



Dental Faculty Students' Understanding of Dental Care during the COVID-19 Pandemic

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Abstract

Background: Teeth are one of the important organs in the stomatognathic system. Public awareness of the importance of dental and oral examinations is a concern for health practitioners. This is supported by the fact that the Indonesian population who receive dental and oral care when experiencing dental and oral problems is still relatively low. The occurrence of the COVID-19 pandemic has resulted in restrictions on visits to the dentist. Students can utilize teledentistry to consult with dentists.

Purpose: Hence, the dental students' understanding towards dental care during the COVID-19 pandemic can be known.

Methods: The research was conducted at the Faculty of Dentistry, Prof. Dr. Moestopo (Beragama) University in August-September 2022. The number of subjects in this study was determined by total sample, snowball method who had filled out the questionnaire.

Result: Based on the results of the research that has been conducted, it appears that the most respondents involved in this study are female, as many as 90.5%. Respondents who have knowledge of how to seek treatment or consult a dentist by telephone or teledentistry since the pandemic are 74.3%.

Conclusion: This study reveals that dental students' understanding of dental care during the COVID-19 pandemic is quite good. One of the efforts to prevent the spread of COVID-19 is through the use of teledentistry which is considered very effective and efficient.

Keywords: COVID-19, dental students, teledentistry.

Introduction

The stomatognathic system is the functional unit of the body that coordinates the functions of mastication, swallowing and speech. The main components of the stomatognathic system are the temporomandibular joint, masticatory muscles and the tooth-periodontal complex that work in harmony and are closely related in a system. Therefore, teeth are one of the important organs in

the stomatognathic system. Disorders that occur in the teeth will disrupt the stomatognathic system.¹

Public awareness of the importance of dental and oral examinations is a concern for health practitioners. This is supported by the fact that the Indonesian population who received dental and oral care when experiencing dental and oral problems is still relatively low, which is only 31.1%. Therefore, the motivation of each

individual to make regular visits to the dentist needs to be improved.²

Oral and dental diseases are currently ranked 8th out of the top ten outpatient diseases. In addition, the Household Health Survey (SKRT) reported by the Indonesian Ministry of National Health in 2013 showed that 70% of people suffered from dental caries and gingivitis (gum inflammation) and in adults, 73% suffered from dental caries.³

The prevalence of caries in developing countries is still quite high. Caries can cause discomfort to the patient, and lead to pain in the tooth. This condition will have a negative impact on the patient.⁴ For a student, this will interfere with the learning process, so that students cannot achieve again.

On March 11, 2020, the World Health Organization (WHO) declared the Corona virus disease outbreak, COVID-19 as a global pandemic. This status was declared due to positive cases outside China which increased thirteen times in 114 countries with a total death toll at that time reaching 4,291 people. WHO stated that so far there has never been a pandemic triggered by the corona virus and at the same time, there has never been a pandemic that can be controlled. On that basis, WHO is asking countries to take urgent and aggressive action to prevent and overcome the spread of the COVID-19 virus.⁵ Coronavirus disease 2019 (COVID-19) is a new type of disease that has never been identified before in humans. The virus that causes COVID-19 is called Sars-CoV-2. Based on scientific evidence, COVID-19 can be transmitted from human to human through coughing/sneezing droplets, The people most at risk of contracting this disease are people who are in close contact with COVID-19 patients including those who care for COVID-19 patients.⁶

The COVID-19 pandemic means that people are unable to visit the dentist as regularly as they did before the pandemic. The Executive Board of the Indonesian Dental Association (PB PDGI) has issued a circular letter on dental service guidelines during the COVID-19 virus pandemic. One of the things stated in the letter is to delay action without symptomatic complaints.⁷

Teledentistry has been developed to facilitate online consultation to patients.⁸ However, it is not yet known whether all students at the Faculty of Dentistry, Prof. Dr. Moestopo (Beragama) University are aware of and utilize these facilities. Based on this background, this study aims to explain the understanding of students at the Faculty of Dentistry, Prof. Dr. Moestopo (Beragama) University towards dental care during the COVID-19 Pandemic.

Material and Methods

This research was conducted at the Faculty of Dentistry, Prof. Dr. Moestopo University (Religious) in August-September 2022. Determination of the number of subjects in this study was determined by total sample, snowball method. The number of subjects used were 74.

The type of research used is descriptive research, with a cross sectional research design. The subjects in this study were students of the Faculty of Dentistry, Prof. Dr. Moestopo University (Religious) who had filled out a questionnaire.

This study used the informed consent sheet and questionnaire in the form of Google form. The first data analysis is data entry, then descriptive analysis is carried out which is presented in tabular form.

Result

The results in this study can be seen in the following tables

Table 1 Frequency Distribution of Respondents Based on Gender

Gender	Frequency	Percentage
Female	67	90.5
Male	7	9.5
Total amount	74	100

The results of the study in table 1 show data obtained from 74 research respondents who have participated, consisting of 90.5% (67 respondents)

are female and as many as 9.5% (7 respondents) are male.

