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Development of a Device that Identify Volatile Gases in Halitosis: Efficacy Assessment in a Sample of Elderly People

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***Keywords*— Halitosis, Diagnosis, Health Promotion, Quality of life, Seniors.**

***Abstract*—** *The proposed study aims to verify the effectiveness of the developed device capable of recognizing and measuring halitosis. This is a qualitative, descriptive and exploratory research that will use the experimental method for the purpose of creating and verifying the effectiveness of a device that recognizes volatile gases in halitosis. For the design of the device, through analysis of the main components present in these halimeters, the best way to build a halimeter was sought based on the Arduino, which is composed of a RISC Microcontroller, and uses C/C as a programming language. C++ and to capture the gases the MQ-135 sensor was selected. For testing purposes, it happened in a sample of institutionalized elderly residents in a city in the interior of the state of Minas Gerais, composing the sample of 16 participants who met the inclusion and exclusion criteria. Data collection took place through the control group in 3 (three phases), where, phase 1 application of the health condition questionnaire, phase 2 the handling of the device without proper mouth hygiene and in phase 3 the repetition of phase 2 however, participants performing proper mouth hygiene. The results reveal that 100% of the participants are female with a mean age of 73,125 years old, between 60 and 94 years old; 50% of the elderly women have dental calculus, 56.3% have visible biofilm and 93.8% have hygiene difficulties; as for the functioning of the device, it identified the good functioning with regard to the expected, with no failure during the applicability of the exam in any of the stages, evidencing the effectiveness of the device in measuring and assisting in the diagnosis of halitosis; 94% of the elderly women did not express complaints during the phase 2 examination and 87% in phase 3; stating that most n=14 of the elderly women indicated halitosis in phase 2 and in phase 3 only 5 indicated halitosis, effectively demonstrating that adequate hygiene and mouth care contributes to the absence of the pathological condition of bad breath and confirms the effectiveness of the device to which proposed. It was concluded that it was possible to attest in the sample of elderly women that halitosis is in fact an oral health problem present in this population and that it needs care and routine monitoring by their caregivers regarding the hygiene condition; as for the developed*

device, it was found to be efficient due to its characteristics, with no limitation, being able to be used as a diagnostic resource by dental professionals in different contexts.

I. INTRODUCTION

In summary, halitosis or bad breath is an unpleasant odor that is exhaled from the mouth and, in most situations, originates from the metabolism bacteria and other germs present in the mouth. Halitosis causes discomfort for the person who owns it, as well as for those around them, changing, in a way, social relationships (CALIL *et al.*, 2006).

The expression halitosis derives from Latin, in which the term "breath" translates to air. expired and "osis" means pathological change. In this way, halitosis is summed up briefly in a breath change, being classified as pathological or physiological, however, the two are identified by a repulsive breath emitted by expiration (BUTZE *et al.*, 2015).

There are several causes linked to halitosis, in which it originates in the extraoral or intraoral cavity, with approximately 75% of cases having origin in the oral cavity (BUTZE *et al*., 2015). The main oral microorganisms causes of bad breath are Gram negative bacteria, such as Treponema denticola, Porphyromonas and Tannerella that produce volatile gases from sulfur (CVE), among others (FERREIRA, 2016).

It is known that the main origin of halitosis is the result of diseases periodontal diseases such as gingivitis and periodontitis, unsatisfactory dental restorations, low salivary secretion, biofilm accumulation and others. In this way, the no treatment of these pathologies, may result in periodontal diseases increasingly more serious and consequently the deterioration of halitosis (ANTONIASSI JUNIOR; SANTANA; SOUSA; SILVA, 2016).

According to a study carried out by Martins (2012), on halitosis prevention and treatment, it was possible to verify that 30% of the Brazilian population has bad breath problems about 50 million people and 50% of the population suffer from of chronic halitosis, resulting in personal and social discomfort.

