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Original Article

Influence of alcohol consumption on the taste perception of sweet and salty tastes in college students

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Objective: to evaluate the influence of alcohol consumption on the taste perception of sweet and salty tastes in college students. **Method:** this is an epidemiological, cross-sectional and analytical study conducted with 330 college students. For data collection, we used a questionnaire about personal, academic and socio-demographic information, the Alcohol Use Disorder Identification, with the measurement of anthropometric data, and the taste threshold test was applied. The Kolmogorov-Smirnov normality test was performed, using the Mann-Whitney test to compare the threshold means between the groups, and the stratified correlation analysis to evaluate the effect of alcohol use on the taste threshold. A significance level of 0.05 was adopted for the statistical analyses. **Results:** the mean taste thresholds for sweet 2.98 (dp±2.20) and salty 0.22 (dp±0.23) tastes were found. When comparing the study groups, it was evidenced that alcohol consumption was negatively correlated (r= -0.205; p= 0.004) to the salty threshold among health course subjects. There was no statistically significant correlation between alcohol consumption, physical activity and cardiovascular risk according to waist circumference in the groups evaluated. **Conclusion:** a correlation was noted between alcohol consumption and taste perception; the higher the alcohol consumption, the lower the taste sensitivity to salty taste.

Descriptors: Alcoholism; Students; Nutritional Status; Taste Threshold.

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Influence of alcohol consumption on the taste perception of sweet and salty tastes in college students

Objetivo: avaliar a influência do consumo de álcool na percepção gustativa aos gostos doce e salgado em estudantes universitários. **Método:** trata-se de um estudo epidemiológico, transversal e analítico realizado com 330 estudantes universitários. Para a coleta de dados, utilizou-se um questionário sobre as informações pessoais, acadêmicas e sociodemográficas, o *Alcohol Use Disorder Identification*, com a mensuração de dados antropométricos, e foi aplicado o teste de limiar gustativo. Foram realizados o teste de normalidade Kolmogorov-Smirnov, utilizando-se o teste de Mann-Whitney para a comparação das médias dos limiares entre os grupos, e a análise de correlação estratificada para avaliar o efeito do uso de álcool sob o limiar gustativo. Adotou-se o nível de significância de 0,05 para as análises estatísticas. **Resultados:** foram encontradas as médias do limiar gustativo aos gostos doce 2,98 (dp±2,20) e salgado 0,22 (dp±0,23). Ao comparar os grupos em estudo, evidenciou-se que o consumo de álcool esteve negativamente correlacionado (r= -0,205; p= 0,004) ao limiar salgado entre os indivíduos dos cursos de saúde. Não houve correlação estatisticamente significante entre o consumo de álcool, a atividade física e o risco cardiovascular segundo a circunferência da cintura nos grupos avaliados. **Conclusão:** notou-se uma correlação entre o consumo de álcool e percepção gustativa; quanto maior o consumo de álcool, menor a sensibilidade gustativa ao gosto salgado.

Descritores: Alcoolismo; Estudantes; Estado Nutricional; Limiar Gustativo.

Influencia del consumo de alcohol en la percepcióndel gusto de los sabores dulces y salados en estudiantes universitarios

Objetivo: evaluar la influencia del consumo de alcohol en la percepción gustativa de los sabores dulces y salados en estudiantes universitarios. **Método:** es un estudio epidemiológico, transversal y analítico, realizado con 330 estudiantes universitarios. Para la recolección de datos se utilizó un cuestionario sobre información personal, académica y sociodemográfica, la Identificación de Trastornos por Uso de Alcohol, para medir los datos antropométricos y se aplicó una prueba de umbral gustativo. Se realizó la prueba de normalidad de Kolmogorov-Smirnov, se utilizó la prueba de Mann-Whitney para comparar los umbrales medios entre grupos y el análisis de correlación estratificado para evaluar el efecto del consumo de alcohol en el umbral gustativo. Se adoptó el nivel de significancia de 0.05 para el análisis estadístico. **Resultados:** se encontró la media del umbral gustativo para los sabores dulces 2,98 (DE ± 2,20) y salado 0,22 (DE ± 0,23). Al comparar los grupos en estudio, se evidenció que el consumo de alcohol se correlacionó negativamente (r = -0,205; p = 0,004) con el umbral salado entre los individuos en cursos de salud. No hubo correlación estadísticamente significativa entre el consumo de alcohol, la actividad física y el riesgo cardiovascular según la circunferencia de la cintura en los grupos evaluados. **Conclusión:** hubo correlación entre el consumo de alcohol y la percepción gustativa; a mayor consumo de alcohol menor sensibilidad gustativa al gusto salado.

