Original Research Article

INFLUENCE OF ALCOHOL CONSUMPTION, TOBACCO USE, AND LIQUID INTAKE ON HALITOSIS IN THE ELDERLY: A CROSS-SECTIONAL STUDY

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ABSTRACT

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| **Background:** Halitosis affects people all around the world, but its prevalence is higher in the elderly due to some factors such as poor oral hygiene, changes in eating habits, use of dentures, reduced salivary flow, presence of systemic diseases and use of multiple medications.**Aims:** The aim of this study was to evaluate the association of external factors on the breath of elderly Brazilians aged 65 to 74 years.**Study design:** Analytical cross-sectional study **Place and Duration of Study:** 50 elderly people, living in Juiz de Fora and registered in the Family Health Strategies (FHS), from January to May 2019**Methodology:** Individuals of both sexes, aged between 65 and 74 years, were included. The following information was collected: halitosis measurement, questionnaires on socioeconomic data and daily habits/practices, smoking and alcohol consumption. Halitosis was measured using a portable halimeter, and for addictions to alcoholism and smoking, the AUDIT and QSU-B questionnaires were used, respectively. Pearson's chi-square test was performed, the odds ratio was calculated, and the univariate and multivariate logistic regression model was constructed, using pseudo-R2 measurements. **Results:** The mean age of the 220 individuals was 69.9 (± 2.9) years, and 59% were female. Of these, 111 (50.5%) had excellent to good breath. Older adults aged 70 to 74 years were more likely to have halitosis (OR: 3.01; CI 1.71-5.31; p<0.001) in relation to the elderly aged 65 to 69 years. Individuals who cleaned their mouths once or twice/day were 9.11 times more likely to have halitosis than those who cleaned their mouths three or more times/day. In the multivariate analysis, it was observed that age, sex, fluid intake and alcoholism addiction explained on average 16% of the occurrences of breath changes in the studied population, with a statistically significant association with lower amounts of daily fluid intake (OR: 2.10; CI: 1.55 – 2.84; p<0.001) and greater dependence on alcoholism (OR: 2.12: CI: 1.27 – 3.53; p= 0.004). Each additional year of life increases the chance of halitosis by 7% and the individual being male reduces the chance of having halitosis by 38%, although p values were not significant for these variables.**Conclusion:** This study demonstrated the correlation between lifestyle habits, such as fluid consumption, frequency of hygiene, alcohol dependence, use of tobacco and halitosis in the elderly. |

*Keywords: Halitosis. Tobacco Use Disorder. Alcohol Drinking. Water intake; Elderly.*

1. INTRODUCTION

 Halitosis is an abnormal condition of the breath, not a disease, characterized by local and/or systemic imbalance (Jiun et al., 2015; Tunagre et al., 2023). Approximately 32% of the world's population is affected by bad mouth odor, and there has been a trend of growth over the years (Silva et al.,2018). In Brazil, breath alteration affects approximately 30% of its population, i.e., almost 50 million people (Aguiar et al., 2017).

 When observing this alteration in the elderly, the prevalence is high (Caxias et al., 2020). Some factors may contribute to halitosis being more prevalent in the elderly, such as poor oral hygiene, changes in eating habits, use of prostheses, reduced salivary flow, the presence of systemic diseases, and the use of multiple medications (Nalcaci & Baran, 2008).

 Bad mouth odor is an embarrassing symptom, with an impact on human relationships, affecting millions of people around the world, causing social isolation and impacting the individual's quality of life (Aimetti et al., 2015; Lu et al., 2017; Wu et al., 2020). There is a lack of studies evaluating the influence of external factors, such as alcoholism and smoking, and their impact on halitosis in the elderly. Thus, broader investigations are needed than what has been presented in scientific studies on the subject to evaluate not only organic factors but also external factors to which the population in question is exposed (Eldarrat, 2011; Aguiar et al., 2017).

 Understanding the influencing factors is crucial for effective resolution approaches, minimizing the impacts on social relationships and the quality of life of those affected. Therefore, this study aimed to evaluate the association of external factors on the breath of elderly Brazilians aged 65 to 74 years.

2. material and methods

**2.1 Study design**

 The present study was approved by the Research Ethics Committee of the Federal University of the Vales do Jequitinhonha e Mucuri (UFVJM) under approval number 2.045.667.

 This is an analytical cross-sectional study composed of a sample of elderly people from the city of Juiz de Fora, conducted by UFVJM. The sample included elderly people aged between 65 and 74 years, registered in the Family Health Strategies (ESF) of the city. This study was carried out following the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) (Malta et al., 2010).

