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Alcohol consumption and abdominal fat in blood donors

ABSTRACT

OBJECTIVE: To evaluate the association between alcohol consumption and abdominal fat.

METHODS: Cross-sectional study carried out in a sample of male blood donors (n=1,235), aged 20-59 years, in the city of Cuiabá, Central-West Brazil, between August 1999 and January 2000. Waist circumference and waist-to-hip ratio were indicators of abdominal fat, adjusted for total adiposity. Weight, height, waist and hip circumferences were measured. Alcohol consumption was evaluated using a questionnaire collecting information on type, frequency, and amount of consumption. The association between alcohol consumption and abdominal fat was assessed through multiple linear regression models adjusted for age, physical activity, smoking, and percent of body fat.

RESULTS: After adjustment, waist circumference and waist-to-hip ratio were positively associated with beer ($p = 0.02$) and total alcohol consumption ($p=0.01$; $p=0.03$, respectively). Waist circumference was positively associated with spirit consumption ($p=0.04$).

CONCLUSIONS: Alcohol intake, particularly beer, was positively associated to abdominal fat.

DESCRIPTORS: Blood Donors. Men's Health. Alcohol Drinking, metabolism. Abdominal Fat. Waist-Hip Ratio. Cross-Sectional Studies.

INTRODUCTION

Prospective and cross-sectional epidemiological studies has consistently demonstrated an association between chronic diseases and central body fat.[4,6,11]

Abdominal fat location can be measured using anthropometric measurements, which provide accurate, low-cost measures compared to more complex ones.[8,12]

Several recent studies have underscored the value of measures such as waist circumference and waist-to-hip ratio (WHR) as indicators of fat location. Studies conducted in Brazil have evidenced an association between high levels of these indicators and conditions such as hypertension, diabetes, dyslipidemias, and coronary artery disease.[6,11,13]

Different factors such as genetics, gender and age[3,17] are believed to be major determinants of central body fat. Though still controversial, behaviors such as physical inactivity, alcohol consumption and smoking have also been positively associated.[2,14,18] Yet some studies have not evidenced an association between fat location and dietary habits and alcohol consumption.[9] As for alcohol intake, prospective studies have shown an association only with beer consumption.[15] In Brazil, few studies have assessed the effect of alcohol consumption on fat location.

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The objective of the present study was to assess the association between anthropometric indicators of fat location and alcohol consumption after controlling for potential confounders.

METHODS

Cross-sectional study including blood donors in the city of Cuiabá, central-west Brazil. The estimated sample size was approximately 600 subjects for 80% power, 0.05 alpha error, and 30% prevalence ratio of inadequacy of the waist-to-hip ratio in alcohol consumers and 20% in non-consumers according to that described by Machado & Sichieri.[9] A total of 1,749 blood donors aged between 20 and 59 were invited to participate in the study between August 1999 and January 2000. Women were excluded from the study since the proportion of females among blood donors was very low (n=249). Other donors (n=265) were also excluded: 15 were under diet therapy; 12 were regularly taking medication; 15 reported weight loss in the two months prior to the interview; 15 had body mass index (BMI) <18.5 kg/m^2; 164 had BMI ≥30.0 kg/m^2; 29 refused to participate and 15 were lost. The final sample consisted of 1,235 male subjects, either eutrofic or overweight.

Data was collected through interviews carried out by graduating students of Nutrition. Sociodemographic and lifestyle information (alcohol consumption, smoking, physical activity) was collected using a questionnaire developed for the study.

All respondents reported the frequency and type of alcoholic beverage consumed in the week prior to the interview. Consumption was quantified based on common measures (glass, can, bottle, cup, and dose). The doses were set as follows: beer – 200 mL (a double glass); wine – 150 mL (a cup); and spirits – 50 mL (or one measured amount). Low rate of reporting of other alcoholic beverages did not allow to breaking them down for analysis. The amount of ethanol (g/day) was calculated based on this information considering the average alcohol content contained in the most commonly marketed beverages: beer=5%; wine=12.5%; spirits=39%.

Smoking was measured in number of cigarettes smoked per day. The respondents were divided into three groups according to their smoking habits: non-smokers were those reporting never smoking; smokers were those reporting at least one cigarette a day at the time of the interview; and former smokers were those reporting having smoked in the past but quitted. Physical activity was assessed using the study questionnaire and respondents were considered physically active or inactive during their leisure time based on information regarding the last month prior to the interview.

All body composition measures were taken before blood donation. Waist and hip circumferences were measured in duplicate following Callaway et al[1] standardization. Waist circumference was measured at the level of the subject's natural waist, i.e., at the narrower perimeter of the trunk. Hip circumference was measured at the level of greater perimeter around the buttocks. In the analysis, it was included the mean of two measures.

