was conducted on the overall sample using all nine ICD-10 Y90 categorizations (Appendix A).

Results of this exploration led to the decision to set the BAC thresholds lower for the "no intoxication" (≤ 0.019), "mild intoxication" (≥ 0.020–0.059), and "moderate intoxication" (≥ 0.060–0.199) categories ("severe"/ "very severe" was left at ≥ 0.200). These lower thresholds still fall in line with guidelines set by many countries for low-risk drinking and legal limits for high-risk drinking (*46, 50–52*), which depend on drinking speed and tolerance.

The cross-classification of clinical assessment by BAC was conducted again using the repartitioned BAC thresholds. The resulting τ_b estimate for all injury patients increased dramatically under this new partitioning of BAC (to 0.68 from 0.54; P < 0.01) and τ_b estimates generally showed some improvement across the individual countries (results not shown). Under this new partitioning, 79.2% of all injury patients with a BAC ≥ 0.020 were assessed as intoxicated (410 of 518) and 94.4% of those with a BAC ≤ 0.019 were assessed as not intoxicated (3 161 of 3 350). Approximately 82% of all ED injury patients

with a BAC ≤ 0.019 were clinically assessed as not intoxicated. For patients reporting drinking in the six hours before injury, just under half (47.4%) had a BAC ≤ 0.019 compared to just under three-quarters (70.3%) using the ≤ 0.059 threshold. Using the repartitioned BAC thresholds, a cross-classification of clinical assessment by BAC that once again excluded the Dominican Republic and Guyana resulted in a significant improvement for all injury patients (0.73 compared to 0.68, P < 0.05) but did not reach significance for those drinking in the six hours before injury (0.48 versus 0.51). Under both BAC mapping schemes, τ_b estimates generally increased when the two countries were excluded from their respective aggregate samples, suggesting that improvement was related more to characteristics unique to the two countries and less to how the BAC thresholds were partitioned.

The cross-classification tables provide further information on the direction of mismatched pairs. Whereas estimates on the diagonal represent matched Y90 and Y91 pairs, pairs above the diagonal represent cases where Y91 overestimates Y90, and pairs below the diagonal represent cases where Y91 underestimates Y90. For both the full sample and only those reporting drinking in the six hours before injury, five countries (Argentina, Brazil, Canada, Guatemala, and Mexico) were more likely to assign lower clinical assessments (where Y91 underestimates Y90) relative to BAC categorizations. Four countries (Dominican Republic, Guyana, Nicaragua, and Panama) were more likely to assign higher clinical assessments (where Y91 overestimates Y90) (results not shown). These under- and over-estimations largely balanced out (6.4 / 7.5 and 25.3 / 25.1 respectively) in the combined sample. Table 2 displays Y90–Y91 cross-country estimates for matched pairs on the diagonal (raw agreement), as well as those for BACs ≤ 0.019 matched to "none" on the clinical assessment and BACs ≥ 0.020 matched to any severity level of intoxication (mild or higher) on the clinical assessment. In general, Table 2 suggests more cross-country variability in the rates of agreement between Y90 and Y91 for patients reporting drinking in the six hours before injury than was found for the combined sample.

Influence of other factors on concordance estimates

Table 3 displays the raw agreement (matched pairs on the diagonal) and the τ_b concordance estimates between the clinical assessment and repartitioned BAC categorizations by sex, dependence status (RAPS4), drug use, tolerance, and heavy drinking variables. No differences in τ_b estimates were found by sex or dependence among all injury patients, but agreement and concordance were significantly lower for patients positive on measures for drug use and ≥ 5 drinks weekly (but not positive on measures for daily drinking). Agreement was also significantly lower for those positive on tolerance. For patients who reported drinking in the six hours before injury, concordance was significantly lower for those positive on the two heavy episodic measures, ≥ 12 drinks monthly and ≥ 5 drinks weekly (but not positive on measures for tolerance).

Using τ_b, the concordance of Y90 and Y91 was also estimated for each country by sex, dependence, and the two heavy drinking variables; other factors were excluded due to very small cell counts. The results for Canada are not included here because almost all injury patients reported no or very low levels of intoxication. Concordance estimates were unaffected by gender in each country. For Guatemala and Nicaragua, concordance was significantly lower for those positive on ≥ 12 drinks monthly and ≥ 5 drinks weekly. No other significant within-country concordance differences were found. However, small cell counts, especially for those positive on the above-mentioned factors, limit conclusions that can be drawn from these estimates.

DISCUSSION

Are the two ICD Y intoxication codes capturing similar phenomena? The answer appears to be "it depends." Overall, the agreement of clinical assessment of intoxication with the estimated BAC at the time of the ED visit was high among all injury patients in the nine-country sample from the Americas. The vast majority of injury patients with no intoxication (BAC ≤ 0.019) were clinically assessed as not intox-

TABLE 2. Agreement between ICD-10[a] clinical assessment (code Y91) and blood-alcohol concentration (BAC) standard[b] (code Y90) for 1) all injury patients (n = 3 868) and 2) current-drinker injury patients who drank in the six-hour period before their injury, based on results of emergency department study across nine countries in the Americas, (1989-2011)

| | All injury patients | | | | | Current-drinker injury patients who drank during the six-hour period before injury | | | | |
| | Kendall's τ_b coefficient (SE[c]) | Raw agreement (diagonal totals) | | Y90–Y91 agreement (dichotomized) | | Kendall's τ_b coefficient (SE) | Raw agreement (diagonal totals) | | Y90–Y91 agreement (dichotomized) | |
Country		No. (%)	n	Not intoxicated[d] (%)	Intoxicated[e] (%)		No. (%)	n	Not intoxicate[d] %	Intoxicated[e] %
All	0.54 (0.01)	3 329 (86.1)	3 868	96.7	79.2	0.40 (0.03)	480 (49.6)	968	80.0	68.4
Argentina	0.75 (0.04)	359 (84.7)	424	95.7	81.3	0.48 (0.07)	49 (46.7)	105	75.8	80.6
Brazil	0.61 (0.06)	429 (89.7)	478	95.5	64.4	0.50 (0.07)	104 (68.9)	151	86.9	68.2
Canada[f]	0.28 (0.22)	200 (97.1)	206	96.6	16.7	0.22 (0.31)	10 (62.5)	16	90.0	16.7
Dominican Republic	0.28 (0.07)	401 (85.1)	471	87.9	52.0	0.02 (0.10)	43 (41.7)	103	43.0	58.3
Guatemala	0.85 (0.02)	433 (85.4)	507	95.8	95.1	0.31 (0.08)	50 (44.6)	112	44.4	95.1
Guyana	0.70 (0.05)	407 (86.8)	469	97.3	69.7	0.49 (0.07)	68 (53.1)	128	85.4	69.7
Mexico	0.57 (0.06)	328 (85.0)	386	93.7	64.1	0.39 (0.08)	62 (53.4)	116	72.3	62.7
Nicaragua	0.72 (0.03)	391 (81.1)	482	91.9	85.6	0.31 (0.08)	126 (33.3)	126	35.0	88.4
Panama	0.71 (0.04)	381 (85.6)	445	90.1	82.2	0.43 (0.07)	52 (46.8)	111	64.8	86.0

[a] World Health Organization (WHO) International Classification of Diseases, 10th revision.
[b] BAC thresholds from WHO Collaborative Study on Alcohol and Injuries (WHO-ER).
[c] SE: standard error.
[d] Defined as the % clinically assessed as not intoxicated among those patients with BAC ≤ 0.019
[e] Defined as the % clinically assessed as intoxicated at any of the three severity levels among patients with a BAC > 0.020
[f] Only 6 of 206 cases in Canada had BAC values > 0.059 and 5 of those cases were clinically assessed as not intoxicated.

TABLE 3. Agreement between ICD-10[a] clinical assessment (code Y91) and blood-alcohol concentration (BAC) standard[b] (code Y90b) by characteristics of injury patient sample in emergency department study across nine countries in the Americas, (1989-2011)

Characteristic	All injury patients			Injury patients who drank during the six-hour period before injury		
	Raw agreement			Raw agreement		
	No.	%	Kendall's τ_b (SE[c])	No.	%	Kendall's τ_b (SE)
Total sample	3 868	86.07	0.68 (0.02)	968	49.59	0.48 (0.02)
Male	2 665	81.80	0.68 (0.02)	830	46.75	0.47 (0.03)
Female	1 193	95.56	0.63 (0.06)	137	67.15	0.50 (0.07)
Negative for RAPS4	2 801	92.11	0.63 (0.03)	476	57.14	0.46 (0.04)
Positive for RAPS4	1 067	70.20	0.66 (0.02)	492	42.28	0.44 (0.03)
Negative for drug use	3 510	88.52[d]	0.68 (0.02)	792	52.53	0.50 (0.03)
Positive for drug use	86	47.67	0.52 (0.07)	55	36.36	0.41 (0.10)
Negative for tolerance	3 492	87.63[d]	0.65 (0.02)	807	50.68	0.45 (0.03)
Positive for tolerance	233	65.67	0.73 (0.04)	134	43.28	0.49 (0.08)
Negative for daily drinking[e]	3 593	87.14	0.68 (0.02)	844	49.88	0.48 (0.03)
Positive for daily drinking[e]	193	64.77	0.60 (0.05)	118	46.61	0.42 (0.07)
Negative for drinking 12+ drinks at least monthly[e]	1 767	85.74	0.70 (0.02)	503	52.88[d]	0.53 (0.03)
Positive for ≥ 12 drinks per month (same as above)[e]	516	64.34	0.64 (0.03)	303	42.57	0.43 (0.04)
Negative for 5+ drinks at least monthly[e]	2 848	89.54[d]	0.72 (0.02)	600	53.83[d]	0.56 (0.03)
Positive for ≥ 5 drinks per week (same as above)[e]	414	63.29	0.59 (0.04)	247	42.11	0.34 (0.06)

a International Classification of Diseases, 10th revision.

b BAC thresholds from WHO Collaborative Study on Alcohol and Injuries (WHO-ER).

c SE: standard error.

d P ≤ 0.01.

e Among past-12-month drinkers.

icated (82%), and among those who were intoxicated a slightly higher percentage were represented by matched versus unmatched pairs across the Y90–Y91 levels. Disregarding levels of intoxication, more than 90% of those who were intoxicated (BAC level ≥ 0.020) were clinically assessed as intoxicated at one of the four levels (i.e., Y91 = "mild" or higher). These data are consistent with other estimates showing that 10%–18% of all ED injury patients are alcohol-related cases (*3*). Though the τ_b concordance estimate for this overall injury sample was moderately strong, this statistic was nonetheless driven in large part by the high proportion of patients who registered low on the breathalyzer and were thus clinically assessed as not intoxicated. Taken together these estimates suggest that although the level of agreement between categorized BAC and clinical assessment based on four Y91 categories was only moderate, the identification of no alcohol involvement versus any involvement is very accurate.

