

Research

Habits, Practices and Beliefs Regarding Floss and Mouthrinse among Habitual and Non-Habitual Users

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Abstract

Purpose: The purpose of this survey was to investigate how flossing and rinsing behaviors impact individual beliefs about oral disease risk, the efficacy of floss and mouthrinse, and the perceived benefits and barriers of floss and mouthrinse.

Methods: Participants in this required component of a 12-week plaque and gingivitis randomized clinical trial on flossing and rinsing regimens completed a paper questionnaire prior to randomization and baseline/screening measurements.

Results: All of the clinical trial participants (n=213) completed the questionnaire. Respondents were grouped as habitual or non-habitual users of floss or mouthrinse if the product was used at least once daily; 16% (n=34) were habitual users of floss and 17% (n=36) were habitual users of mouthrinse. Perceived barriers included fear of gingival bleeding and pain, forgetting, and not including flossing or rinsing as part of the daily oral care routine. Non-habitual users were less likely to believe in the intangible benefits of flossing or rinsing and much more likely to perceive barriers to using floss or mouthrinse. Risk perception of developing oral disease was not shown to predict product usage. Respondents viewed their risk of developing gingivitis as relatively low despite this diagnosis being confirmed clinically among the participants.

Conclusion: While respondents strongly believed that brushing, flossing, and mouthrinse use carry unique benefits and that combining all three methods would be optimal, these respondents still had high perceived barriers to using floss and mouthrinse regularly and consequently these habits were not included in their daily oral hygiene regimen. Understanding the perceptions regarding oral health behaviors may help drive more effective interventions and assist practitioners in improving their patients' oral health outcomes.

Keywords: dental floss, mouthrinse, oral hygiene habits, health behaviors, gingivitis

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Introduction

Dental floss is one of the most commonly recommended interdental cleaners because of its ability to reach between the teeth, where toothbrush bristles are not able to easily access, and effectively remove interproximal food, debris and dental biofilm.¹ The Food and Drug Administration (FDA) has classified dental floss as a Class I medical device for removal of plaque and food particles between teeth to reduce tooth decay.² A 2019 Cochrane review of the literature found that the use of interdental brushes or dental floss in conjunction with toothbrushing may reduce gingivitis or plaque or both, when compared to toothbrushing alone.³ Another Cochrane review on the use of dental floss for the management of periodontal disease and dental caries in adults, identified

evidence supporting the use of flossing plus toothbrushing with a small reduction in plaque over the short term (one to three months). Currently, major dental professional associations post information for the public on their websites relating to various oral hygiene routines.⁴⁻⁷

Chemotherapeutic mouthrinses have been shown to access areas in the oral cavity that are difficult to reach with a toothbrush and can help to control plaque, gingivitis, dental caries, and oral malodor depending on the specific formulation of the rinse. The benefits of chemotherapeutic mouthrinses have been consistently demonstrated in a wide range of clinical studies and in subsequent systematic reviews and meta-analyses.⁸⁻¹⁶ Two recent clinical trials comparing various levels of supervised

oral hygiene regimens including flossing and rinsing with an essential oil mouthrinse further reinforced the clinical relevance of adding a chemotherapeutic rinse to the oral care regimen.^{17,18} However, daily recommendations for mouthrinse use are inconsistent across professional organizations.^{5,19} The American Dental Association's (ADA) Council on Scientific Affairs has issued advice on the benefits of ADA Accepted antimicrobial mouthrinses to help prevent and reduce plaque and gingivitis dating back to May 2007,²⁰ and dental hygienists have been identified as key sources of information regarding the evidence supporting antimicrobial rinsing as part of oral hygiene practice.²¹ Yet, despite the published evidence supporting the efficacy of adding a chemotherapeutic mouthrinse to the oral care regimen, reasons as to why the daily use of floss and mouthrinse have not been widely adopted by the general public are not fully understood.

The Delta Dental Oral Health and Well-Being Survey conducted in 2014 found that 35% of the adults surveyed reported flossing at least once daily while 19% reported never using dental floss.²² In a study analyzing two years' worth of data from the National Health and Nutrition Examination Survey (NHANES), Fleming et al. found that 32% of respondents reported they had not used floss at all in the previous week, while an equal number reported using floss daily, and the remaining third reported flossing their teeth only on some days of the previous week.²³ Certain demographic factors seem to influence dental floss use. Women were more likely to floss daily than men; Asian, non-Hispanic and Hispanic adults were more likely than white, non-Hispanic adults to use floss; those who do not use tobacco more likely than current tobacco users to use floss.²³

In a study focused on mouthrinse use patterns in Scotland, daily mouthrinsing was only practiced by 25% of the respondents, while 38% reported never using it and 17% used it less than once a month.²⁴ Again, women were more likely to use mouthrinse than men, and never-smokers more likely to use a mouthrinse than both current and former smokers; usage decreased with age and lower socioeconomic status.²⁴ Results from this study also identified that people experiencing periodontal disease, ulcers, oral infections/swelling and other problems were all more likely than healthy people to report using mouthrinse.²⁴

While it is helpful to know which types of patients might be less likely to use dental floss or mouthrinse, these demographic differences do not necessarily indicate how interventions for promoting better oral health might be best designed. There are a limited number of published studies that have investigated how individual beliefs and perceptions might influence flossing or mouthrinsing behaviors. Identifying these beliefs might help clarify the most effective methods for health care practitioners to open conversations with patients or for public health outreach programs to encourage specific strategies and product use.

Previous research suggests that attitudes and beliefs about oral health, including feelings of self-efficacy, predict intentions to improve oral care behaviors, while current behavior and subjective norms do not.²⁵ In a study by Buglar et al., self-efficacy, or the confidence in one's ability to perform oral self-care, significantly predicted brushing and flossing behavior, in addition to the perceived barriers to these behaviors.²⁶ Ronis et al. similarly found that flossing habits were best predicted by self-efficacy and perceived barriers, but only looked at a small number (fewer than five) of potential barriers.²⁷

The opportunity to survey the beliefs and perceptions of a larger number of individuals enrolling in a clinical trial focused on various toothbrushing, flossing and mouthrinsing regimens, could provide new insight into these attitudes and provide insight on how to better promote effective oral health regimens. The purpose of this survey was to investigate how flossing and rinsing behaviors impact beliefs about oral disease risk, the efficacy of floss and mouthrinse in patients with gingivitis, and the perceived benefits and barriers of floss and mouthrinse. It further sought to examine the differences that exist between habitual and non-habitual users of dental floss and mouthrinse.

