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Consumption of alcoholic beverages and abdominal obesity: cross-sectional analysis of ELSA-Brasil

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Abstract *The objective was to analyze the association between alcohol consumption and abdominal adiposity in adults. Cross-sectional study conducted at baseline data from ELSA-Brasil (2008- 2010). The sample consisted of 15,065 civil servants from six education and research institutions (35 to 74 years old, both sexes). To identify central adiposity by measuring waist circumference (WC) and waist-to-hip ratio (WHR), the cutoff points recommended by the World Health Organization were used. Poisson regression models adjusted for potentially confounding variables were tested. About 40% of the sample had elevated WC and WHR. The probability of having elevated WC was 5% and 3% higher in the most exposed group of beer consumption in men and women when compared to the reference group [PR= 1.05 (95% CI 1.02-1.08) and P R= 1.03 (95% CI 1.00-1.07)]. A higher probability of having a high WHR was also found among the highest beer consumers [PR = 1.03 (95% CI 1.00-1.07) in men and PR = 1.10 (95% CI 1.04-1.15) in women]. A greater number of doses/week of alcoholic drink increased the probability of occurrence of high WC and WHR, with the beer contribution being more important.*

Key words *Obesity, Abdominal obesity, Alcohol drinking, Waist circumference, Waist-to-hip ratio*

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Introduction

Obesity is an important public health problem and has been gaining prominence in the global epidemiological scenario. Its prevalence has increased significantly worldwide in recent decades[1] and it is believed that the determinants of excess weight comprise a complex set of biological, behavioral, environmental, social, and economic factors. In addition to being considered a disease, obesity is also an important risk factor for the development of numerous adverse health conditions[2], as abdominal fat has a major contribution to determining cardiovascular risk[3,4] and to metabolic alterations[5,6]. In this sense, waist circumference (WC) seems to better explain obesity-related health risk than body mass index (BMI)[7].

Several factors are associated with abdominal obesity, such as age, gender, race/color, socioeconomic conditions, and behavioral variables related to lifestyle[8,9], among which is included the consumption of alcoholic beverages[10,11]. Although this consumption represents a common and ancient habit in many societies[12], recent meta-analyses[13,14] have shown that the use of alcohol, regardless of the quantity, represents a risk to health.

Worldwide, around 2 billion people consume alcoholic beverages per year, which corresponds to approximately 40% of the world population over 15 years of age[12]. In Brazil, the annual consumption of alcohol per capita was estimated at 8.7 liters of pure alcohol per adult per year, a quantity above the world average (6.2 liters)[12].

Alcohol is obtained through the fermentation of carbohydrates present in some foods and provides 7.1 kcal/g to the body, although it is a different energy source due to its toxicity. There is evidence that excessive consumption of alcoholic beverages can produce an increase in fat deposits in the abdominal region via alcohol metabolism[15]. As alcohol cannot be stored in the body, it is quickly metabolized, changing other metabolic pathways, including lipid oxidation, favoring the body's fat storage, with deposition preferentially in the abdominal area[16].

Several cross-sectional studies have evaluated the association between alcohol consumption and abdominal obesity, but the results are still inconclusive, especially due to the wide methodological variation found in the literature on the analysis of the frequency and amount of ethanol consumed, in addition to the variables used in the adjustments of the statistical models. Although studies have found a null or negative association between alcohol consumption and abdominal obesity[17,18,19] others have shown that beer consumption is positively associated with abdominal obesity and that wine can be a protective factor[11,20,21].

Given this scenario, the aim of this study was to analyze the association between alcohol consumption and abdominal adiposity in Brazilian adults.

Methods

Study design and population

This is a cross-sectional study carried out with baseline data (2008-2010) from the Longitudinal Study of Adult Health (ELSA-Brasil), comprising 15,105 public servants, active and retired, between 35 and 74 years of age, of both sexes, from six higher education institutions located in six Brazilian states (São Paulo, Minas Gerais, Bahia, Rio Grande do Sul, Rio de Janeiro, and Espírito Santo). The main objective of ELSA-Brasil was to investigate, first, the incidence and then the determinants of chronic non-communicable diseases in the Brazilian population, with a focus on cardiovascular diseases and diabetes. The general characteristics of the cohort were previously published[22].

