Prevalence of Alcohol-Related Problems in an Elderly Population and Their Association With Cognitive Impairment and Dementia

Marcos A. Lopes, Erikson F. Furtado, Eduardo Ferrioli, Júlio Litvoc, and Cássio M. de Campos Bottino

Background: Studies investigating the association between alcohol use and cognitive disorders in the elderly population have produced divergent results. Moreover, the role of alcohol in cognitive dysfunction is not clear. The aims of this study were to estimate the prevalence of alcohol-related problems in an elderly population from Brazil and to investigate their association with cognitive and functional impairment (CFI) and dementia.

Methods: A community-based cross-sectional study was performed. A sample of 1,145 elderly people was examined in 2 phases. Several instruments were utilized in the first phase: the CAGE questionnaire was used to identify potential cases of alcohol-related problems, and a screening test for dementia was used to estimate CFI. The CAMDEX interview (Cambridge Examination) and DSM-IV (*Diagnostic and Statistical Manual of Mental Disorders, 4th edition*) criteria were used for the clinical diagnosis of dementia in the second phase.

Results: "Heavy alcohol use" (CAGE ≥ 2) was found in 92 subjects (prevalence: 8.2%). It was associated with gender (males, $p < 0.001$), low education (only in females, $p = 0.002$), and low socioeconomic level ($p = 0.001$, in females; $p = 0.002$, in males). The Mini Mental State Examination exhibited a nonlinear relationship with alcohol-related problems in females; "mild–moderate alcohol use" (CAGE < 2) presented the highest score. A significant association between alcohol-related problems and cognitive dysfunction was found only in females. "Heavy alcohol use" was associated with higher CFI and dementia rates compared to "mild–moderate alcohol use" ($p = 0.003$ and $p < 0.001$, respectively). "Mild–moderate alcohol use" had a tendency of association with lower CFI and dementia rates when compared to "no alcohol use" ($p = 0.063$ and 0.050, respectively).

Conclusion: Our findings suggest that alcohol use does not have a linear relationship with cognitive decline.

Key Words: Alcohol Drinking, Alcohol-Related Disorders, Dementia, Elderly.

STUDIES INVESTIGATING ALCOHOL use in the elderly are scarce. Moreover, the different concepts and methods employed make comparisons difficult. In Finland, the "lifetime prevalence of alcohol use" in individuals aged 65 to 79 years was 70.5% (Anttila et al., 2004), while in Brazilian people aged 50 years and older, the "prevalence of present alcohol use" was 37.6% (Almeida and Coutinho, 1993). In a review of studies evaluating drinking patterns of elderly people (predominantly from the United States, United Kingdom, New Zealand, and China), abstinence was found in 40% of the population sampled (on average; range from 16 to 84%). In addition, abstinence was found to be more common in women and those higher in age (Lakhani, 1997). Considering the general concepts of alcohol-related disorders, the rates varied considerably: A 2.0% "alcoholism" rate was found in the Brazilian study (Almeida and Coutinho, 1993); a 2.7% "problem drinking" rate was found in adults from Ethiopia (Kebede and Alem, 1999) (both applying criteria of positivity to at least 2 items on the CAGE questionnaire); and a 22.0% "heavy alcohol use" rate was found in adults from the Ukraine (Webb et al., 2005). In regard to "dependence," rates in general population varied from 6.1% in European countries (Rehm et al., 2005) to 11.2% in Brazil (Carlini et al., 2002).

With respect to the association between cognitive problems and dementia, alcohol use does not exhibit a linear relationship in epidemiological studies (Hulse et al., 2005). Mukamal and colleagues (2003) found a lower risk of dementia among those who consumed 1 to 6 drinks per week in comparison with those who were abstinent. The study also revealed that consumers of 14 or more drinks had the highest risk of

School of Medicine of Ribeirão Preto (MAL, EFF, EF), University of São Paulo Hospital of Clinics, Ribeirão Preto; Old Age Research Group (PROTER) (MAL, CMDCB), Institute of Psychiatry; and Department of Preventive Medicine (JL), School of Medicine, University of São Paulo, São Paulo, SP, Brazil.