Descriptores: Alcoholismo; Estudiantes; Estados Nutricionales; Umbral Gustativo.

Introduction

Alcohol consumption by young college students is a common practice, since it is rooted in culture and traditions, and plays an important role in social relationships as well as in the construction of the college student's social identity[1-2].

According to epidemiological data, alcohol consumption by the world population, aged 15 years and older, corresponds to 55% of individuals who have already tried some type of alcoholic beverage and 43% who declared themselves current drinkers. In Brazil, data revealed that in the year 2018, in this same age range, 78.6% had already consumed alcohol at least once and 40.3% consumed it frequently, revealing data of high alcohol consumption in this age group in the country[3].

A study developed in Ecuador[4] evaluated the prevalence and profile of alcohol consumption among college students and found that most students reported moderate alcohol consumption (51.3%), and only 12.7% reported not consuming alcohol. In another study developed with health care students, it was possible to describe the patterns of alcohol consumption by college students, noting that 65.7% of the survey participants had consumed alcohol in the week before the study[5].

It is important to emphasize the impact of alcohol consumption on health, behavior, and even cognitive function of consumers[6-8]. Five studies analyzed[9-13] evidenced a study developed in Ecuador[4] evaluated the prevalence and profile of alcohol consumption among university students and found that most students reported moderate alcohol consumption (51.3%) and only 12.7% reported not consuming alcohol. In another study developed with health students, it was possible to describe the patterns of alcohol consumption by university students, observing that 65.7% of the research participants had consumed alcohol in the week prior to the study the influence of alcohol consumption on the development of pathologies, such as liver disease, in the occurrence of traffic accidents, in behavioral changes that can trigger episodes of violence, in the reduction of academic performance of students and in associations with suicide attempts.

Furthermore, a study found that alcohol consumption can alter taste perception, which may contribute to the development of Chronic Non-Communicable Diseases (CNCD), such as Diabetes Mellitus, Systemic Arterial Hypertension and obesity, for example[14]. A research conducted with alcoholics in treatment[15] evaluated the effect of alcohol consumption on the perception of sweet and salty tastes, revealing a reduction in taste sensitivity to sweet taste in alcohol users, thus highlighting the need for attention to the consumption of sugar in this population.

Therefore, this study aimed to evaluate the influence of alcohol consumption on the taste perception of sweet and salty tastes in college students.

Method

Study design and population

This is an epidemiological, cross-sectional and analytical study. To ensure the representativeness of the sample, the sample calculation was performed for the finite population in the Open Epi software, version 3, open source calculator, adopting a confidence interval of 95%, which resulted in a sample of 330 people of both genders, aged between 18 and 59 years, from the State University of the Southwest of Bahia (UESB), Jequié *campus*. The exclusion criteria were: smokers, people with colds, diabetics, people with hypertension, people taking antidepressants, people wearing dental prostheses, pregnant women, and people with any oral cavity complications that could influence the perception of taste.

Data collection

Primary data was collected by means of a questionnaire on personal, academic and socio-demographic information for further analysis and characterization of the study population.

Alcohol consumption assessment

To assess alcohol consumption, the Alcohol Use Disorder Identification (AUDIT) was applied, a version validated for the Brazilian population[16]. This instrument makes it possible to identify four patterns of alcohol use or risk zones, which are: low risk use (zero to seven points); risky use (eight to 15 points); harmful use (16 to 19 points) and probable dependence (20 or more points).