The participants, on a previously scheduled day, went to the Research Center (RC) in the morning for clinical, biochemical, and interview examinations. General information on measurement and clinical examinations can be found in a previous publication[23]. Participants who answered the alcohol consumption assessment questionnaire and who had complete anthropometric and sociodemographic data at baseline were considered for analysis. Thus, participants who did not have data on BMI (n = 26), WC (n = 12), and hip circumference (HC) (n = 2) were excluded from this analysis. The final sample consisted of 15,065 participants.

Variables of interest

Anthropometric data

Body measurements (weight, height, WC, and HC) were measured according to standardized procedures[24]. All anthropometric measurements were taken with the participants fasting and with an empty bladder. Body weight was measured with the participant barefoot, wearing a standard uniform over underwear. An electronic scale (Toledo, model 2096PP) was used, with a capacity of 200 kg and an accuracy of 50 g. Height was measured with a wall stadiometer (Seca, Hamburg, FRG) with a precision of 1 mm, affixed to a smooth wall and without a baseboard. The individual was barefoot, leaning his head, buttocks, and heels against the wall and with his gaze fixed on the horizontal plane. Height was checked during the inspiratory period of the respiratory cycle. From the weight and height data, the BMI (body weight divided by the height squared – kg/m²) was calculated and the WHO criteria were used to classify the nutritional status.

WC was measured with the participant in an upright position, breathing normally, with feet together, the upper part of the garment (shirt) raised and arms crossed in front of the chest. The measurement was taken with an inextensible measuring tape at the midpoint between the iliac crest and the lower edge of the last costal arch. High WC was identified when greater than or equal to 94 and 80 cm, respectively, for men and women. HC was measured at the greatest prominence of the buttocks and from these measurements, the waist-hip ratio (WHR) was calculated. Elevated WHR was identified when ≥ 1 and ≥ 0.85, respectively, for men and women. The variables WC and WHR were categorized according to the cutoff points recommended by the World Health Organization[25], thus defining high WC and WHR, which were the dependent variables of the study.

Alcohol consumption

The consumption of alcoholic beverages was reported through structured questionnaires with closed questions, carried out at each RC of ELSA-Brasil, to determine the types of alcoholic beverages (beer, wine, and spirits – cachaça, vodka, and whiskey). The frequency (daily, weekly, monthly) and the amount of consumption in mL/day were also determined[26].

The classification of a unit was established for the different alcoholic beverages considering: a glass of red or white wine (120 mL), one can/long neck beer (350 mL) or one 620 mL beer bottle (two doses). For distilled beverages, 50 mL were considered for a dose of cachaça, vodka, or whiskey.

Thus, each type of beverage (beer, wine, and spirits) and all alcoholic beverages (sum) were classified into dose/week and, subsequently, this consumption in dose/week was divided into quintiles for all analyses.

Covariates

Sociodemographic

Sociodemographic variables were collected through a standardized questionnaire in an interview carried out at each RC of ELSA-Brasil. Age was categorized into four groups (35-44 years, 45-54 years, 55-64 years, and 65-74 years). Race/skin color was self-reported, categorized as white and non/white (brown, black, yellow, and indigenous). Education was categorized as incomplete elementary school, complete high school, and college/graduate. The per capita family income was calculated based on the total net income of the family in Brazilian reais, in the past three months, and divided by the number of people who depend on the income to live and subsequently subdivided into tertiles.

Lifestyle variables

Regarding smoking, the variable was categorized as "ex-smoker", "current smoker", and "never smoked". To measure the level of leisure-time physical activity, the long version of the International Physical Activity Questionnaire (IPAQ) was used, validated for Brazil[27], in the leisure physical activity and commuting physical activity domains. The physical activity variable was recorded in minutes/week and subdivided into weak, moderate, and strong.

Statistical analysis

The chi-square test was used to assess the difference in proportions. The association between dependent variables (high WC and WHR) and alcohol consumption quintiles (independent variable) was analyzed using Poisson models (PR and 95% CI), adjusted for age, per capita income, BMI, smoking, and physical activity.

The criteria used to select the adjustment variables in the model were the biological and theoretical plausibility assessed using the DAG, not including the colliding variables, and applying the minimum adjustment model and the statistical criterion ($p \leq 0.20$ in the bivariate analysis). As education and per capita income are collinear, only one was chosen.

The significance level for all tests was $p < 0.05$. Data were analyzed using the Statistical Package for Social Sciences – SPSS 17.0 (SPSS Inc., Chicago, IL, USA).