Therefore, this problem tends to increase significantly, due to to several factors, specifically, in the elderly population, due to the use of prosthesis and the difficulty with hygienic habits (BRAZILIAN ASSOCIATION OF HALITOSIS [ABHA], 2013) Studies carried out with the elderly population reveal that about 84.61% are prosthesis users, 40% perform only once or twice a day the cleaning of prostheses and 71% have bad breath problems; in which two 98.57% perceived via the mouth (ABHA, 2013; GUIOTTI *et al*, 2014; AGUIAR; PINE; MARCELLIN; LIMA, 2017).

Given this, it is important to be aware that bad breath can be treated. O diagnosis is performed by a dental surgeon, and it is up to him to investigate the history clinic instigating the date of onset of symptoms and duration, use of medications, habits such as smoking, consumption of alcohol, among others, being carefully recorded, which helped the professional to identify the classification of the type of halitosis, namely: genuine, pseudo halitosis and halitophobia. Thus favoring the promotion of health, quality of life and well-being with oral health (ABHA, 2021; FERREIRA, 2016).

In this way, the simplest and most reliable method of diagnosis would be the measurement organoleptic (aspirate the gases expelled from the patient's mouth). Still, especially in the pandemic period in which we live, it is more feasible to gas chromatography, as well as sulphide monitors (Halimeters), which have several benefits; biological markers can also be used such as the BANA test (benzoyl-arginine-naphthylamide enzymatic method), which identifies which main bacteria are present in the mouth (BUTZE *et al*., 2015).

BANA is a rapid test to look for bacteria that produce compounds sulfur volatiles. It consists of a strip of paper with a special composition over which a sample of lining or periodontal material is placed. As a result, they undergo an enzymatic reaction that activates the dye, indicating the presence or absence of high concentrations of CSV-producing bacteria (volatile sulfur compounds) (BUTZE *et al*., 2015; GUIOTTI *et al.*, 2014).

The study proposed here intends to investigate the effectiveness of a device that identifies volatile gases in halitosis. It is considered that with its realization it is possible to use this device both clinically and personally, so that identify yourself halitosis according to scientific standards and then start an appropriate treatment for the patient's bad breath. Another important factor is the decrease in the transmission of viruses and bacteria that occur during the analysis of the patient by the dental surgeon.

In accordance with what is stated in the justification, the present study aimed to guiding parameter the desire to respond to the following questioning: the developed device can identify volatile gases in halitosis proving to be so effective? The developed device can

identify the main gases present in halitosis, such as sulfur, carbon dioxide and ketones due to the use of the MQ-135 sensor. As for the developed software, achieves harmony between the components and the correct functioning of device, but it is also possible to improve it and adapt it to the problems that arise. Thus, so far, it is possible to say that the device is effective, and search can be started.

However, the relevance lies in the use of new equipment for identification of halitosis, being produced a device known with the Halimeter, built in a portable way, searching through this research the functionality compared to the old versions of it and consequently the treatment of patients according to their origin of halitosis. in a social way, this research seeks to identify through the device created, the halimeter, the halitosis diagnosis, as well as its origin and consequently seeking the correct therapeutic resource for the resolution of this pathology.

Finally, the objective of the study was to verify the effectiveness of the device developed capable of recognizing and measuring halitosis in a sample of elderly from a long-stay institution in the interior of the State of Minas Gerais, Brazil.

II. MATERIALS AND METHODS

This is a qualitative, descriptive, and exploratory research that will use the experimental method to produce the exhibition about the investigations identified, regarding the effectiveness of the device that identifies gases volatiles in halitosis; from the perspective of oral health promotion from the perspective of the goal 3 of the Sustainable Development Goals (United Nations [UN], 2022) in its global purpose of ensuring a healthy and promote well-being for all and everyone, at all ages, thus ensuring the effective diagnosis in an attempt to choose the most appropriate treatment for the oral health problems.

The present research complied with the ethical principles according to the Resolutions of the CNS No. 466/2012 and No. 510/2016 for research with human beings. For that, it was submitted, through the necessary documentation for ethical analysis and side dish of the Research Ethics Committee of the Faculty Patos de Minas. O study was carried out after the approval of the CEP/FPM through the CAEE under number of 57804222.1.0000.8078 under opinion number 5.379.591.

