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Large drinks are no mistake: Glass size, but not shape, affects alcoholic beverage drink pours

William C. Kerr, Ph.D. [Senior Scientist][a], **Deidre Patterson, MPH [Research Associate]**[a], **Mary Albert Koenen, MA [Research Associate]**[a], and **Thomas K. Greenfield, Ph.D [Center Director and Senior Scientist]**[a]

[a]Alcohol Research Group, 6475 Christie Avenue, Suite 400 Emeryville, CA 94608

Abstract

Introduction and Aims—Drink alcohol content has been shown to be variable and is an important determinant of alcohol intake. This study evaluates claims regarding the effects of glass size and glass shape on the amount of alcohol in on-premise drinks.

Design and Methods—Wine and spirits drinks were purchased and measured in 80 on-premise establishments in 10 Northern California Counties. Drink alcohol content was measured as the liquid volume of the drink multiplied by the percentage alcohol by volume of given brands or from analysis of mixed drink and wine samples.

Results—Larger glass size was associated with larger on-premise pours of straight shots and mixed drinks served in the relatively large pint glass and variable “other” glass type were found to contain more alcohol than drinks served in a short wide glass. No significant differences were found for other drink types. Drinks poured in short wide glasses were not found to contain more alcohol than drinks poured in tall thin glasses. Bars with mostly black patrons were found to serve spirits drinks with more alcohol than bars with other patron types.

Discussion and Conclusions—Glass shape does not affect actual drink pours in the US but glass size does in some cases. Drinkers should measure wine and spirits pours at home to achieve standard drink amounts and consumer education programs should foster awareness of the relatively high drink alcohol content of on-premise wine and mixed spirits drinks. More research is needed to evaluate potential differences in drink pours by patron race and ethnicity.

Keywords

drink pour; glass size; alcohol content; standard drink; methodology

Introduction and Aims

The amount of alcohol contained in a drink of beer, wine or spirits is a critical and often ignored dimension of ethanol intake assessment. Previous studies have found substantial variation in the alcohol content of both drinks consumed at home (1) and in on-premise establishments (2,3) with a tendency for the average alcohol content to be larger than the standard drink for that country and for spirits drinks to contain more alcohol than beer or wine drinks. For the

Correspondence to: William C. Kerr, wkerr@arg.org.

Contributors:
WCK and TKG conceived, designed and planned the study. WCK is the guarantor. MAK and DP participated in study design and managed the data collection for the bar study. WCK and DP conducted the data analyses. WCK wrote the original draft and all authors contributed to revisions.

US, the most common definition of the standard drink corresponds to 18ml (0.6 ounces or 14 grams) of ethanol, equivalent to 12 ounces (355 ml) of 5 percent alcohol by volume (%ABV) beer, 1.5 ounces (44ml) of 40 %ABV spirits, or 5 ounces (148 ml) of 12 %ABV wine. This is somewhat larger than the standard used in some other countries such as the UK (8 to 10 grams) or Australia (10 grams). Our studies of home and on-premise drink alcohol content utilized in the present analyses have found generally large and variable drinks for the US as well. Home drink ethanol content for spirits drinks averaged 26ml, about 1.5 times the standard, while wine drinks were also larger than the standard averaging 20ml (4). Beer drunk at home was found to be smaller than the standard drink at 16ml of ethanol due to the popularity of 4.2 %ABV light beer, and less variable than other types because most beer drinks were single serve 355ml (12oz) containers. Mean ethanol contents for on-premise beer, wine, and spirits drinks in Northern California were larger than the US standard. Wine drinks had the largest mean alcohol content, 25.5ml, which was significantly larger ($p<0.01$) than mean ethanol content for spirits drinks at 23.4ml and beer drinks at 21.7ml (5).

Several studies have also evaluated the ability of drinkers to pour a standard drink in experimental pouring tasks. Two studies of college students found that over-pouring was common and that the size of the glass positively influenced the amount poured (6,7), however, no difference was found between two similarly sized glasses of different shapes (6). Another study of college students' and bartenders' ability to pour a standard (44ml) shot of spirits found that both groups poured more than this amount and that even experienced bartenders poured 20.5% more into a short, wide glass as compared to a tall, slender glass (8). The stated implication of these experimental studies is that the size and shape of glassware may be important sources of variation in US population drink pours, even those served in on-premise drinking establishments. Further, Wansink and van Ittersum's conjecture is that over-pouring is the result of an illusion resulting from the shape of the glass rather than from the intentions of the bartender and management. The present research addresses these hypotheses in a population or "real world" empirical study, and considers other relevant aspects of drink alcohol content variation, through data on drink alcohol content and on glass shape and size. Data regarding on-premise drinks were collected in 80 bars and restaurants across 10 Northern California counties in 2007 (5). Results highlight the importance of direct measurement of actual drinks in addition to experimental tasks in understanding sources of variation in populations.