When agreement between BAC and clinical assessment was tested across the nine countries among those who drank in the six hours before injury—perhaps the population of most concern in ED settings—the concordance and raw agreement was poor. Further, while the study's capacity to examine whether Y90 and Y91 codes had common reliability across the different drinking cultures was somewhat limited by sample sizes (as evident by differences that appeared large but were not statistically different), cross-country variation was observed, and this variation was highest for those drinking before injury. Thus, significant concerns remain regarding the reliability and interchangeability of Y91 clinical assessment (a subjective assessment) and Y90 BAC (an objective assessment) as intended in the ICD-10 formulation.

Moreover, Y90 and Y91 agreement was poorer for injury patients who reported heavy drinking patterns (≥ 5 drinks weekly and ≥ 12 drinks monthly), and for those who self-reported tolerance—another injury patient population of concern in ED settings. Curiously, the τ_b estimate was the reverse of what was expected for tolerance, perhaps due to small numbers, imbalanced or wide CIs, and weak

significance. These findings for heavy drinkers may have been influenced by particular country contexts, but here, again, small sample numbers limit conclusions. As to other cross-cultural differences, although the percentage of injury patients with high BAC intoxication levels who were clinically rated at lower intoxication levels was about the same as those rated with the reverse pattern in the overall and six-hours-before-injury drinker aggregate samples, variability was found for country-level over- and under-estimations for Y90 and Y91.

The extent of correlation between tolerance and heavy drinking measures was unclear, as neither measure reflected overall drink volume—another way of measuring tolerance. Volume of alcohol typically consumed and occurrence of heavy drinking episodes have been shown to be associated independently with incidence of alcohol-related injury (*53*). Additional analyses revealed correlations between tolerance (a self-reported measure in the current data) and consuming ≥ 5 drinks weekly and ≥ 12 drinks monthly were small (with r values of about 0.30). Someone consuming ≥ 5 drinks weekly could have been drinking at this level once a week or daily—a limitation for this and the ≥ 12 drinks monthly measure. In contrast, the strength of the relationship between levels of drinking of ≥ 5 drinks weekly and ≥ 12 drinks monthly was high (r = 0.52), suggesting these measures might be used interchangeably. These correlations suggest that tolerance (as queried in this study) measured something apart from the two heavy episodic measures used here.

Well-grounded suggestions about alternatives to the Y90 and Y91 as currently used have begun to appear in the published literature (*13, 20, 42, 54*) as well as WHO reports (*3*). These generally propose that Y90 and Y91 are not sufficient in themselves to meet the role intended in the ICD-10 and that both would benefit from augmented information. Two recurrent themes in the Y90 and Y91 literature are 1) how to eliminate barriers to the documentation of alcohol involvement, and 2) how to improve recording of alcohol involvement in injuries in ED settings. The Y90 and Y91 codes have not been used in practice in non-research conditions. A rarely used surveillance system does not

generate reliable information, and low rates of alcohol involvement could result in underestimates of rates of alcohol-related injury (*46*, personal communication). The reality is that the degree to which Y90 and Y91 codes, and even alcohol-specific ICD codes in general, are recorded is largely unknown. Research is currently under way by the authors of the nine-country study to address this issue.

CONCLUSIONS

In terms of reducing alcohol-related injury morbidity and mortality, the ICD plays a critical role in informing prevention efforts and policy responses. The value of coding not only a diagnosis (e.g., head injury) but also causative factors (e.g., alcohol intoxication) is apparent. Because the risk of injury increases with increasing alcohol consumption (*4*), efforts to reduce consumption at both the individu-

al and population level are important (*5*). Potential alcohol policies include government measures that control the alcohol market to help protect the health of the population. Individuals who experience an alcohol-related injury are at higher risk for repeated injury than the general population, and intoxicated trauma patients who require hospitalization are 2.5-fold as likely to be readmitted than those not intoxicated (*55*). From an international perspective, research has shown that alcohol-related morbidity and mortality are linked to economic status, with lower economic development and socioeconomic status associated with higher alcohol-attributable disease burden (*2*). Yet despite the burden of injury attributable to heavy alcohol consumption, the alcohol link is not routinely recorded (*56*), and various epidemiological studies remain the primary source of data on alcohol-related injury (*13*). ■

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Chapter 13 Appendix A

Signs of intoxication used to inform Y91 clinical assessment
1. Smell of alcohol on breath
2. Conjunctival injection and/or flushed face
3. Impairment of speech (e.g., slurring)
4. Impairment of motor coordination
5. Impairment of attention and/or judgment
6. Elated (euphoria) or depressed mood
7. Disturbances in behavioral responses
8. Disturbances in emotional responses
9. Impaired ability to cooperate
10. Horizontal gaze (nystagmus)

Y91: clinical assessment
- **Y91.0 (mild)**: smell of alcohol on breath, slight behavioral disturbance in functions and responses, or slight difficulty in coordination
- **Y91.1 (moderate)**: smell of alcohol on breath, moderate behavioral disturbance in functions and responses, or moderate difficulty in coordination
- **Y91.2 (severe)**: severe disturbance in functions and responses, severe difficulty in coordination, or impaired ability to cooperate
- **Y91.3 (very severe**): very severe disturbance in functions and responses, very severe difficulty in coordination, or loss of ability to cooperate
- **Y91.9**: alcohol involvement not specified otherwise

Response categories for 10 signs of intoxication and Y91
0—none
1—mild
2—severe
3—moderate
4—very severe
5—involved but not sure, not applicable

CHAPTER 14

Strategies to prevent alcohol-related injury targeted to high-risk products, settings, and populations

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SUMMARY

The allocation of resources to prevent alcohol-related injuries should address different risk groups within the population as well as hazardous alcohol products and drinking environments. Because of the high prevalence of hazardous drinking behavior, universal strategies that reduce the alcohol consumption of all drinkers should be a priority, particularly those targeting the price and physical availability of alcohol. Targeting the cheap, high-strength alcohol often preferred by hazardous drinkers through policy interventions (e.g., by setting a minimum price per standard drink) should also be a priority. The risk of alcohol-related injury is highly context-specific, and some drinking environments are especially high risk for injury. There are proven strategies for limiting the risk of injury both in public drinking venues such as bars and nightclubs and on the roads. For example, drinking environments may be modified and staff trained to reduce risk of injury independent of drinking behavior per se. Policing strategies, which can help to reduce risk of alcohol-related violence at drinking venues, and deter impaired driving, can also be implemented. Targeted strategies that screen, identify, and provide brief intervention to hazardous drinkers can also be effective. These types of interventions have been successfully implemented in emergency departments, resulting in reductions in alcohol consumption and related injuries. Evidence that school education and public alcohol awareness campaigns work is weak. However, it is recommended that alcohol education be re-conceptualized as a means to raising awareness of both alcohol-related harms and the availability of effective strategies to increase public support for effective measures to reduce alcohol-related injury. A sea change in public opinion on alcohol and alcohol-related problems is required so that the yawning gap between what is known about the prevention of alcohol-related injuries and what is actually implemented can begin to be closed.

INTRODUCTION

When strategies to address alcohol-related problems are considered, it is tempting to focus initiatives and resources only on those sectors of the population with the highest rate of problems. This approach is effective yet limited for two reasons. First, it does not address occasional alcohol-related incidents, which involve those who typically but not always drink modest amounts. Second, it has no preventive potential for those who 1) are currently not drinking and who may be hurt or injured by someone else's drinking, or 2) may drink themselves in a high-risk manner in the future. Thus, it is important that policies and prevention strategies target the whole population, as well as those who drink large amounts and are most likely to experience alcohol-related trauma. These two foci are related to the concept of the "prevention paradox," discussed in the section below.

It is also important to consider the wide range of risks and potential harm from alcohol. All members of society are at risk of encountering alcohol-related problems, either through their own drinking (e.g., (*1*)) or due to drinking by others (*2, 3*). As noted below, occasional heavy drinking is also a concern

from a population perspective because it can have dangerous, or even lethal, consequences for the drinker or other people in the immediate environment. In addition, there are many more occasional heavy drinkers than regular heavy drinkers, so at the population level the former contribute more to the overall burden from alcohol than the latter.

This chapter describes the importance of considering risk from several perspectives, including risk related to drinkers' behavior (e.g., high-volume alcohol intake), as well as risky products and drinking settings, and how it might change across different contexts. For example, having several drinks at a New Year's party may be low risk if the drinker is using public transit to get home, but is not advisable if he/she plans to operate machinery.

The concept of environmental prevention—the policy context—should also be considered. Environmental prevention refers to strategies that focus on alcohol, selling context, and serving practices, as well as controls on products and drinking settings. While these strategies may affect the drinker and his/her behavior, the focus is on not on the individual per se. As environmental prevention has substantial potential to reduce harm from alcohol (4, 5), the policy context is extremely important. However, sufficient resources and institutional capacity are required to determine which policies are most effective, and how to put them in place—including the necessary regulatory or legislative changes. There often also needs to be investment in informing the public about the value of these strategies, as without public support their effectiveness may be compromised. Finally, in many instances it is insufficient to have sound regulation unless there is sufficient capacity and political will to ensure adequate enforcement.

REDUCING HARM FROM ALCOHOL: THE "PREVENTION PARADOX"

Alcohol-related harm includes various types of trauma, chronic disease, and social problems that can be experienced by the drinker; his/her family, friends, and work associates; or strangers. Even for persons who typically drink modest amounts of alcohol,

such as a few standard drinks per day, occasional events of heavy episodic drinking may contribute to alcohol-related negative incidents or increased probability of such events occurring. Furthermore, there are some situations and contexts when it is not advisable to drink in order to avoid health and safety risks. These include operating machinery; driving motor vehicles, aircraft, or motorized watercraft; being responsible for infants; and during work hours, to mention a few (6). These latter public health considerations apply to drinkers at all levels of consumption, ranging from the naïve first-time drinker to the regular, modest drinker, and the person who regularly drinks large quantities. Given that the number of moderate users in most societies is many times the number of high-risk users, even occasional events of hazardous drinking from this sector will contribute more overall damage in a society from alcohol than the minority who routinely drink to excess. Therefore, a comprehensive approach to reducing alcohol-related public health and safety problems needs to consider the total population, not only those who drink at levels that are hazardous to their health or are considered dependent on alcohol.