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Reprint requests: Marcos A. Lopes, Hospital das Clínicas, Departamento de Neurologia, Psiquiatria e Psicologia Médica, Campus Monte Alegre, 14049-900 Ribeirão Preto, São Paulo, Brazil; Fax: +55-16-36022544; E-mail: lopes@netsite.com.br

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dementia compared to the other 2 groups. A "U" or "J" shaped relationship between alcohol and cognition was also found in other prospective studies evaluating cognitive function (Elias et al., 1999; Kalmijn et al., 2002; Leroi et al., 2002; Mukamal et al., 2003), dementia (Anttila et al., 2004; Deng et al., 2006; Huang et al., 2002; Orgogozo et al., 1997; Ruitenberg et al., 2002), and Alzheimer's disease (Lindsay et al., 2002). On the other hand, Thomas and Rockwood (2001) only observed a higher risk of dementia among alcohol abusers, and Cervilla and colleagues (2000) did not observe a significant effect of type of alcohol use on cognition. Moreover, most of the studies that found a nonlinear relationship evaluated wine along with another alcohol beverage. However, the Rotterdam study (Ruitenberg et al., 2002) did not observe any differences in cognition based on type of alcoholic beverage, while a Canadian Study (Lindsay et al., 2002) found a protective effect of mild–moderate alcohol use only in wine consumers (compared to consumers of beer and spirits).

In spite of the studies published mostly in developed countries, there is a clear absence of consistent information about alcohol-related problems in the elderly population, as well as inconclusive data regarding the association between alcohol and cognition. Indeed, the fast aging, particularly in developing countries, demands a better knowledge of the effects of certain habits on prevalent diseases in the elderly.

The purpose of this study was to estimate the prevalence of alcohol-related problems in a community-dwelling elderly population, as well to investigate related sociodemographic factors and their associations with cognitive and functional impairment (CFI) and dementia.

METHODS

The present study was derived from a cross-sectional survey that investigated the prevalence of CFI and dementia in a community-based sample of individuals aged 60 years or older in Ribeirão Preto, Brazil. Data about the prevalence of CFI has been reported in detail elsewhere (Lopes et al., 2007).

Sampling

We performed a cluster sampling of a population of individuals 60 years of age and older from different socioeconomic levels. The population sample size was calculated by Epi-Info-5.1 software (Dean, 1990) and resulted in 1,110 elderly individuals. The parameters were: dementia prevalence of 7.0% (Herrera et al., 2002); sampling accuracy or error (d) of 2.0%; and confidence level of 95%. The sampling approach has been described elsewhere (Lopes et al., 2007). Much like São Paulo and other Brazilian cities, the city of Ribeirão Preto contains areas with different levels of socioeconomic development. The cluster sampling strategy ensures that the population sample will represent the city's different socioeconomic classes. More specifically, it ensures that sectors from the city's different socioeconomic classes will be present in the sample. To guarantee such a premise, the 406 sectors were firstly classified according to a socioeconomic "score" (based on income and schooling) and ordered in a descendent fashion. Next, the total set of sectors was subdivided in terciles (classes): upper, middle, and low classes. A set of sectors within each class was selected in order to compose the sample by taking into account the following criteria: (i) maintenance of the proportion of elderly individuals in each socioeconomic class; (ii) strategic position in the terciles; (iii) operational aspects that would facilitate the referral of cases, upon the completion of the study, to reference healthcare services; (iv) an elderly population density which would favor field investigation. In this way, the sample was composed according to the calculated number of elderly individuals and their proportions in the 3 different socioeconomic classes. In the end, a socioeconomic classification scale was applied to classify subjects into 5 socioeconomic levels. Regarding the data analysis, this 5-level scale was chosen to better investigate the effect of socioeconomic status upon the dependent variable. This scale was more precise and was used to directly assess the elderly or their relatives.

First Phase

The aim of the first phase was to investigate "alcohol use," "alcohol-related problems," and "cognitive and functional problems." The evaluation instruments were applied to the total sample (at the subjects' homes).

Evaluation instruments:

1. Estimating "alcohol use" (past or present): "yes or no" questions ("do you or did you drink alcoholic beverages?"). Estimating the duration of alcohol use: "years of use." Both were assessed by interviewing the subjects or their informants.
2. Estimating "alcohol-related problems": The CAGE questionnaire, a well-known "4 questions" screening test for alcohol use disorders, was applied. This questionnaire presents good reliability for detecting alcohol abuse and dependence. Its author proposed further investigation when there was at least 1 positive answer (Ewing, 1984), but others observed good levels of sensitivity and specificity with the cut-off point of 2 positive answers (Buchsbaum et al., 1993). The CAGE test was validated in the Brazilian population (Masur and Monteiro, 1983) and was tested in elderly people (Jones et al., 1993). A CAGE score of 2 was associated with heavy drinking according to alcohol consumption (men who drank 60 g or more of ethanol a day and women who drank 30 g or more a day) (Bataille et al., 2003). Moreover, Aalto and colleagues (1999) used the CAGE score to define "heavy drinking" while comparing healthcare outpatients and the general population in Finland. In the present study, the CAGE questionnaire was administered to subjects who answered "yes" to the alcohol use question. Subjects who answered "no" were included in the "no alcohol use" group. Subjects who scored 2 or less (<2) on the CAGE test were classified in the "mild–moderate alcohol use" group, and those scoring 2 or higher (≥ 2) were placed in the "heavy alcohol use" group.
3. Estimating cognitive and functional problems: In order to achieve this objective, the diagnostic category, "CFI," was employed. CFI is a syndromic category that allows the inclusion of all clinical conditions that may affect cognition and functional performance in the elderly population, including dementia. Cognitive impairment is a syndromic category that has been used in epidemiological studies. In these studies, 2 tests that screen for dementia were generally combined (cognitive and functional) in order to define "cognitive impairment." The use of combined tests appears to be a promising procedure for increasing the accuracy of mild dementia diagnoses. This may include a combination of cognitive tests (Heun et al., 1998; Hooijer et al., 1993) or the combination of a cognitive test and a functional evaluation test (Bustamante et al., 2003; Hall et al., 2000; Mackinnon and Mulligan, 1998). Cognitive impairment, which typically includes dementia and other conditions that are not actually dementia, was examined in the present study. The name "cognitive and functional impairment" represents the combination of 2 domains of impairment, "cognitive" and "functional." CFI assessment instruments—Mini Mental State Examination (MMSE), Fuld