Methods

An original, ten-part survey was administered once at the start of a 12-week clinical trial prior to examination and randomization. The purpose of the clinical trial was to evaluate the efficacy of brushing, flossing, and mouthrinsing regimens in the prevention and reduction of plaque and gingivitis. The clinical trial took place at Salus Research, Inc., an American Dental Association (ADA) qualified clinical research site²⁸ located in Fort Wayne, Indiana, USA. The trial received institutional review board approval from IntegReview (Austin, TX, USA) and was registered on clinicaltrials.gov (NCT04750005). After receiving a thorough explanation of the trial and the opportunity to ask questions in private, all participants provided written informed consent on a document which complied with the requirements of the Health Insurance Portability and Accountability Act.

Sample

Participants were from the Fort Wayne, Indiana area and were selected for screening from the clinical test site's database. Males and females between the ages of 18 to 60 years (age limited by the sponsor due to Covid-19 risks at the time of the trial) in good general and oral health, without known allergies to commercial dental products, and with at least 20 teeth with scorable facial and lingual surfaces, were eligible for consideration. All participants needed to present with evidence of gingivitis (although no minimum score on the MGI was required) and be without evidence of advanced periodontitis. Participants needed to have at least 10% bleeding sites based on the Expanded Bleeding Index (EBI), a maximum of three sites of 5mm probing depth and no sites greater than 5mm at the

baseline/screening clinical examination. Participants agreed to attend virtual smart-phone video daily sessions on weekdays for trial procedures. Other inclusion criteria included absence of fixed or removable orthodontic appliances, removable partial dentures, significant oral soft tissue pathology excluding plaque-induced gingivitis, at the discretion of the investigator/dental examiner. Participants were excluded for a variety of reasons, including: dental prophylaxis within four weeks prior to baseline/screening; needing antibiotics prior to dental treatment; use of certain medications within last month (antibiotics, anti-inflammatory or anticoagulant therapy within one month); use of chemotherapeutic oral care products within two weeks; being pregnant or lactating; use of smokeless tobacco, vaping or e-cigarettes or suspected substance abuse; and any other medical or psychiatric condition that would make the volunteer inappropriate for the trial in the judgment of the principal investigator (PI).

Survey instrument

A quantitative recall questionnaire was developed by members of a cross-functional team with more than 20 years expertise in clinical and consumer research studies and product development and followed consumer product industry practices. The ten-part questionnaire consisted of core items previously developed by the sponsor for oral care products to which new items that focused on specific elements of the clinical trial were added. Overall, the questionnaire was designed to identify specific lifestyle measures of the respondents. The questionnaire utilized multiple-choice (habits) and scaled responses (perceptions, beliefs). Table I presents the structure of the questionnaire and description of the items. Individual questions are provided on Tables III, IV, and V. For the purpose of this questionnaire, the term mouthwash was used and may be considered interchangeable with mouthrinse.

Oral care habits and practices

Respondents reported how frequently they brushed their teeth, used mouthrinse, and flossed, with options of “never,” “occasionally,” “once daily,” “at least twice daily,” and “more than twice daily.” Given current recommendations for the use of floss and mouthrinse, respondents were considered ‘habitual users’ of floss or mouthrinse if they used the respective product at least once daily.

Risk perception

Respondents used a 7-point Likert scale (1=strongly disagree to 7=strongly agree) to rate their own perceived risk of developing oral health problems to three items, specifically, “I think my risk of developing gingivitis (red or bleeding gums) is relatively low,” “I think my risk of developing dental cavities is low,” and “I think my risk of losing my teeth as I get older is relatively low.”

Efficacy beliefs of floss and mouthrinse

Responding to ten items, respondents rated the perceived necessity and relative importance of brushing, flossing, and rinsing with mouthrinse on oral health using a 7-point

Table I. Survey structure and item descriptions

| |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part I: 5 multiple choice items regarding respondent’s oral hygiene habits (ie, toothbrushing, use of mouthwash, use of floss); 4 items and 1 open ended question for individuals to quantify time to complete flossing |
| Part II: 2 multiple choice items about respondent’s self-perception about flossing and use of mouthwash |
| Part III: 3 items inquiring about respondent’s belief about their risk for specific oral diseases with responses on a 7-point Likert scale (strongly agree to strongly disagree) |
| Part IV: 10 items inquiring about respondent’s belief regarding the importance of specific oral hygiene habits (flossing, mouthwash, brushing) with responses on a 7-point Likert scale (strongly agree to strongly disagree) |
| Part V: 1 item asking respondents to characterize use of dental floss by 7 descriptors with responses on a 7-point Likert scale (good to bad; pleasant to unpleasant) |
| Part VI: 1 item asking respondents to characterize, on a 7-point Likert scale (easy to difficult), daily use of floss |
| Part VII: 20 items asking respondents to qualify how daily flossing would impact their oral health, self-perception, and others’ perception of them, with responses on a 7-point Likert scale (strongly agree to strongly disagree) |
| Part VIII: 6 items asking respondents about their capability to floss under specific circumstances with responses on a 7-point Likert scale (strongly agree to strongly disagree) |
| Part IX: 18 items inquiring about respondent’s beliefs regarding flossing with responses on a 7-point Likert scale (strongly agree to strongly disagree) |
| Part X: 11 items inquiring about respondent’s beliefs regarding mouthwash with responses on a 7-point Likert scale (strongly agree to strongly disagree) |

Likert scale (1=strongly disagree to 7=strongly agree). Items included “I think that flossing is as necessary as brushing,” “rinsing with mouthrinse is a necessary part of protecting oral health,” “flossing and using mouthrinse are equally good at accomplishing the goal of reaching hard to reach places in the mouth,” and “brushing, flossing, and rinsing with mouthrinse each add unique and necessary benefits to oral care.”