The "prevention paradox" was first outlined by Geoffrey Rose in 1981 (7), and later applied to alcohol consumption by Norman Kreitman (8). As noted by Hunt and Emslie (9), Rose contrasted "the consequences of a focus on sick individuals with that on sick populations." For example, in the case of alcohol, focusing on hazardous users might result in an effective intervention, such as comprehensive screening, brief intervention, and referral to treatment, but would only reduce a portion of alcohol-related harm, and usually at relatively high cost in terms of resources. In contrast, population-level interventions, which have the potential of reducing alcohol-related hazardous incidents, including those associated with that sector of the population that typically drinks moderate amounts, might be very cost-effective. However, there may be little motivation for a moderate drinker with infrequent episodes of binge drinking to change his/her behavior in the absence of external incentives. Interventions that target hazardous users, which are typically more costly, also face the challenges of 1) determining the interven-

tion focus, and 2) once focused, convincing persons who are habituated or dependent on alcohol to dramatically change their behavior. On the other hand, at the societal level, there may be public or administrative resistance to implementing measures that do not target those who frequently drink large quantities, so population-level interventions or policies may face the challenge of persuading policy makers that bringing about modest change in many individuals has sufficient collective benefit to be worth pursuing. Of particular relevance to alcohol-related injury are analyses of the prevention paradox in relation to alcohol use showing that "acute" alcohol-related harms in general are mostly experienced by occasional heavy drinkers (*10-12*). This perspective may be helpful in overcoming theoretical political resistance to the implementation of effective prevention measures that target this common drinking pattern, especially in hazardous settings (e.g., when driving or operating machinery). Based on the theory of the prevention paradox, population-wide measures such as random breath testing, increased pricing and reduced physical availability of alcohol offer the promise of greater impact (*5*)—none of which depend on moderate drinkers being internally "motivated" to reduce their occasional excessive consumption.

This concept has been examined in several different contexts, including binge drinking among college students (*13*), general populations of Norway and Sweden (*14*), adolescents in 23 European countries (*15*), and a household survey in Brazil (*16*). A report by Spurling and Vinson (*17*) based on a population-based case-control and case-crossover study in three emergency departments in a U.S. county estimated the population-attributable fraction (PAF) associated with drinking in the six-hour period before injury. Based on their results, "the PAF that was due to what is usually considered less hazardous alcohol consumption (fewer than 5 standard drinks for men and fewer than 4 for women on one occasion) was 4.5% in the case-crossover analysis and 3.1% in the case-control analysis. The PAF that was due to alcohol dependence was 4.0%" (*16,* p. 47). The critical point here is that there are substantially larger numbers of individuals consuming at the lower levels of

consumption than there are with dependence, so after these attributable fractions are applied there are many more preventable cases among lower-risk versus high-risk drinkers.

Given their differences in scope and goal, these strategies are not mutually exclusive; neither is fully adequate alone in a comprehensive approach, and both population-level and the more focused interventions are needed (*18*). Action on the former is essential to make substantial progress in reducing hazardous drinking and alcohol-related harm, and supportive action in the latter area is required in a comprehensive approach.

In generic terms, eight strategies have been shown to be effective in reducing alcohol-related harm: four types of population-level policies, and four types of targeted policies. All have the potential for reducing the incidence of cases that come to emergency room services. They are presented below by category.

Population-level policies

Population-level policies that have proven effective against alcohol-related harm include 1) alcohol pricing polices designed to control overall consumption and high-risk drinking; 2) controls on physical and legal availability; 3) curtailing alcohol marketing; and 4) regulating and monitoring alcohol control systems. These strategies have been shown to curtail overall drinking, reduce hazardous consumption, and lower harm from alcohol. There is extensive and growing literature in support of the population-level approach (*4, 5*), although the evidence is stronger with regard to pricing policies than it is for controls on alcohol marketing. Price and taxation of alcohol has been linked with overall consumption (*19*) as well as alcohol-related mortality and morbidity (*20-22*).

Targeted policies

Targeted policies and interventions can be used to complement population-level policies. Effective targeted strategies include: 1) countering drinking and driving; 2) changing the drinking context; 3) educating and promoting behavior change; and 4) in-

creasing access to screening, brief intervention and referral to treatment. These types of interventions, while also of benefit to drinkers and non-drinkers, are especially relevant to consumers drinking at hazardous levels or in hazardous contexts—namely, those who drive motor vehicles after drinking, those who are over-served alcohol in license premises, and those who routinely drink above the low-risk drinking guidelines (*6*).

Furthermore, as discussed below, these types of interventions can target hazardous products, hazardous environments, and hazardous drinkers. Both population-level and focused interventions are needed to reduce harm from alcohol, and both types of initiatives will benefit the population presenting in emergency rooms with alcohol-related harm.

TARGETING HAZARDOUS PRODUCTS

In countries with active alcohol markets, there are many thousand different alcoholic products available for sale, all varying in terms of beverage type (beer, wine, spirits, "coolers," etc.); alcoholic strength; price; and volume (*23*). There are also non-beverage alcohol products, and homemade and illicitly supplied alcohol products. The likelihood that each of these products will be consumed in a way that increases risk of injury is not equal. In general terms, these products pose increased risk of injury if they are high in alcohol content and low in price. These two factors can be reduced to one fundamental concept: price per unit of ethanol, which is often usefully illustrated as a price per "standard drink" (a concept defined differently in different countries). Furthermore, associations with harmful outcomes of some beverage types (e.g., beer, fortified wine) can be attributed to having the lowest prices per standard drink.

Risk from low-priced alcohol

There is good evidence that hazardous drinkers seek out the least expensive alcohol to maximize ethanol intake per dollar. Jones and Parry (*24*) found that young Australian drinkers often used labels on alcohol containers to calculate the cheapest way of get-

ting drunk. The consumption of very cheap alcohol from unofficial sources is reported in many countries and is sometimes associated with outbreaks of alcohol-related deaths from poisoning (*25*). Cheap wines have caused substantial problems in rural communities with a high Aboriginal population (*26*). Meier et al. (*27*) found that price increases among cheaper products have a particularly high impact on levels of consumption by hazardous drinkers. A study using relatively complete and accurate data from the Swedish government alcohol monopoly, Systembolaget, also found evidence of substantial brand substitution following price increases, especially among the cheapest brands (*28*). In the United States, Kerr and Greenfield (*29*) found significant substitution among heavier drinkers toward lower-priced alcohol products. An analysis of the 2000 National Alcohol Survey indicated the top 10% of drinkers spend about US$ 0.79 per drink compared to US$ 4.75 per drink for the bottom 50% of drinkers, with similar differences observed across beverage types.

Strong and significantly negative associations have been demonstrated between the price of alcohol and a range of acute adverse outcomes of relevance to injury. Chikritzhs et al. (*30*) found a significant relationship between a five-cent increase in the price of all alcoholic drinks and reductions in acute mortality and morbidity. Wagenaar et al. (*20*) conducted a systematic review and meta-analysis that confirmed significant negative associations between alcohol prices and rates of injury from all causes and specifically from assault, attempted suicide, and road crashes.

Canadian research has confirmed a relationship between the price of the cheapest alcohol available to the population and risk of acute harms from alcohol-related injury or poisoning. In a study of 89 areas in the province of British Columbia across 32 different periods, Stockwell et al. (*22*) reported that a 10% increase in the average price of the cheapest alcohol across all beverage types was associated with an immediate 9% reduction in alcohol-related admissions to the hospital from acute causes.

Collectively, these lines of evidence suggest that policy environments that permit the availability of

cheap alcohol increase the risk of acute alcohol-related harm such as injury.

Risk by beverage type

Low-risk drinking guidelines are promoted in many countries and many of these provide separate advice recommending various upper limits of consumption to minimize risk of short-term or acute-risk harm (injuries and poisonings) as opposed to longer-term risk of serious illnesses (*31*). In Canada (*32*) and the United States (*33*), the suggested upper limits to reduce risk of short-term harm such as injury are 1) three "standard drinks" (12–14 g of ethanol in the US, 13.45g in Canada) in one day for a female and four standard drinks in one day for males. In Canada, the guidelines are qualified by age, with lower limits (by one drink in each case) recommended for young adults < 25 years old and people ≥ 64 years old (*31*). Additional advice is provided regarding low-risk drinking environments and drinking speeds, including suggestions about drinking alcohol with meals and avoiding combined use with other mood-altering drugs. Applying these criteria, Zhao et al. (*34*) analyzed national Canadian survey data to assess the extent to which different types of beverages were consumed in daily quantities inconsistent with these guidelines. Using a specific technique known as the Yesterday Method (*35, 36*), Zhao et al. (*34*) showed that on days when guidelines for avoiding acute harm were exceeded, 55% of the alcohol consumed was in the form of beer and 33% in the form of spirits. However, there were marked gender differences in these trends, with a much higher proportion of males drinking beer versus spirits on risky consumption occasions, and a reverse pattern for females.

Klatsky et al. (*37*) studied correlates of wine, spirits, or beer preference among 53 172 white men and women in a U.S. prepaid health plan. A preference for wine was more likely to be expressed by women, light drinkers, young or middle-aged people, nonsmokers, people with higher education, and those who were free of symptoms or risk of illness. Persons who preferred spirits were likely to be men, heavier drinkers, middle-aged or older, less educated, and afflicted with symptoms or risk factors for major illnesses. Persons who preferred beer were likely to be younger, male, and intermediate between wine and spirits drinkers on level of consumption and health.

The above findings do not imply that the ethanol in beer or spirits is intrinsically more risky than wine, for example, do suggest that due to a constellation of factors and beverage preferences, the consumption of some beverages is more associated with injury risk than others, a conclusion that has policy and prevention implications in relation to marketing and pricing of alcohol in particular. Earlier research also reported marked and similar variations in risk of hazardous drinking as a function of beverage type (*36*).