The prototype of the device for identifying volatile gases in halitosis

The idea of creating the device started during a lecture given by Prof. Dr. Mario Giorgi, nominated member from ABHA, Master of Science in Health, professor and coordinator of the postgraduate course FACOP - SP, which is dealt with halitosis, how it originates, its treatments, among others. In this lecture it was shown that there is a device known as a halimeter, capable of scientifically identify the gases present in halitosis, being a device expensive, big, and not very viable to have in an office.

In this way, the process of thinking about the creation of a device that solved most of the problems that the current halimeters already manufactured have, such as its high price, little functionality, and little practicality.

Thus, through analysis of the main components present in these halimeter, the best way to build a halimeter was sought based on O Arduino, which is a free hardware and software electronic circuit for creating tools, which is composed of a RISC Microcontroller and uses as programming language or C/C . For the capture of expelled gases, selecting the MQ-135 sensor, a module that can be connected to the Arduino, being able to identify gases such as sulfur, CO2 and ketone gases, among others present in halitosis.

Through the MQ-135's internal system, when expelling gases, variations perceptible by the sensor, changing its conductivity. through this variation is possible to measure by means of a software, which was Arduino UNO was used to operate the system through a code programmed in C language for that device, finally displaying on an LCD screen measurement of the patient's breath. After several versions and modifications of the Halimeter based on Arduino and MQ-135, mainly from the software of the device, a viable and functional system was arrived at.

To facilitate the construction of the project, an I2C serial module was used, which helps in assembling the LCD module to the Arduino, decreasing the numbers of pins, and simplifying the interaction between the two. So, to connect it, just plug the pin GND of the module to GND of the Arduino, the VCC of the module to 5V of the Arduino, the SDA of the Module to analog port A4 and module SCL port to analog serial port A5, as can be seen in the schematic drawing of the Module configuration I2C and Arduino from figure 1.

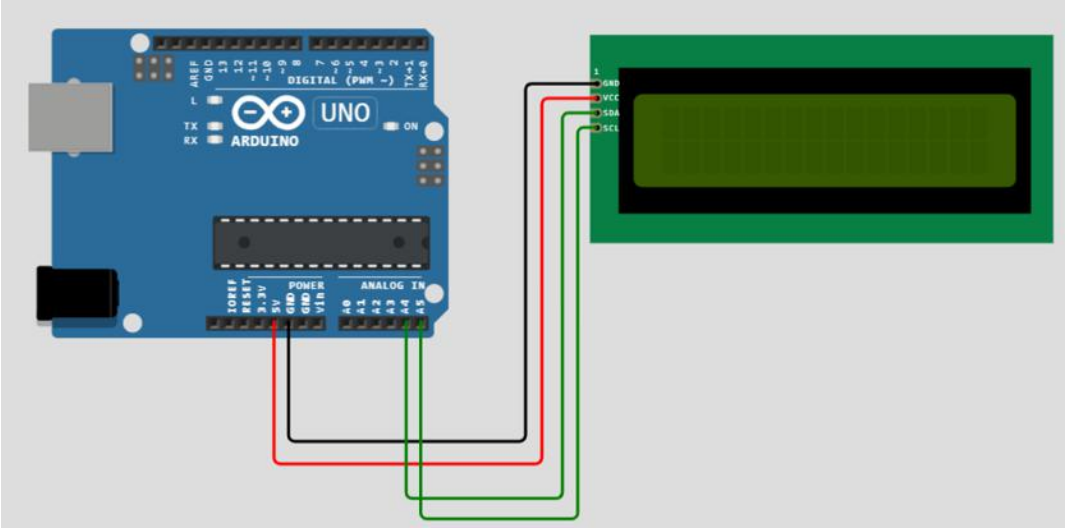

Fig.1. Schematic drawing of the configuration of the I2C Module and Arduino.

Source: Prepared by the authors (2022).

Also, it is necessary to connect the Mq-135 to the Arduino, this sensor can be found both in the module version and in the normal version of it, which can make it difficult for people who are not aware of it to call him. electronics. In this way, to connect the module, connect the VCC pin of the module to 5V of Arduino, the module's GND to the Arduino's GND and the module's A0 to the Arduino analog port A0, as can be seen in the drawing schematic of Figure 2. Finally, the schematic design of the project with the modules in figure 3 and without the modules in figure 4.