Perceived benefits of daily flossing and rinsing

Respondents rated the potential benefits of flossing and rinsing daily as recommended by responding to 20 items using a 7-point Likert scale (1=strongly disagree to 7=strongly agree). Items included benefits related to physical health “my gums would be healthier” and “I would get fewer cavities”, cosmetic concerns “my appearance and smile would be improved” and “I

would be less likely to have bad breath”, and less tangible, emotional benefits “I would feel more confident” and “I would feel good about my oral care routine”.

Perceived barriers to using floss and mouthrinse

To understand how difficult or easy maintaining a daily flossing habit is perceived, six items assessed respondents’ self-efficacy beliefs about their own capability to floss using a 7-point Likert scale (1=strongly disagree to 7=strongly agree). Items included “If I wanted to, I could floss even on days that I am busy and overloaded” and “I could floss even while I am on vacation.”

To assess which barriers may make flossing less likely, 18 items asked about a variety of potential factors that make flossing more difficult or undesired and used a 7-point Likert scale (1=strongly disagree to 7=strongly agree). Items included “flossing is painful for me,” “flossing takes too much time,” “my gums bleed if I floss,” and “I find it physically difficult to floss.” Similarly, 11 items assessed barriers to using mouthrinse, most of which overlapped those for floss. Items included “mouthwash is overpriced,” “I just forget to rinse with mouthwash sometimes,” “my dentist/dental hygienist has not told me to rinse with mouthwash,” and “I think I brush well enough that rinsing with mouthwash just won’t add much.”

Procedure

Respondents completed the paper questionnaire regarding their beliefs, habits, and behavior regarding their oral health, including their floss and mouthrinse usage (not brand-specific) at the baseline/screening visit, prior to randomization into the clinical trial.¹⁸ After completing informed consent documents, all participants had their medical and dental histories, and inclusion and exclusion criteria reviewed, then completed the questionnaire. Only one questionnaire was completed by each participant.

Statistical Analysis

Habitual floss users included those who responded that they used dental floss at least once daily and non-habitual floss users included those who did not floss and those who flossed occasionally. Likewise, habitual mouthrinse users included those who responded that they used mouthrinse at least once daily and non-habitual mouthrinse users included those who did not use mouthrinse and those who used mouthrinse occasionally. Survey questions with Likert scale responses had responses collapsed into two categories: agree responses (ie, strongly agree, agree, somewhat agree) and disagree responses (ie, strongly disagree, disagree, somewhat disagree). Responses to one item included a visual analog scale of responses (e.g., good to bad; beneficial to harmful).

Means for habitual users and non-habitual users for floss and mouthrinse were performed using two-sample t-tests, using a 5% significance level, two-sided. The t-tests used a pooled variance approach if the equal variances assumption was not rejected, or Satterthwaite’s method if the equal variances assumption was rejected. A folded F-test was used for comparing the variances between habitual and non-habitual users. SAS version 9.4 (SAS Institute, Cary, NC, USA) was used for statistical analyses.

Results

All the participants enrolled in the clinical trial (n=213) completed the survey. The sample included 165 females (77.5%) and 48 males (22.5%) ranging from 18 to 59 years of age with an average age of 42 years. Participants

self-identified their race, with 81.7% (n=174) White/Caucasian, 10.8% (n=23) Black/African American, 1.9% (n=4) Asian, 3.8% Hispanic (n=8) and 5.6% (n= 12) other. Only 1.4% (n=3) identified as using tobacco products (smokers). Sample demographics are shown in Table II.

Oral Care Habits and Practices

All respondents brushed at least daily as per the trial eligibility criteria, with 25.8% (n= 55) brushing once daily, 71.4% (n=152) brushing twice daily, and 2.8% (n=6) brushing three or more times. Of particular note, few respondents were habitual users (at least once daily) of either dental floss (16.0%, n=34) or mouthrinse (16.9%, n=36) and 4.2% (n=9) reported using floss or mouthrinse twice daily. By comparison, 29.6% (n=63) reported never using mouthrinse and 10.8% (n=23) reported never using floss. Overall, 6.6% (n=14) were habitual users of both dental floss and mouthrinse.

Efficacy Beliefs for Floss and Mouthrinse

There was high agreement (somewhat agree, agree, or strongly agree) with statements such as “brushing, flossing, and rinsing with mouthwash each add unique and necessary benefits to oral care” (89.7%, n=191) and that “combining brushing, flossing, rinsing is the superior oral

Table II. Sample demographics and baseline characteristics (n=213)

| Characteristic | Total |
|------------------------|--------------|
| n | 213 |
| Mean Age, y (SD) | 42.0 (10.57) |
| Sex | n (%) |
| Male | 48 (22.5) |
| Female | 165 (77.5) |
| Race | n (%) |
| White | 174 (81.7) |
| Black/African American | 23 (10.8) |
| Asian | 4 (1.9) |
| Other | 12 (5.6) |
| Ethnicity | n (%) |
| Hispanic/Latino | 8 (3.8) |
| Not Hispanic/Latino | 205 (96.2) |
| Smoker | n (%) |
| No | 210 (98.6) |
| Yes | 3 (1.4) |

care routine" (91.1%, n=194), indicating participants' stronger endorsement of floss and mouthrinse as essential. While most agreed that flossing is as necessary as brushing (77.9%, n=166) less than half (46.9%, n=100) believed this to be true for mouthrinse, and while most agreed flossing is necessary to protect oral health (88.3%, n=188) only 65.7% (n=140) agreed mouthrinsing is necessary to protect oral health. This positive perception of the unique place that dental floss holds in the oral care routine was further reflected in responses to the statements "electric toothbrushes do the same job as floss" with only 16.4% (n=35) of the respondents indicating any agreement as compared to 61.5% (n=131) indicating any level of disagreement (somewhat disagree, disagree, strongly disagree). Similarly, in response to the item "I think flossing adds little benefit to good brushing habits," most participants (53.5%, n=114) disagreed, suggesting participants understand the importance of flossing. However, most (70.4%, n=150) agreed with the item "flossing and mouthwash are equally good at accomplishing the goal of reaching hard to reach places in the mouth" with only 17.4% (n=37) in disagreement.

