# Research

## Utilization of Periodontal Risk Assessment Tools in the Clinical Setting: Knowledge, attitudes and practice behaviors of dental hygienists

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### Abstract

**Purpose:** Identifying individuals at risk for developing periodontal disease helps to prevent, treat, and manage this condition. The purpose of this study was to explore the knowledge, attitudes, and practice behaviors of dental hygienists regarding the use of periodontal risk assessment tools.

**Methods:** This cross-sectional survey study used a convenience sample of dental hygienists recruited through social media and snowball sampling. The validated electronic survey included items related to demographics, knowledge, attitude, and practice behaviors regarding the use of periodontal risk assessment tools in the clinical setting. Descriptive statistics were used to analyze the data and outcomes were represented through frequencies and percentiles.

**Results:** Two-hundred eighty-two of the respondents (n=282) (n=530) met the inclusion criteria, for a participation rate of 53%. A majority (88%) "agreed" or "strongly agreed" that periodontal risk assessment tools improve communication and increase educational opportunities with patients and 50% reported completing periodontal risk assessments during a patient's scheduled appointment. Significant relationships existed between "frequently" or "always" reviewing periodontal risk assessment outcomes and the participants age, place of employment and number of continuing education (CE) hours completed ($p$=0.004). Participants who were members of the American Dental Hygienists' Association (ADHA) were more likely to correctly answer three or more knowledge questions ($p$=0.01), and more likely to measure and record pocket depths in a periodontal risk assessment tool ($p$=0.005).

**Conclusion:** Although dental hygienists reported periodontal risk assessment tools were helpful for patient communication and education, only 50% reported regular completion while providing patient care. Continuing education on the value of periodontal risk assessment tools and better understanding of the barriers to routine implementation, could expand their use.

**Keywords:** dental hygienists, clinical practice, periodontal risk assessment, periodontal risk assessment tools, periodontal disease, periodontal probing

This manuscript supports the NDHRA priority area, **Client level: Basic science** (clinical decision support tools).

Submitted for publication: 12/20/19; accepted: 6/25/20

## Introduction

Periodontal disease is a significant oral health problem in the United States (U.S.), affecting approximately 46% of all adults.[1,2] Periodontal disease plays an important role in an individual's oral health, systemic health, and overall quality of life.[3,4] Risk factors associated with periodontal disease include, but are not limited to, tobacco use, diabetes, medications, age, heredity, and stress.[1,2] Accurate diagnosis and identifying at risk patients helps to prevent, properly treat, and manage periodontal disease.[3,5]

Periodontal disease susceptibility varies greatly and is now regarded as a multifaceted interaction between an individual's inflammatory and immune responses.[3,6] Risk factors for periodontal disease are influenced by individual modifiable and non-modifiable factors.[7,8] While these risk factors have been associated with the development of or progression of periodontal disease; at risk patients may not be informed of their disease status during routine dental care.[5,7] Recognizing a patient's periodontal risk level is essential in dentistry and should be assessed at every comprehensive and periodontal evaluation.[9]

To help assess a patient's level of periodontal risk, there are a variety of assessment tools available. Mathematical algorithms have been used in computerized periodontal risk assessment

tools to enable prognosis accuracy and limit subjectivity.[7,10,11] Computerized periodontal risk assessment tools have the potential to better identify individuals at high risk before the disease has progressed, allowing for early intervention with the goal of reducing the need for more complex periodontal therapy.[7,11] These tools can also support patient education regarding the risk factors that can be modified to prevent, treat, and manage periodontitis.[10,11] Additionally, periodontal risk assessment tools can provide clinicians' with a framework for planning individualized periodontal treatment and the management of modifiable risk factors.[10,11]

The efficacy of periodontal risk assessment tools is an important consideration in patient care. Prediction of clinical periodontal outcomes are key factors for risk assessment in periodontal disease.[12] Research studies on computerized periodontal risk assessment tools have shown that these tools were able to predict tooth loss and recognize the progression of periodontitis.[13,14] These risk assessment tools have been shown to provide more uniform guidance in predicting disease progression, leading to an increase in early interventions, and reducing the need for more complex interventions.[13,14] In spite of what is known regarding the benefits of periodontal risk assessment tools, clinicians have underestimated their value.[8]