Results

A total of 15,065 participants were evaluated (45.6% men and 54.4% women) with a mean age of 52 years (SD ± 9.0) and about 40% of the sample had high WC and WHR. The consumption of alcoholic beverages was observed in almost half of the individuals studied, with beer being the most consumed beverage in both sexes, followed by distilled beverages for men and wine among women. Men consumed, on average, twice as much beer and spirits in doses/week when compared to women. Mean wine consumption in servings/week also differed among men (3.6 servings/week in men vs. 2.8 servings/week in women) (data not shown in tables). When analyzing the distribution of the sample according to the classification of WC and WHR, statistical significance was observed for all sociodemographic and lifestyle variables analyzed (Table 1).

Higher prevalence of WC was observed in individuals between 45 and 54 years of age, who reported practicing weak physical activity, who had a high level of education (higher education/graduate) and who reported not being smokers, in both sexes. In men, high WC is associated with overweight, white race/color, and last tertile of per capita income, while in women an association with obesity, non-white race/color, and lower tertile of per capita income was observed. Higher WHR prevalence was found in participants who practiced weak physical activity, in both sexes. In men, high WHR was associated with age (55 to 64 years), obesity, complete high school, white race/color, former smokers, and the highest tertile of per capita income. In women, age (45 to 54 years), overweight, higher education/graduate level, non-white race/color, non-smokers, and the lowest tertile of per capita income were associated (Table 1).

Among men, the consumption quintiles (dose/week) of wine ($p = 0.002$), beer ($p < 0.001$), and all alcoholic beverages analyzed ($p > 0.005$) were associated with high WC. Among women, the association was found only for beer ($p < 0.001$) and all alcoholic beverages analyzed ($p = 0.004$). Regarding WHR, among men, the consumption quintiles (dose/week) of all alcoholic beverages analyzed ($p < 0.001$), wine ($p = 0.004$), and beer ($p < 0.001$) and, among women, beer ($p < 0.001$) and all alcoholic beverages analyzed ($p < 0.001$), were associated with high WHR (Table 2).

After adjustment for confounding variables, the probability of having high WC was 5% and 3% higher in the most exposed group of beer consumption (fifth quintile of doses/week) in men and women when compared to the reference group [PR = 1.05 (95% CI 1.02-1.08) and PR = 1.03 (95% CI 1.00-1.07), respectively]. A higher probability of having a high WHR was also found among the highest beer consumers (fifth quintile of doses/week) [PR = 1.03 (95% CI 1.00-1.07) in men and PR = 1.10 (95% CI 1.04-1.15) in women]. No association was found between the consumption of wine and distilled beverages with high WC and WHR (tables 3 and 4).

Discussion

About 40% of the sample had high WC and WHR and almost half reported consuming alcoholic beverages. Beer being the most consumed beverage in both sexes, followed by distilled beverages for men and wine among women. Beer consumption was associated with high WC and WHR in men and women, after adjustment for confounding variables.

Beer consumption was associated with WC and WHR, both in men and women. In Brazil, Ferreira *et al.* (2008), in a cross-sectional study with 1,749 men, blood donors, showed that the prevalence of inadequacy of both WC and WHR linearly increased with the amount of alcohol ingested[28]. A study carried out with data from the Nutrition and Health Survey (*PNS*) identified that the prevalence of high WHR among men was associated with a higher daily amount of beer and there was no association with the consumption of distilled beverages. The prevalence of high WHR increased with age in both sexes and was more pronounced in women over 50 years old[29].

A systematic review addressed the relationship between beer consumption and abdominal obesity, through the assessment of WC and WHR, in cross-sectional and experimental studies. The findings showed positive associations in men, but inconsistent data in women[30]. These results are explained by the difference in the consumption of alcoholic beverages between genders, with a higher consumption among men[31].

In this scenario, most studies related to the consumption of alcoholic beverages treat men and women separately due to the difference between metabolism and consumption[32], with the largest proportion of men being excessive drinkers (five doses or more on one occasion in the last 12 months)[33]. In epidemiological studies, the

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Table 1. Sample distribution according to Waist Circumference and Waist-Hip Ratio (ELSA-Brasil. 2008-2010).