Perceived Benefits of Daily Flossing and Rinsing

Overall, most of the 20 potential benefits of flossing and rinsing daily were strongly endorsed by the respondents (Table III). The two potential benefits that received the highest endorsement were "my gums would be healthier" and "I would be protecting my teeth from plaque and decay" (91.1%, n=194; for both statements). Seventeen of the items had over 70% (n=149) of respondents agreeing that daily flossing and rinsing provided a benefit, with physical health benefits generally being agreed with the most. Items that received the least agreement were the belief that daily flossing and rinsing would improve appearance and smiles (61%, n=130 agreeing; 12.2%, n=26 disagreeing), make one feel better about oneself (57.7%, n=123 agreeing; 8.5%, n=18, disagreeing), and that others would notice an improvement (40.4%, n=86 agreeing; 17.8%, n=38 disagreeing). Even for these items, the rates of disagreement were still rather low, suggesting respondents either endorsed them or were unsure, and none of these items centered on the physical health benefits of flossing and rinsing.

Perceived Barriers to Using Floss and Mouthrinse

Many of the potential barriers to flossing were endorsed as personal challenges of the respondents (Table IV). Interestingly, the barriers with the greatest levels of agreement were routine-based such as "flossing is not a habit of mine" (66.7%, n=142), "I just forget to floss sometimes" (65.3%, n=139), and "flossing is not part of my oral care routine" (64.3%, n=137). The next highest levels of agreement concerned practical matters of flossing, including "my gums bleed when I floss" (46.9%, n=100) and "I have trouble physically getting the floss in some parts of my mouth" (39.4%, n=84).

Similar to the perceived barriers to flossing, the barriers that received the greatest levels of agreement for rinsing were

"rinsing with mouthwash is not part of my oral care routine" (67.1%, n=143 agreeing) and "I just forget to rinse with mouthwash sometimes" (51.6%, n=110 agreeing). Perceived barriers to rinsing are shown in Table V. However, unlike with flossing, the next highest items were "mouthwash is overpriced" (27.2%, n=58) and "my dentist/hygienist has not told me to rinse with mouthwash" (26.3%, n=56). Results for all items are presented in Table V.

Perceived Oral Health Risk

In general, respondents believed that their risk of oral health problems was relatively low. In terms of developing dental caries, over half (58.2%, n=124) agreed their risk was relatively low compared to 29.1% (n=62) who disagreed. Most (65.7%, n=140) also believed their risk of losing their teeth with age was low compared to 22.5% (n=48) who disagreed. Interestingly, over half (56.8%, n=121) also believed that their risk for gingivitis was low, while 29.6% (n=63) indicated disagreement to gingivitis risk. This is particularly noteworthy given that, due to the inclusion criteria, all participants had at least mild gingivitis and a minimum gingival bleeding site requirement of 10% or more.

Respondents were divided into habitual and non-habitual users of dental floss and mouthrinse to better understand the underlying difference between the users and non-users of these products. Habitual floss users (floss at least once daily, n=34) and non-habitual floss users (n=179), and habitual mouthrinse users (rinse at least once daily, n=36) and non-habitual mouthrinse users (n=177) were compared on their perceived oral health risks. Independent t-tests showed that these groups did not differ on risk perception depending on whether they flossed or rinsed regularly ($p>0.05$). Habitual and non-habitual floss and mouthrinse user groups perceived themselves to be at similarly low risk for oral health diseases.

Perceived Benefits and Barriers by Product Usage

Perceptions regarding the benefits of daily flossing and rinsing were compared across habitual and non-habitual users. Habitual floss and rinse users were shown to be more likely to agree that daily usage would lead to their mouths feeling more pleasant, improve their smile and appearance, and feel better about themselves, compared to non-habitual users of floss or mouthrinse ($p<0.05$). Additionally, habitual flossers agreed more strongly than non-habitual flossers that they feel they are doing the right thing for their oral health ($p=0.015$), they are protecting their teeth from plaque and decay ($p=0.024$), they feel good about their oral care routine ($p=0.001$), and that their mouths feel totally clean ($p=0.010$). Habitual users of mouthrinse also agreed more strongly than non-habitual mouthrinse users that their teeth would last a lifetime ($p=0.024$), they would feel more confident ($p=0.018$), others would notice an improvement ($p\leq 0.050$), and their teeth would be healthier ($p=0.003$). No other comparisons were significant ($p<0.05$). The perceived benefits and barriers of floss and mouthrinse by habitual and non-habitual users are shown in Table VI.

Table III. Perceived benefits of daily flossing and rinsing (n=213)

