

The distribution of alcohol consumption and the prevention paradox in Brazil

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ABSTRACT

Aims To examine the proportion of self-reported alcohol consumed by different gender and age groups in Brazil over the past year, and to examine whether the 'prevention paradox' applies to Brazilian data on alcohol-related problems.

Design A multi-stage cluster sample, representative of the Brazilian household population. **Setting** This study was conducted in Brazil between November 2005 and April 2006. **Participants** Respondents were aged ≥ 14 years ($n = 3007$). **Measurements** Measures included past year estimates of (i) number of standard drinks, (ii) frequency of binge drinking, and (iii) alcohol-related problems. **Findings** The survey response rate was 66.4%. The top 2.5% of the drinkers by volume consume 14.9%, the top 5% consume 27.4% and the top 10% consume 44.2% of all alcohol consumed in Brazil. Men consume 77.8% of the total alcohol, and 18–29-year-olds consume 40.3%. Individuals below risky drinking guidelines for weekly volumetric intake account for 49–50% of all problem drinkers and 45–47% of all problem types reported. Individuals who do not binge or who binge infrequently (1–3 times/year) account for 50–51% of all problem drinkers and 45–46% of all reported problem types. Most binge drinkers are low-volume drinkers.

Conclusions Consistent with the prevention paradox literature, most drinking problems in Brazil are associated with low or moderate drinking. Binge drinking accounts more clearly for the distribution of alcohol problems than total volume consumed.

Keywords Alcohol problems, Brazil, drinking patterns, population studies, prevention paradox.

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INTRODUCTION

The distribution of alcohol consumption was described by Ledermann [1] as following a log-normal curve, which is independent of the level of consumption per capita in the population. This log-normal distribution has been seen in various countries [2,3]. Alcohol control policies in public health are aimed at decreasing per-capita consumption, which would shift the entire distribution to the left, minimizing alcohol-related problems.

A second characteristic of alcohol consumption in populations is that consumption is concentrated highly in a small group of heavier drinkers at the extreme right of the curve. In the United States and Sweden, 40% of all alcohol is consumed by the top 5% and 10% of drinkers by volume, respectively [4,5]. In Switzerland, the top

8% of the drinkers accounted for 50% of all alcohol consumed [6]. Alcohol-related problems, however, are distributed typically across a wider range of drinkers. Named the 'prevention paradox' [7], the majority of alcohol problems in a population are often attributable to more moderate (but also more numerous) drinkers. The finding has been replicated across a variety of different types of social problems when using volume-based definitions of heavy drinkers [8–10] (for exceptions, see [11,12]) and holds in situations where problems are related linearly to consumption (in contrast to problems—such as cirrhosis—with more convex risk functions [5,13]).

In retrospect, some researchers (e.g. [14]) have questioned just how paradoxical the prevention paradox is. Roughly a decade after Kreitman's seminal study,

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Stockwell *et al.* [15] showed that the paradox disappeared when risk groups were defined by acute intoxication episodes. Gmel *et al.* [8] demonstrated later that the majority of high-risk binge drinkers actually met criteria for moderate volumetric intake, and importantly, this 'moderate volume, high binge' group also accounted for the majority of societal problems among all binge drinkers (the 'second-order' paradox). In the text below, the phrase 'prevention paradox' is still used in describing these types of findings out of convenience and for consistency with the previous literature, although there may be nothing paradoxical about the notion that light drinkers occasionally binge. One of the key implications of prevention paradox studies is that drinking *pattern* plays an important role in the distribution of alcohol problems in society.

Because of this key implication, there have been calls for assessments of the paradox in cultures or subgroups with unique patterns of drinking behavior (e.g. [14]). However, investigations of the prevention paradox in developing countries and emerging economies have not been a major focus of research to date. The present paper addresses this gap by examining the distribution of alcohol consumption and the prevention paradox in a national sample of individuals aged 14 years and older in Brazil. The paper also examines whether the second-order paradox [8,14]—the notion that alcohol problems reported by binge drinkers are attributable primarily to drinkers with lower levels of volumetric intake—can also be found in the Brazilian data.

The Brazilian context

Brazil is the largest country in Latin America, with a national territory of 8 511 925 km² and a population of 190 million people [16]. It is the eighth largest economy in the world by size, and is one of the four 'BRIC' countries (Brazil, Russia, India and China) identified by the alcohol industry as having considerable potential for market growth [17]. Annual consumption in Brazil is 6 liters per capita for individuals aged 15 years or older [18,19], but because of relatively high abstention rates (past year estimates are roughly 35% and 59% for men and women, respectively; [20]), consumption among drinkers is likely to greatly exceed 6 liters. There also is a high prevalence of alcohol use disorders (12%; [20]). The alcohol-attributable burden of disease in the two regions of the Americas that include most Latin American countries [World Health Organization (WHO)'s Americas 'B' and 'D'] varies between 8.6% and 17.3% for men and 2.2% and 4.1% for women [21]. As a comparison, the world burden from men is 6.5% and for women is 1.3% [21]. Because of this relatively high contribution to the global burden of disease from alcohol in this region of the

world [22], studies of the distribution of consumption and, in particular, of how alcohol problems are distributed across various risk groups, are needed to inform national public health policy in these countries.