There is also growing evidence that combining alcohol with caffeinated or other energy drinks increases risk of a range of acute problems including death from alcohol poisoning (*38, 39*). It appears that adding stimulants to alcoholic beverages encourages people to drink for longer periods and thereby consume more and achieve higher blood alcohol levels. A further complication is that the stimulants appear to alter the drinker's perception of the level of intoxication and give a false impression of being more in control of their reactions and behavior than they actually are (*39*). There is reason for concern here, particularly because caffeinated alcoholic drinks have increased in popularity in many countries (*39*).

Risk by beverage strength

Stockwell et al. (*40*) conducted a controlled examination of the rates of serious alcohol-related harm in communities across Western Australia and related these to socio-demographic characteristics as well as per capita consumption of beer, wines, and spirits. They found that the beverage types most associated with serious harm (alcohol-related hospital episodes and night-time violence) were cheap bulk wines and "full-strength" beers (i.e., around 5% by volume), with low-strength beers (less than 3.8% by volume) associated with lower rates of serious harm. The idea that making higher-strength

drinks more available increases risk of harm is well illustrated in a U.S. college drinking study that compared drinking behavior and enjoyment at fraternity parties with free, unmarked beer, provided under two different conditions. In the first condition, the beer that was provided was only 3% alcohol by volume, and in the second condition, it was 7%. While there were only minor differences in the quantities of high- and low-strength beer consumed, partygoers indicated similar levels of enjoyment and, most importantly, consumers of the 3% beer had substantially lower blood alcohol concentration (BAC) readings than those who consumed the stronger beer (*41*). This implies that if the same scenario had occurred in a commercial setting, the same (or even greater) profit would have been made by the retailers on sales of the weaker beer, but the risk of adverse health and safety effects would have been much lower with the reduced-alcohol drinks. A more recent Canadian study found that young beer drinkers could not reliably tell the difference between high- and low-strength beer in terms of enjoyment or level of intoxication (*42*), suggesting that beverage strength (at least in relation to beer) may be a modifiable risk factor for adverse health and safety outcomes.

TARGETING HAZARDOUS ENVIRONMENTS

Prevention strategies and policies can also target the environment. This can involve making drinking venues, roads, and workplaces safer. There is extensive research on policing of licensed premises, server training and intervention, and enforcement of laws against service to intoxicated patrons and those under-age, which is highly relevant to promoting a safer drinking environment (*5, 43, 49*). The design of licensed premises is also relevant. For example, in drinking establishments, poor lighting, steep staircases without proper railings, or physical arrangements that encourage crowding can contribute to accidents or inter-personal violence (*43*). Furthermore, if staff at these drinking establishments are prone to over-service (continuing to provide alcohol when a customer is obviously intoxicated), the

risk of injury is further enhanced (*5*). Precautionary serving practices in a well-lit, well-designed venue can reduce risk.

In many countries, there has been a decline in crashes, injuries, and deaths involving drivers under the influence of alcohol. While this change can be linked to campaigns, laws, and regulations focusing on preventing drink-driving it is also partly attributable to improvements in road and motor vehicle safety. These include but are not limited to better lighting and signage; more effective and better placement of roadside barriers; clearer and illuminated road markings; and electronic warnings of weather conditions and other hazards. Given these positive developments, someone driving under the influence of alcohol will have a better chance of avoiding a crash, or surviving, should it occur. Changes in automobile design are also relevant, including better braking systems; airbags; mandatory seat-belts; and center-high mount stop lamps (CHMSLs; central brake light mounted higher than the regular left/right brake lamps, sometimes referred to as the "eye-level" or "third" brake light), among others.

In the workplace, in recent decades, there may be a reduction of drinking on the job in some countries. In some settings, alcohol is not allowed and random screening of alcohol can curtail use. Nevertheless, this change will not fully eliminate coming to work while being under the influence of the previous night's drinking. Safety features at the workplace will have potential in reducing all accidents, including those in which the drinker or another worker is harmed.

TARGETING HAZARDOUS DRINKERS

Analyses of international emergency room data suggest that drinkers most likely to drink heavily and subsequently experience injuries have some predictable characteristics. One such study identified the group with the highest risk of alcohol-related injury as those who were male, single, and under 45 years old, who drank in the early hours of the morning on weekends (*44*). This study suggested that these types of presentations in the emergency

department could be used as a surrogate measure of alcohol-related injuries. In line with the prevention paradox theory, it is important to recognize that this pattern of occasional heavy drinking is highly prevalent among young men. A detailed analysis of a Brazilian national alcohol survey concluded that the majority of alcohol problems involved individuals whose average consumption was low or moderate but who occasionally engaged in heavy drinking episodes (*15*). Also, similar to analyses in the United States and Canada, the authors found that the top 10% of drinkers by volume consumed as much as 44% of all alcohol consumed in Brazil. In Canada, it was estimated that the top 10% of drinkers consume 53% of all alcohol consumed (*45*).

These two lines of evidence indicate that prevention strategies need to target both the relatively small proportion of the highest-risk drinkers while also using universal strategies that address drinking by the total population. While a small number of drinkers place themselves at extremely high levels of risk, risk of acute adverse outcomes such as injury are also distributed widely among the much larger group of drinkers who only occasionally drink to excess. There is evidence to support this latter pattern of drinking as characteristic of all regions of the Americas. There is also consistent evidence across multiple studies that risk of alcohol-related harm begins to taper off at higher levels of consumption on a given occasion. Graham et al. (*46*) examined risk of being involved in violent incidents among drinkers in Canadian bars and found that risk leveled off at higher blood alcohol levels, perhaps reflecting reduced activity and capacity at the highest levels of intoxication.

Beyond demographic factors, there is evidence that individual characteristics of drinkers may place them at risk over and above drinking context and amount of alcohol consumed. Sensation-seeking and risk-taking personality styles both independently predict risk of injury among drinkers (e.g., 38), even when contextual factors and amount of drinking are controlled, though typically the latter factors are the more important predictors (*47*).

CONCLUSIONS

Those making decisions about prioritizing the allocation of resources to prevent alcohol-related injury should consider both 1) the evidence of the relative effectiveness of alternative strategies, and 2) the distribution of high-risk drinking and risks of harm among the whole population of people who drink. Three main types are recommended: 1) those that reduce the alcohol consumption of all drinkers; 2) those that limit the risk of injury affecting both drinkers and non-drinkers, in public drinking venues such as bars and nightclubs, and on the roads; and 3) use of targeted strategies that screen, identify, and provide brief intervention to individuals drinking above low-risk guidelines. The use of educational strategies as a means of raising awareness of alcohol-related harms and increasing public support for effective measures to reduce alcohol-related injury is also suggested.

Universal strategies that reduce the alcohol consumption of all drinkers are crucial, given the broad distribution of risk from alcohol-related harm, and the potential for hazardous drinking across the entire drinking population. This approach is further indicated by evidence that universal strategies that influence the price and physical availability of alcohol are the most effective (*4, 5*). In developing these types of strategies decision-makers should also be mindful of the evidence that cheap, high-strength alcohol is most likely to be used by the more hazardous drinkers, making pricing strategies that limit the availability of such products a priority (*45*).

There is a wide range of proven or promising strategies for limiting the risk of injury affecting drinkers and non-drinkers in public places and on the road. This includes policing strategies, which can help reduce risk of alcohol-related violence of drinking venues (e.g., (*46*) and deter drink-driving and hence alcohol-related road trauma (*4*). Risk of alcohol-related injury is highly context-specific, and certain drinking environments are predictably associated with higher risks of injury, such as late night drinking venues and driving while intoxicated. In some cases, environments can be modified and bar staff trained to reduce risk of injury independent of reductions in drinking behavior per se (*43, 49*).

Use of targeted strategies that screen, identify, and provide brief intervention to individuals drinking above low-risk guidelines is recommended based on encouraging evidence that these types of approaches can result in reduced consumption and related harms (*4*). Such interventions have also been mounted in emergency departments, with some showing success in reducing consumption and alcohol-related injuries (*50*).

Finally, although educational strategies were not covered specifically in this chapter (mostly because the evidence that school education and public alcohol-awareness campaigns are effective is weak, at best (*4, 5*), they can also be used to help reduce alcohol-related injury, mainly as a complementary approach to those described above. There is some evidence that public information campaigns can help support the effectiveness of other, proven strategies to reduce alcohol-related injury, such as random breath testing or enforcement of liquor laws (*48, 51*). Alcohol education strategies should be re-conceptualized to focus on raising awareness of the efficacy of these other, more effective strategies, as well as the need for them (*52*). ∎

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CHAPTER 15

Interventions to reduce alcohol-related injury in the emergency department: screening, brief intervention, and monitoring

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SUMMARY

Screening and brief intervention (SBI) is one of the most promising measures to reduce alcohol-related injuries targeted at the individual level. Because SBI is relatively easy to perform, low in cost, and can be carried out quickly, it is ideally suited for implementation in busy health care settings such as emergency departments (EDs). As many injured patients are seen in EDs, and ED patients generally are heavier alcohol consumers than those in primary care or in the general population, patient arrival at the ED is a good opportunity for intervention. Injured patients who report drinking before the injury event or habitual alcohol consumption that exceeds low-risk drinking can be identified through screening followed by brief intervention (BI). This type of intervention involves providing feedback about the results of the screening, educating the patient about low-risk drinking, motivating him/her to change drinking behaviors, setting a goal, fostering coping skills, and monitoring the progress. BI is a short, undemanded, structured intervention delivered by a health care worker and aimed at reducing drinking and/or related problems. The efficacy and effectiveness of BI in ED settings has been supported by numerous studies. Positive outcomes of BI include reduction in alcohol intake and alcohol-related consequences (including re-occurrence of injuries) at six and 12 months after the ED visit. This chapter characterizes BI and describes the evidence supporting its implementation in EDs in the Americas.

INTRODUCTION

Alcohol is the single most important risk factor for morbidity and mortality in the Americas. A considerable fraction of the burden of disease is caused by intentional and unintentional injuries. Thus, alcohol-related injuries represent a public health challenge in the Americas that requires evidence-based actions (*1*). The most effective preventive measures include taxation of alcohol, drink-driving laws, banning of marketing and advertising, and screening and brief intervention (SBI) programs. SBI is also one of the most promising actions for targeting individual drinkers. Given that many injured patients are seen in the emergency department (ED), and ED patients generally are heavier alcohol consumers than people receiving primary care (*2*) or the general population (*3*), patient arrival at the ED represents an ideal opportunity for intervention. This chapter describes BI and the evidence supporting its implementation in EDs in the Americas.