Currently, there is limited research on the use of periodontal risk assessment tools in the dental setting.[5,15] However, Thyvalikakath et al. demonstrated that periodontal risk assessment tools could help improve patients' overall health, provide patient education, and improve business.[5] In addition to considering providers' perception of using periodontal risk assessment tools, it is also important to consider patient's reactions to their risk factors. The use of these tools has been shown to provide patients with a higher degree of understanding regarding the severity of their disease.[5,16-19] In addition, patients expressed a greater intent to follow periodontal treatment recommendations.[5,16-19] More research is needed to more fully explore the impact of periodontal risk assessment tools.[8] The purpose of this study was to identify the knowledge, attitudes, and practice behaviors among dental hygienists in clinical practice regarding the use of periodontal risk assessment tools.

## Methods

This study was approved by the MCPHS University Institutional Review Board (IRB), protocol number IRB080919B. A descriptive, cross-sectional survey research design was chosen, using a convenience sample of dental hygienists recruited via dental hygiene social media sites. Dental hygienists with an active license and six months or more experience providing patient care in a clinical setting

a minimum of 1 day/week, fluency in reading and speaking English, and the ability to access and complete a web-based survey were included in the sample population.

### Statistical analysis

A statistical power analysis and effect size (medium effect size; w=0.03) was performed. The projected sample size needed for an alpha=.05, power=0.80, and a medium effect size (G*Power 3.1), was approximately n=143. A proposed sample size of n=204 was considered more than adequate and allowed for an expected attrition of 30%.

Chi-square tests of independence were used to assess the relationship between categorical demographic variables and survey responses. To improve interpretation and decrease alpha inflation, age was recoded into three separate groups 18-34, 35-54, and 55+. Knowledge was recoded into either the pass group (three or more correctly answered questions), attitudes were recoded into 1=strongly disagree or disagree, 2=neutral, and 3=strongly agree or agree. Clinical practice questions were further collapsed into 1=sometimes or never and 2=frequently or always. Age, education level, years in practice, continuing education (CE) hours, and membership in the American Dental Hygienists' Association (ADHA) were tested for association with knowledge (pass/fail), attitudes, and practices.

### Survey Instrument

The survey included outcome and predictor variables. The instrument was developed based on the literature and included: demographic and professional characteristics (7 items), knowledge (5 items), attitudes (9 items), and practice behavior (10 items). The knowledge questions were selected from information found in the current literature on the subject of periodontal risk assessment tools.[5,3,8,9,18-22] Several response scales were used, including multiple choice, 4-point Likert scale (1=never, 2=sometimes, 3=frequently, and 4=always), and a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree).

The survey instrument was validated using a content validity index (CVI), resulting in a S-CVI score of 0.97. A panel of experts (n=7) rated each question according to its relevance. The expert panel consisted of dental professionals experienced with periodontal risk assessment tools, researchers of periodontal risk assessment, and educators on the use of periodontal risk assessment tools. Revisions were made based on the expert panel feedback. Pilot testing was performed by dental hygienists who met inclusion criteria (n=9); no further changes were required after testing.

### Recruitment

Administrators of dental hygiene Facebook groups, LinkedIn, and Instagram were asked for approval to post the survey invitation. Upon approval, the invitation was posted with a link to the survey instrument hosted through SurveyMonkey™(San Mateo, CA). Members of the social media sites were encouraged to share the survey with other dental hygienists who met the inclusion criteria. Informed consent was obtained before proceeding to the survey. Data collection was carried out over a four-week period (August to September 2019).

### Data analysis

The Statistical Package for the Social Sciences 23 (IBM, Armonk, NY) software was used for data analysis. Responses were summarized and reposed with measures of central tendency (e.g. mean (average) and variance (e.g. standard deviation). All variables were analyzed for statistical assumptions including normalcy and co-linearity. Outliers were identified and removed. Data were analyzed for missing items and any participant with less than 80% of responses completed was removed from analysis.