Evaluation of nutritional state

In order to evaluate the correlation between alcohol consumption and taste perception with nutritional status, we chose to use anthropometric measurements such as: weight; height; waist circumference (WC) and body mass index (BMI).

A calibrated Bioland® EB9010 Plus digital scale, with a maximum capacity of 150 kilograms, was used to measure weight. As a procedure for measuring weight, each of the participants was instructed to go barefoot, wear light clothing and remove all accessories. Height was measured using a stadiometer, fixed to a vertical wall, with a 0.5 centimeter precision. During the procedure, the participant was instructed to remain barefoot and in an orthostatic position[17].

After performing the above procedures, the BMI (weight/height²) was calculated, classifying it according

to the values established for adults by the World Health Organization (WHO), thus identifying the underweight, eutrophic, overweight and obese individuals[18].

To measure WC, an inelastic tape measure with an accuracy of 0.1 centimeter was used. The measurement was taken from the midpoint between the iliac crest and the last rib. The classification of risk for developing cardiovascular disease in the study participants followed the parameters established by the WHO, pointing out the individuals at risk and not at risk[19].

Taste threshold

To evaluate the taste threshold, a sensory analysis test was applied. The test procedures were carried out according to the guidelines of the Brazilian Association of Technical Standards (ABNT) defined in Technical Standard (NBR) 4120[20]. The concentrations of the solutes were prepared according to International Organization for Standardization (ISO) 6564[21].

The procedure consisted of identifying the smallest solute concentration stimulus (sucrose or sodium chloride) necessary for the individual to perceive the taste (sweet or salty). Each participant was asked to perform a series of five sensory tests, of the 3-Alternative Forced Choice (3-AFC) type, for tastes. The samples were presented in a continuous triangular fashion, in increasing concentration of each solute.

In each test, the participant received three samples: two containing only mineral water and one with the test containing the substance to be evaluated in a certain concentration. The participant was asked to identify, using an evaluation form, which sample they thought was different from the ones they had tried[20].

The participants were placed in single booths. The samples were then served individually to each rater in 50 ml disposable cups, which were coded with three digits. The samples were served with a card and a disposable cup with 250 ml of mineral water so that the rater could wash the taste buds between sessions, removing excess solutes.

To evaluate the results of the threshold index test, the values found from each participant's threshold were analyzed. This value corresponds to the geometric mean of the highest undetected concentration and the next highest concentration[22]. The data was tabulated, followed by the application of the formula, for the determination of the individual threshold for each participant.

Formula:

$$A_i = \log(L_i) = \frac{\log(C_0) + \log(C_+)}{2} \quad (1)$$

By considering that C_0 will be the highest concentration not detected/recognized by the participant and C_+, the lowest concentration detected/recognized by a given participant i, then, for this participant, the individual threshold will be given by:

$$L_i = 10^{Ai}$$

After determining the individual thresholds of each participant, a second equation was applied to obtain the group threshold, calculating the geometric mean of the L_i.

$$B = \frac{1}{n}\sum_{i=1}^{n} \log(L_i)$$

Thus, for a group of n participants, one finds:

$$L_g = 10^{B}$$

Statistical analyses

After data collection, the questionnaires were organized for later coding and tabulation in Excel (version 2013). Then, these results were statistically analyzed using the Statistical Package for the Social Sciences (SSPS®) program.

Descriptive statistics as relative and absolute frequency were used to describe the variables under study. Data distribution was assessed using the Kolmogorov-Smirnov normality test.

The means and standard deviation of the sweet and salty thresholds were presented in relation to the other independent variables. The Mann Whitney test was used to compare the threshold means between the groups. In order to better evaluate the effect of alcohol use on the taste threshold, a correlation analysis stratified by the ongoing course was performed. For statistically significant associations, p values <0.05.

