Factors associated with oral hygiene practices among adults with systemic sclerosis

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Abstract

OBJECTIVE—To identify factors associated with oral hygiene practices in adults with systemic sclerosis (SSc)

METHODS—In this cross-sectional study, 178 dentate adults with SSc received an oral examination which included measurement of oral aperture, assessment of manual dexterity to perform oral hygiene, as well as completion of the Center of Epidemiological Studies Depression (CES-D) Scale, and an oral health-related questionnaire.

RESULTS—Multivariable logistic regression modeling showed male, minority and high CES-D scores (i.e., clinically significant symptoms of depression) were associated with less likelihood of participants brushing teeth at least twice daily, but the presence of self-reported dry mouth symptoms increased the likelihood of toothbrushing. Having a dental visit in the past 12 months, and use of an adapted flossing or interdental cleaning device were significantly associated with

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daily dental flossing; however, having difficulty flossing teeth reduced the likelihood of daily flossing.

CONCLUSIONS—Overall, demographic variables were strongly associated with toothbrushing frequency, whereas, flossing self-efficacy and barriers were strongly associated with dental flossing frequency in adults with SSc. The results suggest that dental health professionals should take mental health into consideration when educating patients with SSc to improve their oral hygiene, and consider making referrals for patients exhibiting suspected clinically significant depressive symptoms to mental health professionals for further evaluation and treatment. In addition, an appropriate adapted flossing or interdental cleaning device should be recommended to increase dental flossing practices in this patient population.

Keywords

adapted devices; oral hygiene; scleroderma; mental health; epidemiologic methods

Introduction

Systemic sclerosis (SSc, scleroderma) is one of a group of autoimmune connective tissue diseases that is characterized by inflammation, vascular dysfunction, and excessive fibrosis of connective tissue supporting the skin and visceral organs (1, 2). SSc affects the skin and musculoskeletal tissue of the hands as well as the oral and perioral tissues (3–6). Manual dexterity impairments and orofacial dysfunction (e.g., microstomia and xerostomia) are two major clinical manifestations that may complicate oral hygiene and lead to oral health problems among people with SSc (7–9). Hand deformity and limited oral aperture may affect oral hygiene performance as well as willingness to perform oral hygiene (7, 10). Xerostomia (excessive dry mouth resulting from salivary hypofusion) has been shown to promote the development of dental plaque and increase the risk of developing oral diseases (11–13).

A population survey of dentate adults in Detroit showed dental flossing frequency was associated with flossing self-efficacy and benefits-barriers of flossing.(14) Adapted oral hygiene devices to accommodate microstomia and decreased manual dexterity may help reduce oral self-care barriers in adults with SSc (15–18). Studies comparing the use of an adapted flosser to finger flossing indicated that participants with no manual dexterity impairment preferred the adapted flosser over finger flossing (19, 20). Several authors concluded that the adapted flosser was significantly more effective in facilitating patient compliance and establishing long-term regular flossing habits (17, 21). In regard to xerostomia, patients with Sjogren's syndrome were found to have similar or even better oral hygiene habits than the control subjects without xerostomia (22, 23).

In addition to various SSc disease-related specific factors, such as dry mouth, decreased oral aperture, and manual dexterity impairment, secondary psychosocial conditions such as depressive symptoms may also have an impact on oral hygiene practices. High levels of depressive symptoms are common in adults with SSc (24, 25). Patients exhibiting depressive disorders often demonstrate disinterest in performing oral hygiene (26). A population survey in Northern Finland found persons with a high number of depressive symptoms had lower

toothbrushing frequency than persons with no or only a few depressive symptoms (27). In addition, poor oral hygiene as indicated by high plaque score was significantly associated with higher levels of depressive symptoms (28).

Few studies have investigated the association of SSc disease-related factors and secondary psychosocial conditions with oral hygiene practices in adults with SSc (7, 29–31). Therefore, the purpose of the present study was to identify factors associated with oral hygiene practices in adults with SSc. Identification of these factors (e.g., SSc disease-related and secondary conditions) is important in designing appropriate preventive oral health education and promotion for this patient population. Findings can help the dental health professional tailor oral care educational programs and provide specific evidence that can be used to educate patients with SSc to improve oral hygiene practices.

