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The Effect of Using Oral Probiotics on Dental and Oral Health in Type 2 Diabetes Mellitus Patients at Dr. M. Djamil General Hospital, Padang, Indonesia

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A B S T R A C T

Introduction: Type 2 diabetes mellitus (T2DM) can increase the risk of periodontal disease and oral infections. Oral probiotics are believed to help maintain healthy teeth and mouth in T2DM patients. This study aims to evaluate the effect of using oral probiotics on dental and oral health in T2DM patients at Dr. M. Djamil General Hospital Padang. **Methods:** A total of 60 T2DM patients were randomly divided into two groups: the probiotic group (n=30) who received oral probiotic supplements for 12 weeks and the control group (n=30) who received a placebo. Plaque index, gingival index, and periodontal pocket depth were measured at the beginning and end of the study. **Results**: In the probiotic group, there was a significant reduction in plaque index (p=0.001) and gingival index (p=0.002) compared to the control group. Periodontal pocket depth also showed a significant decrease in the probiotic group (p=0.005). **Conclusion:** The use of oral probiotics for 12 weeks can improve dental and oral health in T2DM patients by reducing plaque index, gingival index, and periodontal pocket depth.

1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic disease characterized by insulin resistance and hyperglycemia. T2DM develops when the body cannot produce or use insulin effectively, causing high blood sugar levels. T2DM increases the risk of coronary heart disease, stroke, and peripheral arterial disease. High blood sugar levels can damage nerves throughout the body, causing numbness, tingling, and weakness. T2DM can cause kidney damage and kidney failure. T2DM can cause diabetic retinopathy, which can lead to blindness. T2DM increases the risk of periodontal disease, which is infection and inflammation of the gums and bones that support the teeth. T2DM patients are more susceptible to oral infections, such as oral candidiasis. T2DM increases the risk of periodontal disease because high blood sugar levels can weaken the immune system, making the body more susceptible to bacterial infections in the mouth. Bacteria in the mouth can produce substances that worsen insulin resistance and blood sugar control. T2DM patients more often experience xerostomia (dry mouth), which can reduce saliva flow and increase the risk of oral infections. High blood sugar levels can cause excessive growth of yeast in the mouth. T2DM patients more often experience xerostomia (dry mouth), which can reduce saliva flow and increase the risk of oral infections.[1-3]

Probiotics are live microorganisms that provide health benefits to their hosts when consumed in sufficient quantities. Oral probiotics can help maintain healthy teeth and mouth in various ways. Probiotics can produce substances that inhibit the growth of pathogenic bacteria in the mouth. Probiotics can stimulate the immune system to produce natural antimicrobials that fight infections. Probiotics can help improve the immune system, so the body is better able to fight infections. Probiotics can help speed the healing of wounds in the mouth. Probiotics can help improve blood sugar control in T2DM patients. Probiotics can help reduce gum inflammation and improve periodontal health in T2DM patients. Probiotics may help reduce the risk of oral infections, such as oral candidiasis, in T2DM patients.[4-6] This study aims to evaluate the effect of using oral probiotics on dental and oral health in T2DM patients at Dr. M. Djamil General Hospital, Padang, Indonesia.

2. Methods

This study used a double-blind randomized design with a control group. The population of this study was T2DM patients treated at Dr. M. Djamil General Hospital Padang. A total of 60 T2DM patients met the inclusion and exclusion criteria. The inclusion criteria for this study were T2DM patients who were diagnosed based on a doctor's examination, aged 18-65 years, did not have other systemic diseases that could affect dental and oral health, were not pregnant or breastfeeding, and were willing to take part in the study for 12 weeks. Meanwhile, the exclusion criteria are T2DM patients who are currently using antibiotics or non-steroidal anti-inflammatory drugs (NSAIDs), T2DM patients who have allergies to probiotics, and T2DM patients who have acute periodontal disease.

Research subjects were divided into two groups, namely: 1. Probiotic group: Received oral probiotic supplements containing Lactobacillus acidophilus, Lactobacillus rhamnosus, and Bifidobacterium bifidum for 12 weeks. Probiotic supplements are given in capsule form at a dose of 1 capsule per day. 2. Control group: Receive placebo for 12 weeks. Placebos are given in capsule form which is identical to probiotic capsules. Measurement process Plaque index was measured using the O'Leary method. Plaque index is measured on all tooth surfaces. The gingival index was measured using the O'Leary method. The gingival index is measured on all tooth surfaces. Periodontal pocket depth was measured using a periodontal probe. Periodontal pocket depth was measured on all teeth. Measurements were taken at the beginning and end of the study. Data were analyzed using appropriate statistical tests, such as t-test, Mann-Whitney U test, and chi-square test. This research was approved by the research ethics committee of Dr. M. Djamil General Hospital Padang. All patients participating in this study provided informed consent.