Statistical testing by cross tabulation, including chi square test of independence or appropriate correlations (Pearson or Spearman), were used to explore the relationship between variables. A t-test or ANOVAs for categorical demographics and linear regression for continuous predictors as fixed effects, were used to determine the effect of demographic or independent variables on the primary outcome variables. The acceptable alpha level was set at .05 for hypothesis testing. Measures of effect size (medium effect size; $w=0.03$, e.g. 95% Confidence Interval, $R^2$, Phi Coefficient) was determined and reported.

## Results

A total of 530 respondents opened the link to the survey; 248 respondents were removed due to lack of starting the survey. An additional 20 respondents were removed from the sample due to completing less than 80% of the survey, yielding a participation rate of 53% (n=282). One-third of the participants were between 45 to 54 years of age (n=92, 33%), and over one-half (n=155, 55%) had been practicing dental hygiene for over 15 years. Participant demographics are shown in Table I.

### Knowledge

Knowledge responses were calculated by scoring each of the five knowledge questions as either correct=1 or incorrect=0. The largest number of correct responses was three questions

**Table I. Respondent demographics (n=282)**

|  | n | % |
|---|---|---|
| **Age** | | |
| 18 to 24 | 11 | 3.9% |
| 25 to 34 | 51 | 18.1% |
| 35 to 44 | 53 | 18.8% |
| 45 to 54 | 92 | 32.6% |
| 55 to 64 | 64 | 22.7% |
| >65 to 74 or older | 11 | 3.9% |
| **Gender** | | |
| Female | 281 | 99.6% |
| Male | 1 | 0.4% |
| Transgender Female | 0 | 0.0% |
| Transgender Male | 0 | 0.0% |
| Gender Variant/Non-Confirming | 0 | 0.0% |
| Prefer Not to Answer | 0 | 0.0% |
| **Highest level of education completed.** | | |
| Associate degree | 146 | 51.8% |
| Bachelor's degree | 111 | 39.4% |
| Master's degree | 25 | 8.9% |
| Doctoral degree | 0 | 0.0% |
| **Years of dental hygiene practice** | | |
| Less than 1 year | 2 | 0.7% |
| 1-5 years | 47 | 16.7% |
| 6-10 years | 42 | 14.9% |
| 11-15 years | 35 | 12.4% |
| More than 15 years | 156 | 55.3% |
| **Hours of periodontal risk assessment continuing education in past 5 years** | | |
| 0 hours | 34 | 12.1% |
| 1-4 hours | 108 | 38.3% |
| 5-8 hours | 66 | 23.4% |
| 9+ hours | 74 | 26.2% |
| **American Dental Hygienists' Association Member** | | |
| Yes | 94 | 33.3% |
| No | 188 | 66.7% |
| **Current employment Setting** | | |
| Clinical Practice | 244 | 86.5% |
| Public Health | 19 | 6.7% |
| Education | 13 | 4.6% |
| Research | 1 | 0.4% |
| Other | 5 | 1.8% |

with 34% of the respondents. Only respondent (0.1%) answered all five questions correctly. Response distributions for the sample are shown in Table II. Members of the ADHA were more likely (50%) to have three or more correctly answered knowledge questions than non-members $(x^2(1)=6.53, p=0.01, phi=-0.15)$. All other comparisons of demographic variables to knowledge questions were not statistically significant $(p>0.05)$.

**Table II. Knowledge items (n=282)**

| | | n | % |
|---|---|---|---|
| Which of the items listed below is a non-modifiable periodontal risk factor? | Incorrect | 29 | 10.3% |
| | Correct | 253 | 89.7% |
| The American Academy of Periodontology recommends periodontal risk assessments be completed at which evaluation? | Incorrect | 153 | 54.3% |
| | Correct | 129 | 45.7% |
| Which of the following is not a benefit of using periodontal risk assessment tools to determine a patient's periodontal disease risk in the clinical setting? | Incorrect | 255 | 90.4% |
| | Correct | 27 | 9.6% |
| Which item listed below is not a common risk variable used in periodontal risk assessment tools? | Incorrect | 187 | 66.3% |
| | Correct | 95 | 33.7% |
| According to recent studies, clinicians expressed which of the following as a major barrier for using periodontal risk assessment tools in the clinical setting? | Incorrect | 151 | 53.5% |
| | Correct | 131 | 46.5% |

