SCIENTIFIC RESEARCH REPORT

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A simple self-report health assessment questionnaire to identify oral diseases

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Background: One approach to addressing oral health disparities for at-risk populations has been to increase discussion of oral health by non-dental healthcare providers. This study examined the accuracy of a simple instrument to detect individuals with a history of dental disease, which would then allow referral for an oral health evaluation. **Materials and methods:** A two-question instrument was evaluated for the relationship to oral diseases, periodontal disease, and decayed, missing and filled teeth in 391 individuals seen in a dental school clinic for non-emergent dental care over a 3-month period. Clinical dental findings were used as outcome variables. The oral health parameters were dichotomised, using different levels of disease severity. The criteria were increased and decreased in an effort to test the robustness of our method. **Results:** While the sensitivity outcomes with one question alone showed significant ability to predict oral disease (59–71%), the addition of a second self-assessment question increased the sensitivity (76–91%) for all oral health parameters studied. As the criteria for oral disease increased so did the sensitivity of this instrument. **Conclusion:** The results presented here offer evidence that a simple two-item questionnaire is an efficient and effective method of detecting populations at-risk for oral diseases.

Key words: *Self-assessment survey, oral disease, primary healthcare, health personnel, healthcare providers*

INTRODUCTION

Oral health disparities for at-risk populations represents an important health challenge globally[1] and in the USA[2]. One suggested approach to addressing this issue has been to increase integration of oral health services into the larger healthcare environment, with an emphasis on interprofessional collaboration[3]. However, these types of initiatives have been slow to spread to non-dental health settings. As an example, approximately 85% of US surveyed adults with diabetes mellitus indicated their medical provider had not informed them about the relationship between oral health and dysglycaemia[4], and only an estimated 30% of US paediatric medical practices provide oral health information to parents of their patients[5].

While approximately 95% of Americans agree that regular dental visits will contribute to their general health, 37% actually visit an oral health provider in a 12-month period[2]. Further, 74% of low-income adults and 48% of high-income adults in the USA believe that tooth loss is a normal component of aging, when actually this condition more often is a result of untreated dental diseases[2]. Finding an effective and efficient means for non-dental health providers to identify individuals in need of dental care can potentially increase the number of Americans receiving dental examinations, preventive services and necessary treatment of dental diseases.

Although previous research has examined the use of self-rated health questionnaires for specific dental diseases[6], this report is the first to our knowledge to examine a two-question instrument for the accuracy in identifying individuals with a history of multiple dental conditions. This research is a first step towards establishing a simple and valid survey instrument that can feasibly be used by non-dental medical providers to identify individuals who require a referral for dental healthcare. Further research would be needed to examine the use of this instrument for individuals seeking non-dental services.

MATERIALS AND METHODS

Study population

A self-reported survey was used to assess the health behaviours of 391 individuals who were seen at a dental school clinic for non-emergent dental care over a 3-month period. Study participants were not continuous care patients of this dental clinic, and represent a convenience sample of individuals seeking initial care examinations. Inclusion requirements were: adults ≥ 18 years old; ability to understand English or Spanish. Individuals that were edentulous or pregnant were excluded. This research was approved by the Internal Review Board of Columbia University, and is in accordance with the World Medical Association Declaration of Helsinki. Further, all study participants provided written consent. Adults were asked to complete questions regarding their oral and general health as well as health-related behaviours, including diet, alcohol consumption, physical activity and tobacco use.

Measurements

The survey included 41 items on four health behaviour topic domains, as well as questions regarding oral and systemic health and healthcare. Survey items were taken from the 2013 Behavior Risk Factor Surveillance System (2013 BRFSS)[7] and the 2013 New York City Community Health Survey (2013 NYC CHS)[8]. Two survey questions regarding individual self-assessment of oral and general health were used in this analysis.

(i) Oral health: "Overall, how would you rate the health of your teeth and gums?: (a) excellent; (b) very good; (c) good; (d) fair; (e) poor"; (ii) General health: "Would you say that in general your health is: (a) excellent; (b) very good; (c) good; (d) fair; (e) poor".