Waist circumference	Waist-Hip Ratio								
	Male			Female		Male		Female	
	Total	**High**	**p-vallue**	**High**	**p-value**	**High**	**p-value**	**High**	**p-value**
	n (%)	**n (%)**		**n (%)**		**n (%)**		**n (%)**	
Age (years)			< 0.001		< 0.001		< 0.001		< 0.001
35 to 44	3334 (22.1)	651 (17.9)		348 (15.1)		176 (10.3)		595 (14.2)	
45 to 54	5926 (39.3)	1424 (39.2)		868 (37.7)		562 (32.9)		1560 (37.2)	
55 to 64	4221(28)	1080 (29.8)		762 (33.1)		625 (36.6)		1453 (34.7)	
65 to 74	1584 (10.5)	474(13.1)		323 (14.0)		344 (20.2)		583 (13.9)	
Nutritional Status	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001		< 0.001
Thinness	3334 (0.9)	-	-	-	-	-			
Eutrophy	5926 (35.9)	182 (5.0)	11 (0.5)	139 (8.1)	868 (20.7)	139 (8.1)		868 (20.7)	
Overweight	4221 (40.3)	2045 (56.4)	559 (24.3)	768 (45.0)	1698 (40.5)	139 (8.1)		1698 (40.5)	
Obesity	1584 (22.9)	1401 (38.6)	1730 (75.2)	800 (46.9)	1617 (38.6)	800 (46.9)		1617 (38.6)	
Physical activity	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001		< 0.001
Weak	11430 (77)	2763 (77.2)	1939 (85.2)	1345 (79.8)	3425 (82.8)	1345 (79.8)		3425 (82.8)	
Moderate	2072 (14)	514 (14.3)	247(10.8)	234 (13.9)	496 (12.0)	234 (13.9)		496 (12.0)	
Strong	1347 (9)	304 (8.5)	91 (4.0)	106 (6.3)	213 (5.2)	106 (6.3)		213 (5.2)	
Education	0.005	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001		< 0.001
Elementary incomplete	888 (5.9)	296 (8.2)	153 (6.6)	197 (1(1.5)	252 (6.0)	197 (1(1.5)		252 (6.0)	
Complete elementary	1025 (6.8)	294 (8.1)	183 (8.0)	168 (9.8)	310 (7.4)	168 (9.8)		310 (7.4)	
Complete high school	5218 (34.6)	1136 (31.3)	930 (40.4)	488 (28.6)	1621 (38.7)	488 (28.6)		1621 (38.7)	
College education/ graduate	7934 (52.7)	1903 (52.4)	1035 (45.0)	854 (50)	2008 (47.9)	854 (50)		2008 (47.9)	
Race/color	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001		< 0.001
Non-white	7118 (47.77)	1578 (44.1)	1216 (53.4)	690 (41.0)	2161 (52.0)	690 (41.0)		2161 (52.0)	
White	7780 (52.23)	2003 (55.9)	1061 (46.6)	991 (59.0)	1994 (48.0)	991 (59.0)		1994 (48.0)	
Smoking	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001		< 0.001		< 0.001
Never smoked	8571 (56.9)	1665 (45.9)	1356(58.9)	688 (40.3)	2461 (58.7)	688 (40.3)		2461 (58.7)	
Ex-smoker	4522 (30)	1507 (41.5)	676 (29.4)	777 (45.5)	1187 (28.3)	777 (45.5)		1187 (28.3)	
Smoker	1971 (13.1)	457 (12.6)	269 (11.7)	241 (14.1)	543 (13.0)	241 (14.1)		543 (13.0)	
Per capita income	0.001	< 0.001	0.001	< 0.001	< 0.001		0.001		< 0.001
1st tertile	4955 (33)	1196 (33.1)	866 (37.8)	540 (31.7)	1474 (35.3)	540 (31.7)		1474 (35.3)	
2nd tertile	4792 (31.9)	1118 (30.9)	721 (31.4)	544 (32.0)	1365 (32.7)	544 (32.0)		1365 (32.7)	
3rd tertile	5264 (35.1)	1303 (36.0)	705 (30.8)	618 (36.3)	1340 (32.1)	618 (36.3)		1340 (32.1)	

*Chi-square test ($p < 0.05$).

Source: Authors.

association between alcohol consumption and body weight varies according to sex. Therefore, first-pass gastric metabolism is reduced in women and the volume of distribution of an alcohol dosage is lower in women. Due to the greater body fat mass, women obtain a higher blood alcohol concentration after ingesting a defined dosage of alcohol than men[15].