### *Attitudes*

Attitude and belief questions had a five-point Likert Scale (strongly disagree=1, disagree=2, undecided=3, agree=4, and strongly agree=5). Across the nine attitude/belief items, participants largely responded with positive beliefs and attitudes towards periodontal risk assessment. Most (84%) agreed or strongly agreed that periodontal risk assessment tools were an integral part of dental hygiene practice and 88%, agreed or strongly agreed that periodontal risk assessment tools improved communication and increased educational opportunities with patients. Attitude and belief response distributions are shown in Table III.

Participants with no CE hours were the least likely (65%) to agree or strongly agree with the statement, "I am confident in my ability to identify and classify periodontal disease without the use of a periodontal risk assessment tool" as compared to participants with 1-4 hours ( 81%), 5-8 (89%), or 9+ hours (89%) of CE $(x^2(6)=14.77, p=0.02, phi=0.23)$. Nearly one quarter of the participants with no CE hours (24%) were also least likely to agree or strongly agree with the statement, "I believe that periodontal risk assessment tools decrease clinician subjectivity in assessing a patient's periodontal risk of future disease," compared to respondents with 1-4 hours (38%), 5-8 (42%), or 9+ hours (39%), $(x^2(6)=16.74, p=0.01, phi=0.24)$. A majority of the participants (84%) reported using a periodontal risk assessment tool is an integral part of dental hygiene practice and felt using a periodontal risk assessment tool improves communication and increases educational opportunities with patients (88%). All other comparisons of demographic variables to attitude questions were not statistically significant $(p>0.05)$.

### *Practice*

Practice related items were coded on a four-point Likert scale (1=never, 2=sometimes, 3=frequently, 4=always). Most clinical practice items were identified as frequently or always regarding the occurrence of periodontal risk assessment practices in clinical practice. A majority of respondents (85%) agreed with the statement "The dentist or dental hygienist measures patients' pockets depths and records required findings into periodontal risk assessment tool." Nearly three-fourths of the participants (72.7%) indicated that they always or frequently completed a periodontal risk assessment tool during the patient care appointment in an effort to collect patient's current health and behavior data for accurate periodontal risk level findings. Over one-half (62.0%) indicated always or frequently completing periodontal risk assessments outcomes or that they reviewed these reports with the patient. Clinical practices of the respondents are shown in Table IV.

Participants aged 55 years and older were most likely (87%) to be employed in a dental practice that frequently or always reviewed risk assessment outcomes with patients as compared to respondents aged 35-54 years (68%), and 18-34 years (65%), $(x^2(2)=11.12, p=0.004, phi=0.20)$. Participants aged 55 years and older were also more likely (77%) to be employed in a practice setting where the dental hygienist frequently or always recorded the bleeding on probing (BOP) as compared to those aged 35-54 years (54%) and 18-34 years (63%). Dental hygienists holding a master's degree were less likely (52%) to be employed in a dental practice allowing for the use of periodontal risk assessment tools, as compared to respondents holding a bachelor's degree (n=80, 72%) or associate degree (n=112, 77%) who reported that their practice setting frequently or always allowed for the use of a periodontal risk assessment tool $(x^2(2)=6.60, p=0.04, phi=0.15)$.