Object Memory Evaluation (FOME), Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), and Bayer-Activities for Daily Living Scale (B-ADL)—were previously tested in patients with dementia and normal subjects (controls) from 3 distinct socioeconomic classes. The purpose of these tests was to define the combination that would provide the best sensitivity and specificity levels for the "screening of dementia." Using logistic regression, ROC curves analysis and logical operators, the final result showed excellent accuracy using the following combination: MMSE ≤ 26 *or* FOME ≤ 35 AND IQCODE ≥ 3.40 *or* B-ADL ≥ 3.19 (Bottino et al., 2009; Bustamante et al., 2003). In this study, different MMSE cut-off scores were used according to schooling levels (< 20: illiterate; < 25: from 1 to 4 years of schooling; < 27: from 5 to 8 years of schooling; < 28: ≥9 years of schooling). This procedure was adapted from a Brazilian study by Brucki and colleagues (2003). In the end, subjects classified as "screen positives" for dementia were labeled as CFI. In this study, the relationship between alcohol-related problems and CFI was investigated using both the CFI classification (dichotomous variable) and the individual instruments used to establish CFI classification (continuous variables).

4. The following instruments were also applied to investigate the association between alcohol use/alcohol-related problems and sociodemographic and clinical variables (assessed through interviews with the subjects or their informants): sociodemographic questionnaire; clinical inventory; inventory of previous personal history and habits; and socioeconomic classification scale—ABIPEME (Brazilian Association of Market Research). This scale classifies families based on schooling and possession of consumption goods such as household appliances. It consists of 5 socioeconomic levels: A, B, C, D, and E, with A being the highest level and E being the lowest level.

Second Phase

The aim of the second phase was to investigate dementia. The "CAMDEX" interview (Cambridge Examination) (Roth et al., 1986) was applied by the trained physicians to subjects who presented as CFI in first phase; the diagnosis of dementia was made according to the DSM-IV (*Diagnostic and Statistical Manual of Mental Disorders, 4th edition*) criteria (American Psychiatric Association, 1994). The "CAMDEX" is a structured interview used to help in the differential diagnosis of mental disorders in elderly subjects, including dementia.

Statistical Analysis

Data were analyzed using the SPSS software, version 10.0 (SPSS Inc., 1999).

The cross-sectional distribution for "alcohol use" and "no alcohol use" differed substantially for males and females. Thus, all analyses were conducted separately for men and women. A chi-squared test was used to compare frequency of "alcohol use" and "no alcohol use" in relation to gender [odds ratio (OR) and 95% confidence interval were calculated]. Sociodemographic variables were also compared according to gender (age, education, and socioeconomic level were considered categorical variables).

Relationships between "duration of alcohol use" and the covariates were tested using analysis of variance for gender and sociodemographic variables (by gender).

According to alcohol use type and CAGE score, 3 categories of alcohol-related problems were created: no alcohol use, heavy alcohol use, and mild–moderate alcohol use. The raw prevalence rate was calculated and differences between males and females were determined for each category (OR and 95% confidence interval were calculated). Two comparisons were applied between the frequency of alcohol-related problems relative to age, education, and socioeconomic level (by gender): mild–moderate alcohol use and no alcohol use, and heavy alcohol use and the rest of the sample. Chi-squared tests and the Bonferroni correction were employed (p values below 0.017 were considered significant).