Ethical aspects

This study was submitted to the Ethics Committee and approved by Opinion No. 1,963,582, in accordance with Resolution No. 466, December 2012, of the National Health Council (NHC), and the Declaration of Helsinki.

Results

The study was characterized by the prevalence of women (68.60%) 21 years old or younger (54.00%), non-white (83.40%), without a partner (93.70%), and from health courses (60.50%).

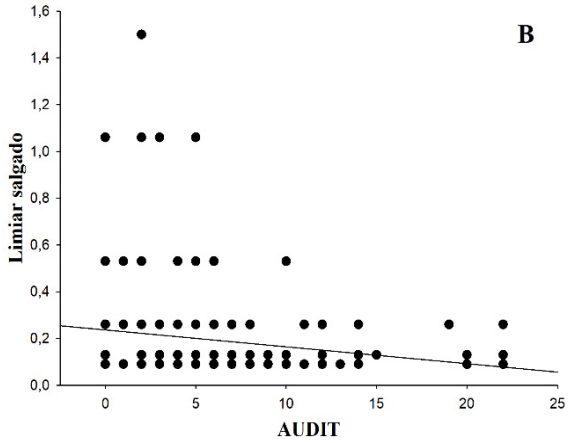
Regarding the sweet and salty taste threshold, the means were 2.98 (sd±2.20) and 0.22 (sd±0.23), respectively. Table 1 shows the sweet and salty threshold means according to the independent variables.

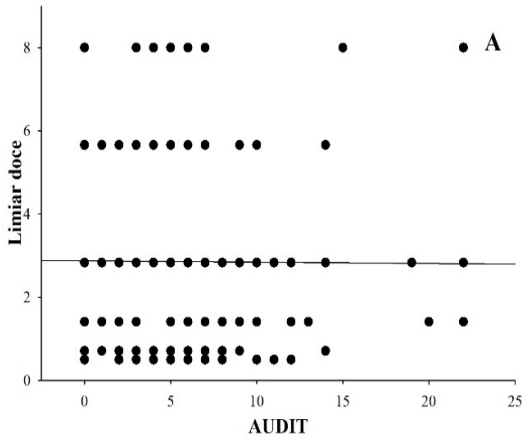
Table 1 - Mean and standard deviation (SD*) of sweet and salty thresholds according to socio-demographic and health variables. Jequié, BA, Brazil, 2019

	Sweet Threshold	p†	Salty threshold	p†
	Mean (sd*)		Mean (sd*)	
Sex		0.55		0.36
Female	3.00 (2.16)		0.21 (0.22)	
Male	2.90 (2.26)		0.24 (0.25)	
Age		0.35		0.51
≤ 21 years	2.88 (2.12)		0.21 (0.22)	
> 21 years	3.07 (2.26)		0.23 (0.24)	
Race/color		0.12		0.61
White	3.38 (2.57)		0.24 (0.27)	
Non white	2.10 (2.88)		0.22 (0.22)	
Marital status		0.05‡		0.17
Without a partner	2.89 (2.17)		0.22 (0.24)	
With a partner	4.21 (2.22)		0.15 (0.11)	
Course		0.21		0.19
Health	2.82 (2.15)		0.20 (0.20)	
Others	3.19 (2.23)		0.24 (0.27)	
Physical activity		0.93		0.44
No	2.99 (2.23)		0.21 (0.23)	
Yes	2.97 (2.18)		0.22 (0.23)	
BMI‡		0.52		0.15
Eutrophic	2.94 (2.21)		0.23 (0.26)	
Overweight/obesity	3.14 (2.19)		0.18 (0.13)	
AUDIT‖		0.58		0.51
Low risk	3.02 (2.19)		0.22 (0.23)	
Risk	2.86 (2.22)		0.20 (0.26)	

*SD = Standard deviation; †p = Significance level; ‡BMI = Body mass index; ‖AUDIT = Alcohol Use Disorder Identification