For the device to work, it is necessary to compile the following code in the Arduino IDE (Software for compiling the necessary programming for the Arduino), it will be necessary to include in the working library "LiquiddCrystal_I2C.h", which can be found in the Arduino IDE described in the 1.

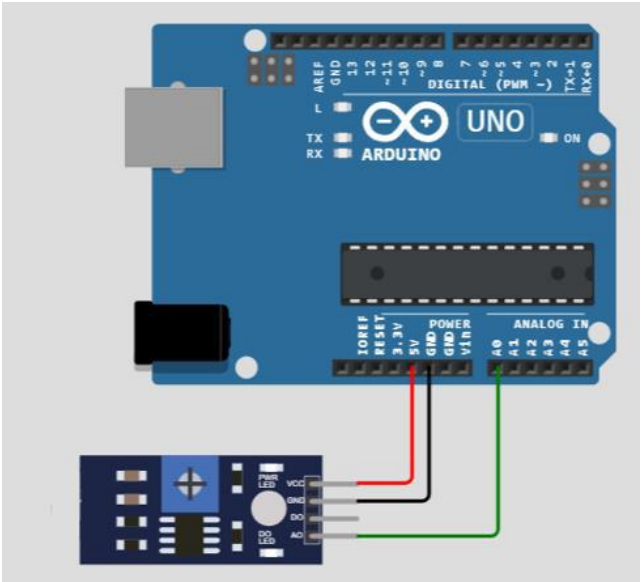

Fig.2. Schematic drawing of the MQ-135 module connection.

Source: Prepared by the authors (2022).

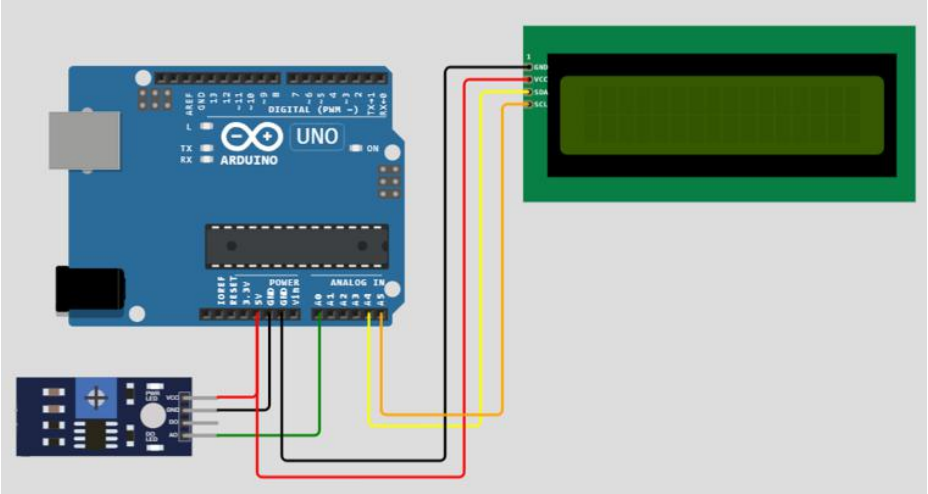

Fig.3. Schematic drawing of the project with modules.

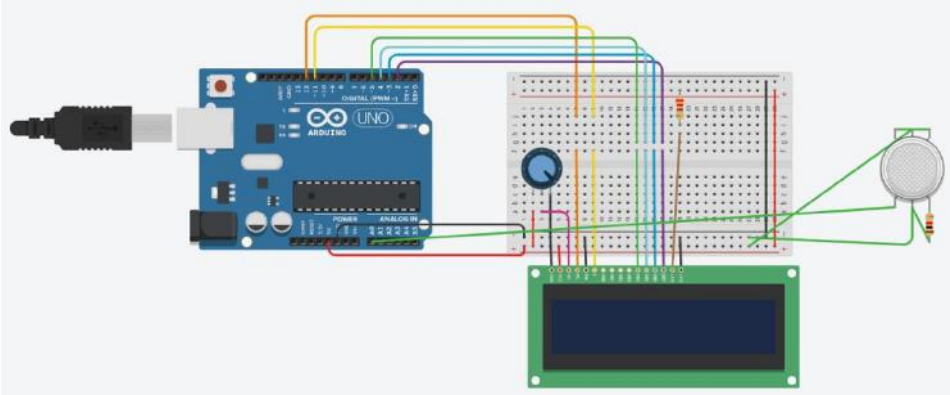

Fig.4. Schematic drawing of the project without the modules.