The frequency of cases (CFI in first phase, dementia in second phase) and controls were compared to estimate the crude prevalence rate. A 95% confidence interval was calculated for each prevalence rate. The cross-sectional association between cognitive impairment and alcohol use was examined in several ways. The relationships between alcohol-related problems and individual cognitive instruments (continuous variables) were tested for males and females using the general linear model and controlling for sociodemographic and clinical variables. Bonferroni's post hoc test was employed to evaluate the difference between alcohol-related problems and MMSE score. Age, education, stroke, hypertension, diabetes mellitus, depression, and estrogen replacement therapy were introduced into the multivariate models as potential confounders because of their influence on cognitive performance in a CFI prevalence study. The differences between alcohol-related problems were also analyzed in relation to the frequency of CFI and dementia rates, by gender, using chi-squared tests (OR and 95% confidence interval were calculated) and Bonferroni correction (p values below 0.017 were considered significant). Three bivariate analyses were performed for both CFI and dementia outcomes: no alcohol compared to moderate alcohol use, moderate alcohol use compared to heavy alcohol use and heavy alcohol use compared to no alcohol use. Multivariate logistic regression models were used to calculate adjusted OR for alcohol-related problems in relation to CFI and dementia in females, controlling for sociodemographic (age and education) and clinical (stroke, depression, and estrogen replacement therapy) variables. Performing a forward stepwise procedure, 3 models were applied: In "model 1," only variables related to alcohol-related problems were included (without controlling for sociodemographic and clinical variables); in "model 2," the sociodemographic variables were added; in "model 3," the clinical variables were added, completing the model with all variables (alcohol-related problems, sociodemographic, and clinical variables). In all models, the category "mild–moderate alcohol use" was used as a reference to the others ("no alcohol use" and "heavy alcohol use").

Ethical Issues

The investigation was approved by the local ethics committee, and all the subjects and their relatives agreed to participate in the study by signing the informed consent forms.

RESULTS

A sample of 1,828 subjects was approached and 1,145 agreed to participate in the study (683 subjects refused to participate; rate of attrition: 37.3%). The sample presented a mean age of 70.9 years (60 to 100; SD: 7.7), and consisted mostly of women (male: 419 subjects, 36.6%; female: 726 subjects, 63.4%) and married individuals who had attended school for up to 4 years (Table 1).

A group of 580 subjects answered positively to the question about alcohol use. The prevalence of "alcohol use" was 51.1% in the total sample (95% CI: 48.4, 53.8), 69.2% in males (95% CI: 66.7, 71.7) and 40.8% in females (95% CI: 38.1, 43.5). The OR for gender was 3.2 (95% CI: 2.5, 4.2; $p < 0.001$). In males, "alcohol use" did not show differences in terms of age, education, or socioeconomic level. In females, "alcohol use" was associated with higher education and

Table 1. Total Sample and its Distribution Relative to Sociodemographic Characteristics, by Gender

	Male		Female		Total	
	N	%	N	%	*N*	%
Age						
60–64	100	24.1	173	24.0	273	24.0
65–69	109	26.3	165	22.9	274	24.1
70–74	96	23.1	156	21.6	252	22.2
75–79	58	14.0	113	15.7	171	15.1
80–84	32	7.7	70	9.7	102	9.0
85–89	12	2.9	31	4.3	43	3.8
≥90	8	1.9	13	1.8	21	1.8
Marital status						
Single	21	5.1	69	9.7	90	8.0
Married	328	79.2	332	46.4	660	58.5
Separated	21	5.1	43	6.0	64	5.7
Widowed	44	10.6	271	37.9	315	27.9
Education levels[a]						
0 (illiterate)	35	8.5	83	11.5	118	10.4
1–4	164	39.7	329	45.6	493	43.5
5–8	35	8.5	73	10.1	108	9.5
≥9	179	43.3	236	32.7	415	36.6
Socioeconomic levels (ABIPEME)[b]						
A	50	12.1	73	10.2	123	10.9
B	151	36.6	232	32.5	383	34.0
C	126	30.5	220	30.8	346	30.7
D	65	15.7	138	19.3	203	18.0
E	21	5.1	51	7.1	72	6.4

[a]Education levels: years of schooling.
[b]ABIPEME: Brazilian Association of Market Research.

socioeconomic level (Figs. 1 and 2), but there was no association with age. "No alcohol use" was observed in 552 subjects, with a prevalence of 49.3% (95% CI: 46.6, 52.0).

The duration of alcohol use varied from 0 (zero) to 82 years, with a mean of 40.1 years (SD: 17.7); 74.5% drank for 30 years or more. Duration was significantly longer in men (mean: 42.0) than in women (mean: 38.4) ($p = 0.026$). A multivariate analysis revealed that the duration of alcohol use was positively associated only with age in both genders (i.e., there was no significant difference as to education or socioeconomic level).