WHAT IS "BRIEF INTERVENTION"?

Although there is a growing interest in brief intervention (BI), as demonstrated by the increasing number of published articles on the topic, this type of intervention is not easily defined. A search in the literature shows that related terms (early intervention; brief motivational intervention; and screening, brief intervention, and referral to treatment (SBIRT)) are sometimes used interchangeably, reflecting a relative diversity in conceptions and theoretical frames.

BI is defined in the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Thesaurus as a "minimal interaction with a medical or mental health professional, ranging in duration from several minutes to several short sessions" (*4*). As seen in the literature, BI can be performed not only by a wide array of professionals such as physicians, nurses, psychologists and social workers (*5*) but also by lay persons (after a short training). One of the most distinctive characteristics of this type of short, opportunistic intervention is the fact that it is not triggered by demand from the patient but is delivered unsolicited to patients considered good candidates for BI benefits. BI may be either aimed at reducing drinking, reducing negative consequences related to drinking, abstaining, or at accepting or facilitating acceptance of referral to specialized treatment.

In sum, BI is a short, undemanded, structured intervention delivered by a health care worker aimed at reducing drinking and/or related problems. Because it is relatively easy to perform, low cost, and can be carried out quickly, it is ideally suited for implementation in busy health care settings such as EDs. From a public health perspective, BI is an effective measure for safety and health promotion as well as prevention of injuries (*6*).

STRUCTURED MODELS

There are several approaches for conducting BI in health care settings, with varying degrees of standardization. Although there is a paucity of information regarding the comparative effectiveness of these approaches, several structured models for BI have been developed, including those developed by the World Health Organization (WHO) (*6*); the NIAAA (*7*); Mercer University (*8*); and Bernstein et al. (the SBIRT model) (*9*). Most models for standardized BI include various training materials, such as brochures for patients, and manuals containing the algorithms for the standardization of procedures. Some are freely available through the Internet, and some include a Spanish version.

Screening and intervention

The main differences among structured BI models can be grouped into two categories: intervention procedures, and screening method. Differences in the screening method mainly involve the instruments and procedures used for assessment, and the cut-points used to establish different levels of risk. Different cutoff levels for risk zones depend on the screening procedures used (e.g., screening for the WHO BI model is carried out using the 10-question Alcohol Use Disorders Identification Test (AUDIT) (*15*), which assigns one of four levels of risk for a patient based on his/her total score). Differences in intervention procedures can include the number of intervention levels resulting from the risk assessment; the goal of each intervention level (i.e., whether patients assessed as alcohol-dependent are referred for specialized treatment); and how the goal is achieved, which in turn may reflect variation in the degree of directiveness of the intervention (e.g., whether a given drinking goal is advised or negotiated with the patient).

Screening. A number of different procedures and instruments can be used to identify people at risk for alcohol-related injury who thus might benefit from BI. These diverse procedures and instruments are designed to assess acute alcohol drinking (e.g., drinking during the injury event), habitual or usual drinking, and negative consequences.

To evaluate if drinking took place before the event that caused the injury, blood alcohol concentrations (BAC), clinical judgment, or self-report are usually employed. Clinical judgment has been shown to be less accurate than the other two measures in detecting intoxication (*10*). Of the other two methods (BAC and self-report), BAC remains the most commonly used in EDs in the United States (*11*), but self-report is preferable. Responses from the patients themselves about whether or not they had any alcoholic drinks in the six hours preceding their injury has been shown to be a better measure than BAC. Many injured patients have been found to report drinking when their BAC was zero (due to the time lapse between drinking, injury, and arrival in the ED, and related metabolism) (*12*). Self-report

has also proven to be a valid method of assessment in EDs across different cultures (*13*). However, because both of these measures only identify patients who were drinking before the injury event, and not those with alcohol problems and/or risky drinking patterns who did not drink prior to their injury, additional methods to evaluate usual consumption and related problems are recommended (*14*).

To evaluate indicators of alcohol-use disorders and risky drinking, a number of standardized self-report brief screeners have been developed. Most of these measures evaluate the consequences of drinking, although some include consumption questions. Whereas most of these tests were developed to detect alcohol use disorders, given that a primary goal of BI in the ED is to identify those at increased risk for injury, even if they do not present with an alcohol disorder, consumption questions to detect usual drinking at risky levels is desirable. Among them, AUDIT (*15*) is perhaps the most well known and commonly used for BI. Its main advantage is that it produces a continuous score ranging from 0 to 40, allowing for several possibilities for adjusting cut-off scores. Another advantage of AUDIT is the fact that it has been developed (*15*) and validated (*16*) in a number of countries.

Because time restriction is one of the factors linked to difficulty in implementation of BI programs in EDs (*11*), short instruments that can be administered easily even without material support (e.g., paper forms) are a clear advantage, and several of these types of instruments have been developed and proposed. Among them are abbreviated versions of AUDIT, such as the Audit-C (*17*), which comprises the first three items of AUDIT that evaluate consumption; the RAPS4 (*18*); and the RAPS-QF (*19*). The RAPS4 is a four-item mnemonic screener whose advantages include brevity and immediate scoring. The RAPS-QF consists of the same items plus two more that evaluate quantity and frequency of consumption. Both the RAPS4 and RAPS-QF have been tested in a number of countries (*20*) and were found to have, compared with several others (including the AUDIT-C), the best psychometric characteristics and the highest correlation with the complete version of AUDIT (*21, 22*). In their attempt to develop a shorter screening instrument, Williams and Vinson (*23*) found a single question inquiring about the last episode of heavy drinking to perform well. Because such an item would indicate risky drinking but would provide no additional information about the severity of any drinking-related problems, one recommended option would be to continue screening with another instrument (e.g., AUDIT or RAPS4) if a positive result is obtained.

This type of screening (known as serial screening) requires a slightly more refined process be put in place, but once implemented may reduce time and costs by allowing for a very short process if results are negative.

As stated earlier, different models of BI propose tailored interventions according to the risk zones estimated by the scores resulting from screening. However, there are very few studies empirically validating the proposed scoring zones using AUDIT (*24, 25*), and risk zones have not been proposed using other screening questionnaires other than AUDIT. Therefore, the evidence produced is insufficient for recommending cutoff scores; perhaps, more importantly, cut points should be adapted to target different populations according to local or regional drinking patterns.

There is some indication of a better psychometric performance from standardized self-report instruments versus laboratory testing to detect risky drinking (*26*). However, studies in the United States show that a large majority of ED practitioners tend to use biological measures (*27*), most likely due to familiarity with such tests through the scope of their emergency medicine practice. Besides better accuracy, standardized screeners present additional advantages. One is lower cost, which might be especially important in countries or settings with limited material resources. In addition, administering the test or reviewing the results of a self-administered test with the patient presents a gateway to talk about alcohol. Furthermore, there is some indication that the screening itself might have the effect of reducing consumption by fostering cognitive awareness of drinking (*5*).

Intervention. The actual intervention generally involves several components, including 1) providing feedback to the patient (informing him/her about the results of the screening), 2) educating the patient (explaining the risks involved at the assessed level of drinking); and 3) informing or advising the patient about what constitutes low-risk drinking. The results of the assessment and level of risk are then linked with the level of intervention deemed appropriate.

Depending on the results of the assessment, the intervention may either terminate (if patient is abstaining or drinking at low risk) or continue (with further action aimed at motivating the patient to reduce drinking, abstain, or seek specialized attention). Motivating the patient to change drinking behaviors typically involves evaluating motivation and fostering ambivalence (e.g., linking the reason for the ED visit (the injury) to drinking). Setting of patient goals can then be achieved by either advising the patient or reaching consensus with him/her about desired drinking behavior (through the setting of goals). Goals might include changing the drinking context to reduce drinking; abstaining; or accepting referral to a specialized treatment. A final element of BI is fostering coping skills by exploring patient strategies to achieve the goal.

Most BI models also include monitoring, which requires the implementation of a procedure to evaluate the patient's progress. Although BI models differ as to whether the aim of the intervention with dependent patients should be advise to abstain, refer to treatment, or negotiate solutions, there is no practical approach for identifying dependent patients among those who screen positive. This places added significance on monitoring, as it provides the opportunity to implement an alternative plan (e.g., the addition of another BI session, or referral to an outpatient service or self-help group) for any patient (including non-identified dependent patients) who failed to reach the desired goal.

ACTIVE INGREDIENTS

One of the key methods associated with BI is motivational interviewing (MI), a therapeutic style associated with promoting behavior change that has been widely implemented in BI programs and studies. MI proposes an empathic, respectful style to enhance clients' motivation for change by addressing ambivalence and emphasizing the patient's responsibility and ability to make choices. These principles have been conceptualized in the model known as FRAMES (*28*), an acronym for Feedback, Responsibility, Advice, Menu of strategies, Empathy, and Self-efficacy. Although information about the relative effectiveness of different therapeutic styles is scarce, several studies assessing the use of MI in BI have reported mixed findings (*29, 30*).

Drawing from the literature on psychotherapeutic procedures, the MI approach appears to be as effective as other more traditional approaches, such as skills training based on the cognitive behavioral approach (*31, 32*). However, some principles of MI seem to be in accord with aspects of the therapeutic style that are known to be effective in psychotherapy research. Some elements of the patient–provider relationship that have been found effective in improving outcomes in regular psychotherapy are 1) building a therapeutic alliance, 2) being empathic, 3) setting goals by reaching consensus, 4) fostering collaboration, 5) obtaining client feedback, and 6) monitoring progress (*33*). Based on the evidence, adapting the approach and communication style to the particular characteristics of the patient is more important than a rigid adherence to the above principles. This may explain the mixed findings reported in the literature regarding the use of MI. One patient characteristic that should be considered by providers is cultural background (*34*). This element may explain the enhanced effectiveness achieved by matching Hispanic patients to Hispanic providers (*35, 36*). Another aspect that is significant for the effectiveness of BI and therefore should be taken into consideration by the provider is the level of resistance exhibited by the patient. Research has found that patients who characteristically exhibit low levels of resistance may respond well to directive types of treatment (e.g., advising), while patients prone to be resistant respond best to non-directive styles (e.g., reaching consensus) (*37*).