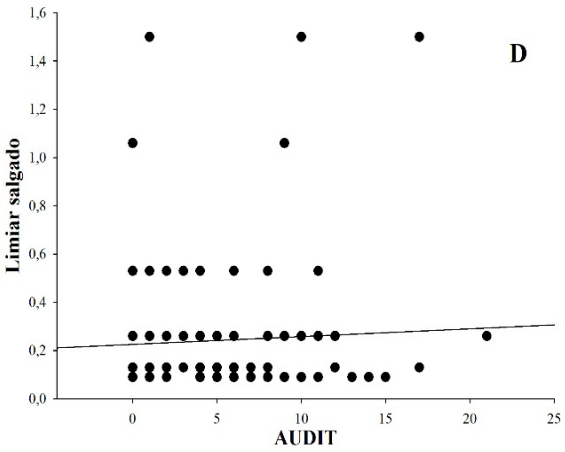
Figures 1 (subjects from health courses) and 2 (subjects from other courses) show the relations between alcohol consumption and threshold to sweet and salty taste. Thus, it was evidenced that alcohol consumption was negatively correlated (r= -0.205; p= 0.004) with the salty threshold among health course subjects (Figure 1 [B]). For the intersection between physical activity and cardiovascular risk, according to waist circumference, there was no statistically significant correlation.

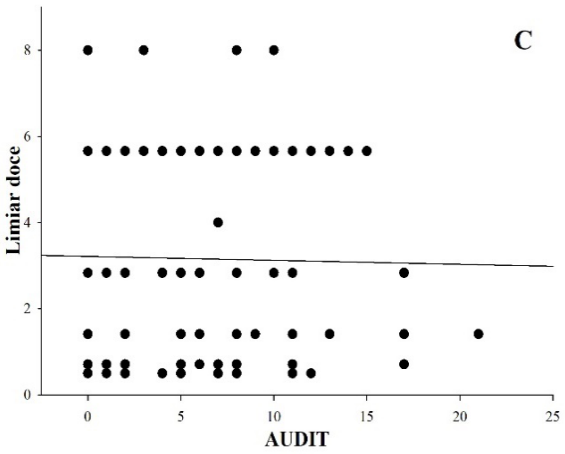




*AUDIT = Alcohol Use Disorder Identification

Figure 1 - Correlation between alcohol consumption (AUDIT*) and sweet and salty thresholds among individuals from health courses. Jequié, BA, Brazil, 2019





*AUDIT = Alcohol Use Disorder Identification

Figure 2 - Correlation between alcohol consumption (AUDIT*) and sweet and salty thresholds among individuals from other courses. Jequié, BA, Brazil, 2019

Discussion

It was observed that the mean taste threshold for sweet taste 2.98 (SD±2.20) was higher than the mean for salty taste 0.22 (SD±0.23). Thus, it was noted that the individuals evaluated had a greater taste sensitivity to the salty taste, requiring a lower concentration of NaCl to identify the presence of the solute in solution.

Deficits in sensory perception can interfere with food intake, since a greater amount of solutes is required for the perception of tastes. High consumption of solutes, such as NaCl and sucrose, can affect nutritional status, immunity, and overall health status[23].

A decreased taste sensitivity to sweet taste can lead to the need for increased sucrose concentration in food and, in turn, contribute to increased intake of refined carbohydrates such as sucrose[24], which, in the long term, may contribute to increased lipogenesis. This metabolic pathway transforms the excess of these substances into fatty acids, which will subsequently be stored in the liver and in the adipose tissue, which favors the increase of body fat and is an indication of a higher probability of comorbidities[25].

In addition, the high consumption of refined carbohydrates contributes to the increase in blood glucose, which, if it persists chronically, can favor the development of diabetes[26].

Regarding gender, there was no significant association between the recognition thresholds for sweet and salty tastes, although the literature points out that men and women have different food preferences[27]. Studies have shown that the median values of the thresholds did not differ according to the variable sex[23,28].