| | 1 = Strongly Disagree (%) | 2 = Disagree (%) | 3 = Somewhat Disagree (%) | 4 = Neither Agree nor Disagree (%) | 5 = Somewhat Agree (%) | 6 = Agree (%) | 7 = Strongly Agree (%) |
|---------------------------------------------------------------------------------------------------------------|---------------------------|------------------|---------------------------|------------------------------------|------------------------|---------------|------------------------|
| My mouth would be cleaner | 1.4 | 1.9 | <1.0 | 6.6 | 17.8 | 46.9 | 24.9 |
| My mouth would feel more pleasant | 1.4 | 1.4 | 1.9 | 11.7 | 19.7 | 39.9 | 23.9 |
| I would be less likely to have bad breath | 1.4 | 1.4 | 1.4 | 17.4 | 25.4 | 31.5 | 21.6 |
| I would be less likely to develop oral disease | <1.0 | <1.0 | 1.4 | 9.4 | 17.8 | 39.9 | 29.6 |
| I would get fewer cavities | <1.0 | <1.0 | 3.8 | 14.1 | 21.6 | 32.9 | 25.8 |
| My appearance and smile would be improved | 2.3 | 3.8 | 6.1 | 26.8 | 23.0 | 24.9 | 13.1 |
| I would feel better about myself | 2.8 | 2.8 | 2.8 | 33.8 | 13.1 | 30.0 | 14.6 |
| My teeth would last a lifetime | 1.4 | 1.4 | 7.0 | 19.2 | 34.7 | 24.4 | 11.7 |
| I would feel like I did the right thing for my oral health | <1.0 | 0.0 | 1.4 | 7.0 | 19.2 | 39.9 | 31.5 |
| My gums would be healthier | <1.0 | 0.0 | <1.0 | 7.0 | 16.9 | 39.9 | 34.3 |
| I would be protecting my teeth from plaque and decay | <1.0 | 0.0 | 1.4 | 6.6 | 19.2 | 43.7 | 28.2 |
| I would feel good about my oral care routine | <1.0 | 0.0 | 1.9 | 9.4 | 18.3 | 39.9 | 29.6 |
| I would be proud of myself for my oral care routine | <1.0 | 0.0 | <1.0 | 12.7 | 18.8 | 36.6 | 30.5 |
| I would worry less about my oral health | <1.0 | 2.3 | 1.9 | 21.1 | 20.2 | 35.7 | 17.8 |
| I would feel like my oral care routine is more complete | <1.0 | <1.0 | <1.0 | 8.0 | 19.7 | 42.3 | 27.2 |
| My mouth would feel totally clean | <1.0 | 1.4 | 2.8 | 9.9 | 29.1 | 35.2 | 21.1 |
| If I used mouthwash in addition to brushing and flossing, then the feeling of a clean mouth would last longer | <1.0 | <1.0 | 1.4 | 11.7 | 23.5 | 40.4 | 21.1 |
| I would feel more confident | 1.9 | 1.9 | 1.9 | 23.9 | 21.6 | 33.8 | 15.0 |
| I think other people would notice an improvement | 3.3 | 5.6 | 8.9 | 41.8 | 19.2 | 15.0 | 6.1 |
| My teeth would be healthier | <1.0 | <1.0 | 1.4 | 10.3 | 20.7 | 40.8 | 25.8 |

Table IV. Perceived barriers to flossing (n=213)

| | 1 = Strongly Disagree (%) | 2 = Disagree (%) | 3 = Somewhat Disagree (%) | 4 = Neither Agree nor Disagree (%) | 5 = Somewhat Agree (%) | 6 = Agree (%) | 7 = Strongly Agree (%) |
|--------------------------------------------------------------------------------|---------------------------|------------------|---------------------------|------------------------------------|------------------------|---------------|------------------------|
| Flossing is painful for me | 13.1 | 33.8 | 8.5 | 13.6 | 23.9 | 4.7 | 2.3 |
| Flossing takes too much time | 14.1 | 24.4 | 12.7 | 18.8 | 22.1 | 6.6 | 1.4 |
| I cannot find the time to floss | 18.8 | 33.8 | 12.7 | 20.2 | 12.7 | 1.9 | 0.0 |
| I find it physically difficult to floss | 29.6 | 35.7 | 8.5 | 11.7 | 8.9 | 5.2 | <1.0 |
| I have trouble physically getting the floss in some parts of my mouth | 18.8 | 28.2 | 6.6 | 7.0 | 22.1 | 12.7 | 4.7 |
| My gums bleed if I floss | 8.9 | 21.6 | 7.0 | 15.5 | 31.0 | 11.3 | 4.7 |
| Flossing is not a habit of mine | 8.9 | 11.3 | 8.0 | 5.2 | 21.6 | 29.6 | 15.5 |
| Flossing is not part of my oral care routine | 9.9 | 11.7 | 9.4 | 4.7 | 25.8 | 25.4 | 13.1 |
| Floss is overpriced | 26.3 | 34.7 | 7.5 | 27.2 | 3.3 | <1.0 | <1.0 |
| I just forget to floss sometimes | 7.0 | 8.0 | 1.9 | 17.8 | 26.8 | 27.2 | 11.3 |
| I think I brush well enough that flossing won't add much | 16.9 | 25.4 | 16.9 | 19.2 | 14.6 | 5.6 | 1.4 |
| My flossing technique isn't very good | 8.5 | 20.2 | 9.4 | 23.9 | 21.6 | 13.6 | 2.8 |
| I would need to floss for at least two minutes to get the benefits of flossing | 5.2 | 7.0 | 13.6 | 36.2 | 14.6 | 20.2 | 3.3 |
| I do not like the feeling of flossing | 16.0 | 32.4 | 5.6 | 19.2 | 16.4 | 8.0 | 2.3 |
| I do not like the taste of flossing | 20.2 | 39.0 | 8.0 | 24.4 | 4.2 | 4.2 | 0.0 |
| I'm not sure that flossing really helps remove plaque | 20.7 | 37.1 | 15.0 | 16.9 | 7.0 | 2.8 | <1.0 |
| Flossing is just too much trouble | 20.2 | 27.7 | 8.0 | 21.1 | 16.9 | 4.7 | 1.4 |
| My dentist/hygienist has not shown me how to floss | 32.4 | 36.6 | 7.5 | 12.7 | 2.3 | 6.6 | 1.9 |