EFFECTIVENESS

There is less evidence about the efficacy/effectiveness of BI in ED settings than in primary care settings (*6*). However, to date, the efficacy/effectiveness of BI in ED settings has been supported by numerous studies. After more than 20 years of research, BI is considered effective, as confirmed by several reviews on the topic (*5, 6, 38–40*).

Nilsen et al. (*5*), in a systematic review of randomized controlled studies of BI with injured patients in emergency care settings, conclude that there was a positive effect on alcohol intake in most studies. There were also positive outcomes on risky drinking and alcohol-related consequences, including reoccurrence of injuries (*41, 42*). The reduction in injury recurrence was also found in a review (*43*) and a meta-analysis (*2*), where BI reduced by half the probability of sustaining an alcohol-related injury at six and 12 months after the ED visit.

BI has often been considered to be more effective with risky or harmful/hazardous drinkers than with dependent patients (*39*). For that reason, most ED-based BI studies have focused on non-dependent drinkers, actively excluding those identified as dependent (*5*). However, new evidence suggests BI may be as effective for dependence as for harmful or risky drinking (*44, 45*). BI has also been shown to be as effective for adolescents as for adults (*46, 47*).

Although a positive effect of BI is observed in most high-quality studies, a tendency to reduce drinking has also been found in control groups (*5*), with a similar magnitude of improvement in drinking outcomes between groups. In addition to other methodological issues (e.g., regression to the mean, and contamination among both conditions by lack of adherence to BI protocols), one mechanism that has been thought to be at least partially responsible for this finding is assessment reactivity. Research from the substance abuse field indicates treatment outcomes may be predicted by the degree of change between the time of assessment and the initiation of therapy (*48, 49*). Furthermore, it has been suggested that self-initiated behavioral change might be prompted by experiencing an alcohol-related injury and subsequent ED

admission (*5, 50*). In another study, Mello et al. found BI to be more effective among those injured from car crashes versus those with other types of injuries. Based on their results, the authors proposed that other negative aspects of the crash, beyond the injury, might create a general nuisance factor that contributes to the reduction in drinking. In research by Walton et al., attributing the injury to alcohol was found to be an important moderator of change; relating the injury to drinking during the BI increased the effect of the intervention (*50*).

While experiencing an injury may augment the effectiveness of a BI, this type of intervention has also been found to be effective in non-emergency health settings such as general primary care (*52, 53*), and in other settings such as college (*54*).

IMPLEMENTATION

Given the promising results of BI, and the evidence of economic benefits from their routine implementation (*55, 56*), many organizations in the United States and Canada have recommended or mandated the implementation of BI programs in ED settings.

BI has also been shown to be highly feasible. Several studies from the United States tested the feasibility of BI implementation, showing that BI in EDs was highly feasible and well accepted by patients and staff (*57, 58*). Sise et al. (*58*) described the successful implementation of a BI program that expanded into BI for adolescents and parents of pediatric injured patients. Their findings also indicated increased job satisfaction among staff and higher satisfaction with the ED services provided, among patients.

Despite evidence of BI feasibility, policies that recommend it, and legislation that mandates it, implementation of BI programs is still not widespread. Recent studies show that in the United States, most trauma centers mandated to perform BI often do not do so, and when they do, they fail to use the most efficacious methods (e.g., standardized screening and BI) (*11, 27, 57, 59*).

A number of factors have been found to be related to the degree of success in implementing BI

in health care settings. These include health care providers' 1) degree of belief in the potential utility/need for BI (*11, 60*); 2) perception of BI as a legitimate biomedical practice to be performed in the ED (*61, 62*); 3) beliefs about patients' discomfort or hostility if a talk about alcohol is initiated (*61, 63*) or they are referred to specialized treatment (*64*); 4) perception regarding the compromise of patient confidentiality, and the potential threat to reimbursement (*62*); 5) level of knowledge of BI components and perceived competence in applying effective procedures (*11, 27, 60, 61, 62, 65*); 6) availability of time and perceived load of duties and responsibilities (*11, 61, 66*); and 7) motivational incentives from ED leaders (*67*).

Other factors related to success in implementing BI include: 1) patients' literacy skills and ability to answer self-administered questionnaires (*63*); 2) health system number and availability of referral options for dependent drinkers or those that may need specialized treatment services (6*3, 64*); 3) health system integration of different levels of care (*61, 62*); 4) ED's organizational climate and personnel job satisfaction level (*67*); 5) ED's financial resources, including committed funding for SBI (*11, 27, 68*); and 6) the degree of political stability, continuity in health policies and programs, and level of rotation/permanence of directors and other personnel (*61*).

The extent to which these factors may affect the feasibility and sustainability of BI programs will likely depend upon specific ED characteristics, including broader cultural context.

CULTURAL ADAPTATIONS

As in much of the literature regarding other aspects of BI (e.g., effectiveness and economic impact), the vast majority of articles evaluating feasibility and factors related to implementation come from the United States, and to a lesser degree from other developed countries. However, among those reviewed here are three empirical studies carried out in Brazil (*61, 63, 67*), and one in Poland (*64*). Among other commonly identi-

fied factors related to the implementation of BI, these studies point to some novel ones, some of which are related to broader social-cultural conditions (e.g., patient literacy level, patient sensibility about discussing alcohol consumption, health care system characteristics, and political stability affecting the continuity of health programs). Cultural adaptation of BI—framing them according to socioeconomic conditions and the cultural milieu—appears to be an important criterion for effective BI programs.

Aspects to be taken into consideration when adapting BI programs to different communities include health providers' role/functions and regulated interactions with patients; ED organizational resources; health system organization, cultural beliefs and values regarding the meaning of drinking; and cultural and political climate. Consequently, some components of the intervention may need adapting. Studies of cultural adaptations of evidence-based programs such as BI (*69, 70*) recommend that while some aspects may be modified to be culturally appropriate, others should not be. Among modifications not advised are reducing the interventions and omitting core components of the program, given the risk of modifying key components for effectiveness, whereas alterations such as modifying some aspect of the activities, replacing images, or adding material while maintaining fidelity are not considered problematic (*70*). For example, while lack of familiarity with the concept of a standard drink in many American countries presents a challenge for assessing and setting BI goals, and may be addressed by using visual aids, other components such as the use of standardized instruments for screening should not be modified.

More research examining which BI components are most effective would benefit cultural adaptation of BI in developing countries in the Americas by helping to determine which modifications are appropriate. Research in developing counties would also inform tailoring of BI programs. Two examples of the potential success of BI in the developing world are the implementa-

tion of a large-scale BI program in primary care in program in Brazil (*66*), and the successful adaptation of a BI study protocol in an ED in Poland (*64*).

Future efforts should seek to implement similar programs, especially in Latin American and Caribbean countries. ∎

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CHAPTER 16
Policies to reduce alcohol-related injury

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SUMMARY

The public health impact of alcohol-related injuries can be reduced through the implementation and enforcement of various alcohol policies and interventions that can be aimed at specific high-risk groups such as heavy drinkers as well as the general population. Substantial international scientific literature has shown that some of these policies and interventions are effective and robust and can be used as the framework for a public health response to alcohol-related injury. These include controls on the availability of alcoholic beverages; price increases through taxation policies; control of alcohol marketing; brief intervention and treatment of alcohol-use disorders; drink-driving countermeasures; modifying the drinking context; school education and mass media campaigns; heath warning labels; community actions; server training programs; and addressing unrecorded alcohol consumption. This chapter addresses these policies in terms of the 10 policy areas of the 2010 World Health Organization (WHO) Global Strategy for Reducing Harmful Use of Alcohol; discusses their relevance for the prevention and management of alcohol-related injuries; and presents an overview of the situation in the Americas with regard to policy responses.

INTRODUCTION

While drinking by people under the legal drinking age seems to be on the rise, and the age of initiation of drinking is decreasing, most alcohol-related injuries occur among young adults of legal drinking age, resulting in fatal and nonfatal injuries and enormous costs to society. The 2010 Global Burden of Disease study has shown that alcohol is the leading risk factor for disease and disability among people 15–49 years of age in 26 out of 34 countries in the Americas, and is the leading risk factor in this age group worldwide (*1*). Therefore, obtaining a measurable impact in the prevention of alcohol-related injuries requires a two-pronged approach: 1) the implementation of measures targeting both adult and underage drinkers, in the short term, and 2) the development of long-term strategies to prevent children and adolescents from initiating alcohol consumption or adopting harmful drinking patterns.

Another important aspect of effective policies for preventing alcohol-related injuries is a multi-sector approach, as implementation and enforcement of most effective measures goes beyond the reach and mandate of the public health sector. For example, many injuries are a direct outcome of violence. Therefore, prevention of alcohol-related injuries requires prevention of violence, which requires the participation of sectors outside the public health realm, including, at minimum, the criminal justice system, law enforcement, health agencies, and the financial sector. Actions limited to the public health sector alone are likely to have limited impact. Therefore, achieving political will and commitment across multiple sectors is a necessary step in formulating and implementing broad alcohol policies that can decrease alcohol-related injuries.

As described earlier in this book, alcohol consumption in a specific population is linearly correlated with both overall mortality and alcohol-specific mortality, including violence, which causes both fatal and nonfatal injuries. Therefore, measures that affect the alcohol consumption of a population as a whole are expected to have an impact on injuries

(*2, 3*). These include universal policies that target the general population, such as controlling the affordability and availability of alcohol, and targeted policies such as drink-driving laws and brief intervention (BI) aimed at drinkers prone to harmful alcohol use (*2*).

This chapter describes public health policies that have proved effective in reducing alcohol-related injuries at the population level versus those targeting individuals or high-risk groups. This distinction is important because individual measures may have the desired impact among high-risk drinkers, who are often motivated to change their behavior but may be difficult to implement and/or have an insufficient effect among large population groups with varying levels of alcohol consumption.

POLICIES AND PREVENTION STRATEGIES

In recent years, several research studies have proposed various policy approaches to address and reduce alcohol-related harm (*2–7*). There is considerable overlap across these approaches, all of which have some bearing on reducing alcohol-related injuries. Anderson et al. (*3*) assess evidence of the impact of specific measures, organized into nine areas: 1) education and information; 2) health sector response; 3) community programs; 4) drink driving policies and counter-measures; 5) the availability of alcohol; 6) the marketing of alcohol; 7) pricing policies; 8) harm reduction; and 9) reducing the public health effect of illegally and informally produced alcohol. Casswell and Thamarangsi (*4*) propose a stepwise approach to selecting alcohol policies focused on five main criteria: 1) affordability, 2) availability, 3) regulation of marketing, 4) control of drink driving, and 5) treatment.

