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CLINICAL SCIENCE

Gender differences in drinking patterns and alcohol-related problems in a community sample in São Paulo, Brazil

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OBJECTIVE: To investigate drinking patterns and gender differences in alcohol-related problems in a Brazilian population, with an emphasis on the frequency of heavy drinking.

METHODS: A cross-sectional study was conducted with a probability adult household sample (n = 1,464) in the city of São Paulo, Brazil. Alcohol intake and ICD-10 psychopathology diagnoses were assessed with the Composite International Diagnostic Interview 1.1. The analyses focused on the prevalence and determinants of 12-month non-heavy drinking, heavy episodic drinking (4-5 drinks per occasion), and heavy and frequent drinking (heavy drinking at least 3 times/week), as well as associated alcohol-related problems according to drinking patterns and gender.

RESULTS: Nearly 22% (32.4% women, 8.7% men) of the subjects were lifetime abstainers, 60.3% were non-heavy drinkers, and 17.5% reported heavy drinking in a 12-month period (26.3% men, 10.9% women). Subjects with the highest frequency of heavy drinking reported the most problems. Among subjects who did not engage in heavy drinking, men reported more problems than did women. A gender convergence in the amount of problems was observed when considering heavy drinking patterns. Heavy and frequent drinkers were twice as likely as abstainers to present lifetime depressive disorders. Lifetime nicotine dependence was associated with all drinking patterns. Heavy and frequent drinking was not restricted to young ages.

CONCLUSIONS: Heavy and frequent episodic drinking was strongly associated with problems in a community sample from the largest city in Latin America. Prevention policies should target this drinking pattern, independent of age or gender. These findings warrant continued research on risky drinking behavior, particularly among persistent heavy drinkers at the non-dependent level.

KEYWORDS: Alcohol; Heavy episodic drinking; Binge drinking; Epidemiology; Brazil.

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INTRODUCTION

Alcohol is the third most important risk factor for the global burden of disease (GBD) (1), particularly in Latin America and the Caribbean, where 10% of all deaths and disabilities are attributable to alcohol use (2). In Brazil, almost 18% of all disability-adjusted life years (DALYs) among men and 3.4% among women are attributable to alcohol (3). Moreover, the average 2003-2005 annual

consumption of pure alcohol per person aged 15 years or older in Brazil was 9.2 liters, far higher than the 2005 average annual worldwide consumption of 6.13 liters (1).

In the past few years, increasing attention has been devoted to patterns of consumption as a predictor of risky drinking (4-11). Brazil has a pattern of drinking score (PDS) of 3. This score is based on several indicators, including heavy drinking occasions, drinking in public settings, and frequency of drinking with meals. The PDS was created for the Comparative Risk Assessment (CRA) module of the GBD to determine whether changes in population health are due to harmful drinking. A score of 1 represents the least detrimental pattern, and 4 represents the most detrimental pattern (1,8,9).

Heavy drinking is a dangerous drinking pattern that leads to intoxication, which is the main mechanism through

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which alcohol-related harm occurs in the general population. Heavy drinking is linked to acute health outcomes (e.g., injuries, sudden cardiac death) and, based on its direct biological effects, to chronic diseases (e.g., high blood pressure, increased risk of liver disease, pancreatic damage, cancer) (9). Approximately 11.5% of drinkers have occasions of heavy episodic drinking (1). For the CRA, heavy drinking is defined as the consumption of >40 g/day for males and >20 g/day for females (9). The term 'heavy episodic drinking,' defined as the consumption of 5 or more drinks for men and 4 drinks or more for women on a single occasion (12,13), has been proposed for research purposes (14) because it retains the heavy quantity and periodic frequency components of the construct.

Whether the five/four-drink benchmark (5/4+) represents a threshold for risk behaviors and associated problems is a concern in alcohol use research (15). In an interesting study, American college students who reported drinking in a heavy pattern three or more times per week, which was called 'heavy and frequent drinking,' had increased odds of reporting related problems. The addition of the frequency criterion was considered to improve the ability to distinguish seriously problematic drinkers from less problematic ones (16).