With regard to the prevention paradox and its relevance in Brazil, a high rate of abstention goes hand-in-hand with a relatively high rate of binge drinking. About 40% of Brazilian men and 18% of women 18 years of age and older report binge drinking in the past year [20]. Given the close relationship between binge drinking and alcohol problems, and the widespread occurrence of binge drinking among drinkers in Brazil, it seems reasonable to expect that alcohol problems here will be distributed over a large base of drinkers. That is, drinking indicators suggest that the first-order prevention paradox will exist in Brazil and will largely be a consequence of the high prevalence of binge drinking among both light and heavier drinkers (Gmel's second-order paradox).

In the present study, we characterize the distribution of alcohol consumption in Brazil by level of consumption. We also examine whether the prevention paradox applies to alcohol problems in Brazil. Our analyses expand on previous prevention paradox studies in two ways. First, we examine volume and binge risk groupings at a finer level of precision than previous reports, which have been limited in their ability to discriminate degrees of risk due to use of binary risk groupings. For example, individuals above risky drinking guidelines [23] but not extreme in their intake (e.g. the top 10%) may nevertheless contribute substantially to problems in society. Secondly, we examine whether the prevention paradox applies to dependence problems. Although previous studies have focused largely on social problems, Poikolainen *et al.* [24] and Stockwell & Gruenewald [25] found evidence of the prevention paradox for deaths attributable to alcohol diagnoses (including dependence) and signs of dependence in adolescents, respectively. No studies, however, have examined the applicability of the prevention paradox to specific dependence problems in the general population, in Brazil or elsewhere.

METHODS

Sample and data collection

The study sample is part of the first Brazilian National Alcohol Survey (BNAS), conducted by the Universidade Federal of São Paulo's Unidade de Alcool e Outras Drogas (UNIAD). Between November 2005 and April 2006, a multi-stage cluster sampling procedure was used to interview 3007 individuals aged 14 years and older from the Brazilian household population (for additional details on the sampling design, see [20]). The survey response rate was 66.4%.

After respondents provided consent, 1-hour face-to-face interviews were conducted in respondents' homes by trained interviewers using a standardized questionnaire. A total of 2522 interviews were conducted with respondents aged 18 years or older and 485 interviews were conducted with respondents aged 14–17 (adolescent oversample). Analyses on the distribution of alcohol consumption are based on responses to questions about annual volume of alcohol consumed from 1380 respondents reporting at least one drink of alcohol in the past year (no missing data). Analyses on the prevention paradox are based on 1334 respondents who provided valid responses to questions about both volume and the frequency of binge drinking in the past year (missing due to refusal or unknown; $n = 46$). In all analyses, the adolescent sample was appropriately downweighted to reflect its true representation in the Brazilian national population.

Measurements

Average number of drinks per year

Alcohol consumption was estimated with a 'graduated frequencies' approach [26,27], where respondents estimate the frequency with which they consume various quantities of alcohol. Questions covered any type of alcohol ('all kinds of alcoholic beverages combined') and the referenced time-frame was the past year. Overall alcohol consumption (number of standard drinks per year) was computed by multiplying the self-reported frequency by the corresponding quantity.

Frequency of binge drinking in the past year

This was defined as drinking four (five for men) or more drinks per occasion within a 2-hour period in the past year. A drink was defined as a 5-ounce glass of wine, a 12-ounce can of beer or a 1.5-ounce shot of liquor.

Alcohol-related problems in the previous year

A total of 14 alcohol-related problems were covered with 28 questions in a dichotomous yes–no response format. Questions asked whether specific types of problems occurred during or as a direct result of drinking within the last year. Social consequences included belligerence, police problems, accidents, health-related problems, problems with spouse, problems with other people, work-related problems and financial problems. Alcohol dependence-related problems included the salience of drinking, need to drink, increased tolerance, impaired control, withdrawal symptoms and prolonged intoxication. Both sets of problems had a unifactor structure with acceptable reliability (social: $\alpha = 0.75$; dependence: $\alpha = 0.76$); To compare with other studies, these summed

scales were dichotomized for cross-tabulation with risk groupings described below. The summed scales (representing the total number of distinct problem types experienced in the last year) were used in additional cross-tabulations to assess the distribution of the number of problem types across risk groups.