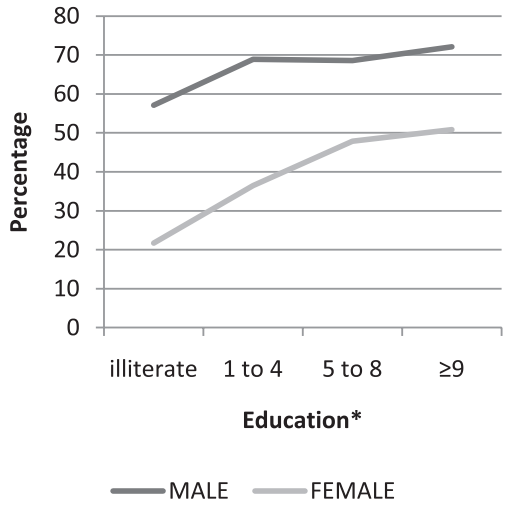

Fig. 1. Proportion of alcohol use in relation to education, by gender. *Years of schooling. Chi-squared test was applied. *p*-value: 0.377 (male) and <0.001 (female). Bonferroni correction was performed.

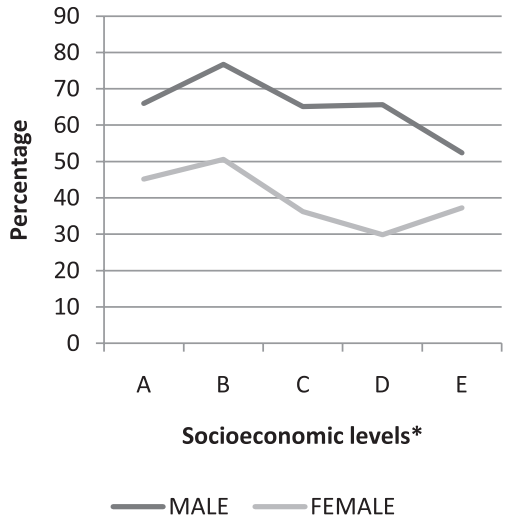

Fig. 2. Proportion of alcohol use in relation to socioeconomic level, by gender. *According to ABIPEME ("A" is the highest level and "E" is the lowest level). Chi-squared test was applied *p*-value: 0.082 (male) and <0.001 (female). Bonferroni correction was performed.

Ninety-two subjects presented CAGE scores ≥2. The prevalence of "heavy alcohol use" (CAGE ≥ 2) was 8.2% (95% CI: 6.7, 9.7) in the total sample, 17.4% in males (95% CI: 15.3, 19.5) and 3.0% in females (95% CI: 2.1, 3.9). OR (male/female) was 6.8 (95% CI: 4.1 to 11.4; $p < 0.001$). Heavy alcohol use was associated with low education only in females, and with low socioeconomic level in both genders (Figs. 3 and 4).

Four hundred and seventy-five elderly participants presented CAGE scores <2. The prevalence of "mild–moderate alcohol use" was 42.4% (95% CI: 39.7, 45.1) in the

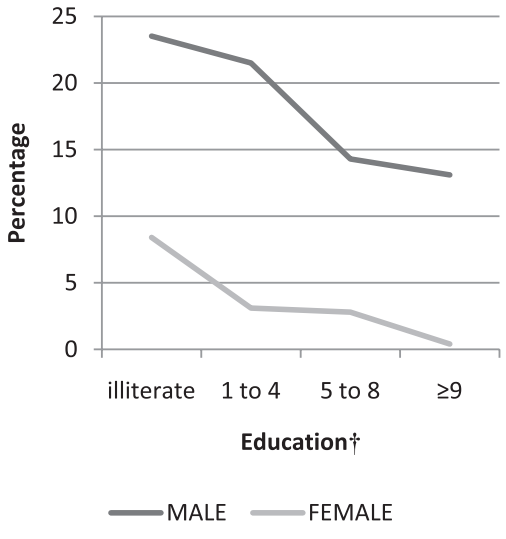

Fig. 3. Prevalence of heavy alcohol use*, in relation to education, by gender. *Heavy alcohol use: CAGE ≥ 2. †Years of schooling. Chi-squared test was applied. *p*-value: 0.158 (male) and 0.002 (female). Bonferroni correction was performed.