Table V. Perceived barriers to mouthrinse use (n=213)

| | 1 = Strongly Disagree (%) | 2 = Disagree (%) | 3 = Somewhat Disagree (%) | 4 = Neither Agree nor Disagree (%) | 5 = Somewhat Agree (%) | 6 = Agree (%) | 7 = Strongly Agree (%) |
|------------------------------------------------------------------------|---------------------------|------------------|---------------------------|------------------------------------|------------------------|---------------|------------------------|
| Rinsing with mouthwash takes too much time | 21.6 | 42.7 | 14.6 | 14.1 | 6.1 | <1.0 | 0.0 |
| I cannot find the time to use mouthwash | 22.5 | 44.6 | 14.6 | 12.7 | 4.2 | <1.0 | <1.0 |
| Rinsing with mouthwash is not part of my oral care routine | 7.5 | 9.4 | 9.9 | 6.1 | 20.7 | 33.3 | 13.1 |
| Mouthwash is overpriced | 14.6 | 20.7 | 8.0 | 29.6 | 15.5 | 7.0 | 4.7 |
| I just forget to rinse with mouthwash sometimes | 8.9 | 13.1 | 3.8 | 22.5 | 23.5 | 22.1 | 6.1 |
| I think I brush well enough that rinsing with mouthwash won't add much | 12.2 | 25.4 | 17.8 | 22.5 | 10.3 | 11.3 | <1.0 |
| I do not like the feeling of rinsing with mouthwash | 17.4 | 36.6 | 13.1 | 11.7 | 13.1 | 5.2 | 2.8 |
| I do not like the taste of rinsing with mouthwash | 16.4 | 35.7 | 12.2 | 11.7 | 14.1 | 5.2 | 4.7 |
| I'm not sure that rinsing with mouthwash really helps remove plaque | 16.9 | 28.6 | 16.4 | 18.8 | 12.2 | 5.2 | 1.9 |
| Rinsing with mouthwash is just too much trouble | 18.3 | 41.8 | 9.9 | 20.2 | 7.0 | 1.9 | <1.0 |
| My dentist/hygienist has not told me to rinse with mouthwash | 23.9 | 30.5 | 3.8 | 15.5 | 9.4 | 13.6 | 3.3 |

Habitual and non-habitual flossers were further compared regarding their perceptions of barriers to flossing. Although self-efficacy was relatively high overall, habitual flossers perceived flossing adoption to be easier as compared to non-habitual users across all items ($p < 0.01$). Habitual flossers agreed more strongly that they could floss daily, even under emotional distress, busy times, or while on vacation. The groups also differed significantly on most potential barriers, with the exceptions being perceptions that floss is overpriced and that they have not been shown how to floss by a dentist/dental hygienist (both $p > 0.05$). Both statements received very low endorsements from the habitual and non-habitual groups. However, non-habitual users were significantly more likely to endorse the other barriers. Most notably, non-habitual users were more likely to agree that their gums bleed if they floss ($M = 4.2$ vs 2.6 , $p < 0.001$), flossing is not a habit of theirs ($M = 5.2$

vs 2.3 , $p < 0.001$), flossing is not part of their oral care routine ($M = 5.0$ vs 2.1 , $p < 0.001$), and that they just forget to floss sometimes ($M = 5.0$ vs 3.4 , $p < 0.001$). These findings accounted for the most strongly endorsed barriers to flossing. Results for the perceived barriers to flossing by habitual and non-habitual users are presented in Table VII.

Similarly, habitual and non-habitual mouthrinse users were compared in their perceptions of barriers to using mouthrinse (Table VIII). Notably, habitual and non-habitual users did not differ in beliefs about mouthrinse use taking too much time, which had fairly low levels of agreement ($M = 2.3$ and 2.5 , respectively, $p > 0.05$), however, the groups differed on all other items. Interestingly, given the higher levels of endorsement, non-habitual mouthrinse users were more likely to say mouthrinse is just not a part of their routine ($M = 5.3$ vs 2.3 , $p < 0.001$), and that they just forget to rinse sometimes ($M = 4.5$ vs 3.2 , $p < 0.001$).

Table VI. Perceived benefits and risks of daily flossing and rinsing by habitual and non-habitual users (n=213)*

| | Habitual Floss Users (n=34) | Non-Habitual Floss Users (n=179) | | Habitual Mouthrinse Users (n=36) | Non-Habitual Mouthrinse Users (n=177) | |
|------------------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------|-------------------|-------------------------------------|------------------------------------------|--------------------|
| | Mean (SD) | Mean (SD) | <i>p</i> -value** | Mean (SD) | Mean (SD) | <i>p</i> -value*** |
| My mouth would be cleaner | 6.0 (1.00) | 5.7 (1.18) | 0.170 | 5.9 (1.04) | 5.8 (1.18) | 0.535 |
| My mouth would feel more pleasant | 6.1 (0.78) | 5.5 (1.29) | 0.002 | 5.9 (0.79) | 5.6 (1.30) | 0.021 |
| I would be less likely to have bad breath | 5.6 (1.33) | 5.4 (1.24) | 0.568 | 5.6 (1.36) | 5.4 (1.23) | 0.312 |
| I would be less likely to develop oral disease | 6.1 (1.10) | 5.8 (1.16) | 0.158 | 5.9 (1.13) | 5.8 (1.16) | 0.740 |
| I would get fewer cavities | 5.8 (0.95) | 5.5 (1.30) | 0.152 | 5.8 (1.02) | 5.5 (1.30) | 0.329 |
| My appearance and smile would be improved | 5.6 (0.92) | 4.8 (1.46) | <0.001 | 5.4 (0.96) | 4.8 (1.48) | 0.007 |
| I would feel better about myself | 5.5 (1.31) | 4.9 (1.43) | 0.018 | 5.4 (1.05) | 4.9 (1.48) | 0.019 |
| My teeth would last a lifetime | 5.4 (1.31) | 5.0 (1.22) | 0.062 | 5.5 (1.06) | 5.0 (1.26) | 0.024 |
| I would feel like I did the right thing for my oral health | 6.2 (0.73) | 5.8 (1.11) | 0.015 | 6.1 (0.78) | 5.8 (1.12) | 0.094 |
| My gums would be healthier | 6.1 (0.74) | 5.9 (1.10) | 0.143 | 6.1 (0.81) | 5.9 (1.10) | 0.342 |
| I would be protecting my teeth from plaque and decay | 6.2 (0.80) | 5.8 (1.07) | 0.024 | 5.9 (0.87) | 5.9 (1.08) | 0.963 |
| I would feel good about my oral care routine | 6.2 (0.70) | 5.7 (1.16) | 0.001 | 5.9 (0.83) | 5.8 (1.16) | 0.368 |
| I would be proud of myself for my oral care routine | 6.0 (0.95) | 5.8 (1.14) | 0.262 | 6.0 (0.79) | 5.8 (1.17) | 0.139 |
| I would worry less about my oral health | 5.5 (1.02) | 5.3 (1.31) | 0.568 | 5.5 (1.03) | 5.3 (1.31) | 0.549 |
| I would feel like my oral care routine is more complete | 6.1 (0.74) | 5.8 (1.16) | 0.051 | 6.0 (0.81) | 5.8 (1.15) | 0.096 |
| My mouth would feel totally clean | 5.9 (0.85) | 5.5 (1.18) | 0.010 | 5.7 (1.14) | 5.5 (1.14) | 0.347 |
| Using mouthwash in addition to brushing and flossing, the feeling of a clean mouth would last longer | 5.8 (0.82) | 5.6 (1.18) | 0.287 | 5.9 (0.94) | 5.6 (1.16) | 0.080 |
| I would feel more confident | 5.6 (1.02) | 5.2 (1.33) | 0.107 | 5.6 (0.96) | 5.2 (1.34) | 0.018 |
| I think other people would notice an improvement | 4.6 (1.33) | 4.3 (1.35) | 0.255 | 4.8 (1.24) | 4.3 (1.36) | 0.050* |
| My teeth would be healthier | 5.9 (0.90) | 5.7 (1.10) | 0.370 | 6.1 (0.72) | 5.7 (1.11) | 0.003 |