Drinkers' classification

Expanding on previous assessments of the prevention paradox (e.g. [8,9,24]), we first split drinkers into three groups by volume categories. 'Low-risk' drinkers were below NIAAA risky drinking guidelines for weekly volume (i.e. no more than seven or 14 drinks per week for females and males, respectively). 'Moderate-risk' drinkers were above these guidelines but not in the top 10% of the volume distribution. 'High-risk' drinkers were in the top 10% of the volume distribution. Cut-points for the top 10% were gender-specific. Secondly, drinkers were split into three binge groups: 'low-risk' drinkers had not binged (defined above) in the past year; 'moderate-risk' drinkers binged one to three times in the past year and 'high-risk' drinkers binged four or more times in the past year. The latter two groups correspond roughly to the two upper quartiles of the binge distribution. Use of an absolute criterion for binge drinking (rather than a relative criterion such as the top 10%) is justified by the key finding from the prevention paradox literature that alcohol-related problems are linked more closely to episodes of binge drinking than to measures of volume consumed over extended intervals. Thirdly, these two classification schemes were combined to form nine groups, representing all factorial combinations of the three-way risk groupings for volume and binge noted above.

Statistical analyses

STATA version 11.0 [28] was used for all analyses, which accounted for the complex sampling characteristics of the data. Analyses were conducted on data weighted to correct for unequal probabilities of selection into the sample, and a post-stratification weight was applied to correct for non-response and adjust the sample to known population distributions on demographic variables (education, age, gender and region of the country) according to the Brazilian Census of 2000 [16]. Cross-tabulations were used to examine the distribution of problem drinkers and number of problem types across different risk groups. The extent to which lower-risk groups account for drinking problems is dependent upon both the conditional problem risk within risk groups as well as the relative size of the risk groups [13]. To complement the tables examining risk groupings and examine conditional problem risks at an even finer level of precision, we used logistic regression to assess independent associations

of continuous versions of the volume and binge variables with social and dependence-related problems. The interaction effect of binge drinking and volume of drinking was also tested.

RESULTS

The distribution of alcohol consumption

Alcohol consumption in Brazil is concentrated highly in a small group of heavy drinkers (Table 1). The top 2.5% of the drinkers in Brazil consumed 14.9% of all alcohol consumed in the country in the past year, the top 5% consumed 27.4% and the top 10% consumed a little less than half (44.2%). By gender, men consumed 77.8% and women consumed 22.2% of all alcohol consumed. By age, 14–17-year-olds, who are under the legal drinking

age of 18 in Brazil, drank 6% of the total alcohol consumed. Those aged 18–29 years drank the largest proportion (40.3%) and the next two groups, aged 30–39 and 40–49 years, consumed similar proportions (20.4% and 19.3%, respectively). The two oldest groups, aged 50–59 and 60 years and older, also consumed similar proportions (7.6% and 6.5%, respectively).

The prevention paradox

For volume, roughly one-fifth of drinkers in the low-risk group exhibited a social or dependence problem (Table 2), and each of these risks more than doubled for the moderate-risk group. For high-risk drinkers, slightly fewer than two-thirds exhibited a social/dependence problem. Of all drinkers reporting a social or dependence problem, roughly half (49–50%) were low-risk.

Table 1 Cumulative percentage of alcohol consumed and the relative contribution of gender and age groups: Brazil 2006 ($n = 1380$).

Drinks/year	Percentile group	Cumulative percentage consumed								
		Overall	Males	Females	14–17	18–29	30–39	40–49	50–59	60+
0–4	100	100.00	77.81	22.19	5.98	40.25	20.35	19.27	7.61	6.54
4–13	90	99.97	77.80	22.16	5.98	40.25	20.34	19.26	7.61	6.54
13–37	80	99.80	77.74	22.06	5.96	40.20	20.31	19.23	7.58	6.51
37–90	70	99.30	77.52	21.78	5.91	40.04	20.18	19.15	7.55	6.46
90–180	60	98.03	76.82	21.21	5.81	39.45	19.95	18.98	7.44	6.40
180–301	50	95.18	75.20	19.98	5.68	38.39	19.38	18.40	7.26	6.07
301–495	40	89.99	72.15	17.84	5.33	36.71	18.20	17.34	6.69	5.73
495–709	30	81.70	66.63	15.06	4.93	33.30	16.55	15.67	6.11	5.14
709–851	25	75.21	61.59	13.62	4.19	31.28	14.68	14.26	5.74	5.06
851–1099	20	67.00	54.64	12.36	3.85	28.56	13.24	12.40	4.41	4.55
1099–1336	15	56.57	45.87	10.70	3.13	24.17	11.66	11.11	2.86	3.63
1336–1950	10	44.16	36.94	7.22	2.64	19.31	7.65	9.31	2.22	3.02
1950–2568	5	27.38	22.30	5.08	2.23	10.12	4.68	6.32	1.80	2.22
2568+	2.5	14.85	13.08	1.77	1.28	2.55	2.03	5.90	1.80	1.29

Table 2 Prevalence of problem drinkers and proportion of reported problems by volume risk categories: Brazil 2006.