Oral disease parameters used for analysis were: decayed, missing and filled teeth (DMFT), number of missing teeth (M) and periodontal probing depth (PD).

Decayed, missing and filled teeth are a reliable measure of past and present disease of dentition, and are often used in surveys for caries experience[9]. Existing restorations such as fillings and crowns indicate past and expected need of future care[9]. Tooth loss is frequently used as a summative measure of advanced dental disease, primarily dental caries and periodontitis[11]. Additionally, tooth loss can reflect social factors related to oral healthcare access and utilisation[11,12]. Periodontal probing depth is an indication of the health of the supporting structures of the mouth, including alveolar bone, mucosal tissue and periodontal ligament[13,14]. Different oral conditions were used to examine the robustness of this instrument and assess the relationship of self-assessed oral and general health with the most common dental conditions.

Statistical analysis

The oral health self-assessment and general health self-assessment were dichotomised as fair/poor and good/excellent, and correlated, both individually and in combination, with various oral health parameters, including DMFT, M and PD (expressed as % of teeth with at least one site with probing depth ≥ 5 mm). Clinical criteria for disease severity were selected as outcome variables and were used to dichotomise the oral health parameters using various cutoff values. The sample mean was used as the cutoff value for DMFT, and the cutoff value for M, ≥ 4, was based on previous research for identification of periodontal disease[15]. The 75th percentile for the % of teeth with at least one site ≥ 5 mm was used as the cutoff value for PD to define moderate periodontal disease[16]. Chi-squared tests for 2×2 tables are used to assess the association. Odds ratios for the associations between the self-assessment and the oral diseases, sensitivities for detecting the severity of oral diseases are reported. The analysis is conducted using SAS version 9.4. A P-value < 0.05 is considered statistically significant.

RESULTS

The study sample included 391 adults between 19 and 88 years of age (YOA), with a mean of 46 YOA (SD = 18). Sixty-four percent were female and 36% were male, 243 (62%) of adults reported a college education, 83 (21%) were black, 84 (22%) white, 19 (5%) Asian and 204 (52%) identified as another race, 241 (62%) were Hispanic (*Table 1*). The median number of M was 2 (interquartile range = 6), DMFT mean was 12 (SD = 7). The median percentage of teeth with at least one site with PD > 5 mm was 5% (interquartile range = 20%; *Table 1*). Differences in sample size noted in the tables reflect the number of patient records available for analysis, i.e. when a particular clinical parameter was not recorded.

Sensitivity is an important measure of the likelihood of identifying disease history. The oral health self-assessment question alone showed significant ability to identify oral disease with sensitivity ranging from 59% to 71% across all oral variables examined. The addition of the general health self-assessment question resulted in an increased sensitivity (76–91%) for all oral health parameters. For adults with > 12 DMFT, 66% [odds ratio (OR) = 2.32] reported fair/poor oral health when asked only one of the two possible survey questions, 80% (OR = 1.65) reported fair/poor oral or general health, when both questions were

Table 1 Demographic information

Variable	Summary
Age	46 ± 18
Gender	
Female	253 (64%)
Male	142 (36%)
Race	
White	84 (22%)
Black	83 (21%)
Asian	19 (5%)
Other	209 (52%)
Ethnicity	
Hispanic	241 (62%)
Non-Hispanic	150 (38%)
Education	
College or above	243 (62%)
High school or below	152 (38%)
Number of missing teeth*	2 (6)
DMFT	12 ± 7
% of teeth with >1 site with PD > 5 mm*	5% (20%)

*Reported as median (interquartile range) due to skewness.

included (*Table 2*). Accuracy in identifying M also increased when both questions were considered, 65% (OR = 1.93) *versus* 85% (OR = 2.56) of adults with ≥ 4M, reported fair/poor oral health (*Table 3*). A similar pattern was observed for PD when both questions were included, specifically, 67% (OR = 2.03) *versus* 83% (OR = 2.06) when using the threshold of > 20% teeth with ≥ 1 site with PD > 5 mm (*Table 4*).