**2.2 Sample**

 For the sample calculation, a pilot study was carried out, where data were collected from 50 elderly people, living in Juiz de Fora and registered in the Family Health Strategies (FHS), from January to May 2019, using the standard deviation found for normal salivation (± 0.69) in the formula below.

 Considering the 95% confidence interval and an error of 0.1, the sample size of 183 older adults was used. To compensate for possible losses, 20% was added to the amount, totaling 220 participants, who were distributed proportionally to the number of elderly people registered in each FHS. All 38 FHS, in the urban area, were included in the research, and the number of people invited from each unit was proportional to the total elderly population registered by the team, in a proportional stratified randomization.

 The inclusion criteria were individuals of both sexes, aged between 65 and 74 years. The exclusion criteria included individuals who were hospitalized, institutionalized, and had disabilities that prevented them from answering the questionnaire or participating in data collection were excluded from the study.

 **2.3 Characterization of variables and data collection**

 The degree of halitosis was the dependent variable, classified according to the measurement on the portable halitosis meter. The independent variables were age, sex, oral hygiene, fluid intake, and alcohol and smoking addictions.

 A single trained and calibrated researcher, whose minimum intra-examiner Kappa index was 0.82, collected the data at the basic health units.

 Halitosis measurement: a portable digital halitosis meter (Breath Alerth®, TANITA, Japan) was used to measure halitosis. The device was calibrated before each use. The participants were instructed to blow for five seconds on the device, at five centimeters, and at the end of this procedure, the device generated the degree of halitosis on a scale from 0 to 4, where 0 (excellent), 1 (good), 2 (regular), 3 (poor) and 4 (very bad). This procedure was repeated three times, and the final degree of halitosis for each participant was the average between the values of the three calculations. This variable was dichotomized into unaltered breath (values 0 and 1) and halitosis (values 2, 3 and 4).

 This procedure was repeated three times, with the interval between assessments being the time it took for the device to return to the assessment mode (an average of four seconds). The final halitosis level for each participant was the average of the values ​​from the three assessments.

 Questionnaires: two questionnaires were used to interview the participants, in addition to collecting social data (gender, age) and lifestyle practices/habits (fluid intake and oral hygiene). Both questionnaires were validated and translated into Portuguese, and included questions about alcohol addiction (Alcohol Use Disorders Identification Test - AUDIT) (Lima et al., 2005) and smoking (Questionnaire of Smoking Urges Brief - QSU-B) (Araújo et al., 2007).

 The AUDIT consists of 10 questions that aim to identify possible alcohol dependents. The score ranges from 0 to 40 and has four levels of evaluation of the results (abstainers, risky use, harmful use and probable dependence). This categorization suggests making (or not) an intervention concise. The QSU-B is structured with 10 affirmative questions to which the answers are a 7-point Likert scale ranging from "strongly disagree" to "strongly agree". The results can be analyzed through the total sum of points. The cut-off points of the Brazilian version are from 0 to 13 points, minimum craving; from 14 to 26, light craving; from 27 to 42, moderate craving; and 43 or more points, intense craving.

 In another study, using the same sample, the association of these external factors with changes in salivary flow was assessed (Lima et al., 2024).

**2.4 Statistical analysis**

 Data were tabulated and analyzed using Data Analysis and Statistical Software College Station, Texas, USA (STATA, version 15). Pearson's chi-square test was performed, the odds ratio was calculated, and the univariate and multivariate logistic regression model was constructed, using pseudo-R2 measurements. The multivariate model chosen considered the Log Likelihood value, considering a CI of 95% and p≤ 0.05.

3. RESULTS

 The mean age of the 220 individuals was 69.9 years (± 2.9), and 59% were women. Of these, 111 (50.5%) had excellent to good breath, 44 (20%) had regular breath, and 65 (29.5%) had bad to very bad breath. Most individuals reported being mixed-race (55.9%), and 62.5% of the elderly reported having up to eight years of schooling. The income of 91.8% of the individuals ranged from less than one minimum wage to three minimum wages. Most individuals were married (62.3%) (Table 1).