Data on the influence of drinking patterns and associated problems are less prevalent in Brazil compared to overall alcohol consumption estimates (17-19). Recently, patterns of alcohol use and related problems have been studied in adult populations. As part of the Genacis project (20), an urban population-based survey in Southeast Brazil showed that 11% of the sample reported consuming five or more drinks at least once in the previous month, with a male/female ratio (M/F) of 1.6 (14% men; 8.8% women). Approximately 4% of the sample reported this heavy pattern of drinking and one negative consequence (5.4% men; 3.9% of women). In a national household survey of patterns of alcohol consumption (n=2,346), 28% of respondents (40% men; 18% women; M/F: 2.2) reported drinking 5/4+ in the previous year, and 9% (14% men; 3% women; M/F: 4.7) drank in this pattern at least once a week (21). Drinking problems were reported by 23% of the total sample. Among drinkers, men were more likely to report problems (58%) than females (26%; M/F ratio 2.2). Those aged 18-24 years reported more problems (53%) than older groups. Another study that evaluated factors associated with alcohol use among 609 traffic accident victims admitted to two emergency rooms in Porto Alegre found that binge drinking in the previous 12 months increased the risk of alcohol-related accidents 2.4 times (22).

Accurate information on gender differences in drinking patterns and alcohol-related problems is important for identifying at-risk populations and planning prevention programs. Our research group previously described the sociodemographic predictors of heavy episodic drinking within the previous year in a population-based survey of adults living in the city of São Paulo, Southeast Brazil (23). In addition to identifying patterns of alcohol consumption in any 12-month period of the person's life and their correlates, we assessed the association between drinking patterns and alcohol-related problems, hypothesizing that heavy episodic drinking occurring three or more times a week led to more negative consequences. That study also

examined gender differences in drinking patterns and associated problems.

METHODS

Participants

Data were obtained from the São Paulo Catchment Area Study, a household survey conducted in two boroughs in the city of São Paulo, Brazil (24). This study was the Brazilian part of the WHO International Consortium in Psychiatric Epidemiology (ICPE), a landmark community-based survey of mental disorders (25-27). Eligible respondents included non-institutionalized adults (18 years old or older), with an oversampling of persons aged 18-24 years. Of the 1,906 individuals selected to participate, 442 refused, resulting in a final sample of 1,464 subjects and an individual response rate of 76.8%. Face-to-face interviews were conducted in 1995 using the Brazilian version of the Composite International Diagnostic Interview (CIDI), version 1.128. All participants gave written informed consent before the interview, and the study's procedures were approved by the Research and Ethics Committee of the School of Medicine, University of São Paulo (Project number 93/0501-4). The procedures are presented in more detail elsewhere (23,24).

Measures

Drinking patterns and alcohol-related problems. The alcohol section of the CIDI 1.1 includes drinking quantity (mean number of doses per drinking day), frequency (drinking days per week), and alcohol-related problems for subjects who reported consuming at least 12 doses in a 12-month period in their life. Drinking patterns were evaluated for the previous year and/or for the 12-month period during which the respondent drank the most. The patterns were categorized into: non-heavy, heavy, and heavy and frequent drinking. Heavy drinking (HD) was defined considering five doses or more in one occasion for men and four or more doses in one occasion for women, adjusting for gender differences in metabolism and body weight (9). Heavy and frequent drinkers (HFDs) reported heavy drinking at least three times a week in a 12-month period (16). Subjects who reported drinking at least 12 doses in a 12-month period in their lifetime but did not engage in heavy drinking were classified as non-heavy drinkers (NHDs). Lifetime abstainers were those who reported that they had never consumed more than 12 doses in any 12-month period in their lifetime. All four groups were mutually exclusive.