Table 2. Frequency Distribution of Respondents Based on the Use of Mouthwash During the COVID-19 Pandemic

Use mouthwash regularly during the pandemic	Frequency	Percentage
Yes	35	47.3
No	39	52.7
Total amount	74	100

The results of the study in Table 2 show data obtained from 74 research respondents who have participated, consisting of 47.3% (35 respondents)

who routinely use mouthwash during the pandemic and as many as 52.7% (39 respondents) who do not use mouthwash.

Table 3 Frequency Distribution of Respondents Based on Frequently Used Mouthwash during the COVID-19 Pandemic

Frequently used mouthwash during the pandemic	Frequency	Percentage
Non-alcoholic mouthwash	20	27
Alcohol mouthwash	17	23
Herbal mouthwash	15	20.3
Not using mouthwash	22	29.7
Total amount	74	100

The results of the study in table 3 show data obtained from 74 research respondents who have participated, consisting of 27% (20 respondents) who use non-alcohol mouthwash, 23% (17

respondents) who use alcohol mouthwash and as many as 20.3% (15 respondents) use herbal mouthwash. The remaining 29.7% (22 respondents) did not use mouthwash.

Table 4 Frequency Distribution of Respondents Based on Reasons for Using Mouthwash

Reasons for using mouthwash	Frequency	Percentage
Prevents bad breath	20	27
To avoid bacterial buildup	18	24.3
For a fresher mouth	14	18.9
Not using mouthwash	22	29.7
Total amount	74	100

The results of the study in table 4 show data obtained from 74 research respondents who have participated, consisting of 27% (20 respondents), using mouthwash for reasons to prevent bad breath. Respondents as much as 24.3% (18

respondents) on the grounds that there is no accumulation of bacteria in the oral cavity. Another reason is to make the mouth feel fresher as many as 18.9% (14 respondents). Meanwhile, 29.7% (22 respondents) did not use mouthwash.

Table 5 Frequency Distribution of Respondents Based on Visits to the Dentist During the COVID-19 Pandemic

Visiting the dentist during the pandemic	Frequency	Percentage
Yes	49	66.2
No	25	33.8
Total amount	74	100

The research results in table 5 show data obtained from 74 research respondents who have participated, consisting of 66.2% (49 respondents)

who have visited the dentist during the pandemic. Respondents who never visited a dentist during the pandemic were 33.8% (25 respondents).

Table 6 Frequency Distribution of Respondents Based on Reasons for Visiting Dentists during the COVID-19 Pandemic

Reasons to visit the dentist during the pandemic	Frequency	Percentage
Dental pain	8	10.8
Routine control (once every 6 months)	4	5.4
Scaling	14	18.9
Orthodontic appliance control	20	27
Tooth filling	1	1.4
Endodontic treatment	1	1.4
Tooth extraction	1	1.4
Never visited a dentist during the pandemic	25	33.8
Total amount	74	100

The research results in table 6 show data obtained from 74 research respondents who have participated, consisting of 1.4% (1 respondent) who visited the dentist during the pandemic for reasons of filling, nerve treatment and tooth extraction. Respondents who came for dental pain were 10.8% (8 respondents). Respondents who

came for routine control were 5.4% (4 respondents), while for scaling were 18.9% (14 respondents). The most common reason for coming to the dentist was for orthodontic appliance control as many as 27% (20 respondents).

Table 7 Frequency Distribution of Respondents Based on Whether They Fear Coronavirus Exposure When Visiting a Dentist During the COVID-19 Pandemic

Are you afraid of being exposed to the Coronavirus when visiting the dentist during the Pandemic?	Frequency	Percentage
Yes	33	44.6
No	26	35.1
Never visited a dentist during the pandemic	15	20.3
Total amount	74	100

The research results in table 7 show data obtained from 74 research respondents who have participated, consisting of 44.6% (33 respondents) who feel afraid of being exposed to the Corona

virus when visiting a dentist during a pandemic. Respondents who did not feel afraid were 35.1% (26 respondents).

Table 8.Frequency Distribution of Respondents Based on Choosing a Dentist to Visit during the COVID-19 Pandemic

Choosing a Dentist to Visit During the COVID-19 Pandemic	Frequency	Percentage
Choosing a clinic that prioritizes sterilization of equipment and rooms	21	28.4
Choosing a regular dentist	29	39.2
Never visited a dentist during the pandemic	24	32.4
Total amount	74	100

The research results in table 8 show data obtained from 74 research respondents who have participated, consisting of 28.4% (21 respondents) who choose clinics that prioritize sterilization of

tools and rooms when visiting dentists during a pandemic. Respondents who chose their usual dentist were 39.2% (29 respondents).

Table 9 Frequency Distribution of Respondents Based on Actions Taken by Dentists during the COVID-19 Pandemic

Actions taken by dentists during the pandemic	Frequency	Percentage
Non-emergency cases	27	36.5
Emergency cases	15	20.3
Do not know	32	43.2
Total amount	74	100

The research results in table 9 show data obtained from 74 research respondents who have participated, consisting of 36.5% (27 respondents) who answered that the actions taken by dentists during the pandemic were non-emergency cases. Respondents who answered that dentists took

emergency action during the pandemic were 20.3% (15 respondents). Respondents who did not know what actions dentists took during the pandemic had the largest percentage, namely 43.2% (32 respondents).