Weight was measured in kilogram using bioimpedance. Subjects wore light clothing and no shoes during measurements. Height was measured using a metallic tape measure attached to a wooden pole and mounted to a wall with no baseboard. Measurements were taken while subjects were standing barefoot with their backs against the pole, and gazing forward, and recorded to the nearest centimeter. Percent of body fat was estimated using electric bioimpedance and the same analyzer of body composition used for weight measures (Tanita, model TBF-305), at an electric current of 500 μA and low frequency (50 kHz). Further details on the technique used for anthropometric and percent of body fat measurements are available elsewhere.[8]

Fat distribution-related factors were analyzed in linear regression models. Waist circumference and waist-to-hip ratio were included as dependent variables in individual models. Since the analysis showed both dependent variables did not have a normal distribution, they underwent logarithmic conversion to meet the assumed normality required in linear regression models. Whenever the logarithmic models showed similar results to those found in non-converted models, we present the latter. The models used to assess the predictive ability of ethanol (g/day) and a dose of each one of the alcoholic beverages studied related to the indicators of fat location were adjusted for age as a continuous variable, percent of body fat, smoking, and physical activity.

A previous study in the same population[8] evidenced a strong correlation between fat location (especially waist circumference but also waist-to-hip ratio) and measures of total body fat (BMI and percent of body fat). Hence, the assessment of the independent predictive ability of alcohol consumption related to the indicators of fat location required the inclusion of percent of body fat in the models. The choice for percent of body fat rather than BMI is justified by the fact the percent of body fat is more effective in eliminating the effect of total body fat. Studies[4,7,8] have pointed that percent of body fat is a better indicator than BMI because BMI effectiveness as an indicator of total body fat decreases with age. In addition, the adjustment for total energy consumption is crucial in the analysis of potential associations between nutrients or foods and outcomes,[19] and percent of body fat is considered an indicator of energy intake as well.

Physical activity[14] and smoking[2] are also considered confounders of the association between fat location and alcohol consumption and were adjusted for in the models.

The study was approved by Research Ethics Committee at Júlio Muller University Hospital of Universidade Federal de Mato Grosso.

RESULTS

More than half of the subjects (56.7%) aged between 20 and 29 and attended eight to 12 years of school (64.9%). Of all donors, 22.1% were smokers, 16.3% were former smokers, and 61.6% were non-smokers. Among blood donors 55% reported engaging in physical activities during leisure time. A total of 594 subjects (48.1%) reported not consuming alcohol at all (Table 1). Beer was the most commonly consumed alcoholic beverage among those reporting alcohol intake (90.6%). The prevalences of consumption of the main types of alcoholic beverages are shown in Table 2. Most reported consuming only one type of alcoholic beverage in the week prior to the interview and a same subject consumed at most three different types of alcoholic beverage during this same period. Weekly consumption ranged between one and seven days.

The prevalence of overweight was 40.1%. Notably, there was a difference in the prevalences of inadequacy of the waist circumference and the waist-to-hip ratio when the cutoffs described in the previous study for this population (85 cm for waist circumference and 0.90 for waist-to-hip ratio)[6] and WHO-recommended (94 cm for waist circumference and 1.00 for waist-to-hip ratio) were applied.[20] These data are shown in Table 3.

Table 4 shows that the prevalence of inadequacy of the waist circumference and the waist-to-hip ratio linearly increased with alcohol consumption (p=0.02 and p=0.04, respectively).

After adjusting for total body fat and potential confounders, waist circumference and waist-to-hip ratio remained positively associated to consumption of beer and total amount of alcohol consumed. Waist circumference had an association only with spirits consumption (Table 5).

Table 1. Sociodemographic and lifestyle characteristics of blood donors. Cuiabá, Brazil, Central-West 1999–2000. N=1,235

Variable	n	%	95% CI
Age (years)			
20–29	700	56.7	53.9;59.5
30–39	363	29.4	26.9;32.0
40–59	172	13.9	12.1;16.0
Schooling (years)			
<8	333	27.0	24.5;29.5
8–12	801	64.9	62.1;67.5
>12	101	8.2	6.7;9.9
Income*			
<1.0	372	30.1	27.6;32.8
1.0–2.0	392	31.7	29.2;34.4
>2.0	471	38.1	35.4;40.9
Smoking			
Non-smoker	761	61.6	58.8;64.3
Former smoker	201	16.3	14.3;18.5
Smoker	273	22.1	19.8;24.5
Alcohol consumption (g/day)**			
None	594	48.1	45.3;50.9
<6.4	208	16.8	14.8;19.1
6.4–15.5	214	17.3	15.3;19.6
>15.5	219	17.7	15.7;20.0
Physical activity during leisure time			
No	548	44.4	41.6;47.2
Yes	687	55.6	52.8;58.4

* Per capita minimum wages
** Tercile of consumption

Table 2. Prevalence of consumption by type of alcohol beverage in blood donors. Cuiabá, Central-West Brazil, 1999–2000.

Type of alcoholic beverage	n	%
Beer	581	90.6
Wine	45	7.0
Spirits	32	5.0
Other	8	1.2

Table 3. Prevalence of overweight and abdominal obesity defined by waist circumference and waist-to-hip ratio in blood donors based on two cutoffs. Cuiabá, Central-West Brazil, 1999–2000.