Sensitivity was high even at the defined lower limits for oral disease. For example, the sensitivity for adults reporting fair/poor oral or general health were 76% (OR = 1.28) for adults with DMFT scores > 6, 85% (OR = 2.84) for adults with ≥ 3M, and 77% (OR = 1.26) for adults with > 12% of teeth with ≥ 1 site with PD≥5 mm.

The relationship of survey responses to the extent and severity of oral disease was analysed. As the threshold for oral disease increased so did sensitivity when both questions were included. For example, 76% (OR = 1.28) of adults with a DMFT score > 6 reported fair/poor oral and general health *versus* 91% (OR = 4.31) of adults with a DMFT score > 18 (*Table 2*). Further, 85% (OR = 2.56) of adults with ≥ 3M compared with 88% (OR = 3.35) of adults with ≥ 5M reported fair/poor oral or general health (*Table 3*). Predicting periodontal probing depth also increased as the PD severity increased, 77% (OR = 1.26) of adults with > 10% of teeth with ≥ 1 site with PD > 5 mm, *versus* 83% (OR = 1.83) of adults with > 30% of teeth with ≥ 1 site with PD > 5 mm.

DISCUSSION

Self-reported health measures are an efficient patient-centred method used for identifying health outcomes, even for patients without prior health problems[15] Patient-reported data has been examined for usefulness in predicting illnesses, such as chronic obstructive pulmonary disease, diabetes mellitus, musculoskeletal pain, as well as healthcare utilisation[17–19]. Further, the survey questions were taken from the BRFSS, a valid and frequently referenced self-report survey used for chronic disease surveillance[20].

Oral health self-assessment questionnaires have been evaluated for identifying periodontal disease and dental caries correlated with general health, with results modified by factors such as age, gender, race, education and psychosocial stressors[21,22]. For adults, and in particular older adults, self-rated oral health and general health have been found to independently explain their sense of life satisfaction[2,11,23]. Additional analysis to check the moderating effect of age was completed in this research and no significant effect was found. The validity of this two-question instrument was strengthened by the observation of improved sensitivity with increased disease severity.

Similar to US national oral health utilisation data, only 40% of study participants had a dental visit in the previous 12 months[2]. Oral health disparities

Table 2 Sensitivity, specificity, and odds ratio for oral disease based on dental burden (DMFT) (n = 357)

	DMFT > 6	DMFT > 12	DMFT > 18
Fair/poor in oral health self-assessment (Yes *versus* No)	(59%, 56%, 1.80*)	(66%, 54%, 2.32***)	(71%, 49%, 2.29**)
Fair/poor in general health self-assessment (Yes *versus* No)	(61%, 45%, 1.29)	(66%, 46%, 1.67*)	(78%, 45%, 2.89***)
Fair/poor in oral OR general health self-assessment (Yes *versus* No)	(76%, 29%, 1.28)	(80%, 30%, 1.65*)	(91%, 29%, 4.31***)

DMFT, decayed, missing and filled teeth.
*P-value < 0.05; **P-value < 0.01; ***P < 0.001.

Table 3 Sensitivity, specificity, and odds ratio for oral disease based on number of Missing Teeth (M) (n = 388)

	Missing Teeth ≥ 3	Missing Teeth ≥ 4	Missing Teeth ≥ 5
Fair/poor in oral health self-assessment (Yes *versus* No)	(65%, 53%, 2.14***)	(65%, 51%, 1.93**)	(70%, 51%, 2.39***)
Fair/poor in general health self-assessment (Yes *versus* No)	(73%, 51%, 2.81***)	(72%, 47%, 2.37***)	(76%, 47%, 2.86***)
Fair/poor in oral OR general health self-assessment (Yes *versus* No)	(85%, 33%, 2.84***)	(85%, 31%, 2.56***)	(88%, 31%, 3.35***)

**P-value < 0.01; ***P < 0.001.

Table 4 Sensitivity, specificity, and odds ratio for oral disease based on # of teeth with ≥1 site with PD > 5 mm (n = 364)