Table 10 Frequency Distribution of Respondents Based on What They Did When Experiencing Dental Pain During the COVID-19 Pandemic

Things to do when experiencing dental pain during the pandemic	Frequency	Percentage
Buying over-the-counter medications (without a dentist's prescription)	12	16.2
Visit the dentist and ask for a prescription	36	48.6
Never visited a dentist during the pandemic	26	35.1
Total amount	74	100

The research results in table10 show data obtained from 74 research respondents who have participated, consisting of 16.2% (12 respondents) who chose to buy over-the-counter drugs (without

a dentist's prescription) during the pandemic. Respondents who chose to come to the dentist and ask for a prescription were 48.6% (36 respondents).

Table 11.Frequency Distribution of Respondents Based on Knowing How to Seek Treatment or Consult a Dentist by Phone or Online Since the COVID-19 Pandemic

Knowing how to seek treatment or consult a dentist by phone or online since the pandemic	Frequency	Percentage
Yes	55	74,3
No	19	25,7
Total amount	74	100

The research results in table 11 show data obtained from 74 research respondents who have participated, consisting of 74.3% (55 respondents) who know how to seek treatment or consult a

dentist by telephone or online since the pandemic. Respondents who did not know about this were 25.7% (19 respondents).

Table 12 Frequency Distribution of Respondents Based on Knowledge that They Can Get Prescription Medicine After Consulting a Dentist by Phone or Online Since the COVID-19 Pandemic

Knowing that you can get prescription drugs after consulting with a dentist by phone or online since the COVID-19 pandemic	Frequency	Percentage
Yes	59	79,7
No	15	20,3
Total amount	62	100

The results of the study in table 12 show data obtained from 74 research respondents who have participated, consisting of 79.7% (59 respondents) knowing that they can get prescription drugs after

consulting with dentists by telephone or online since the pandemic. Respondents who did not know about this were 20.3% (15 respondents).

Table 13. Frequency Distribution of Respondents Based on the Need for Patients to Know the Management of Dental Care in the New Normal Order

It is necessary for patients to know the management of dental care in the new normal order	Frequency	Percentage
Yes	72	97,3
No	2	2,7
Total amount	74	100

The results of the study in table 13 show data obtained from 74 research respondents who have participated, consisting of 97.3% (72 respondents) think that it is necessary for patients to know dental care procedures in the new normal order. Respondents who considered it unnecessary were 2.7% (2 respondents).

Discussion

Circular Letter No.2776 / PB PDGI / III-3 / 2020 concerning Guidelines for Dentistry Services during the COVID-19 Virus Pandemic, clearly

describes information regarding the management of preventing transmission of COVID-19 in dental practice rooms. WHO also stipulates the prevention or limitation of the spread of COVID-19 with standard precautions.⁷

Related to the COVID-19 pandemic, this study was conducted to find out how the Faculty of Dentistry students at Prof. Dr. Moestopo University (Beragama) understand dental care during the COVID-19 pandemic. The COVID-19 pandemic has caused various changes. Indonesia has tried to control and break the COVID-19 chain

by making and implementing applicable regulations. However, in dealing with COVID-19, the role of various sectors is needed, including the government, health workers and also public awareness to be able to heed the appeals of the government and health workers and increase self-awareness to prevent the spread of the COVID-19 virus.⁶

Based on the results of the research that has been conducted, it appears that the most respondents involved in this study are female, as many as 90.5%. This is because the majority of Faculty of Dentistry students are female.

Respondents who routinely used mouthwash during the pandemic were 47.3%. More respondents did not use mouthwash during this pandemic. The type of mouthwash that is often used by respondents is non-alcoholic mouthwash, 27%. The most common reason for using mouthwash is to prevent bad breath, which is 27%. Based on research by Ferdina et al in 2022, it is said that the use of mouthwash during a pandemic will be able to reduce the risk of COVID-19 transmission. The most effective Povidone iodine concentration is 1% for 15 seconds and can reduce viral activity by 99.99%.⁹

Respondents who continued to visit the dentist during the pandemic were 66.2%. The most common reason why respondents continue to visit the dentist during a pandemic is because of orthodontic appliance control. Based on research conducted by Wahyuni et al in 2019, it is said that orthodontic treatment takes a long time to complete. Regular visits for orthodontic appliance control must be adhered to with an interval of about 4-6 weeks. Patients must show high motivation and seriousness in treatment, in order to get maximum results. Failures that occur during orthodontic treatment, generally occur because patients are not orderly in conducting routine controls.¹⁰ Therefore, during the pandemic, patients should still visit the dentist for orthodontic appliance control.