* Mean responses are on a Likert scale, 1 (strongly disagree) to 7 (strongly agree)

p*<0.050; *p*=0.0495

Discussion

Results from this survey help to illuminate reasons for low adoption rates of using both dental floss and mouthrinse as part of the daily oral care routine. Respondents of this survey reported that they are not flossing or using mouthrinse as frequently as generally recommended by oral health care professionals. Interestingly, results from this survey indicate that practices of daily flossing were lower than those reported in previously published studies.^{22,23} In general, respondents believed their risk for gingivitis, tooth loss, or dental caries was relatively low. This was notable given that all the participants in this trial were previously screened from the trial site's database as having some gingivitis. All individuals accepted for participation in the trial met the inclusion criteria to have a minimum gingival bleeding site requirement of $\geq 10\%$ as assessed by a dental examiner at baseline/screening. An assumption might be that non-habitual users of dental floss and/or mouthrinse may not do so because they perceive their risk is lower than habitual users. However, this low level of perceived risk did not differ between habitual and non-habitual users, suggesting that there may be another component influencing perceived risk for oral disease.

Overall, participants indicated understanding that brushing, flossing, and mouthrinsing provide unique and valuable benefits to oral health. Respondents indicated stronger endorsement for the essential role of dental floss in oral care regimens as compared with mouthrinse. However, there was very strong agreement that both daily flossing and rinsing provide clear and broad benefits for oral health. This is perhaps not surprising given the recommendations made by dental professionals and organizations regarding interdental cleaning and the use of mouthrinses.^{4-7,19}

Table VII. Perceived barriers to flossing by habitual and non-habitual users (n=213)*

| | Habitual Floss Users (n=34) | Non-Habitual Floss Users (n=179) | |
|--------------------------------------------------------------------------------|-----------------------------|----------------------------------|---------|
| | Mean (SD) | Mean (SD) | p-value |
| I can start flossing immediately on a regular basis | 6.2 (0.70) | 5.6 (1.21) | <0.001 |
| I could floss even on days when I feel busy and overloaded | 6.1 (0.74) | 5.7 (1.18) | 0.002 |
| I could floss even on days when I am feeling tired | 6.2 (0.65) | 5.6 (1.18) | <0.001 |
| I could floss even on days when I am feeling down in the dumps | 6.2 (0.61) | 5.7 (1.22) | <0.001 |
| I could floss even when I am feeling anxious or nervous | 6.2 (0.65) | 5.7 (1.13) | <0.001 |
| I could floss even while I am on vacation | 6.3 (0.68) | 5.9 (1.04) | 0.006 |
| Flossing is painful for me | 2.4 (1.40) | 3.4 (1.64) | 0.001 |
| Flossing takes too much time | 2.1 (0.95) | 3.6 (1.59) | <0.001 |
| I cannot find the time to floss | 1.9 (0.99) | 3.0 (1.39) | <0.001 |
| I find it physically difficult to floss | 1.9 (1.12) | 2.6 (1.57) | 0.001 |
| I have trouble physically getting the floss in some parts of my mouth | 2.8 (1.81) | 3.5 (1.93) | 0.038 |
| My gums bleed if I floss | 2.6 (1.52) | 4.2 (1.64) | <0.001 |
| Flossing is not a habit of mine | 2.3 (1.49) | 5.2 (1.63) | <0.001 |
| Flossing is not part of my oral care routine | 2.1 (1.32) | 5.0 (1.62) | <0.001 |
| Floss is overpriced | 2.3 (1.22) | 2.5 (1.29) | 0.324 |
| I just forget to floss sometimes | 3.4 (1.97) | 5.0 (1.48) | <0.001 |
| I think I brush well enough that flossing won't add much | 2.0 (1.10) | 3.3 (1.55) | <0.001 |
| My flossing technique isn't very good | 2.6 (1.45) | 4.0 (1.57) | <0.001 |
| I would need to floss for at least two minutes to get the benefits of flossing | 3.6 (1.76) | 4.3 (1.35) | 0.018 |
| I do not like the feeling of flossing | 2.3 (1.40) | 3.4 (1.69) | <0.001 |
| I do not like the taste of flossing | 2.1 (1.31) | 2.8 (1.37) | 0.017 |
| I am not sure that flossing really helps remove plaque | 2.1 (0.98) | 2.7 (1.40) | 0.003 |
| Flossing is just too much trouble | 2.1 (1.37) | 3.3 (1.60) | <0.001 |
| My dentist/hygienist has not shown me how to floss | 2.2 (1.32) | 2.5 (1.61) | 0.361 |

*Mean responses are on a Likert scale, 1 (strongly disagree) to 7 (strongly agree).