**Table III. Attitude Questions (n=282)**

| | Strongly Disagree | | Disagree | | Undecided | | Agree | | Strongly Agres | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n Count | % | n Count | % | n Count | % | n Count | % | n Count | % |
| I feel using periodontal risk assessment tools, to determine a patient's periodontal risk level, is an integral part of dental hygiene practice | 21 | 7.4% | 2 | 0.7% | 23 | 8.2% | 102 | 36.2% | 134 | 47.5% |
| I feel using periodontal risk assessment tools improves communication and increases educational opportunities with patients | 15 | 5.3% | 5 | 1.8% | 13 | 4.6% | 115 | 40.8% | 134 | 47.5% |
| I feel I have enough time to perform periodontal risk assessment on each patient | 42 | 14.9% | 112 | 39.7% | 41 | 14.5% | 72 | 25.5% | 15 | 5.3% |
| I am confident in my ability to explain periodontal risk assessment results with the patient | 5 | 1.8% | 20 | 7.1% | 48 | 17.0% | 135 | 47.9% | 74 | 26.2% |
| I am confident in my ability to identify and classify periodontal disease without the use of a periodontal risk assessment tool | 4 | 1.4% | 6 | 2.1% | 38 | 13.5% | 142 | 50.4% | 92 | 32.6% |
| I feel using periodontal risk assessment tools improves communication between myself and the dentist | 37 | 13.1% | 112 | 39.7% | 73 | 25.9% | 46 | 16.3% | 14 | 5.0% |
| I feel periodontal risk assessment tools improve treatment processes and patient outcomes | 20 | 7.1% | 75 | 26.6% | 68 | 24.1% | 87 | 30.9% | 32 | 11.3% |
| I feel I can assess periodontal risk based on my personal knowledge, expertise and practice experience, and do not feel a risk assessment tool is of value | 6 | 2.1% | 14 | 5.0% | 19 | 6.7% | 144 | 51.1% | 99 | 35.1% |
| I believe that periodontal risk assessment tools decrease clinician subjectivity in assessing a patient's periodontal risk of future disease | 12 | 4.3% | 81 | 28.7% | 83 | 29.4% | 87 | 30.9% | 19 | 6.7% |

Current members of the ADHA were more likely to frequently or always (73%) measure patient's pocket depths and record into a periodontal risk assessment tool than non-members (56%), ($x^2(1)=7.71$, $p=0.005$, phi$=0.17$). Several practice items were dependent on the number of CE hours a participant had completed in the last five years. Relationships between practice items and CE hours in periodontal risk assessment are shown in Table V.

## Discussion

As preventative specialists, dental hygienists are in a unique position to use periodontal risk assessment tools to educate patients regarding their level of periodontal disease risk.[20] While most participants were knowledgeable about the identification of modifiable and non-modifiable risk factors for periodontal disease, the majority lacked sufficient knowledge regarding the benefits of risk assessment tools, common risk variables, and when to complete a periodontal risk assessment evaluation. Thyvalikakath et al. conducted qualitative research with focus groups to explore use of periodontal risk assessment tools and identified the need to educate all oral health care providers on performing risk assessments.[5] The study findings suggested these tools could enable clinicians to play a bigger role in patient care as well as

**Table IV. Clinical practice related items (n=282)**

| | Never | | Sometimes | | Frequently | | Always | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| DH* completes periodontal risk assessment tool during patients scheduled appointment in an effort to collect patient's current health and behavior data for accurate periodontal risk level findings, i.e., smoking history | 16 | 5.7% | 61 | 21.6% | 85 | 30.1% | 120 | 42.6% |
| Dentist or DH measures patients' pocket depths and records required findings into periodontal risk assessment tool | 15 | 5.3% | 27 | 9.6% | 94 | 33.3% | 146 | 51.8% |
| DH records BOP on patients and records required findings into periodontal risk assessment tool | 17 | 6.0% | 62 | 22.0% | 89 | 31.6% | 114 | 40.4% |
| DH evaluates patients' current and historical radiographs and records required information into periodontal risk assessment tool | 20 | 7.1% | 45 | 16.0% | 77 | 27.3% | 140 | 49.6% |
| DH inquires about HbA1c levels for diabetic patients, and discuss the relationship between periodontal disease and diabetes | 34 | 12.1% | 73 | 25.9% | 63 | 22.3% | 112 | 39.7% |
| Periodontal risk assessment outcomes or reports are printed for each patient | 182 | 64.5% | 67 | 23.8% | 19 | 6.7% | 14 | 5.0% |
| Periodontal risk assessments outcomes or reports are reviewed with the patient | 54 | 19.1% | 53 | 18.8% | 65 | 23.0% | 110 | 39.0% |
| My dental practice or place of employment allows for the use of periodontal risk assessment tools to assess a patient's level of risk | 71 | 25.2% | 63 | 22.3% | 57 | 20.2% | 91 | 32.3% |
| My dental practice or place of employment implements periodontal risk assessment tools as an evidence-based approach to individualized dental care | 74 | 26.2% | 62 | 22.0% | 70 | 24.8% | 76 | 27.0% |
| My dental practice or place of employment encourages continuing education classes on the benefits of using periodontal risk assessment tools | 87 | 30.9% | 65 | 23.0% | 54 | 19.1% | 76 | 27.0% |