Respondents who felt afraid when visiting the dentist were 44.6%, while respondents who never

visited the dentist during the pandemic were 20.3%. During the pandemic, respondents prefer to visit their usual dentist, 39.2%, rather than choosing a clinic that prioritizes sterilization. This shows that respondents are more concerned with the convenience of seeing a familiar dentist, rather than a clinic with good sterilization equipment. Respondents' knowledge regarding cases worked by dentists during the pandemic has also been asked in this research questionnaire. The majority of respondents were students of the Faculty of Dentistry who were in the first semester, as many as 71.6%. Therefore, knowledge of what actions are taken by dentists during a pandemic does not seem appropriate, because many respondents answered non-emergency cases as much as 36.5%, while 43.2% stated that they did not know to answer this question. Cases performed by dentists during a pandemic based on Circular Letter No.2776 / PB PDGI / III-3 / 2020 concerning Guidelines for Dentistry Services During the COVID-19 Virus Pandemic, it is said that dentists are asked to postpone action in the absence of complaints, which means that only emergency cases are carried out during this pandemic.⁷

What respondents did when experiencing dental pain, 48.6% chose to visit the dentist and ask for a prescription, while 16.2% chose to immediately buy over-the-counter drugs (without a doctor's prescription). Respondents who chose not to visit the dentist were 35.1%. Respondents who have knowledge of how to seek treatment or consult a dentist by telephone or teledentistry since the pandemic are 74.3%. The remaining 25.7% were respondents who did not know about it. Respondents who know that they can get prescription drugs after consulting with a dentist by phone or online since the pandemic are 79.7%. The American Dental Association (ADA) describes teledentistry as "the use of telehealth systems and methodologies in dentistry", which includes a wide range of technologies and measures to deliver medical, health and educational services virtually.¹¹ The use of teledentistry is considered very effective and

efficient, so as to reduce direct contact and prevent the spread of COVID-19.¹²

Respondents who felt it was necessary for patients to know the management of dental care in the new normal order as much as 97.3%. This is in line with Desi PS's research in 2021 which states that in the current new normal era, it is highly recommended to develop a high standard teledentistry application and service management system to support services in the field of dentistry. Teledentistry as a medium for transition and collaboration between conventional systems and digital systems is considered to be able to support and greatly assist patients in overcoming oral health problems during the COVID-19 pandemic.¹²

Conclusions and Suggestions

Based on the results of the research that has been conducted, it can be concluded that the understanding of dental students towards dental care during the COVID-19 pandemic is quite good. This can be seen from the results of the study which show that the majority of respondents know how to seek treatment or consult a dentist by telephone or online since the pandemic through teledentistry. One of the efforts to prevent the spread of COVID-19 is through the use of teledentistry which is considered very effective and efficient.

Although the existence of teledentistry cannot fully replace dental practice, it is hoped that the public can sort out what cases are urgent enough to be examined by a dentist immediately. Non-emergency dental cases are expected to be postponed until the pandemic is over. Dental care should still be done at home so that the condition of the teeth and mouth can be maintained optimally.

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Effectiveness of Using *Weissella cibaria* CMU Bacteria as Oral Probiotics for Halitosis Therapy: A Scoping Review

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ABSTRACT

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Halitosis is an unpleasant odor that is produced during exhalation, originating both inside and outside the oral cavity with volatile sulphur compound (VSC) as the main component. VSC is produced as a result of protein degradation by gram-negative anaerobic pathogenic bacteria. Halitosis poses a problem in the field of dentistry and has an impact on the psychosocial well-being of patients. Current halitosis therapy through conventional mechanical and chemotherapeutic methods still has obstacles, so it is necessary to look for alternative therapies that are safer and more effective, including through the use of *Weissella cibaria* CMU bacteria as an oral probiotic. Clinical investigations on humans have provided just a small amount of data on the efficacy of *Weissella cibaria* CMU as an oral probiotic for the treatment of halitosis. Purpose of this article to analyze the effectiveness of *Weissella cibaria* CMU as an oral probiotic for halitosis therapy from various human clinical studies. Preferred Reporting Item Guidelines for Methods of Systematic Review and Meta Analysis (PRISMA) selection process for articles. The articles were sourced from PubMed, Google Scholar and ResearchGate databases for the period 2013-2023 using the Boolean search "halitosis" AND "oral probiotics" AND "*Weissella cibaria*." The inclusion and exclusion criteria were used for a total of 4 articles, which were then reviewed. Clinical studies have shown that *Weissella cibaria* CMU can be used as an oral probiotic to improve halitosis. It is also safe for the body and health, thus it may be considered of as a support option for halitosis therapy.

KEYWORDS:

Halitosis, volatile sulphur compound (VSC), oral probiotics, *Weissella cibaria* CMU

INTRODUCTION

Halitosis, malodor, fotor oris atau bad breath are terms that generally describe a foul of unpleasant odor during exhalation, This can come from either inside or outside of the mouth cavity^{1,2,3,4} Types of halitosis according to Miyazaki H et al cited by Hunny Sharma in 2015⁴ are classified into physiological halitosis, pathological halitosis (intra oral and extra oral), pseudohalitosis dan halitophobia. Almost 90% of halitosis cases have an etiology that originates from intraoral factors.⁵ The source of intra oral halitosis can be due to the presence of periodontitis, gingivitis, periodontal pocket, deep caries, endodontic lesions, pericoronitis, mucosal ulceration, periimplant disease, oral malignancy, food debris trapped in