Design and Methods

2007 Bar Study

Initially, two focus groups were conducted, including a total of 16 bartenders recruited from an online posting. Bartenders were paid $100 for their participation and were of varied ethnicity, age and gender. Before the focus groups, informed consent was obtained and a brief bartending experience questionnaire was administered. The groups followed a semi-structured format to explore bartenders' views on variations in alcohol pours. Topics included typical drink pours, pouring methods, management expectations, instructions and compliance techniques related to drink pours, and identification of other factors that may contribute to variation. A series of bar visits were also conducted prior to the main study to field test on-premise drink measurement protocols and to help determine popular drinks that should be emphasized in the main study.

The 10 Northern California counties were: San Francisco, Alameda, Contra Costa, Solano, Napa, Sonoma, Marin, Yolo, Sacramento and San Joaquin. The bar locations in the study area were selected using a multi-stage sampling scheme by county, first selecting two cities, towns or areas in each. In each location four licensed establishments, three with a full liquor license and one licensed to sell only beer and wine, were selected randomly from the list of potential bars, restaurants and other drinking establishments obtained from the California Department of Alcoholic Beverage Control.

A team of three or four research assistants (between the ages of 23 and 50) conducted bar visits from March 2007 through May 2007. Bar visits were made during weekdays, between 4pm and 10 pm, due to logistical and scheduling considerations. Research assistants visited all four drinking establishments in a town on one night. They purchased a draught beer, glasses of red and white wine, a shot of straight spirits, a rum and coke, a margarita, and other popular mixed drinks (as determined by previous studies and preliminary bar visits) at each location. Since the subject of the research was the drinks purchased rather than the bartender, no informed consent was required as determined by the Public Health Institute IRB. Bottled beers were not purchased, since the %ABV and volume of bottled beers are known. Altogether 480 beverages from 80 establishments were purchased and measured in the main study.

The volume of each drink was discreetly measured using graduated cylinders and beakers at a relatively private table or in the bathroom. Samples of each mixed drink and some wines were taken using a standard medicine dropper bottle for later analysis. The research team also recorded establishment and clientele characteristics. Establishments were categorized by food available (full kitchen, a few items or none), noise level (low, medium or loud) and license type (full bar or beer and wine only). Clientele were categorized by age (under 40, over 40 and mixed) and predominant race/ethnicity (white, black, Hispanic or mixed). For each purchased drink, price, measured volume, brand or %ABV, and specific drink type were recorded. The actual price of the drink including tax was obtained for 57% of the drinks, while in other cases several drinks were purchased at once and an average price was calculated. Actual prices were not asked because we felt that this could be seen as unusual behavior and compromise the main purpose of the study. For these analyses drink prices were categorized as less than $4, $4–6, $6–8 and more than $8. Group comparisons were conducted both for all drinks and for the subset of drinks where actual prices were obtained. Photographs of each drink were taken to aid in determining the glass shape, size and fill level.

To determine %ABV, sampled drinks were analyzed using the Analox AM3 Alcohol Analyzer within 36 hours of each visit. The Analox Analyzer determines %ABV by using an oxygen-sensitive electrode to measures the rate of oxygen uptake, which is directly proportional to alcohol concentration. The AM3 was calibrated with known alcohol standards corresponding to the expected concentration of specific drink types. To ensure reliability and accuracy each sample was run three times and the results were averaged (the average error was less than 0.05%). Drink alcohol content was calculated as the drink volume multiplied by the measured or producer-reported %ABV. To account for the multi-level stratified sampling design of the study, we conducted analyses using the svy commands in Stata 10 (9). The data were organized by drink record within a primary sampling unit of the establishment, secondary sampling unit of the city or town and stratification by county. Incorporating the survey design, Adjusted Wald tests were used to determine whether differences in group means were significant at the 95% confidence level.