Importantly, the marital status described as "with partner" had a lower threshold for salty taste detection than the "without partner" participants. Studies have

shown that individuals with a partner have practices associated with healthier eating habits[29-30].

Regarding the sweet taste threshold, the values were higher in participants who did not practice physical activity, were overweight/obese, without risk measured by WC, and with low risk of alcohol consumption measured by AUDIT, i.e., they have lower taste sensitivity. The literature found that overweight/obese individuals are less sensitive to sweet taste[31-32].

Differing taste sensitivity among individuals and modifications in specific genes that encode taste may be one of the multifactorial causes of these distinctions. Obese individuals have a preference for some taste stimuli, which may be related to excessive energy consumption. As a result, these individuals need to consume more to get the same taste stimulation in order to compensate for their impaired sensitivity, with long-term health implications[31].

Regarding alcohol consumption and sensory perception of sweet taste, college students with low risk of alcohol consumption measured by AUDIT also showed low sensitivity. Alcohol consumption produces a range of oral sensations, some of which demonstrate modifications in taste sensitivity[33]. Scientific findings point to an association in humans between a preference for sweet solutions and alcohol consumption[15,34-35], which may be related to the fact that the perception of sweet taste is diminished.

On the other hand, regarding the salty threshold, it was higher in physically active, eutrophic individuals, with no cardiovascular risk measured by WC and low risk by AUDIT. The verification of the salty taste detection threshold is very relevant, taking into account that the perception of NaCl may be a contributing element to food intake. However, the result differs from most of the findings, which stated that overweight or obese individuals have a reduced taste perception compared to the eutrophic group[36-38].

A negative correlation was noted between alcohol consumption and threshold to salty taste among college students in health courses, indicating that the two variables move in opposite directions. Thus, the higher the AUDIT, the lower was the threshold for salty taste.

Scientific findings pointed to the effect of moderate alcohol consumption as a stimulant on food intake. Thus, it was noted that moderate alcohol consumption was associated with an increase in the intake of high-fat salty foods, and also increased the implicit craving for salty foods before a meal. These findings may be explained by the fact that alcohol consumption is usually combined with the consumption of salty foods[39].

In addition, research has shown that drinking can lead to increased food consumption by stimulating appetite, and is commonly seen in combination with fast-food or convenience foods such as potato chips and nuts[40]. Similarly, studies have shown that moderate alcohol consumption is associated with higher fat and protein intake, often found in salty-tasting foods[41].

Excessive consumption of alcoholic beverages contributes to the increase in blood pressure and, consequently, to the development of hypertension[42]. Moreover, the high consumption of NaCl, the solute responsible for the perception of salty taste, is another important factor in the development of hypertension, since it is common in hypertensive individuals a lower taste sensitivity to salty taste[43]. It is important to note that the reduction in NaCl intake is one of the main strategies for controlling blood pressure levels[44].

Studies published in Brazil and another one by the WHO[18,43] pointed out the relevance of conducting studies on the relationship between taste perception and various health conditions. Therefore, this study sought to contribute to the understanding of how and with what intensity alcohol consumption can influence the taste threshold of sweet and salty tastes in college students.

Finally, it is important to highlight the limitation of this study, especially in view of the fact that, for data collection, only the population of a single university institution was used, making visible the need for research in other communities so that the findings of this study can be extended to more university populations.

Conclusion

It was noted that taste thresholds differ between the tastes evaluated, evidencing that the threshold for sweet taste was higher when compared to salty taste. Lower taste sensitivity to sweet tastes results in higher sucrose consumption, for sensory perception, which contributes to the development of chronic diseases.

It was also observed in the study population that marital status, physical activity, nutritional status and alcohol consumption somehow interfere with taste perception. Moreover, it was noted that the higher the alcohol consumption, the lower the taste sensitivity to salty taste, which leads to a higher consumption of NaCl for taste perception. Thus, attention is drawn to this problem, since the exacerbated consumption of alcoholic beverages and NaCl are risk factors for the development of hypertension.

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