Babor et al. (*2*) identified 11 "best practice" alcohol policies based on effectiveness, scope of impact, quality of the studies that propose them, and cross-cultural testing: 1) alcohol taxes; 2) restrictions on hours and days of sale, and 3) outlet density; 4) lower alcohol strength; 5) government retail monopolies; 6) minimum legal purchase age; 7)

random breath testing for drivers; 8) lowered BAC limits for driving; 9) administrative licensing for novice drivers; 10) BI for hazardous drinkers; and 11) treatment and detoxification programs. Building on this analysis and focusing on the Canadian context, Giesbrecht et al. (*6*) and the Canadian Public Health Association (*7*) each provide a two-tiered organization of alcohol policies: population-level interventions, and focused strategies. The former include pricing policies; controlling physical and legal availability; curtailing alcohol marketing; and regulating and monitoring alcohol control systems. The latter include countering drinking and driving; changing the drinking context (e.g., serving practices, and control of alcohol service to minors or intoxicated patrons); education and promoting behavior change; and increasing access to screening and brief intervention (SBI).

The content of this chapter is based on a recent report by Giesbrecht et al. (*8*) and also draws on WHO (*5*), Anderson et al. (*3*), Casswell and Thamarangsi (*4*), and Babor et al. (*2*). A strong national alcohol strategy should include the key elements of the 2010 WHO Global Strategy on Alcohol (*5*), which provides a comprehensive set of goals for an effective alcohol control policy.

The sections below describe the criteria for effective alcohol policies targeting general and specific populations, organized by the 10 areas of the WHO Global Strategy to Reduce the Harmful Use of Alcohol (*5*).

Area 1: Leadership, awareness, and commitment

Preparing, selecting, implementing, and sustaining effective alcohol policies requires strong leadership and a solid base of awareness plus political will and commitment (*5*). Ideally, the commitment should be expressed through adequately funded, comprehensive, inter-sectoral national policies based on available evidence and tailored to local circumstances, with clear objectives, strategies, and targets, including those that proved to be particularly relevant to reducing alcohol-related injuries. The policies should be accompanied by specific action plans, or-

ganized by the responsibilities of each partner, and supported by effective and sustainable implementation and evaluation mechanisms. In addition, national governments should be encouraged to ensure public health precautionary dimensions pertaining to alcohol are protected in trade agreements (*4*).

Area 2: Health services response

Health services are central to tackling harm at the individual level among those with alcohol-use disorders and other health conditions caused by harmful use of alcohol, including harm related to injuries. Health services should provide prevention and treatment interventions to individuals and families at risk of or affected by alcohol-use disorders and associated conditions (*5*).

An important component of the health services response is screening, brief intervention, and referral to treatment (SBIRT) (*2–4*). The cumulative evidence from several hundred empirical studies, recent meta-analyses, and systematic reviews is that the use of SBIRT in health care settings is an effective method for reducing alcohol consumption and associated problems, particularly among those with early-stage or less severe alcohol dependence (*9–12*). Chisholm et al. (*13*) conducted a meta-analysis of all high-quality, published studies on these types of interventions and estimated a net reduction in consumption of 22% among hazardous drinkers. This approach has been shown to be effective among males and females (*14*) as well as both adolescents and adults (*2*). Given the high rates of alcohol-related injuries in these populations, use of SBIRT is expected to have a beneficial impact with regard to injury rates. A study by Rehm et al. (*15*) focusing on Canada estimated that a 70% uptake of SBIRT in general practice would result in annual cost-savings of US$ 1.6 billion in health, crime, and productivity. Chapter 15 of this book discusses the use of SBIRT within the context of emergency rooms.

Area 3: Community action

As noted in the WHO Global Strategy to Reduce the Harmful Use of Alcohol (*5*), the impact of harmful use of alcohol on communities can trigger and foster local initiatives and solutions. Communities should be supported and empowered by governments and other stakeholders to use their local knowledge and expertise in adopting effective approaches to prevent and reduce the harmful use of alcohol by changing collective as well as individual behavior, while being sensitive to cultural norms, beliefs, and value systems. Several of the policies discussed elsewhere in this chapter are particularly relevant at the local level. This includes controls on serving practices, density of alcohol outlets, controls on drinking and driving and their enforcement, and collecting and disseminating local information on alcohol-related injuries and precautionary interventions. Other types of harm reduction policies such as pricing or alcohol control systems are likely to fall under regional or national jurisdiction but can also benefit from strong local advocacy.

Area 4: Drinking and driving policies and countermeasures

Alcohol-impaired driving is a significant public health problem that affects not only the drinker but also, in many cases, innocent parties. Alcohol-related collisions remain one of the leading sources of alcohol-related deaths and injuries internationally (*1*). Some evaluations have identified policies and programs that may substantially reduce the impact of drinking and driving on crashes, injuries, and fatalities (*16*). Young and newly licensed drivers are at substantially increased collision risk. Some research has shown that the use of graduated licenses, which are designed to prevent young or novice drivers from experiencing specific driving hazards such as driving after drinking, is effective in reducing automobile collision rates, including those resulting from alcohol (*17–19*). Other research provides evidence that setting or lowering administrative and criminal per se legal limits at/to 0.05% blood alcohol concentration (BAC) results in significant decreases in alcohol-related collisions, injuries, and fatalities (*17, 20*). Other research shows that to be effective sanctions such as vehicle impoundment must have a sufficient deterrent value (*21*). Voas et al. found that vehicle impoundment resulted in reduced rates of drinking and driving (*22*). Other studies have shown that in-

dividuals apprehended for drink-driving offenses are at very high risk for subsequent drink-driving offenses, collisions, and alcohol-related deaths (e.g., (*23, 24*). Remedial programs based on principals of effective alcohol intervention (including SBIRT, and more intensive treatment, when necessary) have been shown to reduce recidivism and collision risk among offenders (*25–28*). The use of ignition interlock devices, through mandatory installation programs, has been shown to reduce recidivism rates substantially (*22*), and use of a combination of mutually supportive remedial and interlock programs has been identified as a promising countermeasure strategy (*22, 29*).

Complementary and supportive interventions, as recommended by WHO (*5*), include the provision of alternative transportation; public awareness and information campaigns in support of specific policies; and the implementation of evidence-based, high-intensity mass media campaigns designed for use during specific high-risk periods, such as holiday seasons, or targeting specific audiences, such as young people.

Area 5: Availability of alcohol

WHO's 2010 Global Strategy to Reduce the Harmful Use of Alcohol (*5*) proposes two main policy approaches. The first approach is to establish, operate, and enforce a system to regulate the production, wholesaling, and serving of alcoholic beverages that places reasonable limitations on the distribution and sale of alcohol in accordance with cultural norm, by 1) introducing a public health–oriented government monopoly or licensing system on retail sales; 2) regulating the number and location of on- and off-premise alcohol outlets; 3) regulating days and hours of retail sales; 4) regulating modes of retail sales of alcohol; and 5) regulating retail sales in certain locations or during special events. The second approach is to establish an appropriate minimum age for purchase or consumption of alcoholic beverages. Evidence of the effect of these two main approaches is summarized below.

Alcohol control system. There is substantial evidence that systems that control the production,

wholesaling, serving, and physical availability of alcohol play an important role in influencing alcohol consumption and health outcomes. International research indicates that the privatization of retail alcohol sales (even partial privatization) is associated with substantial increases in per capita sales, an established proxy for alcohol consumption (*2, 30–34*), and re-monopolization is associated with a decrease in alcohol-related harms (*35*). Other research shows that selling alcohol outside government-regulated outlets increases its perceived acceptability, thereby contributing to higher levels of consumption (*36*). Alcohol monopolies also provide an ideal vehicle for counter advertising. While social marketing programs have shown mixed effects, evidence shows that they contribute to raising public awareness and play an important supportive role in a comprehensive alcohol policy (*2, 3*). Based on the research, nearly all policies identified in this chapter are easier to implement consistently within a government alcohol monopoly arrangement versus a fully or partially privatized system.

Physical availability is set primarily by the number of outlets and licensed establishments in a certain area, or on a per capita basis, as well as the hours and days when these outlets are open. Outlet density is associated with drinking levels in the local population (*37*). A substantial increase in the number of alcohol outlets has been shown to be associated with increases in alcohol consumption and associated harm (*37, 33, 34, 38, 39*). Harm from alcohol is especially prevalent in neighborhoods with high outlet density (*40, 41*). The impact of outlet density on high-risk drinking among younger drinkers is especially pronounced (*38, 42*). Evidence points to increases in consumption and harms that can result from even minor changes in outlet density due to the gradual relaxation of liquor regulation (*2*). Livingston (*43*) has demonstrated that the effect of outlet density on assaults varies depending on the level of outlet density, suggesting a plausible density limit.

International evidence indicates longer hours of sale significantly increase the amount of alcohol consumed and the rates of alcohol-related harms. Changes to late-night retail hours in particular

are associated with levels of heavy drinking (*2*). Extended hours of sale attract a younger drinking crowd and result in higher BAC levels for males (*44*). Several studies indicate that acute harms were most likely to increase with the extension of hours of sales (*45, 46*).

Legal drinking age. Minimum alcohol drinking age laws also play a role in health outcomes, particularly for younger populations. A comprehensive review conducted by Wagenaar and Toomey (*47*) concluded that implementing a legal age of 21 for both purchases and consumption of alcohol is the most effective strategy for reducing related problems among younger drinkers. The implementation of a uniform minimum legal drinking age has demonstrated significant decreases in alcohol consumption, drink-driving incidents, and alcohol-related hospital admissions (*2, 48, 49*). However, the evidence suggests the effectiveness of a higher minimum legal drinking age is strongly influenced by the level and consistency of law enforcement efforts and the extent of implementation of other effective alcohol control policies (*50*).