	>12% teeth with ≥1 site with PD > 5 mm	>20% teeth with ≥1 site with PD > 5 mm	>30% teeth with ≥1 site with PD > 5 mm
Fair/poor in oral health self-assessment (Yes *versus* No)	(62%, 52%, 1.72*)	(67%, 50%, 2.03**)	(65%, 48%, 1.76*)
Fair/poor in general health self-assessment (Yes *versus* No)	(60%, 42%, 1.12)	(69%, 45%, 1.78*)	(70%, 44%, 1.78*)
Fair/poor in oral OR general health self-assessment (Yes *versus* No)	(77%, 28%, 1.26)	(83%, 29%, 2.06*)	(83%, 28%, 1.83)

PD, periodontal probing depth.
*P-value < 0.05; **P-value < 0.01.

related to utilisation of services persist in certain segments of the populations despite the recognised need for oral healthcare services to maintain general health[23]. Approximately, one in four US adults 20–64 years and children 3–5 years living at or below the federal poverty level have untreated dental decay[24]. Globally an estimated 3.9 billion individuals are living with oral diseases, with untreated dental decay the most prevalent condition[25]. Further, an estimated 39% of low-income US adults reported diminished quality of life due to the condition of their mouth and teeth[2]. The World Health Organization (WHO) estimated that oral diseases ranked among the top 100 causes of disability-adjusted life-years worldwide[25]. This study sample was comprised of predominantly low-income adults seeking low-cost dental services at a dental school clinic. These findings suggest that this simple instrument is well suited to alert non-oral healthcare providers to ask their patients about their last dental examination and refer them to an oral health provider when necessary and where available.

Previously examined multiple-item self-assessment measures requiring score tabulations have had limited the utilisation for oral disease[26]. The acceptance of self-report questionnaires by patients and health providers can depend on the ease of use and their ability to be integrated into clinical care visits[27]. The results presented here offer initial evidence that a two-item instrument provides an efficient and effective method of identifying individuals with a history of dental disease who are at greater risk for future disease.

Primary medical care settings are traditionally the first point of contact within a healthcare system for routine examination and provision of health information[16,28]. Limited time and knowledge have been cited as barriers to including oral health information in routine medical care[29]. This simple instrument could be integrated into a primary care visit, to identify patients in need of a dental referral. Early identification of dental diseases can be associated with a variety of positive outcomes, for example it has been shown that treatment for dental diseases such as periodontal disease and dental caries has resulted in fewer dental-related emergency department visits[28,30]. Further, individuals with a history of oral disease, indicated by existing restorations or missing teeth, are at increased risk for future oral diseases[31].

Limitations of this study include a sample consisting of patients seeking dental care services, the majority of whom were Medicaid recipients living in a predominantly Hispanic community, possibly reducing the generalisability of results. Additionally, the cutoff point values were selected to capture moderate to severe periodontal disease, and were twice the values used in other research identifying periodontal disease[14]. These cutoff points may not be applicable to other populations. Further research will be needed to demonstrate the ability of this two-question instrument to identify patients with a history of dental diseases in populations seeking other types of healthcare services in suburban or rural settings.

Untreated oral disease remains a significant public health concern. Dental caries and tooth loss are important health determinants for adults as they can negatively affect the ability to eat, to speak clearly and live without chronic pain[24]. The results presented here indicate that this instrument has a high probability of identifying individuals with a history of oral diseases who are at greater risk for future disease and in need of an oral examination. This would allow a non-dental healthcare provider to confidently suggest a dental visit and make the needed referral.

Advances in understanding of the relationship between oral health and systemic health have led to increased interest in coordinated patient care through shared health information and interprofessional teamwork[32]. This simple two-item instrument may easily be integrated into preliminary patient interviews and may prove to be a useful tool for nurse practitioners, physician assistants and primary care physicians to highlight the importance of oral health and provide a dental referral when needed. This study serves as proof of principle for the use of this instrument to identify individuals in need of oral healthcare services.

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Conflict of interest

The authors declare that they have no competing interests.

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