Results

Glass size and shape

Table 1 presents differences in mean ethanol content for selected drinks by glass type as categorized by glass size and shape. Examples of each type of glass are illustrated in Figure 1 using pictures of actual drinks purchased and measured in the study. When comparing mean ethanol content by glass type, only a few significant differences were seen. As expected, mean ethanol content for shots served in a large shot glass (B) at 19.2ml, were significantly larger than those in a smaller shot glass (A) averaging 15.2ml ($p<0.01$). The type of glass used appeared to influence the overall ethanol content of mixed drinks as well. Significant differences were seen when comparing the mean ethanol content of mixed drinks poured in the relatively large pint glasses (not shown) at 29.5 ml, to tall wide glasses (C) at 23.3ml ($p<0.05$), and short wide glasses (D) at 22.2ml ($p<0.01$). Mean ethanol content for other spirits glasses (F), at 27.2ml, were also significantly larger than the mean ethanol content for short wide glasses (D) ($p<0.05$). On the other hand, the five types of wine glasses, shown in Figure 1 as G, H, I and J, were also found to contain about the same amount of alcohol on average despite substantial differences in total volume, with fill levels varying to account for glass size.

While some of the glassware comparisons support the hypothesis that larger glasses are associated with larger drinks, the hypothesis that the short and wide glasses (D) would result in larger drink pours as compared to tall thin glasses (E) was clearly rejected. No significant differences in mean alcohol content were found between these two glass types. To the contrary, for all mixed drinks, rum and coke drinks and gin and tonic drinks, the tall thin glass type (E) was found to contain more alcohol on average. Similarly, no significant differences were found in ethanol content between the five glass types for the popular margarita drink type, despite considerable differences in the size and shape of glassware involved.

Drink price and establishment characteristics

The mean alcohol content of measured beer, wine and spirits drinks are presented in Table 2 by patron and establishment characteristics. No differences were found by establishment food availability or noise level so these are not shown. Establishments with mostly black patrons were found to have significantly larger spirits drinks than all other types. Only two such bars were visited and these did not serve draught beer or wine by the glass so these beverage types could not be evaluated. Patron age was found to influence beer alcohol content only with mixed age group establishments having significantly more alcohol per beer than those with patrons under 40 years of age. Establishments with a full bar were found to have more alcohol in beer drinks than those with a beer and wine license only.

Mean drink alcohol content of beer, wine and spirits drinks categorized by price are presented in Table 3. A general pattern of increasing alcohol content with price is seen for each beverage. However, significant differences are only found between beer drinks costing more than $8 as compared to groups costing less than $6 and between spirits drinks costing more than $8 and all lower priced groups.

Discussion and Conclusions

Our results indicate that while the shape of glassware may have affected pour size under experimental conditions(8), this effect does not appear to be significant or substantial in the pouring of actual drinks on-premise. These findings highlight issues of external validity from experimental studies. Most bartenders in the focus groups reported either using speed pouring devices for spirits, which regulate the pour rate and with practice allow precise pouring regardless of glassware, or pouring over ice in well known glassware together with visual judgment of the appropriate ratio of spirits to mixer. While the glass types used in the Wansink & van Ittersum study (8) were commonly used in our study, and would therefore be familiar to bartenders, they are unlikely to be the exact glasses used in each bar and did not contain ice. Glass size was not found to affect wine pour size. Wine pours by bartenders do not typically utilize measuring devices, but the glassware used in a particular establishment tends to be standardized such that practice on the same glass results in consistent pour sizes. The size of shot glasses was found to be related to larger pours. Small shot glasses are designed to limit the amount poured, though often appearing larger than they actually are. The use of larger shot glasses may signify management intentions to provide or allow larger serving sizes. Larger glasses such as pints and the varied “other” glass type were also found to result in larger average

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alcohol content drinks, however, this could be explained to some extent by the tendency to serve stronger drink types like the Long Island ice tea or martini in such glasses.

Although only two bars with predominantly black patrons were visited, a substantial and significant positive difference in the alcohol content of spirits drinks was found compared to all other patron types. Future research should focus on racial and ethnic differences in drink alcohol content in both on and off-premise contexts to confirm and better understand the details of this potentially important cultural difference.

There are limitations to the present study to be considered in the interpretation of our findings. The sample was limited to 10 Northern California counties, which may not be representative of the US. The shape and size of glassware were not completely separable in all cases as in experimental studies; however, the short wide and tall thin glass types were common and easily distinguishable. Bar visits occurred between 4 and 10 PM, later times and weekend may be more crowded potentially leading to less accuracy. Study personnel were new to each bar so that important sources of alcohol pour variation identified in focus groups such as larger drinks for big tippers, friends or "regulars" and the potential effects of other patron characteristics on drink pours could not be evaluated.

Efforts to achieve consistent standard drink pours in home and on-premise settings in the US have been limited. Wine and beer labels often do not include %ABV information and no alcoholic beverage labels include standard drink or pour size information as in Australia (10). These omissions may make it difficult for even well intentioned consumers to achieve consistent standard pours. For wine, and particularly for spirits, an easy to use measuring device or perhaps bottle markings of standard pour amounts would also be desirable. For on-premise drinks, disclosure of pour amounts should be considered and could be included as part of responsible beverage service training. A lack of explicit drink pour policies could be interpreted as negligence on the part of management as it may lead to larger pours by servers and customers who drink more than intended. We hope that our research highlighting these important issues will lead to increased attention on standard drink pouring in the US and around the world.