Source: Prepared by the authors (2022).

Table 1. Description of the code to be applied to the Arduino to operate the device

```
#include <Arduino.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2)
void setup()
{
  lcd.init();
  lcd.backlight();
  lcd.setCursor(2,0);
  lcd.print("HALITO");
  lcd.setCursor(9,1);
  lcd.print("PPM");
}
void loop()
{
```

```
    int sensorValue = analogRead(A0);
    lcd.setCursor(4,1);
    lcd.print(sensorValue);
    delay(2000);
  }
```

Source: Prepared by the authors (2022).

The device will indicate the exam result through the code above the which includes the libraries necessary for the functioning of the LCD module (I2C), starting so the LCD, previously printing on its screen "Breath" and "PPM", as also reading the Arduino analog port A0 and showing on the screen its reading to every 2 seconds.

Study place

The study was carried out with elderly people residing in a Long-Term Institution Permanence - ILP, located in a medium-sized city in the interior of the state Minas Gerais, Brazil, in the region of Alto Paranaíba According to data from Brazilian Institute of Geography and Statistics ([IBGE] 2021), the estimate population in 2021 is 154,641 inhabitants, specifically in the last census of 2010, the population corresponds to 138,710 inhabitants, 51% women and 49% men; with 16,359 inhabitants aged 60 and over.

According to data from the National Secretariat for Promotion and Defense of Rights of the Elderly Person of the Ministry of Women, Family and Human Rights, the municipality to which the research will be carried out has 3 (three) Long-term Institutions Permanence that, in its entirety, correspond to 97 institutionalized elderly people (BRAZIL, 2020).

The research sample was carried out using the non-specific sampling method probabilistic constituted in a random way, intentional and for convenience using the snowball technique. For this, the sampling took place in a specific interval period of ten (10) days, in which the researchers visited the institutions and thus later screened the participants, defining from the defined criteria: such as inclusion criteria for research participation corresponded to the elderly who aged 60 years or older and were available to participate in the experimentation group respecting the characteristics defined for the exam; and as exclusion criteria for participation in the research were those elderly who presented some impairment such as mental retardation, critical mobility and communication, which would hamper the procedure to carry out the data collection.

Data collection procedures and research instrument

Data collection took place through the mobilization of researchers members of the Research Group on Culture, Subjectivity and Psychosocial Promotion from the Center for Studies and Research in Applied Psychology and Clinical School (CEPPACE) of the Psychology course at Faculdade Patos de Minas.

On the verge of the data collection method was through a group control defined by the same participants in experimentation of the prototype of the device for identifying volatile gases in halitosis. The members are justified of the control group were the same participants in phase 1, phase 2 and phase 3 in because of the characteristics of the maneuver to perform the examination for diagnosis from halitosis.

In the first moment, called phase 1, it was given by the definition of the research participants application of the health condition questionnaire prepared according to studies by Camelier (2004); Lino *et al.*, (2008); Nunes, Duarte, Santos and Lebrão (2015) and Oliveira (2019). In phase 2 having the participants defined, they do not perform mouth hygiene in the period of 04 hours that preceded the exam time. In phase 3, the participants performed mouth hygiene 30 minutes before the exam.

The research tool

As a research instrument for phase 1, the *Questionnaire of Investigation of the Elderly Health Care Condition* containing participant identification, life history, hygiene habits and care with the oral health. in the collection of data from phase 2 and phase 3 used the Checklist to obtain the necessary information, which contained the following information available about the exam, observing*: the proper functioning of the device during the exam; whether there were any complaints from the participant during the exam; whether the device has reached the test result as expected*.