Area 6: Marketing of alcoholic beverages

As noted in the WHO Global Strategy to Reduce the Harmful Use of Alcohol (*5*), reducing exposure to alcohol marketing, particularly among young people, is an important consideration in reducing the harmful use of alcohol. The exposure of children and young people to alluring and engaging alcohol marketing is an alarming phenomenon and one that is difficult to prevent. When advertisers target young adult consumers, cohorts of adolescents under the legal age are likely to be exposed to the same marketing. Alcohol is marketed through increasingly sophisticated advertising and promotion techniques, including sponsorship of sports and cultural activities; product placement; email; text messages or short message services (SMS) and podcasting; and social media campaigns. The transmission of alcohol marketing messages across national borders via satellite television and the Internet is emerging as a serious concern in some countries, as is the targeting of new markets in developing and low- and mid-

dle-income countries with a current low prevalence of alcohol consumption.

Extensive research has indicated young people's exposure to alcohol advertising is linked to increased drinking if the young person currently drinks (*51–55*), and earlier initiation of drinking if the young person has not yet begun drinking (*56–59*). Exposure to alcohol promotion through event and team sponsorship, television, movies, the Internet, billboards, and other media further reinforce positive associations with alcohol (*60*) and proffer unrealistic expectations of the effects of drinking, often resulting in consumption in high-risk contexts (*61, 62*). Especially problematic are advertisements featuring young women and girls who are increasingly shown as objectified and sexualized (*63*).

For all of the reasons above, there is widespread consensus on limiting exposure to alcohol advertising, as advocated by Canada's Alcohol Strategy (*64*); the U.S. Surgeon General (*65*); the American Academy of Pediatrics (*66*); the National Research Council and Institute of Medicine (USA) (*67*); Anderson et al. (*56*); Casswell and Thamarangsi (*4*); and the Center on Alcohol Marketing and Youth (*68*).

Three main policy options and interventions are recommended by WHO (*5*) for limiting alcohol marketing and advertising. The first is setting up regulatory or co-regulatory frameworks for alcohol marketing, preferably with a legislative basis, and supported, when appropriate, by self-regulatory measures, by: 1) regulating the content and volume of marketing; 2) regulating marketing in media; 3) regulating sponsorship activities that promote alcoholic beverages; and 4) banning promotions in connection with activities targeting young people. The second is developing, through public agencies or independent bodies, effective systems of surveillance of marketing of alcohol products. The third policy option is setting up effective administration and deterrence systems for breaches of marketing restrictions.

Area 7: Alcohol pricing policies

Although there are some important differences, alcohol is like many other products in that its de-

mand is inversely related to its price. This means that when the price of alcohol products increases, sales decrease, if other factors such as income are kept constant.

Increasing the price of alcoholic beverages is one of the most effective interventions for reducing the harmful use of alcohol and alcohol-related harm at the population level (*2, 69, 70*). Pricing policies can be used to 1) reduce underage drinking, 2) halt progression toward drinking large amounts of alcohol and/or episodes of heavy drinking, and 3) influence consumer preferences.

Several policy interventions are recommended by WHO (*5*) for alcohol pricing. These include 1) establishing a system for domestic taxation on alcohol accompanied by an effective enforcement system, which may take into account the alcoholic content of the beverage; 2) regularly reviewing prices in relation to level of inflation and income; 3) banning or restricting the use of direct and indirect price promotions, deep discounting, or other types of volume sales; 4) establishing minimum prices for alcohol; 5) providing price incentives for nonalcoholic drinks; and 6) reducing or eliminating subsidies to economic operators involved in the production, wholesaling, or distribution of alcohol. Minimum prices reduce the economic availability of the least expensive alcohol often favored by risky drinkers. Pricing based on alcohol content raises the price of higher-strength products and reduces the price of lower-strength products to reduce overall ethanol consumption across the population (*2, 71–76*). Regularly adjusting alcohol prices for inflation ensures that alcohol products do not become cheaper relative to other goods in the marketplace. Tax increases can have different impacts on sales, depending on how they affect the price to the consumer. A key factor for the success of price-related policies in reducing the harmful use of alcohol is an effective and efficient system for taxation matched by adequate tax collection and enforcement (*5*). These policy options maintain the ability of prices to protect public health and safety of the population (*2, 77*). However, factors such as consumer preferences and choice, changes

in income, alternative sources for alcohol, and the presence or absence of other alcohol controls may influence the effectiveness of this policy.

Area 8: Reducing negative consequences

This area includes policy options and interventions that focus directly on reducing the harm from alcohol use without necessarily affecting the underlying level of alcohol consumption. In implementing these approaches, managing the drinking environment, or informing consumers, the perception of endorsing drinking should be avoided. Several policy options and interventions are recommended by WHO (*5*). These include 1) regulating the drinking context to minimize violence and disruptive behavior, including serving alcohol in plastic containers or shatterproof glasses, and strategies to handle alcohol-related behavior at large-scale public events; 2) enforcing laws against serving to intoxication, and legal liability for consequences resulting from over-service; 3) enacting policies related to the responsible service of alcohol and training staff in relevant sectors in how to better identify and manage aggressive drinkers; 4) reducing the alcoholic strength of certain beverage categories; 5) providing necessary care or shelter for severely intoxicated people; and 6) providing consumer information on harms related to alcohol use, including labeling alcoholic beverages containers (*5*). Three specific interventions are described in more detail below: server and management training, liquor store surveillance programs, and alcoholic beverage warning labels.

Anderson et al. (*3*) and Babor et al. (*2*) review evidence that some server and management training programs can have a desirable impact on reducing service to minors and over-service to patrons in on-premise establishments. It is assumed that a comprehensive, intensive, evidence-based, mandatory training program that applies to all venues and event types will have the greatest potential to reduce service to intoxicated and underage customers. However, the effectiveness of these programs appears to be contingent on active enforcement of relevant liquor laws (i.e., those prohibiting the sale of alcohol to minors and intoxicated customers) (*78*).

The reviews by Anderson et al. (*3*) and Babor et al. (*2*) indicate that special surveillance programs (typically called "challenge refusal programs") at off-premise liquor stores can have some impact on sales of alcohol to minors and those who are intoxicated. The impact is usually greatest if the program is mandatory, valued by alcohol management authorities, comprehensive, and includes regular documentation and periodic evaluation.

Warning labels on alcohol containers and point-of-sale warning signs have the potential to raise awareness of alcohol-related health issues and support the adoption of other, more directly effective, policies. There is only limited evidence of effectiveness for warnings implemented as an isolated strategy (*2, 3*). Almost all published research on warnings focus on the introduction of small beverage label warning messages introduced in the 1980s in the United States. It was reported that these warning messages increased conversations about the health risks of alcohol (*79*) and were associated with slightly reduced likelihoods of drinking and driving (*80*).

Area 9: Reducing the public health impact of illicit and informally produced alcohol

Consumption of illicitly or informally produced alcohol could have increased health consequences due to a higher ethanol content and potential contamination with toxic substances, such as methanol. Good market knowledge and insight into the composition and production of informal or illicit alcohol (*81*) is important when coupled with an appropriate legislative framework and active enforcement. These interventions should complement rather than replace other interventions to reduce the harmful use of alcohol (*5*).

Area 10: Monitoring and surveillance

As noted by WHO (*5*), data from monitoring and surveillance create the framework for successful and appropriate delivery of the other nine policy options. Local, national, and international monitoring and surveillance are needed to 1) monitor the magnitude and trends of alcohol-related harms, 2) strengthen advocacy, 3) formulate policies, and 4) assess the

impact of interventions. Monitoring should also capture the profile of the people who are accessing the services as well as the reasons why those most affected by the harms of alcohol are not accessing prevention and treatment services. As data may be available in other sectors, good systems for coordination, information exchange, and collaboration are also needed to collect the potentially broad range of information required for comprehensive monitoring and surveillance.

Development of sustainable national information systems using indicators, definitions, and data collection procedures compatible with WHO global and regional information systems provides an important framework for effective evaluation of national efforts to reduce the harmful use of alcohol, and for monitoring trends at the subregional, regional, and global level. While continual, systematic collection and analysis of data and timely dissemination of information and feedback to policy makers and other stakeholders are resource-intensive activities, they should be an integral part of implementing any policy or intervention to reduce the harmful use of alcohol and alcohol-related injuries.

SITUATION IN THE AMERICAS

The best examples of the use of specific alcohol policies currently available come from laws related to drink-driving and hours of sale, implemented in a few countries, which have good results in jurisdictions where they are enforced. Brazil has set the example with a zero tolerance law. At the municipal level, several cities in Brazil, along with Lima, Peru, and Cali, Colombia, have passed laws reducing the hours of sale of alcoholic beverages and have subsequently experienced a decrease in homicides rates (*82–84*). Recently, alcohol taxes were increased in Venezuela and Suriname.

Despite these achievements, alcohol policies are not comprehensive in the Americas and do not exist in most countries in the region. Those that do implement them have thus far chosen only one or a few policies that are likely to have no impact on the overall level of injuries, particularly if they do not influ-

ence per capita consumption. According to the WHO Global Survey on Alcohol and Health 2008, only eight out of the 34 countries in the Americas region have a national alcohol policy; only 19 have valued-added taxes (VATs) on alcohol (ranging from 5% in Canada to 22% in Uruguay); and only six countries have excise taxes. Most countries also do not have alcohol availability policies such as those limiting density of retail outlets, days of sale, or sales to intoxicated persons. Controls on alcohol advertising and product placement are very weak or non-existent.

CONCLUSIONS

Much more needs to be done to reduce alcohol-related injuries at national and regional levels. Implementation of the global strategy adopted by the World Health Assembly to reduce the harmful use of alcohol (*5*), which includes the 10 policy areas of action described above, could lead to significant reductions in alcohol consumption and alcohol-related harm. In 2011, using the WHO global strategy as a framework, WHO member states in the Americas

adopted a regional plan of action (*85*) that includes WHO's 10 policy action areas and aims to provide technical cooperation across countries for their implementation and evaluation.

In addition, technical tools are being developed to help countries in the Americas build capacity for collecting information, using the information, and revising or developing effective national alcohol policies and plans. This book is an attempt to document and analyze data from the Americas region about the impact of alcohol-related injuries in health care systems and associated costs to society, and to provide a wake-up call for action. Given the pace of economic and social development in many countries in the Americas, without government action, the risks of alcohol-related injuries will most likely increase, along with the production, promotion, and sales of, without any regulatory control. This is likely to be a deadly combination in many societies that are striving to rise out of poverty yet still unwilling to address harmful drinking and its consequences. ■

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