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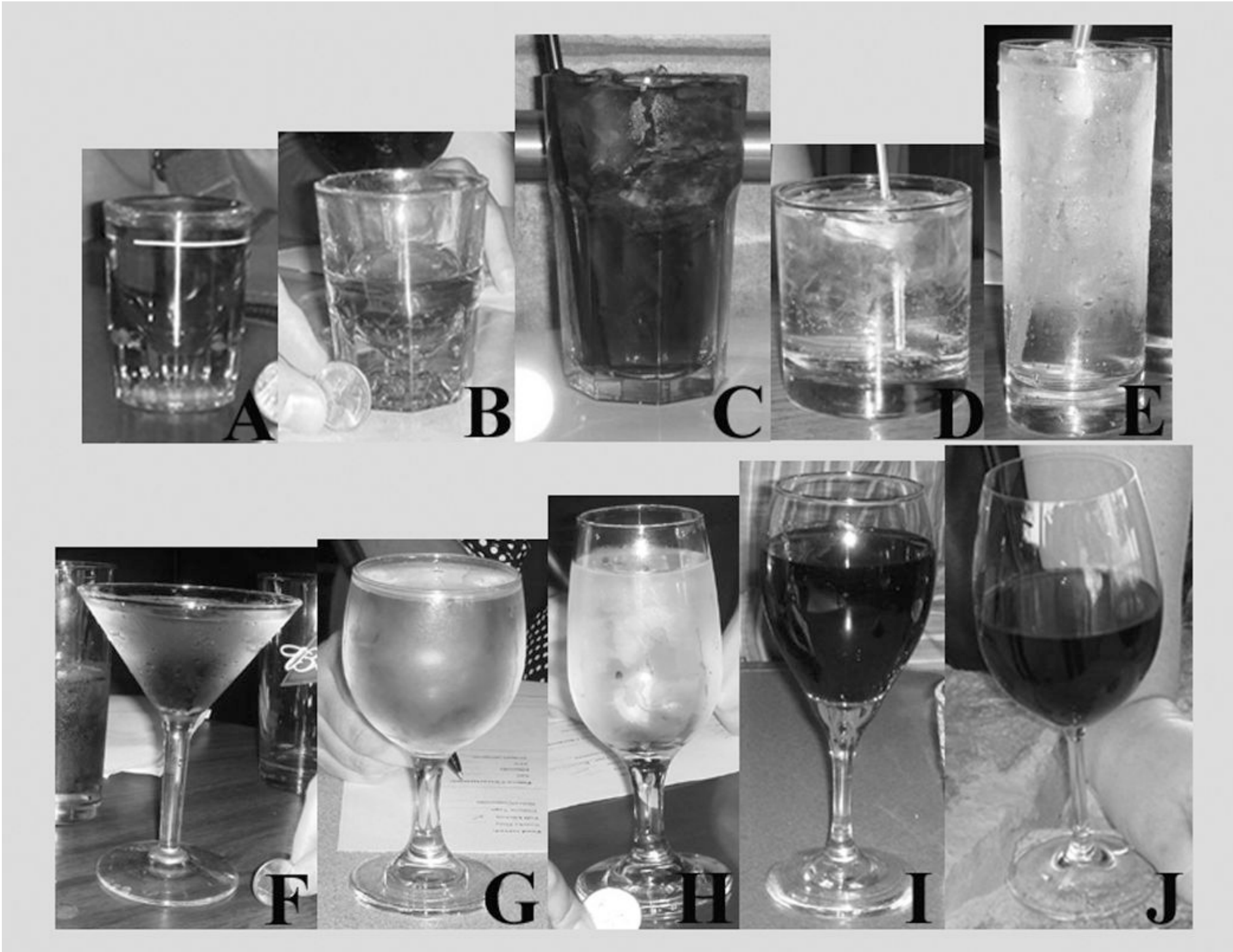

Figure 1.
Pictures of spirits and wine drinks purchased in the bar drink study. Each picture is one example of a glassware type used in our analyses.