Twenty-four alcohol-related problems, categorized into nine groups, were assessed among non-abstainers:

- 1) interpersonal problems: objections to drinking from family, friends, a doctor, or a clergyman or a breakup between a drinker and his or her family or a friend;
- 2) unintentional injuries: accidental self-injury when drinking (bad fall, bad cut, traffic accident);
- 3) risky driving and/or drinking while operating machines: trouble with authorities when driving under the influence of alcohol in situations with a risk of being injured;
- 4) role interference: trouble at work or school, drinking or being hung over prevented the respondent from working, going to school, or taking care of children,

- giving up or greatly reducing important activities in favor of drinking;
- 5) drinking more than expected: needing to drink more to obtain the same effect, strong desire or urge to drink, want to stop or cut down on drinking but unable, spend a great deal of time drinking;
 - 6) violence problems: fights while drinking and/or being stopped by the police, being arrested, or going to a treatment center;
 - 7) physical symptoms and/or health problems: stopping drinking causes physical problems, need a drink to prevent problems (shaking hands, problems sleeping, feeling nervous or restless, sweating, rapid heartbeat, nausea or vomiting, headaches, weakness, hallucinations, fits or seizures), and/or physical health problems due to drinking (e.g., liver disease, stomach disease, vomiting blood, tingling feet, feeling numb, memory problems when not drinking, pancreatitis);
 - 8) emotional problems: alcohol ever caused emotional or psychological problems (lack of interest in usual activities, depression, suspicious or distrustful, strange thoughts);
 - 9) continue to drink despite interpersonal problems, physical symptoms and/or health and/or emotional problems.

Sociodemographic correlates and other variables. Sociodemographic correlates included gender, cohort, education level, and marital status. The cohort was defined by age at interview in the following categories: 18–24, 25–34, 35–44, 45–54, and 55 years or older. Education level was categorized in the following ranges of completed years of education: 0–8, 9–11, 12–15, and 16 or more. Marital status was classified as married or cohabitating, previously married (widowed, separated or divorced) and never married.

The potential association of drinking patterns with lifetime CIDI 1.1/ICD-10 depressive disorders (depressive episode and/or dysthymia), any lifetime anxiety disorders (generalized anxiety, panic disorder, agoraphobia, social phobia, simple phobia, obsessive-compulsive disorder) and nicotine dependence was also analyzed.

Data analysis

Data were weighted to adjust for differential probabilities of selection and non-response. The overall and gender-specific prevalences of lifetime abstinence and drinking patterns were calculated. The prevalence of each of the nine groups of problems was assessed for each drinking pattern using the Cochran-Mantel-Haenszel χ^2 test to test for linearity.

A multivariate response profile analysis implemented via the generalized estimation equation (GEE) (29) approach for correlated binary responses was used to examine gender differences in the frequency of all groups of problems for each drinking pattern. The log odds of each group of problems were compared between genders and drinking patterns, with gender as a between group factor and the group of problems as the within group factor. The exchangeable correlation option of the GEE was used to estimate the parameters for these models, assuming that the correlation between any pair of group of problems was equal.

The associations between drinking patterns, sociodemographic correlates and mental disorders were first examined

with crude odds ratios (ORs), using the Wald χ^2 test to detect within group differences. Lifetime abstainers were the reference category for all models. Polychotomous logistic regression (30) was used to identify predictors of each drinking pattern. The best-fitting model was designed as a function of age, marital status, nicotine dependence, lifetime depressive disorder, and the interactions of gender and education using stepwise backward logistic regression. Anxiety disorders were eliminated from the final model because they were not associated with any drinking pattern in the unadjusted model. Significance was based on two-sided tests using the 0.05 significance level. Analyses were conducted using SAS 9.1.

RESULTS

Drinking patterns and gender differences

Of the entire sample, 22.2% were lifetime abstainers, including 32.4% of women and 8.7% of men (F/M: 3.7; $\chi^2 = 116.2$; $p < 0.0001$). The majority of lifetime alcohol users (60.3%) were NHDs, with no difference between genders (Table 1). Considering heavy drinking as a summary category, 26.3% men reported drinking in this pattern in a 12-month period, compared to 10.9% of women (total: 17.5%; M/F: 2.4; $\chi^2 = 59.8$; $p < 0.0001$).