* Dental hygienist

educate patients regarding their periodontal risk to improve oral health outcomes.[5] Increasing dental providers education on the various periodontal risk assessment tools could in turn expand knowledge of the benefits of these tools. Participants who held membership in the ADHA were 50% more likely to have three or more correct responses in the knowledge section demonstrating a possible relationship between belonging to a professional association and increased knowledge level relating to periodontal risk assessment tools. This relationship may be due to increased exposure to these assessment tools as a result of professional programs or education opportunities for association members.

Study findings demonstrated a positive relationship between dental hygienists who considered a periodontal risk assessment tool an integral component of dental hygiene practice (84%) and improving communication and educational opportunities with patients (88%). There was also a strong relationship between participants who reported not having any CE hours on periodontal risk assessment tools and a lack of confidence and ability to identify and classify periodontal disease without the use of a risk assessment tool demonstrating a need for more education on the benefits of using periodontal risk assessment tools for both the clinician and the patient. Research conducted by Asimakopoulou et al. identified that practitioner - patient

**Table V. Clinical practice item relationships by CE hours in periodontal risk assessment in the past 5 years (n=282)**

| 0 hours | | | | 1-4 hours | | | | 5-8 hours | | | | 9+ hours | | | | Chi square Test | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sometimes or never | | Frequently or always | | Sometimes or never | | Frequently or always | | Sometimes or never | | Frequently or always | | Sometimes or never | | Frequently or always | | $x^2$ | Phi |
| (n) | % | (n) | % | (n) | % | (n) | % | (n) | % | (n) | % | (n) | % | (n) | % | | |
| 21 | 61.8% | 13 | 38.2% | 31 | 28.7% | 77 | 71.3% | 17 | 25.8% | 49 | 74.2% | 8 | 10.8% | 66 | 89.2% | 30.7** | 0.33 |
| 13 | 38.2% | 21 | 61.8% | 17 | 15.7% | 91 | 84.3% | 8 | 12.1% | 58 | 87.9% | 4 | 5.4% | 70 | 94.6% | 20.3** | 0.27 |
| 19 | 55.9% | 15 | 44.1% | 38 | 35.2% | 70 | 64.8% | 14 | 21.2% | 52 | 78.8% | 8 | 10.8% | 66 | 89.2% | 28.2** | 0.32 |
| 18 | 52.9% | 16 | 47.1% | 26 | 24.1% | 82 | 75.9% | 12 | 18.2% | 54 | 81.8% | 9 | 12.2% | 65 | 87.8% | 23.0** | 0.29 |
| 20 | 58.8% | 14 | 41.2% | 51 | 47.2% | 57 | 52.8% | 25 | 37.9% | 41 | 62.1% | 11 | 14.9% | 63 | 85.1% | 27.0** | 0.31 |
| 32 | 94.1% | 2 | 5.9% | 98 | 90.7% | 10 | 9.3% | 60 | 90.9% | 6 | 9.1% | 59 | 79.7% | 15 | 20.3% | 7.4 | 0.16 |
| 21 | 61.8% | 13 | 38.2% | 50 | 46.3% | 58 | 53.7% | 22 | 33.3% | 44 | 66.7% | 14 | 18.9% | 60 | 81.1% | 23.4** | 0.29 |
| 26 | 76.5% | 8 | 23.5% | 56 | 51.9% | 52 | 48.1% | 30 | 45.5% | 36 | 54.5% | 22 | 29.7% | 52 | 70.3% | 21.7** | 0.2 |
| 26 | 76.5% | 8 | 23.5% | 57 | 52.8% | 51 | 47.2% | 31 | 47.0% | 35 | 53.0% | 22 | 29.7% | 52 | 70.3% | 21.9** | 0.28 |
| 29 | 85.3% | 5 | 14.7% | 67 | 62.0% | 41 | 38.0% | 30 | 45.5% | 36 | 54.5% | 26 | 35.1% | 48 | 64.9% | 28.8** | 0.32 |