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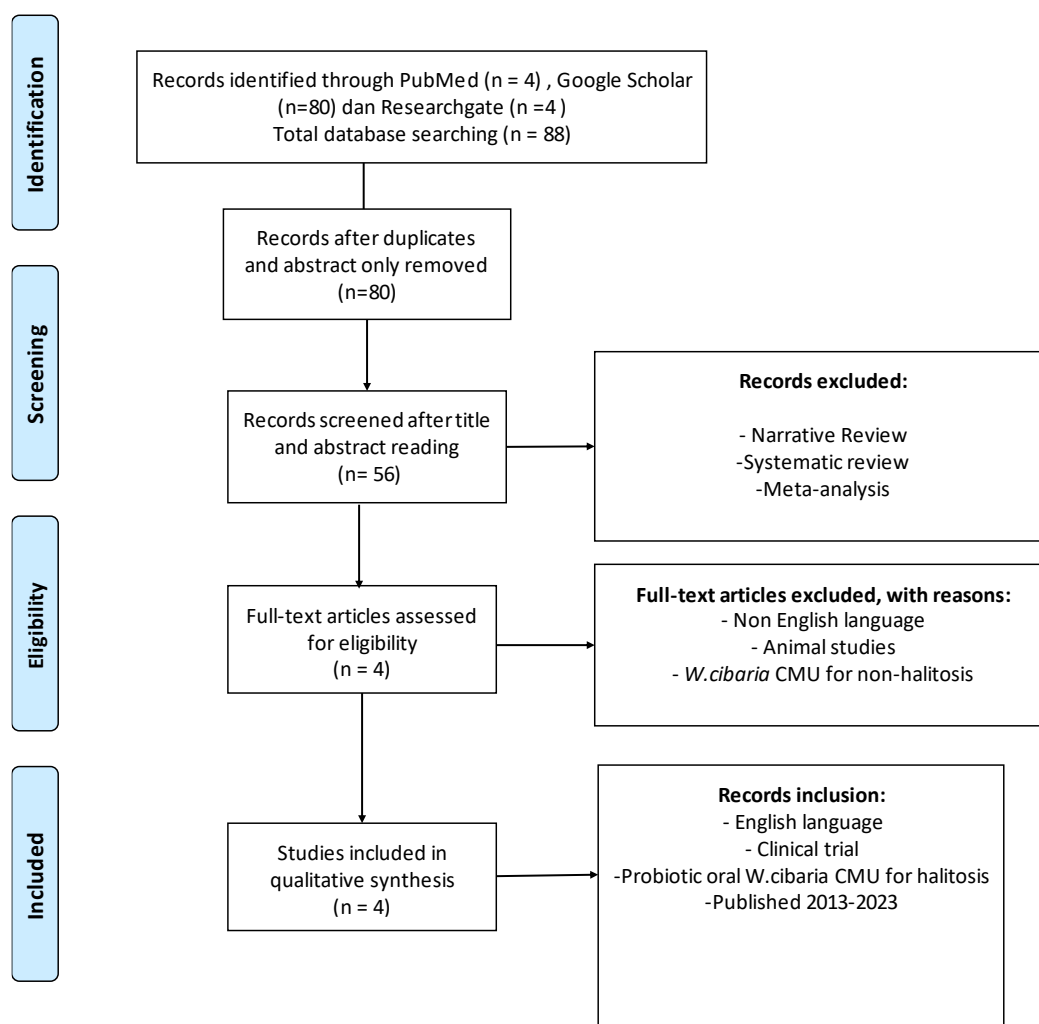
the oral cavity, tongue debris, poor oral hygiene, restorations with insufficient dexterity, and factors that cause a decrease in salivary flow rate.^{6,7,8} Extra oral halitosis is halitosis whose source is related to conditions in the ear, nose, throat, pathological conditions of the lungs, gastrointestinal tract and halitosis through the bloodstream (blood borne halitosis which is usually related to endocrine diseases, metabolic disorders, liver disease and certain drugs and foods) which are carried to the lungs and then evaporate when entering the exhalation.⁹ According to Lanton P et al cited by Sharma H et al in 2015⁴ they state that certain medications that can cause halitosis because it reduces salivary flow, namely antidepressants, decongestants, narcotics, antipsychotics, antihistamines and antihypertensives. Behavior and habits of consuming alcohol and tobacco that causes the mouth to dry out, can also increase the risk of halitosis.⁷ Since the oral environment is dynamic, the balance of the normal flora (commensal) of the oral cavity, which prevents the colonization of pathogenic bacteria, is the key element that contributes to the development of halitosis, despite the fact

that it can be brought on by a variety of factors..^{10,11} Halitosis not only causes problems in the field of dentistry, according to Heo HY et al cited by Lee DS et al ¹² it can also have an impact on the quality of life of sufferers because it causes problems with social interaction, decreased self-confidence, and mental stress. The component that causes halitosis which generally originates from within the oral cavity is Volatile Sulfur Compound (VCS) which is a product of the decomposition of sulfur-containing amino acids by gram-negative anaerobic pathogenic bacteria in the oral cavity, especially on the tongue's dorsal surface..⁴ The prevalence of halitosis from research in several countries ranges from 14.8-75.1%.^{13,14,15,16} Halitosis management has been commonly carried out so far to eliminate pathogenic bacteria that causes halitosis and maintain oral hygiene, it's done through conventional mechanical methods (brushing teeth, using dental floss, using a tongue scraper, scaling, and root planning) and chemotherapeutic methods (mouthwash, toothpaste, mouth spray).^{4,7,17,18} However, there are still weaknesses in these methods related to the risk of negative impacts on microflora homeostasis in the oral cavity, bacterial resistance, trauma to the tongue and short duration of effectiveness, so it is necessary to find alternative strategies for halitosis management that are safer and more effective.¹⁹ The oral probiotic method is currently being developed as an alternative effort for halitosis therapy.¹⁹ Live bacteria contained in probiotics are acceptable for human consumption and are able to have a beneficial effect on the health of the body when consumed in adequate amounts.²⁰