Methods

Participants

Participants eligible for this cross-sectional study were adults (aged > 18 years old) diagnosed with SSc, and who fulfilled the American College of Rheumatology preliminary classification criteria for SSc (32). Exclusion criteria were localized scleroderma (e.g. morphea, linear scleroderma, and en coup de sabre).

Recruitment

Study participants were recruited through the Medical University of South Carolina (MUSC) scleroderma clinic and a local connective tissue disease database (CTDD). The CTDD contains medical information on the majority of patients with SSc who received consultation and/or treatment at the MUSC scleroderma clinic beginning in 2001. At the time when this study started (which was in October of 2007), the CTDD contained contact information on 509 patients with SSc. Potential subjects listed in the CTDD and patients who visited the MUSC scleroderma clinic were invited (either in person or by phone) to participate in the dental survey study. The research coordinator, on behalf of the physicians at the MUSC scleroderma clinic, contacted the patients by phone and reminded them of their upcoming physician appointment and invited them to participate in the study. In addition, during the week (every Monday), the research coordinator was assigned to the scleroderma clinic for recruitment. The research coordinator explained the study to potential participants including their time commitment, obtaining verbal consent, and scheduling an oral examination appointment. The study required a single dental visit of about 1.5 hours duration.

Procedures

Informed consent was obtained, and the oral examination was conducted at the MUSC General Clinical Research Center. The examination included measurement of the oral aperture, assessment of manual dexterity to perform oral hygiene, and dental and periodontal health, as well as completion of the Center of Epidemiological Studies Depression (CES-D) Scale (33), a self-report instrument to assess depressive symptomatology, and a package containing an oral health-related questionnaire. Two trained and calibrated dental hygienists were designated as the oral health examiners and conducted the mouth cavity assessments

(34). The protocol was approved by the MUSC Institutional Review Board. The clinical trial protocol number was NCT01817361.

Outcome variables

Frequency of toothbrushing and dental flossing were the two outcome measures. Frequency of toothbrushing was defined as toothbrushing at least twice daily versus less often (coded as 1 or 0 respectively). Frequency of dental flossing was defined as flossing at least once a day versus less often (coded as 1 or 0 respectively).

Explanatory variables

Manual dexterity to perform oral hygiene was assessed by the Toothbrushing Ability Test (TAT) (35, 36). Detailed procedures and scoring have been described in the literature (35, 36). Briefly, participants were requested to brush the front surfaces of all lower front teeth (i.e., from canine to canine) in 30 seconds using a regular manual toothbrush. After being stained, three anterior mandibular teeth (i.e., #22, #25, and #27) were scored according to Patient Hygiene Performance (PHP) criteria (37). The score of the TAT ranges from 0 to 19 with a score greater than 6 indicating manual dexterity impairments.

Maximum oral aperture was measured, using a small metal ruler, as the distance in mm between the upper and lower incisal edges of the right central incisors when the participants were requested to open their mouth as wide as possible (38). If the right central incisors were absent, the left central, right lateral, or left lateral incisors were substituted in that order (38). Three successive trials of maximum oral aperture measurement, with a 5s pause in between each measurement, were conducted and recorded (39). An average of the three successive trials for each oral aperture measurement was computed.

The Center for Epidemiologic Studies Depression (CES-D) Scale is a self-report instrument to assess the presence and severity of depressive symptomatology in the general population (33). The CES-D consists of 20 items (symptoms) grouped into four multi-item subscales that assess general depression, positive affect, somatic/vegetative symptoms, and interpersonal difficulties. The frequency of occurrence of each symptom during the past week is rated on a 4-point Likert-type scale ranging from "rarely" (0) to "mostly" (3). After reverse coding of 4 items, scores from 20 items are summed to form a composite score with a possible range of 0 to 60. A higher score reflects a higher level of depression. The CES-D has been demonstrated to be a reliable and valid measure of depressive symptoms in patients with SSc (40). The CES-D score of 19 has shown to be the most accurate cut-off for identifying patients with rheumatoid arthritis who exhibit clinically significant symptoms of depression (41).