The prevalence of overweight and obesity in this sample was higher than that found in the Brazilian population in general[34]. Unlike the present study, a survey conducted by Pinho and collaborators with individuals 25 to 59 years of age in the State of Pernambuco identified a higher prevalence of abdominal obesity in females and especially from the third decade of life on-

Tabela 2. Consumo de bebidas alcoólicas (doses/semana), segundo circunferência da cintura e relação cintura-quadril (ELSA – Brasil, 2008-2010).

Kind of alcoholic beverage (quintile)	Waist circumference						Waist circumference					
	Male			Female			Male			Female		
	High			High			High			High		
	n	%	p value*	n	%	p value*	n	%	p value*	n	%	p value*
Wine			0.002			0.132			0.004			0.516
1st	240	20.3		121	34.4		110	20.5		216	30.9	
2nd	269	22.7		90	25.6		104	19.4		177	25.3	
3rd	172	18.2		50	14.2		73	13.6		91	13.0	
4th	240	14.5		42	11.9		126	23.4		108	15.5	
5th	261	22.0		49	13.9		124	23.1		107	15.3	
Beer			< 0.001			< 0.001			0.001			<0.001
1st	221	11.1		167	29.5		106	11.9		279	26.6	
2nd	324	16.3		121	21.4		140	15.7		235	22.4	
3rd	420	21.2		112	19.8		177	19.9		239	22.8	
4th	453	22.8		98	17.3		186	21.0		183	17.4	
5th	569	28.6		68	12.0		280	31.5		113	10.8	
Distilled beverages			0.090			0.887			0.090			0.226
1st	263	31.7		46	56.8		115	29.0		96	54.5	
2nd	174	21.0		16	19.7		78	19.6		34	19.3	
3rd	95	11.4		10	12.4		46	11.6		20	11.4	
4th	135	16.2		5	6.2		64	16.1		13	7.4	
5th	163	19.6		4	4.9		94	23.7		13	7.4	
All drinks			< 0.001			0.004			< 0.001			< 0.001
1st	233	10.0		251	33.5		118	11.0		439	30.1	
2nd	327	14.0		169	22.5		141	13.2		320	22.5	
3rd	458	19.5		142	18.9		199	18.7		309	21.7	
4th	567	24.2		111	14.8		238	22.3		213	15.0	
5th	756	32.3		77	10.3		371	34.8		140	9.9	

*Chi-square test.

Source: Authors.

wards, in the lowest level of education, in addition to higher consumption of alcoholic beverages in men when compared to women[8].

Although other studies have shown that light and moderate alcohol consumption represents protection against increased WC and WHR and overweight[35-37], in this study we did not verify this association, as a comparison was not made between non-drinkers and the quintiles of alcohol consumption. A case-control study conducted in the United States showed lower percentages of abdominal adiposity among those who consumed alcoholic beverages compared to those who did not, and in women, abdominal adiposity tended to decrease with the increase in beverage consumption. The study identified that in addition to the amount of alcohol consumed, the pattern of consumption can affect the distribution of body fat[38].

A British study with 7,735 men, 40 to 59 years of age, observed that the consumption of alcoholic beverages was positively associated with the means for BMI, WC, and WHR. The results showed greater effects on WHR and WC than on BMI. Despite this, the variables were not significant for the types of beverages separately[11]. It is important to mention that high consumption of alcoholic beverages increases the risk of exceeding the recommended daily energy intake. In the long term, daily energy intake that exceeds daily energy expenditure is the driving force for weight gain. Alcohol can represent from 5% to 10% of the energy ingested by adults, being a significant component of the diet[39].

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Table 3. Prevalence ratio and confidence intervals (95% CI) for the association between alcohol consumption and high waist circumference (ELSA-Brasil, 2008-2010).