	Percentage of drinkers with one or more problems by volume risk categories				Percentage of low- and moderate-risk drinkers among all problem drinkers		Percentage of problem types attributable to low- and moderate-risk drinkers	
	Low-risk	Moderate-risk	High-risk	Total	Low-risk	Moderate-risk	Low risk	Moderate-risk
Social problems	18%	42%	63%	27%	49%	26%	47%	23%
Unweighted ratio	(182/990)	(80/206)	(84/138)	(346/1334)	(182/346)	(80/346)	(376/771)	(174/771)
Dependence problems	22%	51%	69%	32%	50%	27%	45%	24%
Unweighted ratio	(200/990)	(94/206)	(93/138)	(387/1334)	(200/387)	(94/387)	(389/821)	(199/821)

'Percentage of drinkers with one or more problems by volume risk categories' corresponds to the probability of having a problem for each of the three volume classifications; 'percentage of low- and moderate-risk drinkers among all problem drinkers' corresponds to the probability of being a low- or moderate-risk drinker given that at least one problem occurred; 'percentage of problem types attributable to low- and moderate-risk drinkers' corresponds to the sum of problem types among low- and moderate-risk groups, respectively, divided by the sum of problem types reported by all drinkers; 'low-risk' drinkers are in the bottom 90% of the volume distribution and are also within National Institute on Alcohol Abuse and Alcoholism (NIAAA)'s safe drinking guidelines. 'Moderate-risk' drinkers are in the bottom 90% but exceed NIAAA guidelines. 'High-risk' drinkers are in the top 10% of the volume distribution.

Table 3 Prevalence of problem drinkers and proportion of reported problems by binge risk categories: Brazil 2006.

	Percentage of drinkers with one or more problems by binge risk categories				Percentage of low- and moderate-risk binge drinkers among all problem drinkers		Percentage of problem types attributable to low and moderate-risk binge drinkers	
	Low-risk	Moderate-risk	High-risk	Total	Low-risk	Moderate-risk	Low-risk	Moderate-risk
Social problems	12%	29%	52%	27%	21%	29%	16%	29%
Unweighted ratio	(77/655)	(107/367)	(162/312)	(346/1334)	(77/346)	(107/346)	(138/771)	(227/771)
Dependence problems	13%	37%	60%	32%	19%	32%	15%	31%
Unweighted ratio	(72/655)	(130/367)	(185/312)	(387/1334)	(72/387)	(130/387)	(131/821)	(259/821)

'Percentage of drinkers with one or more problems by binge risk categories' corresponds to the probability of having a problem for each of the three binge classifications; 'percentage of low- and moderate-risk binge drinkers among all problem drinkers' corresponds to the probability of being a low- or moderate-risk binge drinker given that at least one problem occurred; 'percentage of problem types attributable to low- and moderate-risk binge drinkers' corresponds to the sum of problem types among low- and moderate-risk binge groups, respectively, divided by the sum of problem types reported by all drinkers; 'low-risk' corresponds to zero binge occasions in the past year; 'moderate-risk' and 'high-risk' approximately reflect the upper two quartiles of the binge distribution and correspond to one to three and four or more binge occasions, respectively.

Moderate-risk drinkers constituted roughly one-quarter of all social/dependence problem drinkers. These findings were largely mirrored in the results for total problem types (final two columns of Table 2), although the contributions of the two lower-risk groups are slightly lower (e.g. 45–47% for low risk).

Roughly 12–13% of non-binge drinkers (low-risk) reported a social/dependence problem (Table 3). Social problem prevalence increased to 29% and 52% for moderate- and high-risk binge drinkers, respectively. For dependence, prevalence increased to 37% and 60% for moderate- and high-risk binge drinkers, respectively. As in previous studies, a binge criterion weakened the paradox, but a non-trivial proportion of problem drinkers (roughly 20%) occurred among non-binge drinkers ('low-risk'). Moderate-risk binge drinkers made up roughly an additional 30% of these problem drinkers. Together, low- and moderate-risk binge groups accounted for roughly half (50–51%) of all social/dependence problem drinkers. As with volume, these findings were largely mirrored in the results for total problem types, but the contribution of the two lower-risk binge groups was slightly lower (45–46%).