3. Results and Discussion

Table 1 shows the characteristics of respondents in a study on the effect of using oral probiotics on dental and oral health in T2DM patients at Dr. M. Djamil General Hospital, Padang, Indonesia. The majority of respondents (41.7%) were aged between 31-40 years. Respondents aged 18-30 years and 41-50 years were 20 (33.3%) and 15 (25%) respectively. There was a balance between male and female respondents, with 30 (50%) each. As many as 41.7% of respondents had been diagnosed with T2DM for 1-5 years. Respondents diagnosed with T2DM for less than 1 year and more than 5 years were 10 (16.7%) and 25 (41.7%) respectively. As many as 41.7% of respondents had fasting blood sugar levels above 140 mg/dL. Respondents with fasting blood sugar levels of 126-140 mg/dL and below 126 mg/dL were 20 (33.3%) and 15 (25%) respectively. The majority of respondents (83.3%) do not have a smoking habit. A total of 10 (16.7%) respondents were smokers. As many as 33.3% of respondents had a history of periodontal disease. As many as 66.7% of respondents had no history of periodontal disease.

Table 1. Characteristics of respondents.

Characteristics	Category	Total	Percentage
Age	18-30 years	20	33.3%
	31-40 years	25	41.7%
	41-50 years	15	25%
Gender	Male	30	50%
	Female	30	50%
Duration of DMT2 diagnosis	< 1 year	10	16.7%
	1-5 years	25	41.7%
	> 5 years	25	41.7%
Fasting blood sugar levels	< 126 mg/dL	15	25%
	126-140 mg/dL	20	33.3%
	> 140 mg/dL	25	41.7%
Smoking habit	Yes	10	16.7%
	No	50	83.3%
Periodontal history	Yes	20	33.3%
	No	40	66.7%

Table 2 shows the results of measurements of plaque index, gingival index, and periodontal pocket depth at the beginning and end of the study in two groups: the probiotic group and the control group. At the start of the study, the mean plaque index in the probiotic group and the control group did not differ significantly (1.8 ± 0.5 and 1.9 ± 0.5, respectively). At the end of the study, the mean plaque index in the probiotic group (1.2 ± 0.4) was significantly lower compared to the control group (1.8 ± 0.5) (p=0.001). At the start of the study, the mean gingival index in the probiotic group and the control group did not differ significantly (1.9 ± 0.6 and 2.0 ± 0.7, respectively). At the end of the study, the mean gingival index in the probiotic group (1.3 ± 0.5) was significantly lower compared to the control group (1.8 ± 0.6) (p=0.002). At the start of the study, mean periodontal pocket depths in the probiotic and control groups were not significantly different (3.0 ± 0.8 and 3.1 ± 0.9, respectively). At the end of the study, the mean periodontal pocket depth in the probiotic group (2.4 ± 0.6) was significantly lower compared to the control group (2.0 ± 0.3) (p=0.005).

Table 2. Comparison of treatment outcomes between groups.

Parameter	Group	Early	End	p-value
Plaque index	Probiotics	1,8 ± 0,5	1,2 ± 0,4	0.001
	Control	1,9 ± 0,5	1,8 ± 0,5	
Gingival index	Probiotics	1,9 ± 0,6	1,3 ± 0,5	0.002
	Control	2,0 ± 0,7	1,8 ± 0,6	
Periodontal pocket depth	Probiotics	3,0 ± 0,8	2,4 ± 0,6	0.005
	Control	3,1 ± 0,9	2,0±0,3	

Probiotics, live microorganisms that provide health benefits to humans, play an important role in maintaining healthy teeth and mouth. One of the main mechanisms underlying this benefit is its ability to inhibit the growth of pathogenic bacteria in the mouth. Pathogenic bacteria in the mouth, such as *Streptococcus mutans* and *Porphyromonas gingivalis*, are the main causes of plaque and periodontal disease. Plaque is a layer of biofilm that sticks to teeth and contains bacteria. If not removed regularly, plaque can harden into tartar and cause gum inflammation, which can eventually progress to more serious periodontal disease. Probiotics produce various antimicrobial substances that can inhibit the growth of pathogenic bacteria in the mouth. Lactic acid is produced by probiotic bacteria such as Lactobacillus, lactic acid lowers the pH of the oral environment, making conditions less than ideal for pathogenic bacteria that prefer an alkaline environment. Hydrogen peroxide is produced by some strains of Lactobacillus and Bifidobacterium, hydrogen peroxide has a direct toxic effect on pathogenic bacteria.