Association of drinking patterns with alcohol-related problems

As expected, the proportion of subjects who had experienced negative consequences increased with the hazardousness of the drinking pattern (Table 2). Significant linearity ($p < 0.0001$) in the Cochran-Mantel-Haenszel χ^2 test was observed for all nine groups of problems analyzed. HFDs had the highest rates of adverse outcomes, with nearly 60% reporting that they continued drinking despite physical or psychological problems and 52.6% reporting that they consumed more than expected. Moreover, approximately 35% of HFDs reported role interference, and almost 30% reported risky driving and/or drinking while operating machines. One in four HFDs had physical symptoms and/or health problems, and the same proportion reported emotional problems. Violence and unintentional injuries were reported by 20% and 13% of HFDs, respectively.

A smaller proportion of HDs reported problems, with at least one in three reporting interpersonal problems (32.6%), continuing to drink despite problems (31.3%), and drinking more than expected (30.5%). Risky driving and/or drinking while operating machines was reported by approximately one in five HDs, and violence was reported by approximately 15% of HDs. Unintentional injuries were the least frequently reported type of problem (6.7%).

Table 1 - Patterns of alcohol consumption by gender. São Paulo Epidemiological Catchment Area Study (n = 1,464; weighted data).

Type of drinker	Men % (SE)	WomEn % (SE)	Total % (SE)
Lifetime Abstainers	8.7 (1.0)	32.4 (1.4)	22.2 (1.0)
Lifetime Alcohol Users:			
Non-heavy drinkers	65.0 (1.9)	56.7 (1.5)	60.3 (1.2)
Heavy drinkers	12.0 (1.2)	5.5 (0.8)	8.2 (0.7)
Heavy and frequent drinkers	14.3 (1.3)	5.4 (0.7)	9.3 (0.7)

Table 2 - Percentage of alcohol-related problems stratified by drinking pattern. Cochran-Mantel-Haenszel χ^2 test-to-test linearity (SP-ECA; n = 1,464).

Group of problems	Non-heavy (n = 845) %	Heavy (n = 118) %	Heavy and frequent (n = 120) %	χ^2 (1 df)
Interpersonal problems	11.6	32.6	61.8	197.7*
Unintentional injuries	3.7	6.7	13.1	21.2 *
Risky driving and/or drinking while operating machines	5.7	19.6	28.9	83.4*
Role interference	7.7	17.1	35.2	85.8*
Drinking more than expected	8.9	30.5	52.6	182.4*
Violence problems	3.4	14.8	20.2	67.3*
Physical symptoms [§] and/or health problems [¥]	5.3	11.0	25.9	77.4*
Emotional problems [£]	3.6	8.5	25.7	84.2*
Continue to drink despite problems	9.7	31.3	58.1	203.7*

* $p < 0.0001$; [§] Defined as frequently experiencing shaky hands, being unable to sleep, feeling very nervous or restless, sweating, fast heartbeat, nausea or vomiting, headaches, weakness, seeing or hearing things, fits or seizures, or other similar problems. [¥] Defined as liver disease or hepatitis, stomach disease, vomiting blood, tingling feet, feeling numb, memory problems even when not drinking, pancreatitis, or other disease. [£] Being uninterested in usual activities, being sad, blue or depressed, being suspicious or distrustful, or having strange thoughts.

NHDs had the lowest percentage of problems reported, although approximately 10% reported interpersonal problems, continuing to drink despite problems, and/or drinking more than expected. Problems related to role interference and risky driving and/or drinking while operating machines were reported by 8% and 6% of NHDs, respectively. Other problems occurred with a frequency of 5% or less in this group.