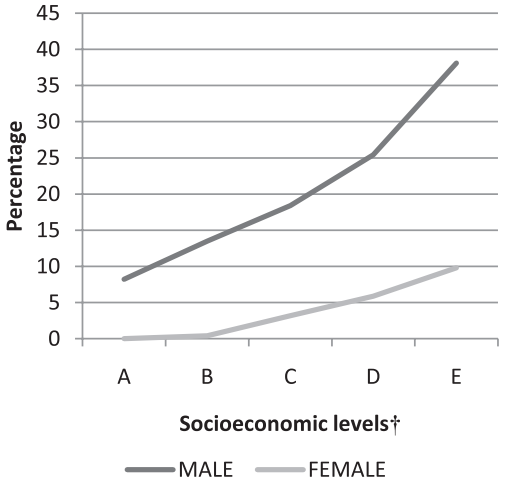

Fig. 4. Prevalence of heavy alcohol use*, in relation to socioeconomic level, by gender. *Heavy alcohol use: CAGE ≥ 2. †According to ABIPEME ("A" is the highest level and "E" is the lowest level). Chi-squared test was applied. *p*-value: 0.009 (male) and 0.001 (female). Bonferroni correction was performed.

total sample, 51.3% in males (95% CI: 48.6, 54.0) and 37.3% in females (95% CI: 34.6, 40.0). OR (male/female) was 1.7 (95% CI: 1.3 to 2.2; $p < 0.001$). For both genders, "mild–moderate alcohol use" was associated with higher education and socioeconomic level compared to "no alcohol use" (statistically significant). There was no association with age (Table 2). In females, "mild–moderate alcohol use" was also associated with fewer cases of depression and a higher frequency of estrogen replacement therapy.

Cognitive and functional impairment was found in 217 subjects in the first phase, and dementia was diagnosed in 69 subjects in the second phase. Prevalence of CFI and dementia were 18.9% (95% CI: 16.6, 21.1) and 6.0% (95% CI: 4.6, 7.3), respectively.

Table 2. Mild–Moderate Alcohol Use in Comparison With No Alcohol Use, Relative to Age, Education, and Socioeconomic Levels (by Gender)

	Male		Female	
	Mild–moderate alcohol use[a]	No alcohol use	Mild–moderate alcohol use	No alcohol use
Age				
60–64	59.5	40.5	44.4	55.6
65–69	67.4	32.6	36.5	63.5
70–74	55.8	44.2	40.5	59.5
75–79	60.5	39.5	35.2	64.8
≥80	68.9	31.1	33.3	66.7
	$p = 0.454$[b]		$p = 0.322$	
Education levels[c]				
0 (illiterate)	42.3	57.7	14.5	85.5
1–4	60.2	39.8	33.8	66.2
5–8	63.3	36.7	45.7	54.3
≥9	67.1	32.9	50.4	49.6
	$p = 0.103$		$p < 0.001$	
Socioeconomic levels[d]				
A	62.2	37.8	44.4	55.6
B	72.7	27.3	50.2	49.8
C	56.9	43.1	34.3	65.7
D	53.2	46.8	24.4	75.6
E	23.1	76.9	30.4	69.6
	$p = 0.002$		$p < 0.001$	

All numbers written as percentages.
[a]Mild–moderate alcohol use: CAGE <2.
[b]"Chi-squared" test and the corresponding *p*-value (statistical significance) were applied. Bonferroni correction was performed.
[c]Education levels: years of schooling.
[d]Socioeconomic levels: according to ABIPEME (Brazilian Association of Market Research).

Association Between Alcohol-Related Problems and Cognitive Instruments, CFI, and Dementia

Cognitive Instruments. "No alcohol use," "mild–moderate alcohol use," and "heavy alcohol use" were not significantly different in terms of cognitive performance in males. In females, a multivariate analysis revealed that "mild–moderate alcohol use" was associated with higher FOME scores compared to "no alcohol use" ($p = 0.035$). No linear relationship was found for the MMSE: "No alcohol use" presented an intermediate score ($p = 0.005$, in relation to "heavy alcohol use"; $p < 0.001$, in relation to "mild–moderate alcohol use"), while "mild–moderate alcohol use" presented the highest score ($p < 0.001$, in relation to the others) and "heavy alcohol use" presented the lowest score.

There were no differences in MMSE scores between genders in "mild–moderate alcohol use" and "heavy alcohol use." In "no alcohol use," men had higher MMSE scores than women ($p < 0.001$). This was also found in the total sample.

CFI and Dementia. A significant association between CFI and dementia and alcohol-related problems was found only in females (Table 3).

CFI: After multivariate analysis, "mild–moderate alcohol use" presented lower CFI odds when compared to "no alcohol use" (significantly associated in "model 1," and tendency of association in "model 2"); "heavy alcohol use" had CFI higher odds when compared to "mild–moderate alcohol use" (Table 4).

Dementia: After multivariate analysis, "mild–moderate alcohol use" had lower odds of dementia than "no alcohol use" in "model 1"and "model 2" (tendency of association); "heavy alcohol use" presented significantly higher odds of dementia compared to "mild–moderate alcohol use" (Table 4).