The oral health-related questionnaire contained items addressing the demographic and socioeconomic characteristics of the participants, as well as their dental care visit patterns, oral hygiene behaviors, smoking habits, and dry mouth symptoms. Demographic and socioeconomic characteristics included age, gender, race (minority [i.e., African-American and others] versus Caucasian-American), marital status (married / live together versus unmarried), education (less than college versus college and beyond), employment status (paid employment versus not employed), annual household income (ranging from below

$10,000 to $75,000 and above, with $5,000 incremental brackets), and dental insurance (private/public-funded versus none). Dental visits in the past year were re-coded as "yes / 1" or "no / 0." Mouth rinsing practices were indicated by using mouth rinse at least once a day versus less often. Other questions related to oral hygiene included use of adapted oral hygiene devices (1=use, or 0=not use), having difficulty cutting a piece of dental floss from a floss box (1=have difficulty, or 0=no difficulty), and having difficulty flossing teeth (1= have difficulty, or 0=no difficulty). Participants' smoking was indicated by current smokers versus past smokers and those who never smoked.

The presence of dry mouth symptoms (coded as "1") was indicated by a positive response to one or more of the following 4 questions (42): 1) "Do you sip liquids to aid in swallowing dry foods?"; 2) "Does your mouth feel dry when eating a meal?"; 3) "Do you have difficulties swallowing any foods?"; and 4) "Does the amount of saliva in your mouth seem to be too little?"

Data analysis

Prior to developing multivariable logistic regression models for predicting the probability of patients with SSc who complete daily oral hygiene practices (i.e., toothbrushing and dental flossing), bivariate analyses (using univariate regression models) were performed to determine the relationship between the explanatory variables and daily oral hygiene practices. Explanatory variables with a P-value less than 0.2 in bivariate models were considered to be candidates for multivariable modeling (43). Certain demographic and socioeconomic status variables such as gender, marital status, education and income have been shown to be positively associated with oral hygiene practices (14, 44), we controlled for the confounding effect of these variables in our multivariable analysis regardless of its P-value in the univariate analysis. Age and SSc disease onset were highly correlated (r=.65). To avoid problems caused by collinearity, we selected age as the more appropriate variable to be included in the multivariable analysis. All P-values reported in the multivariable models were two-sided, and the type I error rate was set at 0.05. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 20 (www.spss.com).

Results

We contacted all 509 patients in the CTDD and invited them to participate. Of these patients, 72 patients' phones were disconnected, 20 were deceased, 160 declined, 20 were not diagnosed with SSc, and 47 gave verbal consent but did not show up to their appointment. In summary, 190 patients with SSc completed the oral examination with a recruitment rate of 37.3%.

Only dentate participants (i.e., those with at least one tooth) were included in the study. Eleven participants were edentulous and excluded for analysis. In addition, one African-American male participant did not complete the oral health-related questionnaire. Therefore, the analytic sample consisted of 178 participants with usable data for this study.

Tables 1 and 2 show the characteristics of the 178 dentate participants, which includes their diagnosis, co-morbidities, socio-demographics, and oral health-related behavior information.

The majority of participants were Caucasian (66.3%), and 32.0% of them were African-American; 3 participants (1.7%) identified themselves as Asian or Hispanic/Latino. The median disease duration and its interquartile range were 4.8 and 3–12 years, respectively. The mean (SD) number of participants' natural teeth (excluding 3rd molars) was 23.4(6.2) with a range from 2 to 28. The median number of missing teeth was two. The majority of the participants (85.3%) demonstrated impairment in manual dexterity to perform oral hygiene as indicated by TAT scores above six; about three quarters (71.5%) reported having dry mouth symptoms; and one quarter (24.7%) were classified as having clinically significant symptoms of depression as indicated by their CES-D score above 18. The mean (SD) of participants' size of oral aperture was 37.8(8.5) mm with about 16% of the participants having an oral aperture of less than 30 mm.