Gender differences regarding the association of drinking patterns with alcohol-related problems

The GEE multivariate response profile analysis model provided evidence for a gender effect in each group of alcohol-related problems among NHDs (Table 3), with different proportions according to the type of problems reported (χ^2 for the interaction between gender and group of problems = 16.78; df = 8; $p = 0.0325$). A higher proportion of NHD men than women consistently presented problems.

In seven groups of problems, the OR was above 3, with women serving as the reference category. The highest ORs were for acting-out behaviors (e.g., risky driving and/or drinking while operating machines), violence problems, and unintentional injuries. Interpersonal problems were the most frequent group of problems reported by both NHD men and women (17.9% and 6.2%, respectively). The least frequently reported types of problems were emotional problems for NHD men (5.5%) and violence for NHD women (0.7%).

The scenario changed when the drinking pattern became heavier. The gender effect was no longer observed in the GEE model for HD, indicating that men and women typically did not differ in the proportion of problems reported within each group of problems. The exception was "interpersonal problems." Although this group was the mostly frequent type of problem for men and women, men were three times more likely to report these problems than

Table 3 - Percentage of alcohol-related problems stratified by drinking pattern. Wald χ^2 test for men/women (M vs. W) differences; results are presented as odds ratio and 95% confidence interval (ORs, 95% CI) from the multivariate regression model with generalized estimating equations (GEEs) (SP-ECA; n = 1,464).

Group of problems	Non-heavy		Heavy		Heavy and frequent	
	%M vs. %W	OR 95%CI [€]	%M vs. %W	OR 95%CI [€]	%M vs. %W	OR 95%CI [€]
Interpersonal problems	17.9/6.2***	3.3 (1.9-5.5)	36.6/26.0*	2.9 (1.3-6.5)	66.0/53.6	1.7 (0.7-3.8)
Unintentional injuries	7.0/1.0***	7.3 (2.7-19.7)	5.3/8.9	0.6 (0.1-2.8)	11.6/16.0	0.7 (0.2-2.1)
Risky driving and/or drinking while operating machines	11.4/0.9***	14.8 (6.2-35.4)	25.2/10.4	2.9 (0.6-13.3)	30.3/26.2	1.2 (0.5-2.9)
Role interference	13.2/3.0***	4.9 (2.7-9.2)	16.5/18.0	0.9 (0.3-2.7)	36.4/32.8	1.2 (0.5-2.7)
Drinking more than expected	14.2/4.3***	3.6 (2.0-6.6)	34.9/23.2	1.8 (0.7-4.7)	50.0/57.9	0.7 (0.3-1.6)
Violence problems	6.5/0.7***	9.4 (3.0-29.1)	23.8/0	--	21.8/17.2	1.3 (0.5-3.7)
Physical symptoms [§] and/or health problems [¥]	8.8/2.4**	3.9 (1.8-8.9)	11.4/10.4	1.1 (0.2-5.4)	25.4/35.8	0.6 (0.2-1.5)
Emotional problems [£]	5.5/2.1 *	2.7 (1.1-6.3)	7.4/10.2	0.7 (0.2-2.5)	23.3/30.3	0.7 (0.3-1.7)
Continue to drink despite problems	13.9/6.1 **	2.5 (1.4-4.3)	34.6/25.8	1.5 (0.6-3.6)	62.2/49.8	1.7 (0.7-3.6)
Generalized Estimating Equations (GEEs)						
χ^2 score for gender	20.66; df = 1; $p < 0.001$		0.33; df = 1; $p = 0.5646$		0.01; df = 1; $p = 0.9544$	
χ^2 score for group of problems	55.58; df = 8; $p < 0.0001$		30.01; df = 7; $p < 0.001$		48.87; df = 8; $p < 0.0001$	
χ^2 score for the interaction between gender and group of problems	16.78; df = 8; $p = 0.0325$		9.56; df = 7; $p = 0.2148$		8.18; df = 8; $p = 0.4162$	