Table VIII. Perceived barriers to mouthrinse use by habitual and non-habitual users (n=213)*

| | Habitual Mouthrinse Users (n=36) | Non-Habitual Mouthrinse Users (n=177) | |
|------------------------------------------------------------------------|----------------------------------|---------------------------------------|---------|
| | Mean (SD) | Mean (SD) | p-value |
| Rinsing with mouthwash takes too much time | 2.3 (1.33) | 2.5 (1.18) | 0.490 |
| I cannot find the time to use mouthwash | 1.9 (1.04) | 2.4 (1.20) | 0.020 |
| Rinsing with mouthwash is not part of my oral care routine | 2.3 (1.43) | 5.3 (1.45) | <0.001 |
| Mouthwash is overpriced | 2.4 (1.29) | 3.7 (1.67) | <0.001 |
| I just forget to rinse with mouthwash sometimes | 3.2 (1.81) | 4.5 (1.61) | <0.001 |
| I think I brush well enough that rinsing with mouthwash won't add much | 2.2 (0.98) | 3.5 (1.55) | <0.001 |
| I do not like the feeling of rinsing with mouthwash | 2.1 (1.12) | 3.1 (1.65) | <0.001 |
| I do not like the taste of rinsing with mouthwash | 2.2 (1.27) | 3.2 (1.74) | ≤0.001 |
| I'm not sure that rinsing with mouthwash really helps remove plaque | 2.3 (1.23) | 3.2 (1.57) | 0.001 |
| Rinsing with mouthwash is just too much trouble | 1.9 (0.79) | 2.8 (1.40) | <0.001 |
| My dentist/hygienist has not told me to rinse with mouthwash | 2.3 (1.60) | 3.3 (1.90) | 0.004 |

* Mean responses are on a Likert scale, 1 (strongly disagree) to 7 (strongly agree)

Over 90% of the respondents agreed that daily flossing and rinsing practices would result in healthier gums and protect their teeth from plaque and decay. However, despite the beliefs that flossing and rinsing will improve oral health in an at-risk population, only 16% reported flossing daily and only 17% reported using a mouthrinse at least once daily. There were areas identified where increased education might encourage individuals to adopt good oral care behaviors. Non-habitual users were significantly less likely to believe that flossing or mouthrinse use could provide psychosocial benefits such as improving their appearance and smile, suggesting that these may be more useful points of discussion for oral health professionals attempting to persuade patients to adopt these habits. Also, as non-habitual flossers were more likely to say that their gums would bleed if they flossed, it would be important for oral health professionals to explain that bleeding is a sign of inflammation indicating that an individual needs to floss more frequently and that habitual interdental cleaning would reduce these symptoms.²⁹

Professional and supervised daily dental flossing and mouthrinsing have been shown to be beneficial in reducing gingival bleeding.^{17,18} Results from Milleman et al. suggest that the addition of flossing to brushing and mouthrinsing regimens contributed incrementally

to the reduction of whole mouth and interproximal percent bleeding sites after 4 weeks, but not at 12 weeks, as compared to brushing and rinsing alone.¹⁸ In spite of the research to support the incorporation of mouthrinsing into daily oral health regimens,⁸⁻¹⁶ one of the barriers cited by more than one quarter of the respondents in this survey was that their dental professionals had not recommended mouthrinsing to them. Receiving the endorsement from their oral health care professional to use mouthrinse may provide the motivation to incorporate it into their daily oral hygiene routine. Habit formation is a means to promote healthy behaviors such as flossing and mouthrinsing.^{30,31} The goal should be to achieve optimal oral health for patients. Mouthrinses are an effective option to offer patients as an adjunct to brushing, flossing or other types of interdental cleaning.

Results from this survey suggest that it may be the perceived barriers to flossing and rinsing, rather than beliefs about efficacy or benefits, that are the strongest differentiators in habitual flossing and mouthrinsing. People often forget to use these products, do not like the way they feel or taste, and do not include them as part of their current oral care routines. Oral health care providers may find that discussing strategies for healthy habit formation, promoting self-efficacy in developing these habits, and addressing the specific patient perceived barriers are more likely to lead to healthy oral care behaviors rather than discussing benefits or efficacy of these products. Research suggests applying the theory of planned behavior and motivational habit formation approaches may increase individuals' intentions towards incorporating new oral health behaviors.^{30,31}

Given that the main barriers to habitual use of floss and mouthrinse were not due to lack of knowledge regarding their benefits, but rather

due to forgetfulness, incorporation of behavior change theory for habit formation may be particularly useful in future research. Future studies should support the development of effective interventions to increase the daily use of mouthrinse and interdental cleaners such as dental floss.

Limitations

This survey used self-reported information and did not capture actual flossing and mouthrinsing behaviors. Moreover, the sample was limited to volunteers for a clinical trial and may not be representative of the general population. The clinical trial also specifically recruited people with some gingivitis and the results may not generalize to a population with higher or lower levels of gingival inflammation. The trial was also conducted during the COVID-19 pandemic, which may have further influenced who volunteered (e.g., age, risk tolerance) for the trial and the mindset of the participants.

Conclusion

While a majority of the participants in this survey strongly endorsed the belief that brushing, flossing, and using a mouthrinse carry unique benefits and that combining all three methods would be optimal for oral health, results suggest that the perceived barriers to using floss and mouthrinse regularly limited the adoption of these self-care routines. Dental professionals should consider assisting patients with strategies to build habits for effective interdental cleaning. Understanding the perceptions and barriers regarding oral health behaviors may help drive more effective interventions and support practitioners in improving their patients' oral health outcomes.

Disclosures

Johnson & Johnson Consumer Inc. (JJCI; Skillman, NJ, USA) sponsored this clinical trial and was responsible for the trial design and the collection, analysis, and interpretation of the data. Katie Rotella, Mary Lynn Bosma, James McGuire, Anusha Sunkara, and Alicia DelSasso are employees of JJCI. Jeffery Milleman and Kimberly Milleman are principals at Salus Research, Inc., and have received grants from JJCI to conduct this trial. Megan Gaff is employee at Salus Research, Inc.

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