CONCLUSIONS

The prevalence of "alcohol use" and "heavy alcohol use" in the present study were at an intermediate level compared to the findings of previous studies (Almeida and Coutinho, 1993; Anttila et al., 2004; Kebede and Alem, 1999; Webb et al., 2005). However, these comparisons are problematic, as alcohol use measurements, concepts of alcohol-related disorders and the age of population were different in those studies. Our results confirm the known J-shaped relationship between alcohol use and cognitive decline, particularly in females.

Table 3. CFI and Dementia Prevalence, in Relation to Alcohol-Related Problems, by Gender

	Male				Female			
	%	p^a	OR	95% CI	%	p	OR	95% CI
CFI								
Mild–moderate use[b]	14.3				13.6			
No use	14.1	0.955	0.9	0.5, 1.8	22.4	0.004	1.8	1.2, 2.7
Mild–moderate use	14.3				13.6			
Heavy use[c]	21.1	0.174	1.6	0.8, 3.2	42.9	<0.001	4.7	1.8, 12.1
No use	14.1				22.4			
Heavy use	21.1	0.199	1.6	0.7, 3.4	42.9	0.031	2.5	1.0, 6.3
Dementia								
Mild–moderate use	6.0				3.2			
No use	5.8	0.943	0.9	0.3, 2.5	7.4	0.028	2.4	1.0, 5.3
Mild–moderate use	6.0				3.2			
Heavy use	4.7	0.687	0.7	0.2, 2.8	25.0	<0.001	9.9	2.9, 34.1
No use	5.5				6.6			
Heavy use	4.2	0.701	0.7	0.1, 3.0	23.8	0.003	4.4	1.5, 12.9

OR, odds-ratio; 95% CI, 95% confidence interval; CFI, cognitive and functional impairment.
[a]"Chi-squared" test and the corresponding p value (statistical significance) were applied. Bonferroni correction was performed.
[b]Mild–moderate alcohol use: CAGE <2.
[c]Heavy alcohol use: CAGE ≥2.
Three comparisons were made: mild-moderate alcohol use with no alcohol use, mild-moderate alcohol use with heavy alcohol use, and no alcohol use with heavy alcohol use (bivariate analysis).

Table 4. Multiple Analysis With CFI and Dementia Prevalence, Applying Three Models to Investigate the Association With Alcohol-Related Problems, in Females

	p^a	OR	95% CI
CFI			
No alcohol use and mild-moderate alcohol use[b]			
Model 1	0.004	1.8	1.2, 2.7
Model 2	0.063	1.5	0.9, 2.4
Model 3	0.109	1.4	0.9, 2.3
Heavy alcohol use[c] and mild–moderate alcohol use			
Model 1	0.001	4.7	1.8, 12.1
Model 2	0.005	4.5	1.5, 12.7
Model 3	0.003	5.2	1.7, 15.5
Dementia			
No alcohol use and mild-moderate alcohol use			
Model 1	0.032	2.4	1.0, 5.3
Model 2	0.050	2.3	0.9, 5.3
Model 3	0.151	1.9	0.7, 4.9
Heavy alcohol use and mild-moderate alcohol use			
Model 1	<0.001	9.9	2.9, 34.1
Model 2	<0.001	15.9	3.8, 65.7
Model 3	<0.001	25.5	5.2, 125.7

OR, odds-ratio (adjusted); 95% CI, 95% confidence interval; CFI, cognitive and functional impairment.
[a]Model 1: alcohol-related problems variables. Model 2: adjusted for sociodemographic variables (age and education). Model 3: adjusted for sociodemographic variables (age and education) and clinical variables (stroke, depression, and estrogen replacement therapy).
[b]Mild–moderate alcohol use: CAGE <2.
[c]Heavy alcohol use: CAGE ≥2.

The higher rates of "alcohol use" and "alcohol-related problems" in men (as opposed to women) confirmed previous data (Almeida and Coutinho, 1993). Men drank more and had more problems, in spite of higher female physical vulnerability for alcohol (Mann et al., 1992). In women, there was a sociocultural influence on alcohol use and problem drinking. Literate women were proportionally more exposed to alcohol, whereas the illiterate group presented a higher frequency of problems (heavier alcohol use). In other words, women of low educational levels drank proportionally less, but heavier drinking was found in those who did drink. Concerning problem drinking, men also had the same social and educational influence. This result reinforces the existence of a social effect on the types of drinking and problem drinking. Moreover, more data on the characteristics of different education levels could help to answer these questions.