Data are presented by both volume and binge in Table 4. Problem prevalence in the various groups generally followed a sensible trajectory, with problem risk increasing for respondents at higher levels of either volume or binge risk. Among binge drinkers (moderate- and high-risk columns), the lowest volume group accounted for 18 + 17 = 35% of all social problem drinkers, the moderate volume group accounted for another 6 + 14 = 20% and the high volume group accounted for 5 + 19 = 24%. Respective numbers for dependence problem drinkers were 36%, 23% and 23%. In other words, across both problem domains, low-volume binge drinkers made up the largest share of problem drinkers, and binge drinkers in lower-risk volume categories com-

Table 4 Prevalence of problem drinkers by volume and binge risk categories.

Volume risk	Binge risk		
	Low	Moderate	High
Social problems			
Low			
% with a problem	9%	26%	38%
Unweighted <i>n</i>	590	247	153
% of all problem drinkers	14%	18%	17%
Moderate			
% with a problem	42%	29%	52%
Unweighted <i>n</i>	49	77	80
% of all problem drinkers	6%	6%	14%
High			
% with a problem	27%	47%	78%
Unweighted <i>n</i>	16	43	79
% of all problem drinkers	1%	5%	19%
Dependence problems			
Low			
% with a problem	11%	31%	46%
Unweighted <i>n</i>	590	247	153
% of all problem drinkers	14%	18%	18%
Moderate			
% with a problem	33%	44%	65%
Unweighted <i>n</i>	49	77	80
% of all problem drinkers	4%	8%	15%
High			
% with a problem	25%	57%	82%
Unweighted <i>n</i>	16	43	79
% of all problem drinkers	1%	6%	17%

See Tables 1 and 2 for definitions of volume and binge risk categories; unweighted *n* corresponds to the unweighted number of respondents in the risk grouping defined by each cell.

binated accounted for over 50% of problem drinkers. The second-order paradox therefore holds. Also, this table illustrates that low-volume drinkers made comparable contributions to the total number of problem drinkers,

regardless of binge risk. Moderate- and high-volume groups showed more of a gradient, with the largest contributions coming from high-risk binge drinkers. Identical patterns were seen for total problem types (data not shown).

The association of binge and volume with social and dependence-related problems

For the multiple logistic regression, we rescaled the continuous volume and binge measures from a yearly to a weekly time-scale to facilitate coefficient interpretation. Both binge [odds ratio (OR) = 3.3; 95% confidence interval (CI) = 1.4–7.4] and volume (OR = 1.07; 95% CI = 1.05–1.08) were associated independently with social problems, and the interaction effect of these two variables was significant (OR = 0.98; 95% CI = 0.97–0.99). The same results were found for dependence problems, with both binge (OR = 3.9; 95% CI = 1.4–10.4), volume (OR = 1.08; 95% CI = 1.06–1.10) and their interaction (OR = 0.98; 95% CI = 0.97–0.99) reaching significance. The results indicate that among low-risk volume drinkers, problem risk increases by a factor of 3.3 or 3.9 for each additional binge occasion per week. The negative coefficient for the interaction term, however, indicates that this effect weakens slightly at higher levels of volumetric intake. This mirrors trends seen with the cruder risk categories depicted in Table 4: for example, for low-volume risk, social problem risk increases by a factor of about 4 across binge categories, but by a factor of 3 for the high-risk volume group.

DISCUSSION

The distribution of alcohol consumption

The distribution of alcohol consumption in Brazil is highly concentrated, but slightly less so than in other countries. For instance, the top 2.5% and 5% of the drinkers by volume in the United States account for about 25% and 42%, respectively, of that country's total alcohol consumption [29]. In Brazil, the same groups consume roughly 15% and 27% of all alcohol. Gender and age breakdowns, however, are comparable, with men consuming just over 75% of all alcohol in both countries and 18–29-year-olds consuming more than other age groups (Brazil: 40%; United States 44%). These findings provide important information for alcohol policy development in Brazil. The high proportion of alcohol consumed by males and younger ages is consistent with findings from previous analyses of these data which show that the rate of abuse or dependence is 19% among males and 19% among people aged 18–24 years [20]. In 2002, the rate of abuse or dependence was 12.4% and 16.2%

among US males and 18–29-year-olds, respectively [30]. Similarly, in Brazil the prevalence of binge drinking is four times higher in younger age groups than in individuals aged 60 or older [20].