Factors affecting toothbrushing frequency among adults with SSc

Results of the bivariate analyses indicated that toothbrushing at least twice daily was shown to be significantly related to the following variables: race, gender, income, had a dental visit in the past 12 months, daily dental flossing, CES-D score, and dry mouth (all P-values < 0.05). Table 3 shows the results of the bivariate analyses and variables that were included in the multivariable logistic regression model. After adjusting for other explanatory variables, only race, gender, CES-D score, and dry mouth were included in the final multivariable model for toothbrushing at least twice daily (see Table 3). Compared to the minority group (95% of them were African Americans), Caucasians had a 2.5 times greater odds of brushing teeth at least twice daily (adjusted OR = 2.52, 95% CI = 1.18–5.37, P < 0.05). Females with SSc had a 4.5 times greater odds of brushing teeth at least twice daily compared to their male counterpart (adjusted OR = 4.41, 95% CI = 1.70–11.40, P < 0.005). Dentate adults with SSc who reported dry mouth symptoms had a 2.8 times greater odds of brushing teeth at least twice daily compared to those who did not complain of dry mouth (adjusted OR = 2.77, 95% CI 1.22–6.29, P < 0.05). Dentate adults with SSc who reported having clinically significant symptoms of depression (i.e., CES-D   19) had 71% less odds to perform toothbrushing at least twice daily than those who reported less severity of depressive symptoms (adjusted OR = .29, 95% CI = .12–.67, P < 0.005).

Factors affecting dental flossing frequency among adults with SSc

Results of the bivariate analyses indicated that dental flossing at least once daily was shown to be significantly related to the following variables: age, race, had a dental visit in the past 12 months, daily toothbrushing, and use of an adapted flossing device (all P-values < 0.05). Table 4 shows the results of the bivariate analyses and variables that were included in the multivariable logistic regression model. After adjusting for other explanatory variables, had a dental visit in the past 12 months, use an adapted flossing or interdental cleaning device, and having difficulty flossing teeth were included in the final multivariable model for daily flossing (see Table 4). Participants who had a dental visit in the past 12 months had a 3.9 times greater odds of flossing teeth daily compared to those who did not have a dental visit in the past 12 months (adjusted OR = 3.88, 95% CI = 1.47–10.26, P < 0.01). Participants who used an adapted flossing or interdental cleaning device had a 2.5 times greater odds of flossing teeth daily compared to those who did not use an adapted or interdental cleaning device (adjusted OR = 2.50, 95% CI = 1.27–4.92, P < 0.01). Participants who reported

having difficulty flossing teeth had 55% less odds to floss daily compared to those who did not report having difficulty flossing (adjusted OR = .45, 95% CI .23–.89, P < 0.05).

Discussion

As indicated in the results, factors that influence toothbrushing frequency differed from flossing frequency in dentate adults with SSc. For toothbrushing, race, gender, self-perceived mouth dryness and depressive symptoms are the four explanatory variables that were significantly associated with toothbrushing at least twice daily. Whereas, had a dental visit in the past 12 months, use of adapted flossing or interdental cleaning devices, and have difficulty flossing teeth are the three explanatory variables that were significantly associated with daily dental flossing.

Consistent with the literature on predicting oral hygiene habits in the general population (14), demographic variables were strongly associated with toothbrushing frequency, whereas, flossing self-efficacy and barriers were strongly associated with dental flossing frequency in adults with SSc. For example, participants who were minority (African-American), and male (14, 44) were less likely to brush teeth at least twice daily. Similar to patients with Sjogren's syndrome (22), participants who reported mouth dryness had a higher toothbrushing frequency than those who reported no mouth dryness. The clinical implications of the association between higher scores on the CES-D (i.e., having clinically significant symptoms of depression) and less likely to brush teeth at least twice daily is that significant neglect of oral hygiene in patients with SSc may alert dental health care professionals to be aware of potential underlying depressive symptoms (including diagnosis and anti-depressants used by patients with SSc), and to consider making timely referrals to mental health professionals for evaluation and treatment.