Among the probiotic *strains* that has now been developed as a commercial product for oral health care include, namely *Weissella cibaria* Chonnam Medical University or *Weissella cibaria* CMU.^{6,12,21} Nonetheless, information on the effectiveness including safety aspects on general body health and effects on psychosocial health from the use of *Weissella cibaria* CMU as an oral probiotic for halitosis therapy from clinical research in humans is still limited. The purpose of this scoping review is to analyze the effectiveness of using *Weissella cibaria* CMU as an oral probiotic for halitosis therapy from various human clinical research results so that it can be useful as a basis for consideration in choosing alternative halitosis therapies that are proven to be safer and more effective, especially through the use of oral probiotics so as to increase the success of halitosis therapy in general.

METHOD

In accordance with the Preferred Reporting Item Guidelines for Methods of Systematic Review and Meta Analysis (PRISMA), the flow of article selection for this review was represented by a diagram.²² The analysis criteria include PICO (*Population, Intervention, Comparison, Outcome*). Three electronic databases were used to search for scientific articles, namely PubMed, Google Scholar and ResearchGate from January 2013-June 2023. The *Boolean search* used in the search process for scientific articles to be studied include "halitosis" AND "oral probiotics" AND "*Weissella cibaria* CMU." Figure 1 shows the process of filtering articles according to the inclusion and exclusion criteria to acquire papers for this review's analysis.



RESULTS

A total of 88 scientific articles relevant to the Boolean search “halitosis” AND “oral probiotics” AND “*Weissella cibaria* CMU” were obtained in this review with details identified from the PubMed data base with 4 articles, Google Scholar with 80 articles, and ResearchGate with 4 articles. The screening articles from these data bases after removing duplicated articles and abstract only, 80 articles. Screening based on exclusion criteria by reading the title and abstract, 56 articles were obtained. Eligibility of articles after reading the entire contents of the article based on the exclusion criteria, 4 articles were obtained. The selection of articles to

be included in the final qualitative synthesis of this review was based on the inclusion criteria, with a total of 4 articles. All studies analyzed in this review were conducted in Korea with double-blind, randomized, placebo-controlled study with the total number of halitosis-affected people (according to the inclusion criteria of each researcher) who received oral probiotic intervention *Weissella cibaria* CMU were 142 people, while the control subjects who received placebo totaled to 137 people. A summary of all articles that meet the eligibility for final synthesis synthesis related to the effectiveness of using *Weissella cibaria* CMU as an oral probiotic for halitosis therapy, can be seen in Table 1

Sinta Deviyanti et al, Effectiveness of Using *Weissella cibaria* CMU Bacteria as Oral Probiotics for Halitosis Therapy: A Scoping Review