As in other countries, in Brazil binge drinking is a risk factor for acute alcohol problems such as car crashes, particularly in younger age groups [31,32]. The establishment of epidemiological surveillance of emergency room admissions is therefore an excellent way to monitor alcohol consequences in this group. The present results also suggest that 6% of consumed alcohol is drunk by individuals under the legal drinking age in Brazil. Other research has shown that this age group reports high exposure to alcohol advertising [33], a factor linked to intentions to drink and purchase alcohol [34,35] and to consumption [36,37], and relatively little exposure to alcohol prevention messages. Thus, besides the provision of treatment, brief interventions and lower legal blood alcohol content (BAC) level, other alcohol control policies such as control of marketing by the alcohol industry are also important to consider and enforce in Brazil.

The prevention paradox

The prevention paradox as described by Kreitman [7] and the second-order paradox [8,9,14,15] are present in Brazil. By a volume criterion, the majority of the problem drinkers are at lower levels of risk. Alternatively, for a binge criterion the majority of problem drinkers are binge drinkers, most of whom are at lower levels of volumetric risk. This also indicates that pattern of consumption—not volume alone—has an important association with problems in Brazil, as elsewhere. The regression model supported this as well, where both volume and binge were independently associated with problems.

Findings of a first- and second-order paradox for dependence problems might seem counterintuitive, particularly with respect to classical conceptions of addiction as a chronic, progressive condition emerging after many years of sustained, high-volume drinking [13]. In this regard, it is important to note that dependence problems—not dependence diagnoses—were analyzed: people were considered 'problem' cases even if they exhibited one problem. Consequently, low-severity cases can make substantial contributions to total problem counts. Consistent with this, inspection of the number of problem types reported (data not shown) revealed that more than half of problem drinkers reported two or fewer dependence problems, regardless of risk category. These findings are also consistent with general population data outside Brazil, which show that although they are not a majority, a considerable number of moderate drinkers with and without a history of bingeing report problems associated with alcohol dependence (see for instance

[38]). When taking into account the large size of these low-risk groups, the relatively isolated problem episodes seen among people at lower levels of severity add up quickly, contributing to a prevention paradox for dependence. These results are also consistent with studies that have analyzed dependence problems indirectly or in specific subgroups [24,25].

Strengths of the present study are that it was based on a representative sample of the Brazilian population, used face-to-face interviews and achieved a good response rate (66.4%). Measures of consumption, binge and problems were also based on the same 12-month time-frame. Most of the roughly 33% who were not interviewed lived in unreachable, gated and closed condominiums in large metropolitan areas in Brazil. If these respondents are different from those who were interviewed, the findings may not fully represent drinking and alcohol problems in Brazil. Although we used measures of the number of problem *types* reported, this is not equivalent to the frequency or severity of alcohol-related problems. If specific problems differentially reflect overall severity (i.e. the items do not exhibit a parallel factor structure; [39]), the sum of problem types may not be an appropriate proxy for problem severity (but see [8]). In addition, respondents may have under-reported some of the behaviors under analysis. If under-reporting is higher in a particular group than in others, this could affect the results reported. In particular, if the extent to which self-reported consumption underestimates actual consumption is more pronounced in heavier drinkers, higher-risk groups may account for more of the total alcohol consumed as well as more problems (as a result of underestimating the size of higher-risk groups), which would make the prevention paradox (for volume) appear more extreme than it actually is. Finally, the data under analysis are cross-sectional in nature and therefore limit the ability to draw causal inferences from the data.

With these results and caveats as a background, what types of alcohol control policies should be implemented in Brazil? First, the discussion of the proportional distribution of volume of drinking across gender and age groups in Brazil, above, suggests that a comprehensive approach is necessary. That is, strategies targeting specific population groups as well as general alcohol control policies directed at the population as a whole are indicated. This approach has been proposed in the literature [34], in accordance with the variety and complexity of the alcohol problems that need to be prevented. It is also supported by the present analyses on the prevention paradox in Brazil, which suggest that general alcohol control policies directed at lowering per-capita consumption in the population (such as taxation and control of alcohol availability) are warranted. Combined with the relatively high prevalence of binge drinking in Brazil, the