Table 1

Bar Drink Study mean alcohol content for glass types shown in Figure 1

Glass type -Figure 1 Letter	Mean ml. of alcohol	95% CI
Shot		
Standard shot glass - A	15.18 [a]	(14.21, 16.14)
Large shot - B	19.21 [a]	(17.11, 21.31)
Mixed Drink		
Pint – (not shown)	29.47 [b, c]	(24.94, 34.01)
Tall thin glass – E	26.21	(21.44, 30.97)
Short wide glass – D	22.24 [b, d]	(19.64, 24.85)
Tall wide glass – C	23.26 [c]	(20.95, 25.57)
Other spirits glass – F	27.18 [d]	(24.31, 30.04)
Rum & Coke		
Tall thin glass – E	24.24	(19.93, 28.55)
Tall wide glass – C	20.64	(17.66, 23.62)
Short wide glass – D	19.92	(17.47, 22.38)
Gin & Tonic		
Tall thin glass – E	25.29	(19.50, 31.08)
Tall wide glass – C	23.40	(19.22, 27.59)
Short wide glass – D	22.60	(19.18, 26.02)
Margarita		
Pint - (not shown)	24.73	(18.84, 30.61)
Tall thin glass – E	24.36	(17.93, 30.78)
Tall wide glass – C	24.36	(20.61, 28.110)
Short wide glass – D	25.64	(21.31, 29.97)
Other spirits glass – F	26.52	(23.10, 29.95)
Martini		
Short wide glass – D	31.53	(24.75, 38.31)
Other spirits glass – F	28.29	(24.88, 31.69)
Wine		
Medium slender glass – G	25.57	(24.01, 27.12)
Narrow wine glass – H	24.75	(23.17, 26.33)
Medium wine glass – I	25.56	(23.12, 27.99)
Large wine glass - J	26.49	(25.10, 27.88)
Other wine - (not shown)	25.11	(21.70, 28.53)

[a, b, c, d] Significant difference between glass types within drink type at 95% confidence level

Table 2

Mean drink alcohol content in milliliters for each beverage type by establishment and patron characteristics. Some establishments were missing data for patron ethnicity (n=2) and age (n=6).

	# of Bar	Beer	Wine	Spirits
	(80 Total)	**Mean ml. (95% CI)**	**Mean ml. (95% CI)**	**Mean ml. (95% CI)**
Patron Ethnicity				
Mostly White	48	22.08 (20.12, 24.03)	25.77 (23.94, 27.60)	23.38 (21.85, 24.91)
Mostly Black	2	-	-	35.06** (31.84, 38.28)
Mostly Hispanic	1	16.28	-	23.06
Mixed group	23	21.78 (19.26, 24.31)	25.13 (24.15, 26.10)	21.77 (20.12, 23.41)
No Patrons	4	19.45 (15.82, 23.07)	27.06 (23.82, 30.29)	23.57 (21.28, 25.87)
Patron Age				
Mixed age	11	26.00* (20.45, 31.56)	24.84 (22.53, 27.15)	23.67 (21.58, 25.76)
Over 40	40	21.74 (19.74, 23.74)	26.18 (24.38, 27.99)	24.13 (21.80, 26.46)
Under 40	19	19.97* (18.37, 21.57)	24.53 (23.41, 25.66)	21.41 (19.20, 23.62)
No Patrons	4	19.45 (15.82, 23.08)	27.06 (23.63, 30.49)	23.57 (21.28, 25.87)
License Type				
Beer and Wine	19	18.22** (14.34, 22.09)	24.89 (23.42, 26.37)	
Full Bar	61	21.97 (20.51, 23.43)	25.79 (24.60, 26.97)	

* Indicates significant ($p<0.05$) difference between groups marked.

** Indicates significant ($p<0.05$) difference between group marked and all other groups.

Table 3

Mean alcohol content for each beverage type by price group for all drinks where the actual price was obtained.

	Beer	Wine	Spirits
Drink Price Group	**Mean alcohol content (95% CI) Number of drinks**	**Mean alcohol content (95% CI) Number of drinks**	**Mean alcohol content (95% CI) Number of drinks**
Under $4	19.64[1] (16.51, 22.78) 12	23.10 (20.22, 25.98) 11	18.98 (13.15, 24.82) 8
Between $4 and $6	22.62[2] (20.14, 25.11) 13	25.49 (24.22, 26.77) 37	22.06 (18.99, 25.12) 39
Between $6 and $8	23.07 (14.56, 31.58) 3	25.94 (25.07, 26.81) 36	20.91 (19.26, 22.55) 70
Over $8	26.27[1,2] (25.51, 27.03) 2	26.37 (24.66, 28.08) 13	29.37** (24.32, 34.43) 25

[1,2] Indicates significant ($p<0.05$) differences between these price groups for beer.

** Indicates significant ($p<0.05$) difference between the price group marked and all other groups for spirits.