* See Table IV   **=p=0.001. Df for all tests = 3

encounters focused on individualized risk communication increased the patient's awareness of disease risk and increased intentions to adhere to periodontal treatment which was consistent with our findings.[16]

Participants employed in practices or other employment settings that allowed for the use of periodontal risk assessment tools indicated that they had adequate time to perform periodontal risk assessments. These findings were similar to those of Francisco et al. who studied dental hygienists performing caries risk assessments during the dental hygiene care appointment.[23] Findings from this study were unexpected since the additional time needed to complete and use and a periodontal risk assessment tool has been suggested as a barrier to implementation in previous research.[5,23] Reasons for this difference in findings is unknown, but may be impacted by the self-selection of participants, a limitation of non-probability sampling.

Continuing education hour content on periodontal risk assessment tools was shown to be a strong predictor of clinical practice behaviors. Significant relationships were identified between CE hours in the last five years and hygienists utilizing periodontal risk assessment tools at patients scheduled appointments, inquiring about HbA1c levels for patients with diabetes, reviewing periodontal risk assessment outcomes with patients, and employment in clinical settings allowing for the use of periodontal risk assessment tools. These clinical settings implemented periodontal risk assessment tools as an evidence-based approach to individualized dental care and encouraged CE on utilizing periodontal risk assessment tools.

Research indicates there are barriers to using periodontal risk assessment tools in clinical practice. The validity of the science, cost of implementation, and lack of reimbursement have been cited as major barriers.[5,17] There is also a gap in the literature regarding the long-term success of periodontal risk assessment tools.[10] In addition, recently developed Periodontal Classifications now includes grading, which

addresses some of the major modifiers of periodontal disease progression, such as diabetes and tobacco use. However, web-based periodontal risk assessment tools have the added benefit of using complex algorithms to improve accuracy of assessing risk, which is not possible with other approaches.[16] It is yet to be demonstrated how the new classification system could be used together with a periodontal risk assessment tool to identify the modifiable risk factors that clinicians and patients can address to modify long term disease progression of disease.

This study had limitations. The non-probability convenience sample and self-selection bias limiting generalization of the findings. Access to social media and technology was also a limitation and may have introduced bias by individuals who use social media versus those who do not. Other limitations included self-report and recall bias. Close-ended questions, although quick and less costly to analyze, may have limited the accuracy of the respondents. There were also inconsistencies in responses related to items in the clinical practice section of the survey. Approximately 50% of the respondents indicated using a periodontal risk assessment tool, however 85% reported recording periodontal probing depths in a periodontal risk assessment tool. This inconsistency may be due to a misinterpretation of the survey item. Future studies should examine the impact of periodontal risk assessment tool use on long-term patient outcomes and continue to explore barriers to implementation of periodontal risk assessment tools in clinical practice as well as patient perceptions of their use. Comparisons between periodontal risk assessment tools and the 2017 Periodontal Classification system should also be studied.

## Conclusion

Periodontal disease requires prevention and management strategies for oral health care professionals and patients. Periodontal disease risk identification also plays a key role in patient education. Results from this study demonstrated a need to improve dental hygienists' knowledge, attitudes, and practice behaviors regarding the use of periodontal risk assessment tools. Continuing education in periodontal risk and disease management should be implemented to increase dental hygienists' knowledge and utilization of these evidence-based tools.

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