Variable	n	%	95% CI
Overweight*	495	40.1	37.3;42.9
Waist circumference			
≥85 cm**	380	30.8	28.2;33.4
≥94 cm***	79	6.4	5.1;7.9
Waist-to-hip ratio			
≥0.90**	356	28.8	26.3;31.5
≥1.00***	20	1.6	1.0;2.5

* 25.0 ≤ BMI ≤ 29.9 kg/m^2 [BMI = body mass index]
**Cutoff values described by Ferreira et al[6]
*** World Health Organization-recommended cutoff values[20](1998)

Table 4. Prevalence of abdominal obesity defined by waist circumference and waist-to-hip ratio in blood donors by alcohol consumption. Cuiabá, Central-West Brazil, 1999–2000. N=1,235

Alcohol consumption (g/day)	High level of waist circumference (≥85 cm)*		High level of waist-to-hip ratio (≥0.90)*	
	n	%	n	%
None	169	28.5	158	26.6
<6.4	60	28.8	58	27.9
6.4 to 15.5	72	33.6	67	31.3
>15.5	79	36.1	73	33.3
p-value of linear trend	0.02		0.04	

* Cutoff values described by Ferreira et al[6] 2006

Table 5. Coefficient of regression and p-value associated to abdominal fat indicators and alcohol consumption in male blood donors. Cuiabá, Central-West Brazil, 1999–2000. N=1,235

Variable	Waist circumference*		Waist-to-hip ratio*	
	β	p-value	β	p-value
Beer (dose)	0.026	0.02	0.0002	0.02
Wine (dose)	–0.0002	1.00	0.0013	0.56
Spirits (dose)	0.244	0.04	0.0006	0.60
Ethanol (g/day)	0.019	0.01	0.0002	0.03

* Adjusted for age, percent of body fat, physical activity and smoking

DISCUSSION

The most consistent association found in the present study was a positive correlation between weekly consumption of beer and total daily amount of alcohol consumed and indicators of fat location. This association was statistically significant for both waist circumference and waist-to-hip ratio after adjusting for potential confounders.

It was also found in this same population that beer and ethanol consumption (g/day) had an independent effect on blood levels of HDL-cholesterol (p=0.002 and p=0.003, respectively). This same association has been described in other studies[10] and supports the validity of alcohol consumption estimates in the present study.

Although the present study design does not allow any inferences on a causal relationship, the multivariate analysis allowed to exploring potential associations between alcohol intake and anthropometric measures of fat location after controlling for major risk factors.

A strength of the present study compared to other cross-sectional studies was the exclusion of obese blood donors since blood donors are less likely to have health problems. This approach may have contributed to reduce biases. Obese individuals, aware of the need to restrict alcohol intake, could have lower alcohol consumption, which would have affected the interpretation of results due to reverse causality, often seen in cross-sectional studies. Alcohol consumption is frequently lower in individuals with medical conditions and its relationship with outcomes is reflected as either a J-shaped or U-shaped curve.[15] This fact has been reported in studies that evaluated several different outcomes while studying alcohol consumption as an explanatory variable.

A strong association was found between total alcohol consumption and beer consumption and the indicators of abdominal fat. Consistently with our findings, several studies have showed that the total amount of alcohol consumed has a major effect on abdominal fat.[15,18]

In the present study the prevalence of inadequacy of both the waist circumference and the waist-to-hip ratio linearly increased with the amount of alcohol consumed, suggesting a dose-response relationship, already reported in other studies.[5]

Recent studies have failed to show consistent associations between particular types of alcoholic beverages and abdominal fat. Corroborating our findings, Machado & Sichieri[9] reported that daily intake of four or more glasses of beer in men was an independent predictor of inadequacy of the waist-to-hip ratio while the deleterious effect of distilled beverages on abdominal fat was seen only in post-menopausal women.

The type of alcoholic beverage, dose consumed and exposure time seem to play an important role in the association between alcohol consumption and changes in the indicators of fat location. A prospective study evaluating the amount and type of alcoholic beverage consumed showed a significant increase in the waist circumference in men with a weekly intake of more than 21 doses of beer over ten years.[16]

Despite its limitation for causality inferences, common to cross-sectional studies, the present study was able to detect a statistically significant association between beer consumption and both indicators of abdominal fat studied. In the multivariate analysis, after adjusting for potential confounders, nearly a 0.3-cm increase in the waist circumference was evidenced in those consuming 10 glasses of beer weekly compared to those who did not consume any beer. For spirits consumers, the effect was greater per dose consumed, i.e., a weekly 10-dose intake could result in 2.4-cm increase in the waist circumference compared to those who did not take spirits. Machado & Sichieri[9] did not find any association between inadequacy of the waist-to-hip ratio and consumption of spirits in men.

Despite using a careful methodological approach in this study, especially in the construction of regression models, it cannot be assured that all potential confounders

were controlled for. Given its cross-sectional design, the study results should be cautiously interpreted because a temporal relationship cannot be established between exposure and the outcomes studied.

The present study evidenced an association between overall alcohol consumption and some types of alcoholic beverages and distribution of abdominal fat even in a group of people that are healthier than the general population. There is thus a need to further investigate other characteristics of food intake that have been little explored, such as type of alcoholic beverage consumed, which may play a major role in the development of chronic diseases.

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