*** $p < 0.0001$, ** $p < 0.005$, * $p < 0.05$; NS: not significant at $p = 0.05$ [€] For the odds ratio (OR), women served as the reference category. [§] Defined as frequently experiencing shaking hands, being unable to sleep, feeling very nervous or restless, sweating, rapid heartbeat, nausea or vomiting, headaches, weakness, seeing or hearing things, fits or seizures, or similar problems. [¥] Defined as liver disease or hepatitis, stomach disease, vomiting blood, tingling feet, feeling numb, memory problems even when not drinking, pancreatitis, or other disease. [£] Defined as being uninterested in typical activities, being sad, blue or depressed, being suspicious or distrustful, or having strange thoughts.

were women. Although no HD women reported “violence problems” (excluded from both the GEE model and χ^2), this kind of problem was reported by approximately one in four HD men. “Drinking more than expected” and “continuing to drink despite problems” were the next most frequently reported groups of problems by both men and women. The least frequently reported group of problems was “unintentional injuries,” reported by 5.3% of HD men and 8.9% of HD women.

The GEE model for HFDs showed no gender effect for all nine groups of problems, with “interpersonal problems” and “drinking more than expected” as the most frequently reported types. Half of the HFDs “continued to drink despite problems.” Except for “unintentional injuries,” the majority of problems were reported by at least 20% of HFDs.

Association between drinking patterns, sociodemographic correlates and mental disorders

Table 4 shows the correlates of the drinking patterns. After the adjustment, the gender effect observed in the univariate analysis (data not shown) appeared as an interaction between gender and education in the three drinking patterns. The more detrimental the drinking pattern, the higher the likelihood that men with low education levels would report it. For instance, men with low education levels were more than 8 times more likely to be HFDs than were men with a college education. Among women, low education was a protective factor within all drinking patterns.

NHD was associated with male gender, higher education and age between 35-44 years. HDs were younger (18-34 years old), separated/divorced/widowed or never married

men with high school or higher educations. HFDs were more likely to be men between 35 to 44 years old with low education levels and were twice as likely to present lifetime depressive disorder compared with abstainers. Lifetime nicotine dependence was associated with all drinking patterns, with a higher strength of association for HDs.

DISCUSSION

The present study contributes to the understanding of drinking patterns and their association with alcohol-related problems in Brazil in two different ways. First, the methodological approach applied in this study represents an improvement for epidemiological studies in our country. The instrument utilized in this study was validated elsewhere, which facilitates better data comparison with other countries. Second, we observed an interesting gender convergence regarding alcohol-related problems associated with heavy drinking, which was not previously reported in Brazil and will be discussed in this section.

In general, subjects who reported the highest number of heavy drinking occasions had the greatest number of problems, confirming the hypothesis that a higher frequency of heavy drinking is associated with an increased alcohol-related disease burden (9,16). The inclusion of frequency in the heavy drinking pattern increased the reports of adverse consequences, indicating a subgroup of more problematic drinkers. In this study, 9.3% of the HFD in the sample reported most of the problems. These findings confirm that adding a measure of frequency to the 5/4+ criterion achieves better accuracy in the definition of “at risk drinking” (16).

Table 4 - Predictors of drinking patterns: demographic variables, lifetime nicotine dependence and lifetime depression, presented as adjusted odds ratios (ORs) and 95% CI. Final model of polychotomous logistic regression; Wald χ^2 (n = 1,464; SP-ECA).