**Table 1: Socioeconomic characterization of the elderly.**

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| **Socioeconomic and Demographic Variables** | **N** | **%** |
| **Age** | 65 to 69 years old | 87 | 39.5 |
| 70 to 74 years old | 133 | 60.5 |
| **Sex** | Women | 130 | 59.1 |
| Men | 90 | 40.9 |
| **Breath** | Excellent to good | 111 | 50.5 |
| Regular | 44 | 20 |
| Bad to very bad | 65 | 29.5 |
| **Skin color** | White | 67 | 30.5 |
| Brown | 123 | 55.9 |
| Black | 30 | 13.6 |
| **Schooling** | More than 11 years of study | 25 | 11.4 |
| From 8 to 11 years of study | 32 | 14.5 |
| Up to 8 years of study | 138 | 62.7 |
| Illiterate | 25 | 11.4 |
| **Income** | Up to a minimum wage | 102 | 46.4 |
| 1 to 3 salaries | 100 | 45.4 |
| 3 to 5 salaries | 18 | 8.2 |
| **Marital status** | Single/divorced/widowed | 83 | 37.7 |
| Common-law marriage/married | 137 | 62.3 |

 Older adults aged 70 to 74 years were more likely to have halitosis (OR: 3.01; CI 1.71-5.31; p<0.001) in relation to the elderly aged 65 to 69 years. There was a statistically significant association between low fluid intake and halitosis, where older adults who ingested less than one liter of fluids per day were 8.15 times more likely to have halitosis, compared to those who ingested more than two liters per day. The greater the alcohol addiction, the greater the chances of halitosis (OR risk: 2.07; CI: 1.13-3.78; High risk OR: 7.85; CI: 2.38-28.24).

 There was a statistically significant association between low fluid intake and halitosis. It was found that elderly individuals who drank less than one liter of fluids per day were 8.15 times more likely to have halitosis, compared to those who drank more than two liters per day.

 The same logic occurred when comparing the variable oral hygiene, with individuals who cleaned their mouths only once or twice a day being 9.11 times more likely to have this alteration compared to those who cleaned their mouths three or more times a day.

 For alcoholism, there was a statistically significant association with halitosis, with the greater the alcohol addiction, the greater the chances of halitosis occurring (OR risk: 2.07; CI: 1.13-3.78; OR high risk: 7.85; CI: 2.38-28.24)(Table 2).

**Table 2: Univariate regression between the independent variables and halitosis in the elderly aged 65 to 74 years.**

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| **Variable** | **Scale** | **Halitosis** |
| **% (n)** | **Halitosis**% (n) | **Normal**% (n) | **P** **value** | **psR2** | **OR (Gross)**(IC) |
| Age | 65 a 69 | 39.5 (87) | 26.6 (29) | 52.3 (58) | **<0.001** | -26.2 | Reference |
| 70 a 74 | 60.5 (133) | 73.4 (80) | 47.7 (53) | 3.01 (1.71-5.31) |
| Sex | Women | 59.1 (130) | 61.5 (67) | 56.8 (63) | 0.477 | 4.8 | Reference |
| Men | 40.9 (90) | 38.5 (42) | 43.1 (48) | 1.21 (0.70-2.08) |
| Fluid intake | > 2 L | 13.6 (30) | 6.4 (7) | 20.7 (23) | **<0.001** | -40.0 | Reference |
| 1 to 2 L | 40.5 (89) | 27.5 (30) | 53.2 (59) | 1.67 (0.43-4.33) |
| < 1 L | 45.9 (101) | 66.1 (72) | 26.1 (29) | 8.15 (3.15-21.08) |
| Frequency of oral hygiene | >2 times/day | 62.7 (138) | 39.4 (43) | 85.6 (95) | **<0.001** | -48.5 | Reference |
| ≤ 2 times/day | 37.3 (82) | 60.6 (66) | 14.4 (16) | 9.11 (4.73-17.53) |
| AUDIT | Low risk | 61.8 (136) | 50.5 (55) | 73.0 (81) | **<0.001** | -25.2 | Reference |
| Risk | 29.6 (65) | 34.9 (38) | 24.3 (27) | 2.07 (1.13-3.78) |
| High risk | 8.6 (19) | 14.7 (16) | 2.7 (3) | 7.85 (2.38-28.24) |
| QSU-B | Minimal | 83.6 (184) | 78.9 (86) | 88.3 (98) | 0.131 | -13.1 | Reference |
| Moderate | 10.0 (22) | 11.9 (13) | 8.1 (9) | 2.78 (1.11-6.97) |
| Intense | 6.4 (14) | 9.2 (10) | 3.6 (4) | 3.97 (1.20-13.17) |

Note: N: total number of elderlies; psR²: pseudoR²: correlation coefficient; OR: odds ratio; CI: confidence interval.