Table 1

No	Authors-Year	Subjects	Amount of Subjects	Design of Study	Intervention	Results
1	Lee DS et al (2020)	Students and personnel in Kongwon National University of Korea; 20-39 years of age; Meet the inclusion criteria	Healthy adult with halitosis whose exhibit VSC level >1,5ng/10ml (n=34); Healthy control (n=34)	Randomized Double Blind Placebo Control Trial	Probiotic group was given an 800 mg tablet (to let it melt and suck on their tongue) contained 1.0x10 ⁸ CFU/g of probiotic <i>W.cibaria</i> CMU (oraCMU;OraPharm,Inc.,Seoul, Korea) taken once daily every night before bed time after brushing their teeth for 8 weeks; Control group was a placebo tablet from the same manufacturer without probiotic <i>W.cibaria</i> CMU	Mean OLT scores and concentration of VSC revealed lower significant (P<0.05) in probiotic groups at week 4; Mean BBI scores were lower significant (P<0.05) in the probiotic groups at week 8; Level of <i>W.cibaria</i> in the probiotic group was higher significant (P<0.05) than in control group from baseline to 8 weeks; Vital sign, hematological finding and blood chemistry were within normal ranges in both group
2	Lee DS et al (2021)	College students in Gangwon province, South Korea; Over 20 years of age; Meet the inclusion criteria	Healthy adult with halitosis whose exhibit VSC level >1,5ng/10ml (n=34); Healthy control (n=28)	Randomized Double Blind Placebo Control Trial	Probiotic group was given an 800 mg tablet (to let it dissolved on their tongue) that contain 1.0x10 ⁸ CFU/g of probiotic <i>W.cibaria</i> CMU (oraCMU;OraPharm,Inc.,Seoul, Korea) taken one tablet once daily every night before bed time after brushing their teeth for 8 weeks; Control group was a placebo tablet without probiotic <i>W.cibaria</i> CMU	Subjective halitosis if they have perceived they had no halitosis after treatment were significant higher in probiotic group than control (p<0.030); Depression(p=0.605) and self esteem (p=0.688) before and after treatment which no significant difference between the two group; Oral health status related quality of life before and after treatment getting better significant in test group than control. (p=0.036); No severity of symptoms were identified as adverse event towards the participants safety.
3	Kim DH et al (2020)	Adults men and women with 20-70 years of age; exhibit VSC level >0,015ng/ml and who score >2 points in a halitosis sensory evaluation test(n=29); Healthy control (n=29)	Healthy adult with halitosis whose exhibit VSC level >0,015ng/ml and who score >2 points in a halitosis sensory evaluation test(n=29); Healthy control (n=29)	Randomized Double Blind Placebo Control Trial	Probiotic group was given the powder form contained 1.0x10 ⁸ CFU/bag of probiotic <i>W.cibaria</i> CMU (Oradentics,Co.,Ltd.,Seoul,Korea) placed in the mouth immediately before going to bed and left until the powder got melted for 8 weeks; Control group was administered maltodextrin alone as a filler in powder production without <i>W.cibaria</i> CMU	Mean concentration of VSC was reduced by 0,030 ng/ml in the probiotic group and increased by 0,005 ng/ml in the control group after week 8 of ingestion but not statistically significant; Score self evaluation of improvement was halitosis reduction significant after week 4 (P=0,0301) and week 8 (P=0,0038) of ingestion in the probiotic group compared to the control group.
4	Han HS et al (2023)	Participants from the Departement of Periodontology, Seoul National University Dental Hospital were aged 20-70 years; Meet the inclusion criteria	Healthy adult with halitosis whose exhibit VSC level >1,5ng/10ml (n=45); Healthy control (n=46)	Randomized Double Blind Placebo Control Trial	Probiotic group was given an 800 mg tablet (to chew and suck) contained 1.0x10 ⁸ CFU/g of probiotic <i>W.cibaria</i> CMU (oraCMU;OraPharm,Inc.,Seoul, Korea) taken once tablet every night before bed time after brushing their teeth for 8 weeks; Control group was a placebo tablet from the same manufacturer without probiotic <i>W.cibaria</i> CMU	Total VSC was significantly lower in probiotic group compared to control group at based line and at 8 weeks; BBI score probiotic group was significant different compared than control group at week 8 which probiotic group showed a decreased and control group showed an increased (p=0.006); Levels of <i>W.cibaria</i> were significant higher in the probiotics group than in the control group (p<0,001) at week 8; Psychosocial health involved depression (p=0.049), oral health related quality of life (p=0.001) and objective oral health status(p=0.007) significantly improved from baseline to week 8 in probiotic group; No clinical significant changes in indicator vital signs, hematological finding, blood chemistry result of safety evaluation in the probiotic group

DISCUSSION

An oral probiotic method is currently being developed as an alternative halitosis therapy, because it can inhibit the growth of pathogenic bacteria without causing adverse effects on the normal microflora ecosystem in the oral cavity.¹² One of the oral probiotics that has been developed as a commercial product for oral health care, especially for halitosis therapy, is the *Weissella cibaria* CMU (Chonnam Medical University)

strain of bacteria.^{3,5,12} Saliva of the children in Korea, ages 4 to 7, with good oral health, were used as subjects for the isolation of this probiotic species of *Weissella cibaria* CMU.¹² *Weissella cibaria* species is a group of lactic acid bacteria with round morphology (*coccus*) or *rod*, is classified as a type of facultative anaerobic gram-positive bacteria from the family *Leuconostocaceae*, order *Lactobacillales*, class *Bacilli*, and phylum *Firmicutes*.²³ The ability of *W.cibaria*

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CMU as a probiotic to reduce halitosis has been proven from various human clinical studies analyzed in this review.^{3,5,12,18}

The intervention in the treatment group of all studies analyzed in this review was the administration of probiotic *W.cibaria* CMU tablets (containing 1×10^8 CFU/gr) which were sucked and allowed to dissolve in the oral cavity with a frequency of administration 1 x every night before bedtime for a period of 8 weeks, except in the Kim DH et al study in 2020 which provided probiotic *W.cibaria* CMU preparations in powder form (containing 1.0×10^8 CFU/bag) and allowed them dissolve in the oral cavity.^{3,5,12,18} The control group of all the studies mentioned above, received placebo tablets without any probiotic content, except for the Kim DH et al study in 2020 which provided placebos in the form of maltodextrin without probiotic content of *W.cibaria* CMU.^{3,5,12,18}

The improvement in halitosis conditions in the treatment group (probiotics) from the results of the studies analyzed in this review, appears to occur due to a significant increase in the number of *W.cibaria* CMU bacteria after the administration of probiotic *W.cibaria* CMU tablet preparations to the treatment group at week 8 as shown from the results of Lee DS et al in 2020 and Han HS et al in 2023, so that it might take the place of the bacteria's colony in the oral cavity that causes halitosis which in turn has an impact on reducing the concentration of VSC in the oral cavity.^{3,12} The VSCs that contribute to the onset of halitosis are known to composed of the following components, namely hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH) dan dimethyl sulfide (CH_3SCH_3), which are produced by gram negative anaerobic bacteria in the oral cavity, such as *Porphyromonas gingivalis*, *Fusobacterium nucleatum*, *Prevotella intermedia* and *Treponema denticola* through protein degradation (L-cysteine, L-methionine that contain sulfur).^{10,12} Study conducted by Jang HJ et al, which proves the ability of VSC inhibition (especially H_2S dan CH_3SH) produced by *Fusobacterium nucleatum* bacteria by *W.cibaria* CMU as an oral probiotic at 97% and the ability of VSC inhibition (especially H_2S dan CH_3SH) produced by *Porphyromonas gingivalis* bacteria at 93,9%.²⁴