Risk Factor	Non-heavy Drinkers		Heavy Drinkers		Heavy and Frequent Drinkers		Wald χ^2	p-value
	OR	95% CI	OR	95% CI	OR	95% CI		
Age (years):							32.7	<0.0001
18-24	0.9	0.5-1.5	4.1	1.6-10.5**	1.9	0.7-4.7		
25-34	1.0	0.7-1.7	2.9	1.2-6.7*	2.5	1.1-5.3*		
35-44	1.8	1.1-2.8*	2.3	0.9-5.8	3.7	1.8-7.8**		
45-54	1.5	0.9-2.4	2.4	0.9-6.0	1.5	0.8-4.3		
55 or older	1.0	-	1.0	-	1.0	-		
Marital status:							17.9	0.006
Separated/divorced/widowed	1.1	0.7-1.6	2.7	1.4-5.2**	1.6	0.9-2.9		
Never married	1.2	0.8-1.7	3.3	1.6-6.7**	1.9	0.9-3.6		
Married/cohabiting	1.0	-	1.0	-	1.0	-		
Gender and education interaction:							21.1	0.01
Male x Education, years:								
0-8	1.3	0.6-2.6	2.4	0.8-7.1	8.5	3.3-21.6***		
9-11	1.1	0.5-2.4	2.9	1.1-7.8*	3.2	1.1-9.0*		
12-15	3.6	1.8-7.5**	6.2	2.5-15.5***	5.3	2.0-14.0**		
≥ 16	1.0	-	1.0	-	1.0	-		
Female x Education, years:								
0-8	0.3	0.2-0.4***	0.2	0.1-0.5*	0.2	0.05-0.4**		
9-11	0.6	0.3-0.9*	0.4	0.1-1.1	0.5	0.2-1.4		
12-15	0.9	0.5-1.4	0.4	0.2-0.9*	0.9	0.4-2.0		
≥ 16	1.0	-	1.0	-	1.0	-		
Any lifetime ICD-10 Depressive Disorder							9.1	0.03
Yes	1.1	0.7-1.6	1.5	0.8-2.8	2.1	1.2-3.7*		
No	1.0	-	1.0	-				
Lifetime ICD-10 Nicotine Dependence							37.5	<0.0001
Yes	1.7	1.2-2.5**	4.0	2.4-6.8***	3.5	2.1-5.9***		
No	1.0	-	1.0	-	1.0	-		

Although men were more than twice as likely as women to have a heavy drinking episode, our results showed a gender convergence in the number of problems when this pattern was examined. This convergence occurred in some, but not all, aspects of drinking behavior, revealing the complexity of the socio-cultural and biological factors involved. Male NHDs reported more problems than female NHDs, particularly problems related to acting-out behaviors, such as risky driving and/or drinking while operating machines, and violence. This finding suggests that gender differences in the consequences of smaller quantities of alcohol may nevertheless be influenced by socio-cultural factors.

As the pattern of drinking becomes heavier, socio-cultural aspects interact with the biological effects of alcohol (31,32), which could explain why the HD women had almost the same rates of problems as their male counterparts. According to the GENACIS project, as women's position in society has moved toward higher gender equality, with increased education, employment outside the home, the adoption of male values, and increased consumptive capacity, gender differences in alcohol consequences have decreased (33). Stress related to the dual role in women's lives may be involved in increased drinking and problems (31).

Consistent with the literature in different societies, men were more likely to use alcohol than women (34-36). In almost all Brazilian studies that have explored gender differences, women were more likely to abstain than men, the non-heavy drinking pattern was equally prevalent between genders (19,20,37), and men were more than twice as likely as women to report a heavy pattern of drinking (20,37). Other studies have found that the HD prevalence in adults varied from 5.5% to 24% (19,38), which differs from the present study. These differences may be due to heavy-drinking definitions, time frames, age range, or regional differences.

The gender differences in drinking patterns in our study were mediated through education, which is considered an indicator of socioeconomic status (39). In men, the influence of education varied across drinking patterns, with low- and middle-educated men more likely to be HFDs, whereas NHD males were more likely to have higher education. Previous studies in Brazil have not shown a clear trend, with some studies observing the same trend observed in the present report (19) and others suggesting the opposite trend (20,38). These divergences may be caused by the different approaches used to assess the multiple dimensions of socioeconomic status.