Quintiles of consumption	Men		Woman	
	Crude model	**Adjusted model[a]**	**Crude model**	**Adjusted model[a]**
Wine				
1st quintile	1	1	1	1
2nd quintile	1.04 (1.00-1.09)	1.00 (0.97-1.03)	0.97 (0.93-1.01)	0.99 (0.96-1.02)
3rd quintile	1.06 (1.01-1.10)	1.02 (0.99-1.06)	0.98 (0.93-1.04)	0.99 (0.95-1.020
4th quintile	1.06 (1.02-1.11)	1.00 (0.97-1.03)	0.93 (0.88-0.98)	0.97 (0.94-1.00)
5th quintile	1.08 (1.03-1.12)	1.02 (0.99-1.05)	0.98 (0.92-1.03)	0.99 (0.95-1.03)
Beer				
1st quintile	1	1	1	1
2nd quintile	1.05 (1.01-1.09)	1.01 (0.98-1.04)	0.97 (0.93-1.01)	0.99 (0.96-1.01)
3rd quintile	1.07 (1.03-1.11)	1.03 (1.00-1.06)	0.98 (0.94-1.02)	0.99 (0.96-1.02)
4th quintile	1.08 (1.04-1.12)	1.04 (1.01-1.07)	1.03 (0.98-1.08)	1.02 (0.98-105)
5th quintile	1.10 (1.06-1.14)	1.05 (1.02-1.08)	1.10 (1.04-1.17)	1.03 (1.00-1.07)
Distilled beverages				
1st quintile	1	1	1	1
2nd quintile	0.99 (0.94-1.03)	0.99 (0.96-1.02)	0.98 (0.90-1.07)	1.00 (0.94-1.07)
3rd quintile	1.05 (1.00-1.11)	1.05 (1.01-1.10)	1.05 (0.93-1.19)	1.01 (0.93-1.11)
4th quintile	1.04 (0.99-1.09)	0.99 (0.96-1.03)	1.01 (0.87-1.17)	1.00 (0.90-1.11)
5th quintile	0.99 (0.94-1.04)	1.00 (0.96-1.03)	0.97 (0.84-1.12)	0.98 (0.90-1.08)
All drinks				
1st quintile	1	1	1	1
2nd quintile	1.04 (1.00-1.08)	1.02 (0.99-1.05)	0.97 (0.94-1.00)	0.97 (0.94-0.99)
3rd quintile	1.07 (1.03-1.11)	1.03 (1.01-1.06)	0.97 (0.94-1.01)	0.98 (0.96-1.01)
4th quintile	1.09 (1.05-1.13)	1.04 (1.02-1.07)	0.99 (0.95-1.03)	0.99 (0.97-1.02)
5th quintile	1.12 (1.09-1.16)	1.05 (1.03-1.08)	1.07 (1.01-1.12)	1.02 (0.99-1.06)

[a]Model adjusted for age, body mass index, per capita income, physical activity, and smoking.

Source: Authors.

It is important to emphasize that there is no consensus on the effect of alcohol consumption and changes in anthropometric parameters, which may show both positive, negative, and null associations[31]. In the present study, an association was found for high WC and WHR with beer consumption, which can be explained by the predominant beer consumption among Brazilians[25]. Furthermore, as beer is consumed in larger quantities, it provides greater energy intake when compared to other types of alcoholic beverages, which can influence a greater accumulation of fat.

In this context, the pattern of drinking and eating is crucial, that is, whether alcohol is added to usual food sources or whether alcohol replaces energy from the usual diet has a different impact. Furthermore, the composition of the food to which alcohol is added is of great relevance. Correct assessment of this consumption behavior in epidemiological studies is not possible. The absolute quantity and frequency of alcoholic beverage consumption determine the metabolic pathway (via alcohol dehydrogenase – ADH – or via microsomal ethanol oxidation – MEOS) of alcohol degradation and thus interactions with energy metabolism, as well as another physiological system[15,40,41]. The ADH pathway is responsible for greater energy release and occurs in social drinkers and MEOS is more frequently used in heavy drinkers. The liver is a determinant of both lipid and alcohol metabolism, since lipid metabolism does not occur to give preference to alcohol, there is a positive energy balance of fats and their consequent accumulation, that is, weight gain[15].

The study has some limitations, among which is the cross-sectional design. As the participants were not followed up, it is not possible to establish a cause-and-effect relationship between the outcomes and alcohol consumption. Anoth-

Table 4. Prevalence Ratio and confidence intervals (95% CI) for the association between alcohol consumption and high waist-hip ratio (ELSA-Brasil, 2008-2010).