 Regarding age, it was found that each additional year of life increases the chance of halitosis by 7%, and being male reduces the chance of having halitosis by 38%, although p values ​​were not significant for these variables.

 Regarding fluid intake, elderly individuals with a fluid intake of less than 1L/day had an increased chance of halitosis when compared to groups that consumed more than 1L/day, and alcohol addiction values ​​in the risk and high-risk categories increased the chances of breath changes compared to elderly individuals with low risk, both by 2.1 times (p<0.05).

 For the multivariate analysis, age remained continuous and fluid intake was dichotomized into up to 1L/day and more than 1L/day. These different categorizations of the univariate regression were justified to adjust the statistical model (Table 3).

**Table 3: Multivariate logistic regression on halitosis in the elderly (n=220) aged 65 to 74 years.**

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| **Variables** | **Halitosis** |
| **OR** | **IC 95%** | **P value** | **psR2** | **Log Likelihood** |
| Age | 1.07 | 0.97 – 1.19 | 0.162 | 0.16 | -128.2 |
| Sex | 0.62 | 0.33 – 1.16 | 0.138 |
| Fluid intake  | 2.10 | 1.55 – 2.84 | **<0.0001** |
| AUDIT  | 2.12 | 1.27 – 3.53 | **0.004** |

Note: OR: odds ratio; CI: confidence interval; psR²: correlation coefficient.

 4. Discussion

 The current study revealed a high prevalence of halitosis in the sample, with a significant tendency to be more likely as age advances. This may be related to the fact that as age advances, the elderly has a greater chance of developing systemic diseases and, consequently, an increase in the consumption of medications, which, when combined with the habits of this age group, influence the development of halitosis (Moreno et al., 2022).

 One of these habits is low fluid intake, which in the present study demonstrated a relationship with the presence of halitosis. This can be explained by the fact that dehydration, along with stress and eating habits, are one of the most common causes of the condition (Nalcali et al., 2008). This deficiency in fluid intake can result in a reduction in salivary flow and an increase in saliva viscosity, leading to the development of halitosis (Coelho et al., 2007).

 The relationship between halitosis and oral hygiene revealed that a lower frequency of this practice is associated with higher chances of halitosis. This may be related to the accumulation of bacteria on the tongue, forming a biofilm, the main cause of bad breath (Gaddey, 2017). In addition, decreased motor function or dementia may be factors that lead to a reduction in the frequency and quality of oral hygiene in the elderly (Moreno et al., 2022).

 The present study demonstrated the association of the presence of halitosis with alcohol addiction, which may be related to the fact that the consumption of alcoholic beverages reduces the levels of salivary immunoglobulins, generating toxic metabolites (acetaldehyde) during degradation. This can modify the function of the salivary glands (Waszkiewicz et al., 2014), leading to hyposalivation, dehydration of the oral mucosa, increased epithelial desquamation, and the production of volatile compounds after metabolization, resulting in bad mouth odor (Coelho et al., 2007).

 One of the limitations of the study was the lack of evaluation of halimetry after oral hygiene, which prevented the confirmation of the direct relationship between halitosis and hygiene. In addition, the prevalence of elderly individuals with halitosis and moderate/severe craving was low. The lack of statistical significance may be due to the low number of smokers. The portable halimeter used in the study limited the discrimination of volatile sulfur compounds, not identifying all types and other important odors.

 On the other hand, it is noteworthy that the uniqueness of this study lies in the investigation of halitosis in elderly people, unlike previous studies carried out in long-term care institutions or dental clinics (Zellmer et al., 2016; Aguiar et al., 2017; Caxias et al., 2020). In addition, the fact that the present study used a device to measure halitosis reinforces the validity of the results found, considering that the assessment of halitosis by self-perception can generate results with low precision, considering that the elderly have a loss of smell and do not care as much about the odor when compared to young adults (Massod et al., 2017).

5. conclusion

 This study demonstrated the correlation between lifestyle habits, such as fluid consumption, frequency of hygiene, alcohol dependence, and halitosis in the elderly. Therefore, it is crucial to implement continuous educational actions that promote comprehensive care, adopting interdisciplinary approaches to ensure effective oral hygiene, adequate water intake, and monitoring of other health promotion initiatives.

Consent (where ever applicable)

Authors may use the following wordings for this section: "All authors declare that ‘written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

Ethical approval (where ever applicable)

The present study was approved by the Research Ethics Committee of the Federal University of the Vales do Jequitinhonha e Mucuri (UFVJM) under approval number 2,045,667. All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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