The association of ICD-10 lifetime depression with heavy and frequent drinking is in accordance with several clinical and population studies showing the importance of this relationship when the highest levels of consumption are considered (40), particularly among women (41,42). The existence of a causal relationship between alcohol abuse and depression has long been recognized and one theory is that depressed individuals tend to self-medicate with alcohol. Further evidence suggests that the most plausible causal association between alcohol use disorders and major depression is one in which the first increases the risk of the second (40). Despite the direction of the causal pathway (9), the main factor linking depression with alcohol use is the consumption of large amounts per occasion (42). Depressive episodes contribute to the development of alcohol problems both directly and by drinking to cope (43) with negative feelings and concerns (44). A family

history of mood disorders predicts depressive episodes through interactions with stress, low social support, and a family history of alcoholism (45).

In this study, nicotine dependence was associated with all drinking patterns. Prospective studies have shown that alcohol and tobacco use exhibits monotonic increases over adolescence and young adulthood. Onset and persistence are predicted by the prior use of the other substance, and these associations are robust across gender and ethnicity (46). The combined exposure to both tobacco and heavy drinking results in an increased risk of further disease, premature death(47) and predicted late-life drinking problems (48).

Despite the cross-sectional nature of our data, other drinking pattern determinants in our sample may affect alcohol use trajectories throughout life. NHDs were in their middle thirties to forties and had the least hazardous drinking habits and the lowest strength of association with nicotine dependence, constituting a group with a healthier lifestyle (10). HD could be a transitory level, restricted to young groups (49) and single/divorced people who consume alcohol in this pattern either at parties or due to the breakdown of their marriages. However, HFD was associated with depressive disorders, nicotine dependence, and higher rates of alcohol-related problems, which suggests that this group has a higher disease burden (9). Many of the problems reported by this group may be maintained by the persistent consumption of alcohol in a mechanism related to dependence, as evidenced by the fact that more than 50% of HFDs drank more than expected and continued to drink despite problems.

In addition to the cross-sectional design, some limitations should be mentioned. This sample was drawn from a higher-educated community in which approximately 50% of the sample had 12 or more years of education and only 2% were illiterate, in contrast with the overall Brazilian statistics of 15.0% and 14.7%, respectively. Moreover, in our sample, 60% of women and 70% of men had a paid job in the previous year, compared to 45% and 71%, respectively, who had any occupation in Brazil in the previous year (50), indicating that our results are specific to this social environment. Nevertheless, our results may be compared to other cities with similar characteristics in developing countries or to other Brazilian cities to further explore the influence of socioeconomic status on drinking patterns.

Another limitation is that we did not assess the context and time period of the drinking occasions. These factors influence alcohol blood levels and the probability of experiencing problems related to intoxication. Moreover, self-reporting may introduce bias because it can be influenced by social desirability, and the amount of drinking may be underestimated because we asked the respondents to describe their average drinking pattern. Finally, these data were collected more than ten years ago, and changes may have occurred since then.

Despite these limitations, the present data will be extremely useful for future studies analyzing demographic and gender trends in drinking patterns and alcohol-related problems in the general population. The lack of well-designed epidemiological studies in Brazil reinforces the importance of publishing data such as ours to encourage researchers to explore potential changes in alcohol use and related problems, particularly heavy episodic drinking, which causes an enormous disease burden in our country.

In conclusion, our study reinforces that heavy and frequent episodic drinking is strongly associated with problems in a community sample from the largest city in Latin America. As evidenced in this study, prevention policies should target harmful drinking patterns independent of age or gender and should focus on populations with comorbidities (i.e., nicotine dependence and depression) and men with lower education levels. These findings warrant continued research on risky drinking behavior, with a particular focus on persistent heavy drinking at a non-dependent level.

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AUTHOR CONTRIBUTIONS

Andrade LH conceived and designed the experiments/the study, obtained funding, enrolled participants, collected and analyzed the data, and was also responsible for the first manuscript draft. Silveira CM, Wang YP and Siu ER analyzed the data and were also responsible for the first manuscript draft. Andrade AG analyzed the data, was responsible for the first manuscript draft and obtained funding to the data analysis. Viana MC contribute to the writing of the manuscript.

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