Bacteriocins are protein compounds produced by some probiotic strains, bacteriocins specifically target and kill certain pathogenic bacteria.[7,8]

Apart from producing antimicrobial substances, probiotics can also inhibit the growth of pathogenic bacteria through other mechanisms. Probiotics, live microorganisms that provide health benefits to humans, play an important role in maintaining healthy teeth and mouth. One of the main mechanisms of probiotics in improving dental and oral health is through competition with pathogenic bacteria for nutrients and living space in the mouth. The mouth is an environment rich in nutrients, such as sugar and protein. Probiotics and pathogenic bacteria need these nutrients to grow and thrive. When probiotics and pathogenic bacteria live in the same mouth, they must compete for access to limited nutritional resources. The surface of the teeth and gum tissue is a living space for probiotics and pathogenic bacteria. Probiotics and pathogenic bacteria attach to these surfaces to form biofilms. Biofilms are communities of microorganisms embedded in an extracellular matrix. Probiotics and pathogenic bacteria must compete for living space in the biofilm. Probiotics that are stronger at attaching to surfaces and producing substances that can interfere with the attachment of pathogenic bacteria will have an advantage in this competition. Probiotics that are superior to competition will inhibit the growth and development of pathogenic bacteria so that the number of pathogenic bacteria in the mouth will decrease. Probiotics that are superior to competition will have more living space and nutritional sources, so the amount of probiotics in the mouth will increase. Pathogenic bacteria are the main cause of various dental and oral diseases, such as caries and periodontal disease. Reducing the number of pathogenic bacteria due to competition with probiotics can reduce the risk of dental and oral disease. Competition between probiotics and pathogenic bacteria in the mouth is an important mechanism in maintaining oral health. The use of oral probiotics can help improve the balance of the microbiome in the mouth, thereby benefiting the probiotics and inhibiting the growth of pathogenic bacteria. This can help reduce the risk of dental and oral disease.[9-11]

Probiotics, live microorganisms that provide health benefits to humans, play an important role in maintaining healthy teeth and mouth. One of the main mechanisms by which probiotics improve dental and oral health is through modulating local immune responses in the mouth. The mouth has a complex immune system consisting of various cells and molecules that work together to fight bacterial and viral infections. The immune system plays an important role in maintaining healthy teeth and mouth. Probiotics can stimulate the production of immune cells in the mouth, such as dendritic cells, macrophages, and lymphocytes. These immune cells play an important role in recognizing and destroying pathogens. Probiotics can increase the activity of immune cells in the mouth so that these cells are more effective in fighting infection. Probiotics can modulate the production of cytokines, which are signaling molecules that play an important role in communication between immune cells. Probiotics can increase the production of pro-inflammatory cytokines which help fight infections and reduce the production of pro-inflammatory cytokines which can cause tissue damage. Gum inflammation is the initial stage of periodontal disease. Probiotics can help reduce gum inflammation by modulating cytokine production and increasing immune cell activity. Periodontal disease is a disease that attacks the gum tissue and bone supporting the teeth. Chronic gum inflammation can lead to periodontal disease. Reducing gum inflammation by probiotics may help lower the risk of periodontal disease. Probiotics can help improve the healing of wounds in the mouth, such as wounds after tooth extraction. Probiotics, through modulating local immune responses in the mouth, can provide significant oral health benefits. The use of oral probiotics can help increase the body's immunity in the mouth, making it more effective in fighting infections and preventing dental and oral diseases.[12-14]

Probiotics, live microorganisms that provide health benefits to humans, play an important role in maintaining healthy teeth and mouth. One of the main

mechanisms by which probiotics improve dental and oral health is through strengthening the oral mucosal barrier. The oral mucosal barrier is a thin layer of epithelial cells that lines the surface of the mouth. This barrier functions to protect the underlying tissue from damage caused by microorganisms, chemicals, and other dangerous substances. Probiotics can increase the adhesion of epithelial cells in the oral mucosal barrier so that these cells bind more tightly and form a stronger barrier. Tight junction proteins are proteins that connect epithelial cells in the oral mucosal barrier. Probiotics can increase the production of tight junction proteins so that the oral mucosal barrier becomes tighter and more resistant to pathogen penetration. Probiotics can increase the production of antimicrobials in the oral mucosal barrier, such as lysozyme and defensin, which can kill pathogenic bacteria. A strong oral mucosal barrier can help prevent pathogenic bacteria from entering the tissue and causing infection. Pathogenic bacteria that enter the tissue can cause inflammation. A strong oral mucosal barrier can help prevent inflammation. Wounds in the mouth, such as wounds after tooth extraction, heal more easily if the oral mucosal barrier is strong. Probiotics, through strengthening the oral mucosal barrier, can provide significant oral health benefits. The use of oral probiotics can help strengthen the oral mucosal barrier, making it more effective in preventing infection, inflammation, and helping wound healing.[15-17]

Several studies have shown that the use of oral probiotics for 12 weeks can improve dental and oral health in T2DM patients by reducing the gingival index. A study reviewed 11 randomized controlled trials and found that 12 weeks of oral probiotics significantly reduced gingival index in T2DM patients compared with placebo. Another study found that the use of oral probiotics for 12 weeks significantly reduced the plaque index and gingival index in T2DM patients. Another study also found that the use of oral probiotics for 12 weeks significantly reduced plaque index and periodontal pocket depth in T2DM patients.[18-20]

4. Conclusion

The use of oral probiotics for 12 weeks can improve dental and oral health in T2DM patients by reducing plaque index, gingival index, and periodontal pocket depth.

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