Data collection process

Firstly, the researcher contacted the Municipal Council of Elderly person to present the study proposal and indicate the registered institutions that could participate in the study. Given this, the researcher visited five institutions of long stay presenting the research

proposal in relation to the device development experimentation; resulting only in the release of an institution, in which 21 elderly people live, resulting in the participation of elderly who met the inclusion criteria.

Facing the possibility of participation of elderly residents of the institution, having identified the inclusive criteria, then the reading the Free and Informed Consent Term (TCLE) looking for clear up all the queries you may have responsible for the residents. It is worth mentioning that, as they are elderly people who are tutored in a long-term institution, permanence and possibly many without the possibility of the signature condition of the TCLE, the document was signed by the person in charge, which followed the logic of the free and informed consent form for minors, in this case for the elderly institutionalized.

Shortly thereafter, Phase 1 of the study was carried out, in which participants were identified and the questionnaire was applied. On this occasion, at the request of the team institution's nursing staff, training was carried out with the employees and nursing internships on ways of oral hygiene for the elderly bedridden and who used prosthesis. In the end, therefore, a kit was delivered brushing consisting of a toothbrush and toothpaste for each elderly person and scheduled the dates for the exam, establishing an interval of 7 (seven) days between phase 2 and phase 3.

Respecting the intervals and dates set, the researcher having carried out guidelines on oral hygiene care for the elderly, as well as the guidance of the protocols established for the phases 2 and 3 of the exams, started the experimentation procedure.

Upon arriving at the institution, on the day and time defined for the phase 2 exam, the researcher went to an open place available for care, having a chair for the elderly participant and another for the researcher; being attentive to biosafety issues, the researcher was duly parameterized with hat, disposable gloves, and lab coat. Each elderly person was taken to the site by a caregiver and the examination was performed; in the bedridden elderly, the researchers went to them to collect the data.

The examination consultation took place in the following way: the equipment was previously turned on, as it should be preheated for the operation to occurred correctly. To start, the old man was invited to sit on the chair, and with the sensor for about 5 seconds near the participant's mouth, it was asked him to expel the air. Subsequently, the straw was discarded and the released participant.

This procedure took place in phase 2, respecting the criteria established for execution, following the same protocol, paying attention only to the factor of sanitation. With the caregivers trained, the researcher carried out the brushing process and later the exam collection protocol was repeated.

Data analysis

For the measurement of halitosis indicators, the operation of conventional halimeters that use PPB (Part by billion) and has a normal breath between 80 and 120 PPB, above of 120PPM can be considered halitosis, since the mq-135 sensor works through Part by million (PPM). Therefore, it is necessary to perform a conversion when comparing the two or use new parameters to use the mq-135 as it captures more gases than the conventional halimeter (INTERSCAN CORPORATION, 2020).

Considering the findings, a database was organized through spreadsheets in Excel and statistical analyzes were performed using SPSS software (version 21) to produce descriptive analyzes with frequencies and percentages.

Regarding qualitative analyses, thematic analysis was used, which second (MINAYO, 2014), it is the process carried out from the transcripts of the collected material. It is necessary to gather the material and carry out a pre-analysis, guided by the construction of initial assumptions that will support the interpretation of results. Therefore, it is necessary to carry out the floating reading of the data, respecting some qualitative validity criteria, such as exhaustiveness-representativeness-homogeneity (MINAYO, 2013) in relation to observations and results found to find out whether the device can assist in the diagnosis and care of oral health.

III. ANALYSIS AND DISCUSSION OF RESULTS

The aging of the population has increased rapidly in Brazil and in the world. In 1920, life expectancy was only 35.2 years, and the elderly they represented 4.0% of the total world population; in 2021 Brazil reached a 14.7% share of the population general population of elderly people compared to the estimate of 11.3% in 2012, the number of people in this part of the population circumstantially grew by 39.8% in this interval (2012-2021) highlighting people aged 65 and over who reached 10.2% of the general population, according to the survey on the general characteristics of residents 2020-2021 and in 2030 will have the fifth oldest population in the world surpassing the number of children between 0 to 14 years old (IBGE, 2022; JORNAL DA USP, 2019; MIRANDA; MENDES; SILVA, 2016).