Quintiles of consumption	Men		Woman	
	Crude model	Adjusted model[a]	Crude model	Adjusted model[a]
Wine				
1st quintile	1	1	1	1
2nd quintile	0.99 (0.95-1.03)	0.96 (0.93-1.00)	0.98 (0.94-1.02)	0.98 (0.95-1.02)
3rd quintile	1.01 (0.97-1.07)	0.98 (0.94-1.02)	0.98 (0.93-1.04)	0.98 (0.93-1.03)
4th quintile	1.07 (1.02-1.12)	1.01 (0.97-1.06)	0.98 (0.93-1.04)	1.01 (0.96-1.06)
5th quintile	1.05 (1.00-1.10)	1.00 (0.96-1.04)	1.03 (0.97-1.08)	1.03 (0.97-1.08)
Beer				
1st quintile	1	1	1	1
2nd quintile	1.00 (0.96-1.05)	0.99 (0.95-1.02)	1.01 (0.97-1.05)	1.01 (0.97-1.05)
3rd quintile	1.01 (0.97-1.05)	1.00 (0.96-1.03)	1.05 (0.01-1.10)	1.05 (1.01-1.09)
4th quintile	1.01 (0.97-1.05)	0.99 (0.96-1.03)	1.09 (1.04-1.14)	1.07 (1.03-1.12)
5th quintile	1.06 (1.02-1.10)	1.03 (1.00-1.07)	1.15 (1.09-1.21)	1.10 (1.04-1.15)
Distilled beverages				
1st quintile	1	1	1	1
2nd quintile	1.00 (0.95-1.05)	0.99 (0.95-1.03)	0.98 (0.89-1.07)	0.98 (0.90-1.06)
3rd quintile	1.05 (0.98-1.13)	1.03 (0.97-1.09)	1.07 (0.96-1.20)	1.04 (0.94-1.16)
4th quintile	1.04 (0.98-1.10)	0.98 (0.93-1.03)	1.10 (0.96-1.26)	1.04 (0.90-1.20)
5th quintile	1.05 (1.00-1.11)	1.02 (0.98-1.07)	1.10 (0.96-1.26)	1.12 (1.00-1.27)
All drinks				
1st quintile	1	1	1	1
2nd quintile	0.99 (0.95-1.03)	0.99 (0.96-1.02)	0.98 (0.94-1.01)	0.98 (0.95-1.01)
3rd quintile	1.01 (0.97-1.05)	0.98 (0.95-1.02)	1.03 (1.00-1.07)	1.03 (1.00-1.06)
4th quintile	1.01 (0.97-1.05)	0.98 (0.95-1.01)	1.02 (0.98-1.06)	1.01 (0.98-1.05)
5th quintile	1.06 (1.03-1.10)	1.01 (0.98-1.05)	1.12 (1.07-1.17)	1.07 (1.03-1.12)

[a] Model adjusted for age, body mass index, per capita income, physical activity, and smoking.

Source: Authors.

er limitation is the data collection instrument, which, as a self-report questionnaire, can overestimate or underestimate the consumption of alcoholic beverages, such as the consumption of distilled beverages that can be omitted because of the harmful effect on health, in addition to having its consumption stigmatized for being more consumed by chronic alcoholics. However, it is a type of data collection widely used in large epidemiological studies.

Since obesity has a multifactorial determination, it is indeed complex to assess the independent influence of alcohol consumption and the risk of abdominal adiposity. Epidemiological studies are important to showing an effect of this consumption on the vulnerability of increased WC and WHR. For future studies on this association, it is important to evaluate the relationship between the individuals' diet and alcohol consumption. Although it is known that the energy contribution of alcoholic beverage consumption is considerable in the diet, it is important to understand the contribution of other foods in the genesis of abdominal adiposity.

Conclusion

An association was found between beer consumption and inadequacy of WC and WHR in men and women. It is possible to identify the relevance of the results of this study for a better understanding of the impact of alcohol consumption in the context of public health, since alcohol is an important risk factor for health and its consumption has been increasing, especially among younger people. This fact can greatly contribute to the early increase in cardiovascular risk, with the reduction of consumption being a challenge for public health policies.

Collaborations

GG Torres worked on the conception, design, data analysis and interpretation, on the writing of the article and its critical review. JH Siqueira, OG Enriquez and TS Pereira contributed to the conception, design, data analysis and interpretation, the writing of the article, its critical review and approval of the version to be published. GV Melendez, BB Duncan and AC Goulart acted in the conception, design, data analysis and interpretation and in the approval of the version to be published. MCB Molina assisted in the conception, design, data acquisition, critical review of the content and final approval of its version.

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