close link between both social and dependence problems to episodes of acute intoxication suggests that policies targeting binge drinking behavior may also be useful, for both specific population groups (e.g. adolescents and young adults) and in the general Brazilian population. It is worth noting here that although individuals who did not binge ('low-risk' in Table 3) made the smallest contribution of the three binge risk groups to problem drinkers and problem types, their contribution was not trivial. For example, policies targeting binge drinking exclusively would miss 21% of social problem drinkers, suggesting again that global and multi-faceted approaches are warranted. Because of the relatively high binge prevalence among light drinkers (a recurrent finding in prevention paradox studies; e.g. [8,40]), global policy recommendations can be grounded in the sheer prevalence of risky drinking patterns alone (as opposed to being motivated by anything paradoxical). Similar arguments have been proposed by Stockwell and colleagues [15,41]. Policy choices must also reflect the Brazilian social context, as they must be accepted by the population and must also depend on their level of effectiveness. Public opinion surveys on alcohol control policies show that most Brazilians support limiting hours and places of sale, banning alcohol advertisements on TV, and increasing taxes on alcoholic beverages [42]. Brazilian data on policy effectiveness are already available for some policies, such as hours of sale [43] and control of alcohol advertising [33], but more needs to be conducted in the area of policy evaluation. In conjunction with recent national policy initiatives such as the aforementioned reduction in legal BAC level, the country appears to be interested and has the wherewithal to implement alcohol control policies to minimize drinking problems in the population.

Declarations of interest

None.

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References

1. Ledermann S. *Alcool, Alcoolisme, Alcoolisation [Alcohol, alcoholism, and alcoholization]*. Paris: Presses Universitaires de France; 1956.
2. Bruun K., Edwards G., Lumio M., Mäkelä K., Pan L., Popham R. E. et al. *Alcohol Control Policies in Public Health Perspective*. Helsinki: The Finnish Foundation for Alcohol Studies; 1975.
3. Edwards A. G., Rollnick S. Outcome studies of brief alcohol intervention in general practice: the problem of lost subjects. *Addiction* 1997; 92: 1699–704.