Considering the profile of the study participants, it was possible to observe that 100% (n=16) of the elderly participants are women, with a mean age of 73,125 years

being between 60 and 94 years. One elderly woman is a smoker, 15 are absent dental (93.8%) and 6 use prosthesis (37.5%).

Epidemiological data carried out in Brazil between 2002 and 2003 demonstrate that tooth loss is a worrying problem in the country, correlated with high demand for prostheses in adults and the elderly. In a recent survey epidemiological survey carried out in 2010, the results showed an improvement in the tooth loss in adults compared to 2003, in which the average number of teeth lost decreased from 13.5 to 7.4. In 1.3% of cases, at least one jaw required of complete denture. It is worth mentioning that in 2003 this percentage was 4.4%. In In both studies, the proportion of edentulous elderly remained close to 54%. Your numbers found in 2003 and 2010 were very close, representing more than 3 million elderly people needing complete dentures in at least one jaw and more than 4 million needing prosthesis partial (BITENCOURT; CORRÊA; TOASSI, 2019), becoming a challenge for the health system, policies, and care for the elderly (MIRANDA; MENDES; SILVA, 2016).

Therefore, it was possible to observe in this study that 50% of the elderly (n=8) have dental calculus, 56.3% (n=9) have visible biofilm and 93.8% (n=15) have difficulties with oral hygiene care, as can be seen in table 2 the stratified data in relation to the health condition and habits of the participants.

Table 2. Distribution of the condition and health habits of the elderly women participating in the study.

Variable	Yes n=16 (%)	No n=16 (%)
Do oral hygiene properly	1 (6,3)	15 (93,8)
Has visible biofilm	9 (56,3)	7 (43,8)
Presents dental calculus	8 (50)	8 (50)
It presents prosthetic candidiasis	4 (25)	12 (75)
Has motor disability	4 (25)	12 (75)
Has hypertension	5 (31,3)	11 (68,8)
Has diabetes	6 (37,5)	10 (62,2)
Presents periodontitis	-	16 (100)

Source: Prepared by the authors (2022).

With regard to health care and habits, attention is drawn to the lack of oral hygiene of the elderly participants in the study, however, is essential to assimilate that a good part of the elderly usually carry out their oral hygiene despite physical difficulties, demonstrating that they maintain their autonomy and self-esteem. However, due to motor difficulties, cognitive deficits and depression, oral cleaning habits may become inadequate, leading to loss dental. Some elderly people do not have the habit of going to the dentist regularly, in addition to from the effort to go to the dental office, some elderly people do not believe that there is a benefit of visiting the dentist, except in the context of pain or discomfort. Some systemic diseases impair functional capacity, make it difficult for oral hygiene habits or interfere with body composition and physiology, impact negatively on oral health and lead to high rates of oral diseases, such as caries and periodontal disease (PAULI *et al*., 2018).

Diabetes causes an increase in ketone bodies and through it there is a characteristic odor. In addition, diabetes leads to xerostomia and increased cell desquamation, increasing the production of volatile sulfur compounds. Diabetes and other insulin-related conditions are also associated with insufficient fluid production body, resulting in halitosis (RIO; NICOLA; TEIXEIRA, 2007). The continuous use of medications, especially some varieties of antidepressants, antihypertensives and antiglycemics, worsen the degree of halitosis (LEANDRIN *et al*., 2015).

More specifically about the operation of the device, it was observed that in both phases (phase 2 and phase 3) it worked 100% no presenting failure that compromised the final diagnosis, confirming that the proposed device appears to be viable for use, without interference in the collection of Dice; since malfunctioning halitosis measuring devices are likely to produce inaccurate readings due to some factor affecting their accuracy, since the tested device had no interference capable of to harm good search result.

About phase 2 of the exam, approximately 94% (n=15) of the elderly women did not complain about anything during the examination and 6% (n=1) elderly woman who complained, expressing shortness of breath and problems with motor coordination. In 100% (n=16) of the examined elderly women were able to arrive at the result in an adequate, as foreseen in the operation of the device, reaching average of 63 PPM.