Heavy alcohol use had a harmful effect on cognition, particularly in females; it appeared to be a direct associated factor for cognitive impairment and dementia, as observed in previous studies (Anttila et al., 2004; Deng et al., 2006; Elias et al., 1999; Huang et al., 2002; Kalmijn et al., 2002; Leroi et al., 2002; Orgogozo et al., 1997; Ruitenberg et al., 2002). This observation is supported by some findings that associate alcohol use with more neurocognitive deficits (Parsons, 1998), inflammatory response leading to neuronal loss (Crews et al., 2004), and higher risk of stroke and brain atrophy in heavy consumption (Mukamal et al., 2001; Reynolds et al., 2003). Moreover, thiamine deficiency that leads to Wernicke-Korsakoff syndrome can be a complication of heavy alcohol use; it is also a well-known cause of nondegenerative dementia.

The inverse relationship between mild–moderate alcohol use and cognitive decline, as previously detected (Anttila et al., 2004; Deng et al., 2006; Elias et al., 1999; Huang et al., 2002; Kalmijn et al., 2002; Leroi et al., 2002; Lindsay et al., 2002; Orgogozo et al., 1997; Ruitenberg et al., 2002), was observed in the present study, although not strongly. Cognitive deficits, as individually measured by the MMSE and FOME, exhibited this association only in women. Mild–moderate alcohol use was associated with lower CFI and dementia rates, not only in females, but also in all models. In

addition to depression, other variables may have also influenced CFI results. Women with mild–moderate alcohol use were more educated, less depressed and were more frequently placed on estrogen replacement therapy. All of these variables were separately associated with lower CFI rates; they affected each other, influencing the effect of mild–moderate alcohol use on cognition in the same direction. Despite the controversial results associating estrogens with lower risk of dementia, this possible protective effect in females could be influenced by the action of alcohol, which may increase estrogen levels in postmenopausal women (Moret et al., 2005). In spite of the confounding effects of variables on the results, the inverse effect of mild–moderate alcohol use over cognitive decline would probably be associated with lower cardiovascular risk (Agarwal, 2002) and lower prevalence of white matter abnormalities and infarcts (Mukamal et al., 2001). This finding was related to the antioxidant properties of red wine flavonoids (Aviram and Fuhrman, 2002), as well as other possible alcohol-associated effects (e.g., change in lipid levels, reduction in platelet aggregation and lowering of plasma apolipoprotein(a) concentration) (Agarwal, 2002).

Two other factors must also be considered when analyzing the results: age and the mortality effect. In the present study, frequencies of alcohol use and patterns of alcohol use (mild–moderate and heavy alcohol use) did not change with age. We expected that use and problems related to alcohol use would be less frequent in the highest age groups (Lakhani, 1997). There were no cases of heavy abuse in women aged 80 years or more. However, in the younger age group (75 to 79 years), the proportion of cases was almost double the previous, showing an unstable relationship with age, especially in a relatively small sample of subjects. Moreover, the small number of older women with heavy use of alcohol, coupled with the low number of cases of dementia, led to a significant widening of the confidence interval in the investigation of heavy use and dementia. Considering the known strong effect of age on rates of cognitive disorders in the elderly (Jorm et al., 1987; Lopes and Bottino, 2002; Ritchie et al., 1992), the age variable was adjusted in the analysis of the relationship between use of alcohol and cognitive disorders, with a small influence on the outcome. In turn, the effect of mortality on the results must also be taken into account, although it was not possible to control this variable. In case–control studies of smoking and cognition, mortality was most likely a bias in the detection of the protective effect of cigarette use on cognitive decline, in view of the findings of later studies that found the opposite effect (Anstey et al., 2007) and the higher risk of death among smokers (Katanoda et al., 2008). In the present study, on the other hand, the opposite effect of mild–moderate use of alcohol on cognitive decline was probably modestly affected by mortality because the risk of death has been linked to heavy use and not to mild–moderate use, as measured by quantity and frequency of alcohol use (Breslow and Graubard, 2008).

Some methodological limitations of our study should be considered. Variables related to alcohol were reported directly by the elderly or an informant, which might have lead to imprecise information. Consequently, the number of subjects in the "no alcohol use" group who drank moderately in the past may have been overestimated, decreasing the effect of mild–moderate alcohol use. Although the CAGE questionnaire presents an inferior performance when compared to other instruments (Bradley et al., 1998), easy application justifies its use, particularly in large surveys. The lack of information on specific type of use (present or past), type of alcoholic beverage, and alcohol consumption did not allow us to define and to study these variables more accurately. On the other hand, although the present study evaluated past and present use together, prevalence was probably similar to present use because the duration of use was so long and positively associated with age. The cross-sectional design of the study merely indicates associations, while more strong conclusions on the protective effects or risks associated with alcohol are better addressed in longitudinal surveys.

Finally, this study partially corroborated the J-shaped relationship between cognitive impairment and dementia due to alcohol use, as detected in other epidemiological studies. To date, however, there is insufficient information to recommend mild-alcohol use for protection against cognitive disorders in the elderly.

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