The mechanism underlying the ability of probiotic *Weissella cibaria* CMU to improve halitosis conditions in this review, according to Kang MS et al in 2005 cited by Lee DS et al in 2020, can occur through competition for the attachment of probiotic *W.cibaria* CMU to epithelial cells of the oral cavity.¹² Another mechanism based on Jang HJ et al research, has proven that probiotic *W.cibaria* CMU has the greatest coaggregate ability at 81.2% against pathogenic bacteria *Fusobacterium nucleatum* that produce VSC when compared to other types of lactic acid bacteria such as *Lactobacillus salivarius*, *Streptococcus salivarius*, and *Lactobacillus reuteri*.²⁴ *Weissella cibaria* *Weissella cibaria* CMU bacteria functioning as an oral probiotic to reduce halitosis can also occur through the mechanism of production of antibacterial ingredients, namely *hydrogen peroxide*, which is proven to be

produced in larger quantities by *Weissella cibaria* CMU probiotics when compared to other types of lactic acid bacteria such as *Lactobacillus salivarius*, *Streptococcus salivarius* dan *Lactobacillus reuteri*.²⁴ The antibacterial ability of *Weissella cibaria* CMU as an oral probiotic in inhibiting the growth of pathogenic bacteria *Fusobacterium nucleatum* and *Porphyromonas gingivalis* was shown to reach more than 95%.²⁴ Anti-bacterial ingredients in the form of hydrogen peroxide produced by *Weissella cibaria* CMU as an oral probiotic are further known to produce hydroxyl radicals that play a role in inducing changes in the oral bacterial community and inhibiting the growth of pathogenic bacteria, including *Fusobacterium nucleatum* bacteria that produce VSC.²⁴ Furthermore, according to Thomas EL cited by Jang HJ et al,²⁴ hydroxyl radical action of hydrogen peroxide is known to be able to react with nucleic acids that causes damage to pathogenic bacterial genes, as well as increase permeability and denature proteins in pathogenic bacterial cells that produce VSC as the cause of halitosis.

The decrease in VSC levels and the amount of oral probiotic *Weissella cibaria* CMU after administration of probiotic tablet or powder preparations containing *Weissella cibaria* CMU from various research results mentioned above, Furthermore, it can affect the assessment of the *Bad Breath Improvement* (BBI) score in the probiotic group which is proven to be significantly lower than the control group at week 8 from the results of the study of Lee DS et al in 2020 and seems to be in line with the results of the study of Han HS et al in 2023.^{3,12} The research from Kim DH et al in 2020 has also proven a significant reduction in the self-evaluation of improvement score at weeks 4 and 8 in the probiotic group compared to the control group.⁵ Furthermore, research by Lee DS et al in 2021, has proven that the halitosis subjectivity assessment score, which means that the subject feels that they do not have halitosis, appears to be significantly higher in the probiotic group compared to the control group.¹²

Assessment of oral health status related to quality of life before and after the intervention, appeared to have significantly improved in the probiotic group compared to the control group from the results of the study by Lee DS et al in 2021.¹⁸ Psychosocial health status including depression, oral health related to quality of life and oral health status has shown to have significantly improved from the baseline period to week 8 in the probiotic group compared to the control group from the results of the study by Han HS et al in 2023.³ Assessment of depression and self-confidence levels before and after intervention from the results of Lee DS et al research in 2021 on the contrary showed results that were not significantly different between the probiotic group and the control group.¹⁸ The level of self-confidence in participants in Lee DS et al study in 2021 was further explained that it was not only influenced by halitosis, but could also be influenced by various other factors such as satisfaction in interpersonal relationships.¹⁸ Regarding the safety aspect, the

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use of *W.cibaria* CMU as an oral probiotic for halitosis sufferers from the results of Lee DS et al 2020 study, was proven to be safe because it showed a range of normal values based on the examination of body vital signs, hematological findings and blood chemistry, for both the probiotic group and the control group. The same results have also been shown from the results of Lee DS et al in 2021 and Han HS et al in 2023.^{3,18} The results of research that are also quite interesting to be observed in this review, namely the research by Kim DH et al in 2020, have shown that the decrease in VSC concentration that occurred in the *Weissella cibaria* CMU probiotic group in powder dosage form, proved to have no significant difference when compared to the control group.⁵ Related to this, Kim HJ et al in 2019 has explained that the use of probiotic *W.cibaria* CMU in the form of commercial tablet preparations is more recommended than capsule and powder preparations because tablet preparations are designed for slow dissolution of probiotic preparations in the mouth so as to extend the duration and period of probiotic activity in the mouth.²⁵

CONCLUSION

Clinical studies indicate that consuming *Weissella cibaria* CMU bacteria as an oral probiotic is safe for the body and effective in improving halitosis because it significantly reduces VSC levels, has a positive impact on the balance of oral microflora, increases halitosis assessment improvement scores, and enhances oral health in connection with quality of life, so it can be considered as an alternative to support halitosis therapy

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