In phase 3 of the exam, approximately 87% (n=14) of the elderly women did not complain about something during the examination and 13% (n=2) of the elderly women complained of shortness of breath, problem with motor coordination and difficulty concentrating due to medication use. In 100% (n=16) of the elderly women examined, it was possible to arrive at the result properly, as planned in the functioning of device, reaching an average of 52.125 PPM.

Table 3 presents the distribution of data compared from phase 2 and phase 3 of the PPM results diagnosed by the tested device, in which the participants are in particular by the test order number, followed by a letter and Score.

Table 3. Distribution of PPM indicators of verification by the device in phases 1 and 2 of the elderly participants in the study

Participant	Phase 2		Phase 3	
	Indicator PPM	Classification	Indicator PPM	Classification
1M.	54	Halitosis	46	-
2M.	66	Halitosis	46	-
3L.	49	-	42	-
4T.	70	Halitosis	46	-
5J.	56	Halitosis	42	-
6M.	67	Halitosis	44	-
7M.	53	Halitosis	69	Halitosis
8M.	77	Halitosis	72	Halitosis
9M.	63	Halitosis	63	Halitosis
10V.	66	Halitosis	47	-
11L.	75	Halitosis	37	-
12R.	42	-	46	-
13M.	58	Halitosis	61	Halitosis
14M.	74	Halitosis	48	-
15M.	68	Halitosis	73	Halitosis
16M.	82	Halitosis	46	-

Source: Prepared by the authors (2022).

As can be seen through the indicators in table 3, most of the elderly women had halitosis, especially those who had diabetes and those who did not had the daily habit of oral hygiene (93.8% of the participants) considering those who use prostheses (37.5% of the participants), who when poorly sanitized, bacterial plaques and fungal infections appear, capable of producing bad breath, as can be seen in the comparison between the phases. This is confirmed because when the second sampling was performed, after performing oral hygiene, most of those surveyed had reduced halitosis levels. At phase 3, due to oral cleaning before collecting data from each patient, it was noticed that there was a drop of approximately 17.26% in halitosis levels on average, concluding that oral cleaning is extremely important for decrease in bad breath.

According to a study on halitosis, tests organoleptics with 268 elderly people from 11 Long Stay Institutions for Elderly (ILPI) which: the number of elderly people with halitosis was 26.1%, of which 98.57% of the results were found via the buccal route and 10% via the nasal route, and this variable it was 43% higher for respondents of non-white race/color (p=0.006); 65% more prevalent in those residing in non-profit ILPI (p=0.039); 52% more common in elderly people with oriented

cognitive status (p=0.047); 41% higher in the elderly who have root caries (p=0.029); 62% higher in respondents who did not used dental prostheses (p=0.046); 57% lower in respondents who do not had teeth (p<0.001); and 73% lower in the elderly who did not have biofilm lingual (p=0.001) (AGUIAR; PINHEIRO; MARCELINO; LIMA, 2017).

Diabetes Mellitus triggers halitosis due to various diseases periodontal disease and xerostomia, caused mainly by the presence of bacteria and fungi, resulting in a local inflammation, causing a cellular desquamation and/or decomposition, creating volatile sulfur compounds and making it difficult cleaning mechanisms of the oral cavity, favoring the propagation of cause bad breath (GUIMARÃES *et al.*, 2022).

IV. CONCLUSION

Through this research, it was found that halitosis is present in great part of the Brazilian and world population, becoming a problem worrying due to the physical and psychosocial problems that it brings to the bearer. It is observed that the main cause of bad breath is the lack of oral hygiene, which could be easily eliminated with basic oral hygiene guidelines.

As for the developed device, it appears that it performed correctly all its functions for which it was created, without any limitation. He was able to demonstrate each patient's halitosis levels, providing the researcher to verify that halitosis is present in the researched population, and stated that correct oral hygiene, improves bad breath conditions.

Thus, in this way, it is possible to affirm that the work was developed and successfully completed, being able to reach the results and affirm the way tohalitosis treatment.

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