The dexterity to perform sufficient oral hygiene has been previously suggested as affecting oral health in people with SSc (7, 9). In this study, an objective measure of manual dexterity impairment as indicated by the TAT score, and size of oral aperture were not significantly associated with frequency of oral hygiene practices. As the disease progressed, participants' hand function and size of oral aperture may deteriorate. Participants may maintain their daily frequency of toothbrushing routine, though the quality of plaque removal may be scarified. The majority of patients with SSc develop this disease in middle age and beyond, and toothbrushing habits have already been ingrained in their daily routine.

Having difficulty flossing teeth was significantly associated with being less likely to floss at least daily. In the present study, only 40% of the study participants flossed at least once daily, which is at the same rate as that of a clinical population (45). Since patients with SSc are at a greater risk of dental disease (46, 47), and dental flossing, especially in the evening, was shown to be significantly related to less gingival inflammation in this patient population (9), it is important for dental health professionals to educate patients with SSc on the importance of daily flossing. The strategies that may aid those who floss less than daily include the use of adapted flossing or interdental cleaning device to decrease the difficulty in flossing and increase daily flossing adherence.

The electric toothbrush can compensate for decreased manual dexterity and improve plaque control and reduce gingival inflammation (16), but the size of the brush head of most oscillating-rotating electric toothbrushes is either the same or bigger than that of a manual toothbrush. Dental health professionals should emphasize the importance of at least twice daily toothbrushing by recommending the use of an electric toothbrush with a child-sized brush head.

We acknowledge that the sample selection in this study was limited to one institution and the findings may or may not generalizable to the whole SSc population; however, the participants' demographic characteristics (gender, type of SSc, incidence of limited and diffuse forms of SSc among African- and Caucasian-Americans, and mean age of SSc disease onset) of this large oral health study on SSc are similar to those reported in several population-based epidemiological studies conducted in the US (48–51). For example, about 80% of the participants were women (50, 51), the ratio of limited to diffuse form of SSc was 59.6% to 40.4%, with more African-American participants diagnosed with the diffuse form (56.1%), and more Caucasian-American participants diagnosed with the limited form (67.8%) (49, 51). The mean age of SSc disease onset among African-American participants was about 10 years younger than that of Caucasian-American participants (38.3 vs. 50.2 years of age) (48). Finally, the incidence of having clinically significant symptoms of depression (i.e., CES-D ≥ 19) in the present study (25%) was very similar to that reported in previous studies (26%–29%) (52, 53).

Conclusion

Little was known about factors influencing oral hygiene practices in adults with SSc. Identification of these factors will provide evidence for clinicians to tailor patient education. Findings from this study revealed that clinically significant depressive symptoms reduced the likelihood of toothbrushing. The use of adapted interdental cleaning devices was associated with flossing; whereas, having difficulty flossing teeth reduced the likelihood of flossing. It is concluded that significant neglect of oral hygiene on patients with SSc may alert clinicians to be aware of potential underlying depressive symptoms, and to consider making referrals to mental health professionals for evaluation and treatment. Recommendations on the use of adapted interdental cleaning device may increase flossing adherence.

Acknowledgments

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Table 1

Characteristics of the Participants (N = 178)

Characteristics	Mean±SD (Range) or n (%)
Diagnosis and co-morbidities	
Limited cutaneous subtype of SSc	106 (59.6%)
Diffused cutaneous subtype of SSc	72 (40.4%)
Disease duration (years)[b]	8.4±8.4 (.5 – 40)
Oral aperture (mm)[a]	37.8±8.5 (10–60)
TAT score[c]	9.2±2.7 (0–16)
CDS-D score	12.1±10.4 (0–52)
Self-report dry mouth symptoms[a]	123 (71.5%)
Socio-demographics	
Age (years)	54.5±13.0 (21.9 – 82.7)
Female	149 (83.7%)
Caucasian American	118 (65.9%)
African American	58 (32.4%)
Married / live together	114 (64.0%)
Education (less than college)	91 (51.1%)
Employment (FT and PT)	63 (35.4%)
Annual income (< $20,000)[a]	39 (22.7%)
Annual income ($55,000)[a]	73 (42.4%)
No dental insurance	61 (34.3%)