4. Greenfield T. K., Rogers J. D. Who drinks most of the alcohol in the US? The policy implications. *J Stud Alcohol* 1999; **60**: 78–89.
5. Norstrom T. Prevention strategies and alcohol policy. *Addiction* 1995; **90**: 515–24.
6. Rehm J., Spuhler T. Measurement error in alcohol consumption: The Swiss Health Survey. *Eur J Clin Nutr* 1993; **47**: S25–S30.
7. Kreitman N. Alcohol consumption and the preventive paradox. *Br J Addict* 1986; **81**: 353–63.
8. Gmel G., Klingemann S., Müller R., Brenner D. Revising the preventive paradox: the Swiss case. *Addiction* 2001; **96**: 273–84.
9. Rossow I., Romelsjo A. The extent of the 'prevention paradox' in alcohol problems as a function of population drinking patterns. *Addiction* 2006; **101**: 84–90.
10. Stockwell T., Daly A., Phillips M., Masters L., Midford R., Gahegan M. *et al.* Total versus hazardous per capita alcohol consumption as predictors of acute and chronic alcohol related harm. International Conference on Social and Health Effects of Different Drinking Patterns; November 13–17, 1995; Toronto, Canada.
11. Dawson D. A. Alternative definitions of high risk for impaired driving: the overlap of high volume, frequent heavy drinking and alcohol dependence. *Drug Alcohol Depend* 1999; **54**: 219–28.
12. Wylie A., Zhang J. F., Casswell S. Risk functions for frequency of alcohol-related negative consequences: New Zealand survey data. *Addiction* 2000; **95**: 1821–32.
13. Skog O. J. The prevention paradox revisited. *Addiction* 1999; **94**: 751–7.
14. Skog O. J. Alcohol and the so-called prevention paradox: how does it look today? *Addiction* 2006; **101**: 155–8.
15. Stockwell T., Hawks D., Lang E., Ryon P. Unravelling the preventive paradox for acute alcohol problems. *Drug Alcohol Rev* 1996; **15**: 7–15.
16. Instituto Brasileiro de Geografia e Estatística [Brazilian Institute of Geography and Statistic] (IBGE). *Censo Demográfico 2000 [Population Census 2000]*. Rio de Janeiro: IBGE; 2002.
17. International Center for Alcohol Policies (ICAP). *The Structure of the Beverage Alcohol Industry*. Washington DC: ICAP; 2006.
18. Room R., Jernigan D., Carlini-Marlatt B., Gureje O., Mäkelä K., Marshall M. *et al.* *Alcohol and the Developing World: A Public Health Perspective*. Helsinki: Hakapaino Oy; 2002.
19. Caetano R., Laranjeira R. A. 'perfect storm' in developing countries: economic growth and the alcohol industry. *Addiction* 2006; **101**: 149–52.
20. Laranjeira R., Pinsky I., Sanches M., Zaleski M., Caetano R. Alcohol use patterns among Brazilian adults. *Rev Bras Psiquiatr* 2010; **32**: 231–41.
21. Babor T. F., Caetano R., Casswell S., Edwards G., Giesbrecht N., Graham K. *et al.* *Alcohol: No Ordinary Commodity: Research and Public Policy*. Oxford/New York: Oxford University Press; 2003.
22. World Health Organization (WHO). *The Global Status Report on Alcohol and Health*. Geneva: WHO; 2011.
23. National Institute on Alcohol Abuse and Alcoholism (NIAAA). *Helping Patients with Alcohol Problems : A Health Practitioner's Guide*. Bethesda, MD: NIAAA 2003.
24. Poikolainen K., Paljärvi T., Mäkelä P. Alcohol and the preventive paradox: serious harms and drinking patterns. *Addiction* 2007; **102**: 571–8.
25. Stockwell T., Gruenewald P. J. Controls on the physical availability of alcohol. In: Heather N., Stockwell T., editors. *The Essential Handbook of Treatment and Prevention of Alcohol Problems*. New York: John Wiley & Sons Ltd.; 2004, p. 213–33.
26. Clark W. B., Hilton M., editors. *Alcohol in America: Drinking Practices and Problems*. Albany, NY: State University of New York Press; 1991.
27. Greenfield T. K., Kerr W. C. Alcohol measurement methodology in epidemiology: recent advances and opportunities. *Addiction* 2008; **103**: 1082–99 [Review].
28. STATA Corporation. *STATA Statistical Software: Release 11.0*. College Station, TX: STATA Corporation; 2009.
29. Greenfield T., Rogers J. Who drinks the most alcohol in the U.S.? The policy implications. *J Stud Alcohol* 1999; **60**: 78–89.
30. Hasin D. S., Stinson F. S., Ogburn E., Grant B. F. Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States. *Arch Gen Psychiatry* 2007; **64**: 830–42.
31. Pechansky F., De Boni R., Von Diemen L., Bumaguin D., Pinsky I., Zaleski M. *et al.* Alta prevalencia relatada de beber e dirigir no Brasil: dados do primeiro estudo representativo realizado em domicílios [Prevalence of drinking and driving in Brazil: data from the first representative household study]. *Rev Bras Psiquiatr* 2009; **31**: 125–30.
32. dos Santos Modelli M. E., Pratesi R., Tauil P. L. Alcoolemia em vítimas fatais de acidentes de trânsito no Distrito Federal, Brasil [Blood alcohol concentration in fatal traffic accidents in the Federal District, Brazil]. *Rev Saude Publica* 2008; **42**: 350–2.
33. Pinsky I., El Jundi S. A. R. J., Sanches M., Zaleski M. J. B., Laranjeira R. R., Caetano R. Exposure of adolescents and young adults to alcohol advertising in Brazil. *J Public Aff* 2010; **10**: 50–8.
34. Babor T. F., Caetano R., Casswell S., Edwards G., Giesbrecht N., Graham K. *et al.* *Alcohol: No Ordinary Commodity: Research and Public Policy*, 2nd edn. Oxford: Oxford University Press; 2010.
35. Grube J. Television alcohol portrayals, alcohol advertising, and alcohol expectancies among children and adolescents. In: Martin S. E., editor. *Effects of the Mass Media on the Use & Abuse of Alcohol*. Rockville, MD: National Institute of Health; 1995, p. 105–21.
36. Anderson P., de Bruijn A., Angus K., Gordon R., Hastings G. Impact of alcohol advertising and media exposure on adolescent alcohol use: a systematic review of longitudinal studies. *Alcohol Alcohol* 2009; **44**: 229–43.
37. Smith L., Foxcroft D. The effect of alcohol advertising, marketing and portrayal on drinking behaviour in young people: systematic review of prospective cohort studies. *BMC Public Health* 2009; **9**: 51–62.
38. Caetano R. The identification of alcohol dependence criteria in the general population. *Addiction* 1999; **94**: 255–67.
39. Wright J. G., Feinstein A. R. A comparative contrast of clinimetric and psychometric methods for constructing indexes and rating scales. *J Clin Epidemiol* 1992; **45**: 1201–18.
40. Caetano R., Mills B. A. The Hispanic Americans Baseline Alcohol Survey (HABLAS): is the 'prevention paradox' applicable to alcohol problems across Hispanic national groups? *Alcohol Clin Exp Res* 2011; **35**: 1256–64.
41. Stockwell T., Zhao J., Chikritzhs T., Greenfield T. K. What did you drink yesterday? Public health relevance of a recent

- recall method used in the 2004 Australian National Drug Strategy Household Survey. *Addiction* 2008; **103**: 919–28.
42. Pinsky I., Laranjeira R. Ethics of an unregulated alcohol market. *Addiction* 2007;**102**: 1038–9 [Commentary].
43. Duailibi S., Ponicki W., Grube J., Pinsky I., Laranjeira R., Raw M. The effect of restricting opening hours on alcohol-related violence. *Am J Public Health* 2007; **97**: 2276–80.