

indicating a clean tooth. A comparison of the dry and prewetted toothbrush methods was done using participants from 2 previous experiments involving single-brushing exercises.

## METHODS

The 46 participants were systemically healthy and at least age 18 years (range 20 to 34 years). All were required to refrain from oral hygiene for 48 hours before beginning the experiments. The control intervention was brushing with a prewetted toothbrush, and the test intervention was brushing with a dry toothbrush. No dentifrice was used. Plaque status was scored before and after brushing each time. In addition, subjects completed a questionnaire to judge their perceptions of the process.

## RESULTS

The mean plaque scores obtained before brushing did not differ significantly, nor did those obtained after brushing. Plaque score reduction was 58% with the dry toothbrush and 57% with the prewetted toothbrush. The difference between the 2 methods was not statistically significant.

Subjects reported having to refrain from oral hygiene for 48 hours before each experiment as uncomfortable, as was brushing without a dentifrice. The latter applied to both dry and prewetted tooth brushing. Toothbrush filament stiffness was perceived as between soft and rigid whether wet or dry. The subjects' perceptions of cleaning capability were not significantly different between the 2 brushing methods.

## DISCUSSION

The overall reduction in dental plaque scores was at least 57% after a 2-minute brushing exercise for both the dry and the prewetted tooth brushing. Thus dry brushing was no more effective than prewetted brushing in removing plaque, and prewetting was not superior in plaque removal ability to dry brushing.

### Clinical Significance

Dentists should encourage their patients to brush their teeth daily even if they do it with a dry brush. It will be just as effective as brushing with a prewetted brush. Use of a dentifrice is likely to be preferred by patients, but it's not essential for obtaining clean teeth.

van der Sluijs E, Slot DE, Hennequin-Hoenderdos NL, et al: Dry brushing: Does it improve plaque removal? A secondary analysis. *Int J Dent Hygiene* 16:519-526, 2018

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# ORAL/SYSTEMIC CONNECTIONS

## Mouthwash and increased risk for diabetes



### BACKGROUND

A 2017 study stated that people who use over-the-counter mouthwash at least twice a day have about a 50% increased risk for developing prediabetes/diabetes over a 3-year period compared to people who use mouthwash less often or not at all. This outcome was evaluated by looking at the study itself, the proposed mechanism by which this outcome might occur, the role of oral bacteria in health, and methodological limitations found in the study.

### SAN JUAN OVERWEIGHT ADULTS LONGITUDINAL STUDY SUMMARY

Overweight and obese adults age 40 to 65 years were recruited. Blood samples were taken from the 945 participants, who were then divided into those who were normoglycemic, those who had prediabetes, and those who had diabetes. A complete periodontal evaluation was done to assess periodontal status. Data

on oral hygiene practices, including the use of mouthwash, were collected via questionnaire. The key finding was that individuals who used mouthwash twice a day or more at baseline, which was 22% of participants, had a significantly increased risk of developing prediabetes/diabetes over the next 3 years compared to those who used mouthwash less than twice daily. The effect remained as an approximately 50% increased risk of developing prediabetes/diabetes even after considering income, education, oral hygiene, oral conditions, sleep breathing disorders, diet, medications, insulin resistance, fasting glucose level, 2-hour post-load glucose level, or C-reactive protein. The effect was not related to mouthwash use once a day.

### PROPOSED MECHANISM

Nitric oxide (NO) is important in many cellular functions throughout the body, especially in vascular function and blood flow. Defective NO production is associated with endothelial

dysfunction and cardiovascular problems, including hypertension and atherosclerosis. NO production is achieved through the oxidation of L-arginine by nitric oxide synthases (NOS) to L-citrulline or by the salivary nitrate-nitrite-nitric oxide pathway. This pathway involves the absorption of dietary nitrate in the small intestine, transferring it to the circulation, from which 75% is excreted via the kidneys. The remaining 25% is actively taken up by the salivary glands, so that nitrate enters the saliva. Nitrate-reducing oral bacteria reduce the salivary nitrate to nitrite, which is swallowed, with some reduced in the acidic stomach environment to NO and the rest absorbed into the intestine, again entering the circulation and being reduced to NO.

The primary source of dietary nitrate is vegetables, especially beetroot, celery, lettuce, radish, rocket, and spinach. The body provides oral bacteria with nitrate by the active uptake from the circulation and salivary secretion, and the bacteria use it as a terminal electron acceptor to allow respiration in the absence of oxygen. The bacteria produce nitrite as a by-product of this process. The nitrite participates in many aspects of cellular function.

## STUDY LIMITATIONS

A number of limitations must be mentioned when considering the San Juan study. The principal areas where problems arise are as follows:

1. The reported prevalence of moderate to severe periodontitis in the participants at baseline was high, but the thresholds used to define this condition were not reported.
2. The very high prevalence of periodontitis in the group could have an impact on the risk for developing prediabetes or diabetes. The population was already at higher risk for prediabetes or diabetes.
3. No information was offered regarding the type of mouthwash being used or why it was being used. Different mouthwashes have different effects on plasma and salivary nitrite concentrations and on blood pressure.
4. There was no indication how long the participants had been using the mouthwash.
5. The oral/periodontal microbiome was not investigated, so there was no way of knowing whether nitrate-reducing oral bacteria were present and no measures of salivary or plasma levels of nitrate, nitrite, or NO bioavailability.

Most importantly, the study raises questions related to the high prevalence of obesity, prediabetes, and periodontitis in the participants at baseline, which can predispose individuals to the development of diabetes and confound the analysis.

Transferability of the study findings to persons who are not overweight or obese is problematic.

## ORAL BACTERIA IN HEALTH

The role of oral bacteria in producing nitrite through the salivary nitrate-nitrite-nitric oxide pathway carries implications for understanding connections between oral and general health. A small study found that patients with hypertension who use antibacterial mouthwash for 3 days had significantly less oral nitrate to nitrite reduction, diminished salivary nitrite levels, increased salivary nitrate, and a slightly elevated systolic blood pressure. Another study in healthy volunteers found chlorhexidine mouthwash used for 7 days reduced oral nitrite production by 90% and plasma nitrite levels by 25%, along with increased systolic and diastolic blood pressure of 2.0 to 3.5 mm Hg. A systematic review found that increasing the consumption of vegetables rich in nitrates may reduce the risk of cardiovascular disease. Evidence also indicates that reduced NO bioavailability may be associated with insulin resistance in animals. Obese patients and those with insulin resistance may have reduced NO bioavailability.

### Clinical Significance

Dental professionals must recognize the importance of the oral microbiome and its effects on general health. Mechanical plaque control is an important part of oral hygiene, which dentists need to emphasize is essential for oral health. The use of mouthwashes should not be expected to achieve a clinically relevant benefit that exceeds that provided by mechanical plaque control and is not a substitute for brushing the teeth. Currently insufficient data exist to advise patients to stop using mouthwash because of the risk of adverse general health effects. A large proportion of the population use mouthwash regularly. With further research in this area, it may be possible to recommend once-daily use rather than twice-daily or more. The dental profession should be alert to research developments addressing this topic.

Preshaw PM: Mouthwash use and risk of diabetes. *Br Dent J* 225:923-926, 2018

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