CDS-D = Center of Epidemiological Studies Depression; FT = full time, PT = part time; SD = standard deviation; SSc = systemic sclerosis; TAT = Toothbrushing Ability Test;

[a] less than 4% of the data were missing;

[b] less than 9% of the data were missing;

[c] 16% of the data were missing, as participants who required antibiotic therapy prior to dental examination did not engage in the Toothbrushing Ability Test.

Table 2

Oral Health-Related Behaviors of the Participants (N = 178)

Variables	n (%)
Dental visit (in past 12 months)	138 (77.5%)
Toothbrushing (at least twice a day)	125 (70.2%)
Dental flossing (at least once a day)	72 (40.4%)
Use mouth rinse (at least once a day)	66 (37.1%)
Use an electric toothbrush[a]	64 (36.4%)
Use an oral irrigator[a]	12 (7.0%)
Have difficulty flossing teeth[a]	95 (54.6%)
Have difficulty cutting a piece of dental floss from a floss box[a]	22 (12.7%)
Non-smoker (current)	165 (92.7%)

[a]less than 4% of the data were missing

Table 3

Univariate and multivariable analyses examining factors associated with toothbrushing of at least twice daily in dentate adults with systemic sclerosis.

Explanatory Variables	OR (95% CI)	P-value	Adj OR (95% CI)	P-value
Age (years)	1.02 (.99, 1.05)	.072		
Race (Caucasian)	3.26 (1.66, 6.38)	.001	2.52 (1.18, 5.37)	.017
Gender (female)	3.73 (1.64, 8.47)	.002	4.41 (1.70, 11.40)	.002
Marital status (married)	1.40 (.72, 2.72)	.316		
Education (college)	1.71 (.89, 3.28)	.109		
Income	1.07 (1.00, 1.15)	.036		
Had a dental visit in the past 12 month	3.18 (1.53, 6.62)	.002		
Flossing daily	2.14 (1.19, 4.88)	.014		
Oral aperture	.97 (.93, .1.01)	.151		
Dry mouth	2.23 (1.11, 4.47)	.024	2.77 (1.22, 6.29)	.015
Depression (CES-D 19)	.34 (.17, .70)	.003	.29 (.12, .67)	.004

Note. Adj OR = adjusted odds ratio; CES-D = Center of Epidemiological Studies Depression; CI = confidence interval; OR = odds ratio.

Table 4

Univariate and multivariable analyses examining factors associated with dental flossing of at least once a day in dentate adults with systemic sclerosis.

Explanatory Variables	OR (95% CI)	P-value	Adj OR (95% CI)	P-value
Age (years)	1.04 (1.01, 1.06)	.006		
Race (Caucasian)	2.48 (1.26, 4.89)	.008		
Gender (female)	1.35 (.59, 3.11)	.475		
Marital status (married)	1.66 (.88, 3.14)	.121		
Education (college)	1.08 (.59, 1.96)	.805		
Income	1.05 (.99, 1.12)	.102		
Had a dental visit in the past 12 month	5.19 (2.05, 13.17)	.001	3.88 (1.47, 10.26)	.006
Number of Teeth	1.04 (.99, 1.10)	.123		
Toothbrushing frequency	2.41 (1.19, 4.88)	.014		
Use adapted flossing device	2.21 (1.19, 4.09)	.012	2.50 (1.27, 4.92)	.008
Have difficulty flossing teeth	.55 (.30, 1.01)	.055	.45 (.23, .89)	.022
Have difficulty cutting a piece of dental floss from a floss box	.51 (.19, 1.38)	.183		

Note. Adj OR = adjusted odds ratio; CI = confidence interval; OR = odds ratio.